

Long-Term Growth in Developing Countries

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DECMG

14 December 2021

Contact: spennings@worldbank.org. Long Term Growth Model (LTGM) available at <http://www.worldbank.org/LTGM>.

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Outline of the talk

This talk:

- ***Long Term Growth Model (LTGM):*** a suite of papers and tools to simulate future long-term growth in developing countries.

Part 0: Motivation and Introduction

Part 1: Long Term Growth Model (LTGM) (basic version)

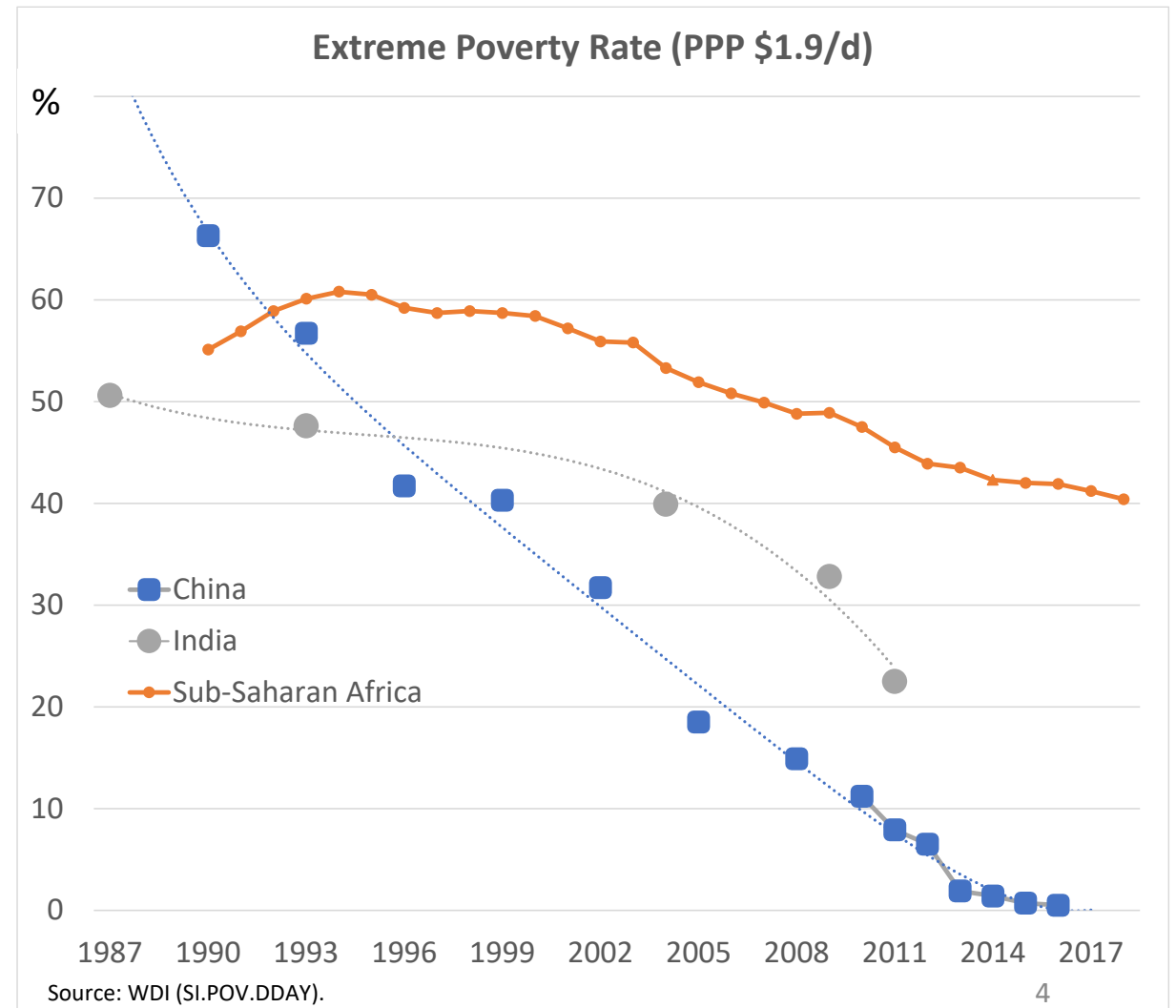
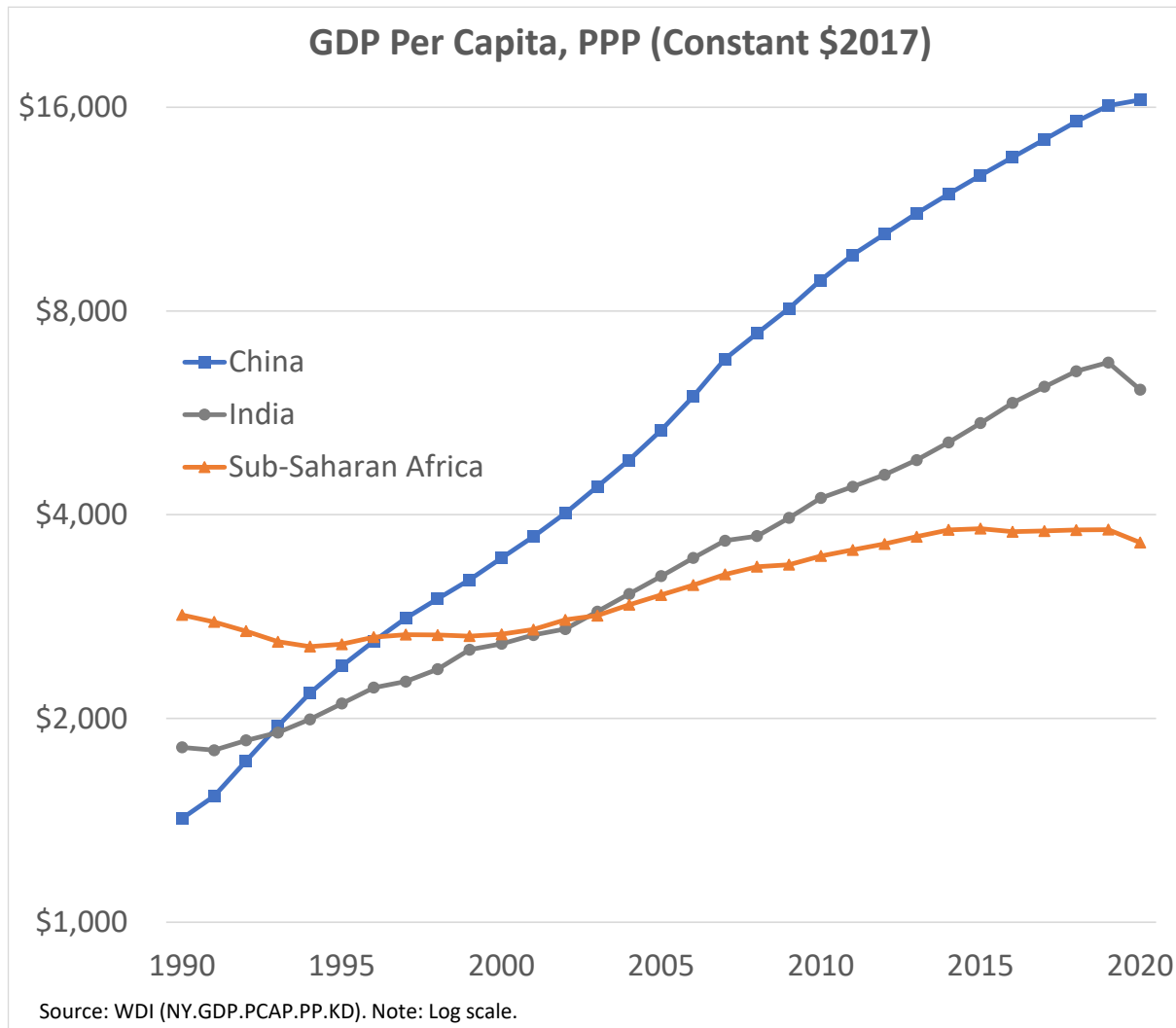
Part 2: Extensions to the basic LTGM (Overview)

