LECTURE 4

Growth Empirics

(lectures 3 and 4 will be presented in the same class)

Six approaches for empirical estimation of growth determinants

Approaches	Description of Method	Main Results	Methodological Problems
1. Simulations of Growth Models	✔	✔	✔
2. Growth Accounting	✔	✔	✔
3. Time-Series Estimations	✔	✔	✔
4. Cross-Country Regressions	✔	✔	✔
5. Panel Regressions	✔	✔	✔
6. Country Studies ("analytical narratives")	✔	✔	

[4.2] Approach 1: Simulation of (Modified) Solow Model

1. Mankiw's defence of the Solow model

Does the so-called new growth theory mean that the Solow Models has lost its relevance? Not according to **Mankiw (1995**). He claims:

a) The virtue of the model is its **simplicity** and focus on the most **important** variables (capital accumulation)

b) To **endogenize savings and technological progress** means little since we have no good theories for how these variables are determined

c) **Technological progress** may be important in explaining growth as such, but **not variations across countries**, which he considers the most important issue (all countries have access to basically the same technology, he argues)

d) The proof of the pudding is in the eating; i.e. the model is "good" if it can predict **differences in income levels** across countries (i.e. past growth). He uses a **modified** version of the Solow model for **simulations** to answer this question.

e) When appropriate (modified) values of the parameters are inserted into the Solow model, it does predict results that are consistent with "reality", not only in **qualitative**, but also in **quantitative** terms.

[4.3] Approach 1: Simulation of (Modified) Solow Model

2. Modifications and equations

Mankiw derives the following expressions from the basic Solow model:

$$\frac{y_1^*}{y_2^*} = \frac{\alpha}{(1-\alpha)}\left[\frac{s_1}{s_2} - \frac{(n+g+\delta)_1}{(n+g+\delta)_2}\right]$$

Which gives the difference (ratio) in steady state per-capita incomes between two economies as a function of differences in **saving** ratio (s) and **population growth** (n), the rates of technological progress (g) and depreciation (δ)., Under the assumption that n, g and δ are the same in the two countries, we have that:

$$y_1^*/y_2^* = \alpha/(1-\alpha)[(s_1/s_2) - 1]$$

That is, the difference (ratio) in steady state per-capita incomes between two economies is as a function of differences in **saving** ratios only if also α is the same.

The α = (dy/dk)(k/y) can be approximated with the **capital share** in total income, since dy/dk = r, the return to capital, which gives that:

α = r k/y.

Most **empirical studies** have estimated that the share of incomes accruing to physical capital to be about 0.3 in many economies

[4.4] Approach 1: Simulation of Solow Model -

3. Mankiw's Modifications of Parameter Values

Mankiw argues that α is **larger** than conventionally thought of because the **Capital share** should be measured as to **include human capital.**

He arrives at the conclusion that the **total return to all capital** (physical and human) in at least developed countries is about **twice as large** as the return to physical capital alone.

So instead of setting α at 0.3, he argues that it should be around 0.6.

Example : $s_1/s_2 = 4$; and $(n + g + \delta)_1 = (n + g + \delta)_2$

$$\alpha = 0.3 \Rightarrow y_1^*/y_2^* = (0.43)(4 - 1) = 1.3 \quad \text{(traditional)}$$

$$\alpha = 0.6 \Rightarrow y_1^*/y_2^* = (1.5)(4 - 1) = 4.5 \quad \text{(alternative)}$$

As we see, when α is set at the conventional level (0.3), huge differences in savings and investment ratios have little impact on **steady state levels of income**. This is counter-intuitive and does not square with independent observations, which suggest very large differences in per capita income (past growth) related to differences in past investment ratios.

With α at 0.6, the income differences will be **much higher** and more in line with what we can **observe when consulting the data**.

[4.5] Approach 2: Growth Accounting

a) Traditional aggregate over whole economy (Cobb-Douglas)

$$Y = K^{\theta k} L^{\theta l}$$

$$dY/Y = \theta_k \, dK/K + \theta_l \, dL/L + TFP$$

$$TFP = dY/Y - [\theta_k \, dK/K + \theta_l \, dL/L],$$

where

$$\theta_k = \frac{\delta Y}{\delta K}\frac{K}{Y} = \frac{r\,K}{Y} \quad \text{and} \quad \theta_l = \frac{\delta Y}{\delta L}\frac{L}{Y} = \frac{w\,L}{Y}$$

are the shares of capital and labour income, respectively, which can be estimated from the National accounts. **Provide your own example**!

b) Modern Growth Accounting, disaggregation at industry and sector level (YOUNG 1995)

Young uses a more sophisticated and disaggregated version:

$$TFP = \hat{Y} - \Sigma_i \, \theta_{ki} \, \hat{K}_i - \Sigma_j \, \theta_{lj} \, \hat{L}_j$$

that is, both capital and labour are **disaggregated** in several dimension (where the hats indicate relative change).

Main difference is hence that this modern version allows for changes, not only in the supply of factors of production in a disaggregated form, but also changes in the **sector allocation** of these resources.

[4.6] Approach 2: Growth Accounting (cont'd)

Table 4.1. Summary of Young's Results for 1960-1990

	Hong Kong	Singa-pore	South Korea	Taiwan
1) Growth of GDP (annual %)	7.3	8.7	8.5	8.5
2) Growth of physical inputs (capital and labour) (percentage points)	5.0	8.5	6.8	6.4
3) Total factor productivity (TFP) growth (percentage points) [1-2]	2.3	0.2	1.7	2.1
4) Traditional TFP growth (percentage points)	3.4	4.1	4.1	4.0
5) TFP growth as % of total growth	32	2	20	25
6)Trad TFP growth as % of total growth	47	47	48	47

With Young's more **disaggregated** method for estimating, at the level of industries, and with human capital as a separate factor, the TFP contribution to growth becomes much smaller (row 3) than when estimated with the **conventional**, aggregated, method (row 4).

The difference between the traditional and new estimates can hence be interpreted as the contribution of (i) human capital investment **and** (ii) **reallocation of resources** from low to high productivity sectors.

