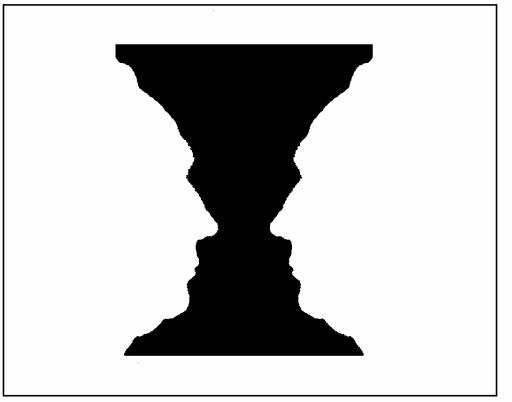
Training Costs and Wage Differentials in the Theory of Job Competition*

by

EKKEHART SCHLICHT

Zeitschrift für die gesamte Staatswissenschaft (ZgS) 137 (1981), 212–221



Zeitschrift für die gesamte Staatswissenschaft (ZgS) 137 (1981), 212–221

Training Costs and Wage Differentials in the Theory of Job Competition*

by

EKKEHART SCHLICHT

Introduction

In one of the most important contributions to the theory of the wage structure, Gary Becker has introduced the notions of general on-the-job training and specific on-the-job training: While doing a certain kind of work, the worker will acquire additional skills and capabilities. This is the meaning of *on-the-job training* (OJT). If this training increases the productivity of the worker in doing this particular job only, on-the-job training is *specific*; if it increases capabilities of the worker with respect to other jobs, too, on-the-job training is *general*[1].

Becker has argued that specific OJT has to be paid by the employer since "the wage that an employee could get elsewhere would be independent of the amount of training he had received ... Firms would have to pay training costs, for no rational employee would pay for training that did not benefit him" (BECKER [1962], p. 18). On the other hand, wages of specifically trained employees would only exceed wages which are paid to comparable untrained workers by a margin which is paid by the firm in order to prevent too high a rate of labor turnover and induced additional training expenses[2].

In the case of general OJT, training expenses are, according to Becker, fully borne by the employees in that they accept lower wages during the training period and consider the temporary reduction in earnings as an investment in human capital. The associated return is provided by higher earnings in the

* An earlier version of the paper was presented at the Econometric Society World Congress 1980 in Aix-en-Provence, France. The research has been made possible by the occasional inactivity of our two infants, Robert and Philipp, to whom this paper is dedicated. The main argument has been developed at the University of Bielefeld, Germany.

[1] The distinction cannot be drawn as sharply as will be presupposed in the following for analytical reasons. In that we follow BECKER [1972], p. 17.

[2] Cf. BECKER [1962], pp. 19–21. A formalization of this argument will be presented in section 2 below. It will, in fact, be generalized to general OJT in order to derive a theory of the wage structure, following the approach of SALOP [1973], SCHLICHT [1978], and others. This kind of behaviour, however, prohibits market clearing and hence a normal functioning of the labour market as has been demonstrated by SCHLICHT [1978] and SALOP [1979].

future. "'Perfectly general' training would be useful in many firms and marginal products would rise by the same extent in all of them. Consequently, wage rates would rise by exactly the same amount" (BECKER [1962], p. 13). General OJT would be provided by rational firms only if costs are covered by correspondingly low wages. The argument amounts to the proposition that careers with much general OJT exhibit a comparatively steep age-earning profile (BECKER [1962], pp. 14f., 43f.).

The main purpose of the present paper is to cast into doubt Becker's analysis of general OJT and to propose another route to arrive at the same result. Taking the point of view of Thurow's job competition model, it will be argued that Becker's assumption of competitive market clearing in all segments of the labour market is not convincing (section 1). This leads to a model which allows for studying the influence of general and specific training costs on the level of wages (section 2). In other words: It is attempted to give an economic explanation for wage differentials within the job-competition framework[3].

The argument rests on the proposition that it will be optimal for any firm to choose a wage level which is neither so low as to cause qualified workers to leave, necessitating the recruitment of inexperienced workers and much training expenses, nor so high as to make labour too expensive. The argument induces some doubts regarding the allocative efficiency of the resulting wage structure (section 3).

