A Refresher on MAMS

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Presentation for Second Intensive Training Workshop of the Project "Strengthening Macro-Micro Modelling Capacities to Assess Development Support Measures and Strategies", Kigo District, Kampala, September 11-14, 2012

Outline

- Introduction
- Structure of MAMS
- Steps in MAMS Analysis
  - Base and Non-Base Scenarios
- Questions Addressed by MAMS

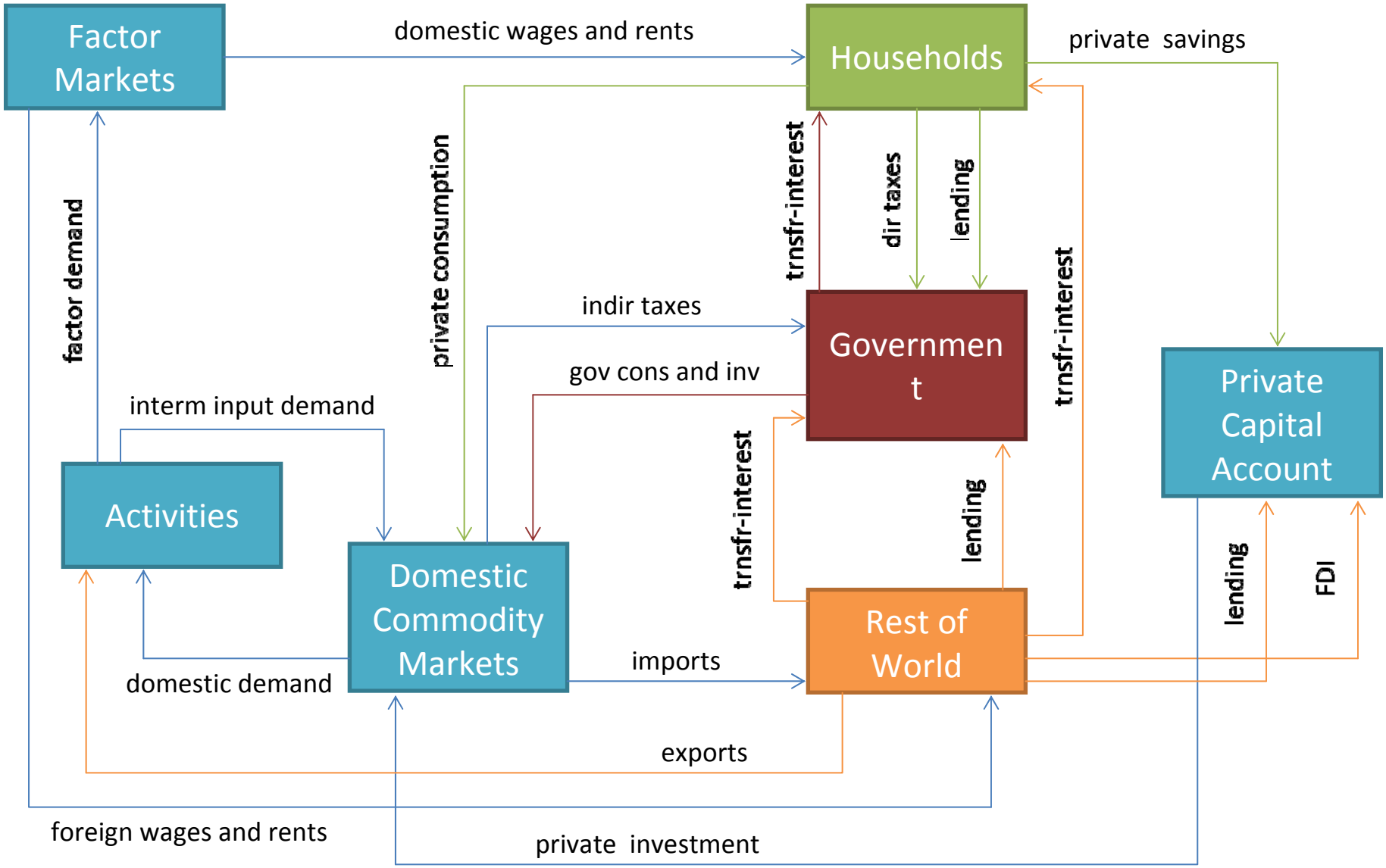
Introduction

- MAMS (Maquette for MDG Simulations) is a recursive dynamic Computable General Equilibrium (CGE) model developed at the World Bank to analyze
  - strategies for achieving MDGs
  - country-level, medium-to-long-run policy analysis
- +65 MAMS applications in 45 countries; most of them through UN-DESA projects.

Model Structure

- MAMS is an open economy recursive dynamic computable general equilibrium (CGE) model; in the tradition of Dervis et al. (1982).
- Three modules
  - intra-period = relatively standard CGE model
  - inter-period = endogenous adjustment of factor stocks and productivity
  - MDG and education = “production” of MDG indicators and educational outcomes
- The model can be run without the MDG module.