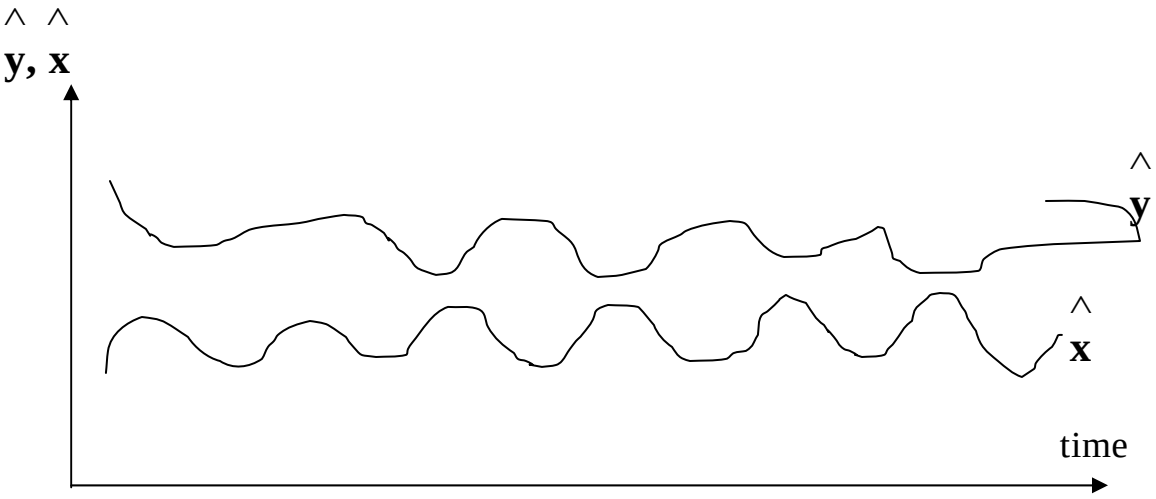
Main problem with method: Very detailed, disaggregated and reliable data are required, which are unavailable for the **least developed** countries.

[4.7] Approach 3: Time-series Regressions

Has been applied to answer different growth questions

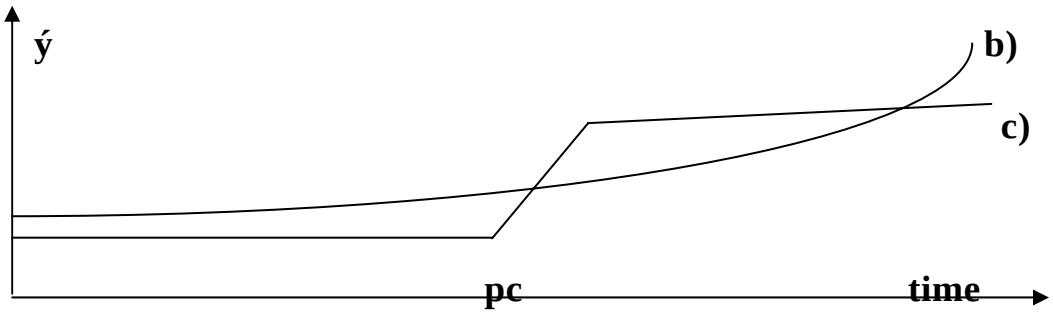
a) The method has sometimes been used for estimating an equation like the following on **annual data** (t):

$$\hat{y}_t = \alpha + \beta_{1t}\hat{X}_{1t} + \beta_{2t}\hat{X}_{2t} + \ldots\ldots\ldots\ldots \beta_{nt}\hat{X}_{nt} + \varepsilon$$



b) The method can also be used to study whether there are any **long-term** changes in the rate of growth within countries, net of influences of physical inputs. The model with **endogenous technological progress** predicts that as a country grows richer, the growth rate will increase (divergence). Control for other influences important!

c) Checks whether abrupt policy changes (pc) affect growth



[4.8] <u>Approach 3</u>: Time-series Regressions (cont'd)

Results and main Methodological Problems

a) The method has only seldom been used to estimate determinants of **annual** changes in growth. There are several reasons for this:

1) **Lags** and **leads** of varying time lengths. Examples: investments in education may affect growth several years later (**lag**); a budget reform in year t may affect growth in previous years if anticipated and expected to enhance the investment climate (**lead**)

2) Difficult to distinguish between **growth proper**

and **business cycle** fluctuations (varying capacity utilisation).

b) When used to estimate the "**accelerating growth hypothesis"**, the result is almost always in the negative.

Growth data for the period 1870-2001 for most of the rich countries show no distinct long-term trend (Maddison, 2003), only fluctuations of various length in time.

c) When used to estimate whether **discrete policy changes** have affected the growth rate, various results. Recently, there has been an intense debate between Dollar & Kraay (2000) and Rodriques and Rodrik (2000), whether **growth in India did accelerate** after it started to liberalise the economy in 1991. Difficult problems of interpretation!!

[4.9] Approach 4: Cross-country Regressions

a) Simplest test of unconditional convergence with only one "explanatory" variable

We want to test the hypothesis that the growth rate (dy/y) tends to decline (or increase) with higher income levels, irrespective of what a country does in terms of the other variables that may influence growth. We then have:

$$dy/y = \alpha + \beta\ GDP/c_{t0} + \varepsilon$$

(cf. simple graph [**1.14**]).

b) Test of Solow Model (see Mankiw et al, 1992).

A test the Solow model on cross-country evidence can be based on the following estimation equation:

$$dy/y = \alpha + \beta_1 GDP/C_{t0} + \beta_2 INV + \beta_3\ POPGrowth + \varepsilon$$

c) Test of New Growth Models

Estimating equation like the one below on the basis of observations for large sets of countries :

$$dy/y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots \beta_n X_n + \varepsilon$$

where n is number of explanatory variables).

[4.10] Approach 4: Cross-country regressions: Results

1) **Unconditional convergence** not confirmed in most studies; that is, poor countries do not grow the fasted irrespective of what policies they pursue (when using unweighted country data).

2) **Conditional convergence** often confirmed (Solow); poor countries tend to grow faster when other variables are controlled.

3) The other main Solow variable, the **investment ratio**, often turns out significant.

4) **Population** growth (Solow) **not** significant in most studies, but in some, e.g. Mankiw et al, 1992.

5) At least **50 other variables** suggested by new growth theory have been shown to be significant **in at least one investigation**.

> These variables include various proxy variables for human capital, fiscal and monetary policies, trade regime, degree of democracy, corruption, ethic and linguistic fragmentation, etc (see the results in Sala-i-Martin, 1997).

[4.11] Approach 5: Panel data (growth) regressions

Similar to cross-country regression, with the difference that the observations for each country are obtained separately for two or more sub-periods.

A **panel regression** is simply to estimate all variables from each country for **sub-periods**, say 1960-69, 1970-79, 1980-89 and 1990-99. Each country then is represented by **four observations**, one for each sub-period. If we have data for **125** countries, we then get **500** observations.

Main advantages:

1) By entering a time fixed effects (a dummy for each period), we can control for **unobserved** changes over time that affect all countries.

2) By entering also country fixed effects (a dummy for each country), panel regressions can control for time-invariant **unobserved** differences (heterogeneity) across countries (e.g. cultural traits, natural resources).

3) Improves the possibility to infer causality rather than associations

4) Increasing the number of observations means that the number of **degrees of freedom** also increases, which enable larger models to be tested.

