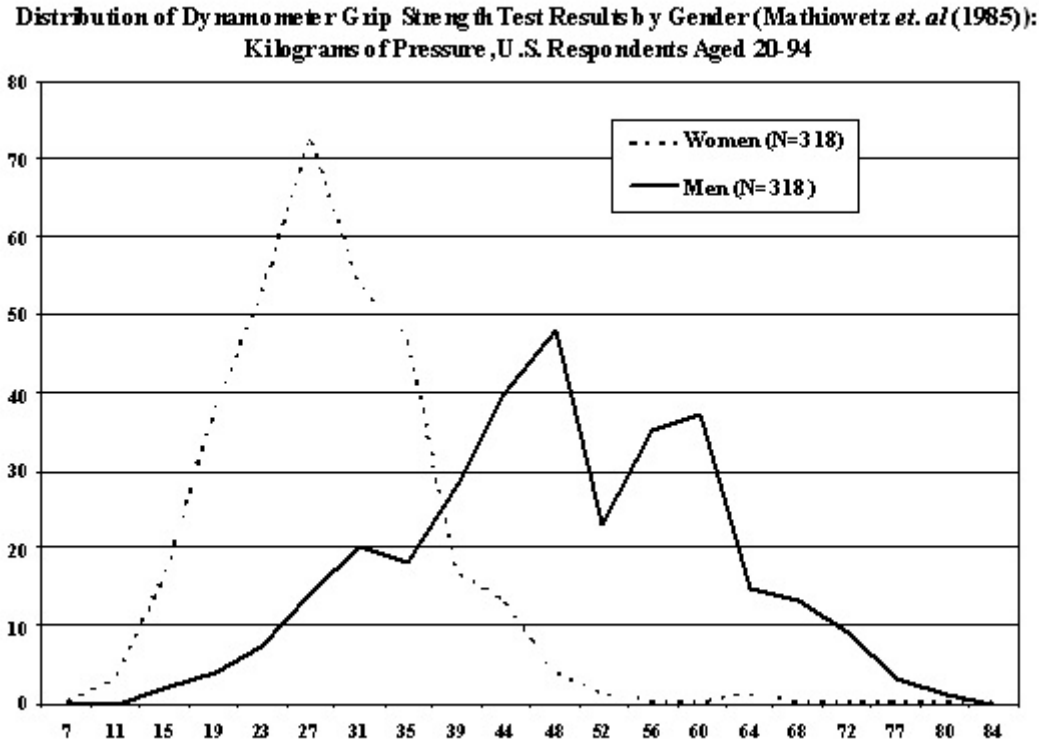
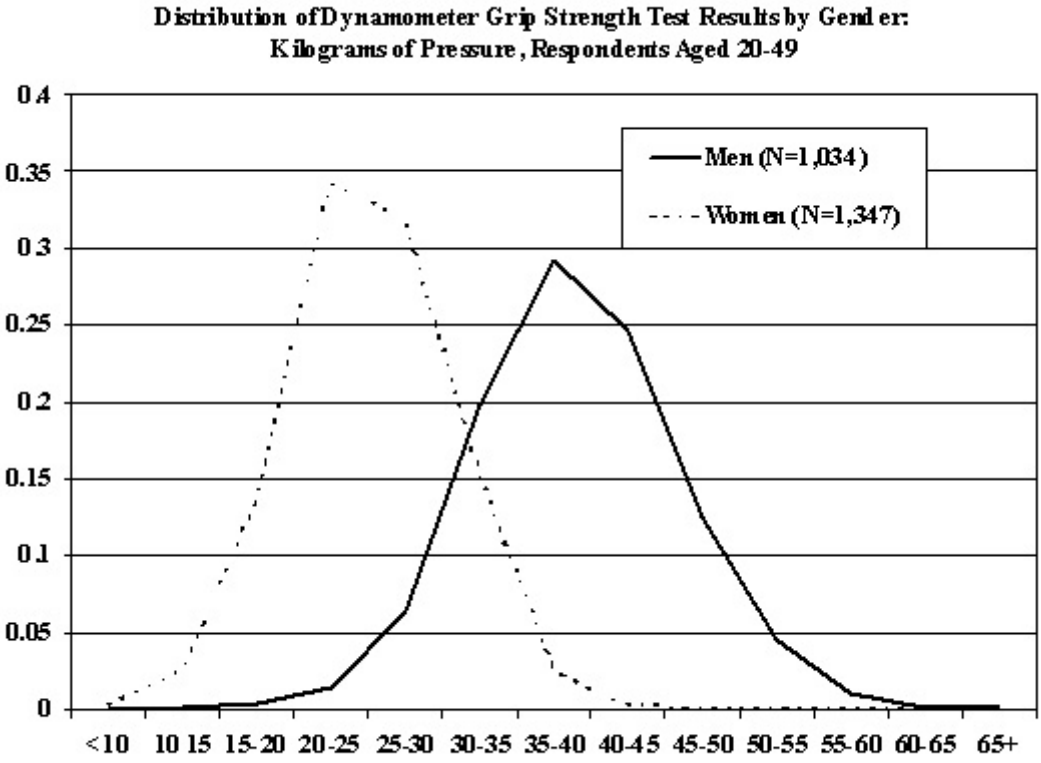
Human Capital Investment and the Gender Division of Labor in a Brawn-Based Economy

