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LECTURE NOTES IN ECONOMICS  
AND MATHEMATICAL SYSTEMS

Rüdiger Wapler

# Unemployment, Market Structure and Growth



Springer

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**Author**

Rüdiger Wapler  
University of Tübingen  
Faculty of Economics  
Mohlstrasse 36  
72074 Tübingen  
Germany

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## Foreword

In his Ph.D. thesis, Rüdiger Wapler analyses the causes of the persistently high unemployment rates especially in continental Europe. Particular emphasis is placed on imperfect labour and product markets on the one hand, and on the numerous links between unemployment, innovations and growth on the other. Hence, Rüdiger Wapler provides an important contribution towards a better understanding of both the development of labour markets as well as the dynamics of growth.

To aid readers with only little prior knowledge of labour markets, the book presents the most common theories of unemployment: (1) trade-union models in which union bargaining power leads to wages above their market-clearing level, (2) efficiency-wage models in which employers voluntarily pay higher wages in order to motivate or discipline their workers or to reduce the job-turnover rate, as well as (3) matching models in which unemployment is caused by the continuous turnover of jobs and workers. In addition, emphasis is placed on the fact that labour needs to be treated as heterogeneous, a fact often neglected in the literature. Subsequently, these labour-market foundations are integrated with modern theories of innovations and growth, making the approach much more relevant and plausible. Without doubt, the generalisations of the models performed by Rüdiger Wapler show that there are limits to such formal analysis. Due to the increasing number of interdependencies, it is doubtful whether even more complex models provide additional (usable) insights. This book is aimed at economists researching on labour markets, innovations and growth. I hope it receives the attention it deserves.

Professor Dr. Manfred Stadler

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Tübingen, April 2003

Rüdiger Wapler

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## List of Symbols

$a$	Job-finding rate
$a_{sS}$	Partial derivative of the unit cost function with respect to wages for labour of type $s$ in sector $S$
$b$	Job-breakup rate
$b_s$	Job-breakup rate for labour of type $s$
$c$	Costs of searching for and hiring a worker
$\hat{c}$	Consumption level measured in efficiency units
$c_j$	Unit costs of producing the intermediate good $j$
$c_S$	Unit costs in sector $S$
$d$	Distribution factor
$\tilde{e}$	Effort
$\tilde{e}_{sS}$	Effort of type $s$ labour in sector $S$
$\tilde{e}_s$	Effort of type $s$ labour
$\tilde{e}^*$	Optimal effort level
$f$	Rate at which vacancies are filled
$f_s$	Rate at which vacancies are filled for labour of type $s$
$g_A$	Growth rate of technological progress
$g$	Growth rate of final output
$g^*$	Steady-state growth rate of final output
$h_j$	Starting index for number of quality improvements of intermediate good $j$

$i$	Firm or brand index
$\tilde{i}$	Firm or brand index with $i \neq \tilde{i}$
$j$	Intermediate goods index
$\tilde{j}$	Component index
$\hat{k}$	Capital intensity measured in efficiency units
$\hat{k}^*$	Steady-state capital intensity measured in efficiency units
$l_j$	Running index for number of quality improvements of intermediate good $j$
$m_i$	Quantity of the manufacturing good of brand $i$
$\bar{m}_j$	Number of qualitative improvements of intermediate good $j$
$\bar{m}_{\tilde{j}}$	Number of qualitative improvements of component $\tilde{j}$
$\tilde{m}$	Matching rate
$n$	Number of varieties of the manufacturing good
$\bar{n}$	Number of different intermediate goods
$\bar{n}_s$	Number of different firms in sector $s$
$p$	Price level
$p_{m_i}$	Price demanded by firm $i$ in the manufacturing sector
$p_j$	Price of intermediate good $j$
$p_s$	Price of the good produced by type $s$ labour
$p_M$	Price index of the manufacturing good
$p_T$	Price of the traditional good
$q_m(j)$	Quality of the $\bar{m}$ th generation of the intermediate good $j$
$\hat{q}_s(\tilde{j})$	Highest quality available of the component $\tilde{j}$
$r$	Interest rate
$s$	Skill index, $s \in \{L, H\}$ with $L$ denoting low- and $H$ high-skill
$\bar{s}$	Worker index
$t$	Time index
$\bar{t}$	Time index
$\tilde{t}$	Time at which a job-worker pair is matched
$u$	Unemployment rate

