

Multiple regression analysis: In practice

Quantitative Methods

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Mortgage lending discrimination in Boston (I)

- Paper: Munnell et al. (1996) American Economic Review.
- Question: Two people, identical but for their race, walk into a bank and apply for a mortgage, a large loan so that each can buy an identical house. Are they both equally likely to have their mortgage application accepted?
- By law they must receive identical treatment. But whether or not they do is a matter of great concern among bank regulators.
- Data: Collected by the Federal Reserve Bank of Boston combining information on mortgage lending decisions as well as other characteristics of the applicant.
- For instance, average denial rate is 9% for white applicants and 28% for black applicants (i.e. 19 pp. higher).

Mortgage lending discrimination in Boston (II)

APPENDIX—SUMMARY OF VARIABLE DEFINITIONS WITH MEANS AND STANDARD DEVIATIONS

Summary of variable definitions

Housing expense/income	1 if greater than .30 0 otherwise
Total debt payments/income	Value of question 46
Net wealth	Value of question 36 less question 38
Consumer credit	1 if no "slow pay" account (code 1 in question 43) 2 if one or two slow pay accounts (code 2) 3 if more than two slow pay accounts (code 3) 4 if insufficient credit history for determination (code 0) 5 delinquent credit history with 60 days past due (code 4) 6 serious delinquencies with 90 days past due (code 5)
Mortgage credit	1 if no late payments (code 1 in question 42) 2 if no payment history (code 0) 3 if one or two late payments (code 2) 4 if more than two late payments (code 3)
Public record	1 if any public record of credit problems (codes 1, 2, 3, 4 in question 44) 0 otherwise
Probability of unemployment	1989 Massachusetts unemployment rate for applicant's industry
Self-employed	1 if self-employed 0 otherwise
Loan/appraised value	Value of loan amount divided by question 50
Denied private mortgage insurance	Derived from question 53
Rent/value in tract	Rental income divided by estimate of value of rental property from Census
Two- to four-family homes	0 if purchasing a single-family or a condo 1 if purchasing a two- to four-family home
Race	1 if applicant was black or Hispanic 0 otherwise

Mortgage lending discrimination in Boston (III)

- Model:

$$D_i = \beta_0 + x_i' \gamma + \beta_1 \text{Race}_i + \epsilon_i$$

where i indexes individuals.

- D_i takes the value 1 if the mortgage application is denied and 0 otherwise.
- x_i is a vector of loan and individual characteristics.
- Race_i takes the value 1 if the applicant is black or Hispanic and 0 otherwise.
- Of course, one can also estimate a probit:

$$E(D_i | x_i, \text{Race}_i) = \Phi(\beta_0 + x_i' \gamma + \beta_1 \text{Race}_i)$$

- Hypothesis to be tested: $\beta_1 > 0$. There is evidence of discrimination.

Mortgage lending discrimination in Boston (IV)

TABLE 2—DETERMINANTS OF PROBABILITY OF MORTGAGE LOAN APPLICATION DENIAL

Variable	Logit		OLS
	Base (1)	Percentage point impact (2)	Base (3)
Constant	-13.69 (12.62)		-0.22 (-1.47)
<i>Risk of default:</i>			
Housing expense/income	0.63 (2.76)	4.6	0.06 (3.56)
Total debt payments/income	0.08 (7.16)	4.3	0.005 (7.21)
Net wealth	0.00008 (0.76)	0.4	0.000004 (0.60)
Consumer credit history	0.51 (9.16)	4.1	0.04 (9.46)
Mortgage credit history	0.43 (2.27)	1.2	0.03 (2.16)
Public record history	1.95 (6.50)	19.3	0.19 (8.09)
Unemployment region	0.11 (2.64)	1.2	0.01 (1.93)
Self-employed	0.70 (2.34)	3.9	0.05 (2.71)
Loan/appraised value-low	-0.89 (-1.31)	-1.7	-0.12 (-2.46)
Loan/appraised value-medium	0.13 (0.23)	0.3	-0.05 (-1.23)
Loan/appraised value-high	1.40 (3.41)	1.7	0.10 (2.66)
<i>Cost of default:</i>			
Denied private mortgage insurance	6.16 (8.55)	65.0	0.65 (16.06)
<i>Loan characteristics:</i>			
Two- to four-family home	0.73 (2.64)	5.7	0.06 (2.57)
<i>Personal characteristics:</i>			
Race	1.00 (3.73)	8.2	0.07 (3.34)
Percent correctly predicted	95.3		
Adjusted R^2			0.32
Number of observations	2,925		2,925

Notes: Numbers in parentheses are t statistics. Census tract (part of the cost of default) and lender ID (a loan characteristic) dummy coefficients are not shown because they are so numerous.

