Online Appendix for
Explaining Educational Attainment across Countries and over Time

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1 Data by Deciles of the Schooling Distribution

Table 1 below reports average years of schooling for people 25 to 29 years of age for countries by deciles of the schooling distribution in 1950. The data is from Barro and Lee (2010) and includes the entire sample of 147 countries. Compared to the dispersion in schooling between rich and poor countries reported in the restricted sample in the paper, the larger sample in Table 1 shows that the pattern of convergence in schooling across countries over time is even stronger, with the schooling gap between countries in the tenth and first deciles being a factor of 31-fold in 1950 and less than 3-fold in 2005.

Table 1: Average Years of Schooling across Countries

Decile	s_{50}	s_{05}	s_{05}/s_{50}
1	0.28	4.06	14.60
2	0.60	6.11	10.26
3	1.07	7.02	6.57
4	1.58	7.34	4.66
5	2.41	8.63	3.58
6	3.39	9.64	2.85
7	4.40	10.11	2.30
8	5.28	10.74	2.03
9	6.85	11.26	1.64
10	8.73	11.69	1.34
$R_{10/1}$	31.41	2.88	–

Note: s is average years of schooling of the 25-29 year old population. Numbers reported are the average of each decile. The countries in each decile are the same in each year and represent the 1950 distribution of schooling.

2 Calibration of Life Expectancy in the Cross-Country Experiments

In our cross-country experiment, we search for 10 combinations of market productivity, z^m, and growth rate, g^m, such that our model matches the relative income gaps in 1950 and 2005, as described in the first table of the paper. We need, for this, to calibrate life expectancy T across countries and over time. Below, we describe our approach to do so.

The empirical measure of T used for the benchmark economy that is best suited for the model is the sum of years spent in school and on the labor market for a generation. The same data is not readily available for the time period and set of countries that we analyze. Thus, to calibrate T across countries and time we estimate empirical relationships across countries between life expectancy at

birth and income per capita as follows:

$$\text{Life Expectancy} = \text{slope} \times \ln(\text{GDP per capita}) + \text{constant} + \text{error}.$$

We estimate this relationship for two time periods. We start with life expectancy of the 1915 generation. There does not exists a wealth of data to estimate this relationship. Thus, we use the data from Preston (1975) pertaining to the 1930s.[1] The estimated slope is 9.481 with an adjusted r^2 of 82%. We estimate the same relationship for life expectancy of the 1970's generation using data from the World Bank Development Indicators and Penn World Tables. The estimated slope is 7.1684 with an adjusted r^2 of 52%. The assumed empirical relationship implies that the difference in life expectancy between any two economies at a point in time is:

$$T_t - T_t^{us} = \text{slope}_t \times \ln\left(\frac{y_t}{y_t^{us}}\right). \tag{1}$$

We use the estimated relationships for 1915 and 1970 and the "school plus work" time (life expectancy) for the benchmark economy to estimate the implied life expectancy for all economies in our cross-country experiments. We note that ideally we would have data for school and work years for each cohort and country as we do for the United States to do the experiments. That data is not available. We would also ideally use cross-country data on life expectancy at age 5 to at least isolate the effects of cross-country differences in infant mortality that are unlikely to be affecting schooling decisions. The available data is too sparse to pursue the cross-county analysis. We use life expectancy at birth because this is the data that is available for cross country analysis over the period we study. We note however how our procedure partially mitigates these concerns since we use Equation (1) to map differences in life expectancy to the levels of school plus work years in the benchmark economy.

[1] Preston also offers data for the 1900s but this data contains only 10 countries. The 1930s data report life expectancy at birth and real income per capita for 38 countries.

3 Robustness

Recall that in our model individuals can acquire human capital by spending time in school and purchasing educational services. The human capital technology is described by

$$H(s,x) = x^{\gamma} \exp\left(\frac{\theta}{1-\psi} s^{1-\psi}\right)$$

where x represents purchases of educational services. Similarly, recall that the utility derived from consumption is described by $U(c) = \ln(c - \bar{c})$ where c is an aggregate of market and nonmarket consumption, and $\bar{c}$ is a subsistence level of consumption.

