DEVELOPMENT AND GROWTH IN MINERAL-RICH COUNTRIES

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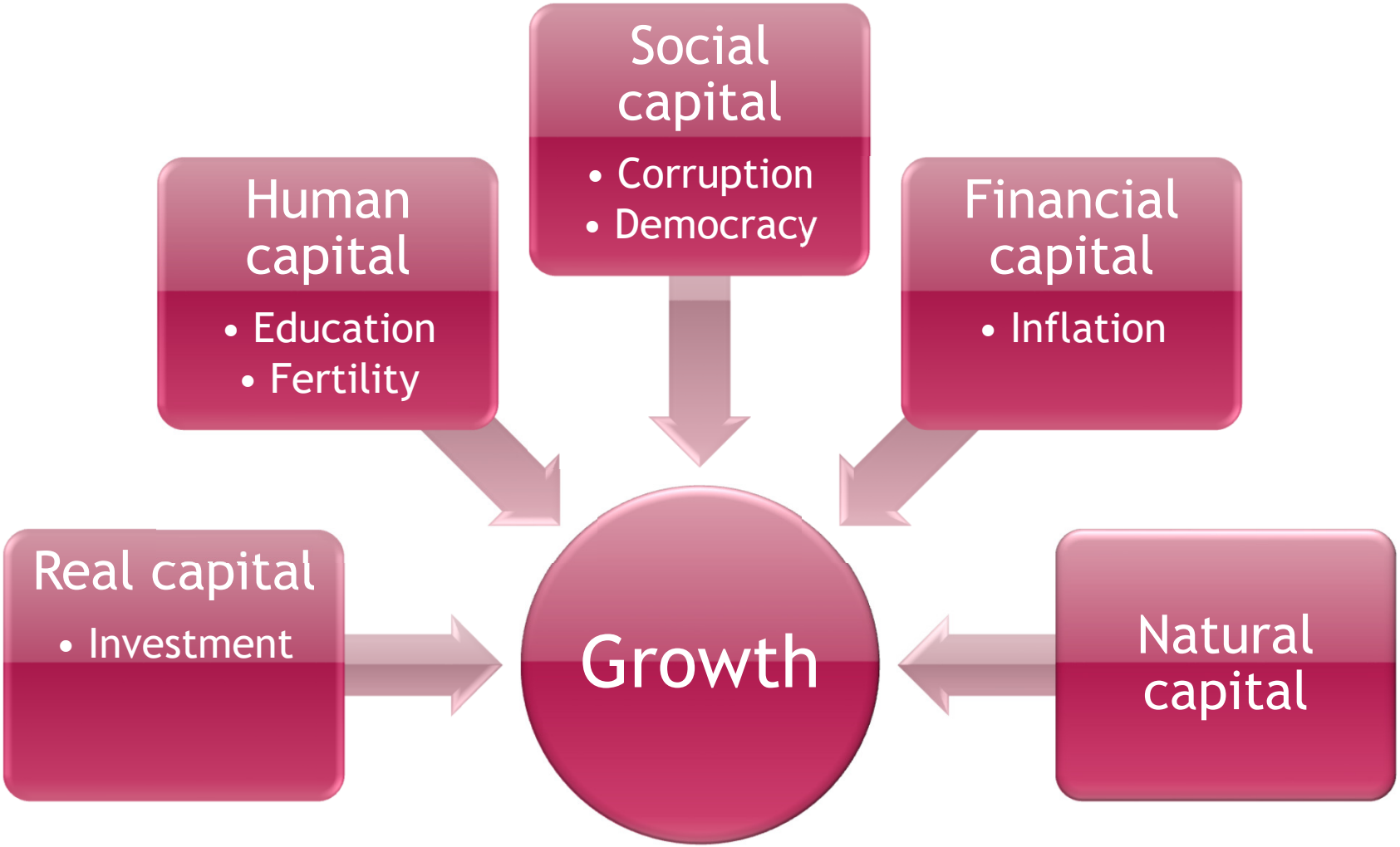
MINERALS IN CONTEXT

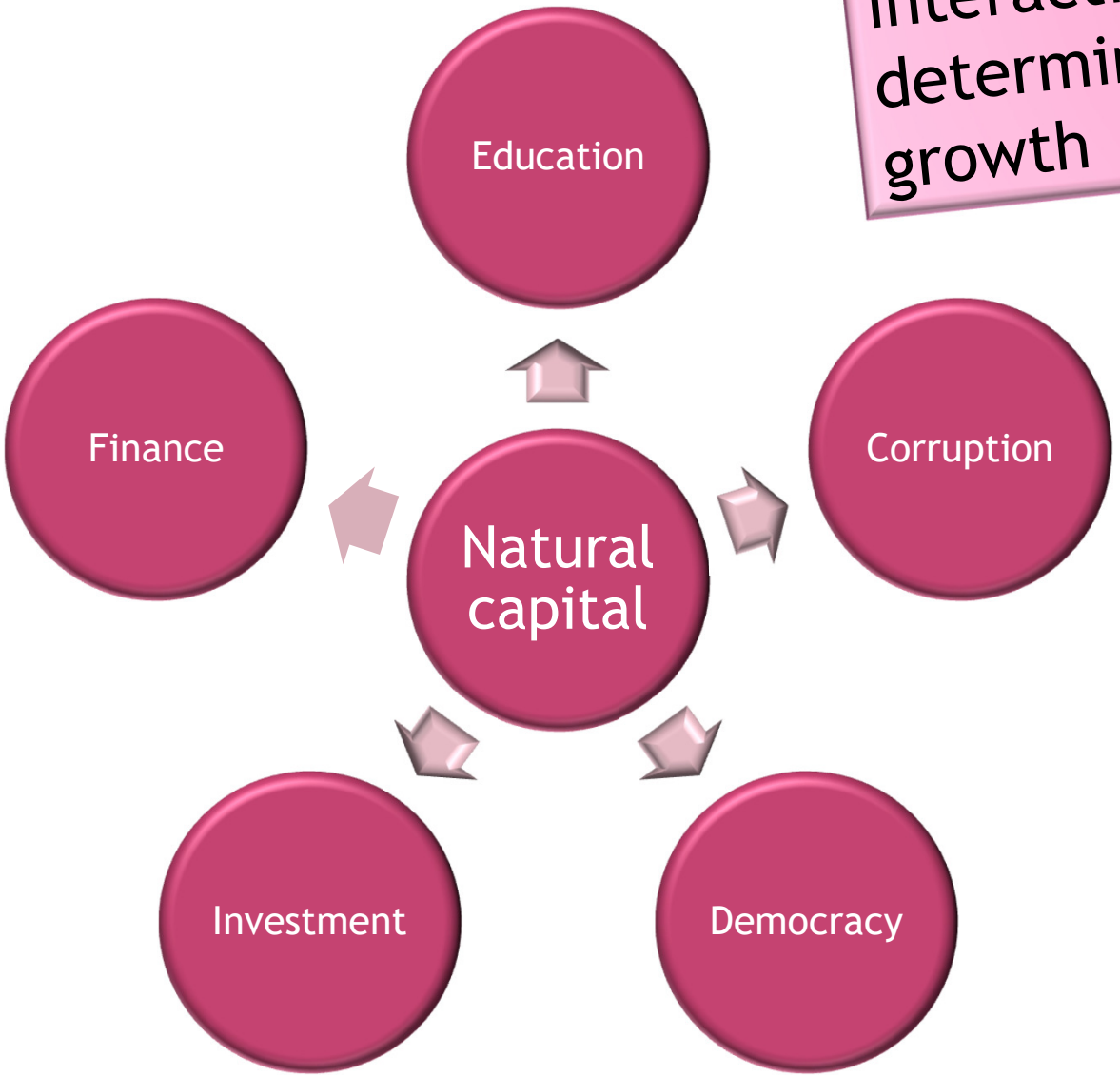
- Social development is integral part of economic development
  - Social policy matters for growth
- Mineral-rich countries
  - Who they are, how they have done
- Cross-country patterns in data
  - 164 countries, 1960-2000
  - New World Bank data on natural capital, including subsoil assets
- Cross-country regressions
  - How robust is natural capital when aspects of human, social, and real capital are included?