$u_s$	Unemployment rate for labour of type $s$
$v$	Vacancy rate
$v_s$	Vacancy rate for labour of type $s$
$w$	Wage rate
$w_{sS}$	Wage rate paid to labour of type $s$ in sector $S$
$w^*$	Equilibrium wage rate
$\hat{w}$	Wage rate measured in efficiency units
$\hat{w}^*$	Equilibrium wage rate measured in efficiency units
$\hat{w}^e$	Expected wage measured in efficiency units
$\hat{w}_i$	Wage rate measured in efficiency units paid by firm $i$
$w^m$	Monopoly union wage rate
$w^{rtm}$	Wage with right-to-manage wage bargaining
$w_c$	Wage rate in a perfectly competitive labour market
$w_{m_i}$	Wage paid by firm $i$ in the manufacturing sector
$w_i$	Wage paid by firm $i$
$w_s^*$	Equilibrium wage rate for labour of type $s$
$w_s$	Wage rate for labour of type $s$
$w_{sj}$	Wage rate in the intermediate sector for labour of type $s$
$w_{sS}$	Wage rate for workers of type $s$ in sector $S$
$w_S$	Wage rate in sector $S$
$\bar{w}$	Alternative wage
$\bar{w}_s$	Alternative wage for labour of type $s$
$\hat{w}$	Wage rate measured in efficiency units
$\hat{w}_A$	Alternative income measured in efficiency units
$\tilde{w}_s$	Proportional rate of change of the wage rate for type $s$
$x_j$	Quantity of intermediate good $j$
$x_s(i, \tilde{j})$	Demand of firm $i$ in sector $s$ for component $\tilde{j}$
$y$	Per-worker output
$\tilde{y}$	Marginal value of worker output
$\hat{y}$	Per-worker output measured in efficiency units



$y_s$	Output per worker of type $s$
$z$	Imputed real income of an unemployed
$\hat{z}$	Unemployment income measured in efficiency units
$A$	Technology parameter
$A_0$	Initial productivity level
$A_K$	Technology parameter for capital
$A_L$	Technology parameter for labour
$A_s$	Technology parameter for labour of type $s$
$A_M$	Average quality of the intermediate goods
$C$	Consumption level
$D_s$	Production delay due to matching frictions
$\tilde{F}$	Fixed costs
$F(\bullet)$	Production function
$\hat{F}(\bullet)$	Production function in intensive form
$G$	Household assets
$I$	Investment
$I_w$	Average wage income
$K$	Capital stock
$L$	Employment
$\bar{L}$	Total labour supply
$\bar{L}_S$	Total labour supply in sector $S$
$L^*$	Equilibrium employment
$L^D$	Labour demand
$L_t^D$	Labour demand at time $t$
$L_{LR}^D$	Long-run labour demand
$L^{rtm}$	Employment with right-to-manage wage bargaining
$L_0$	Minimum employment level that unions will tolerate
$L_{Lj}$	Firm low-skilled labour demand in the intermediate sector $j$
$L_{m_i}$	Amount of labour employed by firm $i$ in the manufacturing sector

$L_s$	Employment of labour of type $s$
$L_s(i)$	Amount of labour of type $s$ employed by firm $i$
$L_{sS}$	Employment of labour of type $s$ in sector $S$
$L^S$	Labour supply
$L_S$	Employment in sector $S$
$L_U$	Number of union members
$M$	Manufacturing good
$P$	Macroeconomic price index
$Q_s$	Average quality of the components in sector $s$
$R$	Revenue
$R_j$	Revenue of firm $j$
$S$	Sector index, $S \in \{M, T, X\}$ , with $M$ denoting the manufacturing, $R$ the research sector, $T$ the traditional sector and $X$ the intermediate sector
$T$	Traditional good
$U$	Intertemporal utility
$U_M$	Unemployment in the manufacturing sector
$V$	Union utility
$\tilde{V}$	Intertemporal union utility
$\bar{V}$	Stock-market value of a monopolist in the intermediate sector
$\bar{V}_s(\tilde{j})$	Stock-market value of a monopolist in sector $s$ producing component $\tilde{j}$
$\bar{V}^m$	Indifference curve with monopoly unions
$\bar{V}^{rtm}$	Indifference curve with right-to-manage wage bargaining
$\tilde{V}^E$	Lifetime utility of a currently employed worker
$\tilde{V}_s^E$	Lifetime utility of a currently employed worker of type $s$
$\tilde{V}^M$	Lifetime utility of a worker currently employed in the manufacturing sector
$\tilde{V}^T$	Lifetime utility of a worker employed in the traditional sector
$\tilde{V}^U$	Lifetime utility of a currently unemployed individual
$\tilde{V}_s^U$	Lifetime utility of a currently unemployed individual of type $s$

