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Online appendix to

Regression-Style Models for Parameter Estimation in Dynamic Microsimulation: An Empirical Performance Assessment

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1. MEAN ABSOLUTE DIFFERENCES AND STANDARDISED MEAN ABSOLUTE DIFFERENCES DATA AT EACH AGE

Tables 1 to 5 show the Mean absolute differences (MADs) and standardised mean absolute differences (SMADs) between simulated and observed data for each age. These values are equivalent to those presented in Table 4 in the main text except that they use data only from one of the ages (e.g. only the age 8 data in used in Table #) and no averaging across age has occurred as was performed for the values in Table 4 in the main text.

TABLE NOTES

The table notes for all tables in Appendix 1 are supplied here:

[a] The PRESS statistic is not a mean absolute difference but a standardised measure of the distance between the observed and predicted values. Smaller values are better.

[b] Time-invariant predictors given a weight of 1/5 each, time-variant predictors given a weight of 1/3 each. Other characteristics were each given a weight of 1.

[c] Means by predictor variables given a combined weight of 1 with the time-invariant predictors each given a weight of 0.1 and the time-variant predictors each given a weight of 1/6. Other characteristics were each given a weight of 1.

Table 1 Mean absolute differences (MAD) (smaller is better) and standardised mean absolute differences (SMAD) (more negative is better) between simulated and observed data for age 9

	OLS-LDV		RE		RE-AR (1)		Hybrid		FE		System GMM DPM	
Data Characteristic	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD
PRESS statistic[0]	0.26	-0.65	0.35	-0.21	0.79	2.01	0.35	-0.19	0.31	-0.43	0.28	-0.53
Overall distributions	1.50	-0.64	1.86	-0.43	5.96	2.01	2.10	-0.28	2.28	-0.18	1.78	-0.48
Means across time	0.50	-1.42	0.69	-0.05	0.70	-0.01	0.93	1.66	0.73	0.23	0.64	-0.41
Within-child correlations (dynamism)	0.09	-1.45	0.23	0.85	0.24	0.92	0.23	0.82	0.15	-0.46	0.14	-0.68
Within-child standard deviations	0.76	-1.75	1.07	-0.27	1.38	1.19	1.13	0.02	1.16	0.14	1.27	0.66
Time-invariant predictors:												
Gender	0.82	-1.06	1.13	0.03	1.28	0.57	1.54	1.47	1.17	0.16	0.79	-1.17
Breast-feading	1.39	-0.71	1.57	-0.35	2.69	1.90	1.90	0.31	1.47	-0.55	1.45	-0.6
Father's education	0.40	-1.24	1.23	-0.03	1.60	1.09	1.51	0.82	1.41	0.52	0.87	-1.16
Mother's education	0.90	-1.1	1.28	0.02	1.71	1.30	1.56	0.85	1.30	0.09	0.88	-1.17
Family's socio-economic status	0.92	-1.17	1.26	-0.02	1.56	1.03	1.58	1.11	1.32	0.19	0.93	-1.14
Time-variant predictors:												
Home-ownership	1.02	-1.13	1.34	-0.38	1.40	-0.23	1.75	0.57	1.27	-0.54	2.23	1.71
Mother's hours worked	3.79	-0.56	4.05	-0.35	7.03	2.03	4.17	-0.26	3.85	-0.51	4.05	-0.35
Father's smoking	3.56	-0.79	4.39	-0.31	8.32	1.98	4.52	-0.24	3.97	-0.55	4.79	-0.08
Weighted means												
Scheme 1[b]	-1.11		-0.08		1.22		0.42		-0.16		-0.29	-1.11
Scheme 2[c]	-1.14		-0.05		1.22		0.42		-0.15		-0.29	-1.14

Table 2 Mean absolute differences (MAD) (smaller is better) and standardised mean absolute differences (SMAD) (more negative is better) between simulated and observed data for age 10

