

The Retirement Decision in Germany

-A Dynamic Programming Approach-

Inaugural-Dissertation
zur Erlangung des akademischen Grades
eines Doktors der Wirtschaftswissenschaft
des Fachbereichs Wirtschaftswissenschaft
der Freien Universität Berlin

vorgelegt von

Diplom-Volkswirt
THOMAS KNAUS

aus
Sigmaringen

Dekan: Professor Dr. Alfred Kuß
Erstgutachter: Professor Irwin L. Collier, PhD
Zweitgutachter: Professor John Rust, PhD

Tag der Disputation: 18. Juli 2002
Diese Version: Berlin, Februar 2003

Berichte aus der Volkswirtschaft

Thomas Knaus

The Retirement Decision in Germany

-A Dynamic Programming Approach-

D 188 (Diss. Freie Universität Berlin)

Shaker Verlag
Aachen 2003

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Knaus, Thomas:

The Retirement Decision in Germany. A Dynamic Programming Approach/
Thomas Knaus.

Aachen : Shaker, 2003

(Berichte aus der Volkswirtschaft)

Zugl.: Berlin, Freie Univ., Diss., 2002

ISBN 3-8322-1292-2

Copyright Shaker Verlag 2003

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publishers.

Printed in Germany.

ISBN 3-8322-1292-2

ISSN 0945-1048

Shaker Verlag GmbH • P.O. BOX 101818 • D-52018 Aachen

Phone: 0049/2407/9596-0 • Telefax: 0049/2407/9596-9

Internet: www.shaker.de • eMail: info@shaker.de

Acknowledgements

I have written this dissertational thesis while being a research and teaching assistant at the Institute of Public Finance and Social Policy at Freie Universität Berlin. I am thankful to my advisor Irwin L. Collier for his help and many valuable comments.

The main part of the project started out from a research stay at Yale University. I thank the German Academic Council (DAAD) for financial support. I am grateful to my second advisor John Rust for his encouragement and support, and to Hugo Benitez-Silva for his help and precious comments during the time at Yale and afterwards. I also thank them and Moshe Buchinsky for providing me parts of the program code used in this thesis.

I also thank the members of my dissertation committee, Irwin L. Collier, Helmut Bester, Lutz Kruschwitz, Jürgen Wolters, Anette Boom and Sven Schreiber.

I also benefitted from discussions with many colleagues and friends, in particular, Miriam Beblo, Andreas Göhler, Sebastian Kessing, Peter Kuhbier, Hans Meier, Hannah Nielsen, Robert Nuscheler, Christoph Reichle, Volker Schmitz, Rainer Schulz, Sabine Stephan, Thorsten Thade-wald, Harald Uhlig, Amelie Wolf and Jürgen Wolters.

I am thankful for helpful comments from seminar and conference participants at Helenenau, Aarhus and Bilbao.

I am especially grateful to Inez Weidinger for inspiring discussions and patient support.

Berlin, February 2003

To my parents

Contents

Acknowledgements	iii
Contents	vii
List of Tables	xi
List of Figures	xiii
1 Introduction and motivation	1
1.1 Related literature	4
1.1.1 Retirement behavior in Germany	4
1.1.2 Modelling retirement behavior in a dynamic programming framework . .	5
1.2 The contribution of this thesis	6
2 Macroeconomic approach	9
2.1 Demographic development	9
2.2 Social security budget	11
2.3 Average retirement age	14
2.4 Average retirement age by cohort	18
3 Institutional approach	21
3.1 Social Security System in Germany before 1992	23
3.1.1 General rules	23
3.1.2 Program specific rules	25
3.1.3 Behavioral implications	26
3.2 Social Security System in Germany after 1992	30
4 Empirical approach	31
4.1 Category I: Definition, data and sample selection	32
4.1.1 Definition of retirement	32
4.1.2 Data and sample selection	33

4.1.3	Income forecasts	34
4.2	Category II: Econometric and economic methods	35
4.2.1	Option value	36
4.2.2	Random lifetime utility	38
4.3	Category III: Estimation results	39
4.3.1	Eastern Germany	39
4.3.2	Western Germany	41
4.4	Category IV: Policy experiments	45
4.5	Evaluation	48
5	Theoretical approach	49
5.1	Dynamic optimization	50
5.1.1	Sequence approach	50
5.1.1.1	An example	51
5.1.2	Dynamic programming	53
5.1.2.1	An example	55
5.1.3	Lagrange multiplier method	58
5.1.3.1	An example	59
5.2	Modelling the retirement decision	60
5.2.1	Discrete labor supply	60
5.2.1.1	Perfect capital markets and actuarially fair pension benefits . .	61
5.2.1.2	Relaxing the assumptions	66
5.2.2	Continuous labor supply	67
5.2.3	Dynamic programming models	67
5.3	The optimal stopping model	68
5.3.1	One retirement program	68
5.3.2	Multiple retirement programs	75
5.4	Actuarial fairness and age neutrality	77
5.4.1	Actuarial fairness	77
5.4.2	Age neutrality	79
6	An integrated approach: the dynamic programming model	81
6.1	Dynamic structural models	82
6.1.1	Discrete Markov Decision Processes (DMDPs)	84
6.1.2	Optimality of Markovian decision rules	86
6.1.3	Identification problem	87
6.2	A theoretical model	90
6.2.1	Specification of preferences	91