Mortgage lending discrimination in Boston (V)

TABLE 3—ALTERNATIVE DETERMINANTS OF PROBABILITY OF MORTGAGE LOAN APPLICATION DENIAL

Variable	Logit				
	General equation (1)	Trust characteristics (2)	Loan characteristics (3)	Personal characteristics (4)	Probability of unemployment (5)
Constant	-17.87 (-8.58)	-8.71 (-11.25)	-10.66 (-9.82)	-13.85 (-12.66)	-13.64 (-11.97)
<i>Risk of default:</i>					
Housing expenses/income	0.22 (2.74)	0.51 (2.97)	0.76 (3.53)	0.70 (3.04)	0.67 (2.75)
Total debt payments/income	0.11 (7.71)	0.06 (6.58)	0.07 (7.29)	0.06 (7.57)	0.09 (6.78)
Net worth	0.0003 (1.89)	0.0008 (0.87)	0.00006 (0.79)	0.00008 (0.82)	0.00022 (2.10)
Consumer credit history	0.57 (8.33)	0.38 (9.53)	0.46 (8.93)	0.53 (9.44)	0.51 (8.62)
Mortgage credit history	0.29 (1.81)	0.41 (3.11)	0.47 (2.47)	0.49 (2.32)	0.25 (1.69)
Public record history	1.81 (5.11)	1.45 (6.75)	1.79 (6.55)	1.99 (6.59)	1.85 (5.70)
Unemployment region	0.68 (1.66)	0.07 (2.16)	0.09 (2.29)	0.19 (2.51)	
Self-employed	1.20 (3.48)	0.62 (2.88)	0.36 (1.78)	0.75 (2.49)	
Probability of unemployment	1.03 (1.17)				1.24 (1.95)
Loan/appraised value—low	-1.24 (-1.61)	-0.73 (-1.33)	-1.60 (-2.59)	-0.98 (-1.45)	-1.04 (-1.47)
Loan/appraised value—medium	0.22 (0.36)	-0.13 (-0.29)	-0.35 (-0.71)	0.07 (0.13)	0.18 (0.31)
Loan/appraised value—high	1.56 (3.16)	0.89 (2.17)	0.75 (2.50)	1.36 (3.35)	1.56 (3.47)
<i>Cost of default:</i>					
Denied private mortgage insurance	6.47 (8.44)	4.77 (8.64)	5.99 (8.46)	6.14 (8.64)	6.29 (8.59)
Rent/price in tract		0.67 (3.14)			
Housing units boarded up		-0.02 (-1.28)			
Housing units vacant		0.01 (0.42)			
Housing value appreciation		0.0002 (0.37)			
<i>Loan characteristics:</i>					
Two- to four-family home	0.65 (1.99)	0.62 (2.34)	0.79 (2.96)	0.62 (2.22)	0.68 (2.28)
Fixed-rate loan	0.73 (2.16)		0.56 (2.21)		
Special program (MIFA)	-1.83 (-1.92)		-1.17 (-2.01)		
Term of loan	-0.091 (-0.23)		0.0095 (0.28)		
Gift or grant in down payment	-0.32 (-1.11)		-0.38 (-1.61)		
Coupler	-0.61 (-1.02)		-0.52 (-1.08)		
<i>Personal characteristics:</i>					
Race	1.10 (3.62)	0.54 (3.13)	0.88 (3.49)	1.01 (3.75)	0.98 (3.43)
Age	-0.0009 (-0.06)			0.04 (0.87)	
Gender (female = 1)	-0.36 (-1.64)			-0.57 (-2.03)	
Number of dependents	-0.001 (-0.01)			0.05 (0.32)	
Marital status (not married = 1)	0.21 (1.19)			0.48 (2.11)	
Percent correctly predicted	96.3	89.2	94.3	95.2	95.5
Adjusted R ²					
Number of observations	2,664	2,907	2,918	2,895	2,698

Mortgage lending discrimination in Boston (VI)

TABLE 3—Continued.

