The Effect of Height on Cognitive Ability and Wage

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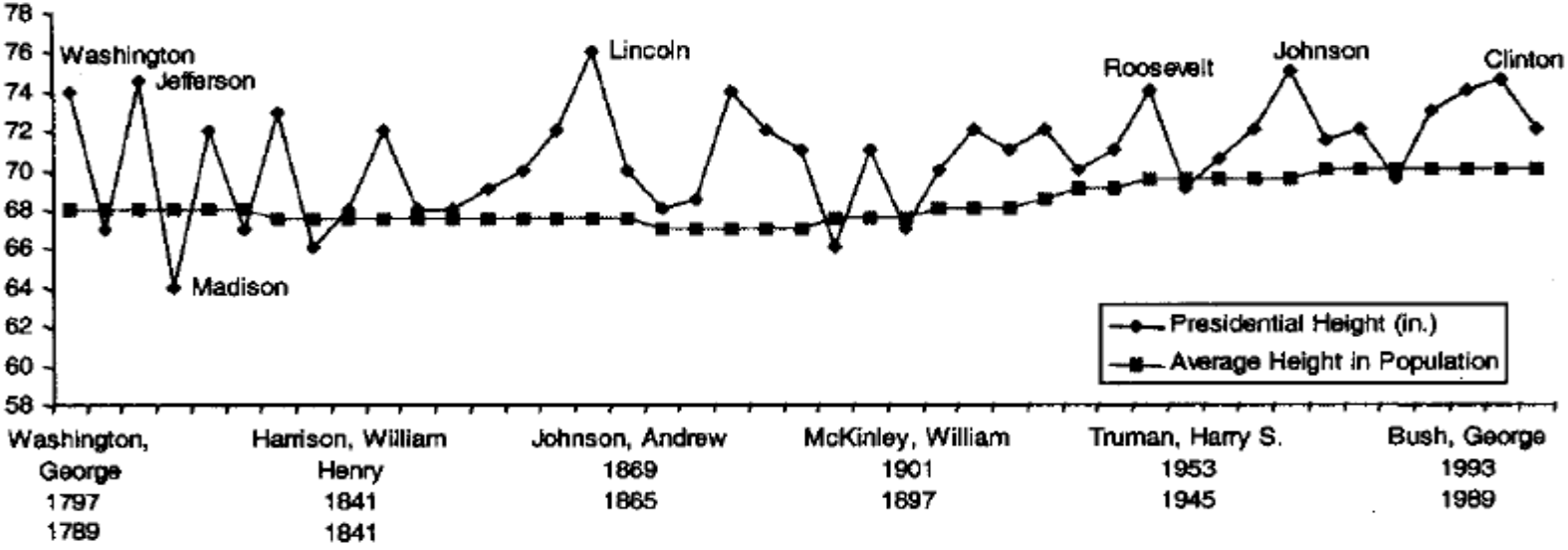
Introduction

- "Kids, I want you to grow taller than me!"
- Height of the U.S. President and their counterpart
  - There were only 4 times that the shorter candidate won the presidential election since 1928.
  - From 1796, 58% winners were taller candidates.



Source: Persico, Postlewaite and Silverman (2004)

Literature Review

- Related Literatures
  - Wage: Loh (1993), Thomas and Strauss (1997), PPS (2004), Dinda et al. (2006), CP (2008), Hubler (2009), Gao and Smyth (2010), Kortt and Leigh (2010), Vogol (2012)
  - Health condition: Rees et al. (2009), Case and Paxson (2010)
  - Self-esteem/Social esteem: Judge and Cable (2004), Rees et al. (2009)
  - Leadership: Judge and Cable (2004), Murray and Schmitz (2011)
  - Job performance: Judge and Cable (2004)
  - Education level: Case and Paxson (2010), Cinnirella et al. (2011)
  - Cognitive ability in the old age: Maurer (2010)
  - Happiness: Carrieri and De Paola (2012)
  - Ability to write: Spears (2012)
  - Career choice: Bockerman et al. (2010)

