Parental Beliefs and Investment in Children: The Distortionary Impact of Schools

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October 2016

INTRODUCTION

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- Yet, most models of parental investment assume parents are fully informed
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  - This is in contrast with recent literature on own HC investment where learning/uncertainty plays a prominent role
- With better information parents may make different investment choices
  - Need to understand the nature and source of information distortions to best design policy

CONTRIBUTION

- Use the Early Childhood Longitudinal Study-Kindergarten Class of 1999 (ECLS-K) to investigate the relationships between information, parental beliefs, investment, and the evolution of child skills

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  - parental beliefs influence compensatory investment choices

- Develop and estimate a dynamic equilibrium model of parental beliefs and investment
  - explore the impact of interventions aimed at minimizing belief distortions

KEY FINDINGS

- Providing all parents with precise information about the average skill level in the population leads to:
  - parents of students in the bottom 10% of the initial skill distribution to increase investment in 1st and 3rd grade by 20% of a standard deviation
  - skills for this group subsequently increase by approximately 10% of a standard deviation in 3rd grade
  - small reductions in investment and skills at the top of the distribution
- Similar results can be obtained through reductions in sorting

OUTLINE

- Data
- Descriptive Evidence
- Model and Estimation
- Results and Counterfactuals

ECLS-K BASICS

- Early Childhood Longitudinal Study - Kindergarten Class of 1998-1999
- Designed to select a nationally representative sample of children attending kindergarten in 1998-99
- Roughly 21,000 children, their families, their teachers, and their schools provide information on children's cognitive, social, emotional, and physical development
- Information is collected in the spring of K, 1st, 3rd, 5th, and 8th grade
- Focus will be on K-3rd years....

ECLS-K KEY FEATURES

- Each round includes direct child assessments in math, reading, and general knowledge
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- In some grades we also see: "**Compared to other children in [CHILD]'s class**, how well do you think he/she is doing in school this spring in math (or reading)?
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  - **Local** beliefs - relative to local population
- Parental investments: how often help with homework, tutoring

ECLS-K KEY FEATURES CONT.

- ECLS-K samples schools and then children within schools. This allows us to group children in schools and thus create a proxy for local average ability
- Teacher assessments of each child
  - "Overall, how would you rate this child's academic skills in each of the following areas, compared to other children of the same grade level?"
- These two variables will be important for understanding the nature and source of distortions in parental beliefs
- Race, gender, parental education, and family income in the fall of kindergarten

SAMPLE SELECTION

- Our sample selection strategy is driven in part by the high attrition levels in the ECLS-K
  - problematic for our approach since we need to calculate a meaningful measure of **local** skills
- In the fall of kindergarten, there are 21,409 children
- Sample selection proceeds in two steps:
  - For each grade eliminate students missing: school identifier, test scores, parental beliefs, and teacher assessments in current and past grades (4,000 and 3,000 in 1st and 3rd respectively)
  - Calculate the number of valid student observations available for each school-grade combination. Eliminate students associated with a school-grade combination with fewer than five students in current and all future grades (1,500 in both 1st and 3rd)

SUMMARY STATISTICS

	K	1st	3rd
% White	0.55	0.57	0.60
Log Income	10.51	10.54	10.60
Mom has BA	0.28	0.28	0.29
Children per School	21.0	16.1	12.5
Comparisons to children of same age			
Above Average	0.34	0.31	0.34
Below Average	0.07	0.07	0.09
Comparisons to children in same class			
Above Average, Math		0.36	0.35
Below Average, Math		0.05	0.08
Above Average, Reading		0.40	0.36
Below Average, Reading		0.09	0.09
Parents help with HW, 5+ times per week		0.28	0.22
Parents help with HW, 3-4 times per week		0.36	0.31
Parents help with HW, 1-2 times per week		0.21	0.30
Parents help with HW, Never		0.05	0.06
N	20,870	15,239	11,100

GOALS OF REDUCED FORM ANALYSIS

- Illustrate the following patterns in the data:

  1. Parental beliefs about child skill relative to the **global** average are locally distorted

  2. Present evidence of one possible channel
     - Teacher assessments of child skill mix **global** and **local** relative comparisons
     - Parental beliefs about child skill relative to the **global** average are influenced by teacher assessments

  3. Parental beliefs about child skill relative to the **global** average impacts compensatory investment behavior

- Ultimately we lack exogenous variation in **local** skill. We pursue a number of strategies which yield similar patterns.

