Assessing the Impact of a School Subsidy Program in Mexico: Using a Social Experiment to Validate a Dynamic Behavioural Model of Child Schooling and Fertility

Petra E. Todd and Kenneth I. Wolpin

(University of Pennsylvania)

Presentation by Janoś Gabler

November 23, 2017

Introduction

Motivation

- The paper evaluates the Conditional Cash Transfer (CCT) program PROGRESA
- Data from a **randomized experiment** is available
- But the authors estimate a **structural model** and don't even use the RCT data to do so

Motivation

- The paper evaluates the Conditional Cash Transfer (CCT) program PROGRESA
- Data from a **randomized experiment** is available
- But the authors estimate a **structural model** and don't even use the RCT data to do so
- **Why are they doing that?**

Contents

The PROGRESA Program

- PROGRESA is the first Latin American CCT program
- Eligible mothers get cash if children attend school and get health checkups
- Transfers start at 3^{rd} grade and end after 9^{th} grade
- Benefit increases with grade level and is higher for girls

Hypothesized Effects of CCTs

Positive

- Increase human capital via school attendance
- Improve child health
- Alleviate extreme poverty

Hypothesized Effects of CCTs

Positive

- Increase human capital via school attendance
- Improve child health
- Alleviate extreme poverty

Negative

- Negative incentives on fertility decisions of young women

The Field Experiment

- Random Assignment of:
  - 320 treatment villages
  - 186 control villages
- In treatment villages, about 50 % of households are eligible
- Pre-intervention data was collected before March 1998
- Post-intervention data was collected until November 1999

Policy Questions

Which Questions Can Be Answered from the Experiment?

Which Questions Can Be Answered from the Experiment?

What is the ATT of the implemented transfer scheme on school attainment

Which Questions Can Be Answered from the Experiment?

What is the ATT of the implemented transfer scheme on school attainment one year after the intervention

Which Questions Can Be Answered from the Experiment?

What is the ATT of the implemented transfer scheme on school attainment one year after the intervention if the policy is introduced as a surprise

Which Questions Can Be Answered from the Experiment?

What is the ATT of the implemented transfer scheme on school attainment one year after the intervention if the policy is introduced as a surprise but announced to be permanent?

And Which Questions Can't?

And Which Questions Can't?

- What is the most **efficient transfer scheme**?
- What is the effect of that policy if it is already **in place when people take fertility decisions**?
- What is the effect on **total school attainment**?

Goals and Contribution of the Paper

Goals and Contribution of the Paper

- **Main Goal**: Answer the questions that can't be answered by the experiment

Goals and Contribution of the Paper

- **Main Goal**: Answer the questions that can't be answered by the experiment
  - This requires a structural model
  - "no consensus on what is a reasonable model structure"
  - Solution: use the treatment group to validate a structural model that was only estimated on control group data

Goals and Contribution of the Paper

- **Main Goal**: Answer the questions that can't be answered by the experiment
  - This requires a structural model
  - "no consensus on what is a reasonable model structure"
  - Solution: use the treatment group to validate a structural model that was only estimated on control group data
- **Main Contribution**: one of the first papers to address and implement model validation in a systematic way

A Model of Schooling Choices and Fertility

Type of Model

- Finite Horizon **Discrete Choice Dynamic Programming** (DCDP) Model
- **Intuitively**: "*a behavioral economic model that can be described as sequential discrete choice optimization problems constrained by resource limitations and imperfect information about future events.*"

Type of Model

- Finite Horizon **Discrete Choice Dynamic Programming** (DCDP) Model
- **Intuitively**: "*a behavioral economic model that can be described as sequential discrete choice optimization problems constrained by resource limitations and imperfect information about future events.*"
- Widely applied for ex-ante policy evaluation
- You already know one from Philipp's talk
- Solution and estimation will be as in that model

Choice Set

- In each period, households decide:
  - Whether to become pregnant or not
  - For each child, decide whether:
    - Child stays at home
    - Child goes to school
    - Child works and earns income
- In each fertile period there are $2 \cdot 3^n$ options, where n is the number of children

Rewards and Constraints

- Utility depends on:
  - Consumption
  - Pregnancy and birth history
  - Schooling history for each child
  - Children at home
  - Distance to school
  - Shocks
- Constraints
  - Consumption = (exogenous) parent income + (endogenous) child labor income

State Space

- **Definition**: set of all factors, known to the individual, that affect current rewards or the probability distribution of any of the future rewards.