By Mark M. Pitt, Mark R. Rosenzweig and Nazmul Hassan

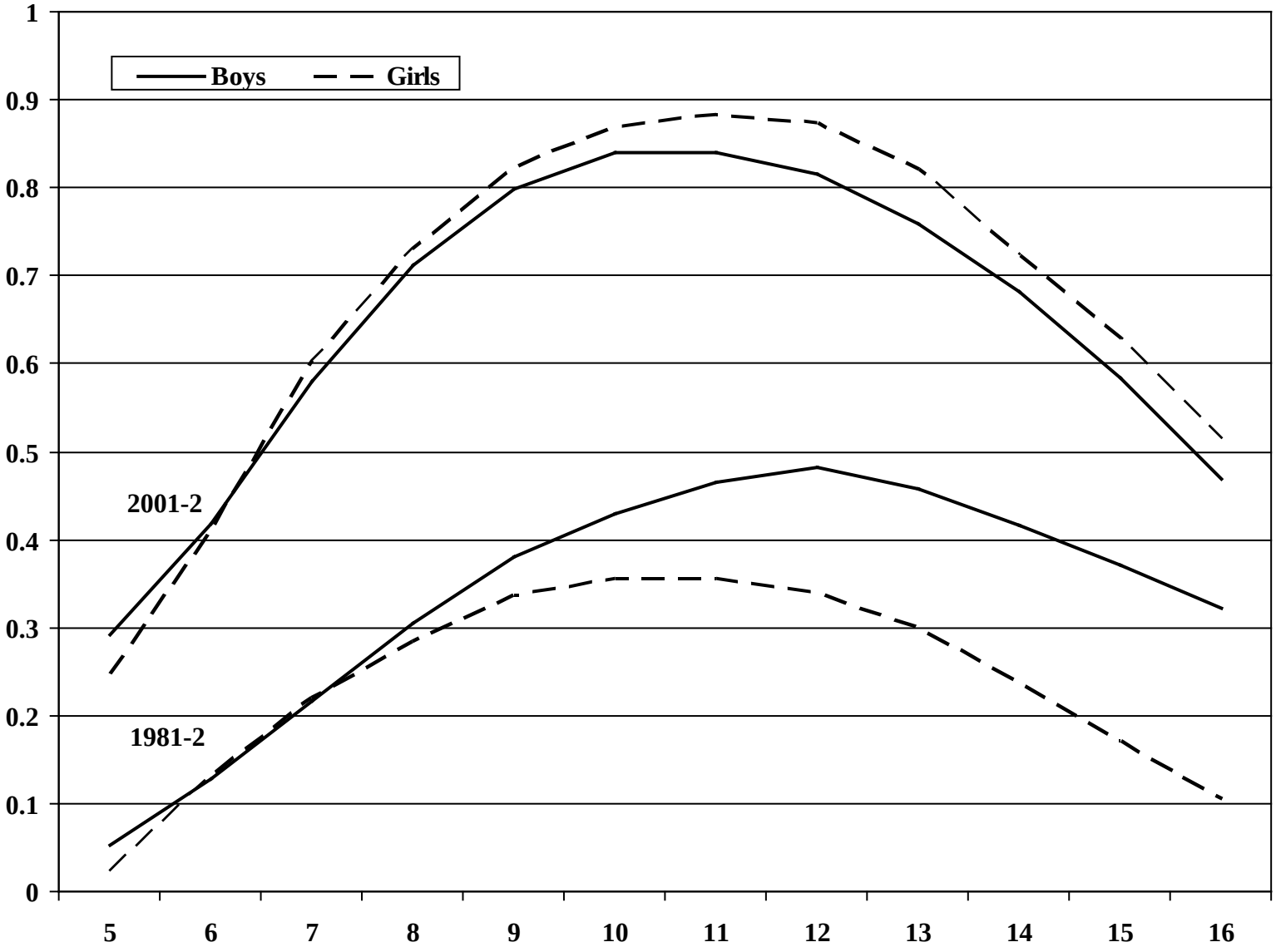
Online Appendix

Figure 1

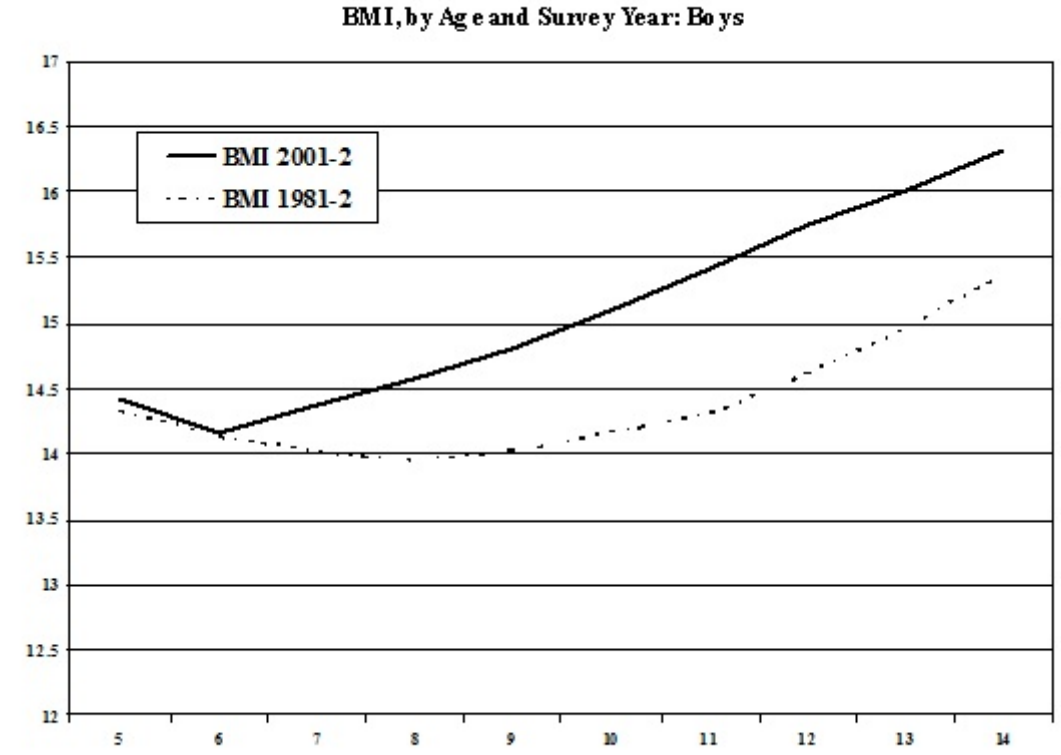

Distribution of Dynamometer Grip Strength Test Results by Gender (Mathiowetz et. al (1985)):
Kilograms of Pressure, U.S. Respondents Aged 20-94
Women (N=318)
Men (N=318)
80
70
60
50
40
30
20
10
0
