Fertility, mortality, and economic development:
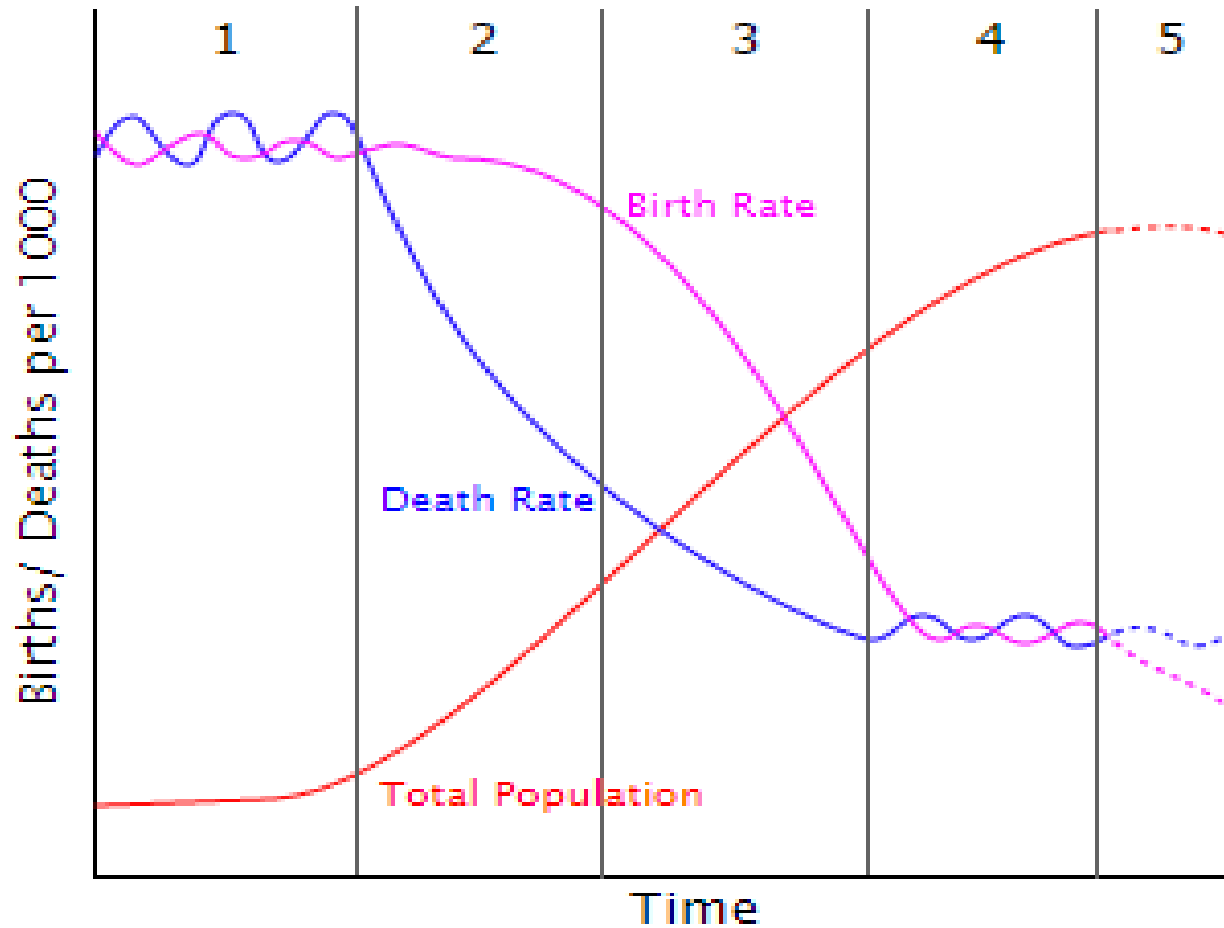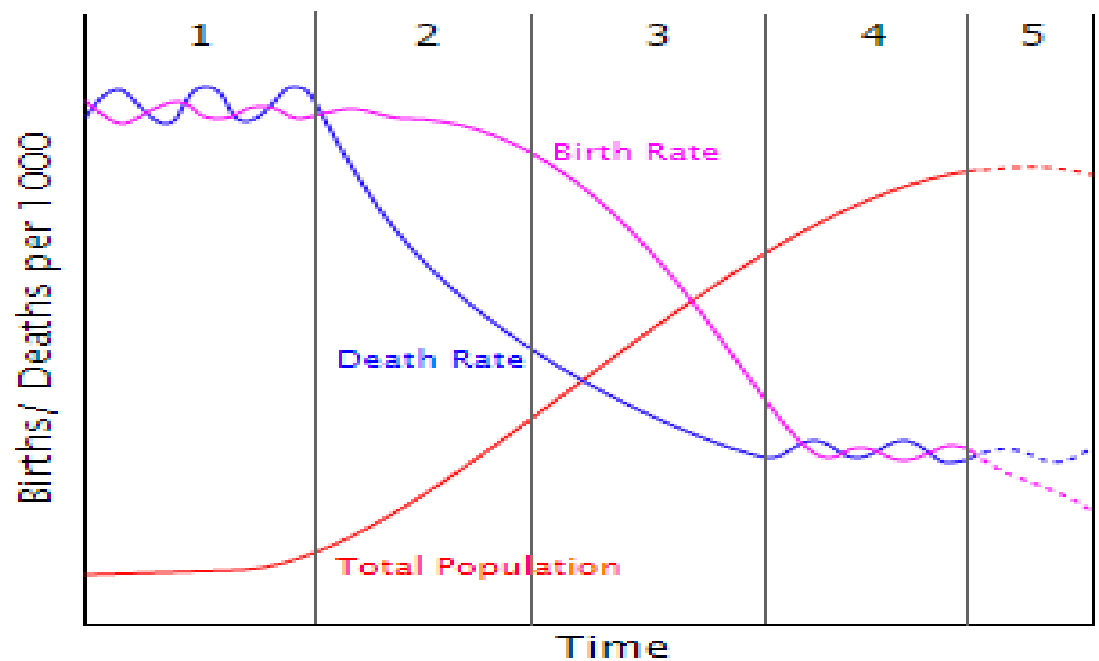# An analysis of 201 countries during 1960-2010

