Instructions for Using the Long Term Growth Model (LTGM) v4.1 Spreadsheet (including poverty extension)

Steven Pennings (spennings@worldbank.org) and Jorge Guzman (jguzmancorrea@worldbank.org), 27 June 2018

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Spreadsheet Overview:

- *InputDataA_GeneralAssumptions* and *InputDataB_ModelSpecAssumptions* are the only two worksheets ("tabs") where the user enters modelling choices:
    - Parameters and assumptions in *InputDataA* affect all Models (1-3).
    - Assumptions in *InputDataB* affect only a specific model.
- *GraphsB* plots **results** of each model (and model-specific assumptions from *InputDataB*).
- *GraphsA* plots all general assumptions in *InputDataA*.
- Tabs Model1, Model1s, Model2, Model2s, Model3, Model3s are where the calculations take place. Model1, 2, 3 reflect the "baseline" and Model1s, 2s, 3s are the "scenario" to be analyzed.
    - Model 1: assume a path for the investment share of GDP (I/Y) → implied GDP growth.
    - Model 2: assume a path of GDP growth → required investment share of GDP (I/Y).
    - Model 3: assume a path for savings share of GDP (S/Y) (+ external sector)→ implied GDP growth.
- (**NEW in LTGM v4.1**) The *DataSummary* tab summarizes data from different sources and time horizons, to give users an idea of trends, volatility and other measurement issues.
- (**NEW in LTGM v4.1**) Users can choose from different data sources/years for parameters/initial values using the dropdown menus next to each variable in *InputDataA* and *InputDataB*. Missing data from the default sources are interpolated based on income group medians, which triggers a red warning cell.
- **Color coding is important:** yellow indicates a cell the user can edit, red indicates one they shouldn't change, and grey indicates an inactive or summary cell.
- (**NEW in LTGM v4**) The model calculates how economic growth affects poverty rates.

Steps to run a simulation:

<u>InputDataA_GeneralAssumptions Tab</u>

- **Country, Year, and Parameters (top of InputDataA tab)**: Choose the country (from the drop-down menu), initial year, and the three parameters required for the model (or use values pre-populated from data):
    a. *initial K/Y* (should be between 1.5 and 3.5 for most countries)
    b. *depreciation rate* δ (should be between 0.03 and 0.06 for most countries
    c. *labor share of income* β (should be between 0.4 and 0.8 for most countries)

  Users can also enter an initial value for real GDP per capita if they would like (eg using the most recent data).
- **Assumptions of future values of exogenous general growth drivers (left of InputDataA tab)** If on "automatic mode", the user can set an initial value for the growth driver, a target future value and a year to reach that value. The target and year achieved can vary across baseline and scenario. The model will then draw a smooth path between initial and target values (and will be constant at the target value after that

year). To set a constant growth rate just set the future growth rate equal to the current rate (the default), or set the target year as the initial year. The user can use the pre-populated initial value from a historical average, or choose an initial value (for example, using updated data) by editing the yellow cell.

a. *Total factor productivity (A)* TFP is one of the most important drivers of growth. Reasonable values for long run annual TFP growth are between 0 and 0.02 (0%-2%) for most countries.[1]
b. *Human capital growth (h)* is also important and growth is between 0 and 0.02 for most countries.
c. *Labor market participation rates by gender*. These are best kept constant for most countries at the initial value (where there is no effect on growth), the default. However, increased female labor force participation can be important for growth in countries which have low initial participation rates.
d. *Demographics*. Calculated by demographers based on trends in births, deaths and the population age structure. Best left on default (automatic) preloaded values for most users.
e. *External balance.* The external balance variables only affect growth in Model 3, but affect the savings rate and either CAB or debt in Model 1 and 2. The user first needs to choose whether to model the external sector via a future path of (i) external debt/foreign direct investment or (ii) the current account balance (CAB). (ii) is the simpler option, and with CAB/Y=0, Model 1 and 3 are identical. Depending on the option the user chooses from the drop-down menu, they need to select initial values, future targets and the target year in a similar way as other variables above.

- **Implied paths of exogenous growth drivers (right of InputDataA tab)** Check the implications of the choices made in (2) above for the future values of exogenous general growth drivers. If on automatic mode, no changes are allowed here. If one wants to choose a particular non-linear path for a variable, just change the drop-down menu to "manual" (previously was "automatic") on the LHS. This will recolor the region on the right to yellow, indicating which cells can be edited manually year-by-year.
- **A summary of the choices for future exogenous growth drivers are shown in tab *GraphsA*.**
- **Effect of Growth on Poverty** At the bottom of InputDataA the user can set the parameters related to poverty, such as initial poverty headcount. The preloaded values are for extreme poverty (<$1.90/day 2011PPP) from the most recent households survey in PovcalNet, but the user can also input the poverty rate at the national (or other) poverty line.[2] How growth affects the poverty rate is governed by the Growth Elasticity of Poverty (GEP), for which there are two options:
    a. The default is that income follows a *log-normal distribution* (generally a good approximation empirically) which automatically generates a relation between growth and poverty (and a GEP).
        i. In this case, the user also has the option to select the path for future income inequality via the income Gini (or Shared Prosperity Premium). This is preloaded from the most recent household survey in PovcalNet or WDI but users can assume a different initial value, a future target or target year (or can choose a manual path for the Gini on the right). A lower Gini generally lowers poverty rates (other things equal) and increases the effect of growth on poverty
    b. Alternatively, the user can input the Growth Elasticity of Poverty on "Manual" from the drop-down menu, and enter a path of GEP year-by-year in the yellow cells that appear on the right.

