

# Water, water everywhere, but too few drops to drink -- for the poor!

## Questions addressed (1-2):

- 1) Is low income (poverty) the main reason why both **private** markets and **governments** have failed to provide an estimated 1.1 billion people with **safe water** and 2.6 billion with basic **sanitation**?
- 2) How should **collective** improved water & sanitation (W&S) services be **financed**? Full cost coverage through **user fees**, **subsidised**, or provided for **free**?

## Questions addressed (3-4)

3) What are the **economic** benefits and costs of meeting the **W&S targets** for the MDGs by 2015?

4) Are investments in improved **W&S** more efficient in reducing **child mortality** than investments in **alternative** sectors, e.g. health care and education?

### **Macro-level evidence**

# Low income and poverty the reason for under-provision?

**Supply side:** small government revenues/expenditures

**Demand side:** low household incomes

- ◆ Strong correlations between population with access to improved W&S and **per capita GNI** across **all** countries [Figure 1.a and 1.b ]
- ◆ High variance – **no significant correlation** – among the **poorest** countries (GNI/C < \$3 000)
- ◆ That some of the poorest countries have improved W&S **coverage** in the 60 to 80% range shows the **feasibility**
- ◆ In fact, if all countries with < 60% coverage could reach this level, the **MDG target** for W&S would **be met**

**What are the main constraints?**

Figure 1.a. Correlation between share of population with improved sanitation and GNI per capita across 85 developing countries in 2002/04

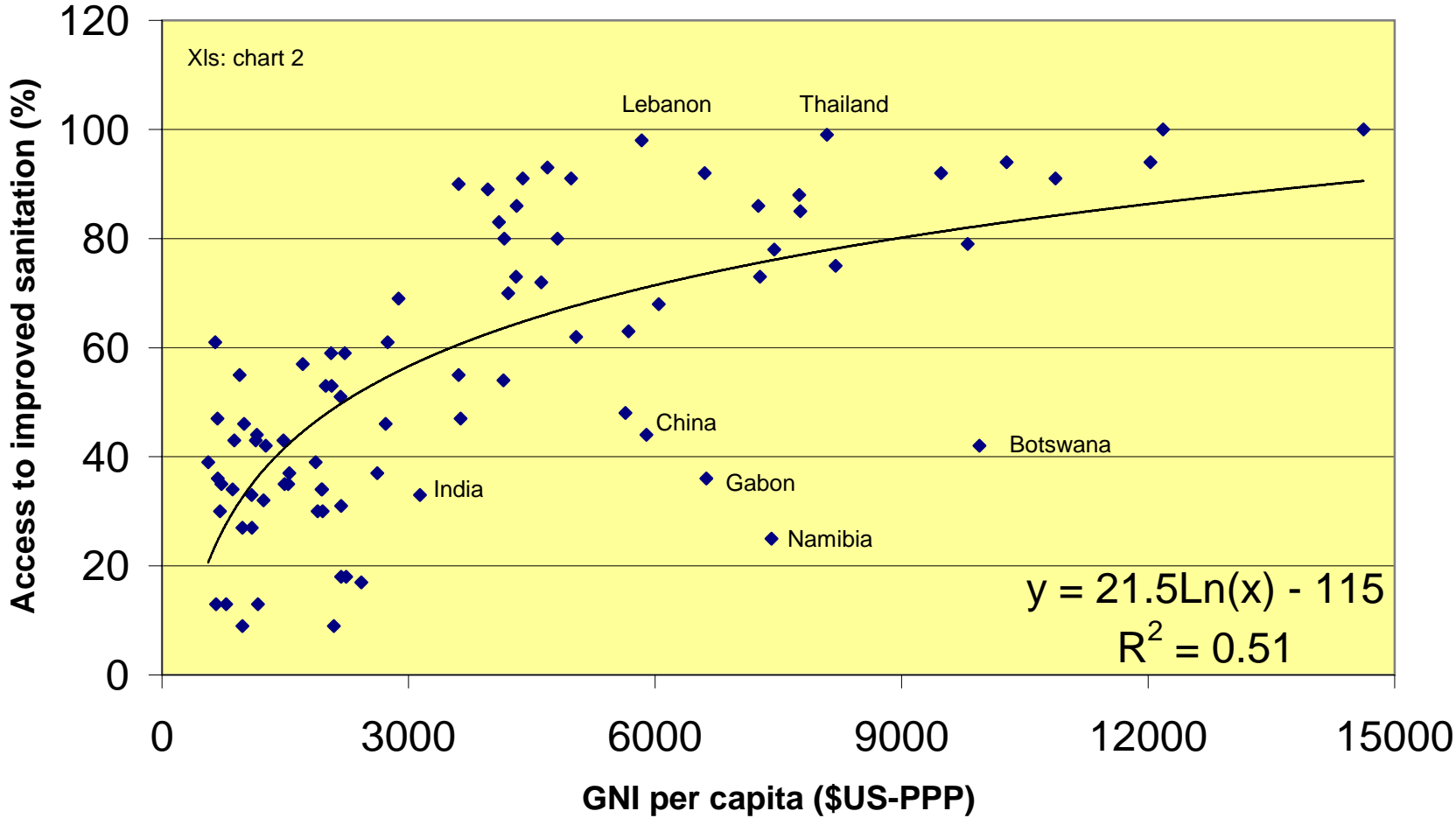
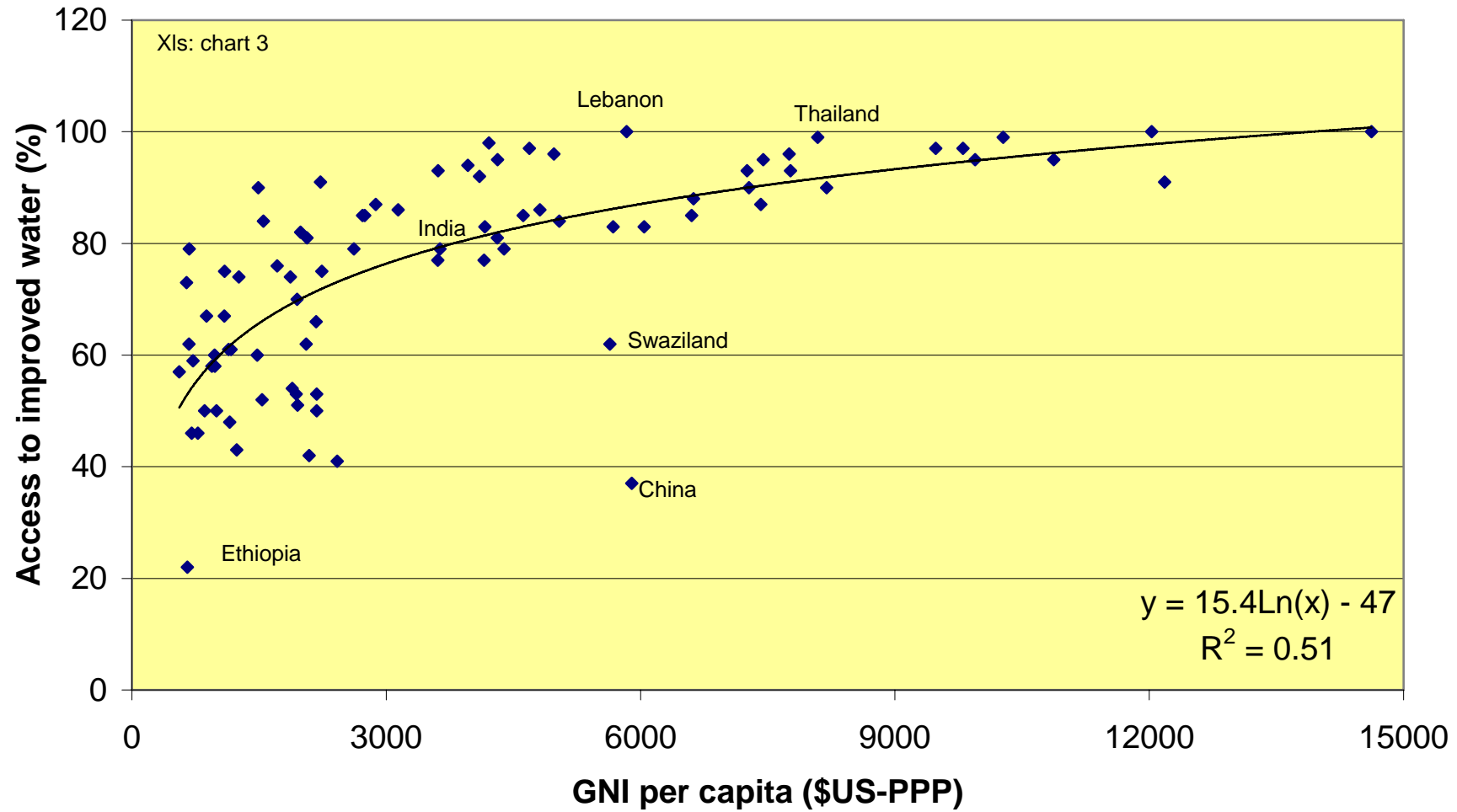