7 11 15 19 23 27 31 35 39 44 48 52 56 60 64 68 72 77 80 84

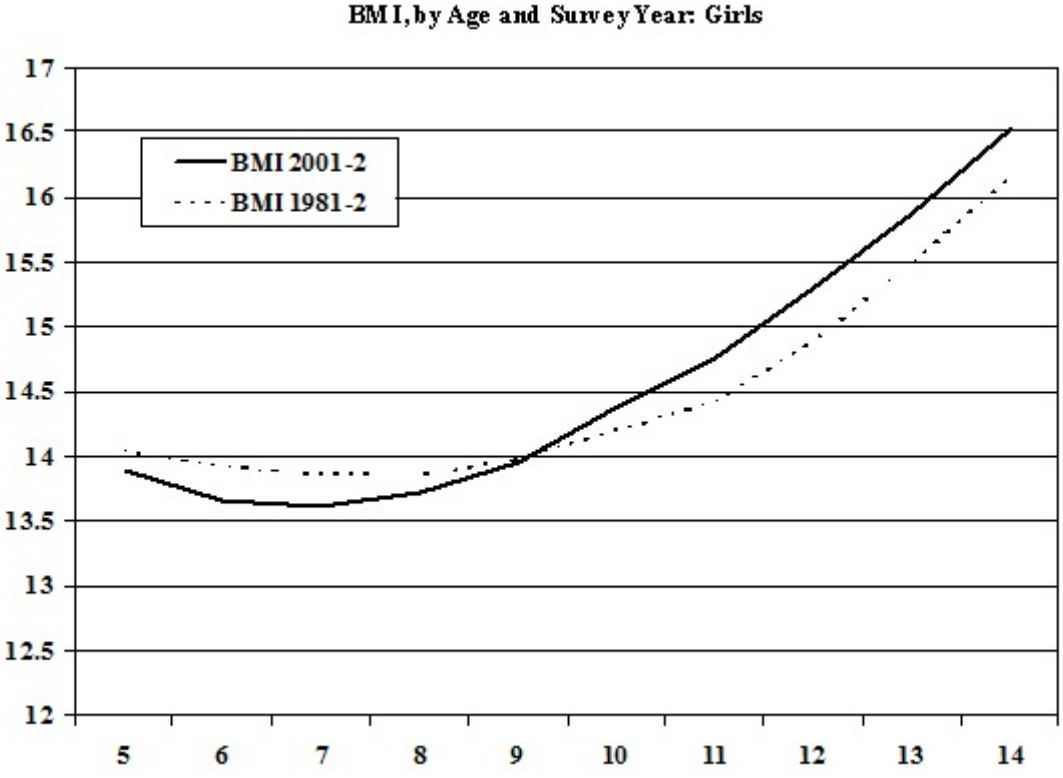

Distribution of Dynamometer Grip Strength Test Results by Gender:
Kilograms of Pressure, Respondents Aged 20-49
Men (N=1,034)
Women (N=1,347)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
<10 10-15 15-20 20-25 25-30 30-35 35-40 40-45 45-50 50-55 55-60 60-65 65+