Why is economic growth important?

- Economic growth is a main driver of higher living standards and economic development.
 - Highly correlated with other measures like the Human Development Index (UNDP) and median incomes.
 - An absence of growth creates other problems like debt crises, unemployment, social unrest.
- Sustained and inclusive long-run growth is central to achieving the World Bank Twin Goals:
 - Ending extreme poverty (Kraay 2006)
 - Boosting shared prosperity – Incomes of the Bottom 40% (Dollar, Kleineberg and Kraay 2015)

Large countries/regions (>1bn): growth and poverty over past 30yrs

- Average GDP PC growth 1990-2020: 8% China, 4% for India, 0.8% for Sub-Saharan Africa



This talk: the Long Term Growth Model (+ extensions)

- Developing countries want to grow at high rates over the **next 30 years**:
 - What growth rates are feasible?
 - How to achieve growth goals?
- This talk discusses **Long Term Growth Model (LTGM)**
 - Spreadsheet-based toolkit (and papers) to answer these questions
 - Designed for simplicity, transparency, ease-of-use and low data requirements.
 - Long-term focused (other tools like MFMOD or Oxford Model are short-term focused).
- LTGM based on the neoclassical Solow-Swan growth model
 - Savings & investment are key; also productivity (TFP), human capital, demographics, FLFP
- Extensions: TFP, Public investment, human capital (HCI), Natural Resources.

What can we learn from the LTGM about growth? Five takeaways

1. Growth performances, constraints and opportunities are *heterogeneous*
2. Investment-led growth strategies are *unsustainable* in the long run.
 - Growth rates will fall as due to the diminishing marginal productivity of capital
 - Need to have broad-based growth – human capital, productivity, labor force participation.
3. Hard to have high investment rates without high *savings rates*.
4. Higher public investment yields only a modest boost to growth (no miracles)
 - Boost to growth no larger in low-income than high-income countries, and is transitory.
 - Level of public investment efficiency has *no effect* on impact on growth (if constant).
5. Fast growth usually involves fast *productivity* (TFP) growth.
 - Human capital growth important too, but less than TFP and operates with a lag.

Some examples of work using the LTGM

Used in CEMs, SCDs and other growth work all over the world (around 45 countries):

- **Sub-Saharan Africa:** Cameroon (CEM), Cape Verde (SCD), Central African Republic (CEM), Eswatini, Gabon, Guinea (SCD), Seychelles (SCD), Ghana (SCD), Malawi, South Africa, Ivory Coast, Mauritania, Niger, Zambia (SCD), Zimbabwe
- **South Asia:** Bangladesh, India, Nepal (CEM), Sri Lanka (CEM)
- **Latin America & Caribbean :** Argentina, Brazil, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, Peru
- **East Asia & Pacific:** Cambodia, Korea, Laos, Malaysia, Philippines, Vietnam, Thailand
- **Europe and Central Asia:** Azerbaijan (CEM), Armenia (SCD), Bosnia, Bulgaria, Georgia (SCD), Kyrgyz Republic (SCD), Tajikistan (CEM)
- **MENA:** Egypt (CEM), Syria
- **Honduras, Panama, Peru, Zambia, Bangladesh, Malaysia, Cambodia** –Training for govt officials

LTGM developed by team as DEC-MTI partnership

co-TTLs:

Norman Loayza

Steven Pennings

Financial support from
Korean Trust Fund.

All LTGM papers and toolkits
can be freely downloaded at:
www.worldbank.org/LTGM

Team:

- Spreadsheet & model development:
 - Jorge Guzman and Leonardo Garrido.
- Early versions: Constantino Hevia
- LTGM Extensions: Sharmila Devadas, Young Kim, Fabian Mendez, Arthur Mendes.
- MTI coordination & support: Vinaya Swaroop
- Data analysis: Diego Barrot and Federico Fiuratti
- Feedback from dozens of country economists

Questions we try to answer (and not answer)

- **Do** try to answer:
 - What growth rates *if* trends in growth fundamentals continue (business as usual)?
 - What growth rates are feasible?
 - How can countries boost long term growth (in terms of growth fundamentals)?

- **Not** try to answer:
 - What growth rates *will* occur? → Difficult to forecast long-run growth
 - Possible growth paths in short term? → LTGM wrong type of model (no demand side)
 - What *specific policies* will boost growth? → Country context & lack of exogenous policies

LTGM Conceptual Approach

Policies → “Solow growth fundamentals” → Growth

(1) Country-specific analysis
(trends/micro studies/judgement)

(2) LTGM

1. Country economists & counterparts to analyze country-specific constraints
 - Also bring in country-specific studies (e.g. firm-level TFP)
 2. The LTGM conducts “future growth accounting” – *proximate* determinants
 - Use the minimum amount of theory → makes the relationship more robust.
- Modelling forces us to be explicit about assumptions, mechanism and dynamics

Outline of the rest of the talk

Part 1: Long Term Growth Model (LTGM) (basic version)

Part 2: Extensions to the basic LTGM (Overview)

1. The basic LTGM

- *Model Overview*
- *Common results*
- *Using the model*
- *The effect of growth on poverty*
- *Policy application to long run growth in Cambodia*

A Simple Model with 3 building blocks

1. Production Function

$$Y_t(GDP) = A_t K_t^{1-\beta} (h_t L_t)^\beta$$

2. Capital Accumulation

$$K_{t+1} = (1 - \delta)K_t + I_t$$

3. Demographics and Labor Market (for GDP Per Capita, y_t^{PC}):

$$y_t^{PC} = \frac{Y_t}{N_t} = \left[\frac{Y_t}{L_t} \right] \frac{L_t}{W_t} \frac{W_t}{N_t} = \left[A_t k_t^{1-\beta} h_t^\beta \right] \rho_t \omega_t$$