Main problem: Panel data difficult to obtain in many instances. But panel regressions have to a large extent replaced simple cross-country regressions in many areas of empirical research (not only growth regressions)

[4.12] **Methodological problems in cross-country and panel regressions to be discussed next**

The by far most empirical evidence we have is based on **cross-country and panel regressions**. I will therefore take up **data** and **methodological** problems associated with these approaches.

1) **Robustness** of significance [4.13 - 14]

2) **Measurements** of key variables (e.g. GDP per capita and **purchasing power parity [**4.15 - 18])

3) The **weighting** of variables (or lack of weighting) [4.19-21]

4) Difficulties in finding **adequate proxy variables**: e.g. for Human capital [4.22]

5) **Simultaneity: reverse** causality from the "dependent" variable to the independent variables [4. 23]

6) **Multicolinearity:** correlation between explanatory variables [4.24]

> For a good summary of problems encountered in cross-country regressions, see Rodriguez and Rodrik (2000) and Temple (1999).

[4.13] Methodological problem 1: Robustness.

1) The Levine & Renelt Robustness test (AER 1992)

The test is conducted by taking each of the 50 or so variables [I_i] that have been found significant in at least one previous study as one explanatory variable and, then, include different random sets of four other explanatory variables at the time **[$Z_{n=4}$]** in the test:

$$dy/y = \alpha + \beta_i \mathbf{I_i} + [\beta_n][\mathbf{Z_n}] + \varepsilon$$

Example: We take the investment ratio as the **I** variable and add four other explanatory variables in the regression at random. We keep the investment variable, and do the same with four other independent variables, and then with different sets of independent variables.

Results: Only three explanatory variables "survived" the test.

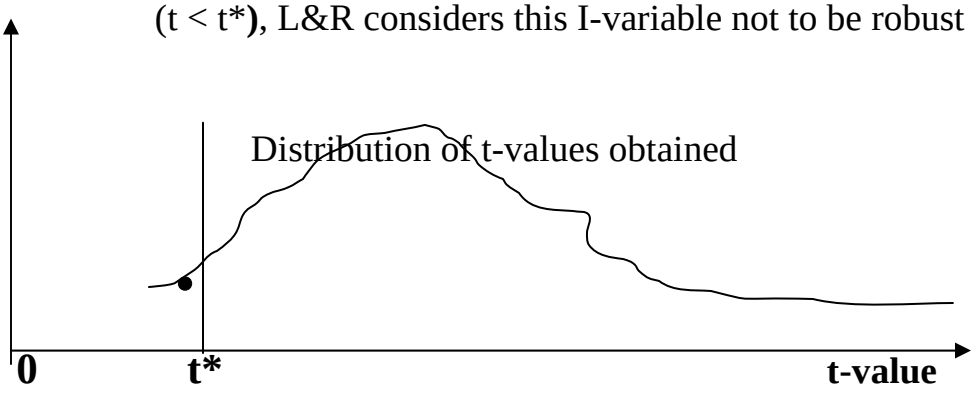
* Initial per capita income
* The investment ratio for physical capital
* One of the proxy variables for Human Capital.

All other variables from the New Growth Theory failed to pass the test!
A final blow to New Growth Theory, and a confirmation, as argued by Mankiw, that the Solow model is focused on the most essential variables?

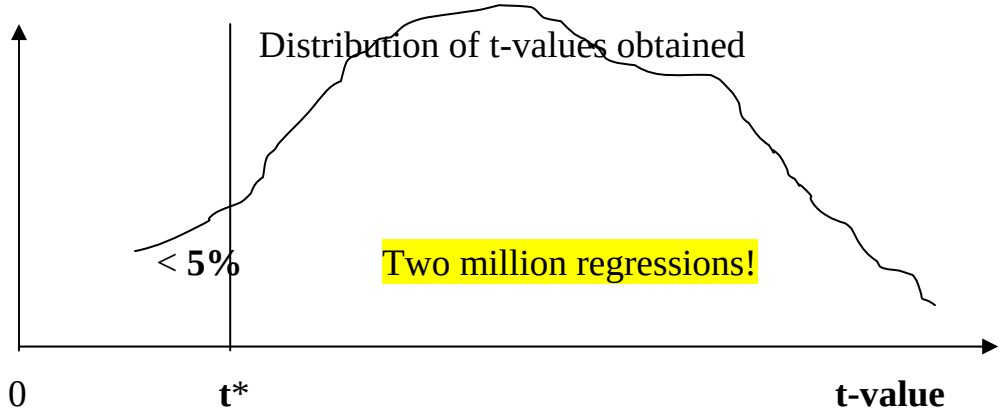
[4.14] Robustness (cont'd): L&R and Sala-i-Martin's tests

Levine & Renelt (AER 1992)

If one **single** t-value for an I-variable turns out insignificant ($t < t^*$**)**, L&R considers this I-variable not to be robust



Sala-i-Martin (AER 1997)



If less than 5% of the t-values of the I-variable turn out lower than t*, signifying insignificance, when different sets of conditioning variables [Z_n] are included, he considers the I-variable to have a robust impact on growth (For Sala-i-Martin's results, see Table 1 in his article)

Conclusion: Regression results often very sensitive to what set of conditioning variables that are included!

[4.14a] Robustness (cont'd): Sala-i-Martin's tests

$$dy/y = \alpha + \beta_1 GDP/C_{60} + \beta_2 LEB_{60} + \beta_3 PSE_{60} +$$

$$\beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \varepsilon$$

That is, all regressions included the same 3 "fixed" explanatory variables, plus different combinations of the 4 out of 59 "other" variables; altogether more than **1 million regressions**!

All explanatory variables measured at the **initial year** (1960) in order to reduce the problem with simultaneity

Results: 3 fixed and 22 other variables significant and robust!

Problems:

a) Initial value of explanatory variables questionable methods for controlling simultaneity (see below

b) Multicolinearity not controlled (see below)

c) Some "robust" variables difficult to interpret (e.g. the shares of different religions)

[4.15] Methodological problem 2: Inaccurate data

Example: Corrected GDP/c data for differences in **Purchasing Power Parity** (PPP) are needed for correctly testing the income convergence hypothesis and estimating world income distribution.