Appendix Figure 2. School Attendance, by Age, Gender and Survey Year

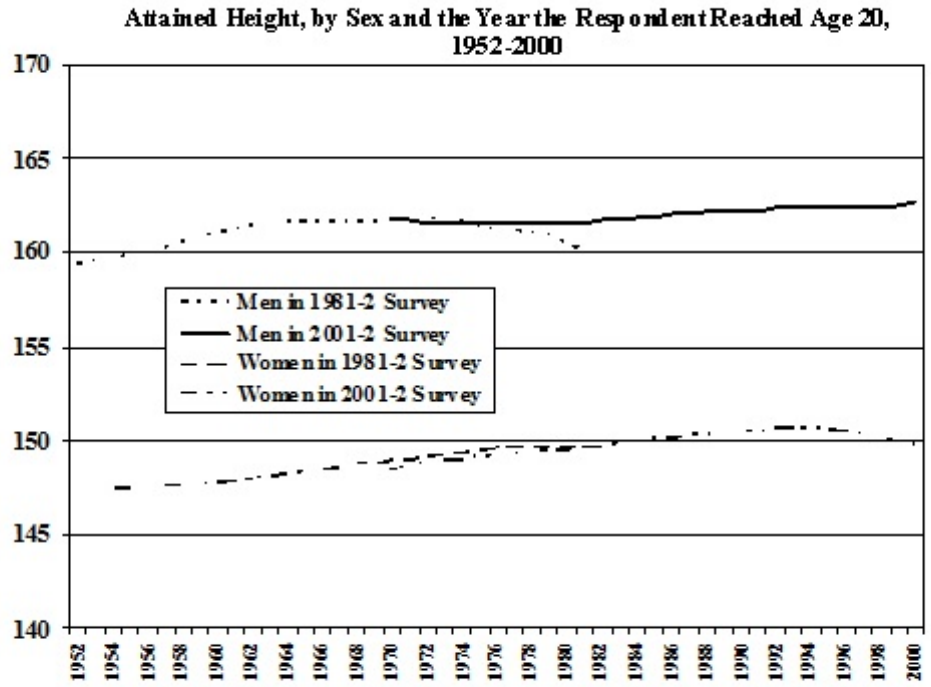


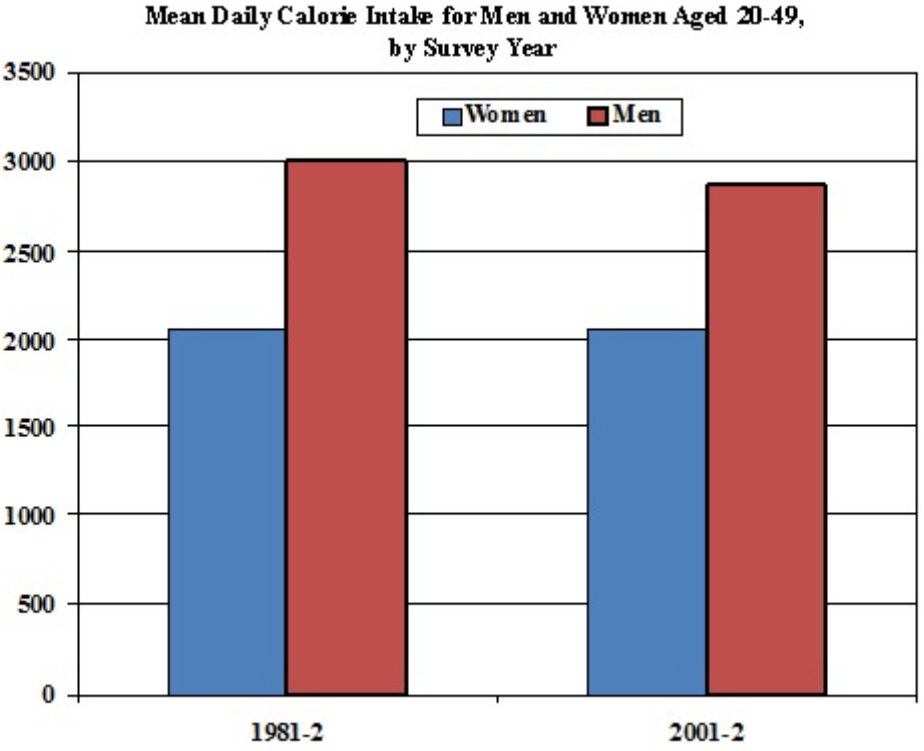
Appendix Figure 3



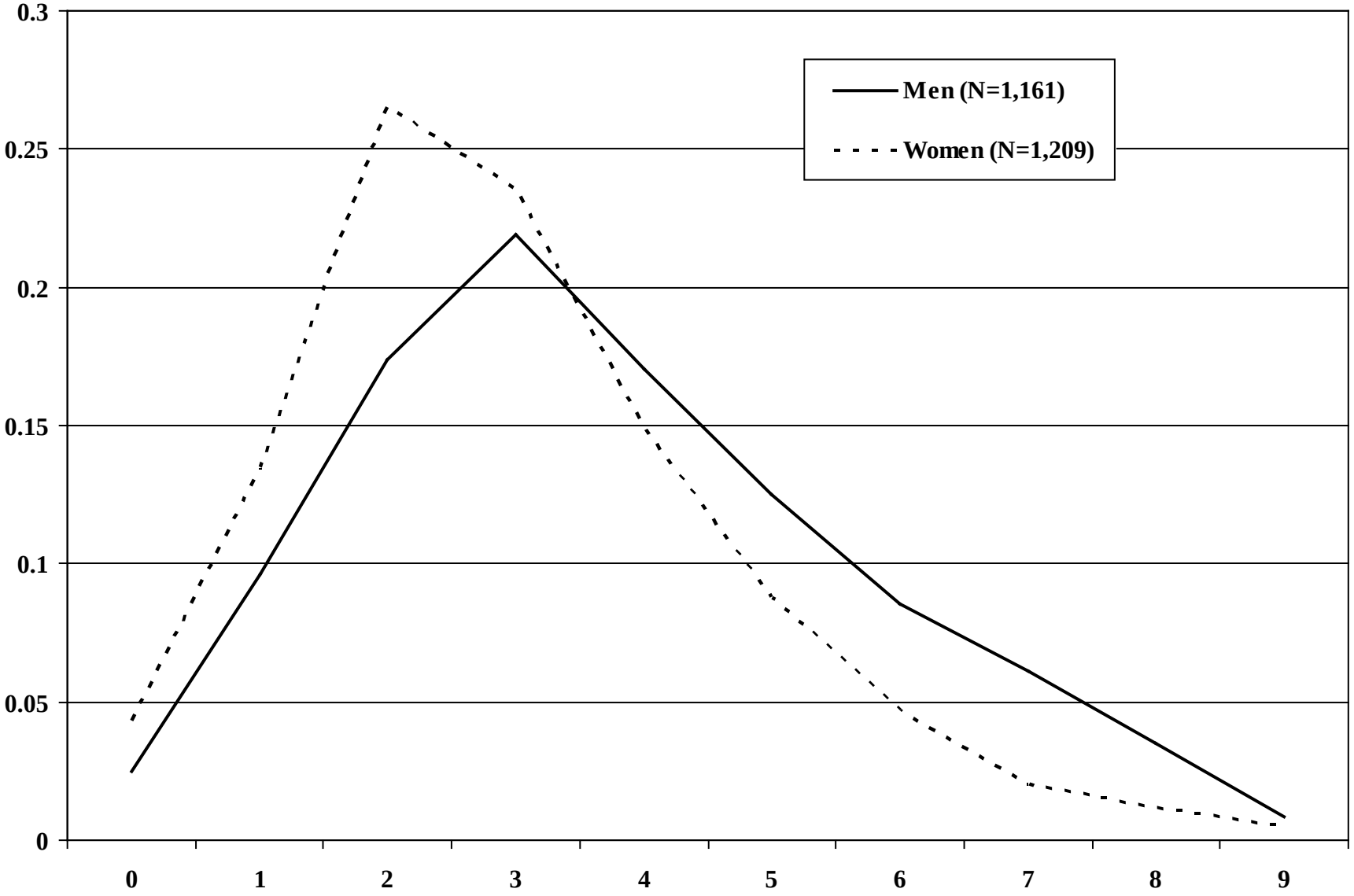


Appendix Figure 4





Appendix Figure A. Distribution of Raven's CPM Test Results by Gender: Number of Correct Answers, Respondents Aged 20-49



Appendix Figure B.
National Per-Capita Availability of Food Grains in Bangladesh (Grams per Day), 1980-81 - 1999-00 (Source: Table 9 in Begum and D'Haese, 2010)

Appendix A

Proof of Proposition 1:

Assume that $U_C + \theta C U_{CC} \leq 0$, then

(A1) $$dS/d\theta = -(\alpha(i)CH_{12}U_w W/H)\Phi_{22} + (U_C + \theta C U_{CC})\Phi_{21} > 0$$

