Ogunniyi M B 1987 Conceptions of traditional cosmological ideas among literate and non-literate Nigerians. *J. Res. Sci. Teach.* 24(2): 107–17
Prewitt K 1982 The public and science policy. *Science, Technology and Human Values* 7(39): 5–14
Rosier M J, Banks D 1990 *The Scientific Literacy of Australian Students*. Australian Council for Educational Research, Victoria
Royal Society 1985 *The Public Understanding of Science*. Royal Society, London
Science Council of Canada 1984 *Science for Every Student: Educating Canadians for Tomorrow's World*. Science Council of Canada, Ottawa
Semin G R, Gergen K J (eds.) 1990 *Everyday Understanding: Social and Scientific Implications*. Sage, London
Shapin S 1992 Why the public ought to understand science in the making. *Public Understanding of Science* 1(1): 27–30
Shen B 1975 Science literacy and the public understanding of science. In: Day S B (ed.) 197? *Communication of Scientific Information*. Karger A G, Basel
Solomon J 1988 The dilemma of science, technology and society education. In: Fensham P (ed.)1988 *Development and Dilemmas in Science Education*. Falmer Press, London
Thomas G, Durant J 1987 Why should we promote the public understanding of science? In: Shortland M (ed.) 1987 *Scientific Literacy Papers*. Department for External Studies, University of Oxford, Oxford
UNESCO 1982 *Out-of-school science education in Asia and the Pacific*. Bulletin of the UNESCO Regional Office for Education in Asia and the Pacific, UNESCO, Bangkok
Wynne B 1991 Knowledges in context. *Science, Technology and Human Values* 16(1): 111–21

Further Reading

Durant J (ed.) 199? *Museums and the Public Understanding of Science*. Science Museum, London
Evered D, O'Connor M (eds.) 1987 *Communicating Science to the Public*. Wiley, New York
Layton D, Jenkins E 1993 *Inarticulate Science? Perspectives on the Public Understanding of Science and Some Implications for Science Education*. Studies in Education, Driffield
Nelkin D 1987 *Selling Science: How the Press Covers Science and Technology*. Freeman, New York
Shapin S 1990 Science and the public. In: Olby R C, Cantor G N, Christie J R, Hodge M (eds.) 1990 *Companion to the History of Modern Science*. Routledge, London

E. W. Jenkins

Screening Models and Education

1. Introduction

Screening theory refers to a range of theories that have in common the fact that they challenge the human capital assumption of the productivity-augmenting role of education. The general term "screening" is often used in two connotations: to indicate that education acts as a signal for pre-existing abilities and as a means for the already better off to get the best jobs. In the first form—where education acts as a signal—wages still equal marginal productivity in equilibrium. In the second form—a view which can be ascribed to Berg (1970) and Thurow (1970) and which we may term the "credentialist" view of education—education only serves as an admission ticket for certain professions. The existence of a relation between productivity and wages is questioned. Since productivity is not altered by schooling, neither is total output raised. In this view education is wasteful as it has an effect on the distribution of income only. The credentialist view is not strongly formalized.

According to the "signaling" view, education yields useful information to identify individuals with a higher expected productivity. This set of theories includes the filtering theory (Arrow 1973), the screening theory (Stiglitz 1975), and the signaling theory in the strict sense (Spence 1973, 1974a, 1974b; Riley 1976, 1979b). Henceforth screening will be identified with signaling. The theories are molded in formalized models. According to this view the (empirical) relation between education and wages is a result of the productivity-identifying role (instead of the productivity-augmenting role in the human capital theory) of education (see Davies and MacDonald [1984] for a comparison of the implications of the human capital and signaling models). In this theory, the extent to which education also has a productivity-augmenting effect is left as an open question. In either case, educational achievements serve as signals for employers and result in an efficient allocation of employees to a diversity of jobs.

