PROFILING, AUDITING AND PUBLIC POLICY
APPLICATIONS IN LABOR AND HEALTH ECONOMICS
ISBN: 978 90 5170 732 8

Cover design: Crasborn Graphic Designers bno, Valkenburg a.d. Geul

This book is no. 639 of the Tinbergen Institute Research Series, established through cooperation between Rozenberg Publishers and the Tinbergen Institute. A list of books which already appeared in the series can be found in the back.
Profiling, Auditing and Public Policy: Applications in Labor and Health Economics
promotoren: prof.dr. B. van der Klaauw
prof.dr. M. Lindeboom
Acknowledgements

Roughly five years ago the journey of writing this dissertation started. Although I already obtained a master’s degree, I felt like there was much more to learn about economics and econometrics than the knowledge I had accumulated at university up to that point. This being the main motivation for me to pursue a PhD in economics, the past years seem to have been successful. I learned a lot about microeconometric methods, computer programming, health and labor economics, but I also gained experience in a more practical way through solving the many issues that showed up in performing the field experiment that is an important component of this thesis. Besides, foreign trips for workshops, courses, seminars and conference visits made me much more experienced and confident in many respects.

Nevertheless, writing a dissertation also turned out to be a tough and lonely journey from time to time. Sometimes weeks passed without any clear achievements. Fortunately, such weeks alternated with weeks in which I wrote large parts of papers and attained a lot of programming skills giving me the required motivation to continue working on the dissertation. Even though many people kept telling me that this diversity in progress is a typical part of doing a PhD, for me it also resulted in doubts and quite some frustration. I am very grateful to everyone who tried to keep me motivated and inspired in this process. This thesis would not have been finished without them.

In some way or another, many people contributed to the successful completion of this dissertation and I would like to take the opportunity to thank them. First, I would like to thank my supervisors, Bas van der Klaauw and Maarten Lindeboom. When writing my first master’s thesis under their supervision in the spring of 2010, they advised me to think about enrolling in the MPhil program at the Tinbergen Institute. Although at first I was quite reluctant about continuing my career as a student, I am glad that they made me consider this choice. By the time I had to choose a PhD supervisor, I soon decided to contact Bas and Maarten again because their research projects and interests were close to what I wanted to do during my PhD. Besides, I really enjoyed their inspiring supervision when writing my first thesis.
Bas and Maarten, I am grateful that you were willing to act as my PhD supervisors. Bas, thanks for all the time and effort you put in the supervision, for being available for many technical and less technical questions, and for the research projects you got me involved in. I learned a lot from you in the past years and it was fun to work together. Maarten, thanks for the opportunities you provided me with in the past years and for supervising this dissertation. Although you were typically quite busy, you kept me motivated by jumping into my office from time to time and cheerfully telling me that you were happy about the progress and quality of my research.

Two chapters of this dissertation examine a field experiment in the Dutch market for long-term care. This large-scale research project in the heart of the public debate was a great project to work on. I am very grateful to the CIZ (Centrum Indicatiestelling Zorg) for giving me the opportunity to carry out this field experiment. In particular, I would like to thank Hans Ouwehand, Marcel de Krosse, and John Braspenninckx for their involvement in the design of the experiment and their interest in the results. Furthermore, I would like to thank Birgit van Veldhuizen for being extremely involved and interested in the project and for putting a huge amount of effort in making this research possible, getting it implemented and realized. Moreover, I want to thank Ellen van der Laan for the construction and provision of the data, Jelle Methorst for the technical implementation of the changes in audit procedures, and Dorie Jansen for answering many questions about the audit procedures. Finally, I am grateful to the assessors (‘toetsers’) and case managers (‘relatiebeheerders’) for giving insightful explanations and for the discussions we had which were helpful in understanding the procedures and in getting the complete picture clear. I very much enjoyed working together with all of you in this research project.

An inspiring and joyful environment turned out to be an important component for the successful completion of this dissertation. I would like to thank Nynke, Paul, Nadine, Dennis, and Lisette for the coffee breaks, for sharing an office, for the chats and (sometimes) serious discussions and for the support in times that I hesitated about the completion of the dissertation. Although I could often not make it to our outings, I really enjoyed your company and hope this will continue in the future. Furthermore, I would like to thank all of my colleagues at the Department of Economics of the Vrije Universiteit Amsterdam for their support and interest in the progress of this research. In particular, I want to thank Sabien, Jonneke, Pierre and Patrick. Nadine, thanks for jointly writing an article on the practical issues surrounding the set-up and implementation of field experiments.¹ It was fun to work

¹See Ketel and Vriend (2015).
on this together. Moreover, I am grateful to France Portrait. It was pleasant to work together in the previous years.