(A_t : TFP; K_t : capital stock, h_t : human capital per worker; L_t : number of workers; I_t investment)

(W_t : working-age pop; N_t : total pop.; ρ_t : labor participation rate; ω_t : working-age-pop. to pop. ratio; k_t : capital/worker)

Growth Drivers

$$g_{y,t+1} \approx g_{A,t+1} + \beta(g_{h,t+1} + g_{\omega,t+1} + g_{N,t+1} + g_{\rho,t+1}) + \left[\frac{1-\beta}{K_t/Y_t} \right] \frac{I_t}{Y_t} - (1-\beta)\delta$$

[GDP Growth] [TFP] [Human Capital] [Demographics] [LF Participation] MPK [Investment]

- Common policy message (1): investment-led growth [by itself] is not sustainable in long run
 - K/Y increases over time because of higher rates of investment
 - Leads to a fall in $MPK = \frac{1-\beta}{K_t/Y_t}$ (diminishing returns)
 - Each extra unit of investment adds less to growth than the previous one
 - Investment-led growth rate will fall over time
- **Policy advice:** Investment to be accompanied by other sources (e.g., human capital, TFP, LF participation) – a broad-based growth strategy.

How to fund investment?

$$\frac{I_t}{Y_t} = \frac{S_t}{Y_t} + \frac{CAD_t}{Y_t}$$

Investment Savings Current account deficit

Current Account Deficit and External Debt approximation (assuming $\Delta NFA_t \approx 0$)

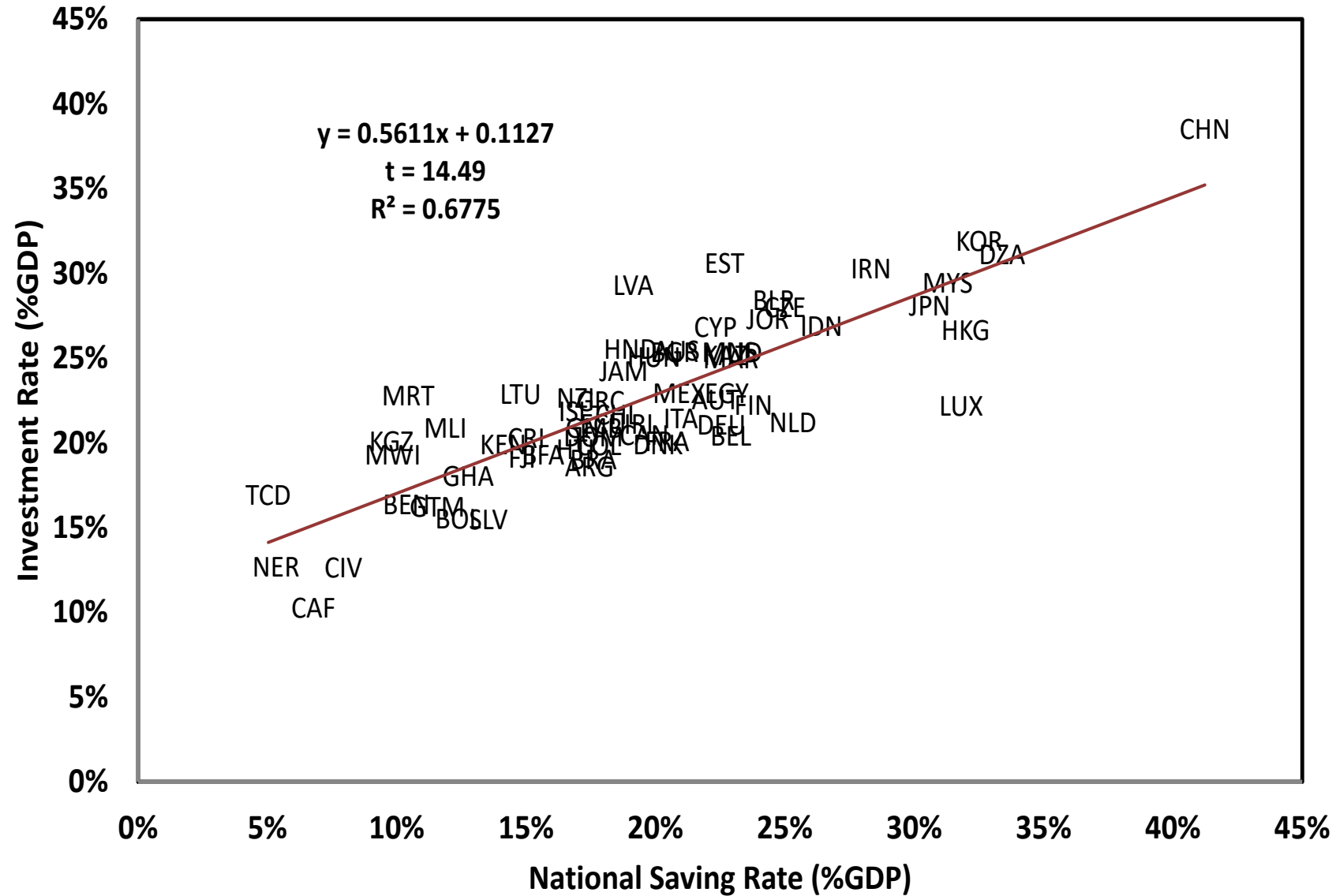
$$\frac{CAD_t}{Y_t} \approx \frac{FDI_t}{Y_t} + \frac{D_t}{Y_t} - \frac{D_{t-1}/Y_{t-1}}{(1 + g_t^Y)}$$

Foreign Direct Inv. Change Total External Debt

- Common policy message (2): need to increase savings or attract FDI to fund investment plans

Saving and Investment

Average, 1980-2008



Source: Hevia & Loayza (2012)