CONTEXT: DIFFERENT KINDS OF CAPITAL DRIVE ECONOMIC GROWTH

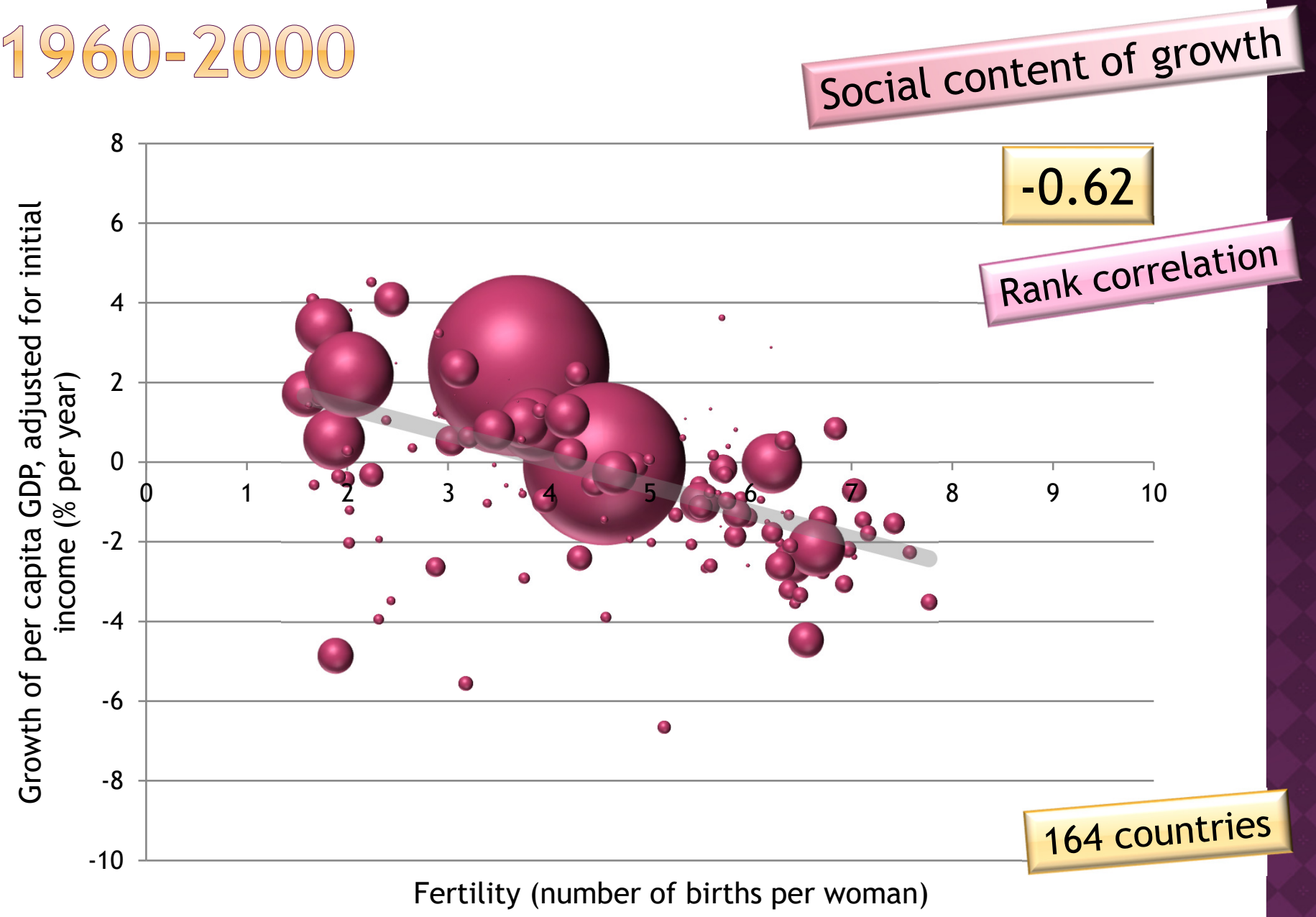


NATURAL CAPITAL AFFECTS OTHER KINDS OF CAPITAL

Interactions among determinants of growth

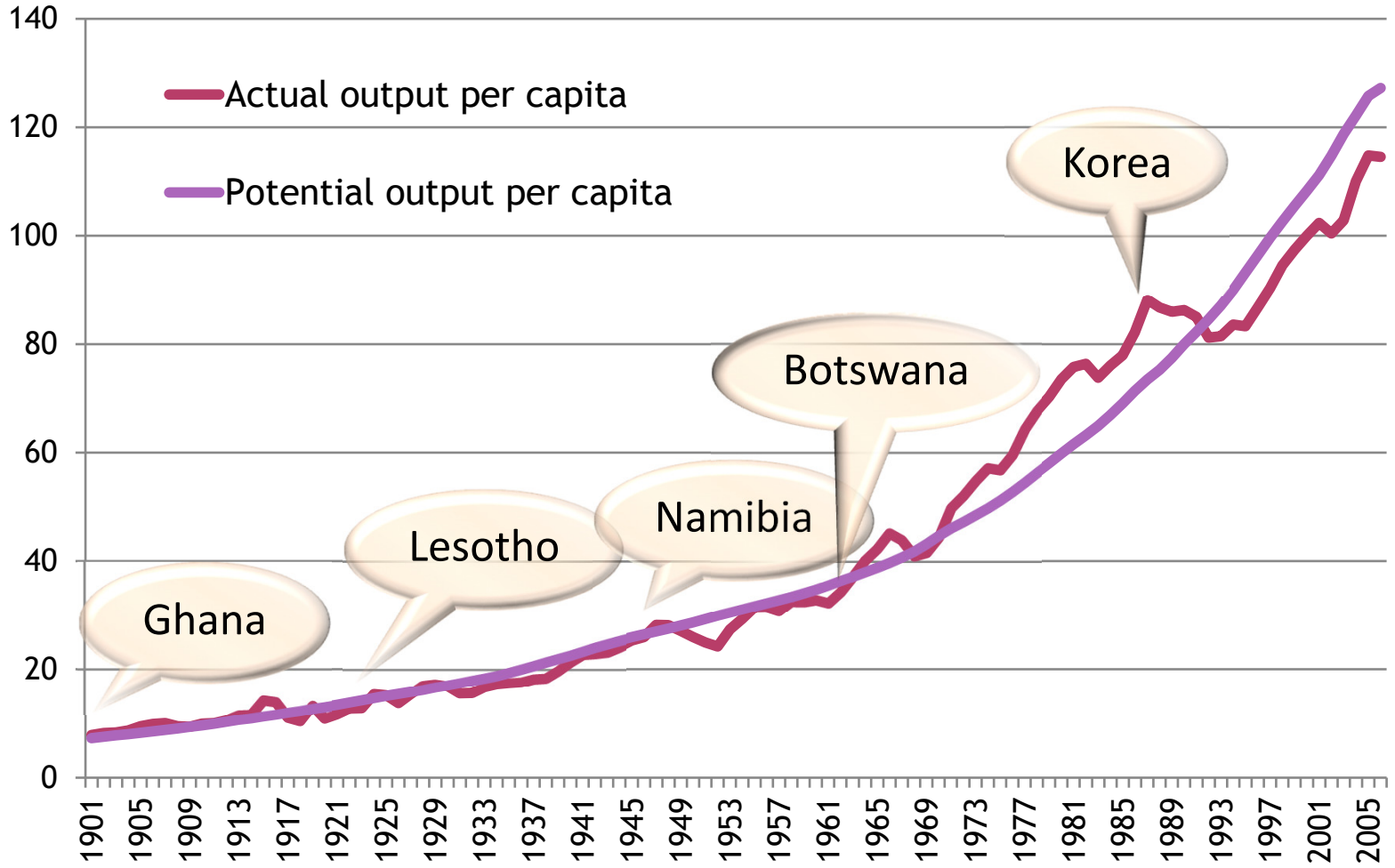


ECONOMIC GROWTH AND FERTILITY 1960-2000

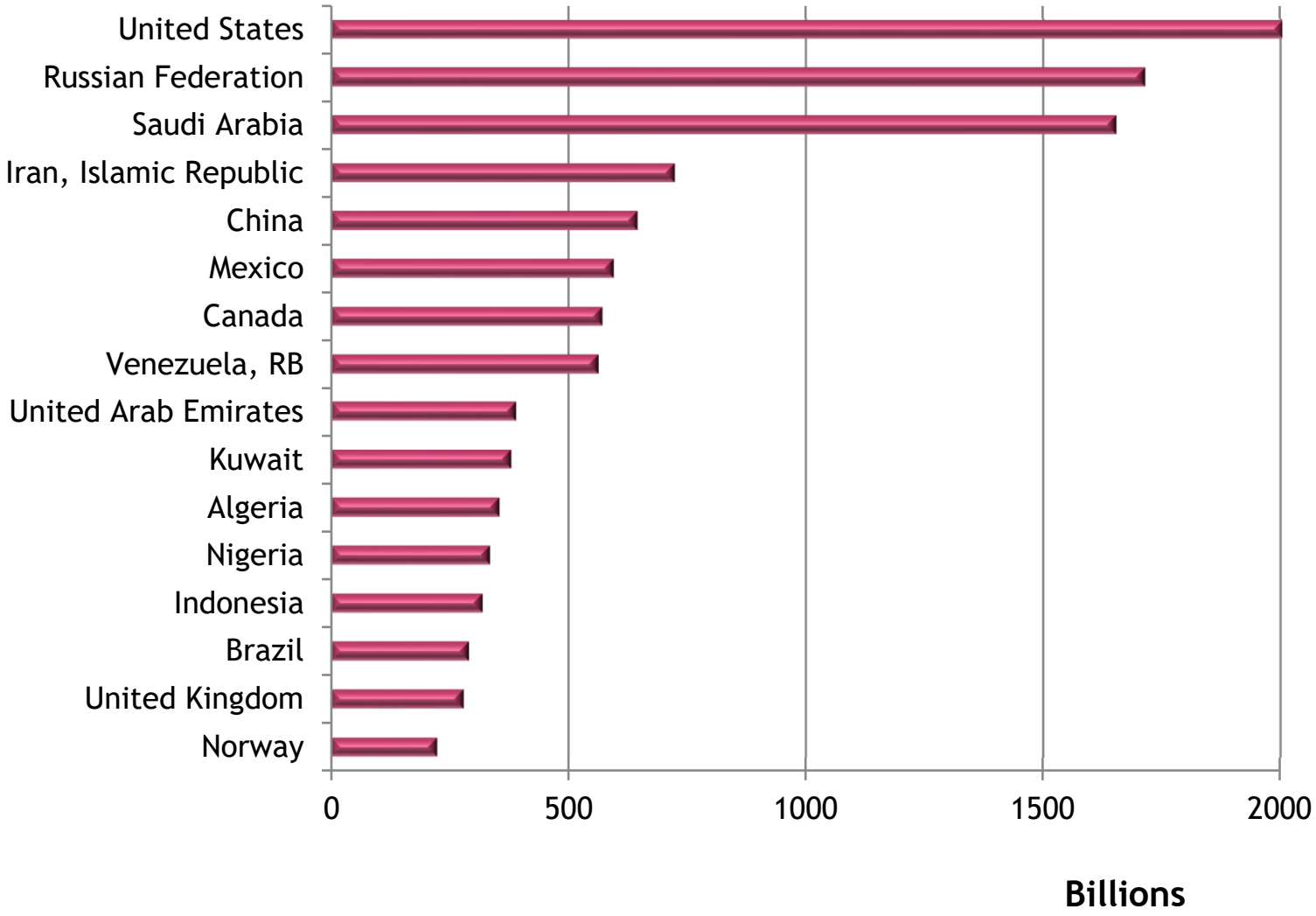


ICELAND'S PER CAPITA OUTPUT 1901-2006 (2000 = 100)