Deviations from Demand-Supply Analysis[4]

Consider a set of identical jobs which have to be performed in different firms and assume that these jobs require previous experience in other jobs. We call these jobs the *preceding jobs*[5]. Suppose now that the jobs under consideration (the *succeeding jobs*) are more attractive than the preceding jobs such that anyone holding a preceding job would like to do the succeeding job for the same remuneration. If the supply-demand apparatus is applied in this situation, the supply for succeeding jobs would consist of all workers holding succeeding jobs and all workers holding preceding jobs for a minimal time required to get the

[3] Within the job-competition framework, wage differentials are taken as exogenously determined. However, I can follow Thurow's sociological considerations of wage differentials (THUROW [1975], pp. 104–113) only insofar as they support a relative inflexibility of the wage structure and job-specific remuneration, but I do not accept wage differentials to be sociologically determined for reasons given in SCHLICHT [1980], [1981].

[4] The section summarizes some well-known arguments which are more comprehensively covered in THUROW [1975].

[5] A good background for the following considerations is provided by the class of models studied in the excellent book of BECKMANN [1978a]. By the way, Beckmann provides an alternative theory of wage differentials resting on mobility costs but independent of training cost.

necessary previous experience and qualification. If the number of preceding jobs is much larger than the number of succeeding jobs (e.g. for technological reasons), demand-supply equilibrium would require that the wage rate of the succeeding jobs be *lower* than the wage rate paid to the preceding job by an amount which makes the workers indifferent between these jobs. This would hold true quite independently of training costs although one would expect the succeeding jobs which are higher on the career ladder, to be better paid – at least one would expect this to hold true in reality. The supply-demand analysis, as used by Becker, seems to be misleading in this case. The analysis of this paper, on the other hand, is designed to cope with problems of this kind.

One might argue, however, that this critique of Becker's analysis does not hold true because we have changed his implicit assumptions. This might very well be the case, but nevertheless an additional analysis of situations like those sketched above seems to be necessary[6].

In the following we will change the strictly competitive framework even further: We will adopt the assumption that, within each firm, all jobs of a given kind are paid equally – independently of the experience of the employee and quite irrespectively of whether he has been trained into the job already, or not. This amounts to the assumption that training costs are borne by the firm, quite irrespectively of whether OJT is general or specific.

The argument behind this assumption is basically that differential payment for identical jobs is detrimental for the production process[7] since it would induce competition instead of cooperation between the employees and would, in particular, reduce the dissemination of knowledge which is necessary for efficient OJT. More experienced workers would have an incentive to monopolize their knowledge and this would lead to dynamic inefficiency. Anyhow, we take job-specific remuneration simply as a presupposition of the whole analysis. This assumption provides, in fact, one of the cornerstones of the job-competition model since it gives rise to the selection of new workers according to their quality – and irrespective of possibly different wage demands which do not enter the picture because wages are tied to jobs and are fixed in the short run[8].

---

[6] However, the analysis in SCHLICHT [1978] and SALOP [1979] indicates that one cannot expect the clearing of all labour market segments through the price mechanism. If "supply" for a given job is defined as the number of all workers holding preceding jobs, and if the analysis of those papers is applied, the picture deviates considerably from a Walrasian structure: Demand-supply analysis seems to run into internal contradictions in the case of the labour market if the price affects the quality of a commodity, and this holds true, typically, in the case of the labour market (see also STIGLITZ [1975], p. 562 n. 18). In particular, supply will exceed demand under these circumstances. Since supply for succeeding jobs is constituted by workers holding preceding jobs, the picture emerging from this very neoclassical argument is a remarkably good portrait of job competition.

[7] With the exception of pure seniority premiums which are disregarded in the following, however.

[8] The reader is referred to THUROW [1975] for further discussion. WILLIAMSON [1975] (ch. 4) is relevant, too, in this context.

2. *Wages and Training Costs*

As usual, the analysis will proceed in terms of a highly simplified and stylized model which exemplifies and illustrates the general argument. We consider a typical firm which considers to fix the wage level for a given number of identical jobs[9].

Denote the *separation rate* to be expected by λ (number of separations per period divided by the number of jobs). Since the number of separations will be equal to replacement demand if the number of jobs is fixed, the separation rate will be equal to the replacement rate.

There are two alternatives for replacement. One can hire experienced workers from other firms who have performed similar work already and have sufficient general training. In this case, only specific training will be necessary, giving rise to *specific training costs* $\alpha \geq 0$ per newly hired employee. If μ denotes the ratio of qualified newly hired personnel to the number of jobs, specific training costs per job will be $\alpha \cdot \mu$. The ratio μ will be termed the *qualified supply rate* henceforth.