Using the Basic LTGM: 3 Steps

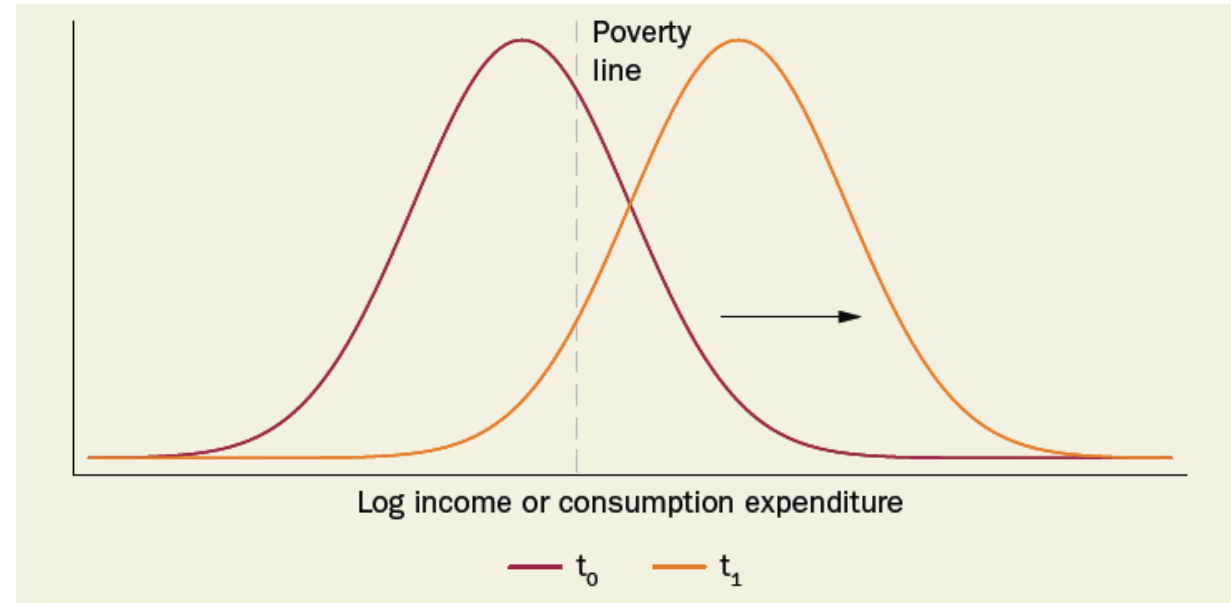
- 1. Calibration:** three variables: β (labor share), δ (depreciation) and K_0/Y_0
 - Increases in β , δ , K/Y make fast growth more difficult. Can usually calibrate from PWT (preloaded)
- 2. Baseline:** Choose future paths of growth drivers (Solow fundamentals):
 - TFP, Human Capital, Demographics (e.g. from UN) - using trends or peer countries
 - Calibrate a path for investment– based on trends, peers or constraints (Submodel 1)
 - Generates “business as usual” baseline path for Growth, GDPPC, and poverty
- 3. Scenarios:** Change growth drivers (TFP, HC, Inv etc) to see how growth and poverty respond

Other exercises:

- Start with a growth/poverty target, and calculate required investment to reach (Submodel 2)
- Start with a savings/debt constraint (rather than investment) and calculate growth (Submodel3)

Growth and Poverty

- Policymakers want to know how growth will affect poverty rates:
 - Usually complicated as need microdata on whole income distribution for all countries
- LTGM uses log-normal approx. of income distribution, requires only 2 data points:
 - Initial poverty rate and Gini coeff. inequality
 - Lopez & Serven (2006) – “well approximated”
- If unchanged Gini, 5% growth increases all incomes by 5% - distribution shift right
- Larger effect of growth on poverty if
 - More people near poverty line
 - More equal income distribution (lower Gini)

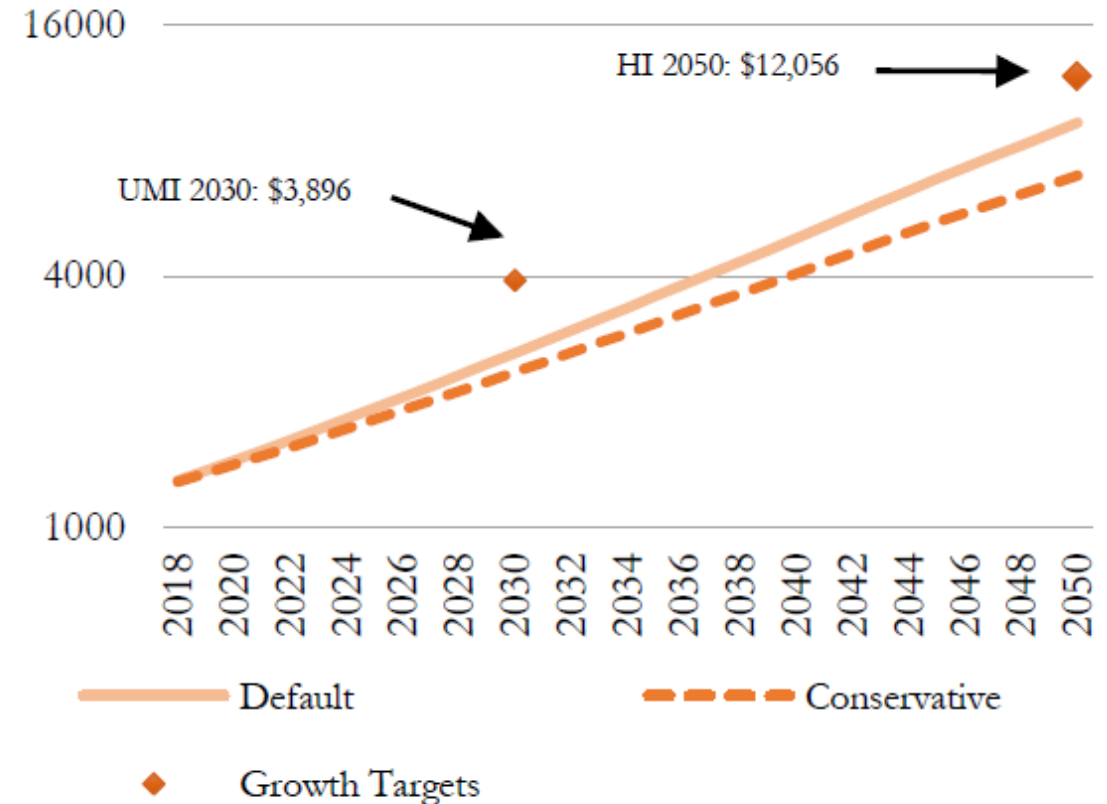


Source: World Bank (2015)

Application: Long run Growth in Cambodia (2018)

- **Context:** GDPPC growing strongly ($\approx 5\%$) surrounded by countries with robust growth.
- **Goals:** Cambodian govt had ambitious growth goals (relative to $\approx \$1200$ in 2017):
 - Upper Middle Income ($\approx \$4000$ pc) by 2030.
 - High income country ($\approx \$12000$ pc) by 2050.
- What rates of growth under current trends (“business as usual”)?
- **Calibrated:** Solow fundamentals to historical averages e.g. Inv/GDP 20-22% (also TFP, HC etc)
- **LTGM Simulation:** baseline growth is rapid, but falls short of ambitious growth targets.