$W^F$	Present-discounted value of expected profits from a filled position
$W_s^F$	Present-discounted value of expected profits of a firm in sector $s$ from a filled position
$W^V$	Present-discounted value of expected profits from a vacant position
$W_s^V$	Present-discounted value of expected profits from a vacancy in sector $s$
$X$	Aggregate output of intermediate goods
$X_s(\tilde{j})$	Aggregate demand for component $\tilde{j}$ in sector $s$
$Y$	Aggregate Output
$Z^*$	Steady-state R&D input
$Z_s(\tilde{j})$	R&D input in sector $s$ aimed at component $\tilde{j}$
$\alpha$	Labours' output elasticity
$\beta$	Union-bargaining power
$\beta_L$	Bargaining power of the union representing low-skilled workers
$\tilde{\beta}$	Worker-bargaining power
$\tilde{\beta}_s$	Worker of type $s$ bargaining power
$\gamma$	Elasticity of marginal utility
$\delta$	Rate of capital depreciation
$\epsilon_{f,\theta}$	Elasticity of the job-finding rate with respect to labour-market tightness
$\epsilon_{\nu,w}$	Elasticity of utility with respect to wages
$\epsilon_{\nu,w_L}$	Elasticity of utility with respect to low-skilled wages
$\epsilon_{F,L}$	Output elasticity with respect to labour
$\epsilon_{F,L_s}$	Output elasticity with respect to labour of type $s$
$\epsilon_{L,w}$	Elasticity of labour demand with respect to wages
$\epsilon_{\nu,\hat{w}}$	Elasticity of labour demand with respect to wages measured in efficiency units
$\epsilon_{L_L j, w_L}$	Elasticity of low-skilled labour demand in firm $j$ with respect to low-skilled wages
$\epsilon_{L_L, w_L}$	Elasticity of low-skilled labour demand with respect to low-skilled wages

$\epsilon_{L_m, w_m}$	Elasticity of labour demand with respect to wages in the manufacturing sector
$\varepsilon_1$	Parameter of the effort function
$\varepsilon_2$	Parameter of the effort function
$\varepsilon_3$	Parameter of the effort function
$\varepsilon_{s1}$	Parameter of the effort function for type $s$ labour
$\varepsilon_{s2}$	Parameter of the effort function for type $s$ labour
$\varepsilon_{s3}$	Parameter of the effort function for type $s$ labour
$\varepsilon_4$	Parameter of the effort function
$\hat{\varepsilon}_s$	Variable
$\zeta$	Expenditure share on manufacturing goods
$\eta_s$	Sociological parameter
$\theta$	Indicator of labour-market tightness
$\theta_s$	Indicator of labour-market tightness for labour of type $s$
$\vartheta$	Importance of wages as opposed to employment levels for unions
$\iota^*$	Steady-state probability of a successful innovation
$\iota_j$	Probability of a successful innovation in sector $j$
$\iota_s(\tilde{j})$	Probability of a successful innovation in sector $s$ of component $\tilde{j}$
$\tilde{t}$	Total number of expected quality improvements
$\kappa$	Degree of homogeneity of goods and indicator for indicator of intensity of competition on the product market
$\lambda$	Innovation size
$\mu$	Output coefficient in the research sector
$\nu$	Worker utility
$\pi$	Firm profits
$\pi^m$	Profits with monopoly unions
$\bar{\pi}^m$	Isoprofits with monopoly unions
$\pi^{rtm}$	Profits with right-to-manage wage bargaining
$\bar{\pi}^{rtm}$	Isoprofits with right-to-manage wage bargaining
$\pi_j$	Profits of a market leader producing the intermediate good $j$

$\pi_m$	Profits in the manufacturing sector
$\pi_{m_i}$	Profits of firm $i$ in the manufacturing sector
$\pi_s$	Profits of a firm producing an intermediate good of type $s$
$\pi_0$	Firms' fallback position
$\rho$	Rate of time preference
$\sigma_{KL}$	Elasticity of substitution between capital and labour
$\sigma$	Elasticity of substitution between two varieties of the composite manufacturing good
$\sigma_s$	Elasticity of substitution between low- and high-skilled labour
$\sigma_S$	Elasticity of substitution between low- and high-skilled labour in sector $S$
$\varsigma$	Fraction of suitable applicants
$\tau$	Time interval
$\phi$	Fraction of workers who are skilled
$\varphi$	Production function in the research sector
$\chi_s(\tilde{j})$	Price of a component with quality $\tilde{q}_s(\tilde{j})$
$\psi(\bullet)$	Probability function
$\omega$	Constant
$\Gamma$	Coefficient
$\hat{\Gamma}$	Coefficient
$\hat{\mathbf{\Gamma}}$	Matrix
$\Delta$	Coefficient
$\hat{\Delta}$	Coefficient
$\mathbf{\Delta}$	Matrix
$\hat{\mathbf{\Delta}}$	Matrix
$\theta_{sS}$	Cost share of labour of type $s$ in sector $S$
$\check{\theta}_{sS}$	Proportional rate of change of the cost share
$\Lambda$	Lagrange multiplier
$\Pi_s(\tilde{j})$	Profits of a firm producing component $\tilde{j}$ in sector $s$
$\Upsilon$	Number of vacancies within a firm