1. Conventional estimates of GDP/c

$$\mathbf{GDP_j/c = NER_j \left[\Sigma P_{jt} Q_{jt} + \Sigma P_{jh} Q_{jh}\right]/c,}$$

where j stands for the particular (developing) country, NER_j is its **nominal** exchange rate, P_{jt} is the **domestic price** of **tradeable** good t; Q_{jt} is the **quantity** of that good produced (measured in value added); P_{jh} is the **domestic price** of home goods and services (non-tradeables), Q_{jh}.

$$\mathbf{RER_j < NER_j \Rightarrow \text{overestimation of } GDP_j/c}$$

$$\mathbf{P_{jh} < P_{ih} \Rightarrow \text{underestimation of } GDP_j/c}$$

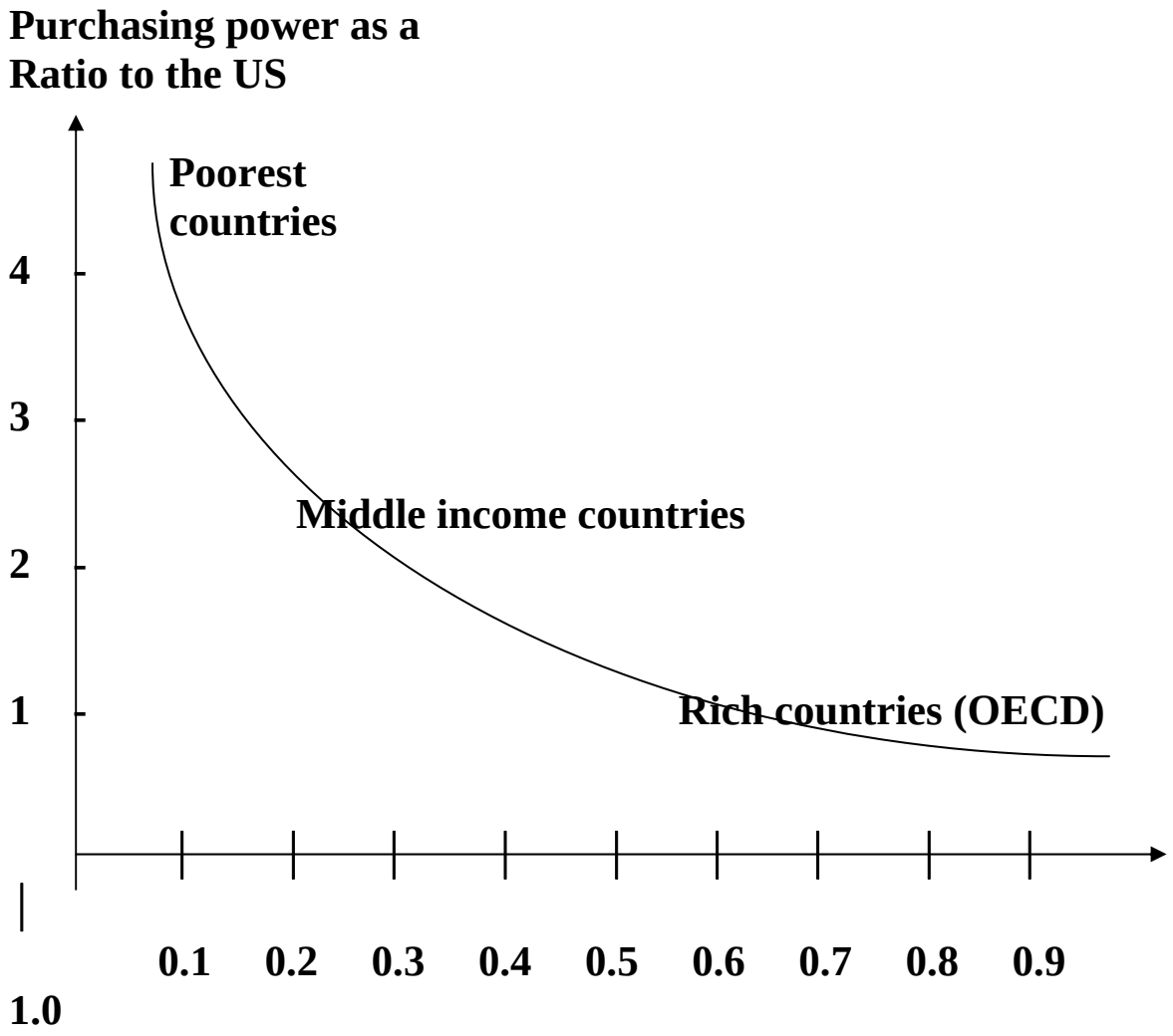
2. The PPP adjusted GDP/c is calculated as follows:

$$\mathbf{GDP_j/c\ (PPP) = \left[\Sigma P_{it} Q_{jt} + \Sigma P_{ih} Q_{jh}\right]/c,}$$

where and P_{it} and P_{ih} are prices of tradeable and home goods valued in "international dollars", which in practice, are US prices. That is, each country's output is valued at **one and the same set of relative prices**.

[4.16] Correct GDP/capita (cont'd)

Large differences in price levels *related* to per-capita income



The purchasing power of a country's per capita income as a ratio to the US, tells us by how much the country's GDP/c has to be **adjusted to accomplish purchasing power parity** (PPP), the by now most common way to compare living standards.

[4.17.a] Corrected GDP/capita (cont'd): Examples 2001

Unadjusted and PPP-adjusted GNP per capita in selected countries and as a percentage of the equivalent US GNP per capita

Country	GNP/capita unadjusted (US$)	GNP/capita PPP-adjust (US$)	PPP ratio (2)/(1)	GDP/C (% of U.S)	
				Unadjus-ted	PPP-adjusted
Ghana	290	2,170	7.5	1	6
Zimbabwe	480	2,220	4.6	1	6
India	460	2,820	6.1	1	8
China	890	3,950	4.4	3	12
Korea	9,460	15,000	1.6	28	44
Greece	11,430	17,520	1.5	33	51
Spain	14,300	19,860	1.4	42	58
Singapore	21,500	22,850	1.1	63	67
Sweden	25,400	23,800	0.9	74	69
U.S.	34,280	34,280	1.0	100	100

Source: World Development Indicators 2003, Table 1.1

[4.17.b] Recent drastic revision of PPP GNI/capita in China and India by the International Comparison Program (ICP)

	Year	Estimate	GNI/capita (US = 100)		
			PPP	US$	PPP/US$
China	2005	Revised	9.8	4.1	2.4
	2004	Old	13.9	3.1	4.5
		PPP/US$ 2005/2004			0.53
India	2005	Revised	5.1	1.7	3.0
	2004	Old	7.8	1.5	5.2
		PPP/US$ 2005/2004			0.58

Sources: 2005 ICP, preliminary results as of December 2007, World Development Report 2006 (data for 2004).