In this section we perform robustness checks with respect to ψ and $\bar{c}$. In our baseline calibration, we follow Bils and Klenow (2000) who report a range of value for ψ. Our baseline value, $\psi = 0.3$, is the middle of this range. We consider a range of alternative values for ψ and, for each value, we recalibrate the model and run our baseline experiment, as described in the paper. We report the results below. We also perform an experiment where we reduce the calibrated value of $\bar{c}$ by 25 percent.

3.1 Setting $\psi = 0.0$

Table 2: Baseline Experiment Results

	Dec.	Rel. Inc.	Work Life	Leis. Hrs	Home Hrs	Mkt. Hrs	School Yrs	$\bar{c}/c$	$\hat{c}/c$	Accounting
										Cross-Section
	1	0.05	20.9	1.6	44.4	66.0	2.0	0.76	1.016	0.92
	2	0.07	24.1	5.3	38.3	68.5	2.5	0.65	1.016	0.89
	3	0.09	26.4	2.8	40.2	69.0	3.1	0.70	1.009	1.01
1	4	0.12	29.2	9.9	33.0	69.1	3.4	0.55	1.012	0.85
9	5	0.17	32.5	10.8	30.9	70.3	4.3	0.52	1.009	0.78
5	6	0.21	34.5	12.5	29.1	70.4	4.9	0.48	1.008	0.85
0	7	0.24	35.7	14.5	27.8	69.7	5.3	0.45	1.008	0.82
	8	0.38	40.1	19.9	24.3	67.8	7.0	0.35	1.007	0.76
	9	0.58	44.1	30.8	22.3	58.9	8.4	0.20	1.007	0.57
	10	0.81	47.3	41.8	22.8	47.3	9.7	0.09	1.006	0.35
	U.S.	1.00	49.3	45.1	23.2	43.8	10.6	0.06	1.006	-
										Time Series
	1	0.06	35.6	16.0	28.3	67.7	4.7	0.44	1.010	0.61
	2	0.05	38.5	17.4	28.6	66.0	4.4	0.42	1.010	0.38
	3	0.21	42.9	28.0	21.6	62.4	9.1	0.21	1.006	1.10
2	4	0.10	44.1	27.8	24.3	59.8	6.5	0.26	1.008	0.49
0	5	0.22	48.2	34.4	21.8	55.8	9.8	0.15	1.006	0.62
0	6	0.31	50.3	36.9	21.3	53.8	11.6	0.11	1.005	0.92
5	7	0.34	51.0	38.4	21.4	52.3	12.0	0.09	1.005	0.92
	8	0.61	54.0	42.2	21.3	48.5	14.9	0.05	1.004	1.15
	9	0.71	56.0	46.4	22.5	43.1	15.1	0.03	1.004	1.04
	10	0.77	57.4	49.3	23.4	39.3	14.1	0.02	1.004	1.11
	U.S.	1.00	58.7	48.5	22.9	40.6	13.8	0.02	1.004	-

