Zeitschrift für Wirtschafts- u. Sozialwissenschaften (ZWS) 114 (1994), S. 337 - 344
Duncker & Humblot, Berlin

# A Simple Test of the Efficiency Wage Hypothesis – A Note

By Knut Gerlach and Gesine Stephan*

Numerous ways for efficiency wages affecting productivity have been suggested in the literature, the empirical investigations of the effects remain inconclusive, however. The basic idea of the proposed test of the efficiency wage hypothesis is, that wage premiums, i.e. the residuals of wage equations, predict which workers will be reluctant to quit, are not strictly supervised and work at jobs which are not monotonous and require their participation in decision-making.

The efficiency wage hypothesis states that when productivity of observably similar workers depends on wages, firms will set the wage per worker to minimize the wage per efficiency unit of labor. Numerous ways for wages affecting productivity have been suggested in the literature: wage premiums may (1) enhance the cost of losing a job for workers dismissed because of low effort (*Shapiro/Stiglitz* 1984); (2) decrease turnover (*Schlicht* 1978); (3) reduce the rate of absenteeism (*Barmby/Sessions/Treble* 1992); (4) augment the level of unobservable human capital (*Weiss* 1991); and (5) raise the probability that workers perceive their wages as fair and, thus, increase satisfaction and morale (*Akerlof* 1982).

The empirical literature on efficiency wages can be summarized under three headings: findings on wage differentials, time series evidence, evidence using data of firms.

Persistent wage differentials between industries, occupations, and firms are found that cannot be explained by compensating differences or human capital endowments (*Dickens/Katz* 1987; *Krueger/Summers* 1988; Hübler/Gerlach 1989, 1990; *Gerlach/Schmidt* 1990; *Schmidt* 1992; *Wagner* 1991). Efficiency wages differ from compensating wage differentials because wage premiums paid as an incentive exceed the differentials required to compensate for negative job attributes. The empirical findings can be interpreted in the light of the efficiency wage hypothesis, but they do not constitute a direct test of efficiency wages.

*Gahlen/Ramser* (1987) investigate whether changes in labor productivity vary positively with increases of the wage drift and unemployment.

* We are grateful to Olaf Hübler and to an anonymous referee for comments and suggestions.

They always obtain positive and generally significant signs for the coefficients of both independent variables in the regressions equations with annual data (1960 - 1982) for four industrial sectors. This finding, although in accordance with the efficiency wage hypothesis, is again an indirect test of efficiency wages, since a positive correlation between growth of labor productivity and changes in the rate of unemployment may be due to the sorting process in the labor market (*Franz* 1991).

Empirical studies of the efficiency wage hypothesis using data of firms have produced mixed results. *Holzer* (1989) found that high wage firms had lower turnover, vacancy rates, and training costs than their low wage counterparts. According to *Wadhwani/Wall* (1988) firms that increase their average wage level tend to increase productivity. However, *Leonard* (1987) obtains the result that controlling for occupations firms which pay high relative wages apparently do not have higher productivity than low-wage firms.

Summarizing, empirical investigations of efficiency wages are inconclusive, and direct and indirect tests of the underlying hypotheses are rare.

One measure of wage premiums can be obtained by first estimating a wage equation with control for demographic and human capital variables such as education, work experience, tenure, and nationality. The residuals of this equation are then interpreted as wage premiums. Workers with large wage premiums in the wage equation are more highly remunerated than workers with otherwise comparable human capital and demographic characteristics. The basic idea of the proposed test of the efficiency wage hypothesis is that these wage premiums predict which workers will be reluctant to quit and thus are more satisfied with their jobs, are not strictly supervised and work at jobs which are not monotonous and require their participation in decision-making. Two specification of the wage equation are used:

$$LNY = \beta_o + \beta_1 S + \beta_2 EXP + \beta_3 EXPSQ + \beta_4 TEN + \beta_6 WTIME + \beta_7 NAT + \beta_8 S \cdot NAT + u \tag{1}$$

$$LNY = \beta_o + \beta_1 S + \beta_2 EXP + \beta_3 EXPSQ + \beta_4 TEN + \beta_6 WTIME + \beta_7 NAT + \beta_8 S \cdot NAT + \beta_7 SECWAGE + \beta_8 FIRMWAGE + u \tag{2}$$

with: *LNY* – log of Monthly Gross Wages; *S* – Schooling (years); *EXP* – Potential Work Experience (years); *EXSQ* – Square of *EXP*; *TEN* – Tenure; *WTIME* – Weekly Working Time; *NAT* – German or Foreign Na-

tionality; *SECWAGE* – Average Sectoral Wages; *FIRMWAGE* – Average Wages in four Firm Size Classes.