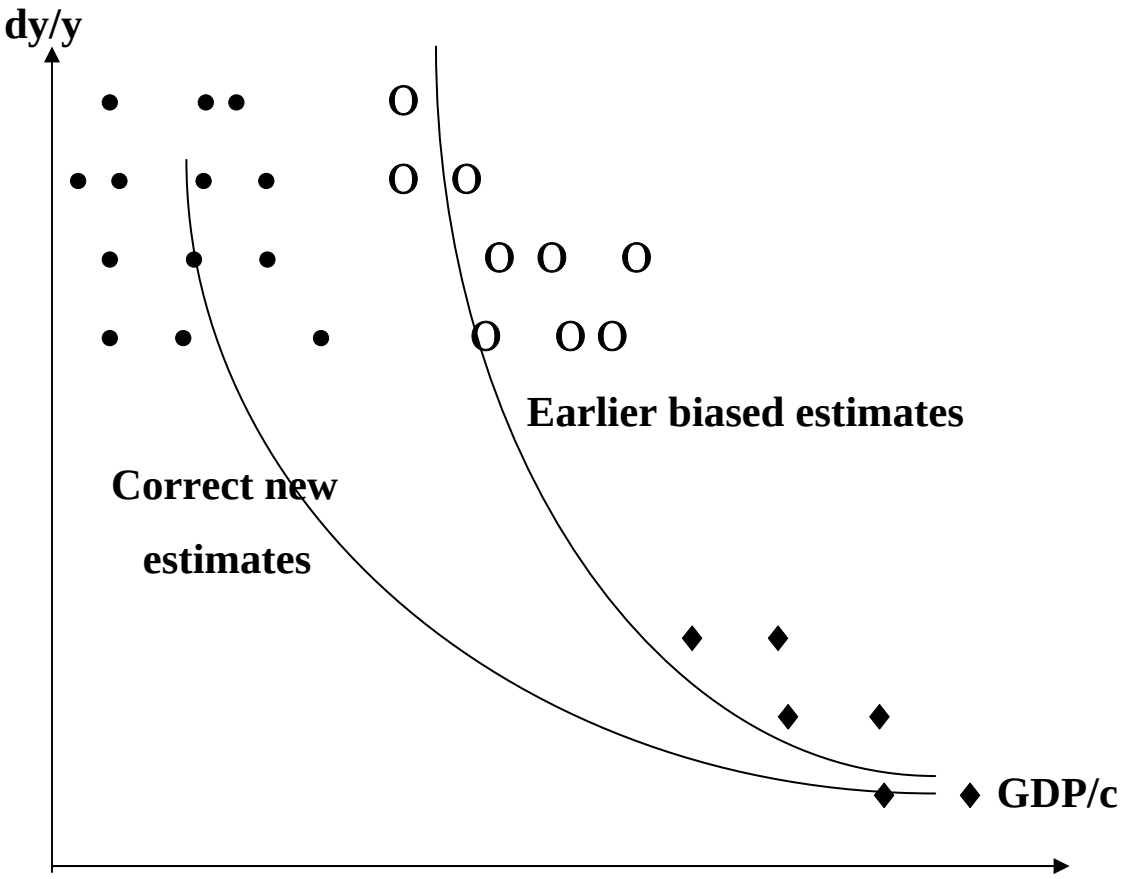
Implications: In terms of purchasing power, the GNI/capita has been revised downwards by 47% in China and by 42% in India. That is, the price levels in China and India are much higher than earlier (obsolete and very crude) estimates show.

This is one of the largest revisions of a key statistic ever made, that it will change drastically the view of the world economy.

[4.18] Inaccurate data: What problems do flawed data induce?

Examples: recent revision of World Bank per-capita incomes

1. Biases in estimated relationships



Possible underlying hypothesis: poor countries tend to grow faster (or slower) than rich countries (cet par)

2. Gives false picture of income distribution across countries (Svedberg 2004, "World income distribution: Which Way?")

(return to in later lecture)

[4.19] Metodological problem 3: Should growth data be (population) weighted or not?

A. Distorted Regression Results?

In almost all cross-country regressions of income growth determinants, **each country constitutes one observation**. This implies that Botswana, with 2 million people, and China with 1,300 million people, weight the same.

An alternative is to use a **population weighted** regression method (e.g. weighted least square), which gives each country an influence on the regression that is **proportional** to its relative share of the **population** in the countries included in the regressions.

The choice of method has **huge consequences** for the results (a graph, from Stan Fischer, AER 2003, demonstrating this will be shown in class).

Which method that is the most appropriate depends on the **question asked**.

-If the question is what income growth the **representative** person in respective poor country has experiences in comparison with the rich countries, an **unweighted** regression is appropriate.

- If the question is what income growth the **average person** in all low-and middle income has experienced (in rich country comparison), a **population weighted** regression is needed.

[4.20] Methodological problem 3 (cont'd): Weighting

For all low- and middle income countries (LMICs), the average per capita GDP growth rates for the period 1980-2001, as reported by the World Bank, is **1.6%** (WDI, 2003). The weights used by the World Bank to derive this average from the regional growth rates are not disclosed, but it seem to be total GDP valued at PPP.

When one recalculates the average for the LMICs in the six main geographical regions, with population shares as the weights, one gets a considerably larger number, **3.1%,** almost 100% higher (Table [4.21]).

Depending on weighting method, two completely different pictures concerning convergence emerge:

* With **World Bank weighted** growth rates, growth in the low- and middle income countries has been notably smaller than in the rich countries, signifying unconditional **divergence**

* With **population** weighted growth rates, there has been unconditional **convergence**.

The high growth experienced by China and India 1980-2005, affecting altogether 2.3 billion people, or almost half the population in the LMICs, is hence not fully reflected in the World Bank publications, the by far most frequently used statistical database for researchers!

[4.21] Methodological problem 3: weighting (cont'd)

Growth of GDP per capita in Low- and Middle income Countries 1980-2001 (annual %), weighted by population and, alternately, by World Bank (non-disclosed) weights

	Population 2001		Growth 1980-2001 (%)		
Low- and middle income countries	Millions	Weight	GDP	Popula-tion	GDP/c
	(1)	(2)	(3)	(4)	(5)
East Asia	*1,823*	*0.352*	***7.5***	*1.4*	*6.1*
South Asia	*1,378*	*0.266*	***5.6***	*2.0*	*3.6*
L. America & Car	524	0.101	2.5	1.8	0.7
Europe & C. Asia	475	0.092	0.6	0.5	0.1
MENA	301	0.058	2.5	2.6	-0.1
Sub-Saharan Africa	674	0.130	2.1	2.7	-0.6
Total above weighted by population	5,175	1.000	4.9	1.8	3.1
Total above weighted by World Bank	5,172	1.000	3.3	1.7	1.6
High Income countr.	957	1.000	2.9	0.7	2.2

Source: *World Development Indicators, 2003,* tables 2.1 and 4.1

[4.22] Methodological Problem 4: Inadequate proxy variables

Example: Human capital

In the cross-country regressions, several different variables have been used as proxies for the stock of human capital in countries:

* share of children that is **enrolled** in school at various levels (primary, secondary, etc.) in the beginning of the period examined.
* The average **number of school years** in the population
* The share of **literate** adults in the population.