[1] Growth rates of many variables can be very volatile in the short term, but these variations even out over time. The user may choose different average over different horizons from the drop-down menu.
[2] Only the poverty headcount rate (not the value of the poverty line or specification in currency/period) affects simulations.

InputDataB_ModelSpecAssumptions Tab

- **If using Model 1 (Input: Investment → Output: Growth),** choose the initial investment share of GDP (or leave blank to use the pre-populated value), the target investment share and also the target year. The user can also choose a 15, 10, 5-year average or the most recent available value for the investment-to-GDP ratio from a drop down menu. The assumed paths of investment are shown on the right. If the user prefers, choose manual (rather than automatic) and enter the investment share of GDP year-by-year in the yellow cells that appear on the RHS. Investment rates are usually between 10-40% of GDP, with investment rates of around 20%-25% being typical.
- **If using Model 2 (Input: Growth target → Output: Investment),** the user first needs to choose a target from the drop-down menu: a [headline] GDP growth target, a GDP per capita (PC) target or a GDP per capita (PC) level target. The user chooses initial values, target values, target years and automatic / manual as above. Additionally, the user can choose a 15, 10, 5-year average or the data point from the most recent available year from a drop-down menu for each variable. Unrealistic growth targets appear as unrealistically high required I/Y.
- **If using Model 3 (Input: Savings → Output: Growth)**, follow the same process for Model 1 in Step 5 above, but apply it to savings rather than investment. Savings rates and investment rates are roughly similar for most countries (the Feldstein-Horioka Puzzle): 10-40% with typical values of around 20%-25%. The difference in Model 3 is that growth depends on the external sector assumptions in *InputDataA* tab (CAB or External Debt/FDI), so the user of Model 3 needs to pay special attention to those assumptions. Also, the user can choose a 15, 10, 5-year average or the most recent available data point from a drop-down menu.
- **Results are plotted in *GraphsB,*** as well as model-specific inputs (which vary by model). Also included is the Marginal ICOR (number of ppts of investment/GDP required to boost growth by 1%) and the K/Y ratio. High marginal ICORs and K/Y ratios mean investment will be inefficient at producing growth.

Optional: Model 1, 1s, 2, 2s, 3 and 3s tabs – calculations at the heart of the model

A feature of the LTGM is the transparency and simplicity of the calculations of growth rates and required I/Y.

- "Summary of Inputs based on User's choice" at the top of each of these tabs which contain all the assumptions of inputs which are used in the model, and is linked to the RHS of *InputDataA* and *InputDataB.*
- "Endogenously Generated Variables" is the core of the LTGM - how growth and I/Y are calculated. These are the most important formulas, and reference only "Summary of Inputs", or "Endogenously Generated Variables" from previous periods. Click in the formula bar to see which cells are referenced.
- "Memorandum Items" are extra variables that are calculated in the model, but do not affect growth or investment rates in current or future years.
- "Poverty-related calculations" are where the LTGM calculates the implications of growth for poverty rates. This includes both assumptions which are linked to the RHS of *InputDataA*, as well as the calculations of the poverty rates. For model 2 (with a poverty target), this part of the sheet calculated the growth rate required to achieve the poverty target.

On the next page are worked examples using the LTGM

Worked Examples and Exercises - Long Term Growth Model (LTGM)

Below are some example scenarios to illustrate the way to LTGM spreadsheet works. In each part, the instructions help the user replicate the graphs below. There are also some questions on why the model generates these results. All the exercises are hypothetical do not necessarily reflect the economic situation in Zambia.