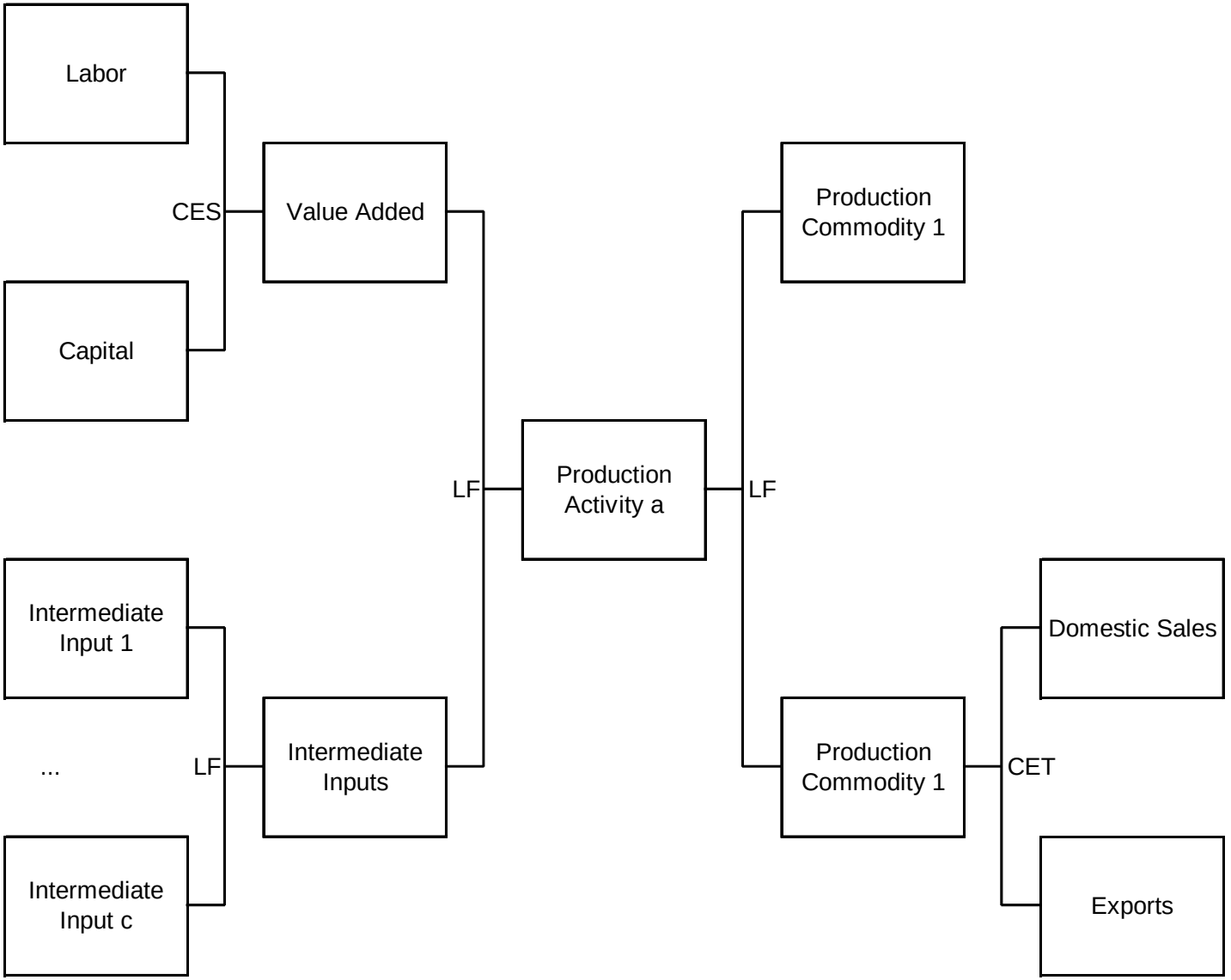
Flow of Payments in MAMS



Activities: Production Function

- The producers are represented by activities; they maximize profits
  - factor hiring and intermediate input use depend on wages, input prices, output prices, etc.
  - output shares exported and sold domestically depend on relative prices

Production Function – cont.



International Trade: Import Side

- Domestic demanders decide on import and domestic shares in their demands based on relative foreign and domestic prices.

$$PM_c = pwm_c EXR\left(1+tm_c\right)$$

$$\frac{QM_c}{QD_c} = CES^*\left(\frac{PM_c}{PD_c}\right)$$

International Trade: Export Side

- Domestic suppliers decide on export and domestic shares in their supplies based on relative foreign and domestic prices.

$$PE_c = pwe_c EXR\left(1 - te_c\right)$$

$$\frac{QE_c}{QD_c} = CET^* \left(\frac{PE_c}{PD_c} \right)$$

Households

- They earn income from
  - factors
  - transfers from government and RoW
  - interest from loans to the government
- They spend their income on
  - direct taxes
  - savings
  - consumption
  - interest payments on foreign debt

Household – cont.

- Their savings rates depend on per-capita incomes – depending on an elasticity.
- Their consumption decisions change in response to income and relative price changes.
- By construction (and as required by the household budget constraints), the consumption value of the households equals their income net of direct taxes and savings.

Government

- Incomes (current and capital) =
  - taxes
  - transfers from abroad
  - domestic and foreign borrowing
    - typically, for supplementary investment funding
  - factor incomes; e.g., oil countries
- Expenditures (current and capital) =
  - consumption; service provision
  - transfers to households