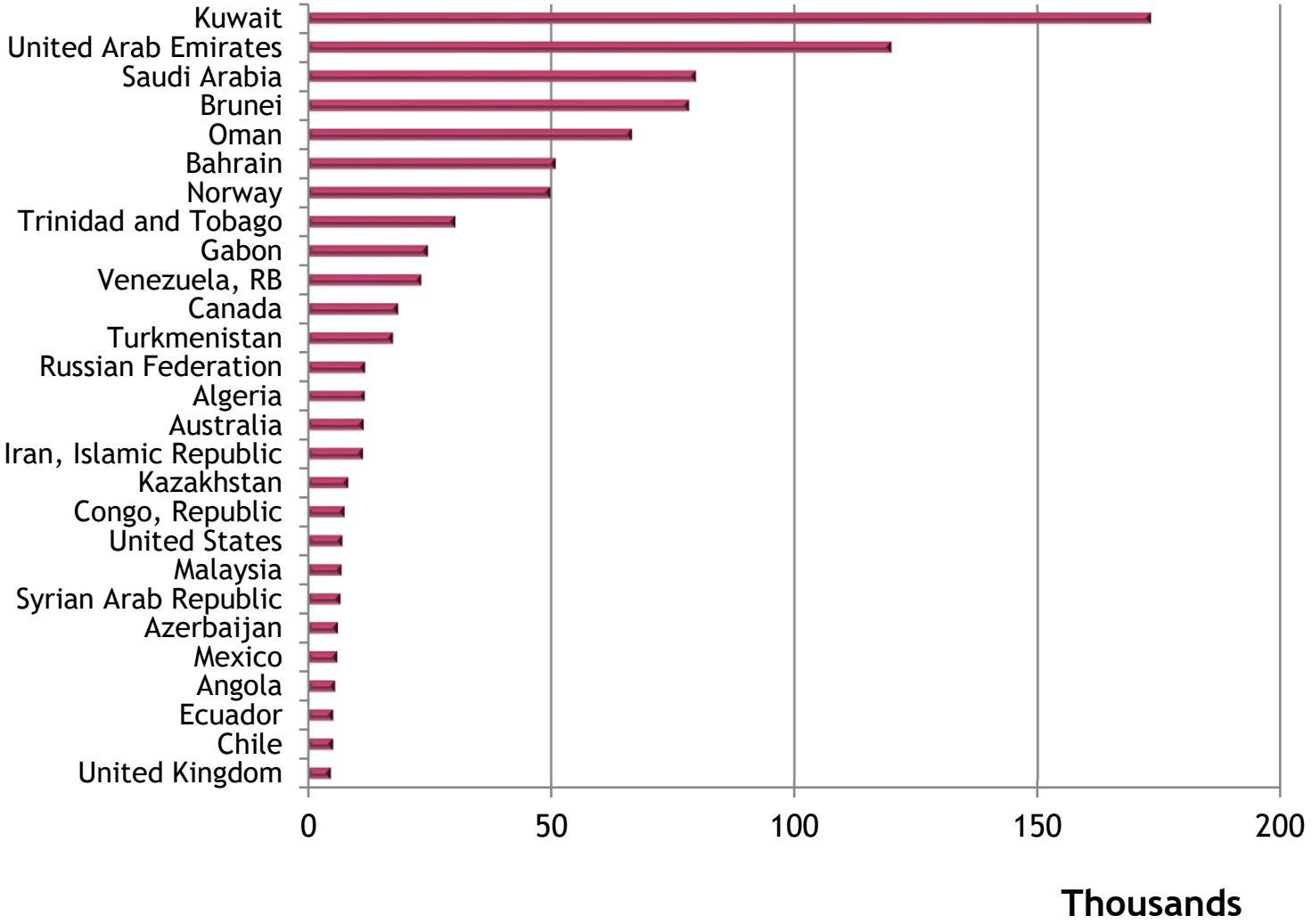
Iceland was Ghana



SUBSOIL ASSETS (USD AT 2000 PRICES AND EXCHANGE RATES)



SUBSOIL ASSETS PER PERSON (USD AT 2000 PRICES AND EXCHANGE RATES)



MINERAL-RICH COUNTRIES: SELECTED INDICATORS

	School life expectancy 2005 (years)	Fertility 1960-2000 (births per woman)	Public health expenditure 2004 (% of GDP)	Democracy 1960-2000 (index)	Corruption 2005 (index)	Investment 1960-2000 (% of GDP)	Per capita growth 1960-2000 (% per year)
Mineral-rich countries	11.7	4.5	2.4	-3.2	3.3	24.3	-0.7
Lower middle-income countries	11.4	3.6	2.6	-1.2	3.0	24.3	3.6
Upper middle-income countries	13.5	2.9	3.8	2.2	4.1	25.9	1.7

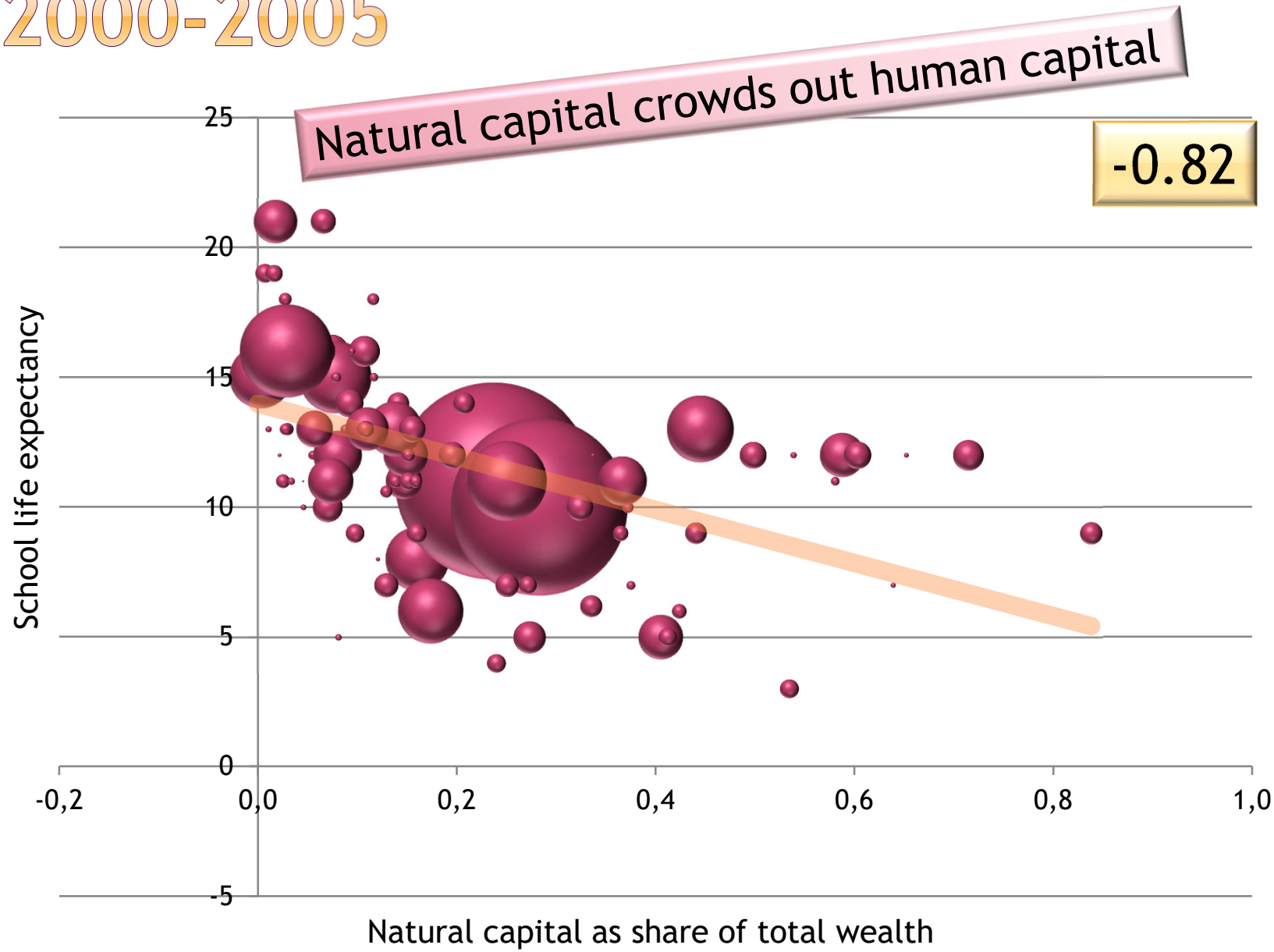
COMPOSITION OF TOTAL WEALTH 2000 (%)

	High-income countries	Low-income countries
Real capital	17	16
Natural capital	2	29
Subsoil assets	(1)	(6)
Intangible capital	81	55
Human capital		
Social capital		