2. Theory

The signaling theory as developed by Spence (1973) starts from the following assumptions: (a) Individuals differ in productivity, productivity is fully person-specific and not affected by schooling; (b) more schooling entails more costs, schooling costs are lower for the more productive; (c) individuals know their productivity, firms do not (asymmetrical information); and (d) educational qualifications can be observed without cost. Firms cannot observe individuals' productivity, and instead use schooling qualifications for hiring decisions and for setting individual wages. Firms assume that the individuals with more schooling are the more productive. Since they can observe total output for the entire workforce, they can use this as probabilistic information to check whether this assumption is correct in the aggregate. Hence, an equilibrium can only exist if more productive individuals indeed choose more schooling. Individuals will invest in schooling as long as the benefits outweigh the cost. With a proper wage structure, schooling will be worthwhile for high-productivity individuals, but not for low-productivity

individuals: offered wages are identical, but schooling cost is higher for the low-productivity individuals. The wage gain from schooling should be sufficient for high-productivity/low-cost individuals and insufficient for low-productivity/high-cost individuals. Thus, schooling may effectively separate high-productivity and low-productivity individuals, and the firms' belief regarding the relation between schooling and productivity may be upheld by individuals' decisions. Finally, individuals take rational decisions on schooling, just as in the human capital theory.

The model assumes that the more able have an absolute advantage in all jobs over the less able. Stiglitz (1975) terms this "hierarchical screening": there is an unequivocal order of productive capacities which is revealed by education. In Stiglitz's own screening model, education identifies productive traits of individuals. The costs of schooling do not vary with capabilities but are equal for all individuals. The returns to schooling do, however, vary with (innate) capabilities. If the screening costs are not prohibitive, more productive workers attain higher expected lifetime earnings by investing in schooling.

Although the assumptions of the screening model are somewhat different from those of the signaling/filtering model, the predictions about the optimal investment in education and the relation between education and productivity are similar.

Wages are solely determined by observable characteristics such as educational qualifications. However, in the signaling theory, wages will also be equal to the expected value of the marginal productivity of employees. The proof of this assertion runs as follows. As employers eventually get to know the productivity of those they have appointed, they will be able to observe the relation between education and productivity of workers. Employers have rational expectations about workers' productivity. This implies that the wage offers to workers equal their expected marginal productivity. Competition will ensure that the wages of employees, which are determined by educational qualification, equal marginal productivity. In this way, the educational signaling mechanism generates a wage which equals the expected value of the marginal product.

Despite this, educational signals do not necessarily have a productivity-augmenting effect. If productive traits are not altered by schooling, education does not lead to higher productivity. In this view investments in education do not determine the size of the total output, but merely the distribution of it: individuals invest in education to obtain a greater share in total output. If education only serves as a screen, the gross social returns to education are zero because of its distributional effects. The net social returns are negative, as investments in education imply social costs which are not matched by higher total output (Stiglitz 1975 p. 285).

The private returns to investment in education are positive for those with more capabilities. In an economy without screening, all employees would receive the same wage equal to the average marginal product. As a result of screening, workers with more capabilities receive more than average, while those with less capabilities receive less than average. Stiglitz speaks of the private returns of screening as "the individual's capturing of his 'ability rents' which in the absence of screening he shares with others" (Stiglitz 1975 p. 186). Spence (1974b) shows that it may be in the individual's interest to form coalitions for promoting screening.

There are three mechanisms by which the productive traits of employees become public knowledge (Stiglitz terms them "screening mechanisms"): selection by educational institutions, educational achievement, and self-selection.

The educational system sorts individuals in two ways: by admission requirements and by grading. The group into which the individual is sorted by the educational system provides information for the employer about the individual.

A second screening mechanism is educational achievement: within a homogeneous educational program a standard test yields information by which individuals can be compared.