Figure 1.b. Correlation between share of populatin with improved water and GNI per capita across 85 developing countries in 2002/04



# Who should pay? Public or private W&S provision?

If one argues from purely **economic principles** the answer is not clear-cut

Improved W&S are “commodities” with several **public-good characteristics** which suggest collective (public) **provision**, or at least **regulation**

- 1) **Inter-individual externalities** that private markets fail to take into consideration, e.g. many waterborne diseases are contagious
- 2) **Inter-community externalities** in the use of W&S, e.g. one community's wastewater is another's drinking water
- 3) Most water resources are common property and at the same time **natural monopolies** which may create monopoly profits if left to private agents to handle

# Water and sanitation infrastructure – private goods?

“Nature provides the water, but not the pipes”

- ◆ To the extent that people can “harvest” water directly from rain or rivers, it should be, and almost always is, a **free public good**
- ◆ Most peoples’ access to improved W&S requires fixed investments in **collection, storage, treatment** and **distribution**. These **value-added** properties of W&S have **private-good** characteristics
- ◆ Improved W&S supply is hence a **composite** good with both public- and private-good properties. Hence difficult to argue for **exclusive** provision by governments or by private agents
- ◆ Other arguments as well! **Efficiency** in delivering, **equity**!

# Provision of W&S in practice

## 1. Small-scale private water markets

**Urban areas.** Those without access to safe (piped) water buy most of their water in private markets – from water vendors, water trucks, kiosks etc., but **prices** are often **5-20 times higher** than paid by those connected to formal water networks.

Moreover, the **quality** is usually lower

**Rural areas.** Most people lacking proximate access to “improved” water in rural areas obtain their water through **private** initiative. This means that they fetch water from a source **located** more than 1 km from home **and/or** that the water source is **contaminated**. While this water may be “free”, people pay a **high price** in terms of **time** collecting it = **Opportunity cost!**



## Provision of improved W&S in practice (cont'd)

### 2. Why large-scale private W&S provision fails: Urban areas

- ◆ Tenure **contracts** are missing or uncertain (often so in slums)
- ◆ Large-scale private W&S utilities are **not permitted** by governments
- ◆ Or **regulated** in ways that do not allow full cost coverage

**Implication:** Only some **10%** of investments in large-scale W&S networks are **private** in developing countries.

# Provision of improved W&S in practice

## 2. Why large-scale private W&S provision fails: Rural areas

- ◆ Large-scale W&S utilities operate under substantial **economies of scale** and small scale **raises cost** per capita
- ◆ Fixed **up-front investment** costs are high and **pay-back periods** long if user fees are to pay for the investment

**Implication:** In **low population density rural areas**, costs of investing and maintaining large-scale private **W&S networks** are often too high to **cover costs** and produce a profit

# Provision of improved W&S in practice (cont'd)

## 3. Why government (public) W&S provision fails

- ◆ Governments and other public agencies have so far provided some 90% of investments in **improved W&S** infrastructure in developing countries
- ◆ At the political level, improved W&S has hence been considered mainly a **public good** for which **governments** should have the chief responsibility.
- ◆ The question is then **why** governments have **failed** to provide improved W&S to an estimated 1.1 and 2.6 billion people, respectively.

## Provision of improved W&S in practice (cont'd)

### Government failure; implausible reasons:

#### 1) There is not enough water to supply all?

What lacks are facilities for **collecting, storing, treating** and **distributing** safe domestic water and **disposing** waste water. **Renewable resource!**

#### 2) It is technically difficult to provide safe W&S?

Low-cost techniques for supplying safe water and basic sanitation are readily available. **No rocket science!** Communal stand-pipes and covered pit latrines (with disposal facilities) go a long way to ensure safe W&S

# Provision of improved W&S in practice

## Government failure; implausible reasons (cont'd):

### 3) The financial costs are prohibitively high?

- ◆ The WHO estimates that extending W&S provision to meet the MDT - at the most basic level of **technology** - would be of the order **\$11 billion annually**
- ◆ Some poor countries already provide between **60%** and **80%** of the population with improved W&S (Figures 1.a-b).

### 4) Small economic returns to public investments in improved W&S?

According to WHO estimates, the economic **benefit-cost (B/C) ratios** are in the 3 to 34 range. I will come back to these estimates.

Figure 1.a. Correlation between share of population with improved sanitation and GNI per capita across 85 developing countries in 2002/04