(Exercise A) Model 1: With automatic path

Chart 1a: Input to model 1: Investment Path

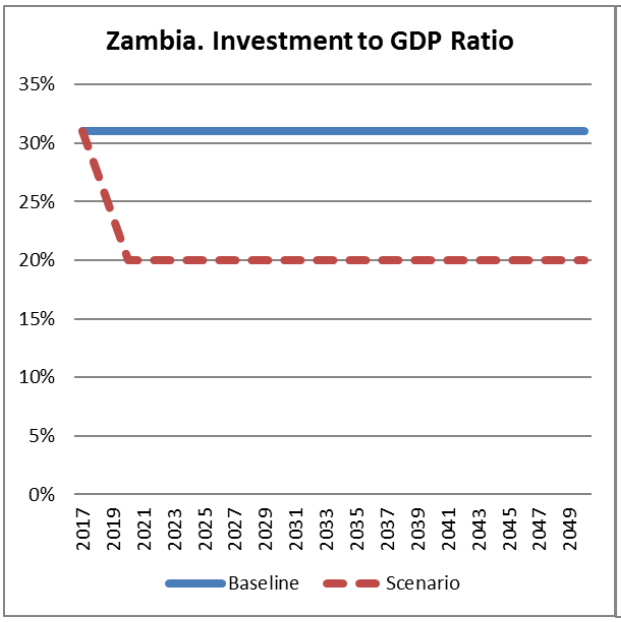
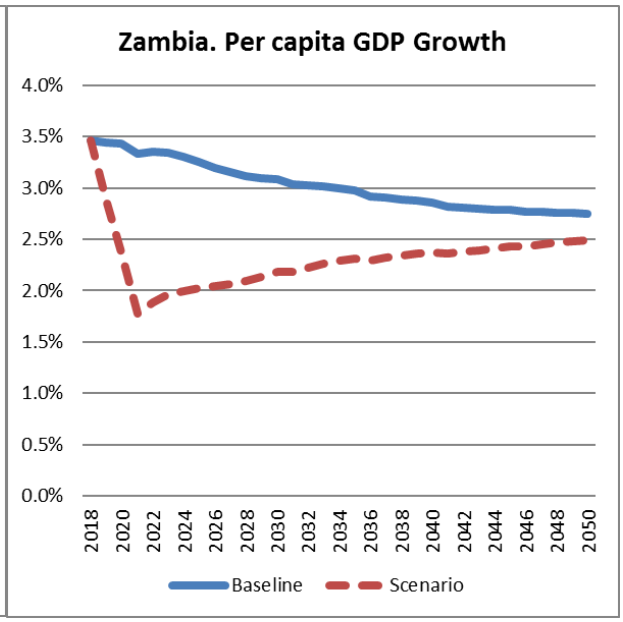


Chart 2a: Output from to model 1: PC GDP Path



1. Choose Zambia from the drop down menu in tab (worksheet) *InputDataA_GeneralAssumptions*
2. Make sure that all drop down menus are on "automatic" and the initial year for estimation is 2017.[3]
3. The user has the option to choose the depreciation rate, labor shares and the capital-to-output ratio from different databases and methodologies such as PWT 8.1, PWT 9, and MFMOD by clicking on the corresponding drop-down menus.
4. Keep universal parameters at default values (though you can type this in the yellow boxes to be sure):
    a. Depreciation rate $(\delta) = 4.9\%$ (choose PWT 8.1 from the drop-down menu)
    b. Labor share $(\beta) = 61.8\%$ (choose "Default PWT 8.1 / GTAP / Interpolated" from the drop-down menu)
    c. Initial capital-to-output ratio $(K_0/Y_0) = 2.42$ (choose PWT 8.1 from the drop-down menu)
5. Set assumptions (LHS of tab *InputDataA_GeneralAssumptions*). Same values for baseline and scenarios. All on automatic.
    a. 0.006 (0.6%) Human capital growth for initial and target (choose" PWT 8.1 10 year average" from the drop-down menu)[4]
    b. Set initial, target and scenario TFP to equal 0.01 (1%) (choose "PWT 8.1 10 year average" from the drop-down menu)
    c. Leave demographics on automatic

[3] In LTGM v4.1, the user can choose from a 15, 10 or a 5-year average for several variables.

[4] Note: if initial = target value, the path for the variable is constant, and it doesn't matter which year the target is reached.

d. Make sure there is no change in female or male participation rates (set target = initial)
e. Ignore external balance for now

6. Model 1 specific assumptions (LHS of *InputDataB_ModelSpecAssumptions* tab):
   a. Baseline: constant investment rate of 31% GDP (D/E4 and D9 = 0.31)
   b. Scenario: equal to 20% by 2020 (E9 = 0.20)
7. Draw Chart 1a (Investment graph) above:
   - Baseline Investment: link to tab *Model 1*: Investment to GDP ratio from "Summary of Inputs based on User's choice (and intermediate calculations)" from years 2017-50 (E10-AL10)
   - Scenario Investment: link to tab *Model 1s*: Investment to GDP ratio from "Summary of Inputs based on User's choice (and intermediate calculations)" from years 2017-50 (E10-AL10)
   - This graph is also drawn automatically around Cell A3:A16 in tab *GraphsB.*
8. Draw Chart 2a (GDP PC growth graph) above:
   - Baseline GDP PC growth: link to "GDP per Capita Growth rate" under "Endogenously Generated Variables" in tab *Model 1*. From years 2017-50 (E23:AL23) Final value in 2050 should be 2.7%
   - Scenario GDP PC growth: link to "GDP per Capita Growth rate" under "Endogenously Generated Variables" in tab Model 1s. From years 2017-50 (E23:AL23) Final value in 2050 should be 2.5%
   - This graph is also drawn automatically around Cell G3:J16 in tab *GraphsB.*