	OLS-LDV		RE		RE-AR (1)		Hybrid		FE		System GMM DPM	
Data Characteristic	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD
PRESS statistic[0]	0.41	-0.31	0.38	-0.48	0.81	1.94	0.39	-0.46	0.32	-0.82	0.49	0.12
Overall distributions	1.46	-0.83	2.77	-0.07	6.25	1.95	2.85	-0.02	1.96	-0.54	2.04	-0.49
Means across time	0.50	-1.42	0.69	-0.05	0.70	-0.01	0.93	1.66	0.64	0.23	0.73	-0.41
Within-child correlations (dynamism)	0.09	-1.45	0.23	0.85	0.24	0.92	0.23	0.82	0.14	-0.46	0.15	-0.68
Within-child standard deviations	0.76	-1.75	1.07	-0.27	1.38	1.19	1.13	0.02	1.27	0.14	1.16	0.66
Time-invariant predictors:												
Gender	0.66	-1.26	1.05	0.15	1.11	0.4	1.32	1.14	1.21	0.74	0.69	-1.17
Breast-feading	1.49	-0.88	1.77	-0.26	2.75	1.93	1.94	0.12	1.68	-0.45	1.67	-0.46
Father's education	0.79	-1.49	1.26	0.03	1.57	1.04	1.44	0.6	1.47	0.72	0.97	-0.91
Mother's education	0.78	-1.4	1.35	0.2	1.70	1.18	1.54	0.71	1.40	0.33	0.92	-1.01
Family's socio-economic status	0.78	-1.46	1.06	-0.21	1.35	1.08	1.28	0.75	1.26	0.65	0.92	-0.82
Time-variant predictors:												
Home-ownership	0.77	-0.67	0.97	-0.47	1.24	-0.19	1.29	-0.15	0.92	-0.52	3.42	2.00
Mother's hours worked	4.67	-0.58	4.77	-0.49	7.44	1.88	4.88	-0.39	4.45	-0.78	5.72	0.35
Father's smoking	4.29	-0.81	4.80	-0.49	8.23	1.71	4.83	-0.47	4.52	-0.67	6.68	0.72
Weighted means												
Scheme 1[b]		-1.10		-0.07		1.18		0.34		-0.24		-0.09
Scheme 2[c]		-1.12		-0.04		1.19		0.36		-0.26		-0.12

Table 3 Mean absolute differences (MAD) (smaller is better) and standardised mean absolute differences (SMAD) (more negative is better) between simulated and observed data for age 11

	OLS-LDV		RE		RE-AR (1)		Hybrid		FE		System GMM DPM	
Data Characteristic	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD
PRESS statistic[0]	0.54	-0.01	0.43	-0.65	0.82	1.55	0.43	-0.65	0.36	-1.05	0.69	0.81
Overall distributions	1.87	-0.93	3.70	0.2	6.32	1.81	3.67	0.18	2.37	-0.63	2.37	-0.63
Means across time	0.50	-1.42	0.69	-0.05	0.70	-0.01	0.93	1.66	0.73	0.23	0.64	-0.41
Within-child correlations (dynamism)	0.09	-1.45	0.23	0.85	0.24	0.92	0.23	0.82	0.15	-0.46	0.14	-0.68
Within-child standard deviations	0.76	-1.75	1.07	-0.27	1.38	1.19	1.13	0.02	1.16	0.14	1.27	0.66
Time-invariant predictors:												
Gender	0.57	-1.5	1.13	0.27	1.14	0.33	1.26	0.71	1.38	1.11	0.76	-0.92
Breast-feading	1.84	-1	2.14	-0.22	2.99	1.93	2.21	-0.04	2.10	-0.32	2.09	-0.35
Father's education	0.83	-1.58	1.33	0.07	1.65	1.08	1.40	0.29	1.57	0.85	1.09	-0.71
Mother's education	0.93	-1.4	1.65	0.3	1.97	1.07	1.72	0.48	1.79	0.63	1.06	-1.08
Family's socio-economic status	0.86	-1.66	1.06	-0.57	1.38	1.22	1.22	0.31	1.26	0.55	1.19	0.16
Time-variant predictors:												
Home-ownership	1.04	-0.79	1.57	-0.4	2.16	0.04	1.78	-0.24	1.34	-0.57	4.71	1.96
Mother's hours worked	5.17	-0.45	5.06	-0.52	8.79	1.9	5.13	-0.48	4.70	-0.76	6.35	0.31
Father's smoking	5.42	-0.88	5.90	-0.51	8.22	1.26	5.96	-0.47	5.65	-0.70	8.27	1.30
Weighted means												
Scheme 1[b]		-1.10		-0.06		1.09		0.28		-0.27		0.05
Scheme 2[c]		-1.10		-0.03		1.09		0.34		-0.30		0.01

Table 4 Mean absolute differences (MAD) (smaller is better) and standardised mean absolute differences (SMAD) (more negative is better) between simulated and observed data for age 12