FIGURE S15: Cambodia GNI PC Level (US\$)

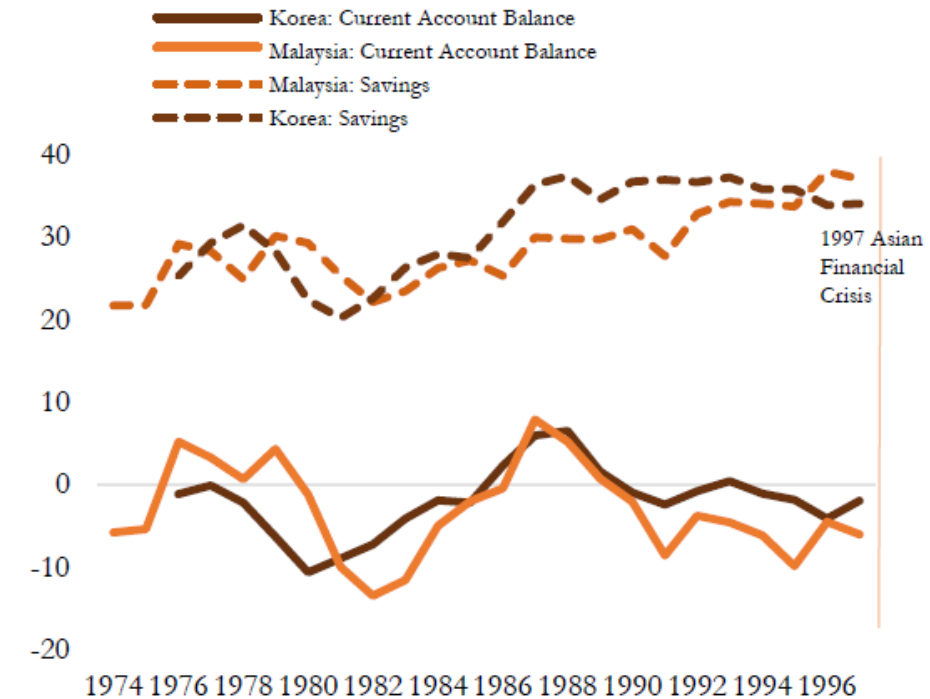


Source: World Bank (2018)

What growth rates are feasible? How to achieve growth goals?

- Human Capital & TFP growth already fast in baseline
 - Maintaining that pace already challenging
- But some peer countries had higher investment:
 - “Investing like Korea” scenario → 33% Inv/GDP (v. ambitious)
 - “Investing like Malaysia” scenario → 28% Inv/GDP
- Challenges:
 1. High investment can become less effective over time at boosting growth (lower MPK, higher [marginal] ICOR)
 2. How fund investment? Peer countries have much higher savings rates (Cambodia $S/Y \approx 10\%$).
 3. High investment can overheat economy.

FIGURE S24: Malaysia and Korea: Savings and Current Account Balance (percent of GDP)
20+ years pre-Asian Financial Crisis*

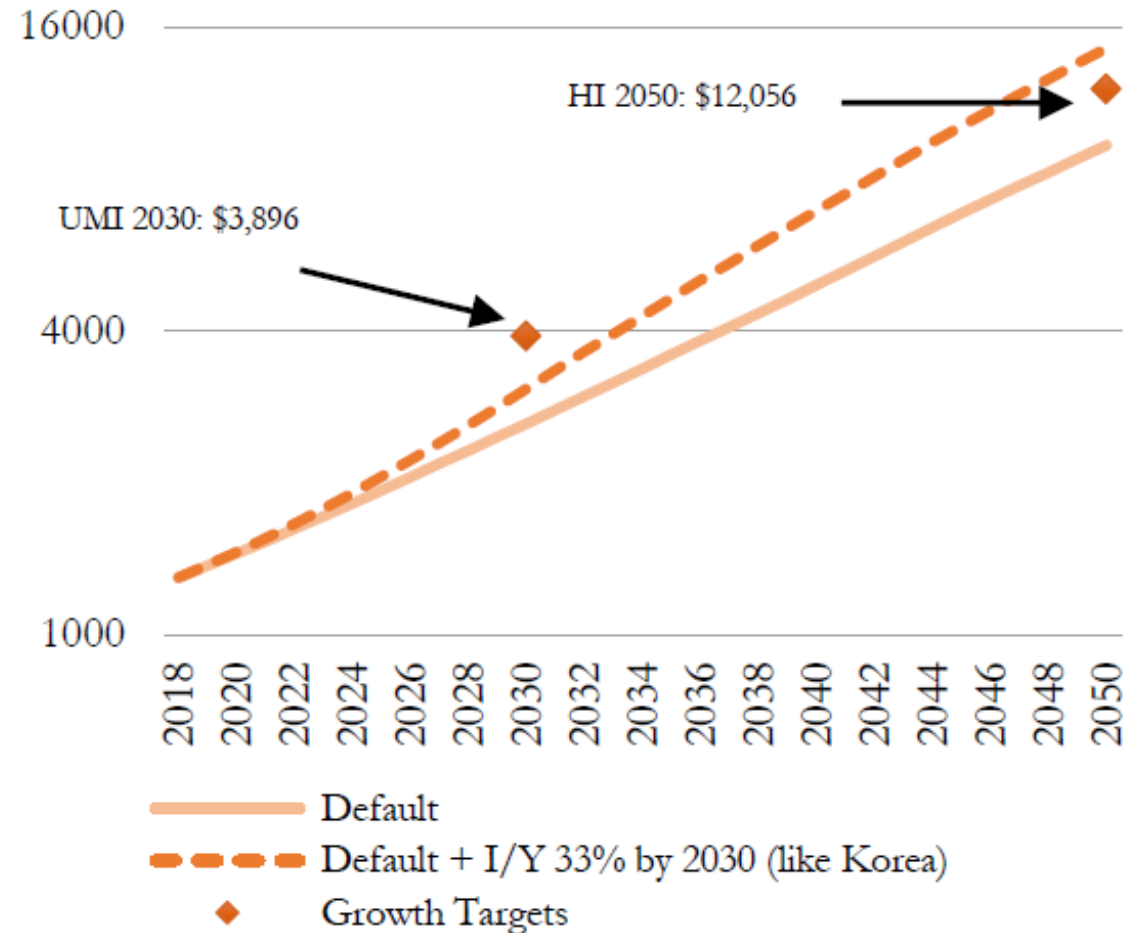


Source: World Bank (2018)

Scenario results and Policy Options

- 2030 target difficult to reach, even with the most optimistic assumptions
 - Suggest less ambitious 2030 target.
 - Focus on sustaining growth and avoiding imbalances
- 2050 target is possible, but only with much higher long run investment and savings.
 - Reforms to encourage financial sector development and improving business environment

FIGURE S17: Cambodia GNI PC Level
(with Korean investment rates from 2030)



Source: World Bank (2018)

Part 2. Extensions to the basic LTGM (overview)