An important source of information is self-selection of individuals. If individuals have more information about their capabilities than employers and some have a (comparative) advantage in one task over another, there are gains to be obtained in selecting oneself for a job in which this trait is rewarded. As noted by Spence (1973), the self-selection mechanism yields signals to the market. This mechanism is emphasized in Akerlof's "theory of lemons" (Akerlof 1970). So, even if education in itself has no productivity-augmenting effect, it can be productivity-augmenting by sorting workers into various jobs. This may be termed the "allocation-effect" of screening.

Schooling can both be productivity-augmenting and act as a signal of (innate) capabilities. The human capital theory and the screening theory are therefore not mutually exclusive. Mincer states that: "The productivity and screening functions of schooling are not mutually exclusive in a world of imperfect information, given that ability is an input in the educational process. The controversy, if any, concerns the relative importance of the productivity and screening functions of schooling in affecting earnings" (Mincer 1980 p. 125). Moreover, as emphasized by Davies and MacDonald (1984), the information generated by schooling may be socially valuable. If the schooling system did not sort individuals by ability, the labor market would have to solve the problem of optimal allocation by reassigning individuals as information gradually emerges with experience. Hence, the prevention of such ignorant, suboptimal initial job assignments has ben-

efits which may be compared with the cost of schooling.

3. The Empirical Results

The empirical research on the validity of the screening hypothesis has focused on testing (some of the extreme) empirical implications of this hypothesis and on assessing the productivity and informational components of education. The hypothesis that the individual financial returns to schooling exceed the social returns based on productivity effects is hard to test, because the true productivity effects of schooling are hard to measure.

In empirical work two implications of the screening hypothesis have been distinguished: the Wiles hypothesis and the sheepskin argument. Both implications are derived from the credentialist variant of the screening hypothesis. These two implications will be discussed in turn.

The Wiles hypothesis (Wiles 1974) states that if the screening hypothesis is correct, there should be no wage difference between workers with qualifications which exactly match the requirements of the profession they work in and workers with equal qualifications working in other professions. If the screening hypothesis is correct, (specific) human capital does not affect performance in a job: according to this view productivity is fully job-specific. The Wiles hypothesis is a logical corollary to the credentialist variant of the screening theory.

The Wiles hypothesis has been tested by Miller and Volker (1984) and by Arabsheibani (1989). Miller and Volker used data for Australia on starting salaries for academics with a technical education and an economics education. They found that economists working in an economic profession were not paid significantly more than those with a technical education working in an economic profession. This corroborates the screening hypothesis. However, the starting salary of males with a technical education working in a technical profession was more than 5 percent higher than the starting salary of economists in a technical profession. This, conversely, is a corroboration of the human capital theory. For women in a technical profession, Miller and Volker found no differences between educations.

Arabsheibani used a sample of Egyptian graduates. It was found that a premium was paid in starting salaries when education was useful in the job. This finding supports the human capital view. Moreover, it was discovered that when education was specifically job-related the premium was high, whereas the premium was low when there was a less specific education–occupation relationship.

The sheepskin argument holds that, if education serves as an admission ticket or credential for a better job with higher earnings, there is a premium for completion of a course with a certificate. Preliminary school leavers or dropouts would, averaged over their years of schooling, have a lower return to education than those who completed their course with a certificate: ". . . graduation from a course should provide more evidence of ability and staying power than mere attendence for a number of years" (Layard and Psacharopoulos 1974). The sheepskin argument has been tested by Layard and Psacharopoulos (1974), Hungerford and Solon (1987), Hartog (1983), and Groot and Oosterbeek (1990).

Layard and Psacharopoulos compared the returns on education of dropouts with the returns for employees who have completed their education. They concluded that there are no significant differences in the returns to education between these two groups. However, Hungerford and Solon pointed out that Layard and Psacharopoulos do not take account of the timing of the decision to drop out. Hungerford and Solon looked for discontinuities in the relation between years of education and earnings. Comparing year-to-year returns they found that the rate of return in the first year and in the final year is higher than in the intervening years. The first finding confirms the prediction by Arrow (1973) that admittance to higher education (college) itself yields an income benefit. The discontinuities in the rates of return are taken as a corroboration of the sheepskin hypothesis.