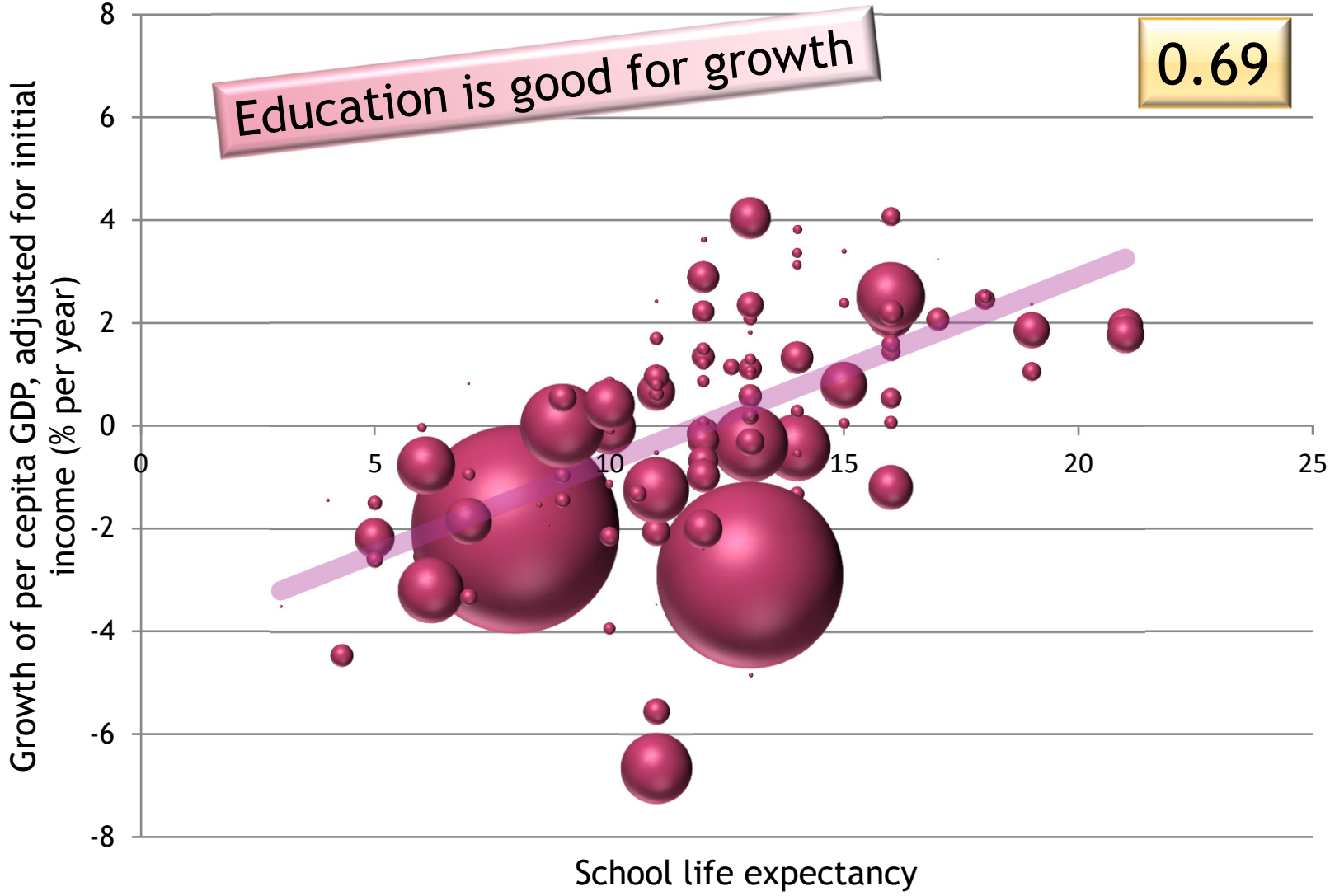
- Total wealth: estimated by perpetual inventory method as present discounted value of future consumption
- Real capital: estimated from investment figures
- Natural capital: cropland, pastureland, subsoil assets, timber resources, nontimber forest resources, and protected areas
- Intangible capital: estimated as residual

Source: World Bank (2006)