Variable	OLS				
	General equation (6)	Tract characteristics (7)	Loan characteristics (8)	Personal characteristics (9)	Probability of unemployment (10)
Constant	-0.28 (-1.71)	-0.29 (-3.25)	-0.26 (-1.67)	-0.27 (-1.78)	-0.18 (-1.21)
Risk of default:					
Housing expense/income	0.06 (3.62)	0.05 (3.71)	0.06 (3.89)	0.06 (3.63)	0.06 (3.43)
Total debt payments/income	0.005 (7.19)	0.005 (8.28)	0.005 (7.48)	0.005 (7.53)	0.004 (6.78)
Net worth	0.000009 (11.21)	0.000009 (11.52)	0.000004 (9.69)	0.000003 (9.47)	0.000001 (8.46)
Consumer credit history	0.04 (0.11)	0.04 (0.90)	0.04 (0.41)	0.04 (0.58)	0.04 (0.96)
Mortgage credit history	0.02 (1.77)	0.03 (3.23)	0.03 (2.20)	0.03 (2.15)	0.02 (1.60)
Public record history	0.16 (6.34)	0.20 (9.09)	0.19 (7.97)	0.19 (7.67)	0.18 (7.04)
Unemployment region	0.004 (1.21)	0.006 (2.20)	0.005 (1.53)	0.03 (1.86)	0.03 (1.86)
Self-employed	0.06 (2.84)	0.05 (3.05)	0.06 (2.90)	0.05 (2.50)	0.05 (2.50)
Probability of unemployment	(1.08)				0.07 (1.54)
Loan/appraised value—low	-0.12 (-2.29)	-0.10 (-2.38)	-0.11 (-2.23)	-0.10 (-2.18)	-0.14 (-2.73)
Loan/appraised value—medium	-0.05 (-0.78)	-0.05 (-1.28)	-0.03 (-0.84)	-0.04 (-0.95)	-0.06 (-1.39)
Loan/appraised value—high	0.10 (2.60)	0.10 (3.19)	0.09 (2.63)	0.10 (2.85)	0.10 (2.98)
Cost of default:					
Owned private mortgage insurance	0.67 (15.97)	0.64 (17.55)	0.66 (16.19)	0.66 (16.06)	0.67 (15.89)
Rent/water in tract		0.07 (2.83)			
Housing units boarded up		-0.002 (-1.50)			
Housing units vacant		0.0001 (0.11)			
Housing value appreciation		0.00002 (0.29)			
Loan characteristics:					
Two- to four-family home	0.06 (2.41)	0.06 (3.64)	0.06 (2.77)	0.05 (2.40)	0.06 (2.35)
Fixed-rate loan	0.05 (1.45)		0.02 (1.43)		
Special program (MIFFA)	-0.09 (-2.60)		-0.08 (-2.48)		
Term of loan	-0.00009 (-0.06)		-0.00002 (-0.16)		
Gift or grant in down payment	-0.03 (-1.46)		-0.03 (-1.73)		
Cosigner	-0.04 (-1.62)		-0.03 (-1.02)		
Personal characteristics:					
Race	0.07 (3.08)	0.08 (3.77)	0.06 (3.14)	0.06 (3.07)	0.07 (3.27)
Age	0.0006 (0.75)				0.001 (1.36)
Gender (female = 1)	-0.04 (-2.21)				-0.04 (-2.48)
Number of dependents	0.003 (0.44)				0.003 (0.56)
Married status (not married = 1)	0.02 (1.03)				0.02 (1.27)
Percent correctly predicted					
Adjusted R ²	0.32	0.32	0.32	0.32	0.32
Number of observations	2,661	2,906	2,917	2,894	2,697

Notes: Numbers in parentheses are *t* statistics. Census tract and lender ID dummy coefficients are not shown because they are so numerous.

Mortgage lending discrimination in Boston (VII)

- Minorities are more than twice as likely to be denied a mortgage as whites.
- Yet variables correlated with both race and creditworthiness are omitted from this comparison.
- The Federal Reserve Bank of Boston collected additional variables important to the mortgage lending decision and found that race continued to play an important, though significantly diminished, role in the decision to grant a mortgage.