Literature Review

- Is height premium a height discrimination?
- There are at least two possible reasons:
  - Teenage height is matter. Height premium is partially mediated through high school sports and clubs experience. (Persico, Postlewaite & Silverman, 2004)
  - A marker of cognitive ability. (Case & Paxson, 2008)

Cognitive Ability

Data

- Taiwan Education Panel Survey (TEPS)
  - First and second wave of survey, including junior and senior high school students.
- Sample size:
  - Junior high school: 20,055 released, 16,522 in use.
  - Senior high school: 19,051 released, 16,442 in use.
- Dependent variable: Cognitive ability
- Major independent variable: Height (cm)
- Control variables: Weight, Father's and Mother's education level and ethnicity, Family monthly income, number of siblings, a series of dummy variables indicating public or private school, location, and birth year.

Cognitive Ability

- Hypotheses

1. Height reflects individual's self-esteem, which affects cognitive ability. (representative variable: Self-esteem)
2. Height reflects interpersonal dominance, which affects individual's cognitive ability. (interpersonal dominance)
3. Height reflects individual's health condition. (mental health, physical health)
4. Height reflects individual's non-cognitive ability. (organization ability, self-discipline)
5. Height reflects individual's social capital through club experience. (athletics, athletic club, academic club, and others)
6. Height reflects individual's leadership. (no. of same sex friends, no. of opposite sex friends)
7. Height reflects individual's time that hit the growth spurts. (menarche age)

Cognitive Ability

- Model Specification - OLS

$$Y_i = \beta_0 + \beta_1 \cdot Height_i + \beta_2 \cdot Weight_i + \sum_{h=1}^{10} \beta_{3h} \cdot Ethnicity_i +$$

$$\sum_{j=1}^{8} \beta_{4j} \cdot Father's\ and\ Mother's\ Edu_i + \sum_{k=1}^{7} \beta_{5k} \cdot Family\ income_i +$$

$$\beta_6 \cdot siblings_i + \beta_7 \cdot school\ type_i + \sum_{l=1}^{2} \beta_{8l} \cdot districts_i +$$

$$\sum_{m=1}^{5} \beta_{9m} \cdot menarcheage_i + \sum_{n=1}^{12} \beta_{10n} \cdot hypotheses\ related_i + \varepsilon_i$$

Table 7 OLS Estimates of Cognitive Ability on Height and Related Theories
(Junior High School, Female)

Dependent Variable: Cognitive ability	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Height (cm)	0.007 [0.002]***	0.006 [0.002]***	0.007 [0.002]***	0.007 [0.002]***	0.006 [0.002]***	0.007 [0.002]***	0.007 [0.002]***	0.005 [0.002]***	0.004 [0.002]*
Self-esteem		0.024 [0.007]***							0.019 [0.008]**
Interpersonal Dominance			-0.077 [0.010]***						-0.057 [0.010]***
Health									
Mental				-0.009 [0.002]***					-0.014 [0.002]***
Physical				0.02 [0.004]***					0.017 [0.004]***
Non-cognitive ability									
Organization					0.039 [0.007]***				0.037 [0.007]***
Self-discipline					0.018 [0.006]***				0.021 [0.006]***
Club									
Athletic teem						0.025 [0.021]			0.027 [0.022]
Athletic club						-0.199 [0.029]***			-0.173 [0.030]***
Academic club						0.11 [0.032]***			0.116 [0.032]***
Other club						0.016 [0.014]			0.006 [0.015]
Evolution									
Friend number in same sex							0.036 [0.008]***		0.027 [0.008]***
Friend number in opposite sex							-0.011 [0.007]*		-0.02 [0.007]***
Menarche age									
9 years old								0.173 [0.166]	0.118 [0.171]
10								0.199 [0.056]***	0.205 [0.057]***
11								0.246 [0.031]***	0.239 [0.031]***
12								0.131 [0.025]***	0.12 [0.026]***
13								0.044 [0.028]	0.056 [0.028]*
Control Variables	V	V	V	V	V	V	V	V	V
Constant	-1.082 [0.276]***	-1.064 [0.277]***	-1.048 [0.276]***	-1.073 [0.287]***	-1.294 [0.276]***	-1.134 [0.274]***	-1.191 [0.276]***	-0.742 [0.278]***	-0.916 [0.291]***
Observations	7954	7862	7877	7567	7856	7904	7954	7954	7309
R^2	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.27

Wage

Data

- Nutrition and Health Survey in Taiwan (NAHSIT), 2005-2008.
  - Conducted in every 5 years.
- Dependent variable: monthly wage
- Independent variables:
  - Height (cm)
  - Menarche age.
- Control variables
  - Weight, Father's and Mother's ethnicity and education level, Individual's education level, age, and menarche age in female samples.