State Space

- **Definition**: set of all factors, known to the individual, that affect current rewards or the probability distribution of any of the future rewards.
- The state space contains:
  - Birth histories of sons and daughters
  - School histories of sons and daughters
  - Age of parents and age at marriage
  - Distance to secondary school and city
  - Current preference shocks (unobserved)
  - Types (permanent heterogeneity, unobserved)
- The state space is huge

Identification of the Policy Effect From Observational Data

Identification of the Policy Effect

Identification of the Policy Effect

- **Best Case**: exogenous variation in tuition costs

Identification of the Policy Effect

- **Best Case**: exogenous variation in tuition costs
- **Instead**: exploit variation in child wages

Identification of the Policy Effect

- **Best Case**: exogenous variation in tuition costs
- **Instead**: exploit variation in child wages
- **Problem**: wages are only observed if children work

Identification of the Policy Effect

- **Best Case**: exogenous variation in tuition costs
- **Instead**: exploit variation in child wages
- **Problem**: wages are only observed if children work
- **Solution**:
  - Estimate the wage offer distribution
  - Model is identified, if there is a variable that affects wage offers but not parents' preference for schooling
  - Authors use distance to next city

Identification of the Policy Effect

- **Best Case**: exogenous variation in tuition costs
- **Instead**: exploit variation in child wages
- **Problem**: wages are only observed if children work
- **Solution**:
  - Estimate the wage offer distribution
  - Model is identified, if there is a variable that affects wage offers but not parents' preference for schooling
  - Authors use distance to next city

Convenience Assumptions

- Distributional assumptions on unobservables
- Functional form assumptions on utility functions
- Not only needed for estimation, but even for identification

Convenience Assumptions

- Distributional assumptions on unobservables
- Functional form assumptions on utility functions
- Not only needed for estimation, but even for identification
- Given those assumptions, model can be estimated by standard maximum likelihood

Model Validation

What Is Meant By Validation

- In-sample goodness of fit measures can't check model's ability to predict counterfactuals
- Instead: use model to predict effects of policies not observed in the estimation sample
- Compare predictions with experimental treatment effects
- If this works, consider the model to be validated with respect to that policy question

Use the Model to Predict Treatment Effects

- Closer look at the budget constraint in the treatment group:

$$C(t) = y_p(t) + \sum_{n=1}^{N} y_n(t)\mathbb{I}_{\{\text{n works}\}} + \tau_n(t)\mathbb{I}_{\{\text{n at school}\}} \qquad (1)$$

- This can be used for counterfactual simulation
- To do so, use 200 simulation draws per family
- In what follows, this is used to:
  - Predict experimental treatment effects
  - Predict choices
  - Answer the policy questions

