High Discount Rates:
- An Experimental Artifact or Caused by Poverty and Vulnerability?

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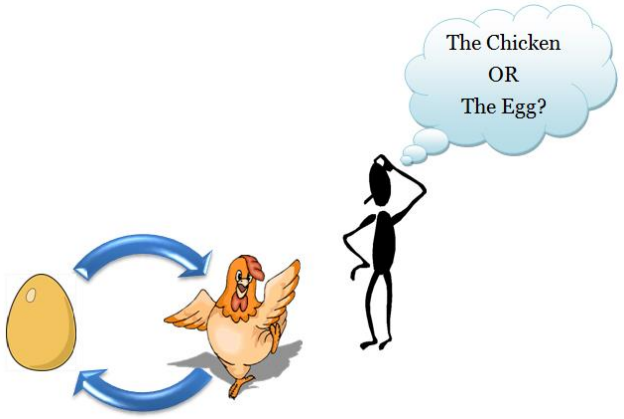
Introduction



- Are poor people poor because they have high discount rates and therefore they do not save and invest?
- Or is the causality the other way around; Poverty causes and forces them to have high discount rates and make them unable to save and invest?
- Holden, Shiferaw and Wik (1998) assessed this possible two-way causality
  - Found very high discount rates in three countries; Indonesia(64-132%, Ethiopia(28-79%) and Zambia(73-147 %)
  - Two important contributions:
    - Theory model to explain high discount rates
    - Causal relation from poverty to high discount rates

Theory model: rational explanation for high discount rates

- If households face immediate credit constraints this may affect their intertemporal decisions and the tradeoff between current and future consumption

$$v'(C_0) = Ev'(C_1)e^{-(\delta - r)} + \lambda$$

where λ is the shadow value on the credit constraint. Combined we get

$$-\frac{dC_1}{dC_0}\Big|_{U=\text{constant}} = e^r + \frac{\lambda e^{\delta}}{Ev'(C_1)}$$

- A positive shadow value on the credit constraint increases the intertemporal rate of substitution (RTP)

Direction of causality? Poverty ←→ Time preferences

- If High RTP → Poverty
  - RTP is a stable preference characteristic
  - RTP is correlated with wealth
  - RTP should not respond to random or location-specific conditions

- If Poverty → High RTP
  - RTP will change with wealth
  - RTP will be influenced by liquidity constraints and location-specific conditions

Implementation of Causality Tests

- Natural experiment in Indonesia
  - Recent resettlements from Java to Sumatra
  - Compared RTPs in new settlements with good and poor market access
    - Poor market access: 132% average
    - Better market access: 64% average
- Utilized economies of scale in consumption in the household in Ethiopia
  - With a causal relationship: Poverty → RTP and economies of scale in consumption:
  - RTP will decline with household size
    - Finding: RTPs declined with household size as well as with asset endowments

Weaknesses of the study

- Compared amounts today with amounts 1 year into the future (upward bias in discount rates due to present bias)
- Used hypothetical questions only (incentive compatible approaches have become the rule since then)
- Ignored risk aversion/concavity of the utility function (upward bias in discount rates)
- Are the high discount rates an artifact based on poor methods?
- **Objective of this paper to assess whether high discount rates are an effect of poorly framed experiments or are caused by people being poor and vulnerable**

More credible methods for elicitation of time preferences

- **Multiple Price List** (MPL) approach introduced for elicitation of risk preferences by Holt and Laury (2002) have gained popularity and credibility (Andersen et al. 2007; 2008)
- Advantages of MPL
  - Transparency
  - With incentives; should reveal truthful responses
- Disadvantages
  - Only identifies an interval response
  - Can be sensitive to framing effects

Time preference experiments in Malawi 1

- The choices are between amounts of money to be received with certainty at different points in the future
- In each case the respondent chooses between two options and indicates the one he/she prefers
- In each price list we kept the future option constant while we vary the more near future (or current) option till we identify the switch point for the respondents
- Expect only one switch point per series for responses to be consistent in that specific series
- Randomized starting point in each series

Time preference experiments

Time preference series 11				
Task	Receive at far future period	Choice	Receive at near future period	Choice
	3 months from now, MK		1 week from now, MK	
111	10000		10000	
112	10000		9500	
113	10000		9000	
114	10000		8000	
115	10000		7000	
116	10000		6000	
117	10000		5000	
118	10000		4000	
119	10000		3000	
120	10000		2000	

Time preference experiments in Malawi 2

- Experiments linked to a household panel survey
  - Introduced the experiments in each district/village one week after the survey
  - Experiment participation seen partly as a compensation for participation in survey (4th round panel survey of the same households)
  - Households had learnt that we are coming back
  - UMB/University of Malawi collaboration since 2005/06
  - Recruited 4 enumerators (with MSc degree in agricultural economics) (one was replaced later)
  - Trained them for one week, including pilot testing of experimental protocol
  - One day in each village
  - Minimize communication among respondents

Time preference experiment treatments

- Far future point in time:
- 1 month, 3 months, 6 months, 1 year
- Near future point in time:
  - Today, 1 week, 1 month
- Future amounts:
  - MK 1000, MK 5000, MK 10000, MK 20000
- Randomized across households
- 10% probability that there will be a real payout for the households
  - Random selection of series and game for households that win in the lottery
  - Need to arrange for a future payment for the winning households (Local researchers must be able to facilitate this, must have sufficient trust among respondents)

Time preference experiment treatments (number of each in parentheses)

Treatment type	Treatment levels
Front end point in time	Current(7), 1 week delay(13), 1 month delay(7)
End point in time	1 month(5), 3 months(11), 6 months(6), 12 months(5)
Future amount level	1000MK(6), 5000MK(6), 10000MK(9), 20000MK(6)

The 27 treatments were randomized across 3 and 3 households (9 TP Series per household)

Natural Experiment

- Experiments took place after a drought year when a large share of the households had experienced dry spells affecting their crops
  - Has the exposure to droughts affected the time preferences of the respondents?
  - How are their time preferences related to their wealth situation?
  - How high are the discount rates after controlling for present bias and risk aversion (curvature of utility functions)?

