Edward B. Barbier
25 “ Water and growth in developing countries“
Handbook of Water Economics

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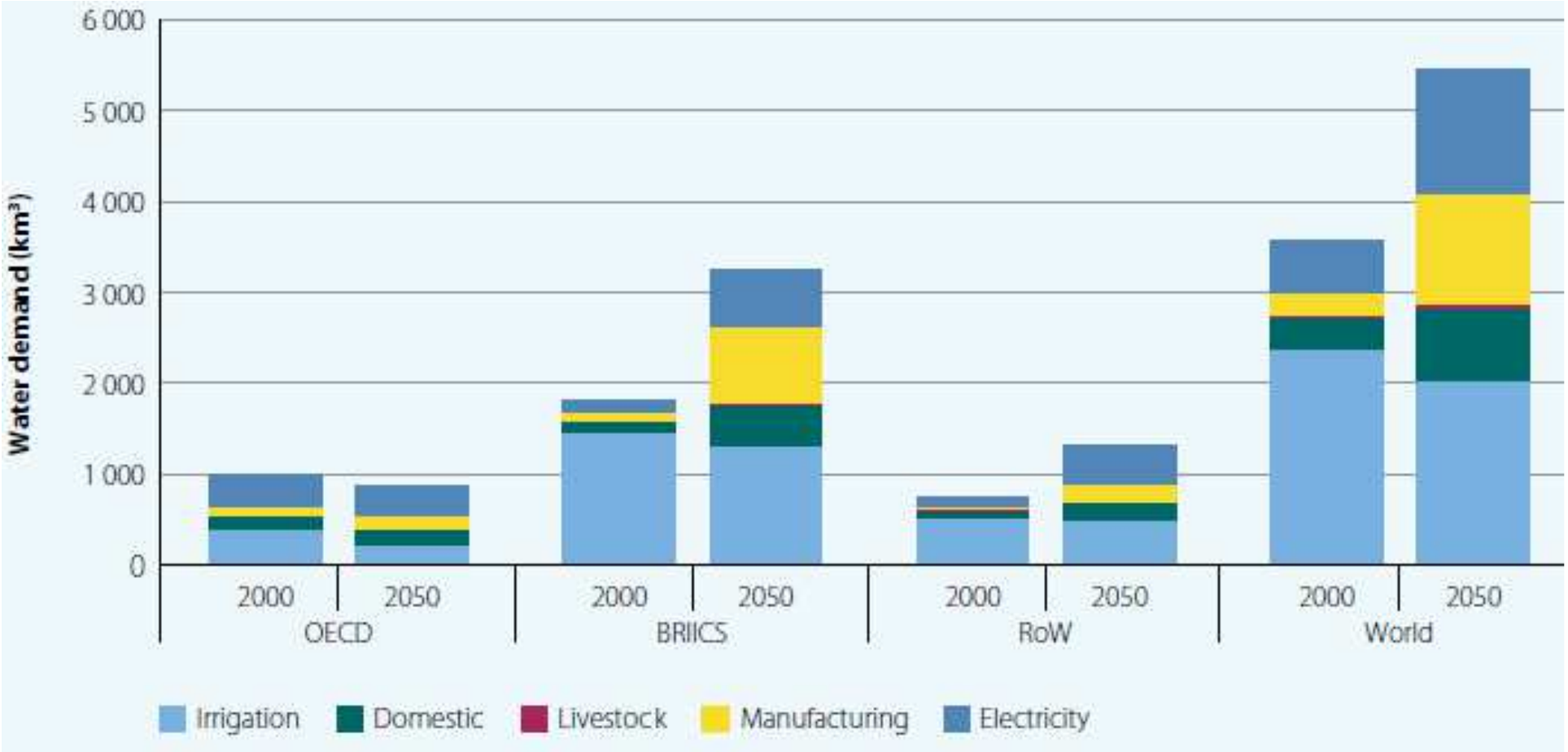
Background

- Growing global water demand is forecast to occur mainly in developing countries.

Growing global water demand

- The world is experiencing increased freshwater demand of about 64 billion m^3 per year (WWAP, 2012)
- Global water demand is anticipated to rise significantly, from about 3500 km^3 in 2000 to nearly 5500 km^3 in 2050 (OECD,2012)
- Water withdrawals are predicted to increase by 50 percent by 2025 in developing countries (UNEP, 2007)

Global Water Demand



Source: OECD(2012)

Note: GLOBAL WATER DEMAND (FRESHWATER WITHDRAWALS): The OECD's 2012 Global Environmental Outlook's Baseline Scenario, 2000 AND 2050

BRIICS (Brazil, Russia, India, Indonesia, China, South Africa); OECD (Organisation for Economic Co-operation and Development); RoW (rest of world). This figure only measures 'blue water' demand and does not consider rainfed agriculture.