1. PARENTAL BELIEFS ARE LOCALLY DISTORTED

- Outcome variable: an indicator for whether parents believe their child is above average relative to children of a similar age (or in same class)
- Show that these beliefs are a function of both global and local relative ability measures
  - Parents of children in better (worse) schools understate (overstate) the position of the child in overall distribution.
  - If parents know the global average skill level, there is no role for the local average
- Then show that only local relative ability when parents are asked to compare the skills of their child with classmates
- Finally we pursue a number of robustness checks...

1. PARENTAL BELIEFS ARE LOCALLY DISTORTED

- Regress beliefs on skills in Spring of 1st and 3rd:
  - Math - measure of relative **global** skill (standardized)
  - School Avg. Math - measure of mean **local** skill

	Above Average Relative to ...	
	Similarly Aged Children	
Math	0.159*	0.110*
	(0.003)	(0.006)
Math - School Avg. Math		0.067*
		(0.007)
Grade Effects	Y	Y
N	23,372	23,372

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  - School Avg. Math - measure of mean **local** skill

	Above Average Relative to ...			
	Similarly Aged Children		Children in Same Class	
			Math	Reading
Math	0.159*	0.110*	0.021*	0.006
	(0.003)	(0.006)	(0.006)	(0.007)
Math - School Avg. Math		0.067*	0.134*	0.136*
		(0.007)	(0.007)	(0.007)
Grade Effects	Y	Y	Y	Y
N	23,372	23,372	23,418	23,433

1. PARENTAL BELIEFS ARE LOCALLY DISTORTED

- Global beliefs question doesn't align perfectly with math skills...replace with **reading** skills
- Regress beliefs on skills in Spring of 1st and 3rd:
  - Reading - measure of relative **global** skill (standardized)
  - School Avg. Reading - measure of mean **local** skill

	Above Average Relative to ...			
	Similarly Aged Children		Children in Same Class	
			Math	Reading
Reading	0.162*	0.114*	0.013**	0.025*
	(0.003)	(0.006)	(0.006)	(0.006)
Reading - School Avg. Reading		0.066*	0.100*	0.174*
		(0.007)	(0.007)	(0.007)
Grade Effects	Y	Y	Y	Y
N	23,092	23,092	23,136	23,151

1. PARENTAL BELIEFS ARE LOCALLY DISTORTED

- We perform additional robustness checks to rule out alternative explanations for the effect of local skills on global beliefs:
  - Measurement error in skills: is local relative ability just capturing imperfectly measured global ability? Instrument using lags Table

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  - Heterogenous reference points: include skill deviations from region or sociodemographic group Table
  - Unobserved School Heterogeneity: include school FE and use deviation from classroom average as local measure Table
  - Identify effect strictly from school switchers (5% of the sample) Table

2. TEACHERS AS SOURCE OF DISTORTION

- 1st and 3rd grade teachers are asked to compare each child to other children in the same grade
- Show that teachers evaluations are a weighted average of global and local relative skills Teach Assess
  - difficult for parents to unravel information
- Moreover, we show that parental beliefs are significantly influenced by teacher opinions Parent and Teacher
  - true conditional on child's global skill measure and lagged beliefs

3. PARENTAL BELIEFS AND REMEDIAL INVESTMENT

- Principal factor: times per week and fraction of times per week that parents help their child with homework and whether the child is tutored
- Investment is measured as behavior during the last school year (decisions based on lagged information Robustness

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	Remedial Investment			
Parental Beliefs (Lagged)	-0.173*	-0.164*		
	(0.015)	(0.025)		
Math Score (Lagged)			-0.134*	-0.120*
			(0.009)	(0.018)
Teacher Assessment (Lagged)			-0.063*	-0.064*
			(0.009)	(0.014)
Investment (Lagged)		0.172*		0.154*
		(0.012)		(0.012)
Twice Lagged Beliefs	N	Y	N	N
Twice Lagged Math and Teacher	N	N	N	Y
Grade Effects	Y	Y	Y	Y
Demographics	Y	Y	Y	Y
N	21,668	8,496	22,107	8,378