Replacement can be achieved, however, by recruitment from preceding jobs. This involves costs for general as well as for specific training of β per man: These are the *total training costs.*

Total training costs are assumed to be larger than specific training costs since they include specific training: $\alpha \leq \beta$. Since $\lambda - \mu$ is the rate of unqualified new recruitment, total training costs per job will amount to $\beta(\lambda - \mu)$. Per capita labour costs are the sum of the wage rate ω and per capita training costs $\alpha \cdot \mu + \beta(\lambda - \mu)$, and it is this expression

$$\omega + \beta \cdot \lambda - (\beta - \alpha) \cdot \mu, \quad 0 \leq \alpha \leq \beta, \quad \beta > 0 , \tag{1}$$

which the firm will try to minimize under constraints to be specified. (The term $(\beta - \alpha)$ represents general training costs.)

We assume the separation rate λ and the qualified supply rate μ to be dependent upon the wage rate ω chosen by the firm relative to the *average wage level* W prevailing in the economy for this kind of jobs. In other words: Both λ and μ will be functions of the *relative wage level* v which is defined as

$$v := \frac{\omega}{W} \tag{2}$$

With regard to the qualified supply rate μ it is assumed that it is an increasing function of v with a slope approaching zero for $v \to \infty$. For $v = 1$,

[9] As a first step, one can take the number of jobs to be determined technologically or from bureaucratical necessities. Since the argument applies for *any* number of jobs, however, nothing precludes the number of jobs being fixed in accordance with marginal productivly considerations in a more comprehensive model a segment of which is developed here.

i.e. if the wage rate offered by the firm equals the average wage rate, μ will assume a positive value, which can be considered as the "natural" qualified supply rate and which is caused by labour movements due to external reasons. If v is equal or below a lower limit $\underline{v}$, the number of qualified job applicants is assumed to be zero. For $v>\underline{v}$ it is assumed to be a concave function (Fig. 1):

$$\mu = \mu(v),\ \mu(v) = 0 \quad \text{for} \quad v \leq \underline{v},\quad 0<\underline{v}<1 \tag{3}$$

$$\mu'>0,\quad \mu''<0 \quad \text{for} \quad v>\underline{v}$$

$$\lim_{v\to\infty} \mu'(v) = 0\ .$$

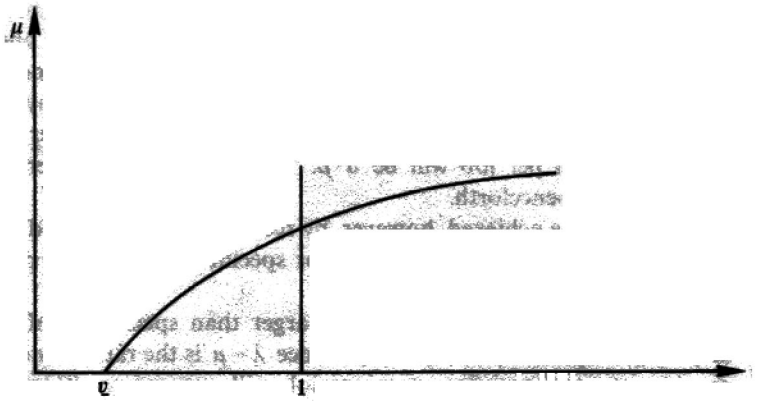


Fig. 1 The qualified supply rate μ as a function of the relative wage level v.

The separation rate λ is assumed to be a decreasing concave function for the very reasons which make $\mu(\cdot)$ increasing and convex: If v is less than unity, a change of the firm – even without promotion – will be attractive. If v is large, λ will approach a lower limit due – at least – to retirements and – possibly – to recruitment for succeeding jobs (Fig. 2).