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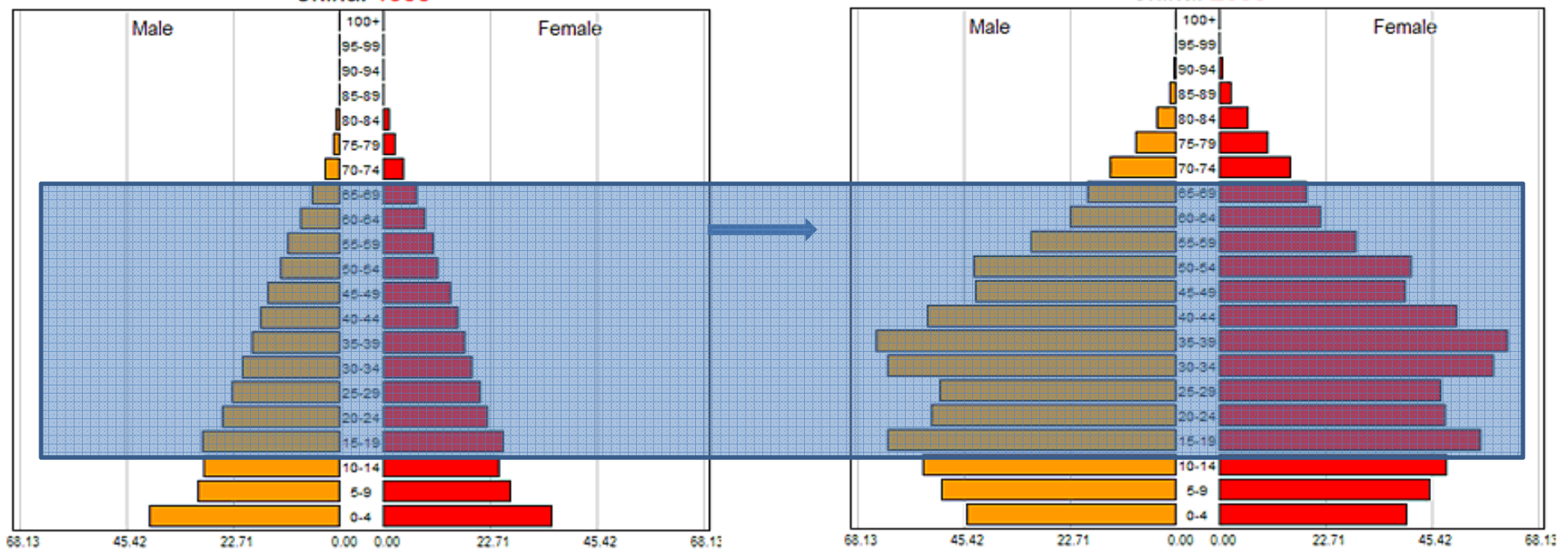# Demographic transition