Estimation Issues

- Non-parametric and parametric estimation
- Exponential discounting versus alternative discounting functions (hyperbolic/quasi-hyperbolic)
  - Exponential discounting with dummies for treatments
  - Test deviations from the standard model
- Choice of utility function versus ignoring risk aversion
  - CRRA utility function: chose a logarithmic function (r=1)
- Allowing for stochastic errors in structural models
  - Luce error

Theoretical framework: structural model

- The decision problem can be framed as a two-period problem choosing between one amount at a near period time and another bigger amount at a more distant point in time:

$$U_A = \left(\left(e^{-\delta(t_1-t_0)}u\left(y_1+M_A\right)\right)+\left(e^{-\delta(t_2-t_0)}u\left(y_2\right)\right)\right)$$

$$U_B = \left(\left(e^{-\delta(t_1-t_0)}u\left(y_1\right)\right)+\left(e^{-\delta(t_2-t_0)}u\left(y_2+M_B\right)\right)\right)$$

It is integrated with some background level of consumption (y): The literature is not very clear on what y should be

Structural model specification

- The latent index may also be written in ratio form;
- 2) $\nabla U = U_A / (U_A + U_B)$
- A further extension of the estimation of the above models is to include stochastic errors. We applied the Luce specification
- 3) $\nabla U = U_A^{1/\mu} / \left(U_A^{1/\mu} + U_B^{1/\mu}\right)$
- With the following likelihood function used for estimation:

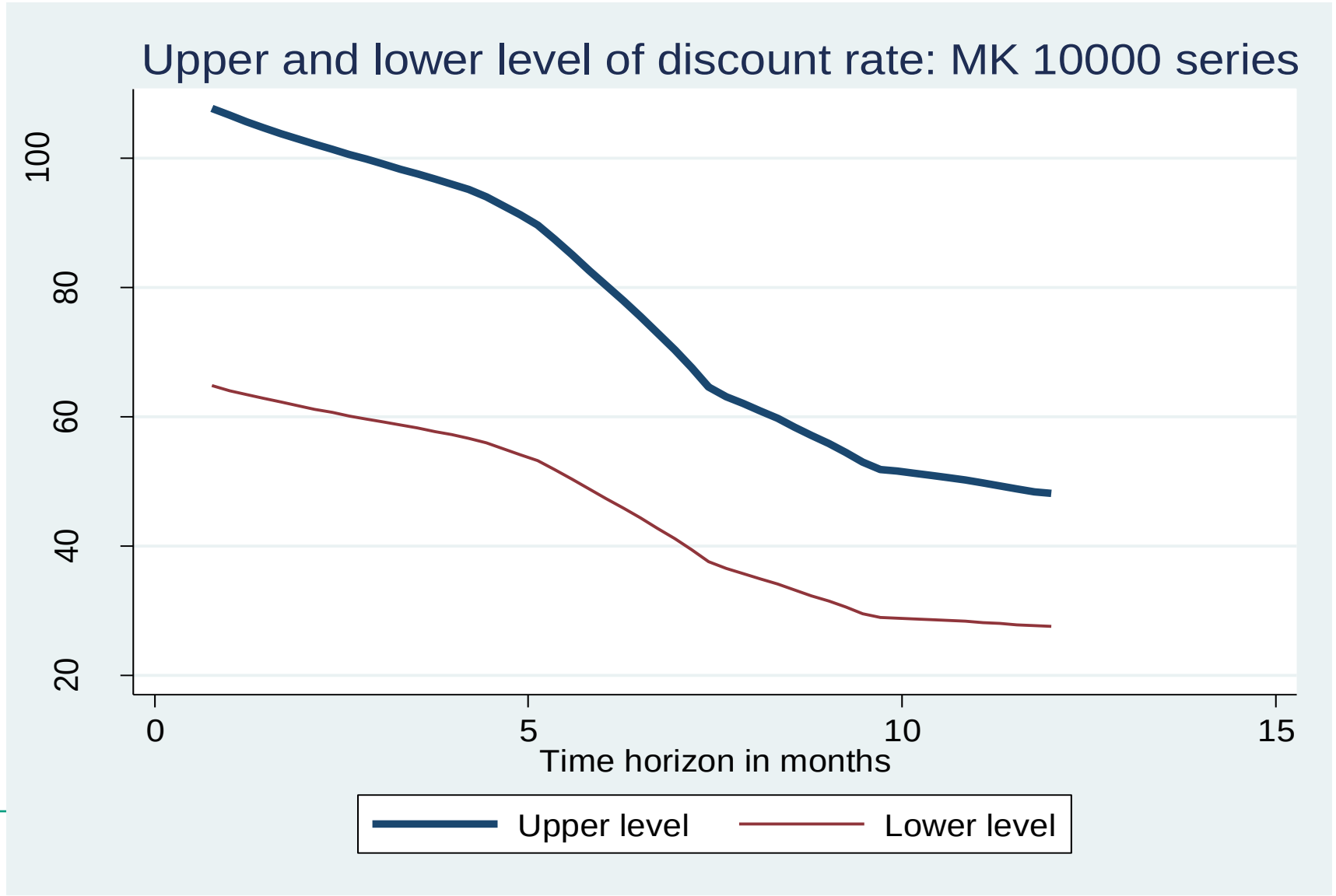
$$\ln L\left(\delta, \mu; Choice_{ij}, Z_i, X_j\right) = \sum_j ((\ln \Phi(\nabla U) \mid Choice_{ij} = 1) + (\ln \Phi(1 - \nabla U) \mid Choice_{ij} = 0))$$