3.2 Setting $\psi = 0.1$

Table 3: Baseline Experiment Results

	Dec.	Rel. Inc.	Work Life	Leis. Hrs	Home Hrs	Mkt. Hrs	School Yrs	$\bar{c}/c$	$\hat{c}/c$	Accounting
										Cross-Section
	1	0.05	20.9	1.9	43.6	66.5	1.6	0.75	1.012	0.97
	2	0.07	24.1	6.0	37.4	68.6	2.0	0.63	1.011	0.95
	3	0.09	26.4	3.3	39.3	69.4	2.9	0.69	1.005	1.03
1	4	0.12	29.2	11.2	32.1	68.7	2.9	0.53	1.007	0.89
9	5	0.17	32.5	12.1	30.1	69.7	4.2	0.50	1.005	0.79
5	6	0.21	34.5	13.8	28.5	69.7	5.0	0.47	1.004	0.83
0	7	0.24	35.7	16.0	27.2	68.8	5.5	0.43	1.004	0.79
	8	0.38	40.1	21.2	24.0	66.8	7.7	0.34	1.003	0.60
	9	0.58	44.1	32.2	22.1	57.8	9.0	0.19	1.003	0.41
	10	0.81	47.3	42.8	22.5	46.7	9.6	0.09	1.003	0.36
	U.S.	1.00	49.3	45.5	22.7	43.9	10.5	0.06	1.003	-
										Time Series
	1	0.06	35.6	17.6	27.5	66.9	4.6	0.42	1.005	0.78
	2	0.05	38.5	19.3	27.8	64.9	4.3	0.40	1.005	0.51
	3	0.21	42.9	29.2	21.3	61.5	10.1	0.20	1.003	1.27
2	4	0.10	44.1	29.8	23.8	58.4	6.7	0.24	1.004	0.61
0	5	0.22	48.2	35.6	21.6	54.8	10.8	0.14	1.003	0.70
0	6	0.31	50.3	37.9	21.0	53.1	12.8	0.10	1.002	1.00
5	7	0.34	51.0	39.3	21.1	51.6	13.2	0.09	1.002	0.98
	8	0.61	54.0	42.8	20.9	48.3	16.3	0.05	1.002	1.14
	9	0.71	56.0	47.0	22.1	42.9	16.0	0.03	1.002	1.03
	10	0.77	57.4	50.1	23.0	38.8	14.5	0.02	1.002	1.21
	U.S.	1.00	58.7	49.7	22.7	39.6	14.7	0.02	1.002	-

3.3 Setting $\psi = 0.2$

Table 4: Baseline Experiment Results

	Dec.	Rel. Inc.	Work Life	Leis. Hrs	Home Hrs	Mkt. Hrs	School Yrs	$\bar{c}/c$	$\hat{c}/c$	Accounting
										Cross-Section
	1	0.05	20.9	2.2	43.1	66.7	2.0	0.74	1.009	0.93
	2	0.07	24.1	6.5	36.9	68.6	2.3	0.63	1.009	0.91
	3	0.09	26.4	3.5	39.0	69.4	3.4	0.69	1.004	0.96
1	4	0.12	29.2	11.7	31.7	68.6	3.4	0.53	1.006	0.84
9	5	0.17	32.5	12.3	29.8	69.9	4.7	0.50	1.004	0.72
5	6	0.21	34.5	13.9	28.1	69.9	5.5	0.47	1.004	0.75
0	7	0.24	35.7	16.0	26.8	69.1	5.9	0.44	1.004	0.71
	8	0.38	40.1	21.0	23.6	67.4	7.9	0.34	1.003	0.53
	9	0.58	44.1	32.2	21.5	58.4	9.0	0.19	1.003	0.36
	10	0.81	47.3	43.4	21.8	46.9	9.6	0.09	1.003	0.33
	U.S.	1.00	49.3	46.2	22.0	43.8	10.3	0.06	1.003	-
										Time Series
	1	0.06	35.6	17.7	27.3	67.0	5.0	0.42	1.004	0.69
	2	0.05	38.5	19.4	27.5	65.1	4.7	0.41	1.005	0.46
	3	0.21	42.9	29.4	20.8	61.8	9.9	0.21	1.003	1.08
2	4	0.10	44.1	29.9	23.4	58.7	6.9	0.25	1.004	0.53
0	5	0.22	48.2	35.9	21.0	55.2	10.4	0.15	1.003	0.60
0	6	0.31	50.3	38.2	20.4	53.5	12.2	0.11	1.002	0.85
5	7	0.34	51.0	39.7	20.4	51.9	12.5	0.09	1.002	0.84
	8	0.61	54.0	43.2	20.2	48.6	15.2	0.05	1.002	0.99
	9	0.71	56.0	47.6	21.3	43.1	14.9	0.03	1.002	0.90
	10	0.77	57.4	50.8	22.2	38.9	13.6	0.02	1.002	1.04
	U.S.	1.00	58.7	50.4	21.9	39.7	13.7	0.02	1.002	-