Average sectoral and average wages in four firm size classes are incorporated in equation (2) to capture the effect on individual wages stemming from sectoral or firm-size affiliation of workers and to take into account efficiency wage payments at the sectoral and firm level. The wage premiums are computed by taking into account the predicted *LNY* and the actual *LNY*; thus wage premium $= exp(LNY - \hat{LNY}) = exp(\hat{u})$. If, for example, the wage premium takes the value 1.25 the worker obtains 125 percent of his predicted wage rate. The wage premiums are used as independent variables in Ordered Probit-estimations with dependent variables that can be interpreted in the light of the efficiency wage hypothesis. The residuals are considered as measures of wage premiums controlling for human capital endowments, working time, nationality, and in equation (2) additionally for sectoral and firm-size affiliation of workers. The wage premiums are, thus, a measure of a substantial part of a worker's cost of losing his job if the worker's opportunity wage is equal to what a worker with similar endowment could earn in the labor market. This procedure, evidently, is subject to an omitted variable problem since additional firm or sector specific variables might have an impact on wages. The results, therefore, have to be interpreted with some caution.

The data are from the German Socio-Eocnomic Panel (*Hanefeld* 1987). They refer to male workers in the years 1985, 1987, and 1989, excluding the public service and agriculture. The three years were selected since only the surveys of these years include the information interpretable in the sense of the efficiency wage hypothesis. The analysis is restricted to male workers, since the estimations of wage functions for female workers requires elaborate specifications of variables like work experience and tenure due to withdrawal from the work force and additional corrections for sample selection.

Table 1 presents the wage equations (1) and (2) for 1985, 1987, and 1989. The results are in accordance with past research on wages in Germany (*Franz* 1991).[1] The residuals are significantly correlated with monthly gross income which implies that workers with high wages are more likely to obtain a high wage premium. The residuals vary between

[1] Computations of heteroskedastic-resistent t-values (*White* 1980) do not lead to different results. The Jaque-Bera test for normality of the residual and the Reset-test for functional form are rejected at conventional levels of significance. This is, however, a typical result encountered in the estimation of wage functions (*Lorenz/Wagner* 1988). Again, due to the omitted variable problem and due to functional form specification problems the results have to be interpreted carefully.

*Table 1*

**Wage Equitations (OLS)**

Dependent Variable: Logarithm of Monthly Gross Income
Estimated Coefficients and $|t|$-values (in Parentheses)

| | 1985 Model I | 1985 Model II | 1987 Model I | 1987 Model II | 1989 Model I | 1989 Model II |
|---|---|---|---|---|---|---|
| Constant | 6.288 | -2.937 | 6.224 | -3.812 | 6.440 | -3.394 |
| | (89.67) | (4.18) | (85.54) | (5.32) | (103.24) | (5.26) |
| Schooling | 0.077 | 0.067 | 0.076 | 0.066 | 0.076 | 0.065 |
| | (19.73) | (17.83) | (18.89) | (17.04) | (21.12) | (18.79) |
| Work Experience | 0.028 | 0.025 | 0.030 | 0.027 | 0.027 | 0.025 |
| | (12.28) | (11.50) | (11.70) | (11.42) | (11.75) | (11.28) |
| Work Experience squared | -0.0005 | -0.0005 | -0.0005 | -0.0005 | -0.0005 | -0.0004 |
| | (10.50) | (9.81) | (10.00) | (9.75) | (9.93) | (9.36) |
| Tenure | 0.005 | 0.005 | 0.005 | 0.004 | 0.006 | 0.005 |
| | (6.13) | (5.42) | (5.01) | (4.18) | (6.72) | (5.80) |
| Weekly Working Time | 0.011 | 0.013 | 0.014 | 0.016 | 0.011 | 0.014 |
| | (10.43) | (12.59) | (12.27) | (14.58) | (11.72) | (15.02) |
| Nationality | 0.673 | 0.567 | 0.667 | 0.572 | 0.596 | 0.500 |
| | (10.62) | (9.33) | (9.79) | (8.85) | (9.47) | (8.44) |
| Nationality * Schooling | -0.067 | -0.057 | -0.068 | -0.059 | -0.061 | -0.052 |
| | (12.86) | (11.37) | (12.21) | (11.19) | (11.62) | (10.57) |
| Average Sector Wage | | 0.566 | | 0.590 | | 0.442 |
| | | (8.80) | | (9.24) | | (6.78) |
| Average Wage in four Firm Size Classes | | 0.596 | | 0.663 | | 0.773 |
| | | (7.47) | | (8.35) | | (11.98) |
| Number of Observations | 1704 | 1704 | 1623 | 1623 | 1718 | 1718 |
| Adjusted $R^2$ | 0.363 | 0.424 | 0.384 | 0.452 | 0.410 | 0.484 |

0.24 (Wage Premium 1, 1989) and 4,53 (Wage Premium 2, 1987). It should be stressed that the impact of firm size on wages has increased strongly between 1985 and 1989 (from 0.596 to 0.773). This accords well with the finding by *Levy/Murnane* (1992), that wage differentials paid by different firms to workers with the same observed characteristics have grown substantially during the eighties in the US.