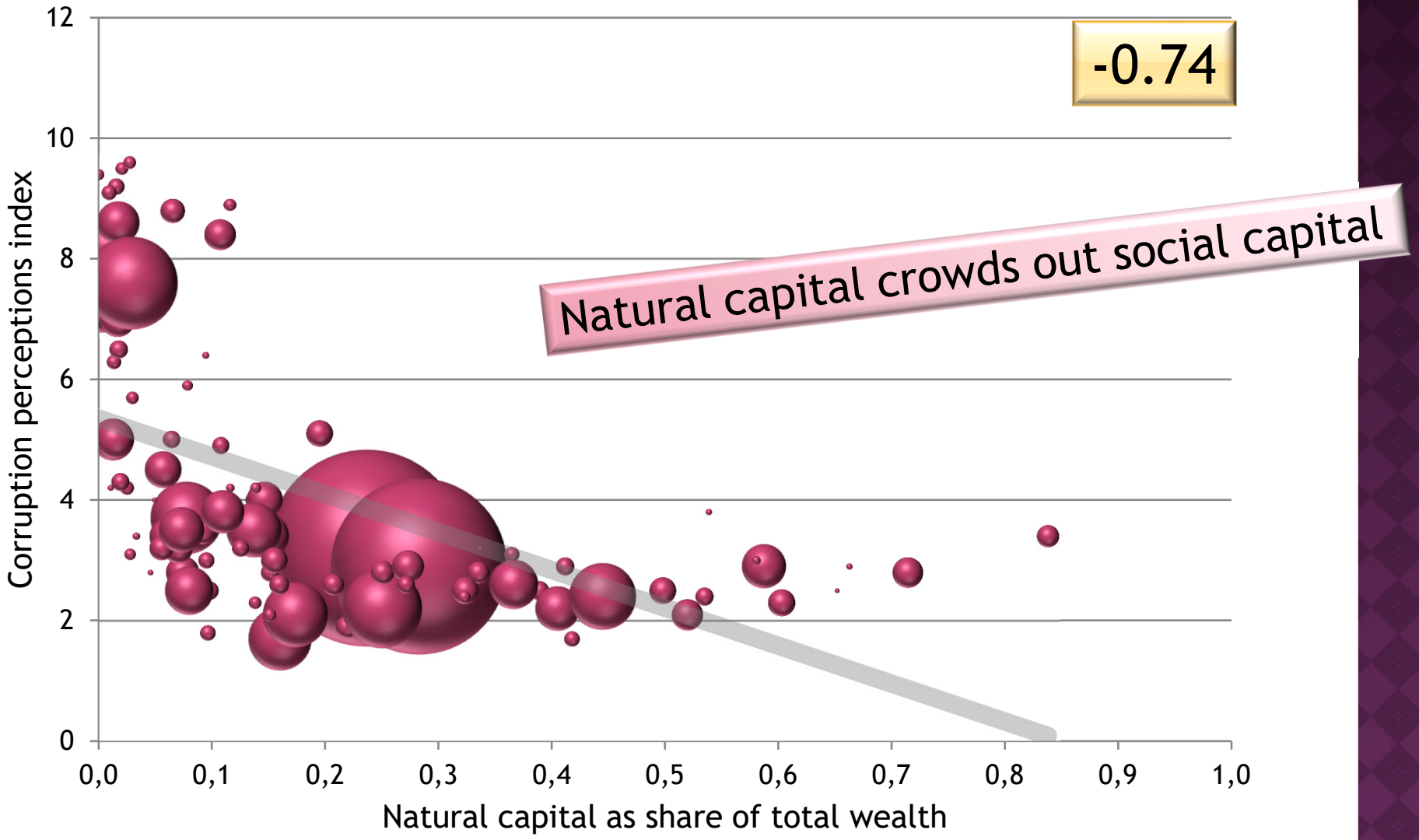
EDUCATION AND NATURAL CAPITAL 2000-2005



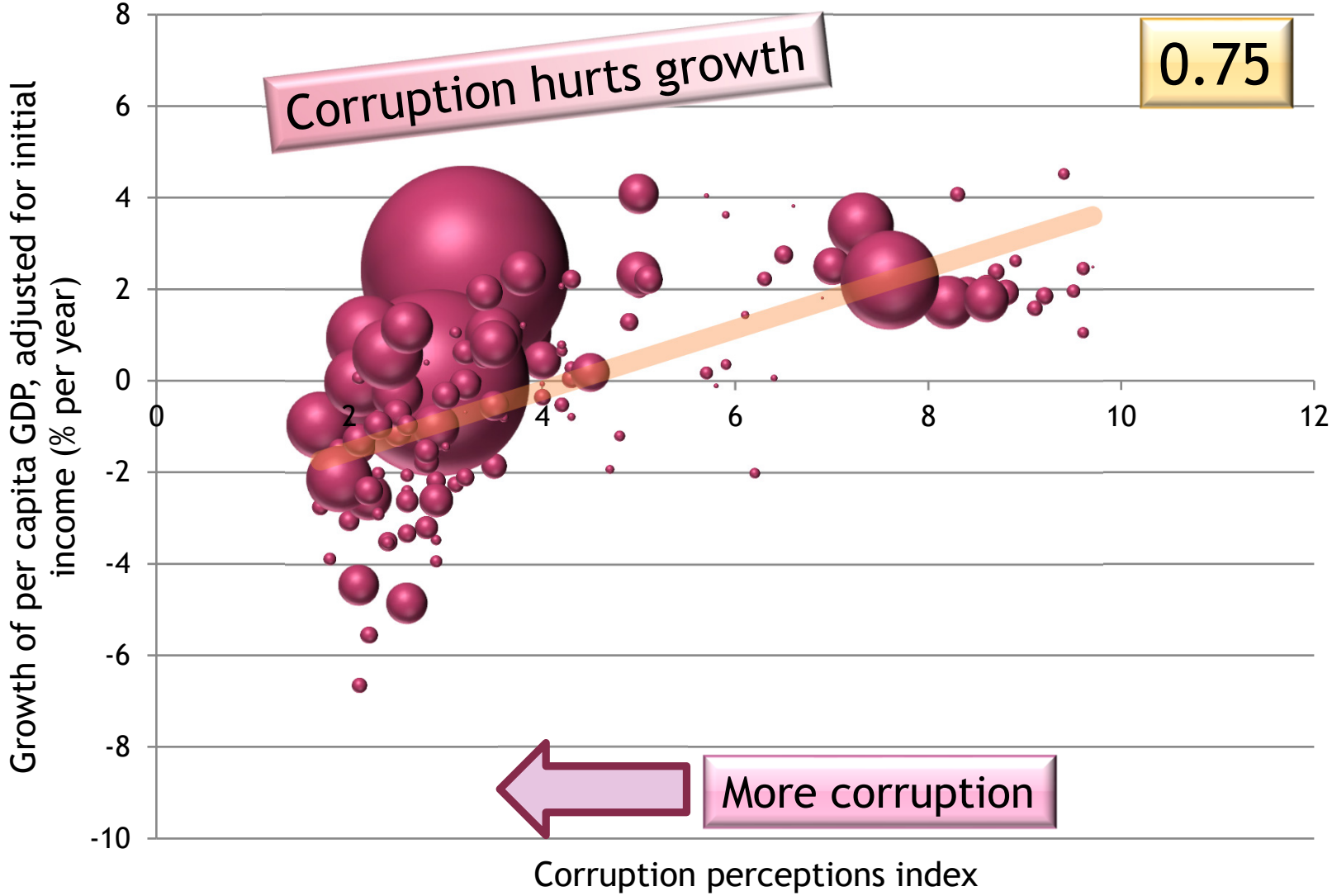
ECONOMIC GROWTH AND EDUCATION 1960-2000



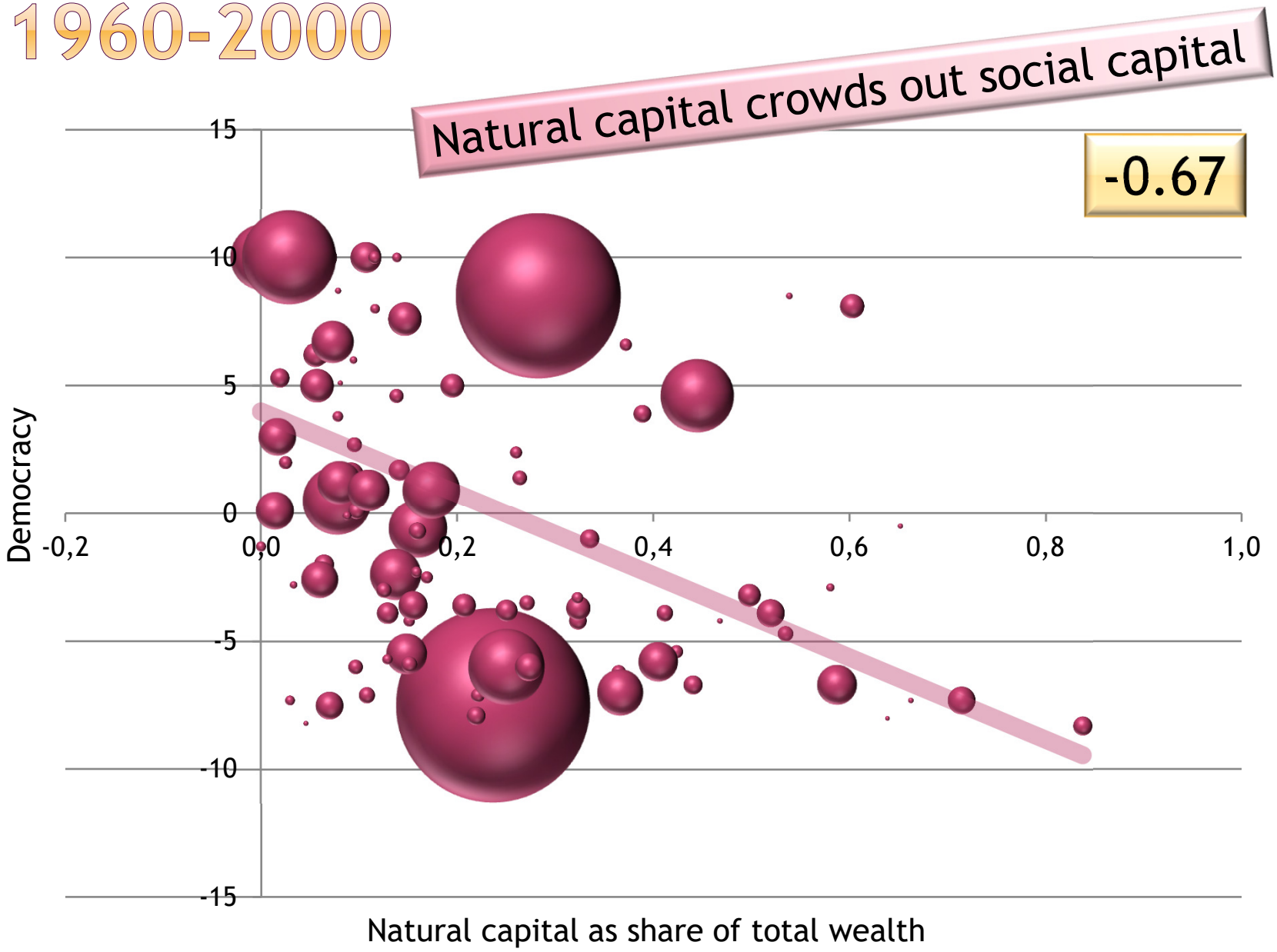
CORRUPTION AND NATURAL CAPITAL 1960-2000



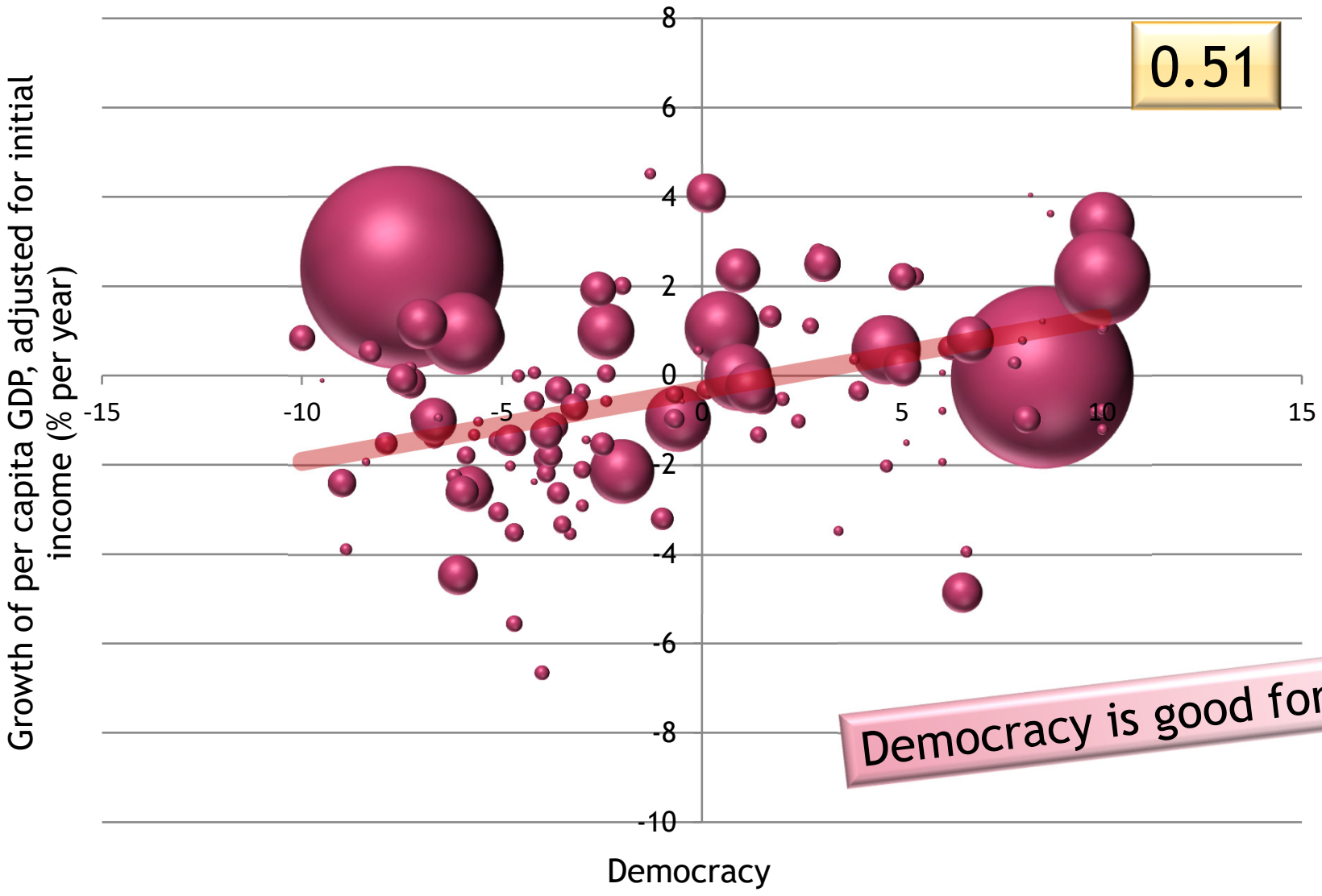
ECONOMIC GROWTH AND CORRUPTION 1960-2000