None of these proxies are particularly adequate:

- school enrolment is a **flow** variable that may have little correlation to the **stock** of human capital. Moreover, enrolment does not take into consideration that many children drop out or are part-time in school.
- number of school years misses the fact that knowledge is obtained in several **other ways** than in schools
- what is "literacy" is **ambiguous** and is difficult to **measure (Basu 1998)**
- **quality** of schooling differ a lot (Pritchet, 2004)

<u>Problem induced</u>: estimates sensitive to proxy chosen

<u>Method for handling</u>:

a) Improve data collection;

b) Test for robustness by using alternative proxies for e.g. education

[4.23.a] Methodological Problem 5(1): Simultaneity

Example:

Investment in physical (or human) capital ⇔ economic growth

Problem induced: Over- or underestimation of coefficients

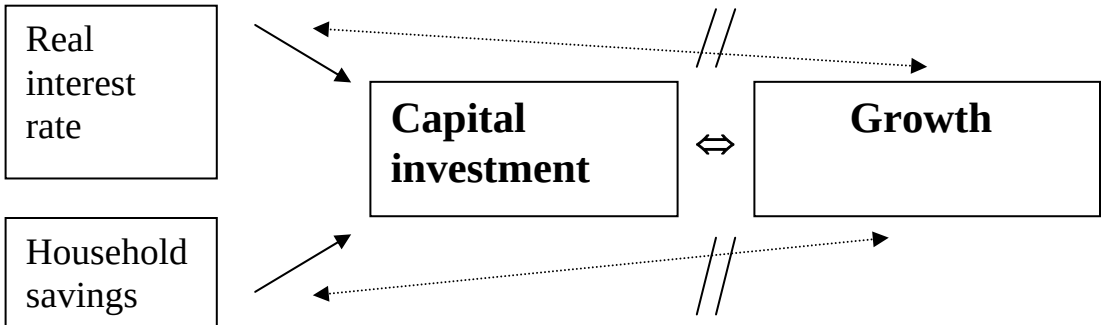
Methods for handling:

1) Values from **initial** year(s) for explanatory variables

Example: $dY/Y_{1980\text{-}2000} = f(INV_{1980}, \mathbf{Z})$ Used by Sala-i-Martin, 1997.

Problem induced: investment in 1980 probably not very important for growth in the **entire** 1980-2000 period. Investment during this very period is what should matter, but then we are back to the simultaneity problem!

2) Instrument variables. Example: under the (questionable) assumptions that (1) the real interest rate and household savings affect capital investment, (2) but there is no **causal link between growth and these two variables**, these two variables can be used as **instruments** for "capital investment" in a growth equation.

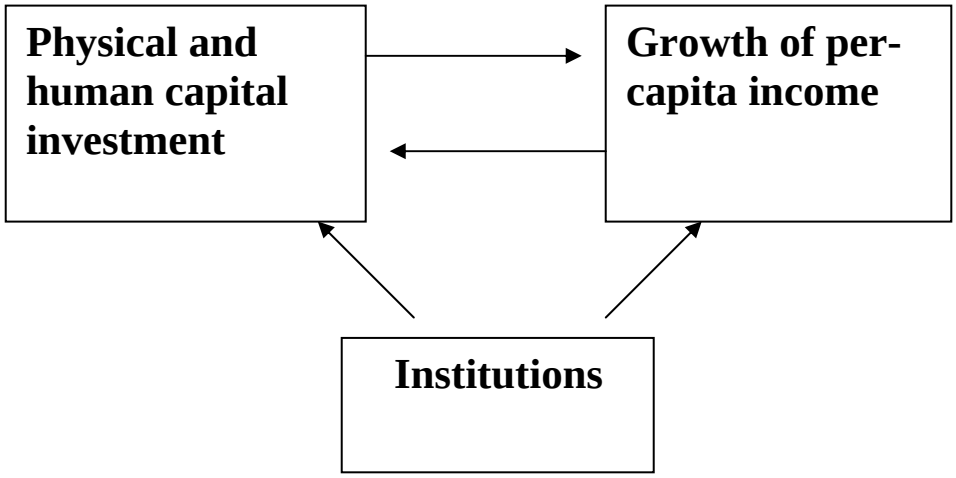


Usually difficult to find adequate instruments!

[4.23.b] Methodological Problem 5(2): Endogeneity

A further problem is sometimes that both what are taken to be the dependent and independent variables are in fact endogenous and determined by a third omitted variable, e.g. adequate institutions

- Inadequate property rights may discourage investments in physical and human capital
- Inadequate property rights may also lead to higher costs for firms and hence lower returns to given investments



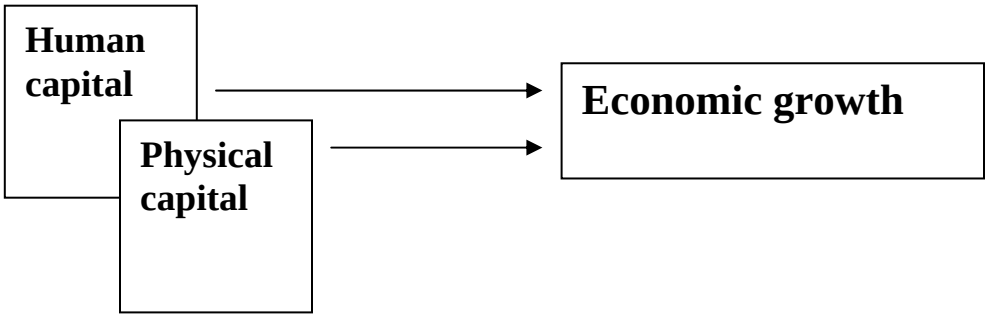
Methods for handling: try to find a proper proxy variable for institutions and include that in the regression

[4.24] Methodological Problem 5(3): Multicolinearity

Means that the explanatory variables are internally correlated

<u>Example</u>: investments in physical capital and in human capital tend to go hand in hand

Explanatory Variables **Objective Variable**



<u>Problem induced</u>: Estimates become biased and sensitive to small variations in data and estimation technique

<u>Method for handling</u>: Not to include two correlating explanatory variables in the same regression, but this may conceal important information.

What we would like to know is the relative importance of investments in physical and human capital, respectively, for growth, but we have no adequate method for doing this.

[4.25a] Approach 6: Country studies ("analytical narratives")

Having now covered many of the **data and methodological difficulties** that beset the various "formal" econometric empirical methods for identifying and estimating growth determinants, one may get the feeling that these are not very reliable. Maybe so, but what **alternatives are there**?