3.4 Setting $\psi = 0.4$

Table 5: Baseline Experiment Results

	Dec.	Rel. Inc.	Work Life	Leis. Hrs	Home Hrs	Mkt. Hrs	School Yrs	$\bar{c}/c$	$\hat{c}/c$	Accounting
										Cross-Section
	1	0.05	20.9	4.2	39.7	68.1	2.8	0.68	1.008	0.83
	2	0.07	24.1	9.8	33.4	68.8	3.2	0.57	1.009	0.80
	3	0.09	26.4	5.9	35.6	70.5	4.3	0.63	1.005	0.84
1	4	0.12	29.2	15.2	28.6	68.2	4.2	0.47	1.007	0.72
9	5	0.17	32.5	15.6	26.8	69.7	5.4	0.44	1.005	0.61
5	6	0.21	34.5	17.0	25.3	69.7	6.1	0.41	1.005	0.64
0	7	0.24	35.7	19.1	24.1	68.8	6.4	0.38	1.005	0.61
	8	0.38	40.1	23.7	21.3	67.0	8.0	0.28	1.004	0.48
	9	0.58	44.1	33.9	20.0	58.1	8.8	0.15	1.004	0.34
	10	0.81	47.3	44.1	21.0	46.9	9.3	0.07	1.004	0.30
	U.S.	1.00	49.3	46.8	21.4	43.9	9.9	0.05	1.004	-
										Time Series
	1	0.06	35.6	21.4	24.5	66.1	5.7	0.36	1.005	0.53
	2	0.05	38.5	23.4	24.8	63.8	5.5	0.34	1.006	0.36
	3	0.21	42.9	31.5	19.2	61.3	9.5	0.16	1.004	0.82
2	4	0.10	44.1	32.8	21.6	57.6	7.3	0.20	1.005	0.40
0	5	0.22	48.2	37.6	19.8	54.6	9.9	0.11	1.004	0.45
0	6	0.31	50.3	39.5	19.5	53.0	11.2	0.08	1.003	0.66
5	7	0.34	51.0	40.9	19.6	51.5	11.4	0.07	1.003	0.65
	8	0.61	54.0	44.0	19.7	48.3	13.4	0.03	1.003	0.79
	9	0.71	56.0	48.1	20.9	43.0	13.3	0.02	1.003	0.72
	10	0.77	57.4	51.1	21.9	38.9	12.3	0.01	1.003	0.83
	U.S.	1.00	58.7	50.6	21.6	39.8	12.3	0.01	1.003	-

3.5 Reducing $\bar{c}$ by 25 percent

We reduce the value of subsistence consumption $\bar{c}$ by 25 percent keeping all other parameters the same. For the benchmark economy, the reduction in $\bar{c}$ implies that this economy accounts for less of the schooling and market hours data targeted in our baseline calibration. In particular, we find that the increase in schooling over time in the benchmark economy is 88 percent of that of the calibrated baseline economy in the paper whereas the reduction in hours is 81 percent of that of the calibrated economy. Hence, this experiment captures a diminished role of productivity in explaining schooling and hours in the time series for the benchmark economy. Or to put it differently, this simple experiment captures the possibility that not all the changes in schooling and hours in the United States over time are due to productivity and life expectancy through the income effect. What are the cross-country implications of the diminished income effect in the model? We summarize our cross country results in Table 6. We find that qualitatively our results remain unchanged although as expected the

Table 6: Model's Implications – The Baseline Experiment

	Baseline Accounting		Lower $\bar{c}$ Accounting	
Deciles	Cross-Section	Time-Series	Cross-Section	Time-Series
1	0.90	0.64	0.81	0.48
2	0.87	0.42	0.80	0.34
3	0.92	0.97	0.81	0.80
4	0.79	0.47	0.73	0.40
5	0.67	0.53	0.61	0.46
6	0.71	0.76	0.64	0.68
7	0.66	0.75	0.60	0.67
8	0.50	0.89	0.45	0.82
9	0.35	0.80	0.31	0.76
10	0.30	0.91	0.28	0.87

Note: The "Cross-Section" column indicates what fraction of the observed difference with U.S. schooling is accounted for by the model in 1950. The "Times Series" column indicates what fraction of the observed growth rate of school years is accounted for by the model. Lower $\bar{c}$ is the model with a 25 percent reduction in the calibrated value of $\bar{c}$, keeping all other parameters the same.

quantitative effects are somewhat diminished. Nevertheless, the the model still accounts for 81 percent of the differences in schooling between the first decile and the benchmark economy in 1950 (versus 90 percent in the baseline) and 48 percent of the change in schooling (versus 64 percent in the baseline). We still view these quantitative results as substantial.