$\Phi$	Coefficient
$\Phi$	Matrix
$\Psi(\bullet)$	Distribution function
$\Omega$	Nash product
$\mathcal{H}$	Hamilton function
$\mathcal{L}$	Lagrange function

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# Contents

<i>Foreword</i> .....	VII
<i>Acknowledgements</i> .....	IX
<i>List of Figures</i> .....	XV
<i>List of Tables</i> .....	XVII
<i>List of Symbols</i> .....	XIX
<b>1 Introduction</b> .....	1
<b>2 Empirical Evidence</b> .....	5
<b>3 Wage Setting and Sector-Specific Unemployment</b> .....	21
3.1 Union Wage Bargaining .....	22
3.1.1 Homogeneous Workers .....	27
3.1.2 Heterogeneous Workers .....	33
3.1.3 Discussion .....	37
3.2 Efficiency Wages .....	37
3.2.1 Homogeneous Workers .....	40
3.2.2 Heterogeneous Workers .....	42
3.2.3 Discussion .....	45
3.3 Matching Processes .....	46
3.3.1 Homogeneous Workers .....	47
3.3.2 Heterogeneous Workers .....	56
3.3.3 Discussion .....	59
3.4 Summary and Conclusions .....	60

- 4   Market Structure and Unemployment . . . . . 63**
  - 4.1   Household and Producer Decisions . . . . . 65
    - 4.1.1   Households . . . . . 65
    - 4.1.2   Firms . . . . . 69
  - 4.2   Wage Setting and General Equilibrium . . . . . 70
    - 4.2.1   Union Wage Bargaining . . . . . 70
      - 4.2.1.1   The Model . . . . . 71
      - 4.2.1.2   Discussion . . . . . 81
    - 4.2.2   Efficiency Wages . . . . . 82
      - 4.2.2.1   The Model . . . . . 82
      - 4.2.2.2   Discussion . . . . . 87
    - 4.2.3   Matching Processes . . . . . 88
      - 4.2.3.1   The Model . . . . . 88
      - 4.2.3.2   Discussion . . . . . 95
  - 4.3   Summary and Conclusions . . . . . 95
  
- 5   Exogenous Growth and Unemployment . . . . . 97**
  - 5.1   The Basic Model . . . . . 98
  - 5.2   Wage Setting and General Equilibrium . . . . . 101
    - 5.2.1   Union Wage Bargaining . . . . . 101
      - 5.2.1.1   The Model . . . . . 101
      - 5.2.1.2   Discussion . . . . . 104
    - 5.2.2   Efficiency Wages . . . . . 105
      - 5.2.2.1   The Model . . . . . 105
      - 5.2.2.2   Discussion . . . . . 106
    - 5.2.3   Matching Processes . . . . . 106
      - 5.2.3.1   The Model . . . . . 107
      - 5.2.3.2   Discussion . . . . . 110
  - 5.3   Summary and Conclusions . . . . . 110



<b>6</b>	<b>Market Structure, Innovation-Based Growth and Unemployment</b>	<b>113</b>
6.1	Household and Producer Decisions	117
6.1.1	Households	117
6.1.2	Firms	118
6.2	Research Decisions	121
6.3	Wage Setting and General Equilibrium	122
6.3.1	Union Wage Bargaining	122
6.3.1.1	The Model	123
6.3.1.2	Discussion	135
6.3.2	Efficiency Wages	137
6.3.2.1	The Model	137
6.3.2.2	Discussion	145
6.3.3	Matching Processes	146
6.3.3.1	The Model	148
6.3.3.2	Discussion	160
6.4	Summary and Conclusions	161
<b>7</b>	<b>Summary and Conclusions</b>	<b>163</b>
<b>A</b>	<b>Appendix</b>	<b>171</b>
A.1	Derivation of the Bellman Equation	171
A.2	Derivation of the Relationship between Labour Productivity and Labour-Market Tightness	172
A.3	Derivation of the Keynes–Ramsey Rule	172
A.4	Derivation of the Price-Index	174
A.5	Derivation of the Demand for a Single Variant when there is Monopolistic Competition	175
A.6	Derivation of the Equilibrium Number of Firms	176
A.7	Derivation of the Growth Rate of the Intermediate Index	177
A.8	Derivation of the Relationship between the Proportional Rate of Change of Cost-Shares and the Elasticity of Substitution	178