Figure: Actual and predicted treatment effects

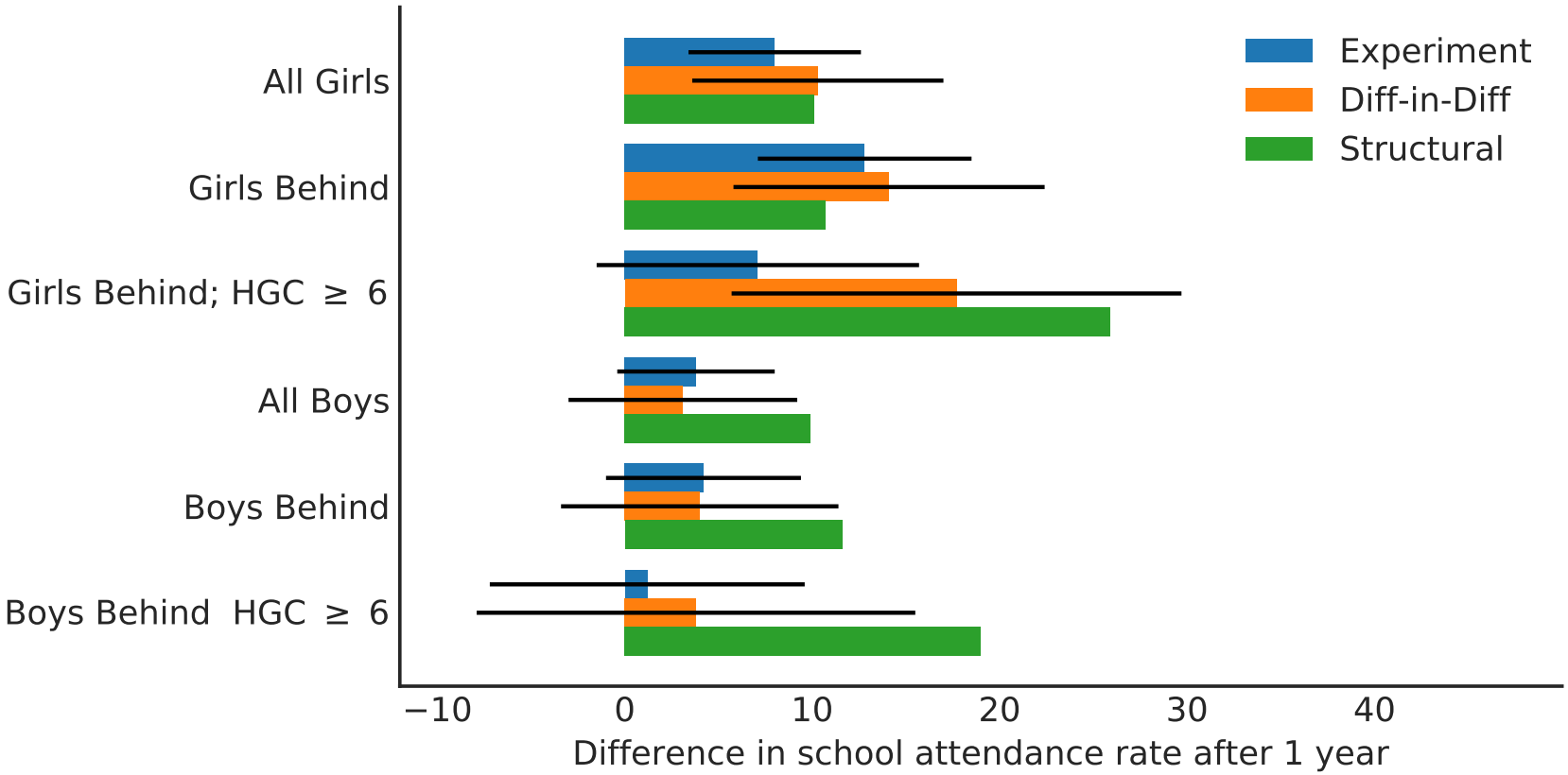