Graph source:
http://en.wikipedia.org/wiki/Demographic_transition

China: 1950

China: 2005

Male	100+	Female
	95-99	
	90-94	
	85-89	
	80-84	
	75-79	
	70-74	
	65-69	
	60-64	
	55-59	
	50-54	
	45-49	
	40-44	
	35-39	
	30-34	
	25-29	
	20-24	
	15-19	
	10-14	
	5-9	
	0-4	

68.13   45.42   22.71   0.00 0.00   22.71   45.42   68.13

68.13   45.42   22.71   0.00 0.00   22.71   45.42   68.13
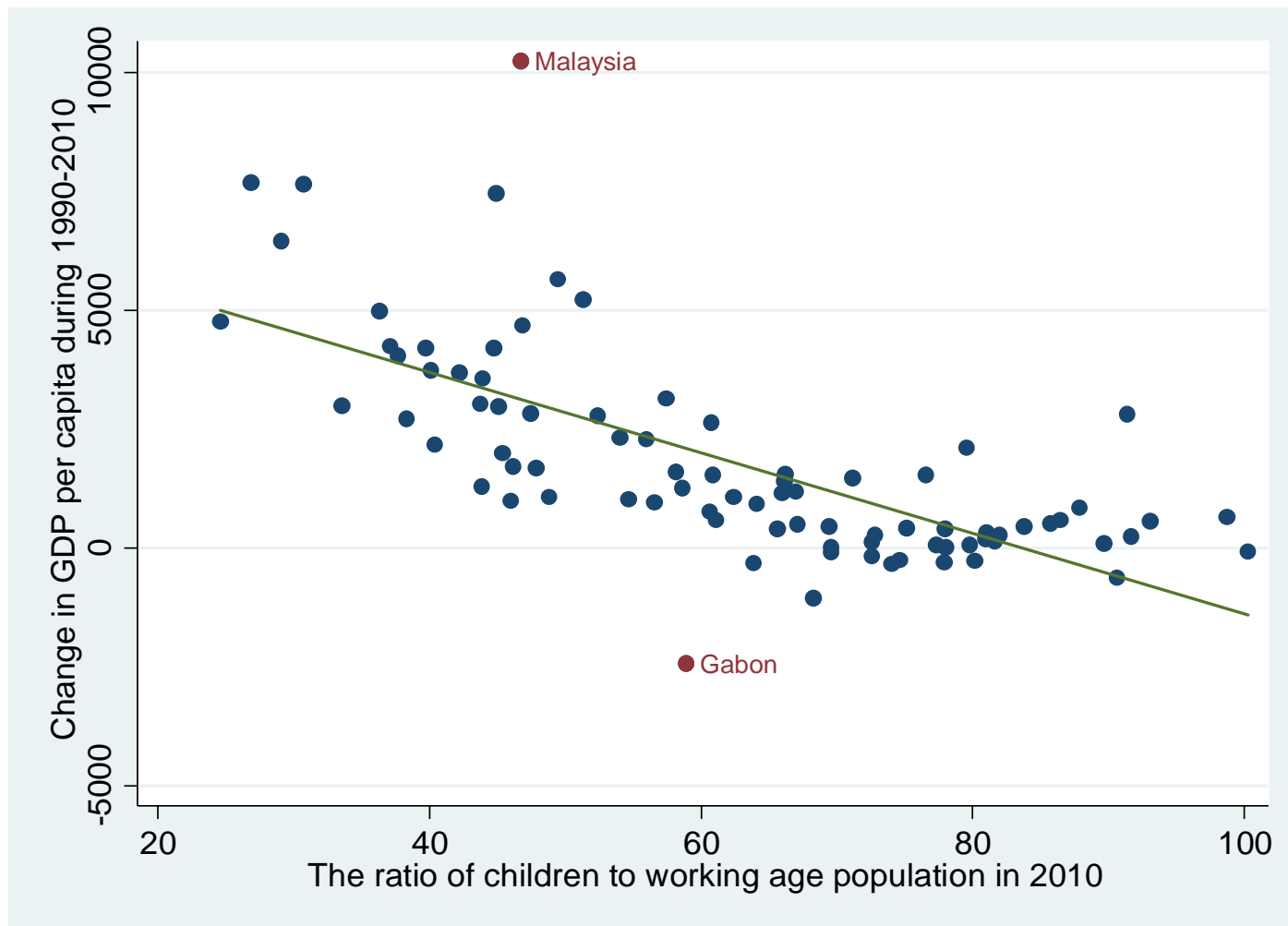
Change in GDP per capita during 1990-2010 and the ratio of children to working-age population in 2010 in Asia, LAC, and SSA