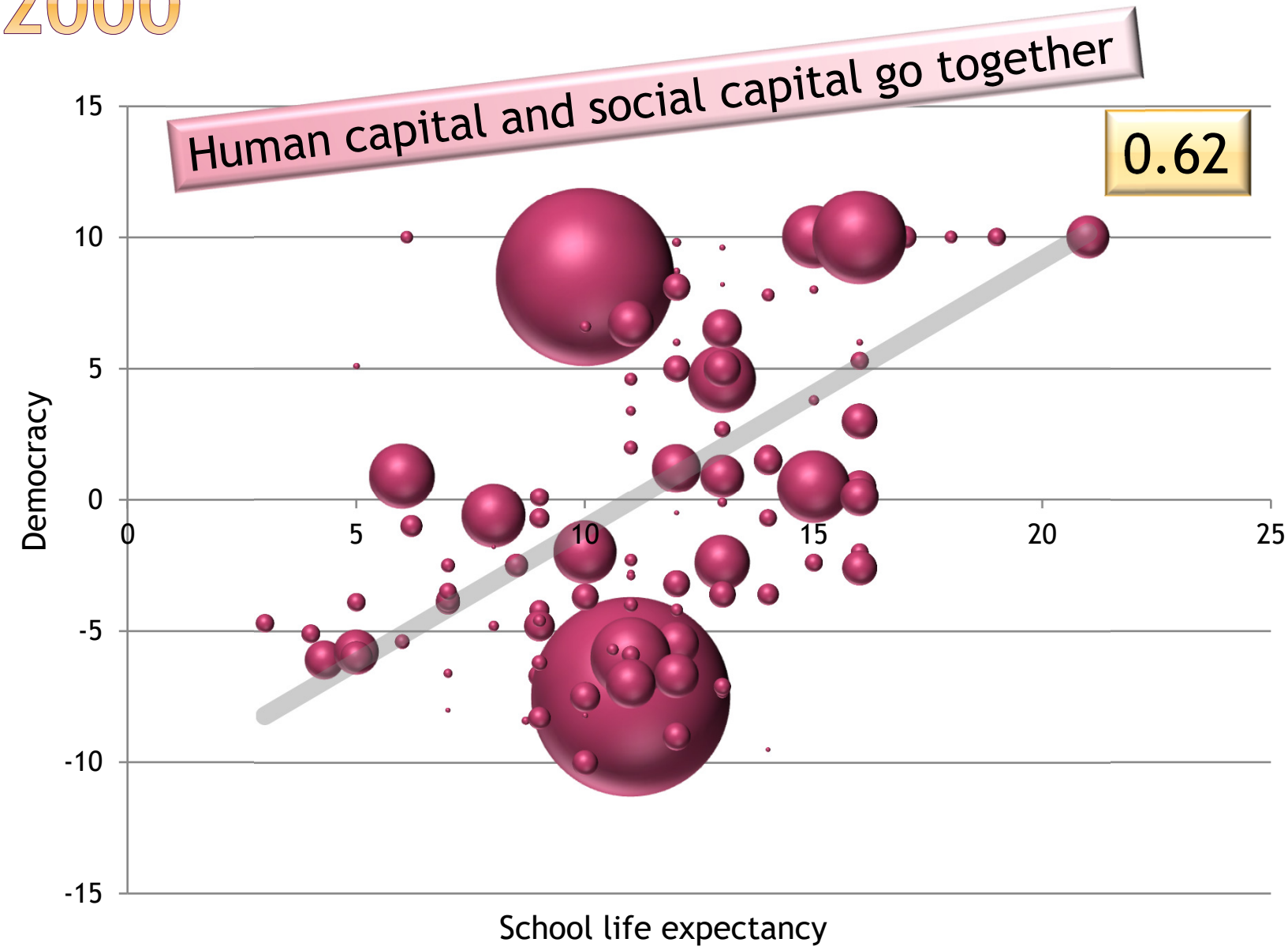
DEMOCRACY AND NATURAL CAPITAL 1960-2000



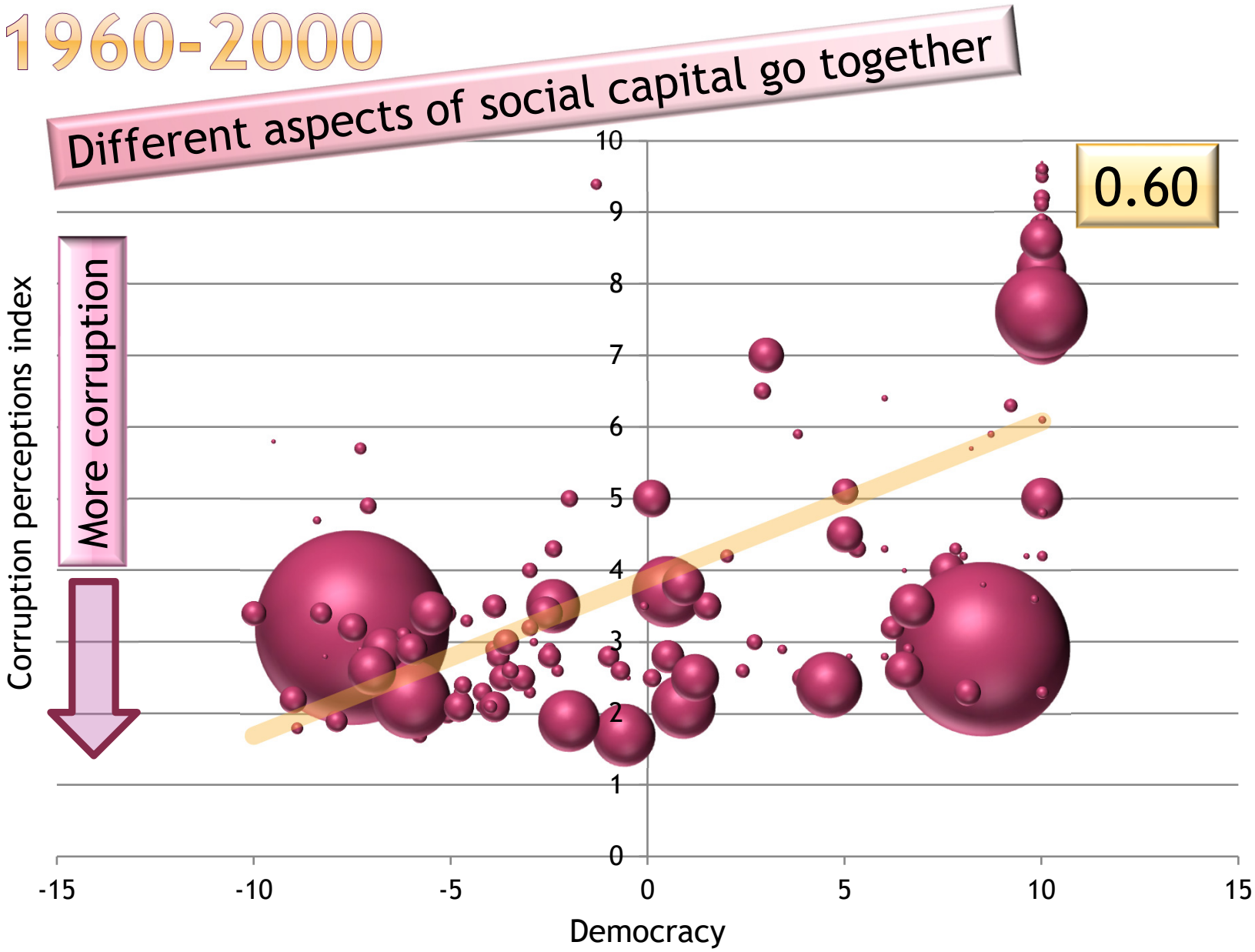
ECONOMIC GROWTH AND DEMOCRACY 1960-2000



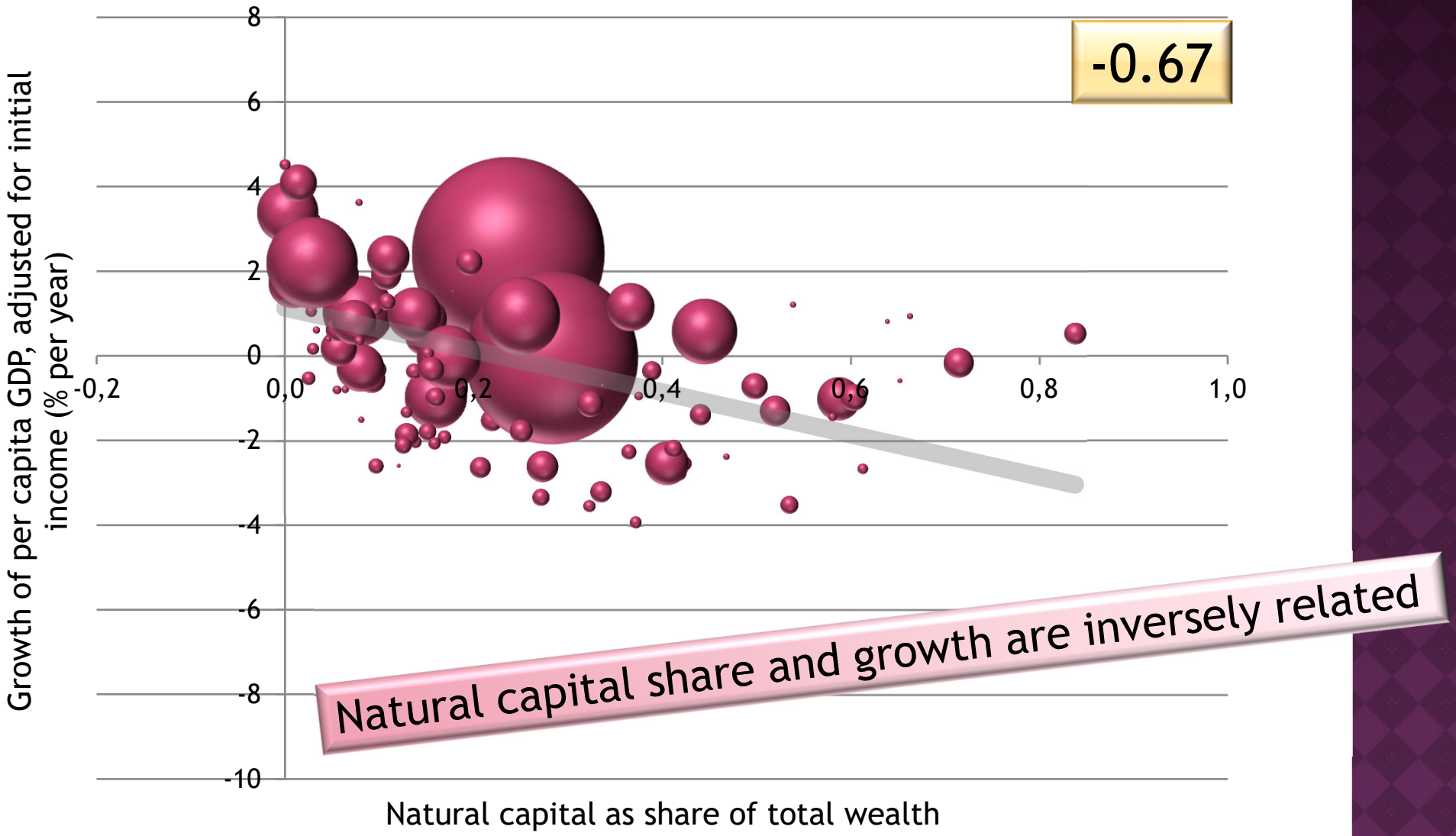
DEMOCRACY AND EDUCATION 1960-2000



CORRUPTION AND DEMOCRACY 1960-2000



ECONOMIC GROWTH AND NATURAL CAPITAL 1960-2000



ECONOMIC GROWTH AND SUBSOIL ASSETS 1960-2000

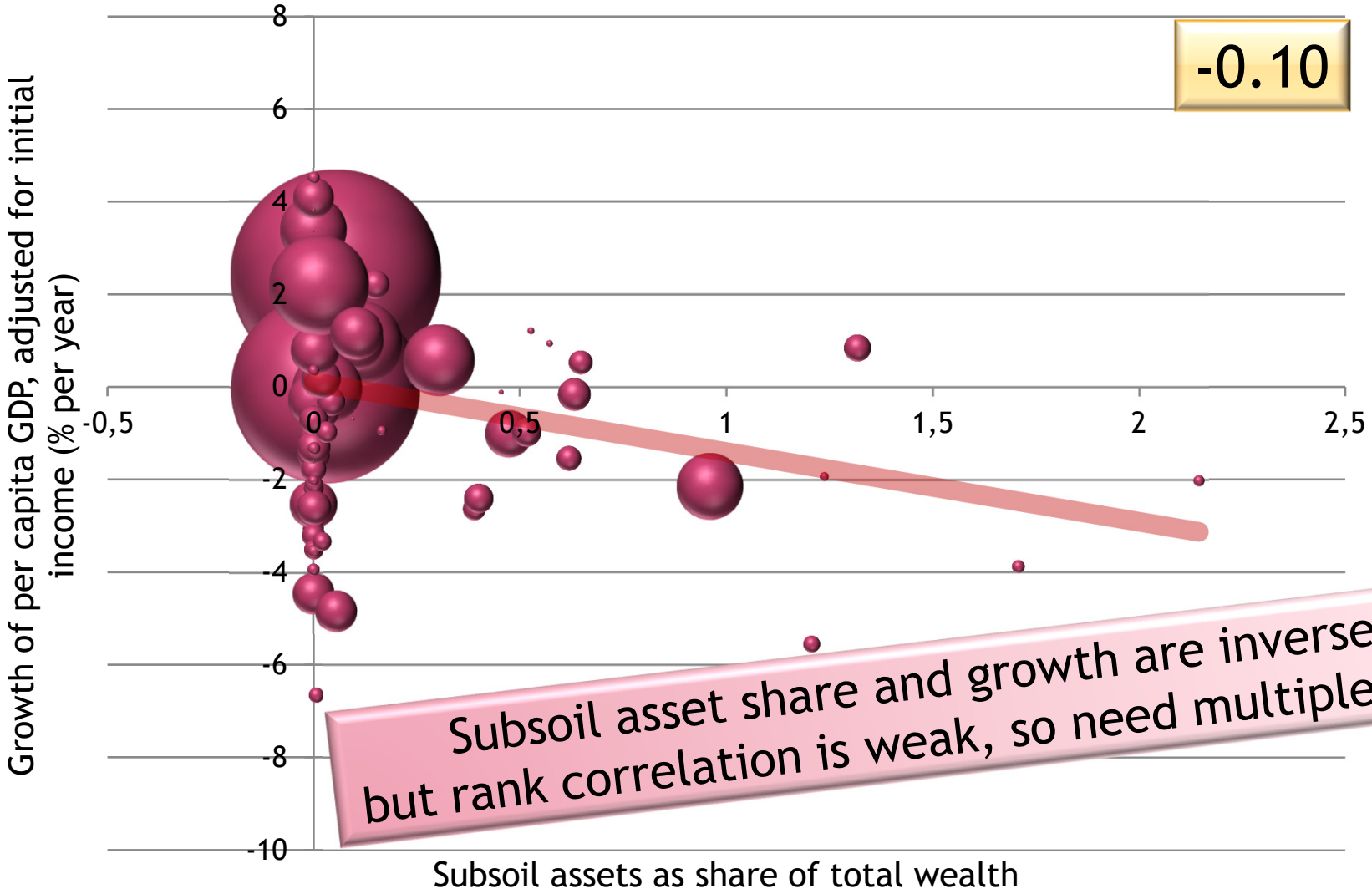


TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1						
Initial income	**-0.74 (5.2)**						
Natural capital share							
Natural capital per person							
Democracy							
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164						
Adjusted R^2	0.14						

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1	Model 2					
Initial income	-0.74 (5.2)	-0.49 (3.1)					
Natural capital share		**-0.04 (5.3)**					
Natural capital per person							
Democracy							
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164	125					
Adjusted R^2	0.14	0.18					

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3				
Initial income	-0.74 (5.2)	-0.49 (3.1)	-0.96 (5.3)				
Natural capital share		-0.04 (5.3)	-0.06 (7.1)				
Natural capital per person			**0.10 (4.5)**				
Democracy							
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164	125	124				
Adjusted R^2	0.14	0.18	0.29				

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4			
Initial income	-0.74 (5.2)	-0.49 (3.1)	-0.96 (5.3)	-1.07 (5.2)			
Natural capital share		-0.04 (5.3)	-0.06 (7.1)	-0.05 (4.7)			
Natural capital per person			0.10 (4.5)	0.08 (3.7)			
Democracy				**0.07 (2.2)**			
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164	125	124	113			
Adjusted R^2	0.14	0.18	0.29	0.27			

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5		
Initial income	-0.74 (5.2)	-0.49 (3.1)	-0.96 (5.3)	-1.07 (5.2)	-1.24 (7.0)		
Natural capital share		-0.04 (5.3)	-0.06 (7.1)	-0.05 (4.7)	-0.04 (5.3)		
Natural capital per person			0.10 (4.5)	0.08 (3.7)	0.06 (3.3)		
Democracy				0.07 (2.2)	0.07 (2.7)		
Investment rate (log)					**2.92 (6.8)**		
School life expectancy (log)							
Fertility							
Countries	164	125	124	113	113		
Adjusted R^2	0.14	0.18	0.29	0.27	0.48		

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	
Initial income	-0.74 (5.2)	-0.49 (3.1)	-0.96 (5.3)	-1.07 (5.2)	-1.24 (7.0)	-1.72 (10.2)	
Natural capital share		-0.04 (5.3)	-0.06 (7.1)	-0.05 (4.7)	-0.04 (5.3)	-0.02 (3.2)	
Natural capital per person			0.10 (4.5)	0.08 (3.7)	0.06 (3.3)	0.04 (2.2)	