3. PARENTAL BELIEFS AND ACTIVITIES INVESTMENT

- Principal factor: reads, tells stories, plays games, does science projects, goes to museums...
- Positively correlated with beliefs, but conditional on lagged investment no relationship

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	Activities Investments				
Parental Beliefs (Lagged)	0.131*	0.020	0.007		
	(0.015)	(0.012)	(0.021)		
Math Score (Lagged)				0.004	0.000
				(0.009)	(0.015)
Teacher Assessment (Lagged)				-0.007	-0.020
				(0.009)	(0.013)
Investment (Lagged)		0.497*	0.493*		0.492*
		(0.007)	(0.010)		(0.010)
Twice Lagged Beliefs	N	N	Y	N	N
Twice Lagged Math and Teacher	N	N	N	N	Y
Grade Effects	Y	Y	Y	Y	Y
Demographics	Y	Y	Y	Y	Y
N	21,538	21,072	8,404	21,963	8,276

STRUCTURAL MODEL

- Reduced form analysis provides compelling evidence of the links between beliefs, information, and investment
- However, it is not possible to investigate how investment behavior and outcomes might change if the information available to parents is altered
- Develop and estimate a dynamic equilibrium model of parental beliefs, information, and investment using the descriptive results as a guide
- Model will cover four periods: fall K and spring K, 1st, and 3rd

BASIC INFORMATION AND SIGNAL STRUCTURE

- Present a simplified version of information and beliefs

- Three skill levels relevant for parents of child i in school j:
  - A: Global average ability
  - A_j: Average ability in school j
  - A_{ij}: Ability of child i attending school j

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- We assume they are related according to:

$$A_{ij} = A_j + \epsilon_{ij} \qquad \& \qquad A_j = A + \epsilon_j$$

where $\epsilon_{ij} \sim N(0, \sigma_{ij})$ and $\epsilon_j \sim N(0, \sigma_j)$

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  where $\epsilon_{ij} \sim N(0, \sigma_{ij})$ and $\epsilon_j \sim N(0, \sigma_j)$
- Parents know both A_{ij} and A_j, but not A. Parents have beliefs given by $\hat{A} \sim N(0, \sigma^2_{\hat{A}})$
  - A is assumed to be zero

BASIC INFORMATION AND SIGNAL STRUCTURE

- Parents update their prior using two pieces of information:

1. A_j acts as a direct signal of the overall average
2. a teacher report given by $T_{ij} = (A_{ij} - A_j) + (A_{ij} - A) - \nu_{ij}$, where $\nu_{ij} \sim N(0, \sigma_\nu^2)$

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- Parents observe T_{ij}, but might not know the exact weights:

$$T_{ij} = (1 + \alpha)(A_{ij} - A_j) + (1 - \alpha)(A_{ij} - A) - \nu_{ij}$$

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- Parents observe T_{ij}, but might not know the exact weights:

$$T_{ij} = (1+\alpha)(A_{ij} - A_j) + (1-\alpha)(A_{ij} - A) - \nu_{ij}$$

- Define global beliefs as $B_{ij} = A_{ij} - \tilde{A}$, where $\tilde{A}$ is the parent's posterior. Probability of an above average response (for a parent with a correct prior):

$$\Pr(B_{ij} > k) = \Pr\left(A_{ij} - \frac{\sigma_{\hat{A}}^2 \left(\sigma_{\tilde{\nu}}^2 \mathbf{A_j} + \frac{\sigma_j^2}{(1-\alpha)} (\alpha \mathbf{A_j} + \nu_{ij}) \right)}{\sigma_{\hat{A}}^2 \sigma_j^2 + \sigma_{\hat{A}}^2 \sigma_{\tilde{\nu}}^2 + \sigma_j^2 \sigma_{\tilde{\nu}}^2} > k \right)$$

FULL MODEL DETAILS

- Parents begin with an unbiased prior over A_0
  - Update beliefs using initial school average, followed by teacher (T_{ijt}) and a unobserved signal (U_{ijt}) each period
  - T_{ijt} and U_{ijt} are a mix of local and global deviations
  - Parents are allowed to misinterpret these signals