Furthermore, I owe my gratitude to my friends who were always there to support me during the past five years. Anne, Penney, Rocher, Inge, Bob, and Mariëlla, thanks for the years of friendship and for making me realize that there are so many more important things in life than writing this dissertation. I hope there are many more years of friendship to come. I would also like to thank my fellow-musicians in the orchestras of Crescendo, and in particular those of you with whom I shared a lot (of time) in the past years, e.g., in organizing the music marathon or in other committees. In particular, I would like to thank Margreet, Lili-Anne, and Eva. Thanks for being interested in the research and the progress of the dissertation, for motivating me in times of lack of progress, and for enjoying music together. Besides, I would like to thank the many people in the protestant church in Sassenheim who showed their interest and sympathy in the past years. Especially, I would like to thank Tim Moll. At quite some points in time you urged and motivated me to continue writing this dissertation. I appreciate a lot that you always kept asking about the progress and scientific output. Thanks for the support and interest. Moreover, I would like to thank the walking dinner team and the people from the ‘belijdenisgroep’ with whom I spent quite some evenings in the past year(s).

Finally, I am extremely grateful to my family, my aunts and uncles, and the family Muilwijk. Thanks for your support, sympathy and interest. Dad and mom, thanks for always being there to support me, even though it has not always been easy. Without your help, love and patience this thesis would not have been completed. And finally, I would like to thank Arjen. You cheered me up, motivated me and made me more confident when it was needed. I am grateful that I can always count on you.

Sandra Vriend

Sassenheim,
November 2015
## Contents

Acknowledgements

Contents

List of Tables

List of Figures

1 Introduction

2 A Nonparametric Method For Predicting Survival Probabilities
   2.1 Introduction .................................................. 7
   2.2 Profiling methods in theory ............................ 11
      2.2.1 Benchmark methods ................................... 11
      2.2.2 Weighted survivor prediction method .............. 12
   2.3 Distances and weights ..................................... 14
      2.3.1 Distance metrics ....................................... 14
      2.3.2 Weighting functions .................................. 19
   2.4 Monte Carlo simulation study .......................... 20
      2.4.1 Data generating process ............................ 21
      2.4.2 Measuring prediction quality ..................... 22
      2.4.3 Set-up of the simulation study .................... 23
   2.5 Results .................................................... 26
      2.5.1 Specification of the weights ....................... 26
      2.5.2 Comparison to other profiling methods .......... 35
   2.6 Empirical application ................................... 42
   2.7 Conclusion ................................................ 48
   2.A Simulation procedure ................................... 50
   2.B Similarity in simulated distances .................... 51
   2.C Construction of the data set and variables .......... 58
3 Audit Rates and Compliance: A Field Experiment in Care Provision 73

3.1 Introduction .............................................. 73
3.2 Institutional background ................................ 76
3.3 The experiment ......................................... 79
  3.3.1 Implementation ...................................... 80
  3.3.2 Hypothesized effects ................................. 80
3.4 Data ....................................................... 83
3.5 Results ................................................... 87
  3.5.1 Sorting effects in the conditional audit rate group ... 90
3.6 Conclusion ............................................... 95
3.A Additional tables ...................................... 97

4 The Effect of Audit Regimes on Applications for Long-Term Care 103

4.1 Introduction .............................................. 103
4.2 Institutional background ................................ 107
4.3 Experimental design .................................... 110
  4.3.1 Set-up ............................................... 110
  4.3.2 Implementation ...................................... 111
  4.3.3 Hypotheses .......................................... 113
4.4 Data ....................................................... 116
4.5 Results ................................................... 117
  4.5.1 Descriptive evidence ................................. 118
  4.5.2 Number of applications ............................... 120
    4.5.2.1 Substitution effects ............................. 122
    4.5.2.2 Short-run, long-run and post-treatment effects ... 124
    4.5.2.3 Hawthorne effect ................................ 126
  4.5.3 Quality of applications .............................. 128
    4.5.3.1 The role of the assessor ......................... 130
4.6 Conclusion ............................................... 133
4.A Information provided to participants .................. 135
4.B Construction of the panel data set ..................... 135
4.C Dynamics in the conditional audit regime .............. 137
4.D Additional tables ...................................... 141
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conclusions</td>
<td>151</td>
</tr>
<tr>
<td>Bibliography</td>
<td>155</td>
</tr>
<tr>
<td>Samenvatting</td>
<td>163</td>
</tr>
</tbody>
</table>
List of Tables