(A2) $$dC/d\theta = (\alpha(i)CH_{12}U_w W/H)\Phi_{21} - (U_C + \theta C U_{CC})\Phi_{11} < 0$$

(A3) $$di/d\theta = (\alpha(i)CH_{12}U_w W/H)\Phi_{32} - (U_C + \theta C U_{CC})\Phi_{31} > 0$$

where $\Phi_{22} = -p^2(\pi_{ii}/\alpha(i)\pi(i) - \pi_i/(\alpha_{ii})^2\pi(i) - 1/\alpha_i\pi_i)/\Delta<0$

$\Phi_{21} = -p(\omega + \rho)(\pi_{ii}/\alpha(i)\pi(i) - \pi_i/(\alpha_{ii})^2\pi(i) - 1/\alpha_i\pi_i)/\Delta<0$

$\Phi_{11} = -(\omega + \rho)^2(\pi_{ii}/\alpha(i)\pi(i) - \pi_i/(\alpha_{ii})^2\pi(i) - 1/\alpha_i\pi_i)/\Delta<0$

$\Phi_{32} = -p^2(H_1/H)/\Delta>0$

$\Phi_{31} = -p(\omega + \rho)(H_1/H)/\Delta>0$ by second-order conditions

Proof of Proposition 2:

Assume that effective calories do not change, so that $U_C + \theta C U_{CC}=0$, then:

(A4) $$dS/d\theta = -(\alpha(i)CH_{12}U_w W/H + \gamma CH_1 W^2 U_{WW}(1 - \alpha(i))\alpha(i)/HB - \lambda\gamma\omega_B B_1)\Phi_{22}$$
$$- (\gamma CB_1 M_1/B)\Phi_{32}$$

(A5) $$di/d\theta = -[\alpha(i)CH_{12}U_w W/H + \gamma CH_1 W^2 U_{WW}(1 - \alpha(i))\alpha(i)/HB - \lambda\gamma\omega_B B_1]\Phi_{32}$$
$$+ (\gamma CB_1 M_1/B)\Phi_{33}$$

where $\Phi_{22} = -[p - \gamma S\omega_B\theta M_1 B_M]^2(\pi_{ii}/\alpha(i)\pi(i) - \pi_i/(\alpha_{ii})^2\pi(i) - 1/\alpha_i\pi_i)/\Delta<0$

$\Phi_{32} = [p - \gamma S\omega_B\theta M_1 B_M][\gamma B_M\alpha_i U_W M_1\theta W(\omega + \rho)/B$

$+ \alpha_i U_W H_1 W(p - \gamma S\omega_B\theta M_1 B_M)/H]/\Delta>0$

$\Phi_{33}<0$, by second-order conditions

Proof of Proposition 3:

(A6) $$dS/dm = (-\gamma B_1\alpha(i)H_1[(1 - \alpha(i))W/HB + U_{WW}W/H] + \lambda\gamma\omega_B B_1)\Phi_{22} - (\gamma B_1/B)\Phi_{32}$$

(A7) $$di/dm = (-\gamma B_1\alpha(i)H_1[(1 - \alpha(i))W/HB + U_{WW}W/H] + \lambda\gamma\omega_B B_1)\Phi_{32} + (\gamma B_1/B)\Phi_{33}$$

Table A
Characteristics and Performance Scores of Respondents Aged 20-49 in 2001-2 and 2007-8, by Gender

Group	Men		Women	
Statistic	Mean (SD)	N	Mean (SD)	N
	Characteristics in 2001-2			
Schooling (years)	3.99 (4.48)	1,264	2.40 (3.57)	1,355
Age	33.7 (8.10)	1,264	32.9 (8.23)	1,355
BMI	19.1 (2.66)	1,264	18.8 (2.79)	1,355
Height (cm)	162.1 (7.89)	1,264	150.3 (6.97)	1,355
Occupation energy expenditure	159.2 (38.2)	1,251	143.6 (7.92)	1,346
Household owned land (hectares x 10^{-2})	91.5 (193.0)	1,264	81.1 (166.7)	1,355
No land owned (%)	48.3 (49.9)	1,264	48.4 (49.9)	1,355
Daily wage (*tk.*)	94.5 (90.0)	1,094	40.1 (32.5)	79
	Assessments in 2007-8			
Grip strength (kilograms of pressure)	37.3 (8.36)	946	24.3 (5.66)	1,087
Number of correct answers, Raven's Matrices	3.66 (1.96)	1,038	2.94 (1.73)	1,200

Source: NSRB 2001-2 and 2007-8

Table B
Multinomial Logit and Logit-GLLAMM Estimates of the Determinants of Children's Activities: Children Ages 10-15 in 2001-2 (Left out activity = Schooling)

Estimation method	Multinomial Logit[a]		ML Logit-GLLAMM[b]	
Activity	Work	Home Time	Work	Home Time
		Boys		
Endowment	2.33	.284	4.09	.426
	(2.42)	(0.15)	(3.41)	(0.13)
Household land owned	-.0599	-.0515	-.0603	-.0515
	(2.93)	(1.01)	(2.94)	(0.55)
No land owned	.356	.348	.359	.344
	(1.09)	(0.45)	(1.19)	(0.04)
Household average endowment	.817	1.38	.784	1.39
	(0.57)	(0.58)	(0.58)	(0.34)
Age	.261	.799	.254	.800
	(2.82)	(2.52)	(2.53)	(0.16)
N	410		410	
		Girls		
Endowment	-5.66	1.46	-6.87	1.72
	(2.62)	(0.89)	(2.84)	(0.93)
Household land owned	.0174	-.0386	.0157	-.0389
	(0.84)	(1.38)	(0.54)	(1.09)
No land owned	.705	.607	.632	.605
	(1.08)	(1.41)	(0.88)	(1.21)
Household average endowment of other family members	-1.61	-.691	-1.94	-.642
	(0.90)	(0.47)	(1.14)	(0.42)
Age	-.0178	.550	-.0994	.581
	(0.07)	(3.18)	(0.36)	(3.06)
N	353		353	

Source: NSRB 2001-2. [a]Asymptotic *t*-ratios corrected for clustering at the household level in columns. [b]Bootstrapped *t*-ratios in parentheses in columns.

Appendix B

Are body mass and "ability" negatively correlated?