One alternative method, nowadays not often used by economists, is **country studies**. Such studies can be described as a systematic assessment of the various institutional and policy parameters that are expected to influence growth. It could be the parameters that have been identified by the more formal methods to be of significance, but also other variables that may not be easily **quantifiable.**

Many outcomes (e.g. growth) do not depend on "inputs" in a **quantitative** sense only, but also on **quality**, which is difficult to assess and capture in econometric analyses.

Recently examined examples are the **quality of schooling** (Pritchet, 2004) and of **health care** (Mills and Shillcutt, 2004). Both studies conclude that the worst outcomes in most developing countries are more related to poor **quality** of services than to under funding, and that just throwing more money on the problem will not help much; that **institutional reform** is of higher priority.

[4.25b] **Approach 6: Country studies (analytical narratives) cont'd**

Recent interesting examples of "analytical narratives" of country experiences can be found in *In Search of Prosperity*, edited by Dani Rodrik (2003). The volume includes studies on:

* What explains the fact that the tiny African country Botswana has managed to grow and develop rapidly and steadily while almost all other African countries have failed to do so? (Acemoglu et al).

* Why was growth in India during the period after independence (1949) and to the mid 1980s so slow and why did it accelerate thereafter (DeLong).

* What explains Venezuela's "growth implosion", a country which is the world's fifth largest oil exporter?

* What lies behind the economic reforms initiated 1978 in China and how to explain the country's formidable growth since then (Qian).

Main advantages: Can capture **qualitative aspects** of the development process that are difficult to quantify and hence take into consideration in econometric analyses.

Main limitations: In the absence of formal tests and quantification, it is difficult to draw strong conclusions. Should be used as a **supplement** to other methods rather than as a single tool.

[4.26] Example of warranted country study: Growth in China

According to official Chinese data, replicated in World Bank publications, per-capita economic growth in China has been 8-9 per cent per annum over the 30 year period since 1978, when China **abolished state planning** and introduced drastic **free-market reforms** (see Holz and Zhu, 2002). If the official data are correct, this is the most notable **growth miracle** in the history of mankind. Ca 1,300 million people have seen their average income increase **seven- to eightfold** over one generation!

This growth record may seem too good to be true, and a number of economists have devoted most of their professional lives trying to find evidence of **data falsification** or misreporting (e.g. Rawski, 2002). The critique has followed four **main lines** (Wang and Meng, 2001):

a) There are strong **incentives for over-reporting** economic growth at the provincial levels in order to comply with "demands" from the central government

b) The GDP growth figures are **inconsistent** with a number of statistics on the growth of the various components of GDP (e.g. industrial energy use, industry quantitative output, food and livestock production, etc)

c) The rate of inflation has been systematically underestimated in China over the years (Maddison and Wu 2008)

d) A steady annual growth rate of 8-9 % is simply not possible in China considering all the **impediments** to growth in its economy

[4.27] Growth Impediments in China: Selected Examples

No doubt, China has many characteristics that seem at odds with the reported high growth:

* Some 60% of the population are rural, making a living mainly from farming very **small parcels** of land (average farm size is 0.6 ha).

* No well-functioning **financial markets**. Most banks are state-owned and allocate most of the credit to unprofitable **state-owned enterprises** (SOE).

* Formal **property rights** and enforcement mechanisms are weak and **corruption** at the local level is rampant.

* Much of the **infrastructure** (e.g. railways and roads) is obsolete and constitute bottlenecks for **transportation** and ineffective use of **energy** (coal accounts for 70% of energy consumption and extracted in thousands of small mines scattered all over the country).

In 2005, extensive and well-researched reports on China were published by:
UNDP, Human Development Report for China 2005;
OECD, Country Report on China. Paris 2005

[4.28] Answers to sceptics of high growth in China

a) Not all i**ncentives** are for over-reporting; some are for **under-reporting** in order to attract more central government funds for investments in lagging provinces. Since the mid 1990s, there is strong central government political commitment to "go west", i.e. to ensure that the poorest provinces in the inland western part of the country are not left out from the growth process

b) That the sector-level statistics are not always consistent with the GDP growth statistics does not automatically mean that the **latter are flawed**. All statistics in China are dubious, and it may well be that the **sector-level data are incorrect**. The energy consumption statistics, which many have used to point out inconsistencies, are especially incomplete and uncertain

c) The lack of formal (***de juro***) property rights is compensated for by strong ***de facto*** property rights for **large (and foreign) investors** and developers. That China attracted some $80 billion of Foreign Direct Investment in 2005 (while India less than $10 billion) is taken as a sign that property rights are ensured **in practice**. Farmers and small private firms have no property rights and "land grabbing" by provincial government is huge, which may in fact be growth **enhancing**, although strongly **non-egalitarian** (Zhang, 2004)

d) **Corruption** is rampant at the provincial and local (county) levels (see Zhang, 2004), but it is "centralised" corruption that favours investment over other income uses, and hence not growth-stifling (Rock and Bonnett, 2004)

e) Maddison's claim that inflation has been underestimated is confirmed by the World Bank ICP revision for China (2007)

[4.29] China's claimed growth advantages:

1) The highest savings and **investment ratios** in the world at about 40% of GDP according to official statistics. The data may be questionable and the definition of "investment" is very wide. Still, no one seems to argue that investments are not very high in international comparison. The testing of most growth models shows high investment to produce high growth.

2) The previous and present investments in education have ensured that practically the entire population is literate (as in many other middle income countries). Most theories and empirical investigations find **human capital** to be one of the main driving forces of growth.

3) China is far from being a democracy, but the **constitutional** political arrangements do not seem to be crucial for growth, one way or the other (in lecture 10 we will come back to this issue). Most-cross-country evidence shows political and economic **stability** to matter more (Barro, 1996).

4) The country is ethnically and linguistically rather **homogenous**, something cross-country evidence suggests favours growth (92% are Han Chinese and the other 8% are divided among some 50 minorities).

5) There is little doubt that the Chinese central government, and also provincial governments, are highly **committed to and focused** on growth (at the expense of income distribution and people's rights and the environment – at least up to very recently).