2.1 TFP Extension

$$Y_t(GDP) = A_t K_t^{1-\beta} (h_t L_t)^\beta$$

2.2 Public Capital

$$Y_t(GDP) = A_t K_t^{1-\beta} (h_t L_t)^\beta$$

2.3 Human Capital

$$Y_t(GDP) = A_t K_t^{1-\beta} (h_t L_t)^\beta$$

2.4 Natural Resources

$$Y_t(GDP) = A_t K_{0,t}^{1-\beta} (h_t L_t)^\beta + p_t^{oil} Q_t^{oil}$$

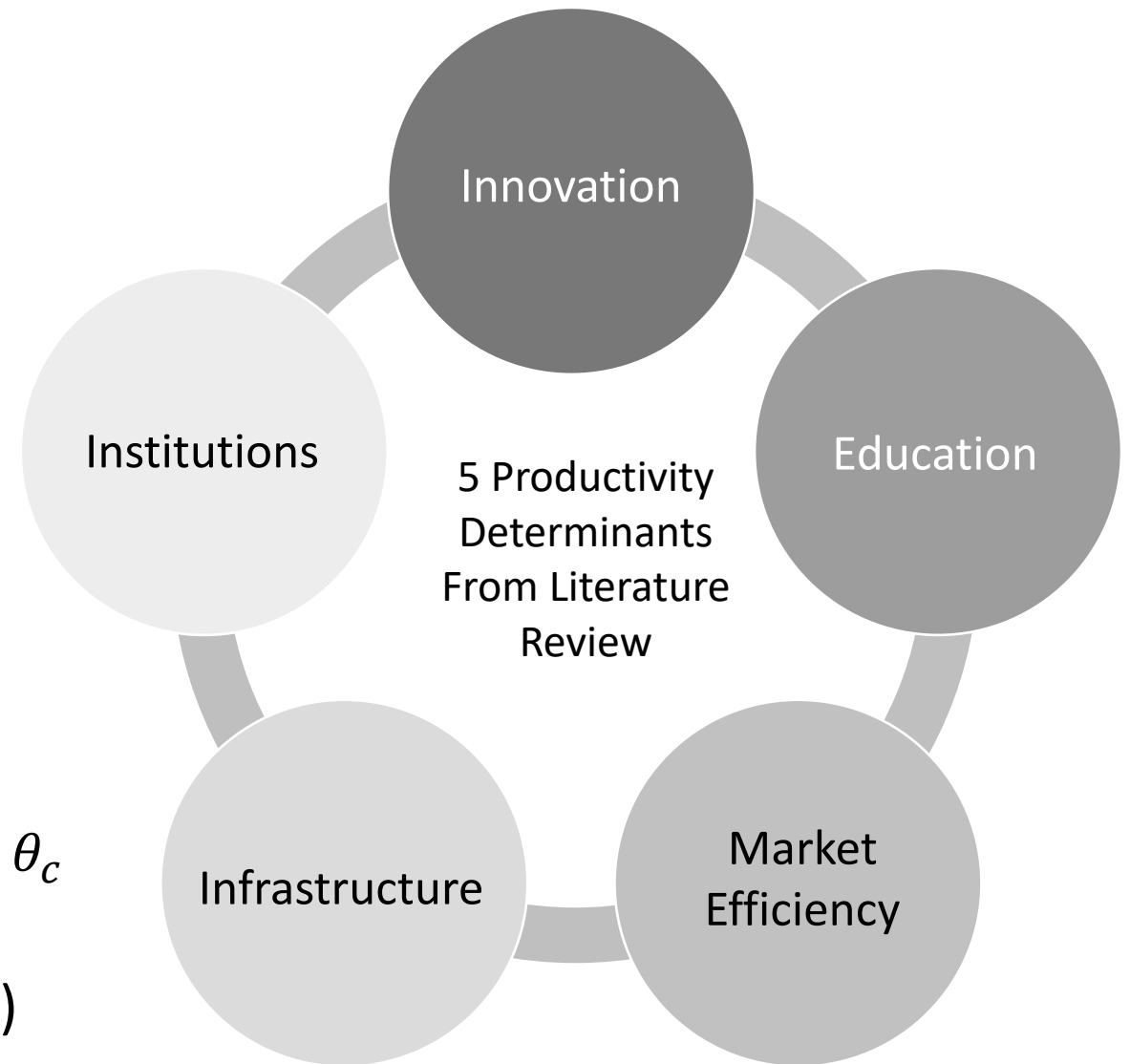
2.1 LTGM-TFP (Kim & Loayza 2019)

$$Y_t(GDP) = A_t K_t^{1-\beta} (h_t L_t)^\beta$$

- Literature review on the determinants of TFP
- Form TFP determinant index ($Index_{c,t}$)
 - Principal components of data in 5 areas
- Run cross-country regression:
 - Connect *determinant index* to TFP growth:

$$\begin{aligned} & Ave. TFP growth_{c;t,t-5} \\ & = \beta_1 \ln(Index_{c,t-5}) + \beta_2 \ln(TFP level)_{c,t-5} + \delta_t + \theta_c \end{aligned}$$

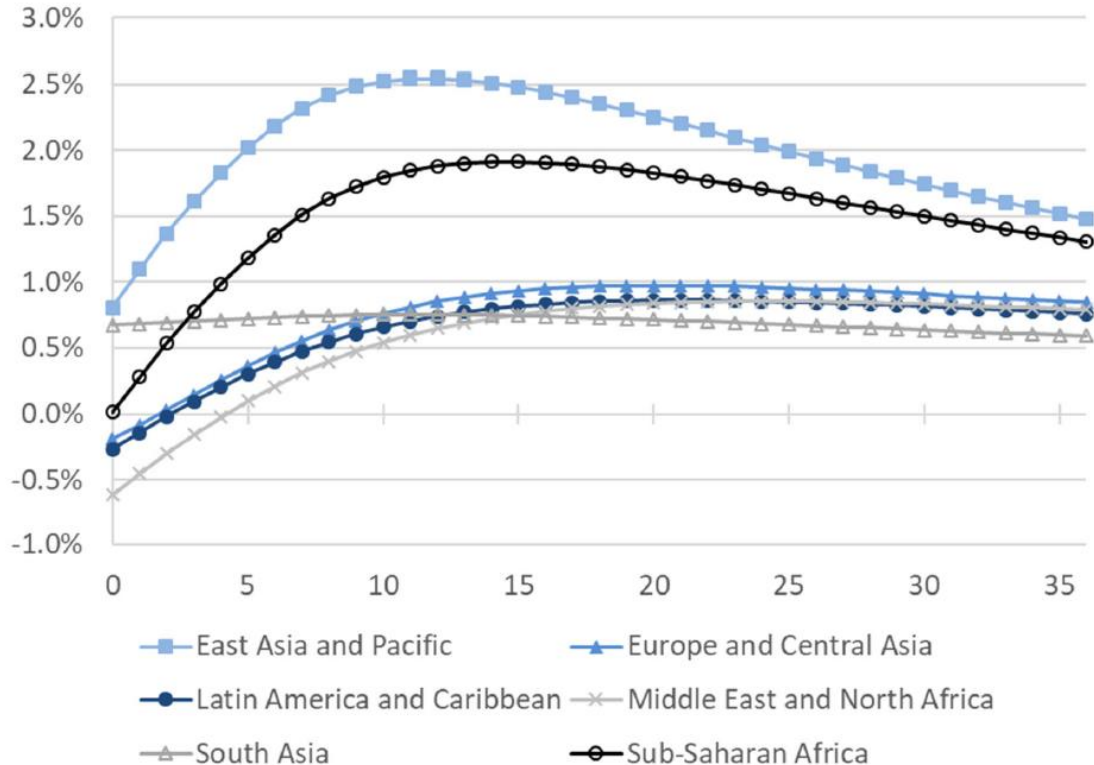
- Higher index \rightarrow faster TFP growth ($\widehat{\beta}_1 = 0.05^{***}$)