Democracy				0.07 (2.2)	0.07 (2.7)	0.08 (3.2)	
Investment rate (log)					2.92 (6.8)	1.39 (3.0)	
School life expectancy (log)						**3.01 (6.4)**	
Fertility							
Countries	164	125	124	113	113	99	
Adjusted R^2	0.14	0.18	0.29	0.27	0.48	0.61	

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.49 (3.1)	-0.96 (5.3)	-1.07 (5.2)	-1.24 (7.0)	-1.72 (10.2)	-1.87 (10.7)
Natural capital share		-0.04 (5.3)	-0.06 (7.1)	-0.05 (4.7)	-0.04 (5.3)	-0.02 (3.2)	-0.02 (2.9)
Natural capital per person			0.10 (4.5)	0.08 (3.7)	0.06 (3.3)	0.04 (2.2)	0.04 (2.4)
Democracy				0.07 (2.2)	0.07 (2.7)	0.08 (3.2)	0.06 (2.4)
Investment rate (log)					2.92 (6.8)	1.39 (3.0)	0.94 (1.9)
School life expectancy (log)						3.01 (6.4)	2.47 (4.9)
Fertility							**-0.31 (2.5)**
Countries	164	125	124	113	113	99	99
Adjusted R^2	0.14	0.18	0.29	0.27	0.48	0.61	0.64

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.49 (3.1)	-0.96 (5.3)	-1.07 (5.2)	-1.24 (7.0)	-1.72 (10.2)	**-1.87** **(10.7)**
Natural capital share		-0.04 (5.3)	-0.06 (7.1)	-0.05 (4.7)	-0.04 (5.3)	-0.02 (3.2)	**-0.02** **(2.9)**
Natural capital per person			0.10 (4.5)	0.08 (3.7)	0.06 (3.3)	0.04 (2.2)	**0.04** **(2.4)**
Democracy				0.07 (2.2)	0.07 (2.7)	0.08 (3.2)	**0.06** **(2.4)**
Investment rate (log)					2.92 (6.8)	1.39 (3.0)	**0.94** **(1.9)**
School life expectancy (log)						3.01 (6.4)	**2.47** **(4.9)**
Fertility							**-0.31** **(2.5)**
Countries	164	125	124	113	113	99	**99**
Adjusted R^2	0.14	0.18	0.29	0.27	0.48	0.61	**0.64**

TABLE 1. REGRESSION RESULTS ON NATURAL CAPITAL AND ECONOMIC GROWTH: LEVELS

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 8
Initial income	-0.74 (5.2)	-0.49 (3.1)	-0.96 (5.3)	-1.07 (5.2)	-1.24 (7.0)	-1.72 (10.2)	**0.26** **(3.8)**
Natural capital share		-0.04 (5.3)	-0.06 (7.1)	-0.05 (4.7)	-0.04 (5.3)	-0.02 (3.2)	**-0.01** **(2.9)**
Natural capital per person			0.10 (4.5)	0.08 (3.7)	0.06 (3.3)	0.04 (2.2)	**0.02** **(2.4)**
Democracy				0.07 (2.2)	0.07 (2.7)	0.08 (3.2)	**0.02** **(2.4)**
Investment rate (log)					2.92 (6.8)	1.39 (3.0)	**0.36** **(1.9)**
School life expectancy (log)						3.01 (6.4)	**0.98** **(4.9)**
Fertility							**-0.12** **(2.5)**
Countries	164	125	124	113	113	99	**99**
Adjusted R^2	0.14	0.18	0.29	0.27	0.48	0.61	**0.88**

DECOMPOSITION OF PER CAPITA GROWTH (IN PERCENT)

Per capita growth (%)	0.99
Natural capital share (19.0)	0.17
Democracy (6.4)	0.15
Investment (log, 0.29)	0.10
School life expectancy (log, 0.35)	0.34
Fertility (1.8)	0.22

Note: Standard deviations within parentheses.