Beauty and the labor market (I)

- Paper: Hamermesh and Biddle (1994) American Economic Review.
- Question: Do more handsome people earn higher wages?
- Data: household surveys for the US and Canada, which provide data on looks and earnings.
 - Those two surveys contain interviewers assessments of the looks of the respondent, grouped into 5 categories.
- Model:

$$\log(wage)_i = \gamma_0 U_i + \gamma_1 H_i + x_i' \beta + u_i$$

where U_i takes value 1 if individual i is ugly and H_i takes the value 1 if the individual is handsome. x_i is a vector of other variables including experience, health status, union membership, race, marital status, schooling, tenure, city, and other physical characteristics.

Beauty and the labor market (II)

TABLE 2—DISTRIBUTION OF LOOKS: QUALITY OF EMPLOYMENT SURVEY (QES), 1977; QUALITY OF AMERICAN LIFE, (QAL), 1971; CANADIAN QUALITY OF LIFE (QOL), 1977, 1979, AND 1981 (PERCENTAGE DISTRIBUTIONS)

Category	QES		QAL		QOL (pooled)	
	Men	Women	Men	Women	Men	Women
1) Strikingly beautiful or handsome	1.4	2.1	2.9	2.9	2.5	2.5
2) Above average for age (good looking)	26.5	30.4	24.2	28.1	32.0	31.7
3) Average for age	59.7	52.1	60.4	51.5	57.9	56.8
4) Below average for age (quite plain)	11.4	13.7	10.8	15.2	7.2	8.3
5) Homely	1.0	1.7	1.7	2.3	0.4	0.7
N:	959	539	864	1,194	3,804	5,464

Beauty and the labor market (III)

TABLE 3—THE IMPACT OF LOOKS ON EMPLOYEES' EARNINGS: QES, 1977

Variable	Men		Women	
	(i)	(ii)	(iii)	(iv)
Looks:				
Below average	-0.164 (0.046)	-0.162 (0.046)	-0.124 (0.066)	-0.107 (0.071)
Above average	0.016 (0.033)	0.010 (0.034)	0.039 (0.048)	0.035 (0.049)
Obese		0.119 (0.172)		-0.122 (0.134)
Overweight		-0.024 (0.038)		-0.016 (0.058)
Tall		0.027 (0.045)		0.104 (0.114)
Short		-0.105 (0.060)		-0.017 (0.124)
\bar{R}^2 :	0.403	0.404	0.330	0.327
p on F statistic for beauty variables:	0.001	0.001	0.069	0.173
N :	700	700	409	409

Below average respondents (in terms of looks) earn 10-16% less (earnings are in logs). Moreover, the effects are significantly different from zero. In comparison, above average individuals are paid slightly more, but the effects are not significant.

Beauty and the labor market (IV)

TABLE 6—STACKED ESTIMATES OF THE IMPACT OF LOOKS ON HOURLY EARNINGS

Sample	Penalty for below-average looks	Premium for above-average looks	$\hat{\beta}_{\text{above}} - \hat{\beta}_{\text{below}}$	p on F statistic for looks	p on intersample equality of looks effects
Men:					
All three samples	-0.091 (0.031)	0.053 (0.019)	0.144 (0.040)	0.0001	0.246
Two U.S. samples	-0.132 (0.039)	0.036 (0.027)	0.168 (0.051)	0.0003	0.443
Women:					
All three samples	-0.054 (0.038)	0.038 (0.022)	0.092 (0.048)	0.042	0.163
Two U.S. samples	-0.042 (0.049)	0.075 (0.037)	0.117 (0.069)	0.041	0.123
Men and women combined:					
All three samples	-0.072 (0.024)	0.048 (0.015)	0.120 (0.031)	0.0001	0.106
Two U.S. samples	-0.092 (0.031)	0.046 (0.022)	0.138 (0.041)	0.0002	0.051

Notes: The dependent variable is log(hourly earnings); standard errors are shown in parentheses.

The evidence in each sample alone is suggestive but not very strong. When the three samples are combined, sample sizes become sufficient to make some fairly clear inferences about the role of beauty in the labor market.