(Exercise B) Model 1: With manual investment path

Chart 1b: Input to model 1: Investment Path

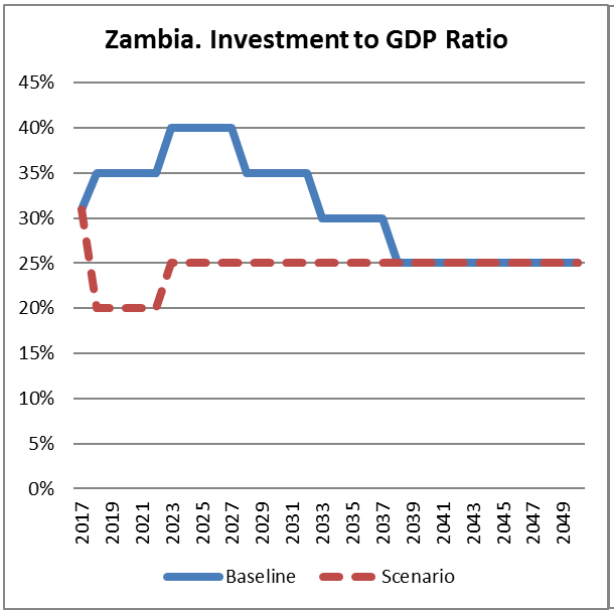
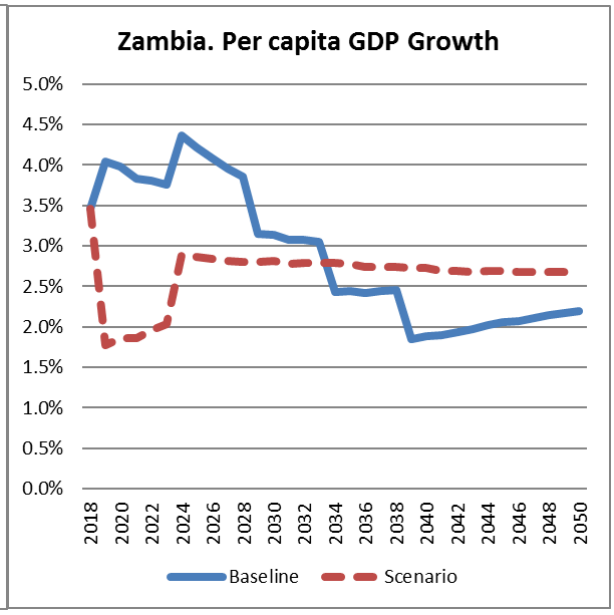


Chart 2b: Output from to model 1: PC GDP Path



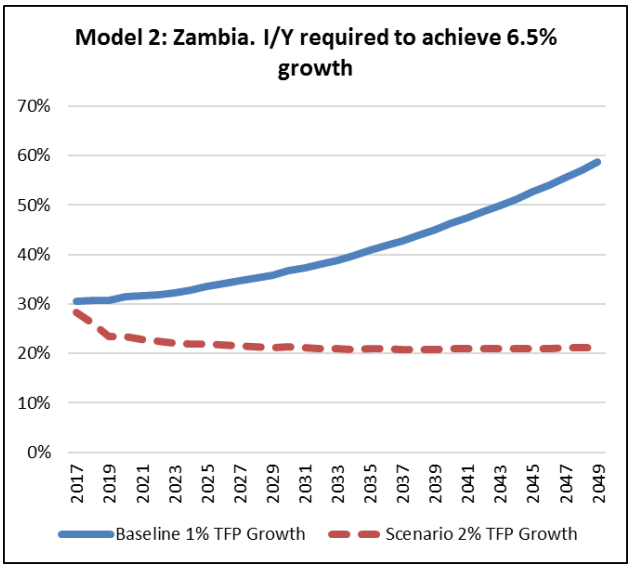
1. Follow steps for Exercise A above but change the following:
2. Tab *InputDataB_ModelSpecAssumptions:* Choice for future Investment: "Manual" mode from dropdown menu. Note that F3 changes to "manual" and cells I4:AP4 and I8:AP8 are available for editing (yellow).
3. Baseline: pickup, then fall in investment share of GDP "Investment to GDP Ratio -User defined, year by year" enter (tab *InputDataB_ModelSpecAssumptions* Cells I4:AP4):
   - 2017: 31%; 2018-22: 35%; 2023-27: 40%; 2028-32: 35%; 2033-37: 30% 2038+: 25%
4. Scenario: fall in investment share, then recovery tab: *InputDataB_ModelSpecAssumptions* "Investment to GDP Ratio -User defined, year by year" enter (I8:AP8):
   - 2017: 31%; 2018-22: 20%; 2023+ 25%

5. Chart 1a and Chart 2a should update automatically to Chart 1b and Chart 2b (changes can be also observed in "GraphsB" tab).
6. GDP per capita growth by 2034 should be 2.4% (baseline) and 2.8% (scenario).
7. **Q**: Why is growth in scenario higher than baseline, when baseline has higher I/Y? (answer at end)[i]
   - Hint: look at the marginal ICOR in sheet Model 1/1s, row 40 or look at the graph in "GraphsB".