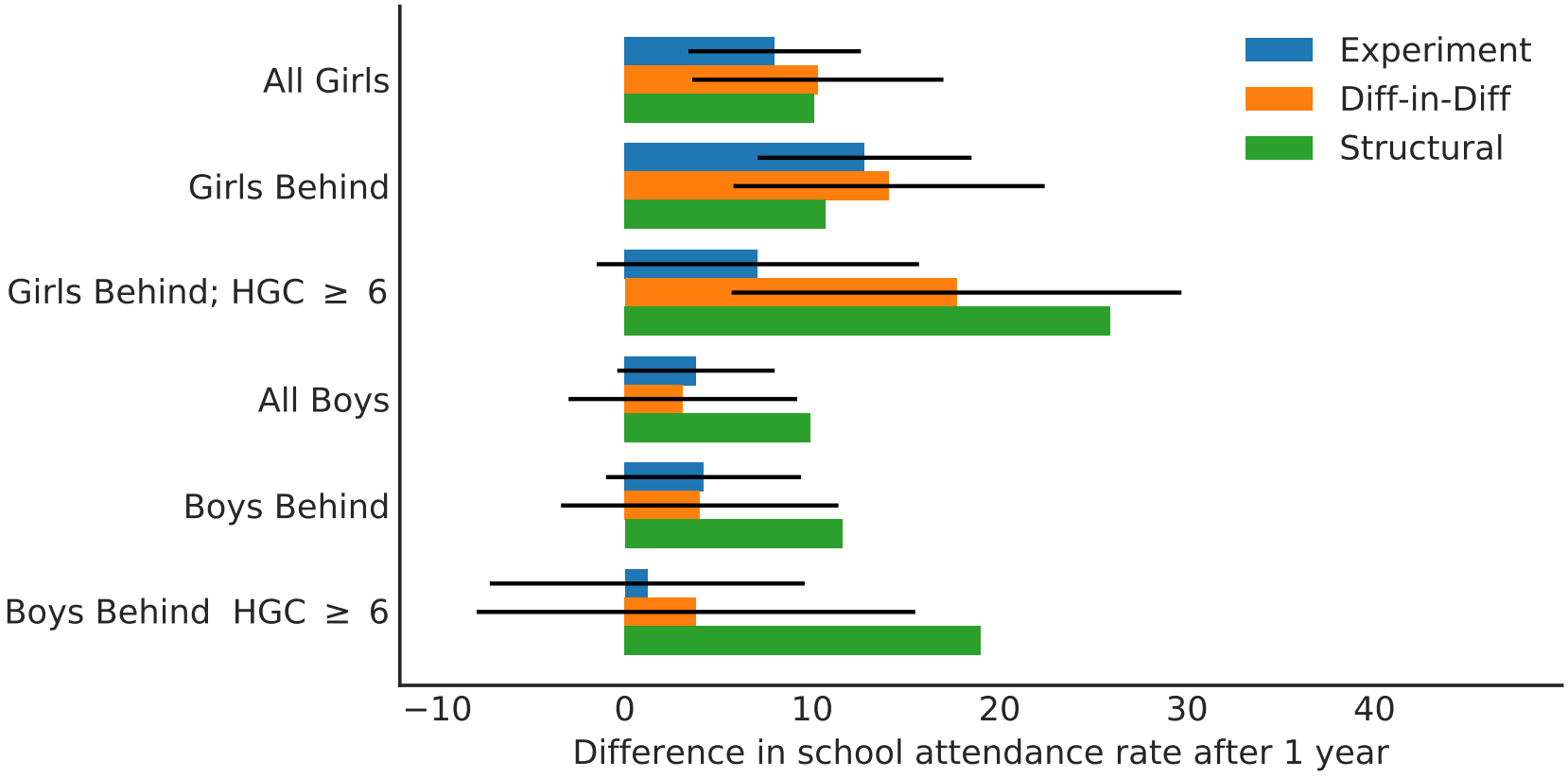
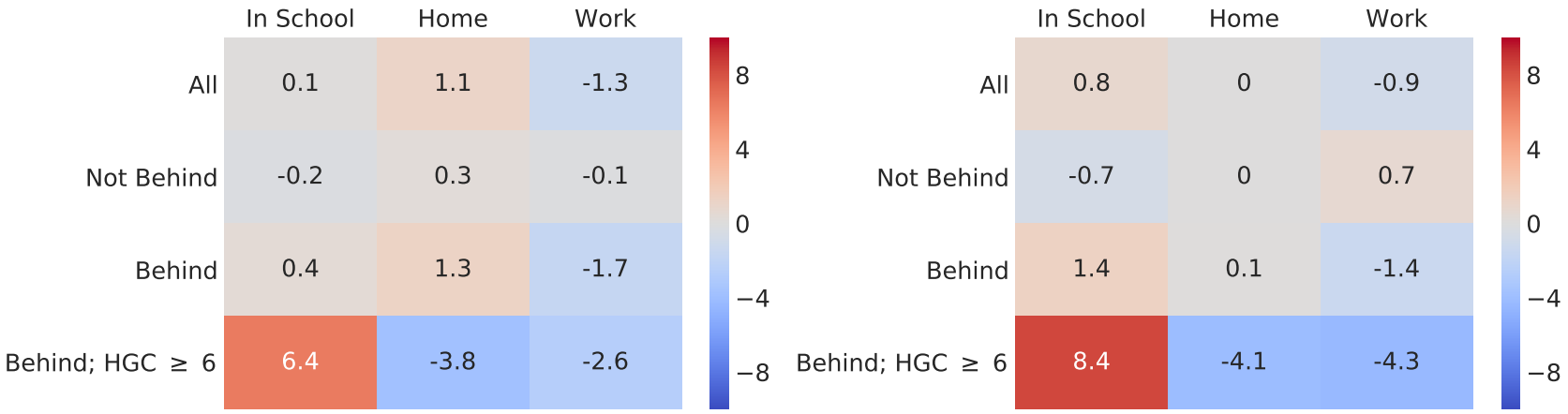