Beauty and the labor market (V)

- Understanding the sources of these differences.

- Model:

$$\log(wage)_i = x'_i\beta_1 + \beta_2^U U_i + \beta_2^H H_i + \beta_3 OCC_i + \beta_4^U U_i OCC_i + \beta_4^H H_i OCC_i + \epsilon_i$$

where OCC_i takes value 1 if the worker's occupation has been identified as one where looks are productive.

- Hypotheses:

- H1: $\beta_4 \neq 0, \beta_2 = \beta_3 = 0$ implies productivity differences.
- H2: $\beta_2 \neq 0, \beta_3 = \beta_4 = 0$ implies employer discrimination.

Beauty and the labor market (VI)

TABLE 9—SORTING, LOOKS, AND THE DETERMINATION OF EARNINGS: QES, 1977; QAL, 1971

Sample and occupation index	Looks below average		Looks above average		Occupation index	\bar{R}^2	p on F statistic on main effects
	Looks below average	× occupation index	Looks above average	× occupation index			
QES, men:							
DOT	-0.177 (0.058)	-0.036 (0.095)	0.041 (0.042)	0.072 (0.069)	0.052 (0.041)	0.405	0.002
Subjective	-0.162 (0.049)	0.007 (0.127)	0.012 (0.035)	0.051 (0.097)	0.124 (0.072)	0.405	0.003
Employers	-0.187 (0.076)	-0.112 (0.107)	-0.095 (0.057)	0.103 (0.084)	-0.066 (0.049)	0.410	0.026
QES, women:							
DOT	-0.174 (0.075)	-0.218 (0.157)	0.023 (0.054)	-0.068 (0.119)	0.032 (0.085)	0.329	0.036
Subjective	-0.115 (0.074)	-0.037 (0.151)	0.050 (0.055)	-0.036 (0.096)	0.083 (0.093)	0.326	0.130
Employers	-0.078 (0.107)	-0.013 (0.158)	0.152 (0.076)	-0.312 (0.111)	0.216 (0.077)	0.315	0.064
QAL, men:							
DOT	-0.102 (0.107)	-0.057 (0.142)	0.070 (0.056)	0.011 (0.089)	0.093 (0.055)	0.373	0.224
Subjective	-0.097 (0.076)	0.078 (0.177)	0.045 (0.048)	0.089 (0.099)	0.085 (0.102)	0.371	0.223
Employers	0.145 (0.150)	-0.107 (0.250)	0.124 (0.121)	-0.072 (0.152)	-0.006 (0.095)	0.213	0.449
QAL, women:							
DOT	0.049 (0.088)	-0.056 (0.159)	0.166 (0.063)	0.175 (0.130)	-0.066 (0.088)	0.282	0.031
Subjective	0.130 (0.090)	-0.172 (0.152)	0.075 (0.068)	0.142 (0.099)	-0.053 (0.099)	0.287	0.266
Employers	0.253 (0.153)	-0.304 (0.229)	0.261 (0.127)	-0.355 (0.162)	0.218 (0.117)	0.272	0.058

Notes: The dependent variable is log(hourly earnings); standard errors are shown in parentheses. Each regression includes the same additional variables as in the corresponding regression in Table 3 or 4. Those using the

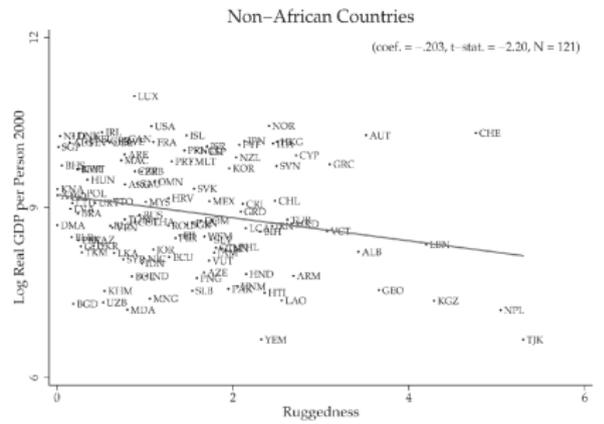
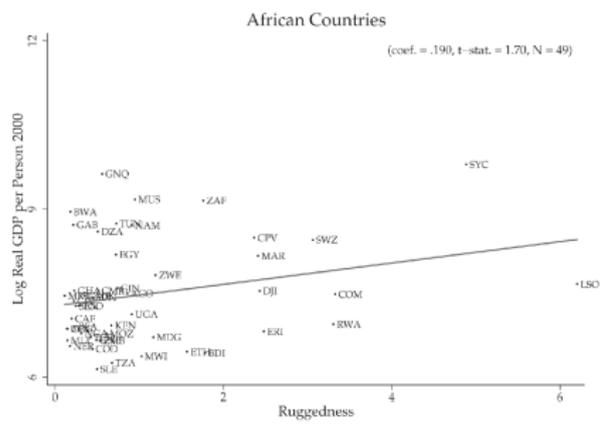
Beauty and the labor market (VII)