Objectives

- To estimate the relative contribution of fertility and mortality decline during 1960-2010 to the favorable age structure shift

- To assess the economic impact of fertility and mortality reduction through population age-structure shifting

Method

- Conducted decomposition analysis to disaggregate the effects of fertility and mortality changes on dependency ratios, which were derived from the counterfactual population growth projections under three scenarios:

  (1) No fertility or mortality reduction during 1960-2010

  (2) no fertility reduction during 1960-2010

  (3) no mortality reduction during 1960-2010

- Also estimated how much lower the GDP per capita would be in 2010 in those three hypothetical scenarios

- Population projections were conducted using cohort component method (CCM)
- CCM is a demographic method used by UN for global population projection
- The fundamental formula for the CCM is,

$$P_{(t+n)} = P_{(t)} + B_t^{t+n} - D_t^{t+n} + IM_t^{t+n} - OM_t^{t+n}$$

$$P_{t+5} = (S + B)_{t,t+5} * P_t$$

where S and B are the transition matrix of the age-specific survival and birth rate

Analytical method for assessing the effects of DR shift on economic growth

- By definition, GDP per capita can be broken down into **GDP per worker** and **the share of working age population**.

- $$y_{it} = \frac{Y_{it}}{P_{it}} = \frac{Y_{it}}{W_{it}} \frac{W_{it}}{P_{it}} = z_{it} w_{it}$$

- Where Y_{it} is the gross domestic product (GDP), y_{it} is the GDP per capita, P_{it} is the total population, and W_{it} is the number of workers, z_{it} is the product per worker, w_{it} is the share of workers in country i in year t

- We can calculate the GDP per capita that would have occurred had one factor not changed. In this study, we estimate the GDP per capita under the assumption that worker productivity did not change during 1960-2010.