Hartog (1983) estimated an earnings equation and a job-level equation, by taking as explanatory variables the highest educational level and a dummy which indicated whether this level was completed with a certificate. At the lower general level and the higher general level (high school) nongraduation does not influence earnings or job level. At the lower vocational level, the extended vocational level, and extended general level, a certificate has an effect on job level but not on earnings. At the higher vocational and university levels, a certificate influences both earnings and job level. However, at these levels there is no premium on a certificate as such: earnings lost per year not attended (years still to go to the diploma when dropout occurs) are roughly equal to what graduates earn per year of attendance.

Groot and Oosterbeek (1990) divided actual years of education into effective years (i.e., the shortest, most efficient path to attaining a certain level of education), inefficient routing years (i.e., skipping and repeating classes, and years spent inefficiently), and dropout years (i.e., years spent in education without receiving a diploma). This division is such that the actual number of years of education is equal to the sum of effective years, repeated years, (minus) skipped years, inefficient years, and dropout years. This decomposition allows a test of the screening theory against the human capital theory. The test relies on two predictions of the screening theory: (a) the sheepskin hypothesis that years spent in education without obtaining a degree should not increase

earnings, and (b) a more rapid completion of a degree signals greater ability and should therefore lead to higher earnings.

For males, the results strongly support the human capital theory and refute the predictions of the screening hypothesis. Skipped years have a significantly negative influence on future earnings. According to the screening hypothesis this effect should be positive, since skipping a class gives a positive signal to potential employers, whereas within a human capital framework the finding can be explained as the manifestation of a less than thorough understanding of the curriculum. Repeated years have no effect on future earnings. This is in accordance with the human capital theory, whereas the screening hypothesis predicts a negative effect because of the negative signal which repeated years give to employers. The absence of influence on earnings from inefficient years of education agrees with both the human capital and screening predictions. Finally, a positive return on dropout years emerges. This is in line with the human capital theory and refutes the sheepskin version of the screening theory.

When data relating only to women are also examined, all results are in line with the human capital predictions and refute the screening theory.

Both the Wiles hypothesis and the sheepskin argument implictly test whether the credentialist version of the screening theory is tenable. However, education can both be productivity-augmenting and can provide information about ability. As stated by Machlup (1984) the controversy is not whether education acts as a sorting mechanism, but whether this is the sole function of education. In this respect Psacharopoulos (1979) made a distinction between the weak and the strong version of the screening hypothesis. According to the weak version, employers offer higher starting wages to the more highly educated because of imperfect information on expected productivity. According to the strong version of the screening hypothesis, this wage differential between the higher and lower educated does not vanish with tenure. As noted by Psacharopoulos (1979), few doubt the validity of the weak version, rather it is the validity of the strong version which is debatable.

Direct testing of the strong version of the screening hypothesis has been performed by Taubman and Wales (1973), Layard and Psacharopoulos (1974), Wolpin (1977), Psacharopoulos (1979), Cohn et al. (1987), Dolton (1986), Mendes de Oliveira et al. (1989), and Rao and Datta (1989). The direct test entails whether the partial effect of education on wages decreases with years of work experience, controling for other productive traits.

Psacharopoulos and Layard (1979) compared earnings by educational level for a 33-year old and a 47-year old in the United States. They found that the relative earnings differential between these two ages increases with the level of education. Similar findings were reported by Cohn et al. (1987) and Psacharopoulos (1979). These findings confirm the strong version of the screening hypothesis.