- The effects of an individual's own looks on his or her earnings are very robust.
- Other things equal, wages of people with below-average looks are lower than those of average-looking workers; and there is a premium in wages for good-looking people that is smaller than this penalty.
- That there are earnings premia and penalties for looks independent of occupation suggest that employer discrimination on the basis of looks may lie behind those premia and penalties.

Unexpected benefits of the geography (I)

- Paper: Nunn and Puga (2010) Review of Economics and Statistics.
- Question: are rugged regions in Africa poorer or richer than other regions?
 - Ruggedness typically has negative effects on economic development because they are more difficult to cultivate, imply higher transportation costs, etc...
 - At the same time, in the context of African development, ruggedness may have made slave trade more difficult, thereby affecting those regions in a positive way.
- Data:
 - Ruggedness is calculated using geological data.
 - Income data is at the country level.
 - Data on slave exports was constructed by the authors using historical sources.

Unexpected benefits of the geography (II)



Unexpected benefits of the geography (III)

- Model:

$$y_i = \beta_0 + \beta_1 r_i + \beta_2 r_i I_i^{Af} + \beta_3 I_i^{Af} + \epsilon_i$$

$$y_i = \beta_6 + \beta_7 r_i + \beta_8 r_i I_i^{Af} + \beta_9 I_i^{Af} + \beta_{10} x_i + \eta_i$$

$$x_i = \beta_{11} + \beta_{12} r_i + \xi_i$$

where i indexes countries.

- y_i is income per capita.
- r_i is the measure of ruggedness.
- I_i^{Af} is an indicator variable that equals 1 if i is in Africa and 0 otherwise.
- x_i denotes slave exports.

Unexpected benefits of the geography (IV)

- Model:

$$y_i = \beta_0 + \beta_1 r_i + \beta_2 r_i I_i^{Af} + \beta_3 I_i^{Af} + \epsilon_i$$

$$y_i = \beta_6 + \beta_7 r_i + \beta_8 r_i I_i^{Af} + \beta_9 I_i^{Af} + \beta_{10} x_i + \eta_i$$

$$x_i = \beta_{11} + \beta_{12} r_i + \xi_i$$

- Hypotheses:

- H1: $\beta_2 > 0$. In Africa, ruggedness has an additional positive effect on income.
- H2: $\beta_{12} < 0$. Ruggedness negatively affects slave exports.
- H3: $\beta_{10} < 0$. Slave exports negatively affect income.
- H4: $\beta_8 = 0$. Once slave exports are taken into account, the effect of ruggedness is no different in Africa.

Unexpected benefits of the geography (V)