4 Model's Implications Country by Country

Table 7: Relative Income and Schooling by Country

	Data		Model		Data		Model	
Country	y_{50}	s_{50}	y_{50}	s_{50}	y_{05}	s_{05}	y_{05}	s_{05}
MWI	0.03	0.94	0.03	1.39	0.02	4.42	0.02	6.06
CHN	0.04	1.72	0.04	1.79	0.14	9.49	0.14	7.32
MMR	0.04	0.56	0.04	1.95	0.11	5.09	0.11	6.87
TZA	0.05	1.30	0.05	1.93	0.02	5.54	0.02	3.49
MLI	0.05	0.15	0.05	2.00	0.03	1.52	0.03	4.08
KHM	0.05	4.23	0.05	2.12	0.06	6.00	0.06	5.40
BGD	0.05	0.91	0.05	2.21	0.03	6.10	0.03	3.99
NER	0.06	0.43	0.06	2.33	0.02	1.90	0.02	2.89
PAK	0.06	1.19	0.06	2.57	0.07	5.60	0.07	5.93
IND	0.06	1.08	0.06	2.61	0.08	5.61	0.08	6.09
UGA	0.07	1.35	0.07	2.46	0.03	5.37	0.03	3.98
VNM	0.07	2.23	0.07	2.74	0.08	6.75	0.08	5.92
ZMB	0.07	2.05	0.07	2.45	0.02	7.25	0.02	3.59
CMR	0.07	0.98	0.07	2.54	0.04	7.29	0.04	4.41
KEN	0.07	1.29	0.07	2.53	0.04	7.85	0.04	4.24
ZWE	0.07	1.82	0.07	2.55	0.03	9.04	0.03	4.16
THA	0.08	3.58	0.08	3.70	0.25	7.82	0.25	10.33
SDN	0.08	0.46	0.08	2.79	0.03	4.13	0.03	3.99
KOR	0.09	5.72	0.09	4.33	0.57	13.59	0.57	13.74
IDN	0.09	1.15	0.09	3.38	0.14	7.33	0.14	7.67
EGY	0.09	0.74	0.09	3.37	0.12	8.77	0.12	7.33
MLT	0.09	3.97	0.09	4.26	0.41	11.11	0.41	12.48
ALB	0.10	9.32	0.10	3.52	0.11	10.63	0.11	7.68
CIV	0.10	0.50	0.10	3.15	0.04	3.94	0.04	4.50
GHA	0.11	0.80	0.11	3.32	0.05	7.40	0.05	4.83
PHL	0.11	3.13	0.11	3.56	0.09	9.46	0.09	6.59
TUN	0.11	0.72	0.11	4.07	0.18	8.58	0.18	8.98
MOZ	0.12	0.26	0.12	3.45	0.06	1.71	0.06	5.62
ROM	0.12	2.79	0.12	3.92	0.13	10.00	0.13	8.38
SEN	0.13	1.41	0.13	3.55	0.04	4.07	0.04	4.52
LKA	0.13	4.58	0.13	4.13	0.14	9.43	0.14	7.59
DZA	0.13	0.89	0.13	3.95	0.11	9.32	0.11	7.20
JAM	0.14	3.75	0.14	4.07	0.12	10.94	0.12	8.21
MYS	0.15	2.10	0.15	5.23	0.32	11.54	0.32	10.90
IRQ	0.15	0.41	0.15	3.95	0.04	6.47	0.04	4.79
IRN	0.16	0.70	0.16	4.67	0.19	9.34	0.19	9.95
JOR	0.16	2.15	0.16	4.59	0.16	9.98	0.16	8.62
BRA	0.17	1.54	0.17	4.81	0.19	8.92	0.19	9.47
BGR	0.18	6.65	0.18	5.06	0.23	9.75	0.23	10.79
TUR	0.18	1.41	0.18	5.17	0.24	7.88	0.24	10.21
CYP	0.19	4.22	0.19	6.06	0.43	12.57	0.43	13.10
ECU	0.19	2.72	0.19	4.77	0.15	8.20	0.15	8.15