Indirect tests of the strong version are performed by earnings comparisons between industries or professions where screening is supposed to be important and industries and professions where screening does not play a role. More specifically, these tests involve comparing wages in the market sector with wages in the private sector, and wages of employees with wages of the self-employed. It is assumed that screening is relatively more important in the public sector and wage sector than in the private sector and the self-employment sector. As the self-employed do not have to invest in educational signals for potential employers, it is expected that employees invest more in education to attain a higher job level than the self-employed. This hypothesis has been tested by Riley (1979a), Katz and Ziderman (1980), Cohn et al. (1987), Wolpin (1977), and De Wit and Van Winden (1989). Riley and Katz and Ziderman found evidence in favor of the screening hypothesis. Riley (1979a) found that the self-employed have less education than the employed, other things being equal. Cohn et al. found only small differences in years of education between employees and the self-employed by job level. Wolpin also found that (nonprofessional) employees and the (nonprofessional) self-employed acquire similar amounts of schooling. On the other hand, Wolpin found that the self-employed have considerably higher productivity than employees as measured by earnings. However, this might be due to earnings of the self-employed that include a return to capital as well. From these findings Wolpin concluded that the strong version of the screening theory has to be rejected. Riley found that in the screened occupations (mainly teaching occupations) education gives a better explanation of earnings than in the unscreened occupations (mainly managerial occupations). De Wit and Van Winden estimated a switching regression model on earnings for employees and the self-employed, controlling for ability. For employees they found positive returns to schooling and a premium on obtaining a certificate. For the self-employed they found no significant returns on schooling and no evidence of a premium on a certificate. These findings confirm the screening theory.

Taubman and Wales (1973) tested the screening hypothesis by comparing the expected and actual distribution of education over occupations. The expected distribution is determined by the income distribution by occupation and is defined as the probability that an individual with a given educational level can earn a higher wage in a certain occupation than in any other occupation. Taubman and Wales found that the actual probability that an individual with an intermediate level education ends up in a

low-paid occupation is higher than the expected probability, while for the higher educated the actual probabilities almost equal the expected ones. From this finding Taubman and Wales concluded that education is used as a screening device to prevent lower educated workers from entering well-paid occupations.

Perlman (1988) tested the screening hypothesis by comparing the actual and expected unemployment rates by level of education. The expected (or standardized) unemployment rate by level of education is defined by the unemployment rate in an occupation multiplied by the share of a certain educational level in this occupation. This generates the unemployment rate that would prevail for an educational group if its members had the average unemployment rate for each occupational group to which it belonged. The results show that for higher educated people the actual unemployment rate is lower than expected, while for the lower educated the unemployment rate exceeds the expected rate. This suggests negative screening or selection of lower educated workers.

Albrecht (1981) tested the screening hypothesis by using data on job applicants at the Volvo company in Sweden. Applicants were distinguished by their educational background and their informational level (i.e., the amount of information the employer has on the job seeker). The information level was determined by the ways job seekers came into contact with the firm. In decreasing order of informational content, these were (a) through a recommendation by a Volvo employee to the employer and an invitation to apply, (b) through the job agency, or (c) through an advertisement or an open application. If the signaling hypothesis is correct, employers will, in their hiring decision, make more use of the educational background of an applicant if the informational content of the applicant is less. The results showed that Volvo preferred applicants with more schooling, and slightly preferred applicants with a higher informational content. However, education does not serve as a substitute for lack of information on the applicant. This implies that education is not considered to be a perfect screening mechanism by employers in their hiring decision.

Finally, some studies have yielded results that confirm both the screening theory and the human capital theory of education. Rao and Datta (1989) concluded that both the strong and the weak version of the screening hypothesis hold good for India, as well as the human capital prediction of decreasing marginal returns to schooling. Dolton concluded from data on the United Kingdom that the human capital theory and the screening theory should not be seen as mutually exclusive but rather as complementary: "In conclusion there are reasonable grounds to support a compromise interpretation of the education–income association which gives credence to both human capital theory and screening theory but supports an extreme version of neither" (Dolton 1986 p. 30).