Table 3 Summary Statistics, by Sex and Adult Height

	Men		Women	
	Height Average or Above	Height below Average	Height Average or Above	Height below Average
Personal Characteristics				
Avg. Height	173.7*	163.63	161.55*	152.64
Age	45*	54	42*	50
Wage per month	31286*	24143	16956*	13179
Education years	11.86*	9.88	10.86*	8.86
Ever married (%)	72.54*	87.19	76.94*	90.18
Divorced or separated (%)	3.09*	4.75	5.03	4.61
Family Background				
Father's year of schooling	6.85*	4.60	6.74*	4.95
Mother's year of schooling	4.84*	2.79	4.55*	3.15
Family income (per month)	66070*	51371	59250*	51012
Observations	892	1038	785	794

Note: * Statistically different at the 5 percent confidence level.

Wage

- Model Specification - OLS

$$Y_i = \beta_0 + \beta_1 \cdot Height_i + \beta_2 \cdot Weight_i + \sum_{j=1}^{10} \beta_{3j} \cdot Ethnicity_i +$$

$$\sum_{k=1}^{8} \beta_{4k} \cdot Father's\ and\ Mother's\ Edu_i +$$

$$\sum_{l=1}^{4} \beta_{5l} \cdot Edu_i + \sum_{m=1}^{9} \beta_{6m} \cdot age_i + \sum_{n=1}^{3} \beta_{7n} \cdot menarcheage_i + \varepsilon_i$$

Table 11 OLS Estimates. Effect of Height on Wage, All Workers. (NAHSIT, 2004)

Dependent Variable: Monthly Wage (NT Dollars)	(1)	(2)	(3)	(4)	(5)	(6)
Height						
Medium 25-75%	8,179.79***	8,475.21***	6,757.74***	6,567.67***	6,334.48***	3,487.76***
	[1,387.11]	[1,499.88]	[1,483.27]	[1,417.61]	[1,412.58]	[1,277.64]
Top25%	9,398.63***	9,986.85***	7,042.32***	8,632.19***	7,734.33***	3,447.64**
	[1,538.31]	[1,642.10]	[1,635.13]	[1,670.89]	[1,674.61]	[1,546.72]
Male	9,747.67***	11,545.02***	10,925.74***	12,596.14***	12,543.28***	10,572.67***
	[1,088.14]	[1,436.95]	[1,454.48]	[1,520.17]	[1,510.40]	[1,404.65]
Weight		-58.91	-3.22	-69.57	-80.93	18.28
		[59.25]	[61.29]	[62.68]	[63.75]	[59.63]
Father's Education Level						
High school					4,919.97***	-203.55
					[1,675.09]	[1,633.45]
College					3,653.46	-2,800.57
					[2,538.31]	[2,546.29]
Bachelor or above					5,265.79	955.55
					[5,104.76]	[4,925.83]
Mother's Education Level						
High school					9,274.79***	6,613.04**
					[3,341.13]	[3,330.80]
College					14,789.57	8,258.32
					[9,689.88]	[9,562.31]
Bachelor or above					-6,972.54	-10,223.35*
					[5,649.42]	[5,527.94]
Personal Education Level						
High school						10,522.84***
						[1,463.64]
College						21,018.95***
						[1,909.31]
Bachelor or above						28,041.91***
						[2,383.34]
Father's and Mother's Ethnicity			√	√	√	√
Age				√	√	√
Constant	18,162.20***	20,908.26***	20,868.71***	11,806.29***	8,275.72**	-7,832.72**
	[1,158.25]	[3,210.67]	[3,327.38]	[3,564.81]	[3,662.43]	[3,540.58]
Observations	2,293	2,037	2,037	2,037	2,037	2,037
R^2	0.078	0.078	0.109	0.174	0.193	0.276