- The gap between the actual (observed) and hypothetical levels (s scenarios) can be interpreted as the impact of the change in population age structure on GDP per capita: $y_{it}^{o} - y_{it}^{S} = z_{it} w_{it}^{o} - z_{it} w_{it}^{S}$

Data

- All of the 201 countries included in the UN's World Population Prospect 2012 dataset are used in this study

- We also conducted decomposition analyses at the regional level for 10 regions

Dependency ratios (DR)

Region	UN WPP 2012		
	Total DR	**Child DR**	**Age DR**
Sub-Saharan Africa (50)	87	81	6
Northern Africa(7)	57	50	8
Asia(51)	48	38	10
Latin America and the Caribbean(38)	54	43	10
Europe(40)	47	23	24
Australia/New Zealand(2)	48	28	20
Melanesia(5)	69	64	5
Micronesia(3)	56	48	8
Northern America(2)	49	29	20
Polynesia(3)	59	50	10
World(201)	52	41	12

The contribution of fertility and mortality decline to the change in total dependency ratio* (DR) in 10 regions during 1960-2010

| Region	UN WPP 2012	DR estimates under constant fertility and mortality		DR estimates under constant fertility	
	Total DR	Total DR	% diff.	Total DR	% diff.
Sub-Saharan Africa (50)	87	86	-1	97	12
Northern Africa(7)	57	90	57	106	84
Asia(51)	48	80	69	91	91
Latin America and the Caribbean(38)	54	87	62	96	78
Europe(40)	47	56	20	60	29
Australia/New Zealand(2)	48	65	35	70	45
Melanesia(5)	69	87	26	94	35
Micronesia(3)	56	94	68	100	79
Northern America(2)	49	66	36	70	44
Polynesia(3)	59	100	68	104	76
World(201)	52	75	43	83	59

*defined as the ratio of the number of dependent (children aged 0-14 and aged >64 years) and the working age population (i.e. aged 15-64 years),

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The contribution of fertility and mortality decline to the change in child dependency ratio* (DR) in 10 regions during 1960-2010

| Region	UN WPP 2012	DR estimates under constant fertility and mortality		DR estimates under constant fertility		
	Child DR	Child DR	% diff.	Child DR	% diff.	Aged DR
Sub-Saharan Africa (50)	81	81	0	92	13	6
Northern Africa(7)	50	85	71	100	102	6
Asia(51)	38	75	101	84	122	8
Latin America and the Caribbean(38)	43	81	87	88	104	7
Europe(40)	23	38	68	39	74	21
Australia/New Zealand(2)	28	54	88	54	88	17
Melanesia(5)	64	84	31	89	39	5
Micronesia(3)	48	89	85	94	95	6
Northern America(2)	29	55	89	55	91	15
Polynesia(3)	50	96	93	100	100	5
World(201)	41	67	66	73	81	9

*defined as the ratio of the number of children aged 0-14 years over the working age population (i.e. aged 15-64 years),