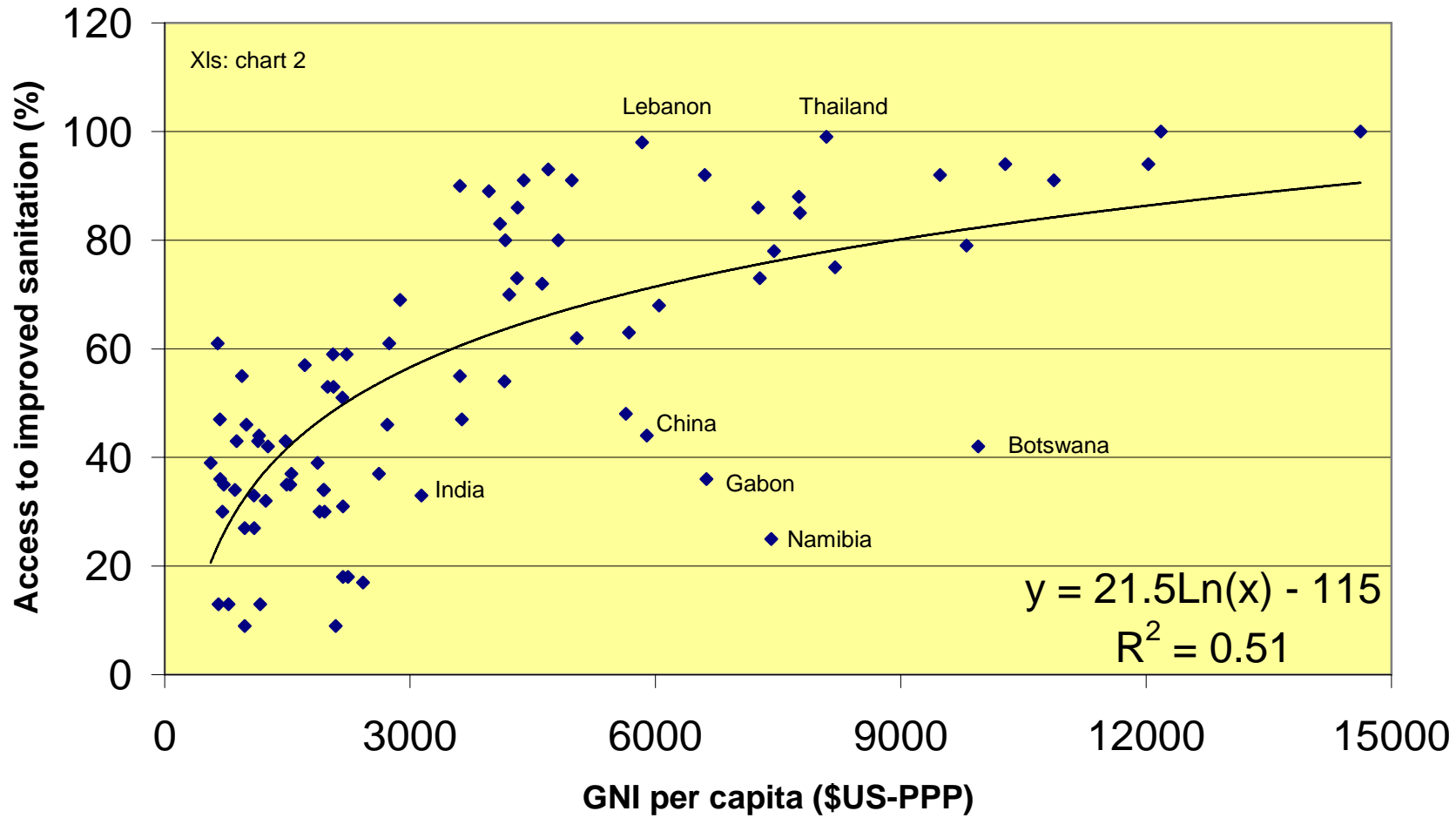
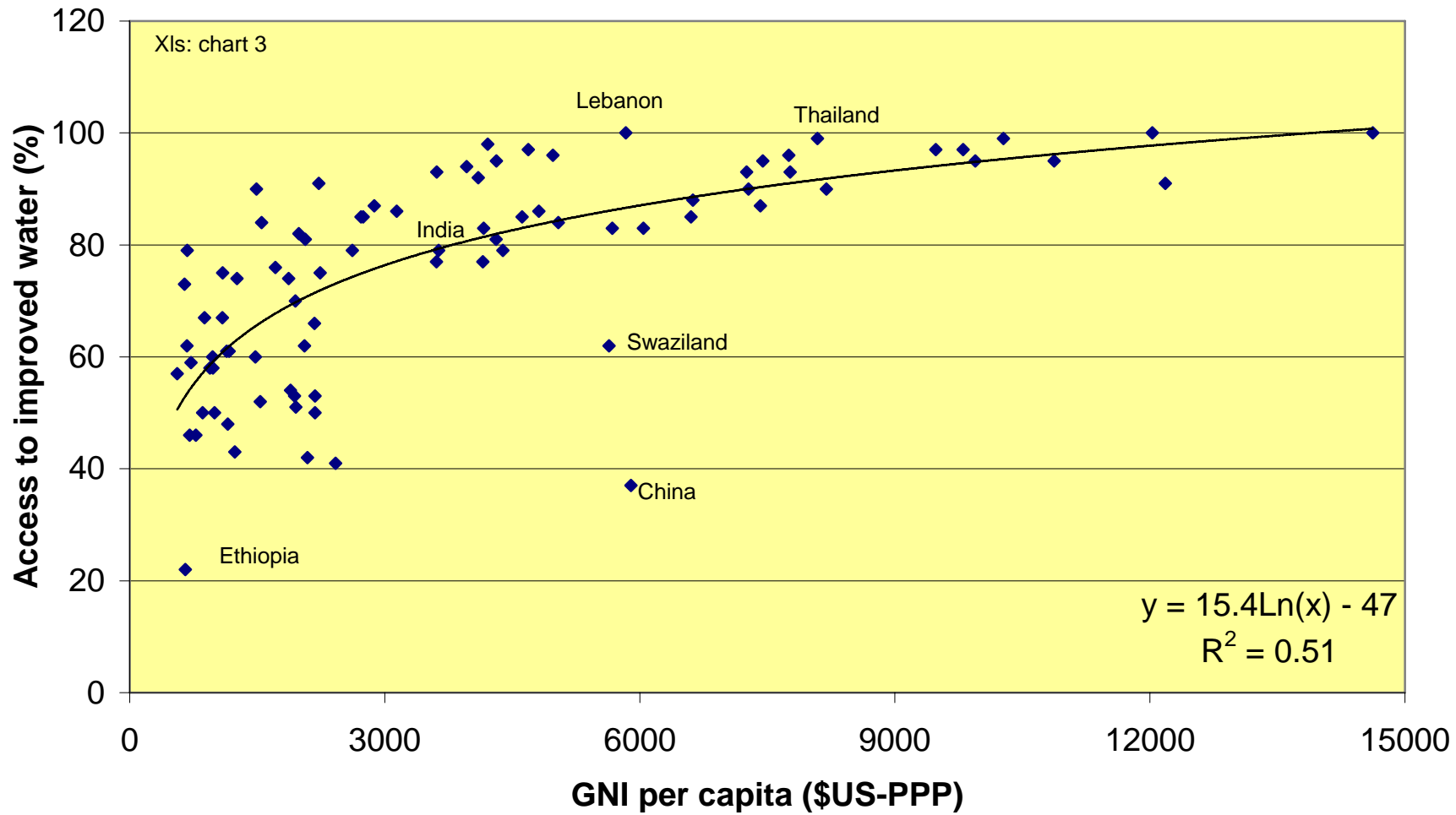


Figure 1.b. Correlation between share of populatin with improved water and GNI per capita across 85 developing countries in 2002/04



# Provision of improved W&S in practice (cont'd)

## Government failure: plausible reasons

### 1) Many governments give low priority to providing W&S services to poor population segments

Most governments in the countries with severe W&S problems are not democratic and their **track records** bluntly show that they give low priority to investments in W&S utilities for the poor (cf. **basic health care** and **education**)

### 2) Perverse incentives for good management in public utilities

Public W&S utilities, financed through the government budget, have little incentive to serve users since they are accountable only to the **politicians** who control the purse



# Provision of improved W&S in practice

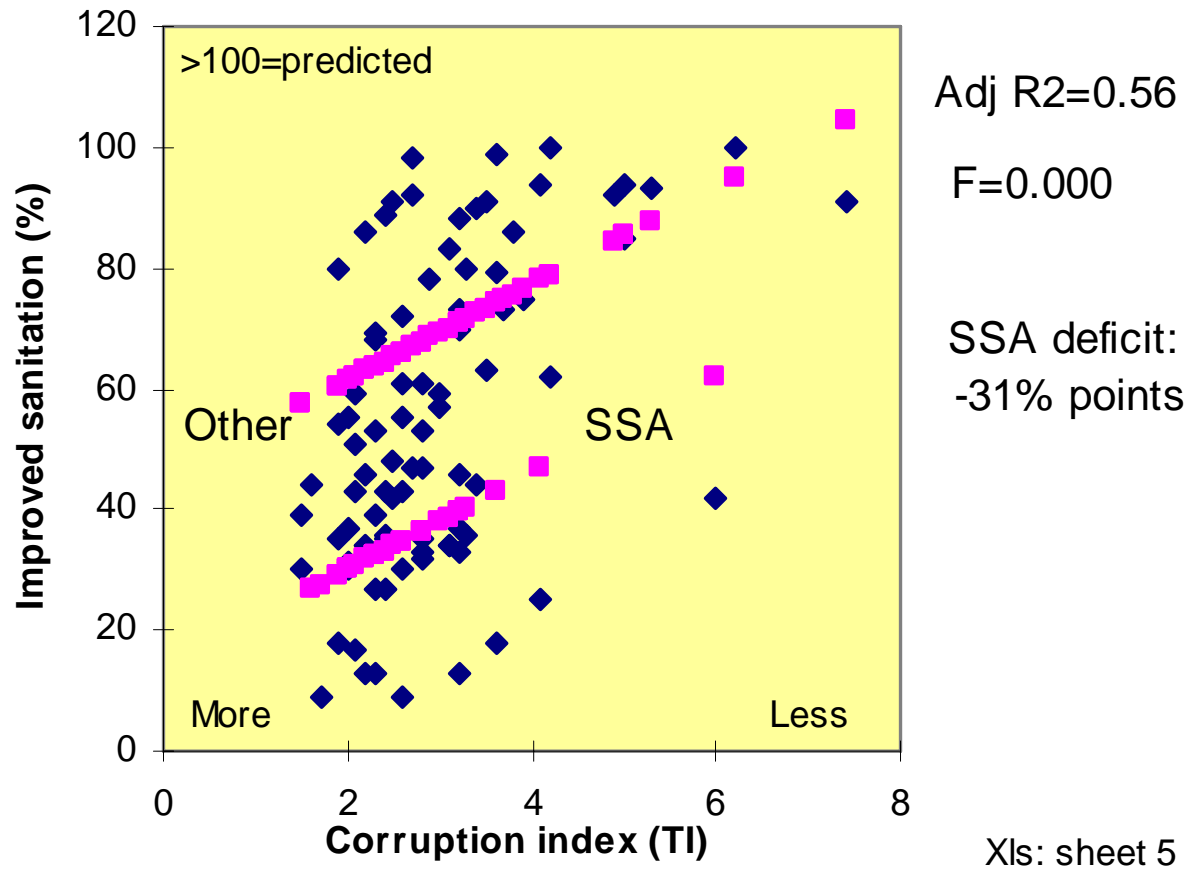
## Government failure: plausible reasons (cont'd)