Example: increasing determinant index to regional leader

- **Scenario:** increase determinant index to the regional leader over 15 years.
- **Result:** Substantial TFP Growth by t+15:
 - 2-2.5% in EAP & SSA
- **Growth:** TFP growth path → main LTGM
 - SR: boost GDP growth one-for-one
 - LR: 1.5-2 times (incl. effect via K)

Figure 7. Simulated average TFP growth rate by region with the scenario that a country increases its overall determinant index to the highest index among developing countries in its region over 15 years



Region	Highest Index in 2014
East Asia & Pacific (EAP)	South Korea
Europe & Central Asia (ECA)	Czech Republic
Latin America & Caribbean (LAC)	Chile
Middle East & North Africa (MENA)	United Arab Emirates
South Asia (SAR)	India
Sub-Saharan Africa (SSA)	South Africa

Source: Kim and Loayza (2019)

2.2 LTGM-Public Capital (Devadas & Pennings 2018)

- Public capital (“essential infrastructure”) thought to boost productivity of other factors.
- Modify production function for infrastructure services S_t provided by public capital K_t^G :

$$Y_t = A_t S_t (K_t^P)^{1-\beta-\phi} (h_t L_t)^\beta \quad \text{where} \quad S_t = [\theta_t K_t^G]^\phi$$

- Allows for lower “efficiency” ($\theta_t < 1$) of public investment (corruption etc)
- Level of efficiency $\theta < 1$ has *no effect* on impact of public inv. on growth (Berg et al 2015)

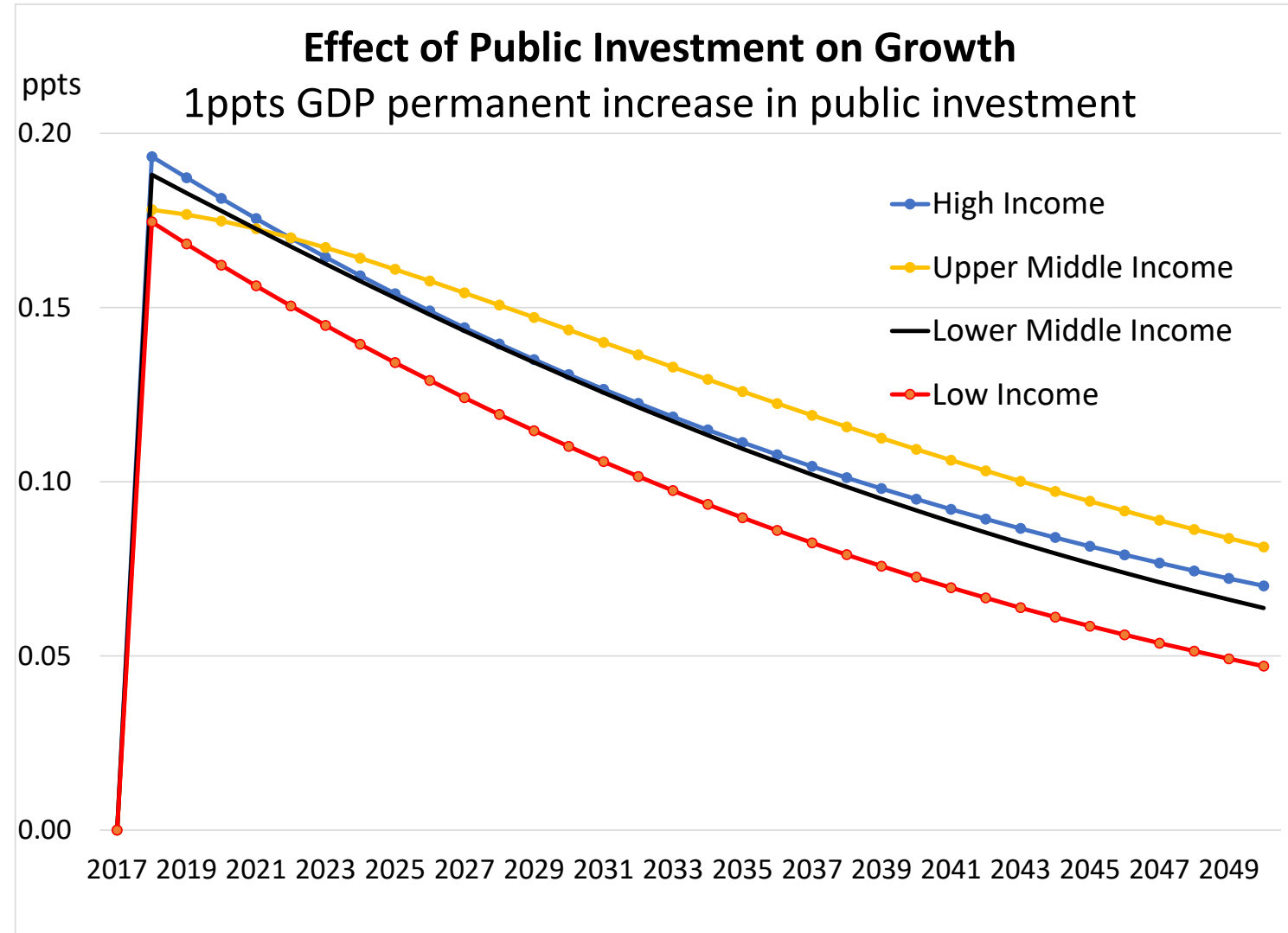
$$g_{Y,t+1} \approx \dots + \left[\frac{\phi}{\theta_t K_t^G / Y_t} \right] \frac{\theta_t^N I_t^G}{Y_t}$$

Less new
 K_G built

Greater need for K_G : $\theta < 1$ increases MPK_G 25

LTGM-Public Capital: Main Findings

- Permanent \uparrow public investment provides **modest** boost to growth.
 - \uparrow 0.15-0.2ppt in short run (excluding multiplier effects).
- Boost to growth is **temporary** (falling MPK for public capital)
 - 0.05-0.1ppts after 30 years
- Helpful, but not a growth miracle
- No larger effect if **low income**
 - Effect size depends on K_t^G/Y , not shortage of public K.
- Heterogeneous effects: LTGM-PC toolkit for individual countries



Source: Devadas and Pennings (2018), Graph 3, Congestion ($\phi = 0.17$) specification.

2.3 LTGM-Human Capital (beta version) $Y_t(GDP) = A_t K_t^{1-\beta} (h_t L_t)^\beta$

- h_t is the productivity of average worker (relative to unskilled) due to human capital
 - Basic LTGM only based only on their years of schooling (Mincer return)

LTGM-Human capital makes two changes:

1. Broader HC definitions based on the WB Human Capital Index (HCI)
 - Learning-Adjusted Years of Schooling (includes quality) + health measures
2. Trace human capital over time by population cohorts (as in Collin and Weil 2018)
 - Reforms affecting today's children, who are not in labor force
 - Delayed effect on h_t and GDP growth in when then those children join the workforce.