Table 2 and 3 contain the core results. In Table 2 three dependent variables that shed light on the efficiency wage hypothesis are regressed against wage premium 1 and 2, the residuals from Table 1 (model 1 and 2). The most striking result is that most coefficients in 1987 and 1989 have the negative signs predicted by the efficiency wage hypothesis and most of them are statistically significant at conventional levels (the computation of robust $t$-values does not change this result). Specifically, workers with high wage premiums exhibit lower probabilities to search for a new job, to expect a new career in a different occupation or to exit from the labor force than their colleagues with low wage premiums. This is in accordance with the turnover variant of the efficiency wage hypothesis. Interestingly, there is much less support for efficiency wages in

*Table 2*

**Probit Estimations of the Effects of Efficiency Wages**

Dependent Variables: Expected Search, Expected Career, Expected Exit
Estimated Coefficients and $|t|$-values (in Parentheses)
Response in the questionnaire: absolutely unlikely, unlikely, likely, certain

| | 1985 Model I | 1985 Model II | 1987 Model I | 1987 Model II | 1989 Model I | 1989 Model II |
|---|---|---|---|---|---|---|
| **Expected Search for New Job** | | | | | | |
| Constant | -0.341 (3.01) | -0.368 (3.10) | -0.064 (0.58) | -0.052 (0.44) | -0.009 (0.08) | -0.044 (0.38) |
| Premium 1 | -0.104 (0.98) | | -0.276 (2.70) | | -0.259 (2.53) | |
| Premium 2 | | -0.078 (0.70) | | -0.289 (2.65) | | -0.226 (2.07) |
| Threshold 1 | 0.775 (24.85) | 0.775 (24.85) | 0.800 (25.14) | 0.800 (25.13) | 0.843 (27.07) | 0.842 (27.07) |
| Threshold 2 | 1.378 (27.67) | 1.378 (27.67) | 1.478 (28.16) | 1.478 (28.14) | 1.557 (30.06) | 1.556 (30.05) |
| LR-Test | 249.8 | 249.4 | 157.2 | 157.0 | 106.4 | 104.2 |
| **Expected Career in a Different Occupation** | | | | | | |
| Constant | -0.487 (3.85) | -0.559 (4.26) | -0.235 (1.90) | -0.213 (1.62) | -0.276 (2.21) | -0.268 (2.02) |
| Premium 1 | -0.264 (2.22) | | -0.436 (3.75) | | -0.419 (3.52) | |
| Premium 2 | | -0.193 (1.56) | | -0.459 (3.68) | | -0.428 (3.38) |
| Threshold 1 | 0.763 (19.38) | 0.761 (19.38) | 0.888 (20.44) | 0.887 (20.45) | 0.823 (20.49) | 0.822 (20.49) |
| Threshold 2 | 1.534 (19.13) | 1.531 (19.12) | 1.701 (18.76) | 1.699 (18.75) | 1.614 (19.64) | 1.613 (19.64) |
| LR-Test | 620.6 | 618.0 | 495.0 | 494.6 | 556.0 | 554.5 |
| **Expected Exit from the Labor Force** | | | | | | |
| Constant | -1.310 (8.87) | -1.307 (8.41) | -0.756 (5.69) | -0.698 (4.95) | -0.841 (5.79) | -0.860 (5.59) |
| Premium 1 | 0.108 (0.79) | | -0.272 (2.17) | | -0.237 (1.72) | |
| Premium 2 | | 0.106 (0.73) | | -0.331 (2.47) | | -0.219 (2.49) |
| Threshold 1 | 0.642 (15.481) | 0.641 (15.48) | 0.705 (17.14) | 0.706 (17.14) | 0.717 (17.64) | 0.716 (17.64) |
| Threshold 2 | 1.011 (16.21) | 1.011 (16.21) | 1.130 (17.84) | 1.131 (17.85) | 1.087 (18.20) | 1.086 (18.20) |
| LR-Test | 1231.4 | 1231.3 | 958.7 | 960.1 | 1077.5 | 1076.8 |
| Number of Observations | 1704 | 1704 | 1623 | 1623 | 1718 | 1718 |