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- Skill production takes a log-CES functional form
  - Key inputs: lag skill, investment, own characteristics, school average characteristics, and skill shock

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  - Parents are allowed to misinterpret these signals
- Skill production takes a log-CES functional form
  - Key inputs: lag skill, investment, own characteristics, school average characteristics, and skill shock
- Parental final utility is a power function over global and local relative ability
- Investment is costly and is heterogenous w.r.t to observables and cost shock. Cost shock is allowed to be correlated with skill shock

MODEL SOLUTION

- Find optimal investment in 3rd grade given accumulated information, integrating over skill shocks and A_3
- Proceed backwards, solving for optimal investment taking into account expected future values

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- Find optimal investment in 3rd grade given accumulated information, integrating over skill shocks and A_3
- Proceed backwards, solving for optimal investment taking into account expected future values
- To solve model, parents form expectations regarding how A evolves over time (endogenously determined through parental investment decisions)
- In order to solve for an equilibrium, we follow an approximation approach similar to Lee and Wolpin (2006)
  - assume parents understand that average skills evolve as a first-order linear difference equation with time varying intercepts (guess and confirm)

ESTIMATION AND RESULTS

- Estimate the model using indirect inference, matching moments from a series of auxiliary models Moments
  - Key regressions: production function, investment function, belief regressions by grade, auto-correlation in beliefs, teacher signals
  - Simulate data for 10K schools and minimize the Euclidean distance between the simulated and actual moments

- Summary of Key Parameters Parameters
  - evidence for dynamic complementarity
  - parents care about both global and local relative ability
  - curvature indicates that parents are particularly averse to low relative skills
  - parents mistakenly interpret the teacher signal as if it is primarily information about a child's skill relative to the overall population

COUNTERFACTUAL SETUP

- Distortions in parental beliefs arise as a result of two features in the model:
  - parents are unaware of the overall average and use local information to learn
  - households sort into localities based in part on skill such that local information is not a good signal for the overall average
- Investigate two types of counterfactuals:
  - information intervention
  - change in sorting
- Alter the environment and simulate investment and skill outcomes

INFORMATION INTERVENTION

- Simulate outcomes assuming parents know A_t for all t
- Significant changes in investment and skill

	Overall		Student Initial Skill		School Initial Average Skill	
	Mean	SD	Bottom 10%	Top 10%	Bottom 10%	Top 10%
Baseline						
Skill, 3rd grade	4.817	0.413	4.547	5.062	4.602	5.019
Invest, 1st grade	0.289	0.820	0.375	0.146	0.295	0.270
Invest, 3rd grade	-0.060	0.747	0.000	-0.144	-0.078	-0.056
Full Information						
Skill, 3rd grade	4.831	0.396	4.586	5.052	4.648	4.999
Invest, 1st grade	0.347	0.717	0.533	0.087	0.489	0.168
Invest, 3rd grade	-0.027	0.703	0.165	-0.201	0.110	-0.155
Δ in Skill (SDs)						
	0.033		*0.094*	*-0.024*	*0.111*	*-0.048*

CHANGE IN SORTING

- Providing parents with the right information, at the right time, with enough frequency can be difficult
- Bringing together A_{jt} and A_t will also mitigate distortions

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No Sorting						
Skill, 3rd grade	4.817	0.409	4.574	5.040	4.817	4.820
Invest, 1st grade	0.298	0.818	0.498	0.062	0.295	0.300
Invest, 3rd grade	-0.051	0.744	0.119	-0.227	-0.054	-0.051
Δ in Skill (SDs)						
	0.000		*0.065*	*-0.053*		

CONCLUSION

- Distortions in parental beliefs generated by local skill comparisons leads to under-investment for low skill children and over-investment for high skill children
  - Improve with better belief measures, more remedial investments, exogenous investment variation
- Contribute to investment literature by exploring the nature and source of parental distortions
- Contribute to peer effects literature - peer channel through parental investment

PARENTAL BELIEFS AND MEASUREMENT ERROR

- Is the local ability showing up because of ME?
- Instrument using lag scores

	Global Beliefs			
	Math Scores		Reading Scores	
	OLS	IV	OLS	IV
Own Score	0.110	0.127	0.114	0.139
(Global Measure)	(0.006)	(0.007)	(0.006)	(0.007)
(Own - School Avg.)	0.067	0.115	0.066	0.099
(Local Measure)	(0.007)	(0.009)	(0.007)	(0.009)
Grade Controls	Y	Y	Y	Y
N	23,372	23,129	23,092	22,476

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HETEROGENOUS GLOBAL REFERENCE POINTS

- Is local ability significant because it is correlated with the true parental reference point?