(Exercise C) Model 2: With automatic path

1. Start with automatic path in Model 1 (Example A)
2. Tab: *InputDataB_ModelSpecAssumptions* "Model 2" on LHS
   - Make sure output target variable= "GDP Growth" (cell D20) & is on "Automatic"
3. Set *headline* GDP growth target: 6.5% (constant)
   - Type initial= 0.065 (D13)
   - Set target= 0.065 for both baseline (D22) and scenario (E22) (not per capita)
4. *InputDataA_GeneralAssumptions*: Initial TFP growth 0.01 (1%) (as Example A, cell D29)
5. Baseline: 0.01 (1%) TFP growth (D34) by 2017
6. Scenario: 0.02 (2%) TFP growth by 2020 (E34)
7. Generate Chart 3:
   - Baseline I/Y path: link to Tab: *Model2*: Investment to GDP ratio from "Investment Ratio to reach target growth rate" under "Endogenously Generated variables" from years 2017-49 (E18-AK18)
   - Scenario Investment: as in Baseline but link to Tab: Model 2**s** (note the s) instead (E18-AK18)
   - These charts are also automatically generated around cells A19:E32 and G19:K32 of tab *GraphsB.*
8. By 2049: Required I/Y rate to produce 6.5% headline growth is 59% (baseline), vs 21% (scenario).
9. **Baseline vs. scenario:** the user will notice that when making simulations, the baseline works as the business-as-usual simulation and the scenario is the one that experiences the changes in productivity. In this case, to see what would happen if TFP growth were to increase from 1% to 2% growth by 2020: the required I/Y would be lower and a 6.5% GDP growth would be achievable under this scenario with higher productivity.
10. **Q:** Why is the required investment rate *so much higher* in the low productivity growth scenario than the high productivity growth baseline? After all it is only 1ppt difference? (answer at end[ii]). Hint: ICOR again.

Chart 3: Output from model 2: required I/Y Path



(Exercise D) Model 3a: External debt (automatic path)

Chart 4: Input to model 3: Savings & Debt Path

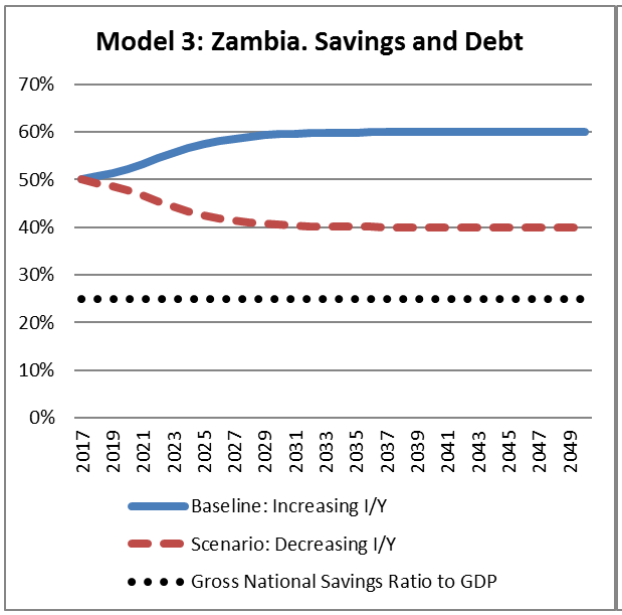
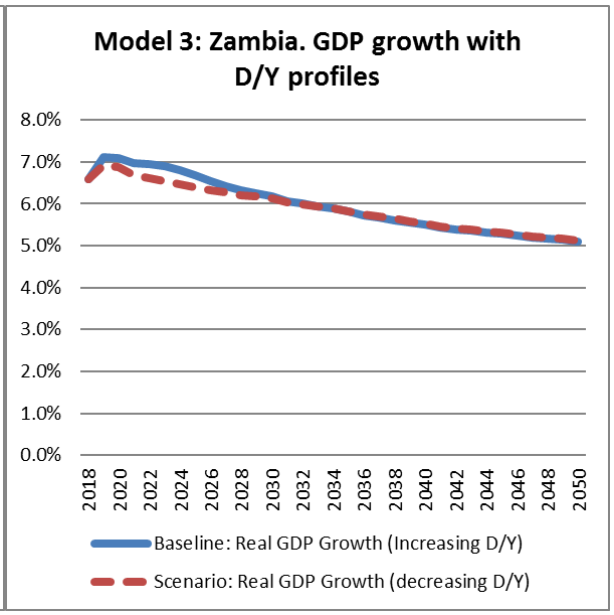