Figure: Actual and predicted treatment effects



- Effects of the policy on school attendance rates after 1 year
- Children aged 12 to 15
- Bars show ± 1 Standard Error

Figure: Actual And Predicted Choices

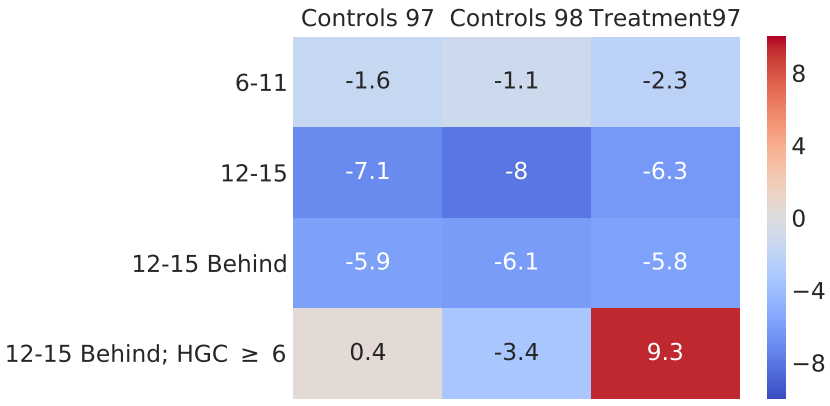


(a) Girls

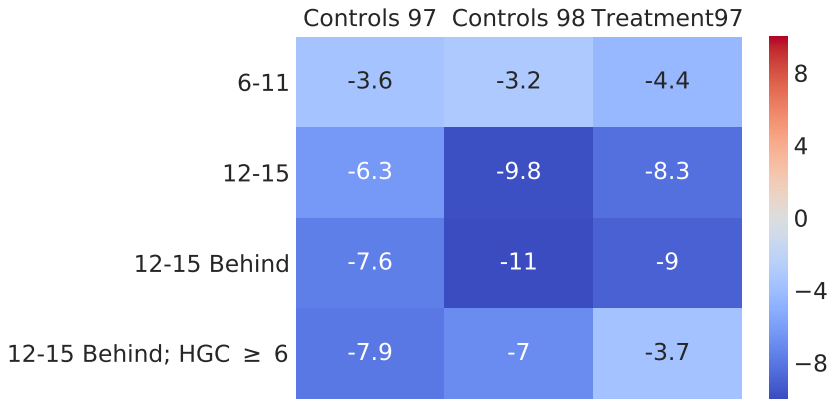
(b) Boys

- Children aged 12 to 15
- Deviations between actual and predicted group percentages
- Overall pretty good!