Table 12 OLS Estimates. Effect of Height on Wage, Male Workers. (NAHSIT, 2004)

Dependent Variable: Monthly Wage (NT Dollars)	(1)	(2)	(3)	(4)	(5)	(6)
Height						
Medium 25-75%	11,757.86***	11,638.87***	8,837.15***	7,969.53***	7,938.04***	5,155.95***
	[2,005.938]	[2,257.197]	[2,213.232]	[2,073.656]	[2,094.239]	[1,907.604]
Top25%	11,717.24***	11,264.37***	7,076.81***	8,256.88***	7,180.75***	2,985.53
	[2,144.169]	[2,445.878]	[2,475.925]	[2,388.371]	[2,418.540]	[2,258.928]
Weight		14.56	76.39	-0.27	-16.65	49.26
		[88.254]	[89.702]	[92.572]	[93.909]	[89.230]
Father's Education Level						
High school					5,561.48**	652.65
					[2,568.693]	[2,586.269]
College					2,174.50	-4,063.80
					[3,648.418]	[3,564.760]
Bachelor or above					-374.79	-2,070.98
					[10,662.672]	[10,150.644]
Mother's Education Level						
High school					12,444.54**	9,400.53*
					[5,417.291]	[5,484.539]
College					21,130.92	14,027.48
					[13,309.569]	[13,256.988]
Bachelor or above					-6,082.60	-11,734.35
					[10,813.948]	[10,501.191]
Personal Education Level						
High school						11,312.13***
						[2,144.293]
College						20,878.19***
						[2,939.679]
Bachelor or above						27,561.79***
						[3,636.457]
Father's and Mother's Ethnicity			√	√	√	√
Age				√	√	√
Constant	25,830.22***	25,549.73***	25,025.69***	14,402.08**	10,281.27	-4,526.18
	[1,433.527]	[5,717.702]	[5,760.679]	[6,352.535]	[6,379.718]	[6,032.398]
Observations	1,344	1,201	1,201	1,201	1,201	1,201
R^2	0.051	0.039	0.084	0.165	0.186	0.251

Table 13 OLS Estimates. Effect of Height on Wage, Female Workers. (NAHSIT, 2004)

Dependent Variable: Monthly Wage (NT Dollars)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Height							
Medium 25-75%	2,836.61*	3,791.86**	3,091.66*	3,591.99**	3,056.84*	301.64	431.43
	[1,700.473]	[1,704.185]	[1,691.729]	[1,719.261]	[1,714.571]	[1,515.591]	[1,531.864]
Top25%	6,096.83***	7,872.76***	6,913.88***	8,749.52***	7,911.20***	3,920.75*	4,107.64*
	[2,116.761]	[2,145.872]	[2,143.819]	[2,424.132]	[2,426.768]	[2,178.321]	[2,242.636]
Weight		-224.45***	-188.04***	-202.00***	-199.40***	-56.35	-59.46
		[64.153]	[69.293]	[69.066]	[70.478]	[62.691]	[61.630]
Father's Education Level							
High school					4,917.48**	-509.72	-240.10
					[1,941.657]	[1,882.536]	[1,890.525]
College					4,481.27	-1,090.24	-1,277.60
					[3,704.124]	[3,742.995]	[3,729.095]
Bachelor or above					9,526.45**	4,029.47	4,106.58
					[4,348.137]	[4,529.239]	[4,499.579]
Mother's Education Level							
High school					6,301.93**	3,889.67	3,998.50
					[2,735.330]	[2,781.717]	[2,759.519]
College					7,178.02	1,755.14	1,313.24
					[7,530.949]	[6,368.738]	[6,372.739]
Bachelor or above					-7,426.49	-8,319.39	-8,307.57
					[6,644.745]	[6,048.093]	[6,053.546]
Personal Education Level							
High school						8,742.53***	8,565.99***
						[1,832.055]	[1,811.046]
College						20,550.19***	20,088.97***
						[2,376.945]	[2,379.806]
Bachelor or above						26,473.74***	25,850.54***
						[2,557.266]	[2,631.609]
Menarche age							
Normal (11-14)							5,712.99*
							[3,033.038]
Late (15-)							3,762.07
							[3,335.072]
Father's and Mother's Ethnicity			√	√	√	√	√
Age				√	√	√	√
Constant	21,111.11***	32,785.07***	33,216.29***	24,913.34***	21,441.05***	2,872.45	-2,067.18
	[1,360.781]	[3,688.947]	[3,953.755]	[4,162.508]	[4,269.885]	[4,450.516]	[5,285.658]
Observations	949	836	836	836	836	836	836
R^2	0.047	0.064	0.093	0.144	0.175	0.308	0.311