	OLS-LDV		RE		RE-AR (1)		Hybrid		FE		System GMM DPM	
Data Characteristic	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD
PRESS statistic[0]	0.65	0.19	0.48	-0.74	0.82	1.05	0.48	-0.73	0.42	-1.06	0.86	1.29
Overall distributions	2.00	-1.1	3.72	0.37	5.23	1.66	3.68	0.33	2.61	-0.58	2.48	-0.69
Means across time	0.50	-1.42	0.69	-0.05	0.70	-0.01	0.93	1.66	0.73	0.23	0.64	-0.41
Within-child correlations (dynamism)	0.09	-1.45	0.23	0.85	0.24	0.92	0.23	0.82	0.15	-0.46	0.14	-0.68
Within-child standard deviations	0.76	-1.75	1.07	-0.27	1.38	1.19	1.13	0.02	1.16	0.14	1.27	0.66
Time-invariant predictors:												
Gender	0.78	-1.49	1.18	0.18	1.09	-0.18	1.31	0.76	1.45	1.33	0.99	-0.61
Breast-feading	1.92	-0.62	1.95	-0.52	2.76	1.94	2.06	-0.19	1.88	-0.73	2.17	0.13
Father's education	0.92	-1.71	1.16	-0.37	1.46	1.25	1.25	0.11	1.33	0.56	1.26	0.16
Mother's education	1.03	-1.57	1.31	-0.22	1.67	1.53	1.42	0.33	1.38	0.11	1.32	-0.18
Family's socio-economic status	1.04	-1.09	1.01	-1.32	1.26	0.97	1.17	0.16	1.18	0.27	1.26	1.01
Time-variant predictors:												
Home-ownership	1.44	-0.49	1.51	-0.44	1.75	-0.29	1.76	-0.29	1.38	-0.52	5.43	2.03
Mother's hours worked	5.14	-0.57	5.30	-0.44	8.14	1.82	5.29	-0.44	4.78	-0.85	6.45	0.48
Father's smoking	7.48	-0.71	7.80	-0.48	9.13	0.51	7.86	-0.43	7.49	-0.71	10.88	1.82
Weighted means												
Scheme 1[b]		-1.06		-0.11		0.94		0.28		-0.30		0.25
Scheme 2[c]		-1.08		-0.05		0.95		0.34		-0.32		0.16

Table 5 Mean absolute differences (MAD) (smaller is better) and standardised mean absolute differences (SMAD) (more negative is better) between simulated and observed data for age 13

	OLS-LDV		RE		RE-AR (1)		Hybrid		FE		System GMM DPM	
Data Characteristic	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD	MAD	SMAD
PRESS statistic[0]	0.78	0.25	0.56	-0.75	0.83	0.5	0.56	-0.73	0.52	-0.93	1.08	1.66
Overall distributions	1.98	-1.43	3.82	0.6	4.39	1.23	3.78	0.56	3.20	-0.09	2.49	-0.87
Means across time	0.50	-1.42	0.69	-0.05	0.7	-0.01	0.93	1.66	0.73	0.23	0.64	-0.41
Within-child correlations (dynamism)	0.09	-1.45	0.23	0.85	0.24	0.92	0.23	0.82	0.15	-0.46	0.14	-0.68
Within-child standard deviations	0.76	-1.75	1.07	-0.27	1.38	1.19	1.13	0.02	1.16	0.14	1.27	0.66
Time-invariant predictors:												
Gender	0.74	-1.65	1.32	0.22	1.12	-0.42	1.40	0.48	1.68	1.36	1.26	0.01
Breast-feading	1.81	-0.38	1.68	-0.75	2.52	1.67	1.73	-0.61	1.69	-0.72	2.21	0.78
Father's education	0.86	-1.39	0.98	-0.72	1.27	0.81	1.11	-0.06	1.12	-0.01	1.37	1.37
Mother's education	0.93	-0.62	0.87	-0.85	1.36	1.08	1.01	-0.27	0.89	-0.78	1.45	1.43
Family's socio-economic status	1.09	-0.26	0.89	-1.08	1.32	0.74	1.01	-0.57	1.03	-0.48	1.54	1.63
Time-variant predictors:												
Home-ownership	1.07	-0.48	1.07	-0.48	1.46	-0.24	1.28	-0.36	1.09	-0.47	5.15	2.03
Mother's hours worked	5.27	-0.79	5.57	-0.56	7.98	1.3	5.60	-0.54	5.40	-0.69	7.95	1.27
Father's smoking	5.79	-0.51	5.75	-0.53	8.22	0.7	5.83	-0.5	5.07	-0.88	10.23	1.71
Weighted means												
Scheme 1[b]		-1.04		-0.11		0.74		0.24		-0.27		0.44
Scheme 2[c]		-1.09		-0.03		0.75		0.33		-0.25		0.29

2. RESULTS FROM SIGNIFICANCE TESTS BETWEEN MODELS

The following abbreviations are used in the tables:

OLS-LDV: Ordinary least squares regression model with a lagged dependent variable

RE: Random effects model with a variance components error structure

RE-AR(1): Random effects model with an autoregressive within-child error structure of order 1

Hybrid: Hybrid model

System GMM DPM: Dynamic panel model estimated with system generalised method of moments

OVERALL DISTRIBUTIONS

Table 2 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed percentiles of the distribution of reading scores). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Percentile				
Comparison	10th	25th	50th	75th	90th
OLS-LDV - RE	-31.08	-19.56	-28.23	-24.00	-14.27
OLS-LDV – RE-AR(1)	-9.90	-18.06	-17.57	-8.52	-6.81
OLS-LDV - Hybrid	-2.11	0.11	2.12	-1.35	-0.61
OLS-LDV – System GMM DPM	1.45	-10.74	-22.55	-7.51	-8.31
OLS-LDV – FE	-29.93	-9.64	-6.25	-29.91	-13.54
RE – RE-AR(1)	-2.63	-2.30	1.66	1.75	-3.02
RE – Hybrid	2.41	9.73	25.19	8.85	2.46
RE - System GMM DPM	11.01	-0.14	12.25	9.27	-2.54
RE - FE	20.03	9.72	3.66	31.28	10.41
RE-AR(1) – Hybrid	14.97	13.80	27.01	22.03	10.03
RE-AR(1) – System GMM DPM	30.17	5.88	14.38	26.04	10.18
RE-AR(1) – FE	3.34	10.18	16.87	6.51	3.00
Hybrid - System GMM DPM	11.02	0.92	5.88	5.89	0.31
Hybrid - FE	2.72	-8.57	-18.00	-4.00	-3.29
System GMM DPM - FE	-31.08	-19.56	-28.23	-24.00	-14.27