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The percentage change in child dependency ratio in three fertility and mortality scenarios compared with UN data by regions in 186 countries in 5 regions
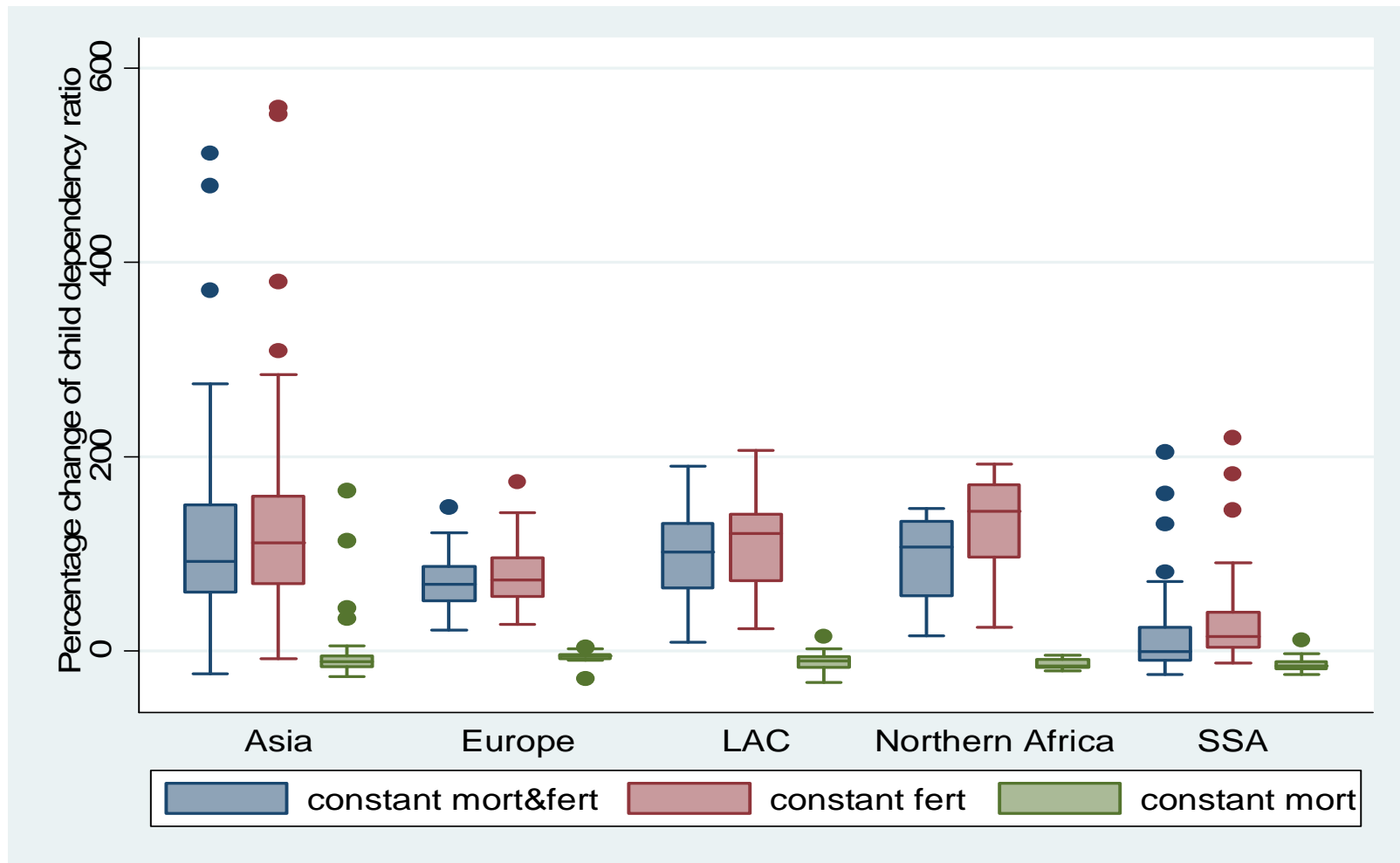
The change in child and total dependency ratios during 1960-2010 in 5 regions