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	**-0.74 (5.2)**						
Subsoil asset share							
Subsoil assets per person							
Democracy							
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164						
Adjusted R^2	0.14						

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.69 (4.6)					
Subsoil asset share		**-0.02 (2.9)**					
Subsoil assets per person							
Democracy							
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164	153					
Adjusted R^2	0.14	0.17					

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.69 (4.6)	-0.74 (4.7)				
Subsoil asset share		-0.02 (2.9)	-0.02 (3.1)				
Subsoil assets per person			**0.01 (1.5)**				
Democracy							
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164	153	153				
Adjusted R^2	0.14	0.17	0.17				

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.69 (4.6)	-0.74 (4.7)	-1.26 (7.5)			
Subsoil asset share		-0.02 (2.9)	-0.02 (3.1)	-0.01 (1.4)			
Subsoil assets per person			0.01 (1.5)	0.03 (2.4)			
Democracy				**0.19 (6.3)**			
Investment rate (log)							
School life expectancy (log)							
Fertility							
Countries	164	153	153	139			
Adjusted R^2	0.14	0.17	0.17	0.34			

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.69 (4.6)	-0.74 (4.7)	-1.26 (7.5)	-1.47 (9.6)		
Subsoil asset share		-0.02 (2.9)	-0.02 (3.1)	-0.01 (1.4)	-0.02 (3.1)		
Subsoil assets per person			0.01 (1.5)	0.03 (2.4)	0.04 (3.8)		
Democracy				0.19 (6.3)	0.17 (6.6)		
Investment rate (log)					**3.08 (5.9)**		
School life expectancy (log)							
Fertility							
Countries	164	153	153	139	139		
Adjusted R^2	0.14	0.17	0.17	0.34	0.48		

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.69 (4.6)	-0.74 (4.7)	-1.26 (7.5)	-1.47 (9.6)	-2.03 (14.4)	
Subsoil asset share		-0.02 (2.9)	-0.02 (3.1)	-0.01 (1.4)	-0.02 (3.1)	-0.01 (2.8)	
Subsoil assets per person			0.01 (1.5)	0.03 (2.4)	0.04 (3.8)	0.04 (5.1)	
Democracy				0.19 (6.3)	0.17 (6.6)	0.12 (5.1)	
Investment rate (log)					3.08 (5.9)	0.97 (1.9)	
School life expectancy (log)						**4.09 (8.9)**	
Fertility							
Countries	164	153	153	139	139	123	
Adjusted R^2	0.14	0.17	0.17	0.34	0.48	0.68	

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.69 (4.6)	-0.74 (4.7)	-1.26 (7.5)	-1.47 (9.6)	-2.03 (14.4)	-2.24 (14.5)
Subsoil asset share		-0.02 (2.9)	-0.02 (3.1)	-0.01 (1.4)	-0.02 (3.1)	-0.01 (2.8)	-0.01 (2.2)
Subsoil assets per person			0.01 (1.5)	0.03 (2.4)	0.04 (3.8)	0.04 (5.1)	0.04 (5.5)
Democracy				0.19 (6.3)	0.17 (6.6)	0.12 (5.1)	0.09 (3.9)
Investment rate (log)					3.08 (5.9)	0.97 (1.9)	0.45 (0.9)
School life expectancy (log)						4.09 (8.9)	3.41 (6.8)
Fertility							**-0.38 (2.9)**
Countries	164	153	153	139	139	123	123
Adjusted R^2	0.14	0.17	0.17	0.34	0.48	0.68	0.69

TABLE 2. REGRESSION RESULTS ON SUBSOIL ASSETS AND ECONOMIC GROWTH

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Initial income	-0.74 (5.2)	-0.69 (4.6)	-0.74 (4.7)	-1.26 (7.5)	-1.47 (9.6)	-2.03 (14.4)	**-2.24** **(14.5)**
Subsoil asset share		-0.02 (2.9)	-0.02 (3.1)	-0.01 (1.4)	-0.02 (3.1)	-0.01 (2.8)	**-0.01** **(2.2)**
Subsoil assets per person			0.01 (1.5)	0.03 (2.4)	0.04 (3.8)	0.04 (5.1)	**0.04** **(5.5)**
Democracy				0.19 (6.3)	0.17 (6.6)	0.12 (5.1)	**0.09** **(3.9)**
Investment rate (log)					3.08 (5.9)	0.97 (1.9)	**0.45** **(0.9)**
School life expectancy (log)						4.09 (8.9)	**3.41** **(6.8)**
Fertility							**-0.38** **(2.9)**
Countries	164	153	153	139	139	123	**123**
Adjusted R^2	0.14	0.17	0.17	0.34	0.48	0.68	**0.69**

REGRESSION RESULTS ON NATURAL CAPITAL AND EDUCATION

	Model 1	Model 2	Model 3	Model 4
Initial income	1.79 (8.6)			
Natural capital share				
Natural capital per person				
Fertility				
Countries	142			
Adjusted R^2	0.34			

REGRESSION RESULTS ON NATURAL CAPITAL AND EDUCATION

	Model 1	Model 2	Model 3	Model 4
Initial income	1.79 (8.6)	2.29 (9.1)		
Natural capital share		-0.06 (4.1)		
Natural capital per person				
Fertility				
Countries	142	108		
Adjusted R^2	0.34	0.58		

REGRESSION RESULTS ON NATURAL CAPITAL AND EDUCATION

	Model 1	Model 2	Model 3	Model 4
Initial income	1.79 (8.6)	2.29 (9.1)	1.76 (6.1)	
Natural capital share		-0.06 (4.1)	-0.07 (5.3)	
Natural capital per person			0.12 (3.3)	
Fertility				
Countries	142	108	108	
Adjusted R^2	0.34	0.58	0.62	

REGRESSION RESULTS ON NATURAL CAPITAL AND EDUCATION

	Model 1	Model 2	Model 3	Model 4
Initial income	1.79 (8.6)	2.29 (9.1)	1.76 (6.1)	0.656 (2.2)
Natural capital share		-0.06 (4.1)	-0.07 (5.3)	-0.044 (3.4)
Natural capital per person			0.12 (3.3)	0.079 (2.6)
Fertility				-1.105 (6.5)
Countries	142	108	108	108
Adjusted R^2	0.34	0.58	0.62	0.72

REGRESSION RESULTS ON NATURAL CAPITAL AND DEMOCRACY

	Model 1	Model 2	Model 3	Model 4
Initial income	2.61 (6.2)			
Natural capital share				
Natural capital per person				
Corruption				
Countries	143			
Adjusted R^2	0.21			

REGRESSION RESULTS ON NATURAL CAPITAL AND DEMOCRACY

	Model 1	Model 2	Model 3	Model 4
Initial income	2.61 (6.2)	3.57 (7.6)		
Natural capital share		-0.08 (3.3)		
Natural capital per person				
Corruption				
Countries	143	113		
Adjusted R^2	0.21	0.49		

REGRESSION RESULTS ON NATURAL CAPITAL AND DEMOCRACY

	Model 1	Model 2	Model 3	Model 4
Initial income	2.61 (6.2)	3.57 (7.6)	2.73 (4.9)	
Natural capital share		-0.08 (3.3)	-0.11 (4.2)	
Natural capital per person			0.17 (2.7)	
Corruption				
Countries	143	113	113	
Adjusted R^2	0.21	0.49	0.52	

REGRESSION RESULTS ON NATURAL CAPITAL AND DEMOCRACY

	Model 1	Model 2	Model 3	Model 4
Initial income	2.61 (6.2)	3.57 (7.6)	2.73 (4.9)	2.051 (3.4)
Natural capital share		-0.08 (3.3)	-0.11 (4.2)	-0.076 (2.5)
Natural capital per person			0.17 (2.7)	0.112 (1.7)
Corruption				0.786 (2.7)
Countries	143	113	113	106
Adjusted R^2	0.21	0.49	0.52	0.53

CONCLUSION

- Diversification is good for growth
  - Economic diversification away from excessive reliance on natural resources, including minerals
  - Political diversification away from narrowly based political elites toward full-fledged democracy
- Social and human capital are good for growth
  - Social policies make a difference, including social insurance as well as education and health care
- Judicious use of natural resources requires good institutions, including democracy
  - Conditional assistance (e.g., World Bank in Sudan)
- Need to develop strategy to turn natural capital sustainably into human and social capital
  - European solution: Pooling coal and steel worked well
  - Pooling fish through CFP has worked less well