MEANS OVER TIME

Table 2 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed means of reading scores). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Age				
Comparison	9	10	11	12	13
OLS-LDV - RE	-1.84	-1.95	-3.48	-0.90	-1.83
OLS-LDV – RE-AR(1)	-1.85	-1.65	-3.75	-1.04	-2.31
OLS-LDV - Hybrid	-3.39	-3.59	-4.38	-3.43	-3.07
OLS-LDV – System GMM DPM	1.80	0.21	-2.02	-1.49	-2.69
OLS-LDV – FE	-1.53	-2.34	-3.70	-1.38	-2.05
RE – RE-AR(1)	-0.05	1.98	-1.10	-0.28	-0.74
RE – Hybrid	-3.47	-2.94	-1.75	-2.64	-1.98
RE - System GMM DPM	2.16	2.12	1.38	-0.77	-1.75
RE - FE	0.96	-0.75	-1.87	-1.57	-1.15
RE-AR(1) – Hybrid	-3.43	-3.13	-1.32	-2.44	-1.72
RE-AR(1) – System GMM DPM	2.18	1.80	1.68	-0.71	-1.56
RE-AR(1) – FE	0.91	-1.55	-1.12	-1.07	-0.38
Hybrid - System GMM DPM	3.65	3.63	2.56	1.05	-0.76
Hybrid - FE	3.54	2.09	0.78	1.79	1.16
System GMM DPM - FE	-1.85	-2.38	-2.02	0.29	1.52

CHILD-SPECIFIC CORRELATIONS (DYNAMISM)

Table 3 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed percentiles of the distribution of child-specific correlations between current and lagged reading scores). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Percentile				
Comparison	10th	25th	50th	75th	90th
OLS-LDV - RE	-37.88	-82.01	-93.94	-89.52	-83.17
OLS-LDV – RE-AR(1)	-30.27	-44.09	-55.95	-62.67	-61.41
OLS-LDV - Hybrid	-40.68	-88.06	-96.87	-87.17	-78.17
OLS-LDV – System GMM DPM	-14.53	-13.64	-13.83	-13.49	-12.42
OLS-LDV – FE	-14.39	-83.70	-111.84	-104.30	-95.05
RE – RE-AR(1)	-14.68	0.23	22.05	40.07	47.60
RE – Hybrid	2.32	2.40	2.45	2.49	2.21
RE - System GMM DPM	3.64	33.06	65.29	75.15	72.97
RE - FE	52.68	51.85	49.02	46.74	44.81
RE-AR(1) – Hybrid	14.35	0.36	-18.04	-30.84	-34.43
RE-AR(1) – System GMM DPM	10.04	25.17	40.75	48.78	49.55
RE-AR(1) – FE	34.24	24.66	14.86	4.77	-2.32
Hybrid - System GMM DPM	3.50	34.37	69.56	75.74	71.70
Hybrid - FE	51.39	48.19	44.55	41.19	37.90
System GMM DPM - FE	9.43	-14.40	-47.04	-63.95	-67.09

WITHIN-CHILD STANDARD DEVIATIONS

Table 4 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed percentiles of the distribution of within-child standard deviations of reading scores). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Percentile				
Comparison	10th	25th	50th	75th	90th
OLS-LDV - RE	-9.99	-7.43	-7.45	10.71	7.70
OLS-LDV – RE-AR(1)	6.32	1.89	-12.79	-22.29	-17.18
OLS-LDV - Hybrid	-10.20	-7.87	-7.97	9.05	8.06
OLS-LDV – System GMM DPM	-8.23	-5.83	-1.88	-11.14	-13.73
OLS-LDV – FE	-9.84	-5.31	-2.92	0.78	-0.01
RE – RE-AR(1)	41.95	42.88	-23.07	-24.19	-15.65
RE – Hybrid	-2.70	-2.81	-2.74	-4.01	0.82
RE - System GMM DPM	3.10	2.52	6.10	-16.29	-15.82
RE - FE	-0.02	9.12	9.48	-5.53	-19.46
RE-AR(1) – Hybrid	-31.43	-22.63	8.32	24.63	16.44
RE-AR(1) – System GMM DPM	-10.40	-6.09	11.37	6.68	4.14
RE-AR(1) – FE	-35.78	-26.65	20.58	9.90	8.05
Hybrid - System GMM DPM	3.54	3.13	6.71	-14.82	-16.49
Hybrid - FE	2.17	7.17	8.74	-3.88	-13.89
System GMM DPM - FE	-3.12	-0.91	-1.21	6.90	6.82