In addition, the natural separation rate $\lambda(1)$ is assumed to exceed the natural qualified supply rate $\mu(1)$:

$$\lambda = \lambda(v)>0,\quad \lambda'<0,\quad \lambda''>0,\quad \lambda(1)>\mu(1)\ . \tag{4}$$

With regard to the supply of unqualified personnel it will be assumed that there are always more applicants than $\lambda(v)$, provided v is above a certain lower limit $\underline{\underline{v}}$ which is even less than the lower limit $\underline{v}$ below which qualified supply is zero. As long as v exceeds $\underline{\underline{v}}$, all workers holding preceding jobs will be interested in getting the jobs under consideration. For the sake of simplicity we will restrict the firm's minimization problem to the range

$$v \geq \underline{v}\ , \tag{5}$$

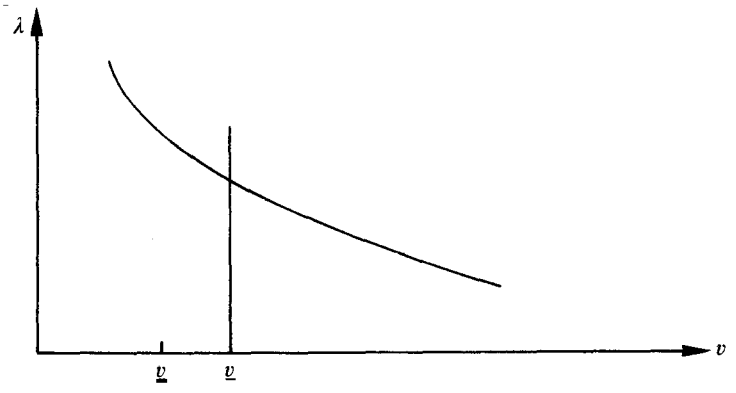


Fig. 2 The separation rate λ as a function of the relative wage level v.

since we will be interested mainly in the equilibrium solution $v = 1$ where the typical firm sets a wage level which is equal to the average wage level in the economy. In this situation, even the constraint (5) will be inoperative.

Using (2)–(5), unit costs of labour (1) can be expressed as a function of the relative wage level which the firm tries to minimize with respect to v:

$$M(v) = v \cdot W + \beta \cdot \lambda(v) - (\beta - \alpha)\,\mu(v) = \min_{v \geq \underline{v}}! \;, \quad 0 \leq \alpha \leq \beta, \quad \beta > 0 \;. \tag{6}$$

Since the second derivative

$$M'' = \beta \cdot \lambda'' - (\beta - \alpha)\,\mu'' > 0 \tag{7}$$

is strictly positive, M is strictly concave.

In order to arrive at an inner minimum we will restrict, as an additional assumption, the argument to the range of average wage levels[10]

$$0 < W < (\beta - \alpha)\,\mu'(\underline{v}) - \beta \cdot \lambda'(\underline{v}) \;. \tag{8}$$

[10] This range must, in fact, be further restricted to the set

$$\{x \mid (\beta - \alpha)\,\mu'(\bar{v}) - \beta\lambda'(\bar{v}) < x < (\beta - \alpha)\,\mu'(\underline{v}) - \beta\lambda'(\underline{v})\}$$

in the case that there exists a solution $\bar{v}$ to $\mu(\bar{v}) = \lambda(\bar{v})$ in order to avoid the case $\mu > \lambda$. This restriction will be disregarded in the following for the sake of simplicity of presentation. The final equilibrium W^* (given in (13) below) will, however, obey this restriction.

The argument will become slightly more complicated if it is taken into account that the wage level of the succeeding jobs W must exceed an opportunity wage level W_0 in order that unqualified supply is sufficient. In this case the range of admissible average wage levels, in addition, must be restricted by $W > W_0$ and it must be required that training costs and the influence of the relative wage level on turnover are sufficiently important to guarantee $(\beta - \alpha)\,\mu' - \beta\lambda' > W_0$. Note, however, that training costs include turnover costs which will be very considerable for responsible jobs as has been argued in SCHLICHT [1980].

(Later on, it will be shown that W will actually decrease if we start close to its upper bound as given in (8).) Granted this additional assumption, we have

$$M'(\underline{v})<0, \quad M'(\infty)>0 \; . \tag{9}$$

Hence there exists a unique optimal relative wage level $v>\underline{v}$, which minimizes labour costs (6) for all average wage levels

$$(\beta-\alpha)\cdot\mu'-\beta\cdot\lambda' = W \tag{10}$$

and which can be considered as a function of W; it is strictly decreasing,

$$v = v(W), \quad v' = \frac{1}{(\beta-\alpha)\,\mu''-\beta\lambda''}<0 \; . \tag{11}$$