Figure: Actual and Predicted Schooling N-Years Ahead



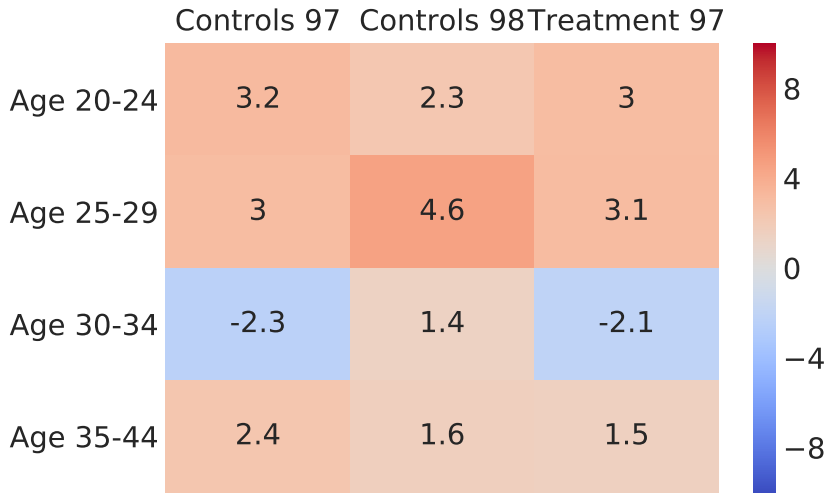
(a) Girls



(b) Boys

- Predictions only based on household characteristics at marriage!

Figure: Actual and Predicted Pregnancy Rate N-Years Ahead



- Predictions only based on household characteristics at marriage!

Answers to Policy Questions

Treatment Effects in the Short and Long Run

	Girls		Boys	
	Short-run effect	Long-run effect	Short-run effect	Long-run effect
Control group				
1997	10.9	11.9	10.7	12.0
1998	11.2	12.3	11.4	12.7
Treatment group				
1997	11.2	12.3	11.3	12.4
1998	11.7	12.7	12.1	12.4

- Effects of the policy on school attendance rates
- Long run means, program is in place since marriage!
- Long effects only slightly larger than short run effects

Effects on Completed Schooling

	Girls		Boys	
	No subsidy	Subsidy	No subsidy	Subsidy
Mean schooling	6.29	6.83	6.42	6.96
% completing grade 6 or more	75.8	82.2	78.8	83.3
% completing grade 9 or more	19.8	25.9	22.8	28.0

Alternative Transfer Schedules

- The authors simulate several alternative subsidies
- A cost neutral shift of transfers towards the higher grades, makes the treatment effect about 25 % larger
- This was to be expected, since school attendance is universal in earlier grades

Alternative Transfer Schedules

- The authors simulate several alternative subsidies
- A cost neutral shift of transfers towards the higher grades, makes the treatment effect about 25 % larger
- This was to be expected, since school attendance is universal in earlier grades
- **Careful**: The outcome variable is only completed schooling; Positive effects on cognitive and non-cognitive skills through other parental investments are not included!

Impact of the Paper

Controversy with Attanasio et al.

- Both evaluate PROGRESA
- Both combine a structural model with an experiment
- Attanasio et al. criticize the identifying assumptions of Todd and Wolpin
- They use the experiment for identification and don't validate their model
- If your interested, I suggest the following redings:
  - Todd and Wolpin, (2006)
  - Attanasio, Meghir, and Santiago, (2012)
  - Wolpin, (2013)

Papers that Validate Structural Models

- D. Wise, 1985
- Lumsdaine, Stock, and D. A. Wise, 1994
- Misra and Nair, 2009
- Cho and Rust, 2010
- Kaboski and Townsend, 2011
- Duflo, Hanna, and Ryan, 2012
- Voena, 2015
- Garlick, 2016
- Dellavigna et al., 2017