### 3) Corruption in government and public agencies/utilities

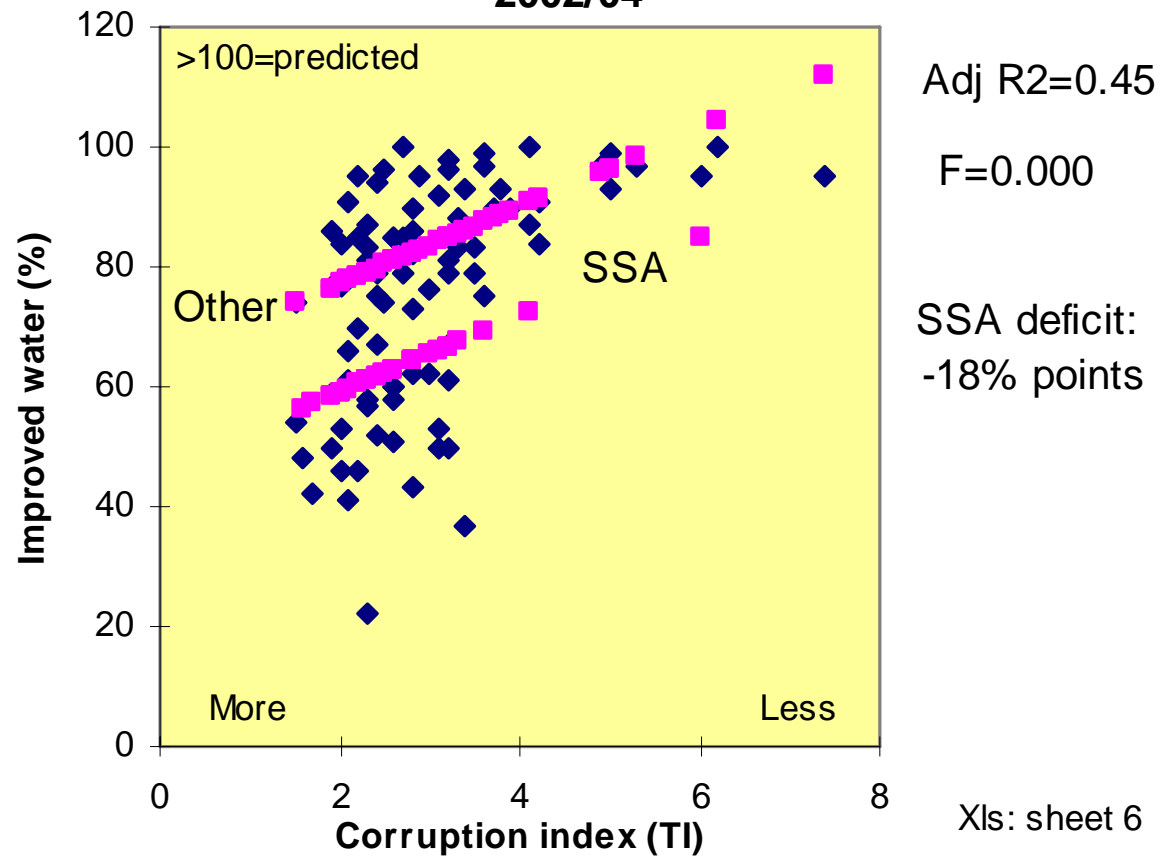
- ◆ The corruption ranges from **petty** corruption (e.g. to expedite repair works) to **kick-backs** to officials in large-scale infrastructure projects (estimated at 6-11%)
- ◆ The World Bank thinks that **20-40%** of water sector finances are lost to **corruption**
- ◆ There is a close correlation across countries between **underinvestment in W&S** and **corruption** (Figure 2.a-b)

### 4) Unsustainable financing methods: **next theme!**

**Figure 2.a. Correlation between share of population with improved sanitation and corruption across 85 developing countries in 2002/04**



**Figure 2.b. Correlation between share of population with improved water and corruption across 85 developing countries in 2002/04**



## Theme 2. Financing collective W&S facilities: Options

Infrastructure for the **collection, storage, treatment** and **distribution** of water and **disposal** of waste water has to be **financed by someone**. Either through the government budget (**taxpayers**) or the private **users** – or a combination.

### Possible combinations of finance and provision of W&S services:

		Improved W&S provision to:	
		Mainly the well-off	All, including the poor
<u>Main financial source:</u>	Tax-payers	1) Most present schemes	3) Dream scenario?
	User fees	2) Other present schemes	4) <b>Realistic and better for the poor than today</b>

## Financing collective W&S facilities (cont'd)

### Why cost-covering user fees for (almost) all?

#### Reason 1: Financial requirements

Public W&S utilities are often **underfinanced**, as reflected in (1) limited **coverage** and (2) inadequate **maintenance**

#### Reason 2: Priceless water $\approx$ Wasted water

Estimates suggest that about half of all water in developing countries' urban networks is **wasted** through leaking pipes. Any commodity provided free of charge signals that it is in **unlimited** supply

## Lack of incentives

- ◆ **Users** only have **incentives** to hold down consumption and avoid waste if they have to **pay** (something) for the water
- ◆ **Public water-managing authorities** have little **incentive** to **extend** and **maintain** facilities if there are no consumers who pay a price and therefore **give voice** if the **price is inflated** because water is squandered by the suppliers and/or supply is **irregular** or **contaminated**

## The conventional objection:

### The poor cannot afford fees for improved W&S services

This argument is in most instances **misconceived!** The proper comparison is between what the poor **pay today** and the user fee they **would pay** if actually provided with improved W&S.

- ◆ **Urban areas.** Connecting the urban poor to formal W&S networks and paying a fee would **not** mean that **previously free** water becomes a **new economic burden**. The urban poor often now pay **10 times higher** prices for **inadequate** and **unsafe** water in **informal markets!**
- ◆ **Rural areas.** Paying a fee for **communal** W&S facilities in rural areas would free women and children from time-consuming collection of water from far-away sources. **Time** that could be used for more productive purposes (work and schooling).

## Theme 3:

### What benefits would meeting the W&S target bring?

The WHO (2004) has estimated the **economic benefits and costs** of reaching the MDG target for improved W&S

**Investment costs** would be about **\$11** billion per year up to 2015.

The annual **benefits** would be **\$85** billion:

- \* Reduced cost for **treating ill health** 7.3
- \* Increase of **working days** due to improved health 0.75
- \* ***Time freed from collecting water/arranging sanitation*** **64.0**

The (average) **benefit/cost ratio** would be 8 (also see Copenhagen Consensus)



# What benefits would improved W&S bring? (cont'd)

Some experts question the WHO estimates.

## Underestimated costs?

- 1) Do not take into account **all indirect investments** in infrastructure and training of manpower into account on the cost side
- 2) The costs of “**scaling up**” have been underestimated

**Marginal costs** are due to **rise** substantially when coverage is increased.

- ◆ In **urban areas** costs are relatively low (extending existing facilities)
- ◆ In **rural areas**, with low population densities and no prior existing networks, marginal costs are apt to be higher

Also differences in **climate** and **topographic** conditions play a role!