Motivation

- These trends in relative water use in developing economies raise the possibility that increasing water use may affect the growth of these economies.

Influences of increased water utilization on growth

- The influences of increased water utilization on growth were explored by Barbier (2004)

- positive influence
  - using ‘freshwater capital’ is beneficial to the economy, as this publicly provided good serves as a productive input to private producers.

- Negative influence
  - the public investments in water institutions and infrastructure necessary to secure freshwater supplies for utilization are a cost
  - these costs rise as a country appropriates and purchases a greater share of aggregate economic output

Hypotheses

- A key hypothesis that growth is positively influenced by the contribution of increased water use to productivity, leading to an inverted-U relationship between economic growth and the rate of water utilization.

- The alternative hypothesis is that growth could decline with the rate of water utilization, or have a U-shaped relationship with water use.

Contribution

- Estimate the relationship between water and growth
- a panel analysis for 112 developing countries from the 1970s through the 2000s
- Find U-shaped relationship

Empirical model

- $g_{t,\, t+5} = F(y_t, h_t, w_t)$

  - $g_{t,\, t+5}$: a country's five-year average per capita growth rate, beginning at initial year t
  - Y_t : per capita GDP
  - h_t : human capital
  - w_t : water withdrawal

Control variables

- economic variables
  - the ratio of domestic investment to GDP
  - the extent of international openness
  - agricultural share of GDP
- geographical variables
  - land or surface area

Data

- water data
  - AQUASTAT (FAO, 2013)

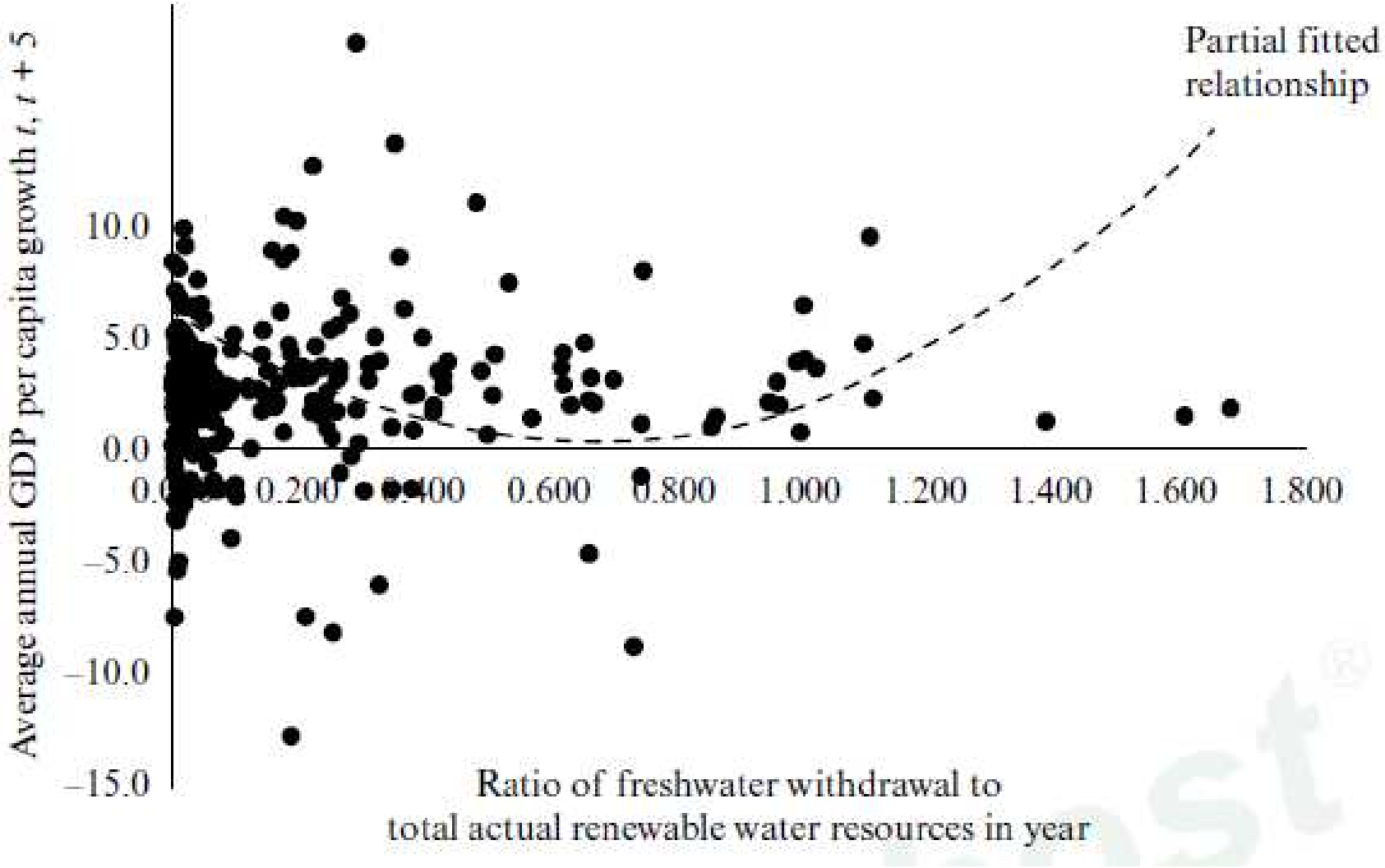
- other economic and geographical data
  - World Data Bank
  - UNDP
  - UNESCO
  - Socrata Open Data