Diseases

- Model Specification - Probit

$$Y_i = \beta_0 + \beta_1 \cdot Height_i + \beta_2 \cdot Weight_i + \sum_{j=1}^{10} \beta_{3j} \cdot Ethnicity_i +$$

$$\sum_{k=1}^{8} \beta_{4k} \cdot Father's\ and\ Mother's\ Edu_i +$$

$$\sum_{l=1}^{4} \beta_{5l} \cdot Edu_i + \sum_{m=1}^{9} \beta_{6m} \cdot age_i + \sum_{p=1}^{4} \beta_{7p} \cdot Occupation_i$$

$$\sum_{n=1}^{3} \beta_{8n} \cdot menarcheage_i + \varepsilon_i$$

Table 14 OLS Estimates of Relation between Height and Diseases in Old Age
(Male, above 45 years old)

Dependent Variable:	(1)	(2)	(3)	(4)	(5)
Diseases	hyperlipidemia	Hypertension	Cancer	Cataract	Emphysema
Height					
Medium 25-75%	-0.16	-0.09	0.42*	0.31**	0.54
	[0.121]	[0.097]	[0.253]	[0.120]	[0.503]
Top25%	-0.61***	-0.41***	0.95***	0.07	0.98*
	[0.195]	[0.145]	[0.307]	[0.179]	[0.578]
Constant	-2.63***	-2.95***	-0.97	-2.84***	-10.99***
	[0.514]	[0.386]	[0.715]	[0.524]	[1.749]
Observations	1,261	1,269	1,210	1,263	783
R^2	0.08	0.09	0.13	0.21	0.26

Note: 1. Standard errors robust to heteroskedasticity are in parenthesis. *** denotes statistically different from 0 in 1% significance level, ** denotes statistically different from 0 in 5% significance level, * denotes statistically different from 0 in 10% significance level,
2. Control variables include father and mother's ethnicity, education level, occupation, and a series of dummy variables which indicate different age group.

Table 15 OLS Estimates of Relation between Height and Diseases in Old Age
(Female, above 45 years old)

Dependent Variable: Diseases	(1) Chronic bronchitis	(2) Thyroid dysfunction
Height		
Medium 25-75%	-0.10	-0.07
	[0.242]	[0.192]
Top25%	-0.68*	0.62***
	[0.350]	[0.217]
Menarche age		
Normal (11-14)	-2.95***	3.13***
	[0.981]	[0.413]
Late (15-)	-2.76***	3.14***
	[1.009]	[0.438]
Constant	1.28	-3.89***
	[1.252]	[0.853]
Observations	1,039	1,055
R^2	0.16	0.14

Note: 1. Standard errors robust to heteroskedasticity are in parenthesis. *** denotes statistically different from 0 in 1% significance level, ** denotes statistically different from 0 in 5% significance level, * denotes statistically different from 0 in 10% significance level,
2. Control variables include father and mother's ethnicity, education level, occupation, and a series of dummy variables which indicate different age group.

Conclusion

- The height in adolescence reflects the time that individual hits the growth spurts. Height serves as a marker of cognitive ability in adolescence.
- There is a positive relation between height and individual's wage. Menarche age also plays an important role. It is cognitive ability rewarded in labor market.
- Height is also related to some diseases. There are different patterns in men and women.

Thank You