## What benefits would improved W&S bring? (cont'd)

### Overestimated benefits?

- 1) The estimated **economic benefit** from time saved collecting water seems suspiciously large, but I have to study this in more detail.
- 2) Most of the estimated **health benefits** are derived from small trial tests under highly controlled (“laboratory”) conditions that seldom turn out as large when **“scaled up”**
- 3) The relationship between child health and W&S at the **macro level** suggests that health benefits are larger for **alternative interventions** *Next theme!*

## Theme 4: Macro-level relationship between W&S and health

### Improved W&S – objective and *instrument*!

- ◆ The main MDGs are to reduce **poverty, hunger,** and **premature mortality**.  
For these overriding goals, improved W&S is an **instrument** - although it is also an **objective** in itself (intrinsic value of improved health)
- ◆ I will focus on improved W&S as an **instrument** for enhancing **child health** relying on observations at the **macro** level
- ◆ I will also raise the question whether improved W&S is **more effective** in reducing child ill health than **alternative interventions**, i.e. parental (health) **education** and child **health care**

# The macro-level relationship between improved W&S and child health

## Proxy variable for child health status: U5MR

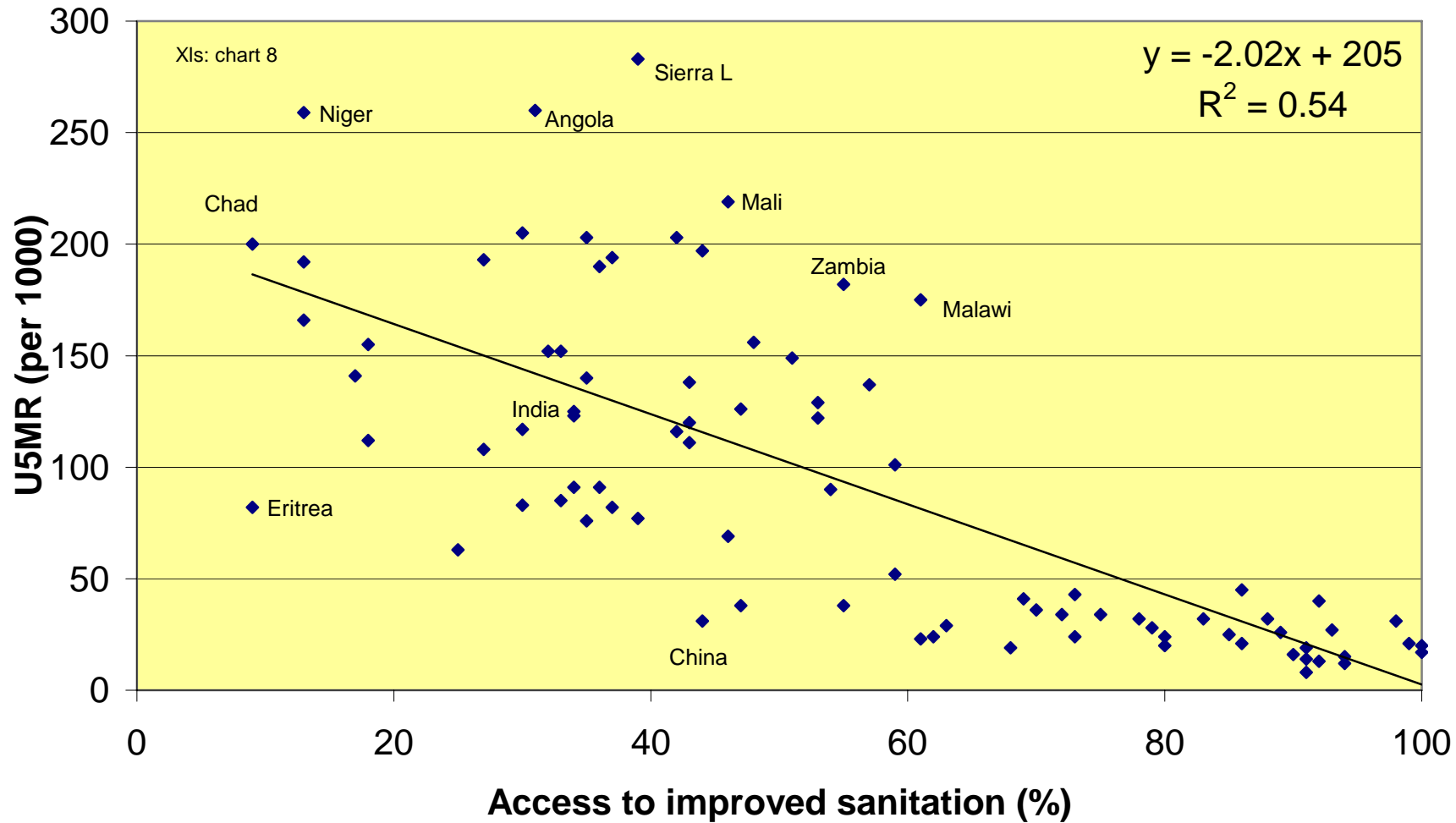
- ◆ There are no estimates of prevalence of child diseases that are possible to aggregate into a **single general measure** of ill health that is **comparable** across countries.
- ◆ In **macro-level** studies, we have to use **proxy variables**, such as **child mortality**. The justifying assumption is that excess **mortality** reflects underlying excess **morbidity**.
- ◆ I will use **U5MR** as the chief indicator of **child health status** (using instead IMR changes nothing of substance).

## Correlation between U5MR and improved sanitation: Figure 3.a

- ◆ Correlation is highly significant and half the variation in U5MR is “explained” by variations in access to improved sanitation
- ◆ All countries with >60% access to improved sanitation have U5MR **below 50** and almost all countries with <60% have U5MR **above 50**
- ◆ Among the countries with <60% sanitation coverage, there is **no significant correlation** between this variable and U5MR

***Implication:*** In these countries (<60%), **factors** other than improved sanitation explain more of the **variation** in child mortality

Figure 3.a. Correlation between under-5 mortality and share of population with improved sanitation across 85 developing countries in 2002/04

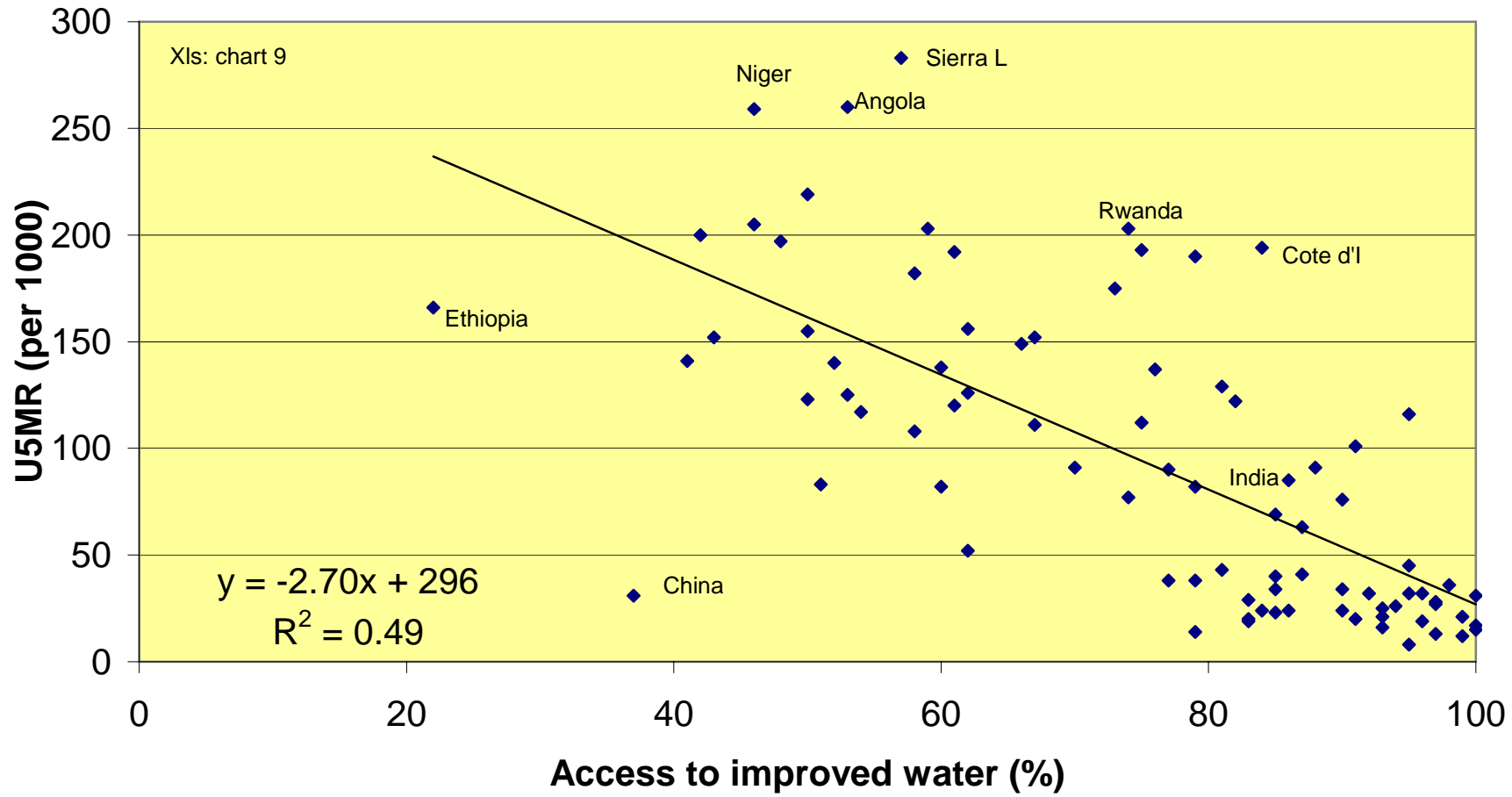


## **Bivariate correlation between U5MR and improved water:**

### **Figure 3.b.**

- ◆ Correlation is highly significant and **half** the variation in U5MR is “explained” by variations in **improved water**
- ◆ In **contrast** to sanitation, even among countries with a high share of the population with access to improved water (>75%), U5MR varies considerably (from 8 to close to 200). This indicates that **other factors** than improved water lie behind the variation in **U5MR**
- ◆ **China** is an extreme outlier with less than 40% coverage of improved water – only Ethiopia lower - and still U5MR is around 30. **Mis-measurement?**