Panel analysis of water and economic growth in developing economies, 1970–2012

Dependent variable: five-year average annual growth (%) of per capita income ($g_{t,t+5}$)					
Explanatory variables	Estimations[b]				
	(1)	(2)	(3)	(4)	(5)
Constant	71.715	72.32	41.838	21.023	21.351
	(8.598)**	(8.727)**	(4.958)**	(1.191)	(1.128)
Rate of water utilization, year t	−10.203	−6.511	−20.463	−21.206	−18.194
	(−1.792)†	(−2.476)**	(−2.950)**	(−3.108)**	(−2.615)**
Rate of water utilization, year t squared	3.305		15.994	16.092	13.869
	(0.720)		(2.476)*	(2.537)*	(2.164)*
Log GDP per capita (constant 2005 US$), year t	−8.044	−8.099	−4.460	−4.558	−4.622
	(−7.632)**	(−7.715)**	(−4.180)**	(−4.325)**	(−4.410)**
Log of fertility rate (births per woman), year $t-5$	−7.91	−8.027	−6.446	−6.914	−6.847
	(−4.713)**	(−2.629)**	(−4.053)**	(−4.383)**	(−4.358)**
Average investment (% of GDP), years t, $t-5$			0.068	0.087	0.081
			(1.863)†	(2.359)*	(2.199)*
Trade openness (trade % of GDP), year $t-5$			−0.014	−0.017	−0.018
			(−1.214)	(−1.509)	(−1.632) †
Agriculture value added (% of GDP), year $t-5$			0.108	0.109	0.110
			(2.603)**	(2.683)**	(2.715)**
Log of surface area (sq. km)				1.886	1.885
				(1.571)	(1.580)

Main determinants on economic growth in developing economies, 1970–2012

Explanatory variables	Mean	Median	Std dev.	Impact[b]
Rate of water utilization, year t	0.214	0.054	0.458	−5.611
Log GDP per capita (constant 2005 US$), year t	7.123	7.153	1.029	−4.756
Log of fertility rate (births per woman), year $t-5$	1.307	1.326	0.493	−3.379
Average investment (% of GDP), years t, $t-5$	22.773	21.904	8.431	0.684
Trade openness (trade % of GDP), year $t-5$	71.976	63.470	38.839	−0.698
Agriculture value added (% of GDP), year $t-5$	23.138	19.991	13.557	1.487
GDP per capita (constant 2005 US$), year t	$1990	$1279	$1898	
Fertility rate (births per woman) in year $t-5$	4.498	4.357	1.899	



Note: The scatter plot is based on the regression sample (254 observations) of estimation 5 in Table 25.1. The dotted line represents the partial relation between the growth rate of per capita income and the rate of water utilization based on estimation 5 and applied to the sample, and with all other variables of the estimation evaluated at their means.

Critique

- Freshwater supplies and use rates vary considerably across the regions within a country.
- Many rivers, lakes, groundwater aquifers and other water bodies often cross political boundaries.
- Freshwater availability could be more problematic for key sectors in developing countries.
- U-shape?

Conclusion

- Increasing rates of water utilization in most developing countries have a significant and negative impact on overall economic growth.
- Freshwater ‘capital’ should be included as an additional factor influencing growth.
- The U-shaped relationship appears to be dominant.