As the next step in the analysis, the changes in the general level of wages must be considered: If the typical firm sets $v(W)>1$, this is to be interpreted that, on the average, firms try to set their wage rate *above* the general wage level W. On the other hand, for $v(W)<1$, firms offer, on the average, a wage below the average wage rate in the next period. Hence W will increase for $v(W)>1$, and it will decrease for $v(W)<1$. Algebraically, this can be translated into

$$\dot{W} = \sigma\big(v(W)-1\big), \quad \sigma>0 \tag{12}$$

where σ represents the speed of adjustment. Since v' has been shown to be negative, the process converges to the unique and stable equilibrium value W^* given by $v(W^*) = 1$ or – according to (10) – by

$$W^* = (\beta-\alpha)\,\mu'(1)-\beta\cdot\lambda'(1) \; . \tag{13}$$

It remains to be shown, however, that this equilibrium wage level falls into the range described in (8). W^* is positive, since at least $(-\beta\lambda')$ is nonnegative. On the other hand, we have $\mu'(1)<\mu'(\underline{v})$ and $\lambda'(1)>\lambda'(\underline{v})$ because of our earlier convexity assumptions[11]. This implies that

$$(\beta-\alpha)\,\mu'(1)-\beta\cdot\lambda'(1)<(\beta-\alpha)\,\mu'(\underline{v})-\beta\lambda'(\underline{v})$$

and hence that W^* lies within the bounds given by (8). Thus, the theory developed here has allowed us to establish the equilibrium wage rate W^* as a function of training costs α and β.

In particular, since

$$\frac{\partial W^*}{\partial\beta} = \mu'(1)-\lambda'(1)>0 \tag{14}$$

we get the proposition: *If general training costs rise, wages will increase.*

Furthermore, since

[11] It is to be remarked that those assumptions are much too strong. $\beta\cdot\lambda''-(\beta-\alpha)\,\mu''>0$ would be sufficient, since (7) guarantees the existence of a minimum, the convergency of (12), and our comparative static results.

$$\frac{\partial W^*}{\partial \alpha} = -\mu' < 0 \,, \tag{15}$$

we get another interesting result: *If total training costs remain constant and specific training costs increase, wages will decrease.*

Next, the "pure" cases $\alpha = 0$ (pure general training) and $\beta = \alpha$ (pure specific training) can be investigated. The case of pure general training is covered by the earlier proposition (14). In the case of pure specific training, (13) turns into

$$W^* = -\alpha \cdot \lambda'(1) \tag{16}$$

and hence

$$\frac{\partial W^*}{\partial \alpha} = -\lambda'(1) > 0 \tag{17}$$

In the case of pure specific training, increasing training costs increase wages.

These results generalize to the theory of wage differentials: *Wage differentials will increase if training costs increase,* both in the case of general training and in the case of pure specific training.

3. *Welfare Considerations: The Three Functions of Wage Differentials*

Three functions of wage differentials can be distinguished:

1. *Justice.* A wage structure can be just according to the norms prevailing in society.
2. *Allocative Efficiency.* The wage structure guides the firms with regard to the establishment of various jobs. If a job requires much on-the-job training, its wage ought to be high in order that firms economize on these jobs. More specifically, wages ought to include cumulated training costs which have been incurred throughout the preceding career in order to reflect true social cost.
3. *Incentive Efficiency.* The wage structure performs another important efficiency function too: If a career is particularly attractive, employees at the bottom will have a strong incentive to work properly in order to achieve rapid promotion: Extraordinary rewards are given to a few in order that the others strain every nerve[12]. This can generate social gains, and a wage structure can be optimal in balancing social gains and losses under this point of view.

The process of wage formation, as discussed in this paper, serves neither of the three purposes: Although wages are related to training costs, these training

[12] See MARSHALL [1920], p. 461, BECKMANN [1978b], p. 61, LAZEAR and ROSEN [1980]. The notion of incentive efficiency is closely related to LEIBENSTEIN's [1975] X-efficiency.

costs are weighted by λ' and μ' which express the sensitivity of turnover on relative remuneration and are not related to total training costs directly. Hence there is no reason to expect incentive efficiency. Similarily, wages are not socially optimal incentives: The incentive aspect is totally unrelated to training costs, but wages are. Furthermore, there is no justification for wage differentials according to training costs which have been incurred by the firms, and not by the workers.

This negative result is due to the *competitive* setting of the problem. If one considers, in contrast, the case of purely internal labour markets and absolute immobility between firms, training costs will be fully internalized. Hence allocative efficiency can be reached without using wages as scarcity indicators. Wages could serve the incentive function and, perhaps, the justice function better (or a compromise of both). This argument is, therefore, strongly in favour of labour immobility which can, typically, be found in large corporations as well as in the context of labour management[13].