6.2.2	Specification of beliefs	92
6.3	Numerical solution	94
6.3.1	Preferences	98
6.3.2	Beliefs	99
6.4	Simulation results	102
6.4.1	Beliefs	103
6.4.2	Behavioral implications	104
6.4.3	Income variables	106
6.5	Simulation experiments	109
6.5.1	Comparison to data	109
6.5.2	Institutional experiments only	111
6.5.2.1	Introduction of adjustment factors in 1992 reform	111
6.5.3	Macroeconomic experiments only	112
6.5.3.1	Increased earnings uncertainty	112
6.5.3.2	Change in life expectancy	114
6.5.4	Institutional and macroeconomic experiments simultaneously	114
6.5.4.1	Change in mortality rates and adjustment factors simultaneously	115
7	Summary and conclusions	117
7.1	Main findings	118
7.2	Policy implications	121
7.3	Outlook	123
A	Data Sources	127
A.1	Bundesministerium für Arbeit und Sozialordnung	127
A.2	Verband Deutscher Rentenversicherungsträger	127
A.3	Statistisches Bundesamt	129
A.4	Wissenschaftlicher Beirat	131
A.5	Empirical literature	133
B	Assumptions	135
B.1	Specification of preferences and beliefs	136
B.2	Solution method	136
C	Notation and abbreviations	137
	Bibliography	139

List of Tables

1.1	Basic facts about the German Public Pension System (GPPS), 2000	2
3.1	Brief history of German Public Pension System (GPPS)	22
3.2	Pathways to retirement for men in West Germany (1972 legislation)	25
3.3	Pathways to retirement for West German men (1920 cohort)	29
4.1	Definition of retirement	33
4.2	Data	34
4.3	Sample selection	35
4.4	Income forecasts	36
4.5	Econometric methods	37
4.6	Economic methods	38
4.7	Estimation results for Eastern Germany	40
4.8	Estimation results (Part I) for Western Germany	43
4.9	Estimation results (Part II) for Western Germany	44
4.10	Mean retirement age in policy simulations from empirical approach	46
5.1	Deterministic period utilities	69
5.2	Distribution (iid binomial) of random state variable $\epsilon_t^i, i = L, P$	69
5.3	Binomial choice probabilities for one retirement program	71
5.4	Logit choice probabilities	73
5.5	Deterministic period utilities	76
5.6	Binomial choice probabilities for multiple retirement programs	76
6.1	Classification of control problems in general	84
6.2	Markov Decision Processes (MDPs)	85
6.3	Income definitions	95
6.4	Notation and parameter values for numerical solution	96
6.5	Estimation results for wages and cumulative relative wages	100
A.1	Indexation regimes in the German Public Pension System (GPPS)	129

A.2 Labor force participation by age	130
A.3 Projected demographic development of population in Germany	131

List of Figures

2.1	Contribution rates, spending and unemployment in total safety net	10
2.2	Revenue and expenditure by region	11
2.3	Net pension levels and contribution rates	13
2.4	Working phase and retirement phase	15
2.5	Average retirement age by gender and region	17
2.6	Average retirement age by program type and region	17
2.7	Average retirement age by cohort	19
3.1	Pathways to retirement in Germany: males	27
3.2	Distribution of retirement ages (1920 cohort and 1984 cross-section of males) . .	28
3.3	Program entry rates and relative program entry rates (1920 cohort)	28
5.1	Two period consumption savings problem	53
5.2	Retirement problem	65
6.1	Preference for leisure	99
6.2	Average gross nominal earnings and indexation factors from 1925 to 1984	102
6.3	Death and survival rates from 1000 iid simulations	103
6.4	Wages and cumulated relative wages from 1000 iid simulations	104
6.5	Labor supply and retirement ages from 1000 iid simulations	105
6.6	Wages, earnings and consumption from 1000 iid simulations	106
6.7	Wages, earnings, benefits and cumulated relative wages from 1000 iid simulations	108
A.1	Future development of contribution rate in GPPS	132