To directly assess whether body mass and ability are significantly correlated we estimated the association between a respondent's body mass endowment and his or her performance on the Raven's CPM tests that were administered to all adult respondents in 2007-8. Table A reports the GLS and GLLAMM estimates, by gender, of the effects of the body mass endowment on the total number of correct answers (out of nine) for respondents aged 20-49 in 2001-2. As reported in Table A of the Appendix the mean (standard deviation) number of correct answers was 3.66 (1.96) for men and 2.94 (1.73) for women, with the complete distribution of test scores by gender depicted in Figure A in the Appendix. The first two columns of Table C indicate that while larger men perform less well than smaller men, the point estimate is very small - a one standard deviation increase in the body mass endowment reduces the test score (total correct answers) by less than 3 percent (one tenth of a question). It is well recognized, however, that performance on the Raven's test, despite neither requiring literacy nor numeracy, is affected by schooling, and larger men have less schooling. When schooling attainment is included in the specification in column 3 its coefficient is indeed highly statistically significant and positive. Moreover, the coefficient on the body mass endowment is reduced by more than an order of magnitude to essentially zero. Evidently, larger men, net of schooling, are no less able to carry out mental tasks than are men with less brawn.

For women, the reduced-form relationship between the body mass endowment and test score performance is positive and marginally statistically significant when measurement error is taken into account (column 5). However, as for men, schooling and test scores are strongly positively correlated (column 6) and the effect of body mass on the test score is not statistically significant when schooling attainment is included in the specification. Although still positive, the point estimate is also small - a one-standard deviation increase in body mass for women, net of schooling, increases the number of correct answers by less than a tenth (3.1%). Interestingly, when schooling is included in the specification, the association between landholdings and test performance is also eliminated for both men and women - larger landowners do not perform better on the test once their higher level of schooling is taken into account.

Table C

The Body-mass Endowment and Raven's Matrices Test Performance (2007-8), by Gender: Respondents Aged 20-49 in 2002

Dependent variable: Number of correct answers						
Group	Men			Women		
Estimation procedure	GLS	GLLAMM	GLLAMM	GLS	GLLAMM	GLLAMM
Endowment	-.355 (1.05)	-.371 (0.96)	-.0251 (0.07)	.605 (2.14)	.724 (1.86)	.347 (0.96)
Schooling	-	-	.151 (9.92)	-	-	.180 (9.18)
Household owned land	.000905 (2.52)	.000896 (2.55)	.0000958 (0.26)	.000561 (1.67)	.000561 (1.73)	-.000127 (0.38)
No land owned	-.365 (2.63)	-.380 (2.77)	-.168 (1.31)	-.328 (2.83)	-.329 (2.80)	-.128 (1.13)
Age	-.0502 (0.73)	-.0475 (0.67)	-.0316 (0.47)	-.0671 (1.16)	-.0682 (1.15)	-.0265 (0.48)
Age squared	.000110 (0.11)	.000069 (0.07)	-.000031 (0.03)	.000429 (0.51)	.000561 (0.52)	.000112 (0.14)
ρ	-	.872	.872	-	.805	.805
N	1,038	1,038	1,038	1,200	1,200	1,200

Source: NSRB 2002-2007 panel. Absolute values of asymptotic *t*-ratios corrected for clustering within households in parentheses. All specifications include village fixed effects.

Table D
The Body-mass Endowment in 1982 and Age at Menarche Reported in 2001-2,
Girls Aged 0-13 in 1982

Dependent variable: Whether age at menarche occurred after age 13, as reported in 2002				
Specification	(1)		(2)	
Estimation procedure	Logit	GLLAMM-Logit	Logit	GLLAMM-Logit
Endowment (1982)	-2.23 (2.11)	-2.81 (1.97)	-2.22 (2.00)	-2.72 (1.85)
Age	-	-	-.132 (0.69)	-.119 (0.62)
Age squared	-	-	.00710 (0.48)	.00586 (0.39)
Household owned land (1982)	-	-	-.000785 (0.87)	-.000784 (0.87)
No land owned (1982)	-	-	.0966 (0.20)	.107 (0.23)
ρ	-	.740	-	.740
N	216	216	216	216

Source: NSRB 1981-2/2001-2 panel. Absolute values of asymptotic *t*-ratios corrected for clustering within households in parentheses. All specifications include village fixed effects.

Appendix C

Procedure and Estimates for Correcting for Selectivity in the Female Wage Equation

The estimates of the wage equation (17) for the sample of women are selectivity corrected using the approach of Lee (1982). The specification of the selection equation is the same as that for the occupational choice equation (13), reproduced below,

$$y_j = \boldsymbol{Z}_j\zeta + bm_j + \varepsilon_j,$$

where now y_j is a binary indicator of whether or not a women is working for a wage, m_j = the production function residual; the $\boldsymbol{Z}_j$ = a vector of exogenous control variables; and ε_j=an error term. We estimate the selection equation by logit GLLAMM that corrects for measurement error in the endowments with the replication sub-sample. The Logit and GLLAMM estimates are reported in Appendix Table E.