Table 8: Relative Income and Schooling by Country

	Data		Model		Data		Model	
Country	y_{50}	s_{50}	y_{50}	s_{50}	y_{05}	s_{05}	y_{05}	s_{05}
GRC	0.20	5.14	0.20	6.19	0.48	12.58	0.48	14.37
JPN	0.20	7.45	0.20	6.80	0.71	13.36	0.71	17.33
BOL	0.20	2.97	0.20	4.58	0.09	10.44	0.09	6.22
CRI	0.20	3.72	0.20	5.38	0.24	9.14	0.24	10.34
GTM	0.20	1.33	0.20	4.84	0.14	4.81	0.14	7.83
PRT	0.21	3.08	0.21	6.34	0.46	10.12	0.46	13.83
BRB	0.21	7.63	0.21	5.72	0.30	9.63	0.30	11.84
BHR	0.22	1.29	0.22	5.32	0.21	10.83	0.21	9.54
COL	0.22	2.55	0.22	5.34	0.20	8.76	0.20	9.21
HKG	0.22	4.74	0.22	7.51	0.84	12.58	0.84	16.51
SAU	0.23	3.28	0.23	5.69	0.28	9.26	0.28	11.88
ESP	0.23	3.43	0.23	6.92	0.59	11.68	0.59	15.09
PER	0.24	3.23	0.24	5.14	0.14	10.07	0.14	7.96
MEX	0.24	2.41	0.24	5.71	0.25	9.68	0.25	10.30
POL	0.25	6.17	0.25	5.94	0.28	10.20	0.28	10.94
HUN	0.26	7.89	0.26	5.97	0.28	11.71	0.28	10.95
ZAF	0.26	4.38	0.26	5.32	0.15	9.31	0.15	7.98
SYR	0.26	1.05	0.26	5.80	0.24	5.02	0.24	9.86
ISR	0.28	7.73	0.28	7.25	0.56	12.34	0.56	14.84
IRL	0.35	8.74	0.35	8.70	0.85	11.12	0.85	15.64
ITA	0.36	4.98	0.36	7.96	0.64	11.79	0.64	15.15
TTO	0.36	5.24	0.36	8.10	0.66	10.76	0.66	15.01
AUT	0.37	3.95	0.37	8.32	0.73	11.45	0.73	15.78
CHL	0.38	5.14	0.38	7.22	0.39	11.13	0.39	11.51
FIN	0.44	5.74	0.44	8.62	0.73	11.67	0.73	15.15
ARG	0.49	5.14	0.49	7.30	0.30	9.75	0.30	9.92
URY	0.50	5.16	0.50	7.30	0.28	9.04	0.28	9.31
ISL	0.53	6.03	0.53	9.09	0.78	12.44	0.78	14.95
FRA	0.53	4.89	0.53	8.81	0.70	12.44	0.70	14.62
BEL	0.56	7.56	0.56	9.01	0.73	12.55	0.73	14.49
NOR	0.56	7.91	0.56	9.54	0.90	12.60	0.90	15.56
NLD	0.60	6.60	0.60	9.19	0.76	12.09	0.76	14.56
SWE	0.68	7.37	0.68	9.30	0.75	12.80	0.75	13.93
DNK	0.68	8.06	0.68	9.42	0.78	10.07	0.78	14.18
GBR	0.70	6.95	0.70	9.33	0.74	11.60	0.74	13.41
AUS	0.74	9.93	0.74	9.53	0.79	12.27	0.79	13.62
CAN	0.75	8.27	0.75	9.55	0.79	12.30	0.79	13.61
VEN	0.77	2.34	0.77	7.81	0.29	6.86	0.29	8.62
NZL	0.80	11.14	0.80	8.99	0.59	13.41	0.59	11.47
LUX	0.81	7.15	0.81	10.77	1.20	10.23	1.20	15.82
CHE	0.93	7.91	0.93	9.55	0.77	9.93	0.77	12.06

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