Figure 3.b. Correlation between under-5 mortality and share of population with improved water across 85 developing countries in 2002/04



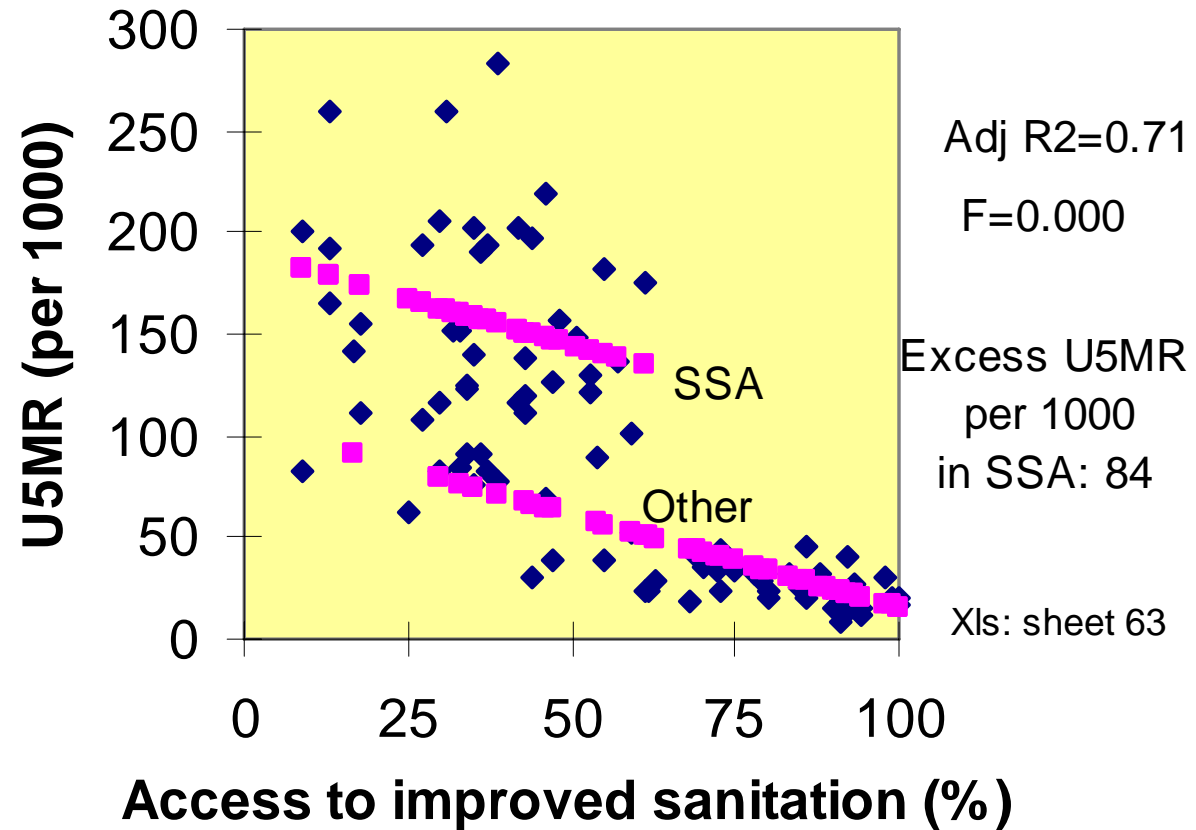


## Is Sub-Saharan Africa special?

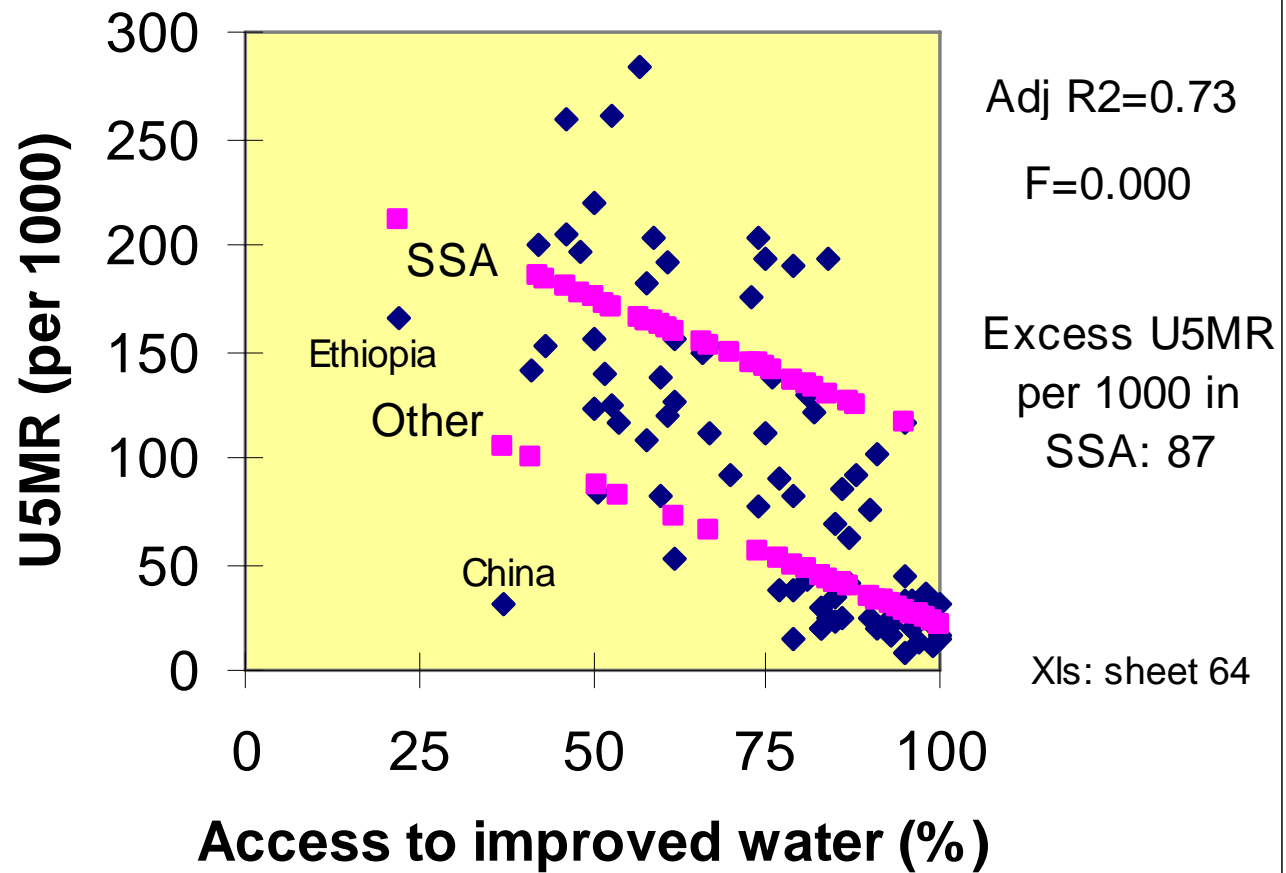
- ◆ Inspection of the data suggests that countries in **Sub-Saharan Africa (SSA)** in general have higher **U5MR** (and IMR) than other countries for given **levels of improved W&S**
- ◆ Regressions with a **dummy variable for SSA** confirm the observation. The coefficients for W&S remain significant, but the coefficient for the **SSA dummy** turns out stronger in both regressions