Summary and Conclusion

Summary and Conclusion

- Many questions cannot be answered by experiments
- Structural models can help, but require untestable assumptions
- Experiments can help in structural estimation
  - By making identifying assumptions more credible
  - Because they make it possible to validate the model
- Validation is always with respect to a quantity of interest
- Validation shifts assessment of credibility from statistical assumptions to content related judgments about precision

References I

Attanasio, Orazio P., Costas Meghir, and Ana Santiago (2012). "Education Choices in Mexico: Using a Structural Model and a Randomized Experiment to Evaluate PROGRESA". In: *The Review of Economic Studies* 79.1, pp. 37–66. ISSN: 00346527, 1467937X. URL: http://www.jstor.org/stable/41407044.

Cho, Sungjin and John Rust (2010). "The Flat Rental Puzzle". In: *The Review of Economic Studies* 77.2, pp. 560–594. ISSN: 00346527, 1467937X. URL: http://www.jstor.org/stable/40587639.

References II

Dellavigna, Stefano, John A. List, Ulrike Malmendier, and Gautam Rao (2017). "Voting to Tell Others". In: *The Review of Economic Studies* 84.1, pp. 143–181. DOI: 10.1093/restud/rdw056. eprint: /oup/backfile/content_public/journal/restud/84/1/10.1093_restud_rdw056/3/rdw056.pdf. URL: +%20http://dx.doi.org/10.1093/restud/rdw056.

Duflo, Esther, Rema Hanna, and Stephen P. Ryan (2012). "Incentives Work: Getting Teachers to Come to School". In: *American Economic Review* 102.4, pp. 1241–78. DOI: 10.1257/aer.102.4.1241. URL: http://www.aeaweb.org/articles?id=10.1257/aer.102.4.1241.

Garlick, J. (2016). *Essays on Development Economics*. URL: https://books.google.de/books?id=u2xzAQAACAAJ.

References III

Kaboski, Joseph P. and Robert M. Townsend (2011). "A Structural Evaluation of a Large-Scale Quasi-Experimental Microfinance Initiative". In: *Econometrica* 79.5, pp. 1357–1406. ISSN: 1468-0262. DOI: 10.3982/ECTA7079. URL: http://dx.doi.org/10.3982/ECTA7079.

Lumsdaine, Robin L., James Stock, and David A. Wise (1994). "Pension Plan Provisions and Retirement: Men & Women, Medicare, and Models". In: *Studies in the Economics of Aging*. Ed. by D. Wise. University of Chicago Press, pp. 183–212.

Misra, Sanjog and Harikesh Nair (2009). "A structural model of sales-force compensation dynamics: Estimation and field implementation". In: 9, pp. 211–257.

References IV

Todd, Petra E. and Kenneth I. Wolpin (2006). "Assessing the Impact of a School Subsidy Program in Mexico: Using a Social Experiment to Validate a Dynamic Behavioral Model of Child Schooling and Fertility". In: *American Economic Review* 96.5, pp. 1384–1417. DOI: 10.1257/aer.96.5.1384. URL: http://www.aeaweb.org/articles?id=10.1257/aer.96.5.1384.

Voena, Alessandra (2015). "Yours, Mine, and Ours: Do Divorce Laws Affect the Intertemporal Behavior of Married Couples?" In: *American Economic Review* 105.8, pp. 2295–2332. DOI: 10.1257/aer.20120234. URL: http://www.aeaweb.org/articles?id=10.1257/aer.20120234.

References V

Wise, David (1985). “Behavioral Model versus Experimentation: The Effects of Housing Subsidies on Rent”. In: *Methods of Operations Research*. 50. Verlag Anton Hain, pp. 441–489.

Wolpin, Kenneth I. (2013). *The Limits of Inference without Theory*. MIT Press. ISBN: 9780262019088. URL: http://www.jstor.org/stable/j.ctt5vjpxr.