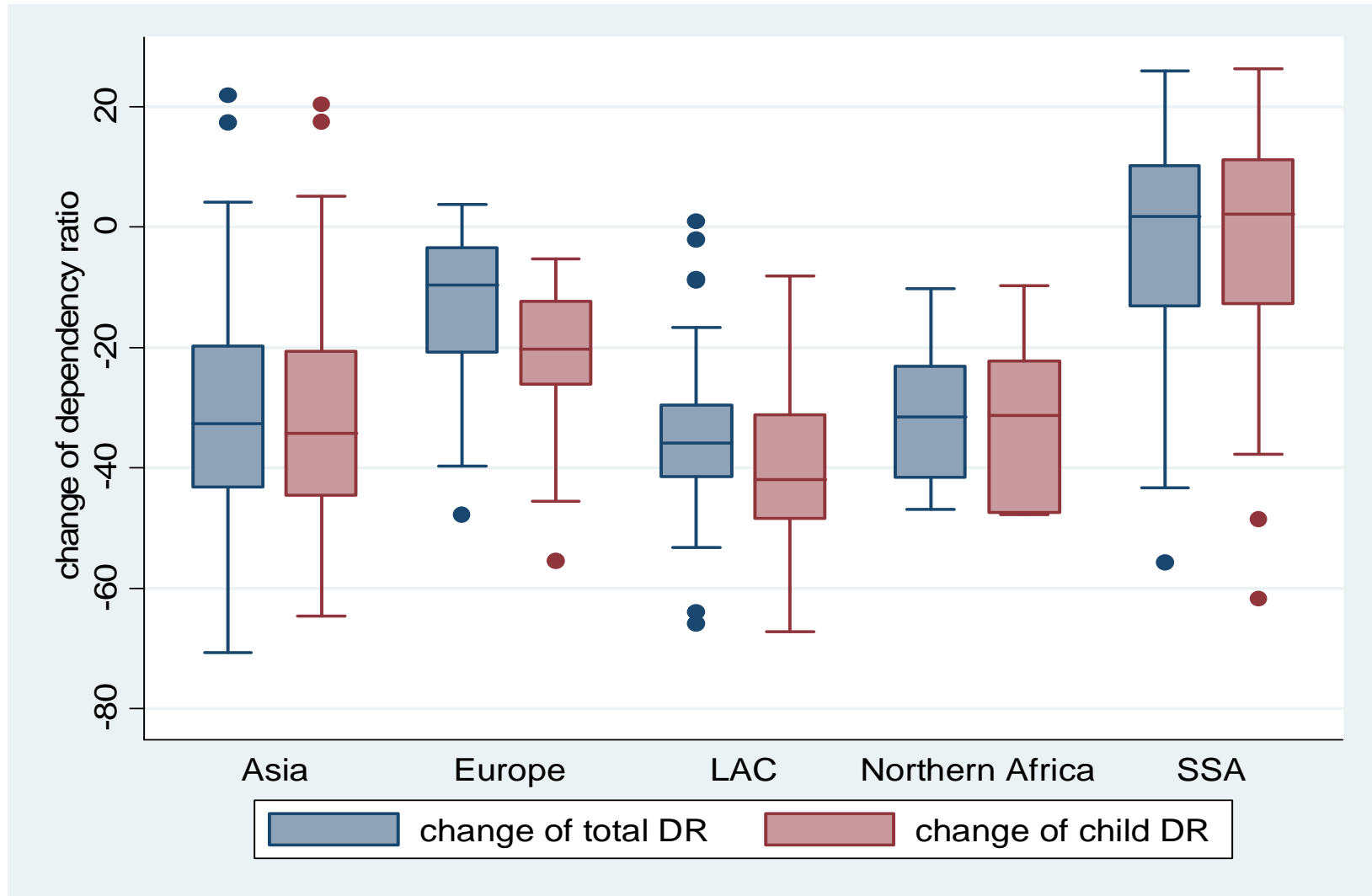
The relationship between total fertility rate (TFR) in 1960 and the contribution of fertility decline to the change in total dependency ratio in developing countries during 1960-2010
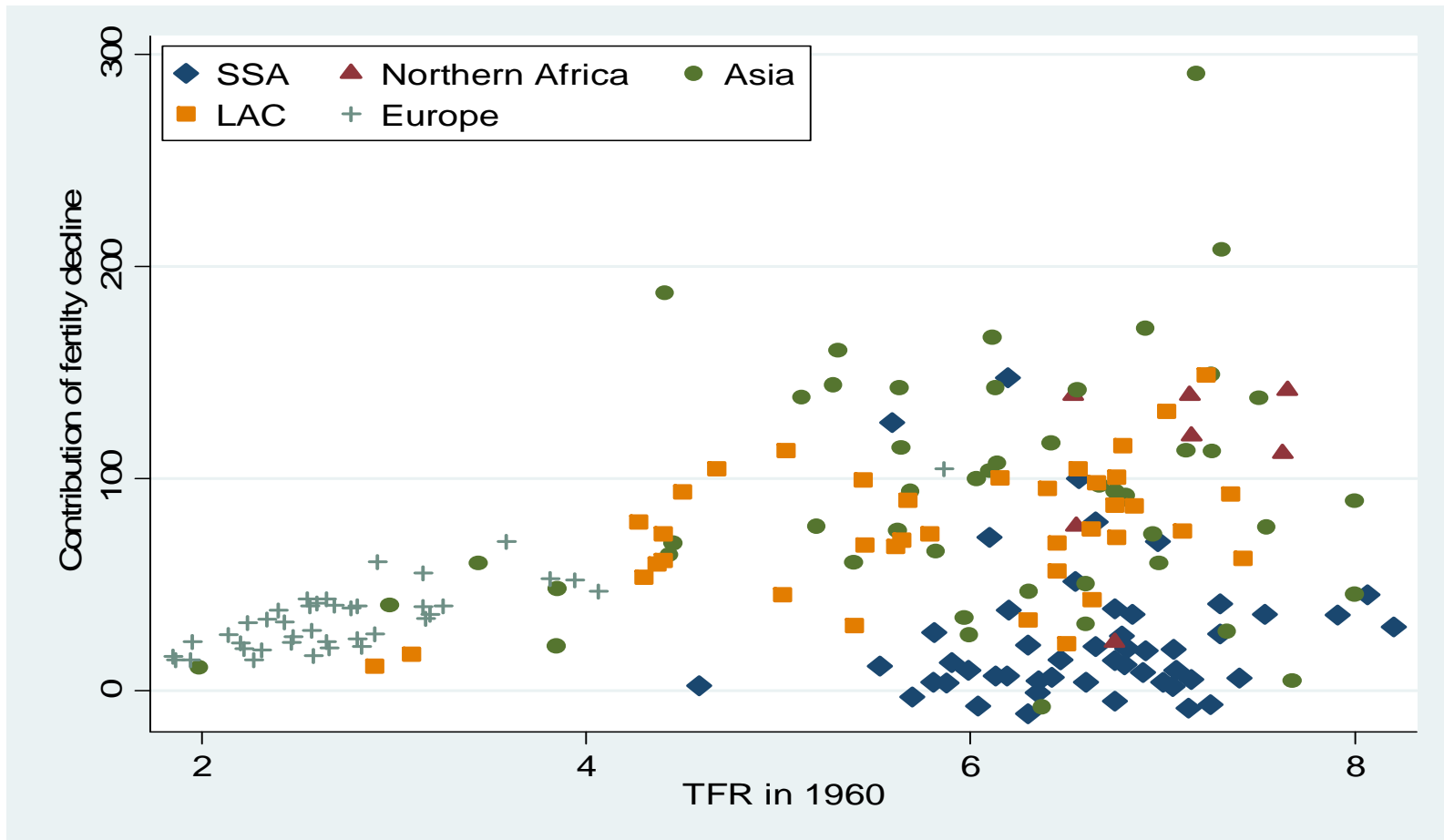
The economic contribution of fertility and mortality decline in 10 regions during 1960-2010