	Global Beliefs					
	Math Scores			Verbal Scores		
Own Score	0.110	0.114	0.090	0.114	0.129	0.131
	(0.006)	(0.009)	(0.21)	(0.006)	(0.009)	(0.024)
(Own - School Avg.)	0.067	0.069	0.065	0.066	0.073	0.067
	(0.007)	(0.008)	(0.07)	(0.007)	(0.008)	(0.007)
(Own - Socio Avg.)		-0.007			-0.023	
		(0.009)			(0.010)	
(Own - Region Avg.)			0.022			-0.018
			(0.022)			(0.025)
Grade Controls	Y	Y	Y	Y	Y	Y
N	23,372	23,372	23,372	23,092	23,092	23,092

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PARENTAL BELIEFS WITHIN SCHOOLS

- Consider classroom level deviations
- 10,578 teacher/grade combinations versus 3,589 school/grade

	Global Beliefs			
	OLS	School FE	OLS	School FE
Math	0.131	0.149		
	(0.004)	(0.006)		
(Math-Class Math Avg.)	0.055	0.037		
	(0.006)	(0.007)		
Reading			0.137	0.155
			(0.004)	(0.006)
(Reading-Class Reading Avg.)			0.049	0.031
			(0.006)	(0.007)
Grade Controls	Y	Y	Y	Y
N	23,372	23,372	23,092	23,092

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PARENTAL BELIEFS AND MOVERS

- What happens when the reference point changes as a result of a change in the composition of schoolmates?
  - Fixed effects where groups are identified by initial (kindergarten) schools
  - School average is constant across grades so identification comes from those that change school (5%).

	Global Beliefs			
	Math Scores		Reading Scores	
	OLS	FE	OLS	FE
Own Score	0.121	0.120	0.124	0.091
(Global Measure)	(0.006)	(0.044)	(0.006)	(0.042)
(Own - FIXED School Avg.)	0.049	0.053	0.049	0.085
(Local Measure)	(0.007)	(0.044)	(0.007)	(0.042)
Grade Controls	Y	Y	Y	Y
N	23,372	23,372	23,092	23,092

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TEACHERS AS SOURCE OF DISTORTION

- 1st and 3rd grade teachers compare each child to other children in the same grade
- Evidence that they use both local and global comparisons

	Teacher Assessed...					
	Math Skills			Reading Skills		
Own Score	0.615*	0.421*	0.229*	0.699*	0.444*	0.281*
	(0.006)	(0.011)	(0.018)	(0.005)	(0.010)	(0.015)
School Deviation		0.264*	0.152*		0.350*	0.236*
		(0.012)	(0.019)		(0.011)	(0.016)
Lag Teacher Rating			0.249*			0.306*
			(0.007)			(0.007)
Lag Test Score			0.106*			0.055*
			(0.018)			(0.016)
Lag School Deviation			0.099*			0.047*
			(0.019)			(0.018)
Grade Effects	Y	Y	Y	Y	Y	Y
N	23,169	23,169	21,700	22,950	22,950	21,244

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TEACHERS INFLUENCE ON PARENTS

- If parents are influenced by teacher assessments, could help explain distortions
- Higher teacher ratings in 1st and 3rd grade increase the likelihood of above average beliefs

	Above Average Relative to Similarly Aged Children					
Math	0.159*	0.106*	0.095*	0.040*	0.046*	0.052*
	(0.003)	(0.004)	(0.004)	(0.005)	(0.009)	(0.006)
Teacher Assessed Math		0.091*	0.060*	0.058*	0.041*	0.053*
		(0.004)	(0.004)	(0.004)	(0.007)	(0.004)
Beliefs, Comparison to Class	N	N	Y	N	Y	N
Lagged Controls	N	N	N	Y	Y	Y
School Effects	N	N	N	N	N	Y
Grade Effects	Y	Y	Y	Y	N	Y
N	23,372	20,809	20,607	17,988	7,397	17,988

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IS PARENTAL INVESTMENT A FUNCTION OF BELIEFS?