2.1 Overview of distance metrics. ............................................. 16
2.2 Overview of weighting functions and bandwidth parameters. ..... 20
2.3 Parameter and distributional choices, fixed across simulations. .... 24
2.4 Parameter and distributional choices for the simulations. ......... 25
2.5 Estimation results of the effect of distance metric, weighting function
and bandwidth on log average prediction quality, MC 1 to 6 ........ 28
2.6 Estimation results of the effect of distance metric, weighting function
and bandwidth on log average prediction quality, MC 7 to 12 ....... 30
2.7 Best performing distance metric in each Monte Carlo experiment, given
Epanechnikov weights & 2% bandwidth ................................. 32
2.8 Difference in MAE of weighted survivor prediction and Cox prediction. 39
2.9 Difference in absolute error of survival probability predictions from the
weighted survivor prediction method and the linear probability model. 40
2.10 Descriptive statistics for the full sample. ................................. 43
2.11 Deviations of the average predicted survivor functions from the Kaplan-
Meier estimate, up to duration of two years. ............................. 46
2.12 Repetition for five subsamples. ............................................ 47
2.12 Average Spearman’s rank correlation coefficients between sets of
distance metrics for the baseline MC ...................................... 52
2.12 Average Spearman’s rank correlation coefficients between selection of
distance metrics for all MC experiments. ................................. 54
2.12 Estimated coefficients used in distance computation .................. 56
2.12 Number of observations with missing information for a particular covariate. 59
2.12 Estimation results of the effect of distance metric and bandwidth on
log average prediction quality ............................................. 61
2.12 Estimation results of the effect of distance metric and bandwidth on
log average prediction quality, MC 7 to 12 ............................ 63
2.12 Best performing distance metric, given Epanechnikov weights and a 2%
bandwidth; alternative definitions ......................................... 65
2.D.4 Censoring thresholds and % with $\alpha = \alpha_1$ for each Monte Carlo experiment. 67
2.D.5 Estimation results for the Cox model using the training sample. 68
2.D.6 Deviations of the average predicted survivor functions from the Kaplan-Meier estimate, up to duration of half a year. 69
2.D.7 Deviations of the average predicted survivor functions from the Kaplan-Meier estimate, up to duration of one year. 70
2.D.8 Repetition for five subsamples; alternative sample sizes. 71
3.1 Descriptive statistics on outcomes in the pre-experiment period (Jan 2012 - Sept 2012) and care provider characteristics, by treatment group. 81
3.2 Descriptive statistics on outcomes during the experiment. 85
3.3 Estimation results: baseline and heterogeneous effects. 91
3.4 Descriptive statistics on the periodic adjustments in the conditional audit rate group. 92
3.5 Pre-experiment performance and final audit rates in the conditional audit rate group. 93
3.6 Actual and simulated audit rate distribution. 93
3.A.1 Robustness: level of aggregation. 97
3.A.2 Robustness: various ways of dealing with inactive care providers. 98
3.A.3 Robustness: time trend specification. 99
3.A.4 Robustness: accounting for serial correlation. 100
3.A.5 Estimation results: approval rate low-risk and high-risk applications. 101
3.A.6 Estimation results: composition low/high risk applications. 101
3.A.7 Estimation results using individual application-level data. 102
4.1 Balancing of pre-experiment outcomes and provider characteristics across treatment groups (January 1, 2012 - September 16, 2012). 112
4.2 Assessor approval rates by group of assessors. 113
4.3 Application characteristics and patient characteristics (January 1, 2012 - April 7, 2013). 117
4.4 Baseline estimates for the number of applications (per week) at the provider level (January 1, 2012 - April 7, 2013). 122
4.5 Substitution effects at the provider level. 124
4.6 Short-run, long-run and post-treatment effects (January 1, 2012 - November 24, 2013). 125
4.7 Baseline estimates for the audit approval rate at the application level (January 1, 2012 - April 7, 2013). 129
4.8 Reasons for audit disapproval before and during the experiment. 131
4.9 Effect of ex-post auditing on approval probability................. 132
4.C.1 Updates of the timing of audit in the conditional audit regime. . . . 138
4.C.2 Descriptives on simulated updates of the timing of audit in the ex-ante audit regime. .......................................................... 140
4.D.1 Descriptive statistics on outcomes during the experiment (September 17, 2012 - April 7, 2013)............................................ 141
4.D.2 Robustness check: level of time aggregation. ...................... 142
4.D.3 Robustness check: inactive care providers.......................... 143
4.D.4 Heterogeneous effect estimates. ....................................... 144
4.D.5 Composition effects in the number of re-assessment applications at the application level. ......................................................... 145
4.D.6 Estimates of a Hawthorne effect for the number of applications. .... 146
4.D.7 Robustness check: including incomplete periods. .................. 147
4.D.8 Robustness check: accounting for serial correlation. ................ 148
4.D.9 Short-run, long-run and post-treatment effects on the audit approval probability (January 1, 2012 - November 24, 2013). ............... 149
List of Figures

2.1 Average survivor functions with various methods. 36
2.2 K-M estimate and predicted survivor functions with various methods. 45
2.C.1 Histograms of observed durations. 60
3.1 AWBZ expenses in the Netherlands, 1998 - 2012. 77
3.2 Timeline for the application process. 78
3.3 Average number of audits. 86
3.4 Average number of applications. 86
3.5 Average approval rate across care providers. 87
3.6 Histograms of realized and simulated end-of-experiment audit rates. 94
4.1 Process of application for long-term care services (before the experiment). 109
4.2 Weekly average number of re-assessment applications in the three treatment groups. 119
4.3 Weekly average number of emergency care and regular applications in the three treatment groups. 119
4.4 Average approval rates in the three treatment groups. 120
4.5 Distribution of number of re-assessment applications for participating and non-participating care providers, February 2012 - June 2012. 127
4.6 Average number of re-assessment applications, providers in ex-ante regime and non-participants. 127
4.7 Estimated assessor fixed effects. 133
4.C.1 Actual and simulated dynamics in the timing of audit. 139