- relevant parameters such as the discount rate (δ), the noise parameter (μ), treatment (prospect) characteristics (*Z*) and respondent characteristics (*X*);

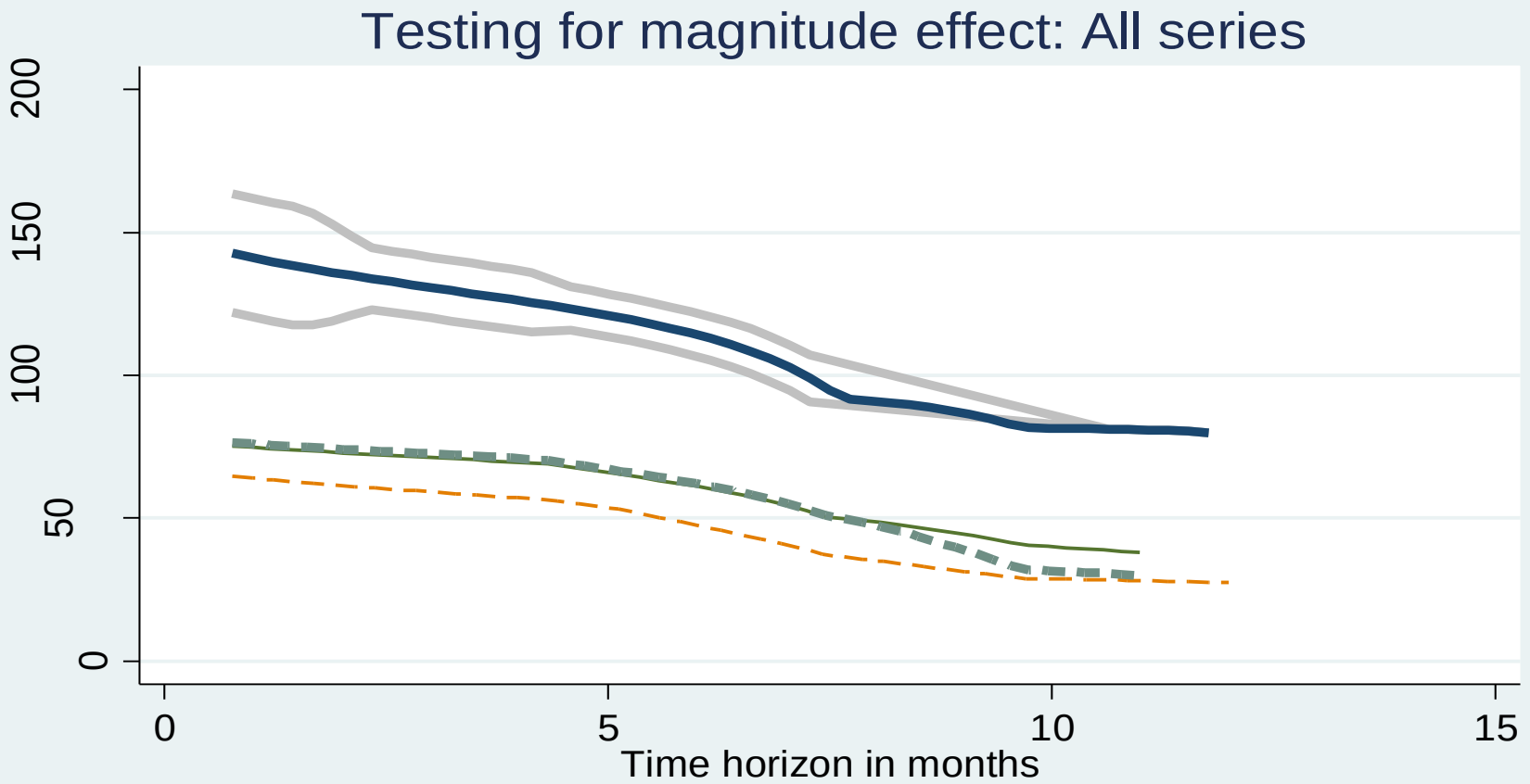
Main hypotheses

- H1. **Previous high discount rates** estimated for poor people are **caused by** poor quality experimental methods and **ignorance of their risk aversion/ concave utility functions & Present bias**
- H2. **High discount rates reflect limited market access, poverty, vulnerability and exposure to shocks**