**WHY?**

**Figure 4.a. Correlation between U5MR and improved sanitation across 85 developing countries in 2002/04**



**Figure 4.b. Correlation between U5MR and improved water across 85 developing countries in 2002/04**



## Is child health-care inferior in SSA?

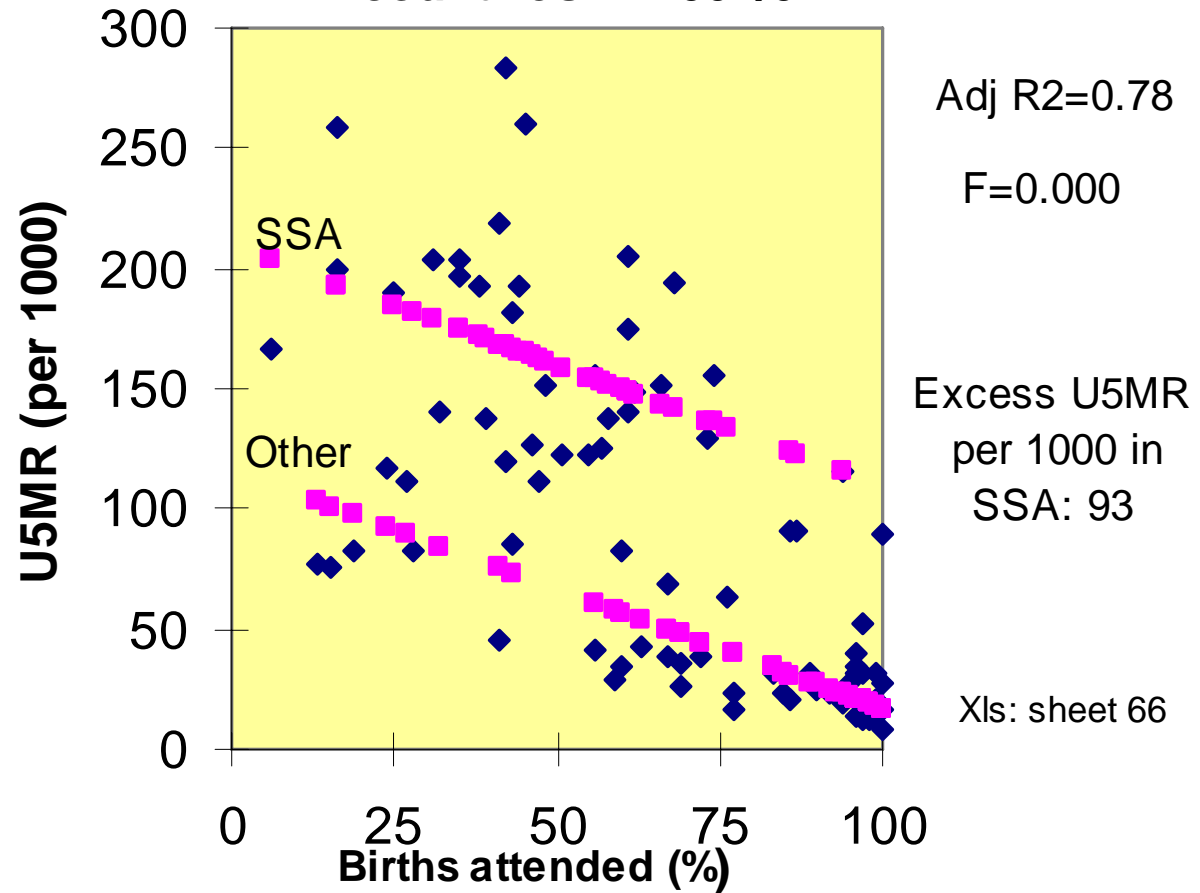
- ◆ There are no **direct measures** of the share of children receiving **professional health care** that are comparable across countries
- ◆ There are, however, estimates of the share of **births** that are attended by **professional health** workers, on the presumption that they reflect the health care provided to young children **more generally**
- ◆ **Correlate strongly** with other indicators of child **health-care** provision, e.g. the share of children **fully vaccinated**.

## Is child health-care inferior in SSA? (cont'd) – Regression results

- ◆ In a correlation between U5MR and the share of **births attended by skilled health personnel** and a **SSA dummy**, both explanatory variables turn out highly significant (Figure 5)
- ◆ The overall **explanatory power** of the regression is **higher** than for the two equivalent regressions with improved W&S, respectively
- ◆ The size of the correlation coefficient for the SSA dummy indicates an **excess mortality** of about **93 children** (per 1000) at given levels of institutional health care

**Why? Low quality of health care in SSA, or missing variables?**

**Figure 5. Correlation between U5MR and share of births attended by skilled health personnel across 83 developing countries in 2002/04**



## Is low per-capita income the reason why SSA stands out?

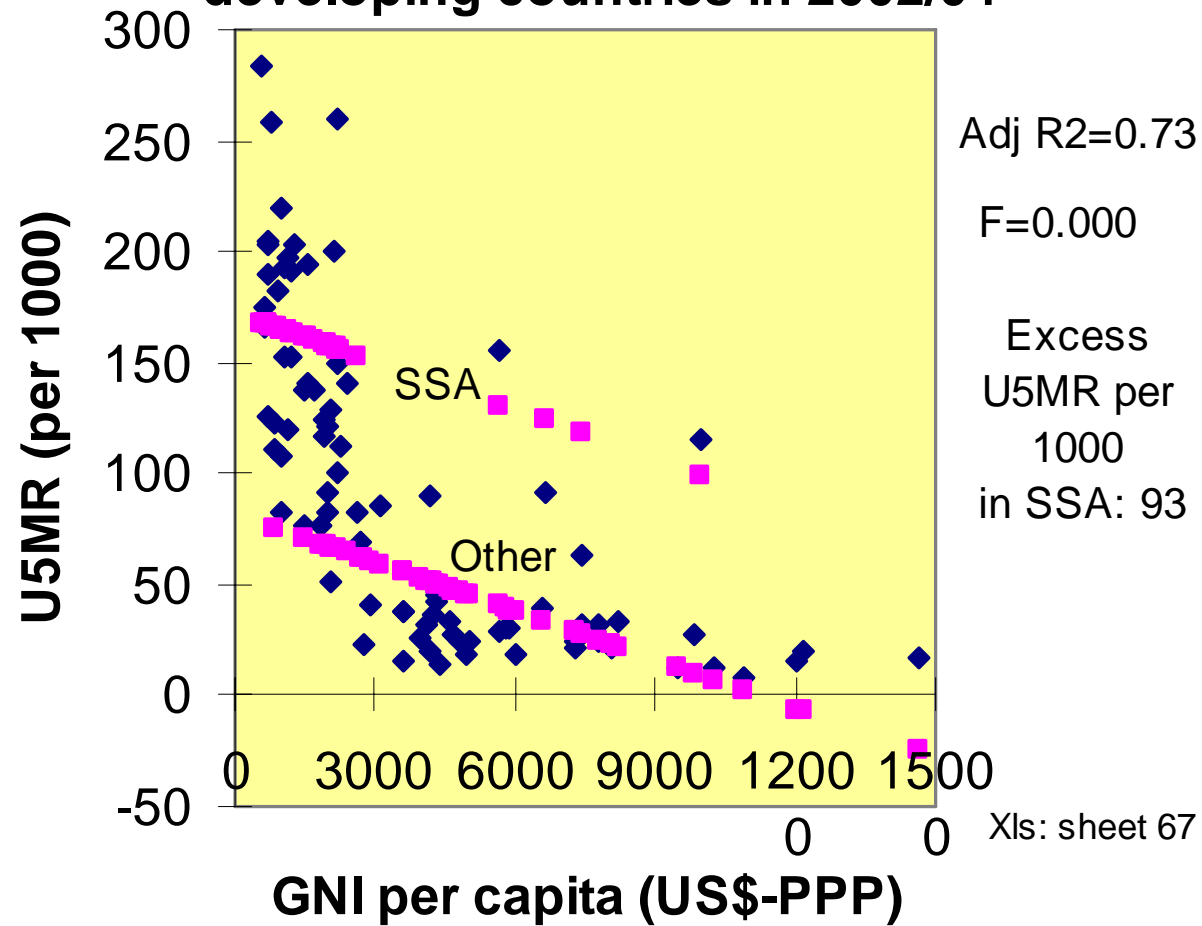
The **SSA countries** are with few exceptions (Gabon and Botswana) among the **poorest** in the world (SAU is not in data set)

Is this **why** they also have the highest U5MR?