*Table 3*

**Kendall's and Spearman's correlation coefficients**
Coefficients and level of significance (in Parentheses)
Response in the questionnaire: not true, partially true, true

| | 1985 Premium I | 1985 Premium II | 1987 Premium I | 1987 Premium II | 1989 Premium I | 1989 Premium II |
|---|---|---|---|---|---|---|
| **Kendall's correlation coefficients** | | | | | | |
| Job includes a variety of tasks | 0.074 (0.00) | 0.085 (0.00) | 0.062 (0.00) | 0.080 (0.00) | 0.086 (0.00) | 0.105 (0.00) |
| Job is characterized by freedom to organize work | 0.089 (0.00) | 0.089 (0.00) | 0.093 (0.00) | 0.101 (0.00) | 0.109 (0.00) | 0.129 (0.00) |
| Working time according to changing work loads | 0.047 (0.01) | 0.069 (0.00) | 0.020 (0.16) | 0.036 (0.04) | 0.056 (0.00) | 0.061 (0.00) |
| Job is characterized by stringent control and supervision | -0.091 (0.00) | -0.100 (0.00) | -0.074 (0.00) | -0.104 (0.00) | -0.032 (0.05) | -0.076 (0.00) |
| Worker's participation in job related decisions | 0.210 (0.00) | 0.222 (0.00) | 0.215 (0.00) | 0.226 (0.00) | 0.218 (0.00) | 0.231 (0.00) |
| **Spearman's correlation coefficients** | | | | | | |
| Job includes a variety of tasks | 0.090 (0.00) | 0.102 (0.00) | 0.075 (0.00) | 0.097 (0.00) | 0.105 (0.00) | 0.127 (0.00) |
| Job is characterized by freedom to organize work | 0.109 (0.00) | 0.109 (0.00) | 0.115 (0.00) | 0.124 (0.00) | 0.133 (0.00) | 0.156 (0.00) |
| Working time according to changing work loads | 0.058 (0.01) | 0.084 (0.00) | 0.024 (0.17) | 0.043 (0.04) | 0.069 (0.00) | 0.076 (0.00) |
| Job is characterized by stringent control and supervision | -0.110 (0.00) | -0.122 (0.00) | -0.090 (0.00) | -0.126 (0.00) | -0.040 (0.05) | -0.093 (0.00) |
| Worker's participation in job related decisions | 0.247 (0.00) | 0.260 (0.00) | 0.251 (0.00) | 0.265 (0.00) | 0.255 (0.00) | 0.269 (0.00) |
| Number of Observations | 1704 | 1704 | 1623 | 1623 | 1718 | 1718 |

1985. It can be supposed that in a period of high unemployment firms are more reluctant to pay efficiency wages.

In the same vein, the correlation coefficients[2] in Table 3 demonstrate that workers with high wage premiums tend to be employed in jobs characterized by a variety of tasks, freedom to organize their own work, lenient control and supervision, working time according to changing work loads, and participation in job related decisions. This could be interpreted in the sense that firms tend to pay high wage premiums if monitoring of workers is expensive and difficult.

Two critical arguments must be considered. First, it might be argued that the correlation coefficients of Table 3 are indicative of compensating differences. Although this interpretation cannot be ruled out entirely, the signs of the correlation coefficients are not easily reconcilable with the theoretical concept of compensating differentials. The second argument asserts that the unobserved heterogeneity of workers

[2] For the computation of the correlation coefficients the residuals are grouped in intervals of 0.1.

might have an impact on wage residuals, quitting behavior and characteristics of the job. The validity of this argument is tested in the following way. For the endogenous variables in Table 2 Fixed-Effects Logit and Random-Effects Probit models (balanced panel design) are estimated. The idea is that an increased wage premium should have a negative impact on expected quit and search behavior. The coefficients have the expected signs, but not all of them are statistically significant. Although some impact of unobserved heterogeneity is detected, the support for the efficiency wage hypothesis remains fairly strong.

Evidently, more research in this realm is needed. With the data from the Socio-Economic Panel we find evidence that contrary to the predictions of human capital theory and, implicitly, to the theory of compensating wage differentials good and bad jobs coexist. In good jobs workers receive wage premiums, are less likely to quit and exit from the labor market and perform in more autonomous work settings. In spite of these findings in favor of the efficiency wage hypothesis it remains to be investigated that the documented effects have an impact on labor productivity which is large enough to justify the payment of wage premiums.