MEAN READING SCORES BY GENDER

Table 5 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by gender). Values greater than 2.46 indicate (unadjusted) significance at the .01 level

	Gender	
Comparison	Girls	Boyx
OLS-LDV - RE	-3.97	-3.21
OLS-LDV – RE-AR(1)	-3.75	-4.12
OLS-LDV - Hybrid	-4.51	-3.65
OLS-LDV – System GMM DPM	-2.48	-1.64
OLS-LDV – FE	-5.08	-4.03
RE – RE-AR(1)	0.97	-0.91
RE – Hybrid	-2.88	-0.98
RE - System GMM DPM	2.22	1.52
RE - FE	-3.70	-3.81
RE-AR(1) – Hybrid	-2.44	0.07
RE-AR(1) – System GMM DPM	1.71	2.30
RE-AR(1) – FE	-2.16	-0.98
Hybrid - System GMM DPM	3.35	1.85
Hybrid - FE	1.12	-1.13
System GMM DPM - FE	-3.41	-2.84

MEAN READING SCORES BY BREAST-FEEDING

Table 6 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by duration of breast-feeding). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Breast-feeding Duration (months)				
Comparison	0	3	6	9	12
OLS-LDV - RE	-0.35	-2.91	-1.63	-5.11	-0.45
OLS-LDV – RE-AR(1)	-2.99	-4.71	-3.66	-4.12	-3.40
OLS-LDV - Hybrid	-2.15	-2.66	-2.87	-4.09	-1.10
OLS-LDV – System GMM DPM	-2.89	-2.52	-2.01	-4.44	-1.10
OLS-LDV – FE	-0.33	-2.46	-2.96	-4.79	-0.96
RE – RE-AR(1)	-3.08	-3.82	-3.46	-0.95	-2.69
RE – Hybrid	-2.76	-1.43	-2.58	3.03	-1.26
RE - System GMM DPM	-2.07	-0.09	-0.91	0.93	-0.09
RE - FE	-0.04	-0.12	-2.42	0.05	-1.61
RE-AR(1) – Hybrid	0.64	2.70	1.78	1.97	2.44
RE-AR(1) – System GMM DPM	0.52	2.42	1.73	1.61	2.82
RE-AR(1) – FE	2.74	3.00	2.53	0.88	1.88
Hybrid - System GMM DPM	-0.10	0.57	0.43	-0.10	0.49
Hybrid - FE	2.38	1.20	0.87	-2.05	-0.10
System GMM DPM - FE	1.95	0.04	0.01	-0.89	-0.47

MEAN READING SCORES BY FATHER'S EDUCATION

Table 7 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by father's education at the child's birth). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Father's education		
Comparison	Tertiary	Secondary	None
OLS-LDV - RE	-3.39	-2.57	-2.37
OLS-LDV – RE-AR(1)	-5.48	-4.60	-2.30
OLS-LDV - Hybrid	-3.19	-3.14	-3.59
OLS-LDV – System GMM DPM	-4.01	-2.57	-1.27
OLS-LDV – FE	-4.96	-2.38	-2.83
RE – RE-AR(1)	-3.49	-3.00	-0.10
RE – Hybrid	-0.38	-0.79	-3.00
RE - System GMM DPM	0.38	0.55	0.65
RE - FE	-4.00	0.17	-1.61
RE-AR(1) – Hybrid	3.59	2.01	-2.10
RE-AR(1) – System GMM DPM	3.24	3.47	0.67
RE-AR(1) – FE	0.26	2.65	-0.59
Hybrid - System GMM DPM	0.55	0.96	2.07
Hybrid - FE	-2.62	0.86	1.97
System GMM DPM - FE	-2.54	-0.43	-1.03

MEAN READING SCORES BY MOTHER'S EDUCATION

Table 8 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by mother's education at the child's birth). Values greater than 2.46 indicate (unadjusted) significance at the .01 level

	Mother's education		
Comparison	Tertiary	Secondary	None
OLS-LDV - RE	-6.45	-0.29	-2.34
OLS-LDV – RE-AR(1)	-6.12	-3.75	-3.28
OLS-LDV - Hybrid	-4.41	-2.06	-3.56
OLS-LDV – System GMM DPM	-3.33	-2.50	-0.42
OLS-LDV – FE	-7.30	0.12	-2.20
RE – RE-AR(1)	-2.01	-4.99	-1.28
RE – Hybrid	0.79	-2.13	-2.76
RE - System GMM DPM	2.81	-1.62	1.36
RE - FE	-3.19	0.97	0.06
RE-AR(1) – Hybrid	2.57	2.54	-1.27
RE-AR(1) – System GMM DPM	5.07	2.15	1.95
RE-AR(1) – FE	0.66	4.18	1.06
Hybrid - System GMM DPM	2.17	-0.06	2.67
Hybrid - FE	-2.45	2.72	2.64
System GMM DPM - FE	-3.92	2.02	-1.34