Zusammenfassung

Ausbildungskosten und Lohnstruktur

Mit Hilfe eines einfachen Modells wird eine Theorie der Lohnsetzung entwikkelt, welche die Lohndifferentiale mit der Höhe der Ausbildungskosten verknüpft (i.e. Kosten für general und specific on-the-job training). Den Ausgangspunkt der Analyse bildet die Annahme, daß die Unternehmen das Lohnniveau für eine gegebene Tätigkeit weder so hoch fixieren, daß die Arbeitskosten zu hoch werden, noch so gering ansetzen, daß die Abwanderung der Arbeitskräfte und damit die Neurekrutierung unerfahrener Arbeitskräfte und die damit verbundenen Kosten zu groß sind. Die Interaktion der Unternehmen führt schließlich zu einem stabilen Lohnniveau, welches von der Höhe der Ausbildungskosten abhängt. Einige Übereinstimmungen mit und Abweichungen vom Humankapitalansatz werden betont, und es wird argumentiert, daß die Effizienz des Arbeitsmarktes bei Arbeitskräfte-Immobilität leichter gesichert werden kann als unter den analysierten Wettbewerbsbedingungen.

References

BECKER, G.S. [1962], "Investment in Human Capital: A Theoretical Analysis", *Journal of Political Economy*, Supplement 1962, 9–49.

BECKMANN, M.F. [1978a], *Rank in Organizations*, Berlin – Heidelberg – New York.

–– [1978b], "Eine Theorie der Karrieren in hierarchischen Organisationen", *Zeitschrift für Wirtschafts- und Sozialwissenschaften*, 53–61.

[13] With regard to labour management, this seems to be an important additional argument in the discussion, see v. WEIZSÄCKER and SCHLICHT [1977] and [1980] and FURUBOTN [1979].

FURUBOTN, E.G. [1979], "Decision Making under Labor Management: The Commitment Mechanism Reconsidered", *Zeitschrift für die gesamte Staatswissenschaft* 135, 216–227.

LAZEAR, E. and ROSEN, S. [1980], *Rank-Order Tournaments as Optimum Labor Contracts*, Paper presented at the Econometric Society World Congress 1980 in Aix-en-Provence (France).

LEIBENSTEIN, H. [1975], "Aspects of the X-Efficiency Theory of the Firm", *Bell Journal of Economics 6, 580–606*.

MARSHALL, A. [1920], *Principles of Economics*, 8th edition, London.

SALOP, S.C. [1973], "Wage Differentials in a Dynamic Theory of the Firm", *Journal of Economic Theory*, 6, 321–344.

-- [1979], "A Model of the Natural Rate of Unemployment", *American Economic Review* 69, 117–125.

SCHLICHT, E. [1978], "Labour Turnover, Wage Structure, and Natural Unemployment", *Zeitschrift für die gesamte Staatswissenschaft* 134, 337–346.

-- [1980] "Commitment and the Time Span of Discretion: A Note on the Economic Foundations of Elliot Jaques' Sociological Theory of Wage Differentials", *Zeitschrift für die gesamte Staatswissenschaft* 136, 161–165.

-- [1981] "Reference Group Behaviour and Economic Incentives: A Remark", *Zeitschrift für die gesamte Staatswissenschaft* 137, 125–127.

STIGLITZ, J.E. [1975], "Incentives, Risk, and Information, Notes Towards a Theory of Hierarchy", *Bell Journal of Economics*, 6, 552–579.

THUROW, L. [1975], *Generating Inequality*, New York.

v. WEIZSÄCKER, C.C., and SCHLICHT, E. [1977], "Risk Financing in Labour Managed Economics: The Commitment Problem", *Zeitschrift für die gesamte Staatswissenschaft, Special Issue: Profit Sharing*, 53–66.

-- and -- [1980], "Labour Management and Commitment: Reply to Furubotn", *Zeitschrift für die gesamte Staatswissenschaft*, 136, 169–171.

WILLIAMSON, O.E. [1975], *Markets and Hierarchies*, New York – London.

Professor Dr. Ekkehart Schlicht
Fachgebiet Wirtschaftstheorie, FB Rechts- und Wirtschaftswissenschaften
Technische Hochschule Darmstadt
Residenzschloß
D-6100 Darmstadt
Bundesrepublik Deutschland