- Columns 1-3: Not a school effect
- Columns 4-5: Both global and local beliefs matter

	Remedial Investment				
Lag Global Beliefs	-0.173	-0.169	-0.184	-0.178	
	(0.015)	(0.015)	(0.016)	(0.025)	
Lag Local Beliefs				-0.164	
				(0.025)	
Lag Math					-0.127
					(0.017)
Lag Local Math					-0.061
					(0.018)
School FE	N	Y	N	N	N
HW Policy	N	N	Y	Y	Y
Grade and Demo	Y	Y	Y	Y	Y
N	21,668	21,668	18,916	8,103	20,468

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SELECTED AUXILIARY MODELS

Dep. Var.		Regressor	Data Coefficient	SE	Model Coefficient	t
Production Fct.						
(3)	S_{ijt}	S_{ijt-1}	0.684	0.005	0.722	S-1&3
		I_{ijt}	-0.033	0.015	-0.086	
		X_{ij}	0.156	0.011	0.146	
		X_j	0.040	0.015	0.017	
		$I_{ijt} \times S_{ijt-1}$	0.005	0.004	0.022	
Investment Fct.						
(4)	I_{ijt}	$S_{ijt-1} - S_{jt-1}$	-0.358	0.067	-0.450	S-1&3
		$(S_{ijt-1} - S_{jt-1})^2$ "+"	0.301	0.134	0.157	
		$(S_{ijt-1} - S_{jt-1})^2$ "-"	-0.177	0.128	-0.069	
		$S_{ijt-1} - S_{t-1}$	-0.218	0.054	-0.154	
		$(S_{ijt-1} - S_{t-1})^2$ "+"	-0.263	0.091	-0.158	
		$(S_{ijt-1} - S_{t-1})^2$ "-"	-0.344	0.092	-0.252	
		X_{ij}	0.203	0.048	0.217	
		X_j	-0.332	0.084	-0.272	

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SELECTED AUXILIARY MODELS CONT.

	Dep. Var.	Regressor	Data Coefficient	SE	Model Coefficient	t
Global Beliefs						
(5)	Above Avg$_{ij0}$	$S_{ij0} - S_{j0}$	0.153	0.023	0.155	F-K
		$S_{ij0} - S_0$	0.339	0.020	0.294	
(6)	Above Avg$_{ij1}$	$S_{ij1} - S_{j1}$	0.158	0.023	0.170	S-1
		$S_{ij1} - S_1$	0.369	0.020	0.409	
(7)	Above Avg$_{ij3}$	$S_{ij3} - S_{j3}$	0.298	0.023	0.185	S-3
		$S_{ij3} - S_3$	0.382	0.020	0.489	
Teacher Signals						
(10)	T_{ijt}	$S_{ijt} - S_{jt}$	1.007	0.029	1.020	S-1&3
		$S_{ijt} - S_t$	1.310	0.025	1.271	

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SELECTED MODEL PARAMETERS

		Coefficient	SE
Teacher Signals			
	γ_0^T	-0.033	0.008
"global weight"	γ_1^T	0.895	0.064
"local weight"	γ_2^T	1.397	0.072
"distortion"	α_T	0.993	0.076
	$\hat{\sigma}^T$	0.419	0.015
Production Function			
"dynamic complementarity"	ρ	-0.303	0.005
	π_1	0.662	0.002
	π_2	0.027	0.001
	π_3	0.031	0.004
	π_4	0.000	0.004
Utility Function			
"global weight"	χ	0.675	0.049
"curvature"	λ	-1.546	0.040
	$\alpha_{0,1}$	-4.616	0.028
	$\alpha_{0,2}$	-3.923	0.024
	α_1	-0.632	0.086
	α_2	0.558	0.308

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