4. Conclusion

In 1976 Blaug concluded his survey of human capital theory with the prediction that: ". . . in all likelihood, the human capital research program . . . will gradually fade away to be swallowed up by the new theory of signaling" (Blaug 1976 p. 850). So far this prediction has not been corroborated. Although the human capital theory is perhaps not as dominant as it was in the 1960s and 1970s, it still stands firm, while the signaling theory has lived a much more marginal existence. During the 1980s, interest in the screening theory appeared to be on the wane. Research has taken other directions: the investment in information has been analyzed by the so-called "information theory" (see Hartog 1981, MacDonald 1980, 1982, Davies and MacDonald 1984, Weiss 1983) and the formation of information on productive qualities has been emphasized in matching theory (Jovanovic 1979a, 1979b, 1984). The lack of developments in the area of the theory of the transfer of information or signaling theory, led Freeman (1986) to remark that "following Spence's analysis a theoretical literature on screening/sorting models flourished briefly" (Freeman 1986 p. 360).

The results of empirical research do not conclusively discount the screening theory. Education seems to have signaling aspects. However, the strong version of the screening theory, which states that the signaling aspect of education prevails over the entire career, must be rejected. Evidence suggests support for the weak version of the screening hypothesis, namely that employers pay highers starting wages to the higher educated because of incomplete information on productivity.

See also: Internal Labor Markets and Education; Education and Earnings; Education and the Labor Market; Labor Market Segmentation and Education; Education and Labor Markets in Developing Nations; Education and the Employment Contract

References

Akerlof G 1970 The market for "lemons": Quality uncertainty and the market mechanism. *Q. J. Econ.* 84: 488–500

Albrecht J W 1981 A procedure for testing the signalling hypothesis. *J. Publ. Econ.* 15: 123–32

Arabsheibani G 1989 The Wiles test revisited. *Economics Letters* 29(4): 361–216

Arrow K J 1973 Higher education as a filter. *J. Pub. Econ.* 2: 193–216

Berg I 1970 *Education and Jobs: The Great Training Robbery*. Praeger, New York

Blaug M 1976 The empirical status of human capital theory: A slightly jaundiced survey. *J. Econ. Lit.* 14: 827–55