TABLE 1.—THE DIFFERENTIAL EFFECT OF RUGGEDNESS IN AFRICA

	Dependent Variable: Log Real GDP per Person, 2000					
	(1)	(2)	(3)	(4)	(5)	(6)
Ruggedness	-0.203 (0.093)**	-0.196 (0.094)**	-0.203 (0.094)**	-0.243 (0.092)***	-0.193 (0.081)**	-0.231 (0.077)***
Ruggedness $\times I^{Africa}$	0.393 (0.144)***	0.404 (0.146)***	0.406 (0.138)***	0.414 (0.157)***	0.302 (0.130)**	0.321 (0.127)**
I^{Africa}	-1.948 (0.220)***	-2.014 (0.222)***	-1.707 (0.325)***	-2.066 (0.324)***	-1.615 (0.295)***	-1.562 (0.415)***
Diamonds		0.017 (0.012)				0.028 (0.010)***
Diamonds $\times I^{Africa}$		-0.014 (0.012)				-0.026 (0.011)**
% Fertile soil			0.000 (0.003)			-0.002 (0.003)
% Fertile soil $\times I^{Africa}$			-0.008 (0.006)			-0.009 (0.007)
% Tropical climate				-0.007 (0.002)***		-0.009 (0.002)***
% Tropical climate $\times I^{Africa}$				0.004 (0.004)		0.006 (0.004)
Distance to coast					-0.657 (0.177)***	-1.039 (0.193)***
Distance to coast $\times I^{Africa}$					-0.291 (0.360)	-0.194 (0.386)
Constant	9.223 (0.143)***	9.204 (0.148)***	9.221 (0.200)***	9.514 (0.164)***	9.388 (0.134)***	9.959 (0.195)***
Observations	170	170	170	170	170	170
R^2	0.357	0.367	0.363	0.405	0.421	0.537

Coefficients are reported with robust standard errors in brackets. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Observe that the effect is negative in the rest of the world, but positive (and significant) in Africa. Evidence in favor of $\beta_2 > 0$.

Unexpected benefits of the geography (VI)

TABLE 5.—THE IMPACT AND DETERMINANTS OF SLAVE EXPORTS

	Dependent Variable: Log Real GDP per Person, 2000				Dependent Variable: Slave Export Intensity		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Slave export intensity	-0.203 (0.037)***	-0.222 (0.035)***	-0.206 (0.036)***	-0.214 (0.034)***			
Ruggedness	-0.203 (0.093)**	-0.169 (0.077)**	-0.231 (0.077)***	-0.220 (0.066)***	-1.330 (0.262)***	-1.326 (0.274)***	-0.989 (0.358)***
Ruggedness $\times J^{Africa}$	0.124 (0.152)		0.047 (0.143)				
J^{Africa}	-0.819 (0.317)***	-0.591 (0.222)***	-0.825 (0.356)**	-0.728 (0.354)**			
Diamonds			0.028 (0.010)***	0.028 (0.010)***		-0.005 (0.006)	-0.001 (0.005)
Diamonds $\times J^{Africa}$			-0.027 (0.010)**	-0.027 (0.010)***			
% fertile soil			-0.002 (0.003)	-0.002 (0.003)		0.042 (0.015)***	0.031 (0.019)
% fertile soil $\times J^{Africa}$			0.000 (0.006)	0.001 (0.006)			
% tropical climate			-0.009 (0.002)***	-0.009 (0.002)***		0.013 (0.009)	0.003 (0.010)
% tropical climate $\times J^{Africa}$			0.009 (0.003)***	0.008 (0.003)***			
Distance to coast			-1.039 (0.194)***	-1.039 (0.194)***		0.154 (1.174)	-1.939 (1.694)
Distance to coast $\times J^{Africa}$			-0.162 (0.321)	-0.191 (0.343)			
Log population density 1400							0.326 (0.179)*
Dist. Saharan slave market							-1.670 (0.914)*
Dist. Atlantic slave market							-0.973 (0.480)**
Dist. Red Sea slave market							-0.082 (0.635)
Dist. Indian slave market							-0.925 (0.486)*
Constant	9.223 (0.144)***	9.175 (0.127)***	9.959 (0.195)***	9.943 (0.195)***	5.572 (0.503)***	3.575 (1.251)***	22.359 (10.008)**
Observations	170	170	170	170	49	49	49
R ²	0.418	0.415	0.586	0.585	0.289	0.448	0.587

Coefficients are reported with robust standard errors in brackets. ***, **, and * indicate significance at the 1%, 5%, and 10% levels.

Unexpected benefits of the geography (VII)

- The effect of ruggedness on income is negative in the rest of the world, but positive (and significant) in Africa. (H1: $\beta_2 > 0$).
- The effect of ruggedness on slave exports for African countries is negative and significant (H2: $\beta_{12} < 0$).
- The effect of slave exports on income is negative and significant (H3: $\beta_{10} < 0$).
- Once slave exports are taken into account, the effect of ruggedness is no different in Africa (H4: $\beta_8 = 0$).