[4.30] Data on Basic Growth Factors in China in Comparison

Indicators	China	Average lower middle Income	Aveage higher middle Income	Saudi Arabia
Economic indicators				
GDP per capita 2001 ($PPP)	3,950	4,700	8,500	13,290
Annual growth of GDP/C 1980-2001 (%)	**9.0**	**2.5**	**0.8**	**-2.7**
GDP/C **1981** ($PPP in 2001 prices)	730	2,900	7,100	23,100
Annual growth of population (%)	1.2	1.4	1.6	3.4
Gross capital formation 2001 (% GNP)	**38**	**26**	**21**	**19**
Annual growth of GCF 1980-2001 (%)	**10.8**	**2.1**	**2.3**	**..**
Government Expenditure 2001 (% GDP)	**10.9**	**20.7**	**24.4**	**..**
Exports (% GDP)	26	33	27	42
Human capital indicators 2000/01				
Literacy rate (%)	86	85	91	93
Average years of schooling	6.4	6.2	6.7	(9)
Gross secondary school enrolment (%)	63	65	91	68
Health expenditures (% GDP)	5.3	5.3	6.6	5.3
Share of private health expenditures (%)	63	51	46	21
Under 5 Mortality Rate (per 1000)	39	41	27	28
Life Expectancy at Birth (years)	70	69	72	73
Survival to age 65 (%)	75	73	74	80
Improved water access (%)	75	80	88	95
Imroved sanitation access (%)	38	55	79	100
Women in decision making position (%)	13	.	8	0
Women in labour force (%)	43	43	36	17

Source: World Development Indicators, 2003, tables 1.1, 1.5, 2.1, 2.2, 2.12-16, 2.20,

[4.31] Tentative conclusions regarding growth in China

After having spent four weeks in China in 2004 and again in 2007, attending conferences, talking to dozens of Chinese independent economists, and travelled in a dozen provinces all over the country, I have tentatively reached the following conclusions:

a) Official growth rates may be exaggerated, **but not by much**. Even if annual per capita growth is 6-7% rather than 8-9% (Chen and Ravallion, 2008; Maddison and Wu, 2008), it is still remarkable.

b) Growth has taken place also in the inland, **lagging provinces**, in the West (Wang and Meng, 2001). I visited and travelled some of these provinces (e.g. Guizhou, Yunnan and Tibet). I was amazed by the economic activity in both cities (mainly construction and commerce) and in the country-side (productive small farms and domestic tourism).

c) There are rapidly growing rural-urban **income inequality**, enormous **environmental (**air and water**)** problems, which threaten political stability. Still, few serious attempts to reverse these trends seem to be on the agenda (Fan et al., 2004). (More on that later.)

d) Although **formal** property rights are lacking, **de facto rights** exist for large investors. For farmers and small private firms, practically no rights exist and "land grabbing" by local governments are rampant, as is local **corruption** (Xiaobo, 2004). Puzzling that this is not hindering growth.

[4.32] Another country study warranted: Saudi Arabia

While the high growth in China may be puzzling, it is equally difficult to understand why some of the countries, which were on the top of the per capita income list some 25 years ago, has since experienced **negative growth**. They are now middle income countries with a per capita income one-third of that in the OECD area. These countries include, above all, **Saudi Arabia**, but also several other countries in the Middle East and North Africa (MENA). As can be seen in Table [4.30], per-capita income in Saudi Arabia in 2001 was about **half** of what it was in 1981 (in 2001 real prices).

Saudi Arabia has several "growth advantages":

* Almost unlimited **funds for investment** and abundant **foreign exchange earnings**, being the world's largest exporter of oil, which brings in more than $60 billion per year (2001). Today much more!

* Highly **literate** population enjoying good health care and excellent sanitation and water facilities (**human capital**).

* **Homogenous population** in terms of language and ethnicity and political stability (so far).

Still, real per capita incomes have been almost halved in 20 years!

[4.33] Reasons for the negative growth in Saudi Arabia

A recent non-technical attempt to explain why growth has been negative or minuscule in many of the oil-exporting Arab countries in the 1980-2000 period, was made in the ***Arab Human Development Report 2002*** (by a team of Arab economists), published by the UNDP. Main conclusions:

Also see articles by Yousef (2004) and Kuran (2004).

1) Remain **"rentier" economies** without growth in the non-oil sectors
2) Authoritarian rule **without private property rights**
3) Investment in mainly **infrastructure and public consumption** with very low returns
4) **Education quality** very low and **labour productivity** as well, and also declining over time
5) **Discrimination of women** (half the potential work force) (see [4.30])
6) **No incentives for R&D and scientific research** (practically no publications in international scientific journals)
7) As a consequence, only **small and stagnant private enterprises**; no big private investments outside the oil sector
8) **Economic and political freedom** (index) is lower than in any other regions in the world

Reason *not* mentioned: **The Dutch disease**—the overvaluation of the exchange rate caused by huge oil exports—that stifle exports of other products (come back to in lecture 9)

[4.34] Summary of Results:

With all the *reservations about the methodological inadequacies* touched upon (also see [4.35]) here, what can we conclude on the basis of the empirical studies of growth determinants?

Simulations: With a redefinition of capital (to include human capital), simulations of the Solow model gives plausible predictions of the main determinants of growth (investments in physical and human capital).

Growth Accounting: of NICs: No Miracle!

Time series regressions: No trend in developed countries growth rates over the long term, which refutes the "new growth theories" that predict accelerating growth.

Cross-country regressions: From **Sala-i-Martin's** study (one of the most extensive and rigours), we can draw the following tentative conclusions:

(1) High investments in **physical and human capital**, and also enforced **property rights**, are necessary, but not sufficient, for high growth, i.e. without these, little growth irrespective of what else countries do.

(2) A large element of **market economy** and an **open trade regime** (qualified in lecture 9) are favourable for growth; **Corruption, internal strives**, and **distorted exchange rates** are bad for growth.

(3) An initial **even distribution of income** and a good **health status** of the population are conducive for growth in subsequent periods.

[4.35] Summary of Data and Methodological Problems

* **Data**. Almost all work on growth determinants is based on the PPP-adjusted income data. These, and many other data used in the regressions, are subject to large margins of error and bias, which may have distorted results. Giant revision of PPP income data in 2007

* **Proxy variables**. Many characteristics of countries that theory predict should have a bearing on growth are difficult to measure and the proxy variables de facto used are often **blunt** (e.g. human capital)

* **Regressions**. Most of the empirical growth evidence at hand stems from (unweighted) cross-country (and panel) regressions in which the problems with **simultaneity** and **multicolinearity** have not been adequately resolved.

* **Outliers**. Many countries are "outliers" in these regressions, signifying that they have traits that are not captured in the regression, and hence that the regressions suffer from "omitted variable bias".

* **Examples**. Here we have focused on **China** as an example of a country that has experienced remarkable growth despite the **absence** of many of the "conventional" preconditions for growth (property rights, low corruption). **Saudi Arabia** is an "opposite outlier"; despite having many favourable preconditions for growth, per-capita income has been halved since 1980.

These and some other examples suggest that our **knowledge** about what fosters growth is **incomplete** and that many **qualitative aspects** of growth have yet to be identified and included in analysis.

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Note that this long list of references is mainly for those who want to write theses on a growth-related topic later on!