MEAN READING SCORES BY SOCIO-ECONOMIC STATUS

Table 9 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by family's socio-economic status at the child's birth). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Socio-economic status		
Comparison	Professional	Clerical	Semi-skilled
OLS-LDV - RE	-2.90	-0.90	0.34
OLS-LDV – RE-AR(1)	-4.91	-2.14	-2.62
OLS-LDV - Hybrid	-2.41	-2.75	-1.37
OLS-LDV – System GMM DPM	-3.18	-1.14	-1.70
OLS-LDV – FE	-4.24	-1.22	0.09
RE – RE-AR(1)	-2.34	-2.12	-3.34
RE – Hybrid	0.00	-3.11	-2.46
RE - System GMM DPM	0.13	0.16	-1.90
RE - FE	-3.99	-1.24	-0.46
RE-AR(1) – Hybrid	2.31	-1.35	1.06
RE-AR(1) – System GMM DPM	2.46	1.29	0.55
RE-AR(1) – FE	-0.30	1.18	2.84
Hybrid - System GMM DPM	0.11	2.10	-0.48
Hybrid - FE	-2.50	2.51	1.83
System GMM DPM - FE	-2.19	-0.52	1.71

MEAN READING SCORES BY HOME-OWNERSHIP

Table 10 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by home-ownership status). Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Home-ownership status	
Comparison	Owned	Rented
OLS-LDV - RE	-4.37	-0.56
OLS-LDV – RE-AR(1)	-4.74	-3.13
OLS-LDV - Hybrid	-4.72	-1.70
OLS-LDV – System GMM DPM	-4.57	-7.86
OLS-LDV – FE	-3.93	0.52
RE – RE-AR(1)	-1.13	-4.04
RE – Hybrid	-2.20	-2.74
RE - System GMM DPM	-2.40	-7.80
RE - FE	-0.59	2.66
RE-AR(1) – Hybrid	-1.83	1.12
RE-AR(1) – System GMM DPM	-2.00	-6.59
RE-AR(1) – FE	0.12	4.75
Hybrid - System GMM DPM	-0.81	-7.30
Hybrid - FE	1.63	3.87
System GMM DPM - FE	2.13	8.07

MEAN READING SCORES BY MOTHER'S WORKING HOURS

Table 11 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by number of hours worked per week by the mother).
The values of working hours chosen at which to compute the significance tests were the minimum (0 hrs, also the 10th and 25th percentiles), mean (16 hrs), 75th percentile (27 hours), and 90th and 95th percentiles (both 40 hrs), for the distribution of mother's working hours at age 11.
Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Mother's Hours Worked (hours per week)			
Comparison	0	16	27	40
OLS-LDV - RE	-3.05	-4.92	4.61	-2.85
OLS-LDV – RE-AR(1)	-4.95	-8.76	1.44	-6.15
OLS-LDV - Hybrid	-4.15	-3.22	4.51	-3.18
OLS-LDV – System GMM DPM	-4.11	-4.30	-1.35	-4.52
OLS-LDV – FE	-2.78	-4.31	3.26	-2.57
RE – RE-AR(1)	-4.54	-7.13	-5.52	-3.86
RE – Hybrid	-3.32	1.02	-0.95	-1.29
RE - System GMM DPM	-2.10	0.47	-5.83	-2.89
RE - FE	0.60	-0.90	-2.07	0.23
RE-AR(1) – Hybrid	1.63	7.43	5.58	1.87
RE-AR(1) – System GMM DPM	0.31	6.53	-2.63	-1.68
RE-AR(1) – FE	3.56	6.24	3.37	3.26
Hybrid - System GMM DPM	-0.50	-0.03	-5.73	-2.22
Hybrid - FE	2.70	-1.94	-1.73	1.34
System GMM DPM - FE	2.35	-0.82	4.07	2.86

MEAN READING SCORES BY FATHER'S SMOKING

Table 12 t-values from paired t-tests (df=29) comparing the absolute differences (between the simulated and observed mean reading scores by number of hours worked per week by the mother).
The values of cigarettes chosen at which to compute the significance tests were the minimum (0 cigarettes, also the 10th, 25th, and 75th percentiles and the median), mean (4 cigarettes), and the 90th and 95th percentiles (both 20 cigarettes) for the distribution of number of cigarettes smoked per day by the father-figure at age 11. Values greater than 2.46 indicate (unadjusted) significance at the .01 level.