Cohn E, Kiker B F, Mendes de Oliveira M 1987 Further

145

evidence on the screening hypothesis. *Economics Letters* 25(3): 289–94
Davies J, MacDonald G 1984 *Information in the Labour Market: Job-Worker Matching and Its Implications for Education in Ontario*. Ontario Economic Council Research Studies, Ontario
Dolton P 1986 Signalling and screening in the graduate labour market. Economics research paper 134. Department of Economics and Commerce, University of Hull, Hull
Freeman R 1986 Demand for education. In: Ashenfelter O, Layard R (eds.) 1986 *Handbook of Labor Economics I*. North Holland, Amsterdam
Groot W, Oosterbeek H 1990 Does it pay to take the shortest way? *Research Memorandum 9013*. Faculty of Economics and Econometrics, University of Amsterdam, Amsterdam
Hartog J 1981 Wages and allocation under imperfect information. *De Economist* 129: 311–23
Hartog J 1983 To graduate or not: Does it matter? *Economics Letters* 12: 193–99
Hungerford T, Solon G 1987 Sheepskin effects in the returns to education. *Rev. Econ. Stat.* 69: 175–77
Jovanovic B 1979a Job matching and the theory of turnover. *J. Pol. Econ.* 87(5): 972–90
Jovanovic B 1979b Firm-specific capital and turnover. *J. Pol. Econ.* 87(6): 1246–60
Jovanovic B 1984 Matching, turnover, and unemployment. *J. Pol. Econ.* 92(1): 108–22
Katz E, Ziderman A 1980 On education, screening and human capital. *Economics Letters* 6: 81–88
Layard R, Psacharopoulos G 1974 The screening hypothesis and the returns to education. *J. Pol. Econ.* 82(5): 985–98
MacDonald G 1980 Person-specific information in the labor market. *J. Pol. Econ.* 88(3): 578–97
MacDonald G 1982 A market equilibrium theory of job assignment and sequential accumulation of information. *Am. Econ. Rev.* 72(5): 1038–55
Machlup F 1984 *Knowledge: Its Creation, Distribution, and Economic Significance: The Economics of Information and Human Capital*. Princeton University Press, Princeton, New Jersey
Mendes de Oliviera M, Cohn E, Kiker K 1989 Tenure, earnings and productivity. *Oxford B. of Econ. Stat.* 51: 1–14
Miller P W, Volker P A 1984 The screening hypothesis: An application of the Wiles test. *Economic Inquiry* 22 (1): 121–27
Mincer J 1980 Human capital and earnings. In: Atkinson A B (ed.) 1980 *Wealth, Income and Inequality*, 2nd edn. Oxford University Press, Oxford
Perlman R 1988 Education and training: An American perspective. *Oxford Review of Economic Policy* 4(3): 82–93
Psacharopoulos G 1979 On the weak versus the strong version of the screening hypothesis. *Economics Letters* 4: 181–85
Psacharopoulos G, Layard R 1979 Human capital and earnings: British evidence and a critique. *Rev. Econ. Stud.* 46: 485–503
Rao M J M, Datta R C 1989 The screening hypothesis and the marginal productivity theory. *Economics Letters* 30(4): 379–84
Riley J 1976 Information, screening and human capital. *Am. Econ. Rev.* 66 254–60
Riley J 1979a Testing the educational screening hypothesis. *J. Pol. Econ.* 87(5): 227–52
Riley J 1979b Informational equilibrium. *Econometrica* 47(2): 331–59
Spence M 1973 Job market signaling. *Q. J. Econ.* 87: 355–74
Spence M 1974a Competitive and optimal responses to signals: An analysis of efficiency and distribution. *J. Econ. Theo.* 7: 296–332
Spence M 1974b *Market Signaling: Information Transfer in Hiring and Related Screening Process*. Harvard University Press, Cambridge, Massachusetts
Stiglitz J E 1975 The theory of "screening," education, and the distribution of income. *Am. Econ. Rev.* 65: 283–300
Taubman P, Wales T J 1973 Higher education, mental ability, and screening. *J. Pol. Econ.* 8(1): 28–55
Thurow L 1970 *Investment in Human Capital*. Wadsworth, Belmont, California
Weiss A 1983 A sorting-cum-learning model of education. *J. Pol. Econ.* 91(3): 420–42
Wiles K 1974 The correlation between education and earnings: The External-Test-Not-Content hypothesis (ETNC). *High. Educ.* 3: 43–57
Wit G de, Winden F van 1989 An empirical analysis of self-employment in the Netherlands. Research paper 89.02. Research Institute for Small and Medium-Sized Business, Zoetermeer
Wolpin K I 1977 Education and screening. *Am. Econ. Rev.* 67: 949–58

W. Groot; J. Hartog

Seating Arrangements in Classrooms

This entry explores the research literature on the nature of students who select different seats in the classroom, the evidence that changing environments improves student learning and interactions, and the use of teacher-determined seating arrangements to fulfill various classroom objectives. Relationships of seating arrangements with on-task behavior and interactions between teachers and students, and among students, are discussed.

Even a casual observer in a classroom might conclude that where a student sits in a classroom affects his or her experiences in the classroom. Seating location results in more or less teacher attention and interaction. Conversely, students in some seats are more likely to pay attention to the teacher and to class assignments, and in turn, receive higher grades. The classroom observer also might notice that teachers use physical resources such as movable classroom seats and desks to facilitate interaction among students, to improve opportunities for teacher–student interaction in discussion sessions, or to improve a student's learning.

In general, the research supports these observations. Weinstein (1979), for example, stated that the arrangement of the teachers, students, furniture, and equipment in the classroom affected both student

146