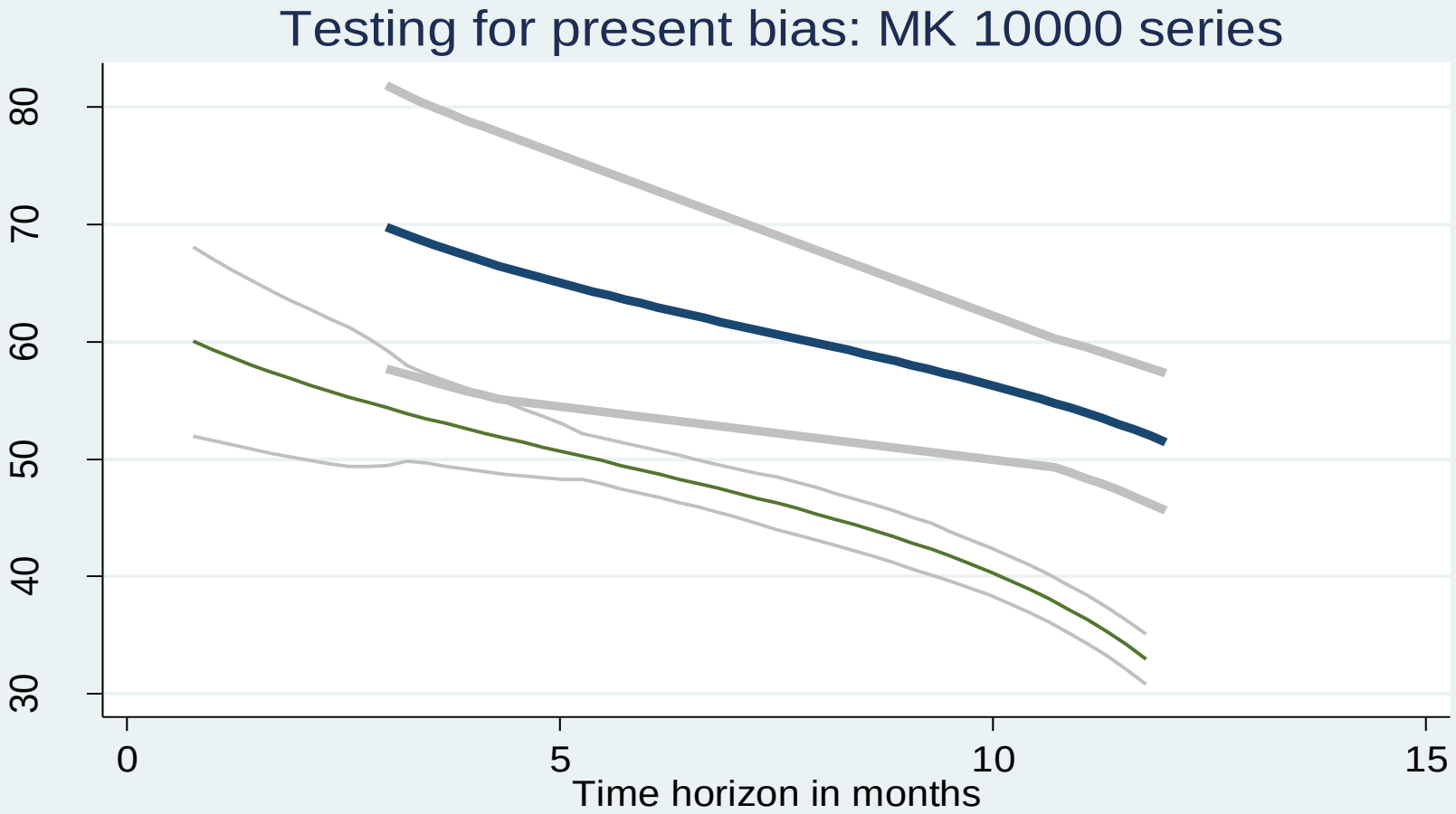
Findings: Non-parametric regressions based on exponential discounting and risk neutrality 2



Findings: Non-parametric regressions based on exponential discounting and risk neutrality 3