The distributions ε_j and ξ_j, the error of the wage equation, are allowed to be correlated. As Lee points out, only the marginal disturbances of ε_j and ξ_j needs to be specified, and not their joint bivariate distribution. Let $\Phi(\cdot)$ be the standard normal distribution function, and $\Phi^{-1}(\cdot)$ be its inverse function. With the completely specified marginal distributions $G(\xi_j)$ and $F(\varepsilon_j)$ of ε_j and ξ_j, respectively, each of these errors can be transformed into a standard normal random variable N(0, 1). Let

$$\varepsilon^*_j = J_1(\varepsilon_j) = \Phi^{-1}(F(\varepsilon_j))$$

and

$$\xi^*_j = J_2(\xi_j) = \Phi^{-1}(G(\xi_j)).$$

Both the transformed random variables ε^*_j and ξ^*_j are standard normal variables with zero means and unit variances. If $F(\cdot)$ and $G(\cdot)$ are standard normal distributions, then the term to add to the censored wage equation to correct for selection is the well-known inverse Mills ratio, $\varphi(\boldsymbol{Z}_j\zeta + bm_j)/\Phi(\boldsymbol{Z}_j\zeta + bm_j)$, evaluated at the estimated values of ζ and b. If $G(\cdot)$ is normal and $F(\cdot)$ is logistic, the selection correction term becomes

(A1) $$\varphi(J_1(\boldsymbol{Z}_j\zeta + bm_j)/\Phi(J_1(\boldsymbol{Z}_j\zeta + bm_j)).$$

The implementation of this selection correction method is complicated by the presence of measurement error in the endowments m_j. We use quadrature methods to compute posterior means in order to net out covariate measurement error in constructing the estimated $(\boldsymbol{Z}_j\zeta + bm_j)$ obtained using GLLAMM. Finally we include the selection correction term (A1), net of covariate measurement error, in the estimation of the wage equation (15) for women reported in the last three columns of Table 8. Standard errors are constructed by bootstrapping.

Table E
Determinants of Working for a Wage, Women Aged 20-49 in 2001-2

Estimation procedure	Logit	GLLAMM Logit
Household owned land	-.00437	-.00441
	(2.32)	(2.33)
No land owned	.283	.278
	(0.86)	(0.84)
Endowment	2.27	2.79
	(4.30)	(4.32)
Household average endowment of other family members	.0533	.0186
	(0.06)	(0.02)
Age	.288	.290
	(2.02)	(2.04)
Age squared	-.00392	-.00393
	(1.88)	(1.88)
ρ	-	.829
N	1,348	1,348

Source: NSRB 2001-2. Absolute values of asymptotic *t*-ratios corrected for clustering within households in parentheses in column. All specifications include village fixed-effects.

Table F
First-Stage Estimates for the Occupation-Specific Wage Function: Men Aged 20-49 in 2001-2

Dependent variable:	Schooling (years)	Schooling x occupational energy expenditure	Endowment x occupational energy expenditure	Age x occupational energy expenditure	Log occupational energy expenditure
Household owned land	.00779	.943	-.00568	-1.32	-.000237
	(8.98)	(7.93)	(2.87)	(4.07)	(4.76)
No land owned	-.815	-92.6	2.54	226.9	.0373
	(2.89)	(2.40)	(3.82)	(2.52)	(2.29)
Endowment	-1.57	-105.4	174.6	3028	.534
	(2.48)	(1.22)	(113.5)	(12.8)	(14.6)
Household average endowment of other family members	2.39	208.8	-7.27	-876.2	-.140
	(3.08)	(1.96)	(3.93)	(3.53)	(3.12)
F(19, 1022)	15.3	13.0	176.2	82.6	20.6
F(3,1022): land, no land, average household endowment	33.1	27.0	18.4	20.1	17.0
F(16,1022): land, no land, average household endowment + village fe	15.3	14.0	6.35	8.00	7.83
N	1,094	1,094	1,094	1,094	1,094

Source: NSRB 2001-2. Absolute values of asymptotic *t*-ratios corrected for clustering within households in parentheses in column. All specifications include village fixed-effects, age and age squared.

Table G
First-Stage Estimates for the Occupation-Specific Wage Function: Women Aged 20-49 in 2001-2

Dependent variable:	Schooling (years)	Schooling x occupational energy expenditure	Endowment x occupational energy expenditure	Age x occupational energy expenditure	Log occupational energy expenditure
Household owned land	.0207	1.99	-.0352	-5.37	-.00116
	(1.96)	(1.22)	(1.65)	(3.11)	(3.66)
No land owned	-.0163	-111.7	-3.77	-349.4	.0781
	(0.01)	(0.54)	(1.87)	(1.79)	(1.97)
Endowment	1.58	-199.9	167.9	317.7	.0588
	(0.54)	(0.47)	(25.9)	(0.89)	(0.70)
Household average endowment of other family members	-146.0	-12595	-52.8	36107	8.08
	(1.53)	(0.90)	(0.69)	(3.24)	(3.71)
λ	2964	2602.4	926.5	-72269	-161.6
	(1.58)	(0.94)	(0.63)	(3.38)	(3.86)
F(19, 75)	7.90	6.25	860.4	1161	136.7
F(3,75): land, no land, average household endowment	4.02	2.42	1.44	7.21	9.26
F(16,75): land, no land, average household endowment + village fe	5.00	3.83	1.99	6.78	14.9
N	79	79	79	79	79

Source: NSRB 2001-2. Absolute values of asymptotic *t*-ratios corrected for clustering within households in parentheses in column. All specifications include village fixed-effects, age and age squared.