Region	GDP per capita in 2010	Relative change had there been no		
		Fertility decline	Mortality decline	Fertility and mortality decline
Sub-Saharan Africa (50)	4,378	-8	7	-2
Northern Africa(7)	12,178	-25	6	-19
Asia(51)	22,362	-22	3	-18
Latin America and the Caribbean(38)	12,424	-21	6	-18
Europe(40)	27,730	-10	3	-7
Australia/New Zealand(2)	34,375	-14	4	-11
Melanesia(5)	3,480	-15	4	-11
Micronesia(3)	2,484	-19	4	-16
Northern America(2)	43,868	-14	3	-12
Polynesia(3)	4,803	-15	5	-13
World(201)	16,382	-15	5	-11

Conclusion

- Globally, fertility decline played the major role in the favorable age structure shift

- The child dependency ratio would be 122% and 104% higher than the observed level in 2012 in Asia and Latin America and the Caribbean (LAC), respectively, had fertility not declined

- It would only be 13% higher if there were no fertility decline in Sub-Sahara Africa (SSA)

- The economic consequences are also substantial. The GDP per capita in Asia and LAC would be 22% and 21% lower than the actual level in 2010 had the fertility decline during 1960-2010 not occurred. The corresponding percentage is only 8% in SSA.

- The population age structure in SSA countries is still unfavorable to the demographic dividend, mainly due to minimal reductions in fertility rates in the past few decades
- SSA can accelerate the catch-up process by investing more in family planning for reducing fertility
- This will lead to a more favorable dependency ratio and consequently open the window of opportunity for a demographic dividend in SSA