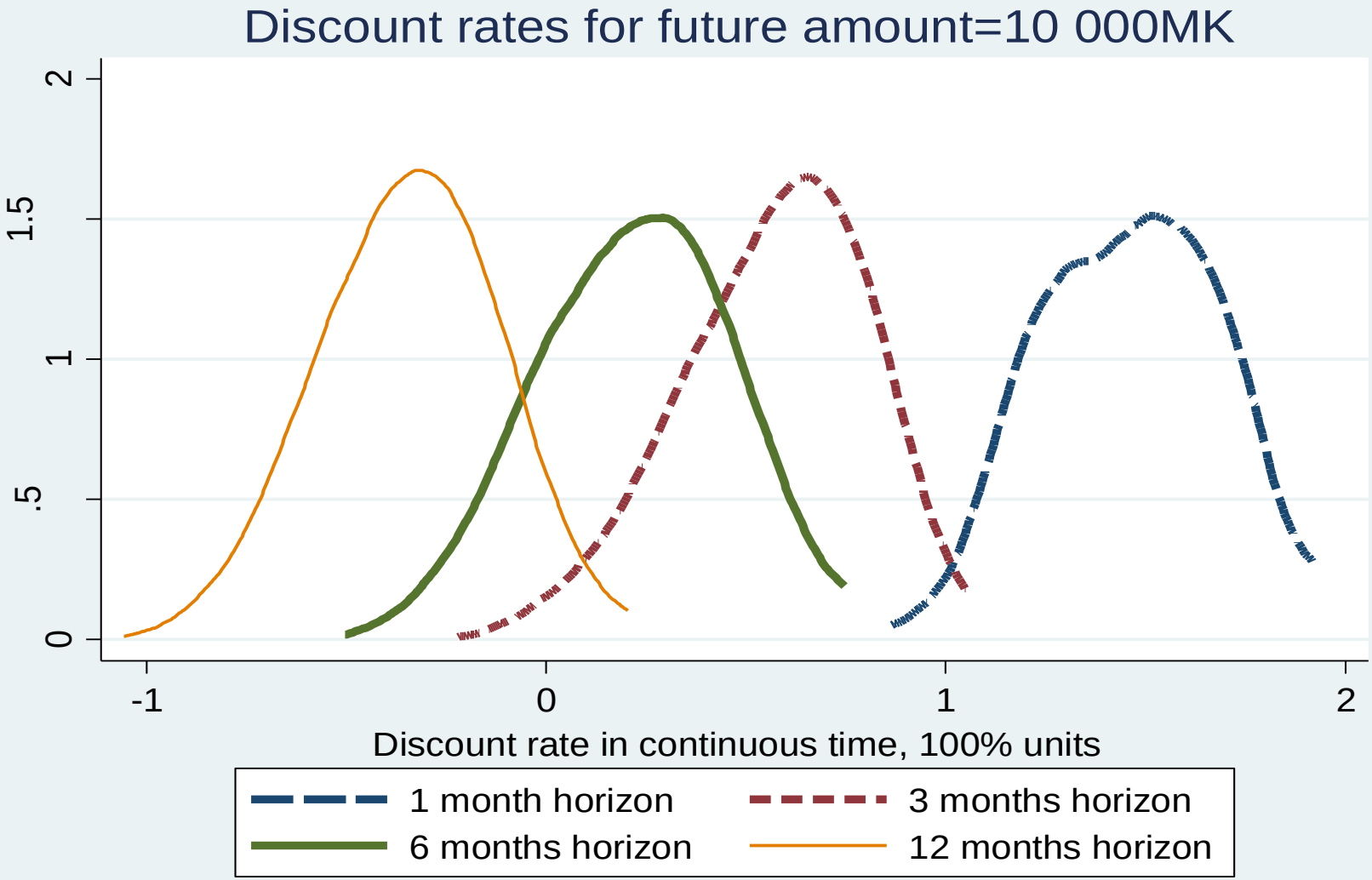
Findings: Non-parametric regressions based on exponential discounting and risk neutrality 5



ML estimates of continuous time discount rates without and with inflation correction

Models where the base consumption level=MK300	Without inflation correction	With inflation correction
Future amount: Baseline=1000MK		
Future amount: 5000MK	-0.526****	-0.569****
Future amount: 10000MK	-0.704****	-0.773****
Future amount: 20000MK	-0.749****	-0.819****
Far future point in time: Baseline=1 month		
3 months	-0.941****	-0.995****
6 months	-1.296****	-1.398****
12 months	-1.846****	-2.096****
Dummy for front end point=current	0.115***	0.122***
Dummy for front end point=1 month	0.098**	0.111**
Experienced drought shock in 2011/12, dummy	0.224*	0.259*
Random starting point dummy*Task number	-0.024****	-0.029****
Farm size in ha, gps-measured	-0.050*	-0.058*
Constant	1.887****	1.825****
Luce error constant	0.061****	0.061****
Prob. > F	0.000	0.000
Number of observations	31631	31631

Predicted discount rate distribution with base consumption=MK300 (constant for all time horizons)



ML estimates of continuous time discount rates without and with inflation correction