	Father's Smoking (cigarettes per day)		
Comparison	0	4	20
OLS-LDV - RE	-3.20	-5.84	-0.03
OLS-LDV – RE-AR(1)	-3.62	-6.38	-0.18
OLS-LDV - Hybrid	-4.33	-5.50	-1.36
OLS-LDV – System GMM DPM	-6.99	-1.60	-6.97
OLS-LDV – FE	-3.02	-3.51	-1.91
RE – RE-AR(1)	-1.42	-5.41	-0.24
RE – Hybrid	-2.69	-0.63	-2.72
RE - System GMM DPM	-4.60	1.81	-7.37
RE - FE	-1.06	0.51	-2.47
RE-AR(1) – Hybrid	-2.03	5.17	-1.46
RE-AR(1) – System GMM DPM	-4.47	5.56	-7.67
RE-AR(1) – FE	0.11	4.33	-1.49
Hybrid - System GMM DPM	-2.77	2.16	-6.86
Hybrid - FE	1.74	0.72	0.15
System GMM DPM - FE	3.88	-1.13	6.95

3. TESTING EXOGENEITY OF PREDICTORS

To test exogeneity of the predictors the C statistic was used by using the ivreg2 function (or the xtivreg2 function for the fixed effects model) in stata with the endogtest option. To perform this test "excluded" instruments are required that are not included in the regression equation. We had available to us a number of variables that had not been included in the any of the models. These were tested to see whether they were potential instruments by testing for instrument relevance and exogeneity (using routines in the ivreg2 suite). We identified nine instruments. We were not able to test the exogeneity of all the predictors in a single joint test due to there not being enough instruments to identify the model, so each predictor was tested for exogeneity individually while treating all other variables in the model (the set of predictors, including the LDV) as exogenous.

Different options of ivreg2 were used to test for exogeneity of predictors for the different models. For the OLS-LDV model the LDV was included in the model and the cluster option was not used meaning that the panel structure of the data would be ignored (as in done in the OLS-LDV model). For the RE model, the cluster options was used such that the panel structure was recognised and the LDV was not included in the model. No convenient tests were available to mimic the RE-AR(1) model and so the tests for the RE model should be referred to for the RE-AR(1) model. For the FE model, the xtivreg2 function was used with the fe and cluster option and the LDV was not included in the model. For the hybrid model, the same options and as used for the RE model were used except that the meaned and deviation score forms of the time-variant predictors were used in the model instead of the variables in their original forms. The tests were not conducted for the GMM dynamic panel model as this model does not need to assume exogeneity of predictors.

4. RESULTS

The results in Tables 1 and 2 below are those referenced in Table 2 in the main article.

Table 3 Exogeneity tests for predictors for OLS-LDV, RE, RE-AR(1), and FE models

	OLS-LDV				RE an RE-AR (1)				FE			
	C statistic: $x^2(1)$	p	Under-identification Test Rejected[a]	Cragg-Donald Wald F	C statistic: $x^2(1)$	P	Under-identification Test Rejected[a]	*rk* statistic[b]	C statistic: $x^2(1)$	p	Under-identification Test Rejected[a]	*rk* statistic[b]
Age	6.93	.0085	Yes	13.60	2.67	.1021	Yes	10.47				
Age squared	4.83	.0280	No	0.71	4.76	.0291	No	1.49				
Time-invariant:												
Father's education – tertiary	0.53	.4273	Yes	5.90	0.05	.8202	No	1.75				
Father's education – secondary	0.01	.9324	Yes	9.85	0.44	.5062	Yes	2.24				
Breast-feeding	0.96	.3263	Yes	28.94	0.31	.5777	Yes	7.23				
Mother's education – tertiary	0.67	.4125	Yes	18.96	5.94	.0148	Yes	5.27				
Mother's education – secondary	0.78	.3766	Yes	24.78	4.87	.0273	Yes	5.77				
Socio-economic status – professional	0.80	.3702	Yes	36.90	4.30	.0382	Yes	8.30				
Socio-economic status –clerical	1.43	.2297	Yes	30.21	6.29	.0122	Yes	5.13				
Gender – male	1.94	.1637	Yes	3.20	3.00	.0831	No	0.51				
Time-variant:												
Father's smoking	0.00	.9615	Yes	41.87	0.12	.7262	Yes	10.14	0.27	.6052	Yes	12.10
Home-ownership	1.24	.2664	Yes	97.35	4.03	.0447	Yes	16.51	0.24	.6278	Yes	6.96
Mother's working hours	5.64	.0175	Yes	67.08	10.81	.0012	Yes	26.95	0.25	.6190	Yes	20.41

[a] Kleibergen-Paap rk LM test. Rejection based at the .05 level.