Chart 5a: Output from model 3: GDP Growth Path



1. Start with automatic path as in Exercise A (remember to set the TFP growth targets back to 1%)
2. *InputDataB*: Set initial and target savings 25% GDP for both baseline and scenario (Cells D26, D31, E31)
3. *InputDataA*: Check initial & target CAB to equal -0.06 (-6%) (for both baseline and scenario D64, D69, E69)
4. *InputDataA*: Set initial and target FDI 6% GDP for both baseline and scenario (Cells D83, D88, E88)
5. *InputDataA*: Check initial & target TFP to equal 0.01 (1%) (for both baseline and scenario, D29, D34, E34)
6. *InputDataA*: Check External Balance is on "Debt" from the drop-down menu (D60)
    - Set initial external debt balance to 0.5 (in D73)
7. *InputDataA*: Baseline: 0.6 external debt to GDP by 2030 (D78, this is a smooth path, rather than a linear)
8. *InputDataA*: Scenario: 0.4 external debt to GDP by 2030 (E78, this is a smooth path, rather than a linear)
9. Create Chart 4 by linking three different lines to:
    - Baseline: link to Model 3: "Debt to GDP Ratio (end of period)" under "Summary of Inputs based on User's choice" (tab *Model 3*> Cells E31-AL31)
    - Scenario: link to Model 3s: "Debt to GDP Ratio (end of period)" under "Summary of Inputs based on User's choice" (tab *Model 3s*> Cells E31-AL31)
    - Savings (both baseline and scenario): link to Model 3: "Gross National Savings Ratio to GDP" under "Summary of Inputs based on User's choice" (Model 3> Cells E6-AL6)
    - This graph is a combination of automatically generated Tab: *GraphsA* J36:O49 (for external debt-to-GDP) and tab: *GraphsB* A35:E48 (for savings).
10. Create Chart 5a (which is *headline* growth not per capita) by linking three different lines to:
    - Baseline: link to Model 3: "Real Total GDP growth" under "Memorandum Items" for 2018-50 (Model 3> Cells F32-AL32)
    - Scenario: link to Model 3**s**: "Real Total GDP growth" under "Memorandum Items" for 2018-50 (Model 3s> Cells F32-AL32)
    - Total GDP Growth in plotted in tab *GraphsB* around cell AG35:AK48.
11. By 2020: GDP Growth rate should be 7.1% (baseline) vs 6.9% (scenario).

12. **Q**: The difference in the growth rate is ≈0.20ppt between baseline and scenario around 2020. Why do these two very different debt paths have such a small effect on growth (answer at end[iii])?

(Exercise E) Model 3b: FDI/Y scenario

Chart 6: Input to model 3: FDI paths

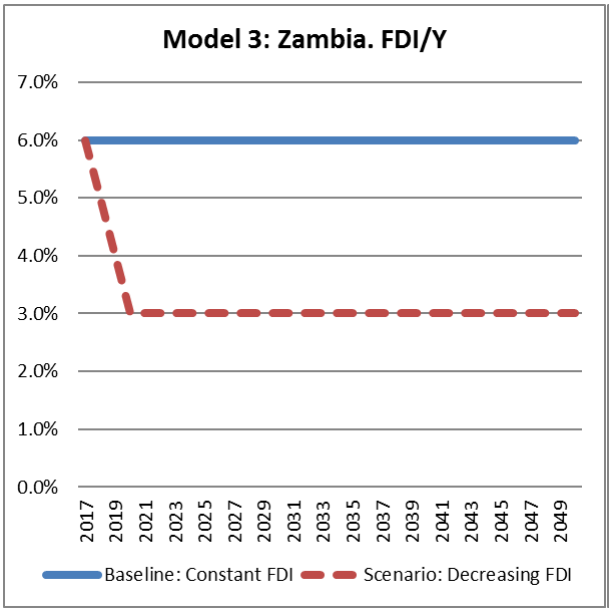
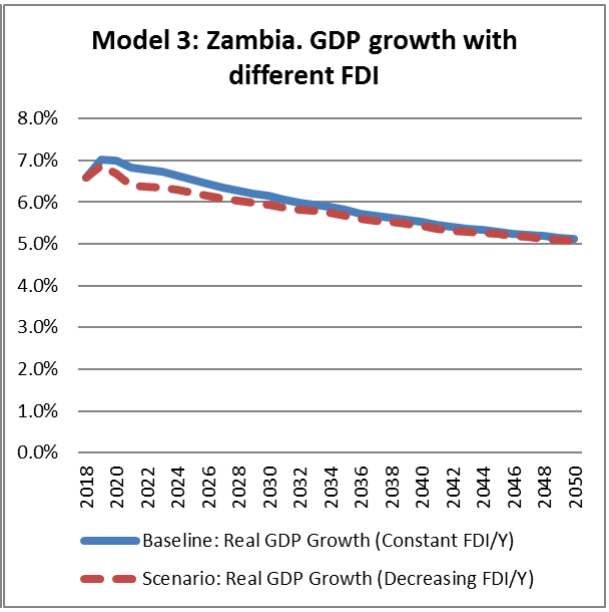