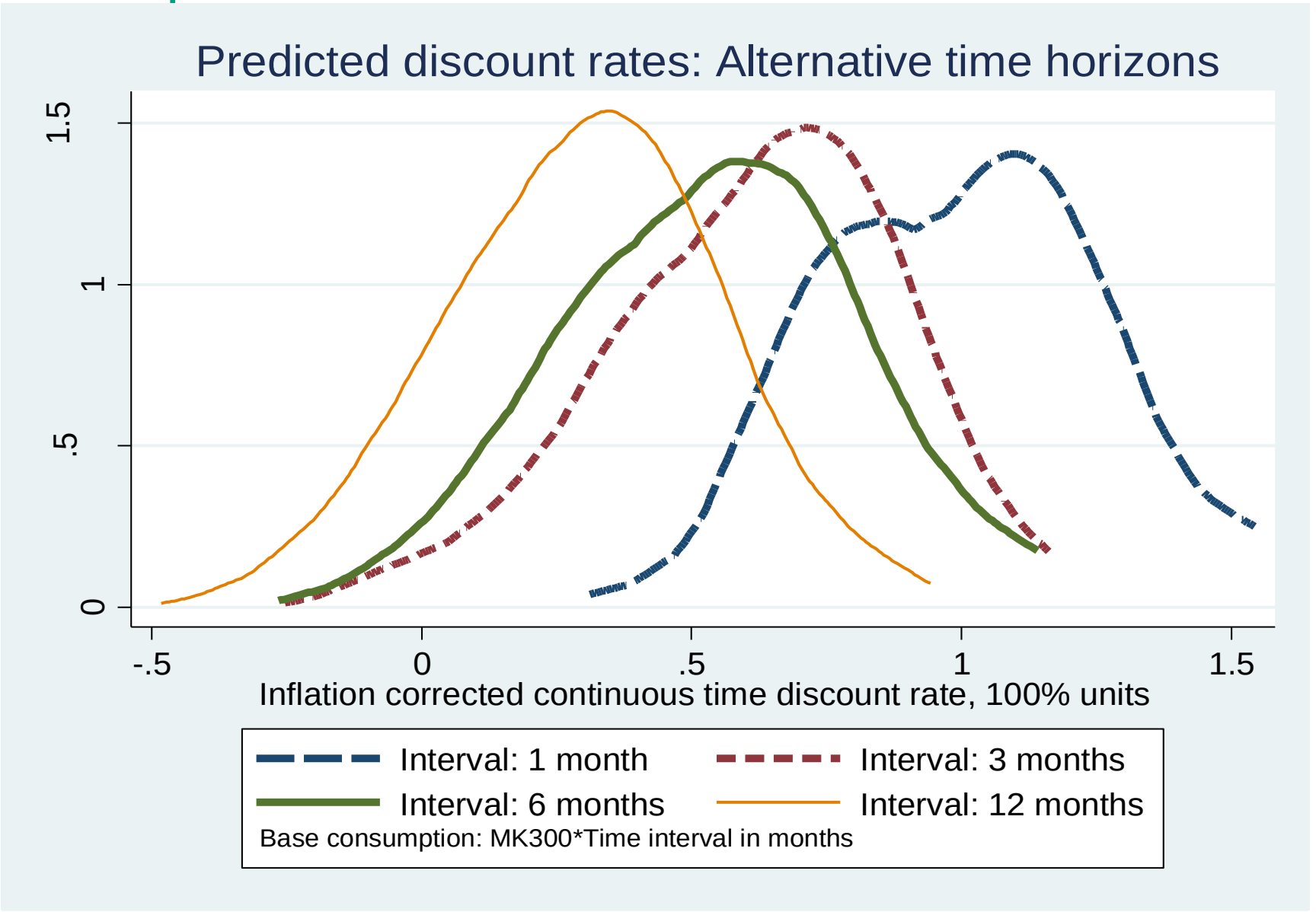
Models where the base consumption level=MK300*Months time delay	Without inflation correction	With inflation correction
Future amount: Baseline=1000MK		
Future amount: 5000MK	-0.635****	-0.666****
Future amount: 10000MK	-0.854****	-0.908****
Future amount: 20000MK	-0.958****	-1.023****
Far future point in time: Baseline=1 month		
3 months	-0.401****	-0.423****
6 months	-0.485****	-0.514****
12 months	-0.671****	-0.728****
Dummy for front end point=current	0.081**	0.083**
Dummy for front end point=1 month	0.075*	0.079*
Experienced drought shock in 2011/12, dummy	0.239*	0.261*
Random starting point dummy*Task number	-0.019****	-0.021****
Farm size in ha, gps-measured	-0.057*	-0.062*
Luce error constant	0.037****	0.037****
Constant	1.663****	1.603****
Prob. > F	0.000	0.000
Number of observations	31631	31631

Predicted discount rate variation with variation in near and far future points in time

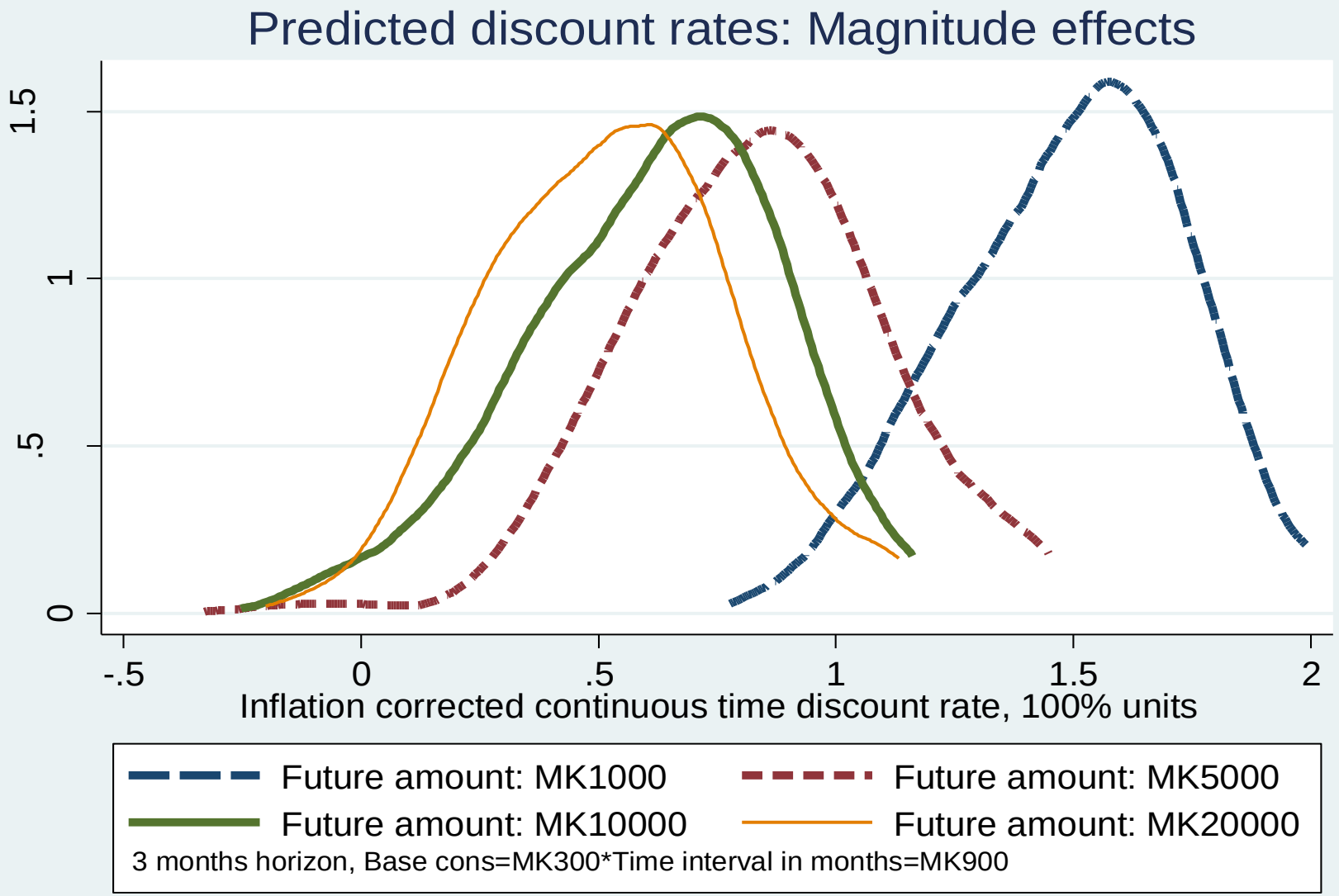
	Near point in time is 1 week or 1 month			With present bias		
Duration to far future point in time (months)	Mean, 100%	se(mean)	N	Mean	se(mean)	N
1	**1.00**	**0.007**	**1101**			
3	**0.62**	0.005	2376	**0.66**	0.007	1105
6	**0.54**	0.006	2297			
12	**0.30**	0.005	2475	**0.34**	0.007	1378