Malaysia example: ↑ Education quality & health to HI median

Common result: Education quality has largest effect on growth and health has smallest

FIGURE 21
Simulations for Malaysia's rate of human capital growth

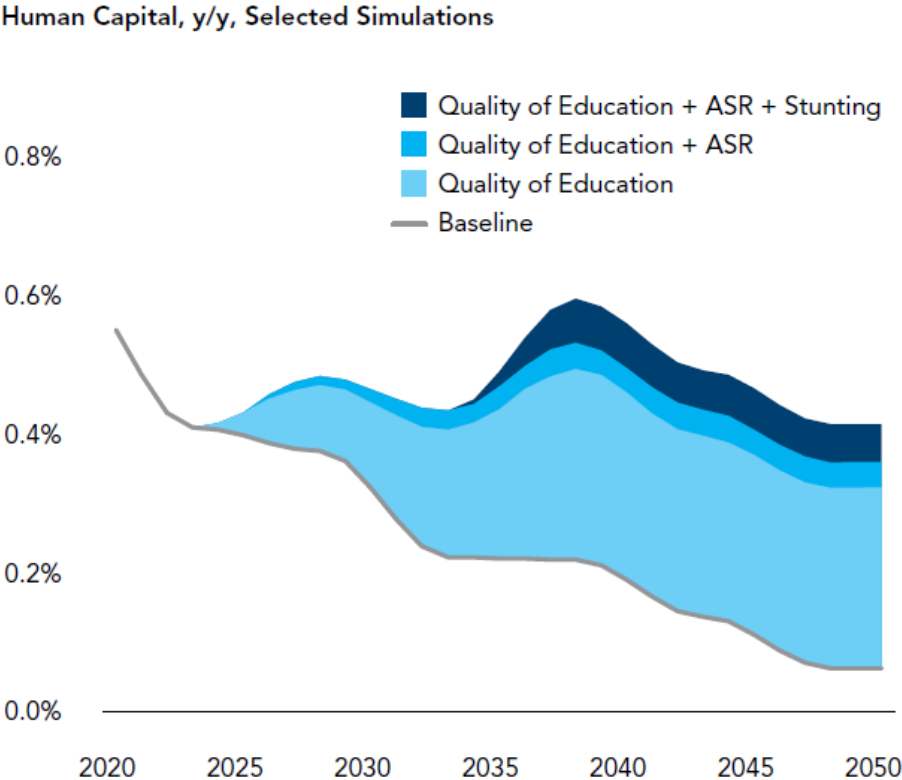
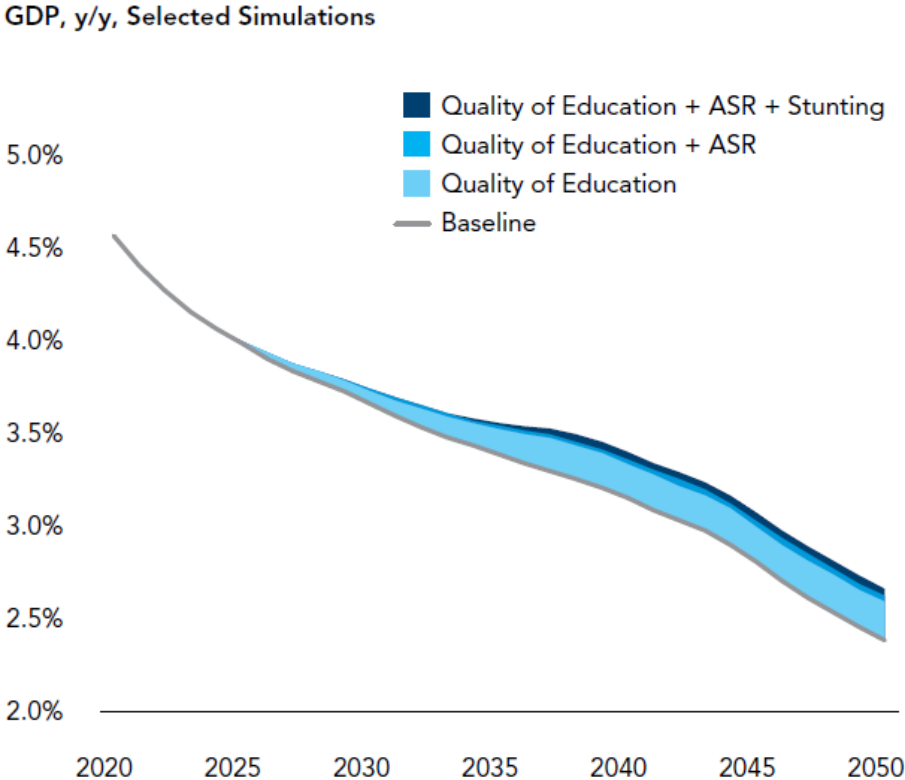


FIGURE 22
Simulations for Malaysia's long-term rate of GDP growth



Source: World Bank (2019)

2.4 LTGM-Natural Resource Extension (beta version)

- LTGM-NR adds commodity sector (e.g. Oil, but could also be copper, gold etc)

$$Y_t(GDP) = A_t K_{0,t}^{1-\beta} (h_t L_t)^\beta + p_t^{oil} Q_t^{oil}$$

- Commodity production Q_t^{oil} depends on oil capital stock and oil reserves
- Govt taxes oil production → invest revenues, spend them or save them abroad (fiscal rule)
- LTGM-NR finding (1): commodity price shocks have no direct effect on *real potential GDP* (only have indirect effect, mostly through fiscal policy).
 - Constant export prices (Kehoe & Ruhl 2008) (models does not consider demand side)
- LTGM-NR finding (2): fiscal rules that invest revenues have fastest growth (Hartwick Rule)

Conclusions

- Growth in developing countries → living standards and World Bank twin goals
- LTGM: simple & transparent toolkit to simulate future growth paths
 - Based on neoclassical Solow-Swan Model
 - Investment, savings, TFP growth, human capital, demographics etc
- Many extensions (TFP, Public capital, HC, Natural Resources)
- Future work: incorporating climate change

Key Takeaways

- Five common findings when applying the Long Term Growth Model:
 1. Heterogeneity in terms of quantitative impacts
 2. Investment-led growth not sustainable in long run → broad-based strategy
 3. Hard to have high investment without high savings
 4. ↑ Public investment usually doesn't generate a growth miracle (but is helpful)
 5. Fast TFP growth usually needed (human capital helps, but operates with a delay)

Questions and Comments

- LTGM papers and toolkits can be freely downloaded at: www.worldbank.org/LTGM
- Contact about LTGM: spennings@worldbank.org

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