Chart 5b: Output from model 3: GDP Growth Path



1. *InputDataB*: Start with automatic path for savings as in Exercise E (D30)
2. *InputDataA*: Set a constant debt path of 0.5 (Input Data: D78 and E78 equal 0.5)
3. *InputDataA*: Check initial and target TFP to equal 1% (for both baseline and scenario, D29, D34, E34)
4. InputDataA_GeneralAssumptions : Check the Baseline: 6% FDI/Y (constant) (D83 and D88)
5. InputDataA_GeneralAssumptions : Scenario: 3% FDI/Y by 2020 (change E88 and E89)
6. To generate Chart 6:
    - Baseline FDI path: link to "Foreign Direct Investment Ratio to GDP under "Summary of Inputs based on User's choice" in tab *Model3* (Cells E13:AL13).
    - Scenario FDI path: link to "Foreign Direct Investment Ratio to GDP under "Summary of Inputs based on User's choice" in *Model3**s*** (Cells E13:AL13).
    - This is also graphed automatically as in tab *GraphsA* around cell S37:Y50
7. Chart 5a should update automatically to generate Chart 5b (Growth rates)
8. By 2020: GDP Growth rate should be 7% (baseline) vs 6.7% (scenario),
9. **Q:** The difference between growth rates is 0.30ppt in 2020 (with rounding). Why? (answer at end[iv])

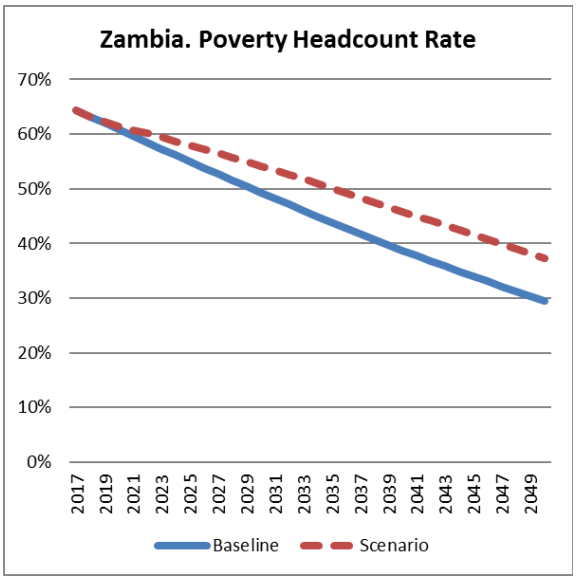
(Exercise F) Poverty extension - *New in LTGM v4*

Changes in poverty rates are generated by GDP per capita growth in Model 1 and 3, and 2 (with a growth or GDP target), so here we use Model 1 and growth fundamentals from Exercise A (I/Y, TFP, Human capital growth, etc).

Exercise F1 (from growth to poverty)

1. Start from the simulation in Exercise A (Model 1) above: *InputDataB* (Model 1):
    a. Baseline: constant I/Y of 31% GDP (D/E4 and D9)
    b. Scenario: I/Y equal to 20% by 2020 (E9)
    c. All other parameters as in Exercise A.
2. Select poverty-specific parameters (bottom of InputDataA_GeneralAssumptions):
    a. Initial poverty rate at 0.644 (default) (D/E125)
    b. Poverty line of $1.9/day (default) (D/E129)
    c. Set the Growth Elasticity of Poverty (GEP) on Automatic (the default) (D133)
    d. Initial Gini coefficient of income at 0.556 (default) and constant over time (D137)
3. Chart 7: At the top right-hand side of *GraphsB* the poverty rate is calculated.
4. By 2049: the poverty rate is 0.30 under the baseline and 0.38 under the scenario (see "Poverty-related calculations" in Model 1, and 1s respectively).

Chart 7: Poverty Rates in Exercise A (Model 1)

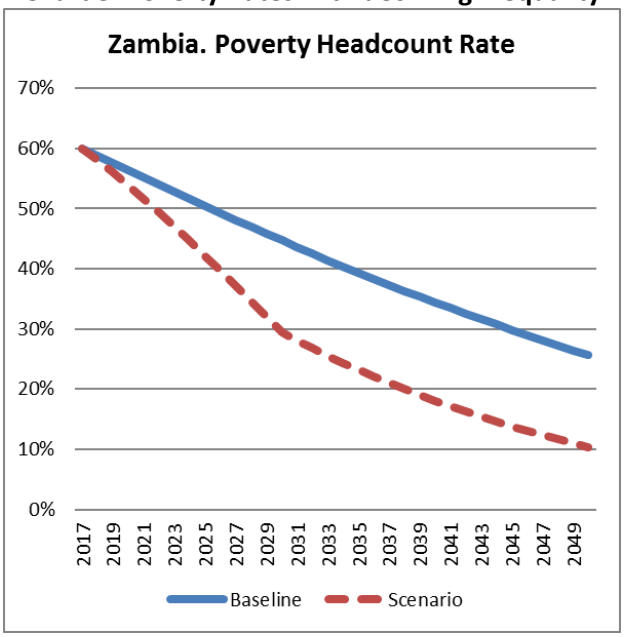


Exercise F2 (changing initial poverty rates and income inequality)

The pre-loaded poverty rates are from the most recent household survey – which can be some years ago – so users may want to change the initial poverty rate. Alternatively, they might want to simulate poverty based on a national poverty line, which is often quite different from the international extreme poverty line (the default).