With continuous time discount rates, logarithmic utility function, **MK10 000 series, with inflation correction**, and **base consumption=MK300*Length of time interval in months**

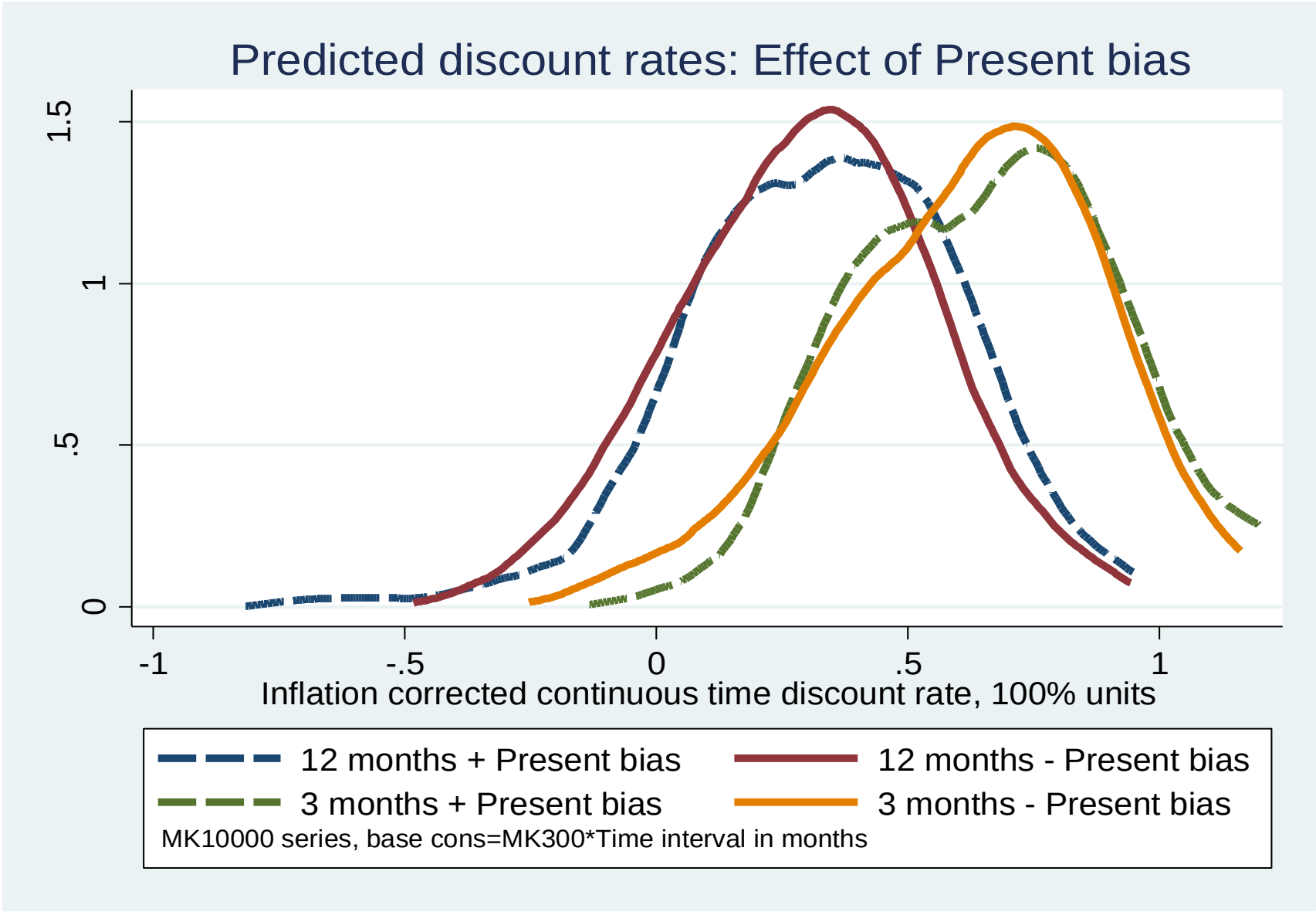
Predicted discount rate distribution with base consumption=MK300*Number of months time horizon