[b] Kleibergen-Paap rk Wald F test

Table 2 Exogeneity tests for predictors for the hybrid model

	C statistic: $x^2(1)$	p	Under-identification Test Rejected[a]	rk statistic[b]
Age	0.80	.3726	Yes	8.03
Age squared	3.19	.0741	No	1.15
Time-invariant:				
Father's education – tertiary	0.00	.9863	No	1.60
Father's education – secondary	0.37	.5457	Yes	2.25
Breast-feeding	0.44	.5063	Yes	7.08
Mother's education – tertiary	4.76	.0291	Yes	4.62
Mother's education – secondary	4.12	.0423	Yes	5.29
Socio-economic status – professional	3.45	.0633	Yes	7.31
Socio-economic status –clerical	5.28	.0216	Yes	4.20
Gender – male	2.48	.1153	No	0.48
Father's smoking means	1.50	.2200	Yes	5.84
Home-ownership means	3.89	.0486	Yes	14.23
Mother's working hours means	9.16	.0025	Yes	18.47
Time-variant:				
Father's smoking deviation score	1.95	.1627	Yes	6.36
Home-ownership deviation score	0.57	.4524	Yes	3.34
Mother's working hours deviation score	7.05	.0079	Yes	11.05

[a] Kleibergen-Paap *rk* LM test. Rejection based at the .05 level.
[b] Kleibergen-Paap *rk* Wald F test

STATA CODE

A glossary for the variable names used in the code in this section can be found in Table #.

Testing exogeneity of potential excluded instruments

The following code is an example of that used to test for the exogeneity of the variable ga.

```
ivreg2 burt agecent agecentsq gender meduc1 meduc2 feduc1 feduc2
ses1 ses2 breast mhrswrk homeown fsmoke (ga=single welfare
fhrswrk chpar kids chres pregalc bw single0 accom fage pregsmk
overcrowd mage msmoke), cluster(id) endogtest(ga)
```

Testing redundancy/relevance of potential excluded instruments

The following code is an example of that used to test for the relevance of the variable z1accom as an excluded instrument.

```
ivreg2 burt agecentsq gender feduc1 feduc2 (agecent meduc1 meduc2  ses1 ses2 breast mhrswrk homeown fsmoke=single0 mage chres single bw ga msmoke pregalc fage pregsmk kids fhrswrk welfare overcrowd accom), cluster(id) redundant(z1accom)
```

Testing exogeneity of predictors

Each of the following code snippets are examples of the code used to test for the exogeneity of the variable mhrswrk for the different models.

OLS-LDV:
```
ivreg2 burti burt_previous feduc2 agecent homeown meduc1 feduc1 ses2 gender ses1 fsmoke agecentsq meduc2 breast (mhrswrk = single single0 msmoke fage pregsmk kids welfare overcrowd accom), endogtest(mhrswrk)
```

RE and RE-AR(1):
```
ivreg2 burt fsmoke feduc1 agecentsq ses1 agecent meduc1 breast gender feduc2 meduc2 homeown ses2 (mhrswrk=single single0 msmoke fage pregsmk kids welfare overcrowd accom), cluster(id) endogtest(mhrswrk)
```

FE:
```
xtivreg2 burt gender agecentsq agecent meduc2 breast feduc2 ses2 feduc1 meduc1 ses1 fsmoke homeown (mhrswrk =single single0 msmoke fage pregsmk kids welfare z1overcrowd accom), fe cluster(id) endogtest(mhrswrk)
```

Hybrid: `ivreg2 burt gender mhrswrkmeans agecentsq agecent meduc2 breast feduc2 ses2 feduc1 meduc1 fsmokemeans dfsmoke ses1 homeownmean dhomeown (dmhrswrk =single single0 msmoke fage pregsmk kids welfare overcrowd accom), cluster(id) endogtest(dmhrswrk)`

Table 3 Glossary of variable names and labels used in stata code

Variable name	Variable label
burt	Burt reading score
agecent	Age centred
agecentsq	Age centred squared
gender	Gender
meduc1	Indicator variable for mother having tertiary education at the child's birth
meduc2	Indicator variable for mother having secondary education at the child's birth
feduc1	Indicator variable for father having tertiary education at the child's birth
feduc2	Indicator variable for father having secondary education at the child's birth
ses1	Indicator variable for family's socio-economic status to be professional at the child's birth to
ses2	Indicator variable for family's socio-economic status to be clerical at the child's birth to
breast	Duration of breast-feeding
mhrswrk	Average number of hours worked per week by the mother
homeown	Indicator variable for owning the home
fsmoke	Average number of cigarettes smoked per day by the father
ga	Gestational age
single	Indicator variable for child living in a single-parent family
welfare	Indicator variable for child's family receiving a benefit
fhrswrk	Average number of hours worked per week by the father
chpar	Indicator variable for whether the child experienced a change in parents in the last year
kids	Number of children in the household
chres	Number of changes in residence over the last year
pregalc	Average number of alcoholic drinks consumed per week during pregnancy
bw	Birth weight
single0	Indicator variable for the child being born into a single-parent family
accom	Indicator variable for the child living in a detached house
fage	Father's age at the child's birth
pregsmk	Average number of cigarettes smoked per day during pregnancy
overcrowd	Indicator variable for the child living in over-crowded conditions
mage	Mother's age at the child's birth
msmoke	Average number of cigarettes smoked per day by the mother
id	Individual child id