## Abstract

The basic idea of the proposed test of the efficiency wage hypothesis is, that wage premiums, i.e. the residuals of the wage equations, predict which workers will be reluctant to quit, are not strictly supervised and work at jobs which are not monotonous and require their participation in decision-making. With the data from the German-Socio-Economic Panel evidence is found that workers who receive wage premiums are less likely to quit and exit from the labor market and are more likely to perform in autonomous work settings. This is in accordance with the efficiency wage hypothesis.



## Zusammenfassung

Der vorgeschlagene Test der Effizienzlohnhypothese beruht auf dem Grundgedanken, daß Lohnzuschläge (d.h. die Residuen aus Lohngleichungen) prognostizieren können, welche Arbeitnehmer mit einer geringeren Wahrscheinlichkeit aus Eigeninitiative kündigen und welche Arbeitsplätze mit genauer Kontrolle und geringer Entscheidungsmitwirkung assoziiert sind. Eine Untersuchung mit den Daten des Sozio-Ökonomischen Panels führt zu den folgenden empirischen Resultaten: Arbeitnehmer, die Lohnzuschläge erhalten, sind weniger als ihre Kollegen bereit zu kündigen und den Arbeitsplatz zu verlassen und arbeiten häufiger mit einem gewissen Entscheidungsspielraum. Diese Ergebnisse sind mit der Effizienzlohntheorie vereinbar.

## References

*Akerlof,* G. (1982), Labor Contracts as a Partial Gift Exchange. Quarterly Journal of Economics 97, 543 - 569.

*Barmby,* T./*Sessions,* J./*Treble,* J. (1992), Absenteeism, Efficiency Wages and Shirking. Mimeo.

*Dickens,* W./*Katz,* L. (1987), Inter-Industry Wage Differences and Industry Characteristics, in: Lang, K. and Leonard, J. (Eds.): Unemployment and the Structure of Labor Markets. London.

*Franz,* W. (1991), Arbeitsmarktökonomik. Berlin.

*Gahlen,* B./*Ramser,* H. (1987), Effizienzlohn, Lohndrift und Beschäftigung, in: Bombach, G., Gahlen, B. and Ott, A. E. (Eds.): Arbeitsmärkte und Beschäftigung. Tübingen.

*Gerlach,* K./*Schmidt,* E. M. (1990), Firm Size and Wages. Labour 4, 27 - 49.

*Hanefeld,* U. (1987), Das Sozio-ökonomische Panel – Grundlagen und Konzeption. Frankfurt.

*Holzer,* H. (1989), Wages, Employer Costs, and Employee Performance in the Firm. NBER Working Paper 2830.

*Hübler,* O./*Gerlach,* K. (1989), Berufliche Lohndifferentiale, in: Gerlach, K. and Hübler, O. (Eds.): Effizienzlohntheorie, Individualeinkommen und Arbeitsplatzwechsel. Frankfurt.

—/ (1990), Sectoral Wage Pattern, Individual Earnings and the Efficiency Wage Hypothesis, in: König, H. (Ed.): Economics of Wage Determination. Berlin.

*Krueger,* A./*Summers,* L. (1988), Efficiency Wages and the Interindustry Wage Structure. Econometrica 56, 259 - 293.

*Leonard,* J. (1987), Carrots and Sticks: Pay, Supervision and Turnover, Journal of Labor Economics 5, 136 - 153.

*Levy,* F./*Murnane,* R. (1992), U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations. Journal of Economic Literature 30, 1333 - 1381.

*Lorenz,* W./*Wagner,* J. (1988), The Earnings-Function under Test. Economics Letters 27, 95 - 97.

*Schlicht,* E. (1978), Labour Turnover. Wage Structure, and Natural Unemployment, Zeitschrift für die gesamte Staatswissenschaft 134, 337 - 364.

*Schmidt,* E. M. (1992), Intersektorale Lohndifferentiale. Zeitschrift für Wirtschafts- und Sozialwissenschaften 112, 201 - 218.

*Shapiro,* C./*Stiglitz,* J. E. (1984), Equilibrium Unemployment as a Worker Discipline Device. American Economic Review 74, 433 - 444.

*Wadhwani,* S./*Wall,* M. (1988), A Direct Test of the Efficiency Wage Model Using UK Micro-Data. Discussion Paper 313, Centre for Labour Economics, London School of Economics.

*Wagner,* J. (1991), Sektorlohndifferentiale in der Bundesrepublik Deutschland. Jahrbuch für Sozialwissenschaft 42, 70 - 102.

*Weiss,* A. (1991), Efficiency Wages. Oxford.

*White,* H. (1980), A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. Econometrica 48, 817 - 838.