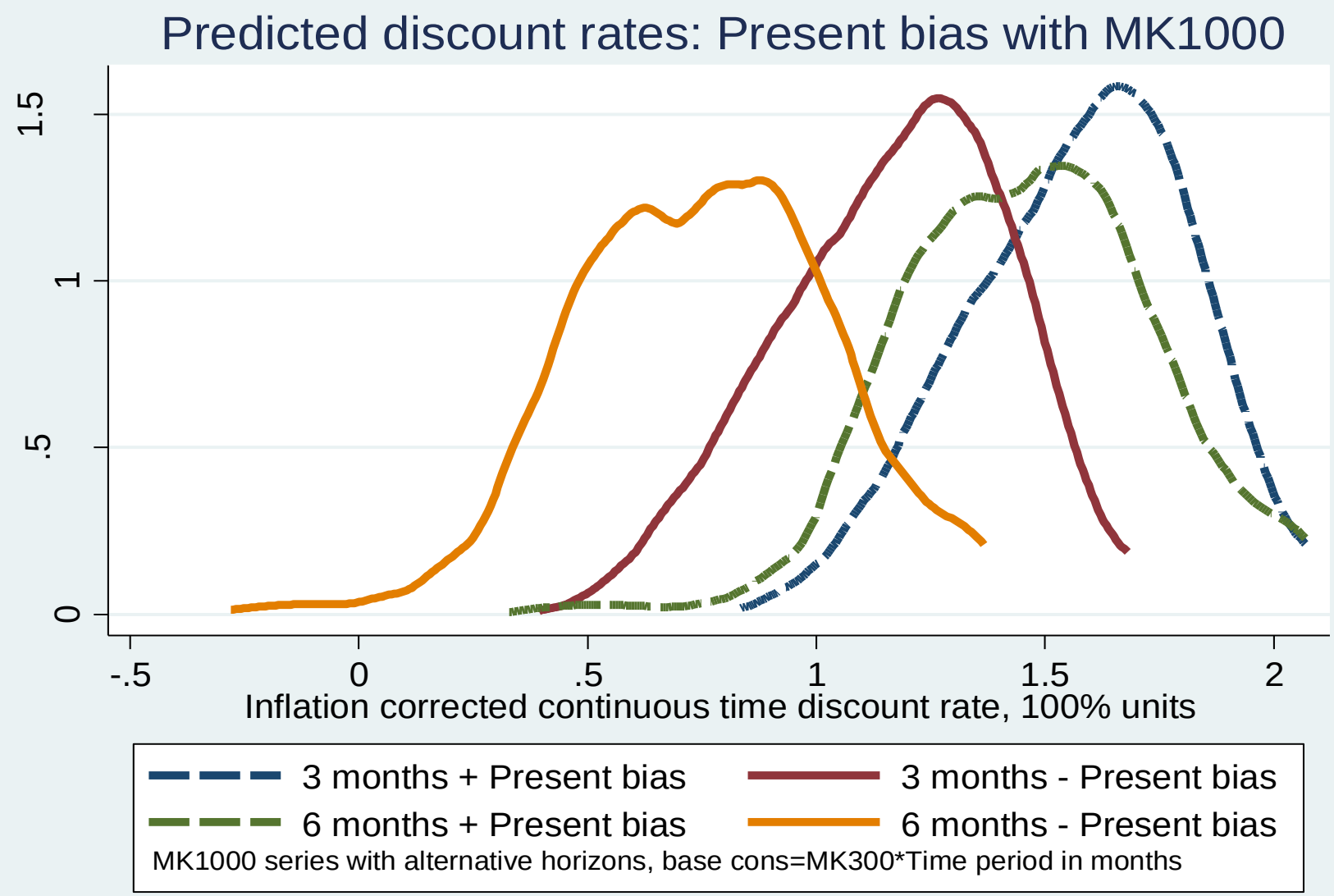
Magnitude effects: Predicted discount rates: logarithmic utility function with Luce error



Extent of present bias and time horizon in series with relatively large amounts (10000 MK)



Extent of present bias and time horizon in series with relatively small amounts (1000 MK)



Conclusions

- Credible time preference estimation requires careful and well organized fieldwork with an incentive-compatible experimental approach
  - Used the MPL approach, the most tested an accepted approach
- Wealth effect: Discount rates were negatively correlated with farm size
- We found that time preferences in Malawi responded to drought shocks (+24-26% higher discount rates):
  - Poverty/vulnerability→High discount rates
- Significant present bias was found (+8% higher discount rates on average), present bias was stronger for small amounts but cannot alone or in combination with correction for risk aversion explain high discount rates