Users can also reduce the Gini coefficient to stimulate the effect of *pro-poor growth.* In many cases, a higher growth rate alone is not sufficient to meet poverty reduction targets - income inequality also has to decline. To see this, consider the following scenario where the user wants to *halve* the rate of poverty by 2030 (from 60% to 30%).

Chart 8: Poverty Rates with declining inequality



1. Start from the simulation in Exercise A (Model 1) and Exercise F1 above.
2. Set the scenario investment rate equal to the baseline investment rate (constant I/Y of 31% GDP). This will mean that the paths of GDP per capita growth will be identical in baseline and scenario.
3. Change the initial poverty rate to 0.6 (D/E 125) at the bottom on *InputDataA.*
4. Set the initial Gini coefficient to 0.556 (D/E 137) (the pre-loaded default for Zambia), and assume it is constant in the baseline. In the scenario, set the target Gini coefficient to 0.42 (D144) by 2030 (a reduction in income inequality). The path for the Gini coefficient is plotted at the bottom of sheet *GraphsA.*
5. By 2030: poverty is 0.447 in the baseline, which is not enough to meet the poverty reduction target. But in the scenario, the poverty rate falls from 0.60 to 0.294 by 2030 with the additional effect of fall in income inequality, which is sufficient to reach the growth target.
6. Chart 8: At the right of *GraphsB* (W3:AA16) the poverty rate is calculated.

[i] **Exercise B Answer:** Growth is higher in the scenario in 2034 (despite lower investment in 2033), because investment is more efficient in the scenario than in the baseline due to lower (marginal) ICOR. The marginal ICOR can be seen in worksheet Model 1 (1s): row 40 for the year 2033. The marginal ICOR is around 8 for Model 1 but only around 6 for Model 1s, which means that each extra investment is 1/3 less efficient in model 1 than model 1s at producing growth. That is an 8 ppts of investment are required to produce an extra unit of growth in Model 1, but only an extra 6 ppts of Investment are needed in Model 1s. The reason for the difference is that in Model 1 investment was very high in the past (2017-32) which increased the capital-to-output ratio in Model 1 relative to model 1s (3.1 vs 2.3) – and the higher the K/Y ratio the less efficient investment. The marginal ICOR is given by (K/Y)/(1-β), where β is the labor share of output (and 1- β is the capital share) as in Model 1 (1s) cell D2.

[ii] **Exercise C Answer**: A 1ppt difference in productivity growth might not seem like much, but it is enough to tip the economy across two very different growth paths.

In the high productivity growth baseline, GDP per worker grows *faster* than capital per worker (on rows 22:23 of Model 2/2s sheets), which means than that the K/Y ratio is falling by 2020 (row 26). This means that each passing year, investment becomes more and more efficient, reducing the required I/Y ratio and helping the K/Y ratio fall further. This creates a virtuous cycle.

In the scenario (with low productivity growth), the reverse occurs. Capital per worker growth is faster than GDP per worker growth, and so the K/Y ratio starts rising. This increases the marginal ICOR which reduces the effectiveness of investment, and, hence, to achieve the same growth rate of 6.5% *more investment* is needed. But the next period the capital stock grows even faster, leading to an even bigger increase in K/Y and a further increase in the ICOR, etc. This creates as vicious cycle of ever less productive investment, which quickly generates I/Y ratios that are unrealistic.

A key result is that an investment-led growth strategy will quickly become *unsustainable* unless it is complemented by high rates of productivity growth (or other growth drivers like human capital or participation).

[iii] **Exercise D Answer**: Debt affects the investment in two ways. The most important effect is through the *change in debt*. At 2020 debt the change in debt in the baseline is about 2ppts of GDP a year higher than under the scenario (because of the shape of the adjustment). The second (much smaller) effect is through the level of debt: a highly a fast-growing indebted economy can borrow more each year and still keep debt to GDP constant (because GDP is increasing). Combined these two factor mean investment is about 2.1ppts higher in the baseline. The marginal ICOR determines how much extra growth is generated by this extra investment. Around 2020, the marginal ICOR is around 6.8, and so the extra growth generated is 2.1ppt/6.8≈0.3ppt (the ICOR is also slightly lower in the scenario than baseline, which accounts for slightly smaller difference). Changes in external debt only having limited effects on growth is consistent with the well-known "Feldstein-Horioka Puzzle" that across countries high domestic investment rates usually go hand-in-hand with high savings rates.

[iv] **Exercise E Answer**: A fall in the FDI rate implies almost a one-for-one change in the investment rate. So a rough calculation is Δ(FDI/Y)/mICOR (in the previous year). The FDI difference is around 2ppts of GDP in 2019, and the marginal ICOR is around 6.5. Hence the difference in growth is 2ppt/6.5≈0.307ppt, which is pretty close to the 0.30ppt fall.