Answer: Low income is one important factor, but the highly **significant dummy for SSA** suggests **missing** variables.

For **given income levels**, the SSA countries have on average **93** more child deaths (per 1000) than other countries.

**Figure 6. Correlation between U5MR and GNI per capita across 85 developing countries in 2002/04**





# Is high fertility the reason behind excessive U5MR in SSA?

What “other” variable have yet to be considered?

Several were examined, but only one seems to have a significant impact on child mortality: **the fertility rate**.

High **fertility** has been **hypothesised** to increase **child mortality**:

- 1) More children in households increases the risk of siblings catching **communicable diseases** from each others
- 2) Less **time** and **income** for parents **to spend** on each child
- 3) High child mortality **increases** fertility (**replacement effect**)

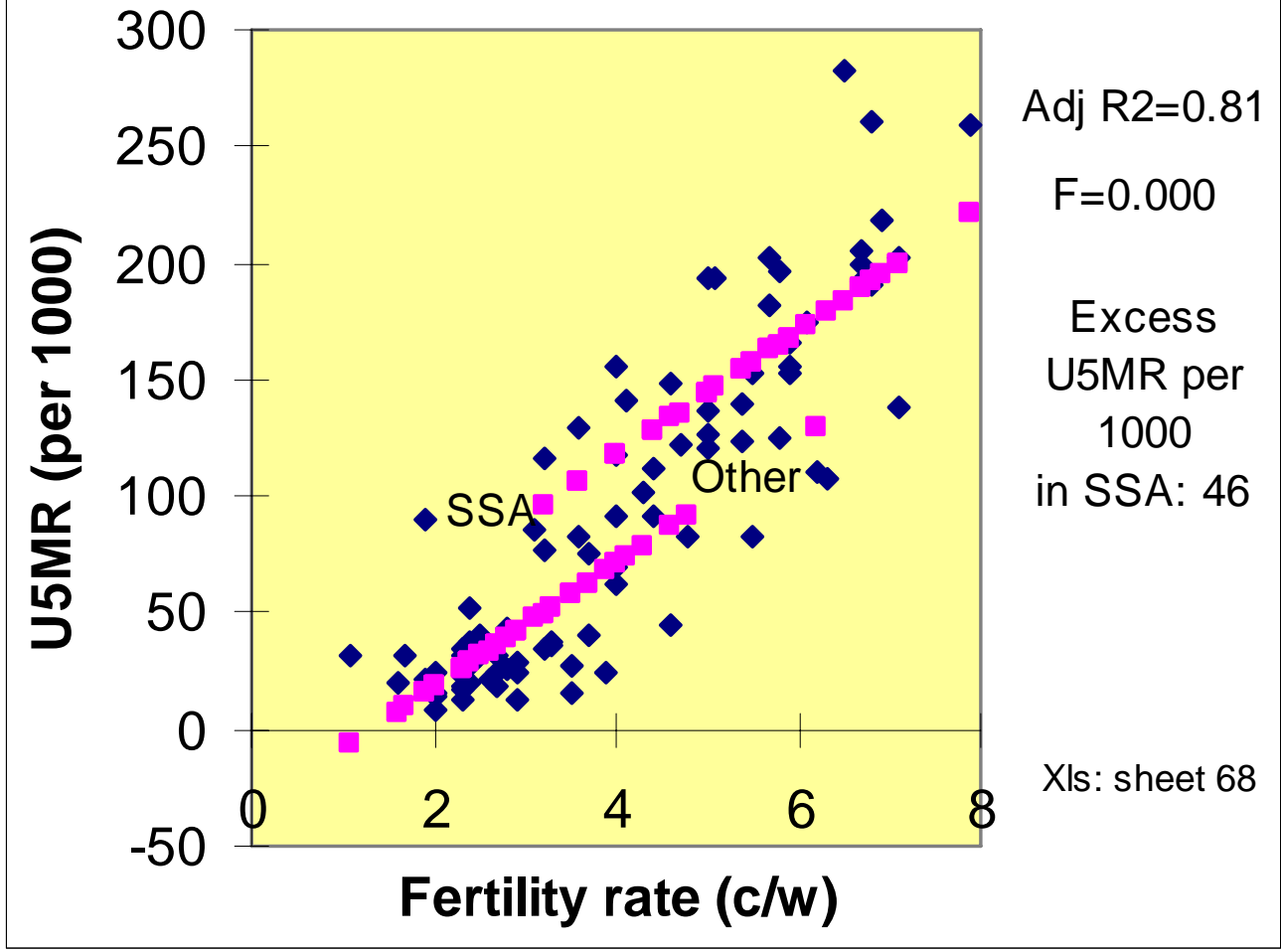
# Is high fertility the reason behind excessive U5MR in SSA?

## Regression results

The correlation between **U5MR** and the **fertility rate** and a **SSA dummy** turns out **highly significant** and explains **81%** of the inter-country variability in U5MR

- ◆ When **fertility** and sanitation are entered jointly in a multiple regressions, the latter variable turns out **insignificant** while **fertility** remains highly significant
- ◆ When **fertility** and water are entered together in a multiple regressions, the latter variable turns out **weakly significant** while **fertility is highly significant**

**Figure 7. Correlation between U5MR and fertility across 85 developing countries in 2002/04**



# Is high fertility the main reason behind excessive U5MR in SSA?

## Interpretation of regression results

- ◆ That the fertility rate comes out as the dominant variable in the multiple regressions indicates that **high fertility** has a larger effect on **child mortality in developing countries in general** than lack of improved W&S
- ◆ The **SSA dummy variable** is highly **significant**, but the excess U5MR in SSA is now reduced to **46** (per 1000)
- ◆ This means that we have probably identified a **main reason** why the SSA countries stand out in terms of high U5MR: **high fertility** (averaging 5.5 as compared to 3.2 in South Asia)

## Policy implications of findings?

The implication for policy is **not necessarily** that more resources should be spent on **reducing fertility** rather than improving W&S

- if the ultimate **objective** is to reduce child mortality (morbidity)

**Feasibility and costs of reducing fertility have to be considered!**

**Policy instruments:**

- ◆ **Short- and medium term:** family planning, education, subsidies?
- ◆ **Long-term:** Economic growth (transition theory)

**All variables considered here are closely related to GNI/C (improved W&S, corruption, U5MR, and fertility)**

## Summary: 1) Determinants of improved W&S

- ◆ Provision of improved W&S is related to **GNI/C**, level of **corruption** and **“geography”** (Sub-Saharan Africa)
- ◆ Since GNI/C and corruption are closely **inter-related**, it is not feasible to say which is the most **important determinant**
- ◆ Countries in **SSA** have low provision of **improved W&S** because incomes are low and corruption rampant, but also for **given levels of these variables**.

**WHY? Bad governance?**

## Summary: 2) Effect of W&S on child health (U5MR)

- ◆ In simple bivariate regressions both improved **sanitation** and **water** are significantly correlated to U5MR
- ◆ The SSA countries stand out. U5MRs are high because improved W&S, incomes and professional health care, are low, but U5MR is significantly higher in SSA **for given levels of all these variables. WHY?**
- ◆ Exceptional **high fertility** is the tentative answer. When fertility is entered in regressions jointly with improved Water or Sanitation, these variables come out weak or insignificant
- ◆ The **SSA dummy** is still significant but much **smaller**

## Concluding remarks

- ◆ The WHO, UNICEF and UNDP have recently published reports with strong pledges for increased investments in improved W&S. The WHO suggests that such investments would bring huge **economic (and health) net benefits**
- ◆ There are some 50 other MDG **targets**, among them universal basic **health-care provision** and primary **education** for all. These interventions are also estimated to bring **large net economic benefits** to the developing countries. How to **prioritise**? (cf. Copenhagen Consensus)
- ◆ Almost all these interventions are commonly understood to be in the **public domain** and, hence, to be **financed by governments**



# Financial requirements and prioritising

## These observations lead to the following awkward questions:

- ◆ Are the developing countries' government revenues **sufficient** for investing in all these sectors simultaneously? Reduction of other expenditures?
- ◆ If not, how should government revenues be increased?
  - Who should be **taxed** and how?
  - Are massive increases in **foreign aid** the answer? **Past experience**?
  - What indicates that **aid** will be more efficient in **the future**?
- ◆ Could it be that **estimated** net benefits from investment in **one sector** at the time will be **exaggerated** - when direct and indirect effects on other sectors and the economy at large **are not considered**?