  - interest on domestic and foreign debt
  - investment; providing the capital stocks required for producers of government services

Government – cont.

- Each receipt and spending item follows some rule with plenty of options
  - exogenous growth, share of GDP, or share of absorption
- Follows a "closure rule" to remain within its budget constraint
  - adjusts some part(s) of its spending on the basis of available receipts, or
  - mobilizes additional receipts of one type or more in order to finance its spending plans

Rest of the World

- The RoW is represented in the Balance of Payments
  - provides foreign currency (forex inflows)
    - transfers to government and households (remittances), FDI, net loans, and exports
  - receives foreign currency (forex outflows)
    - factor payments to RoW, interest payments on foreign debt stocks, and imports
- The world prices are exogenous; i.e., small-country assumption.

Rest of the World – cont.

- The export and import decisions are made by domestic producers and consumers
  - optimization problems
- The other payments follow specified rules
  - with different options; similar to government budget
- The "budget" of the RoW (i.e., the BoP) follows a "closure rule"
  - adjustments in the real exchange rate equalize inflows and outflows of foreign currency -- by influencing exports and imports

Private Investment Financing

- It is provided from
  - domestic private savings (net of lending to the government)
  - foreign direct investment (FDI)
- Alternative closure rules for private savings-investment balance
  - private investment spending adjusts in response to changes in available funding
  - private savings adjusts to achieve an exogenous private investment level (value or share of GDP or absorption)

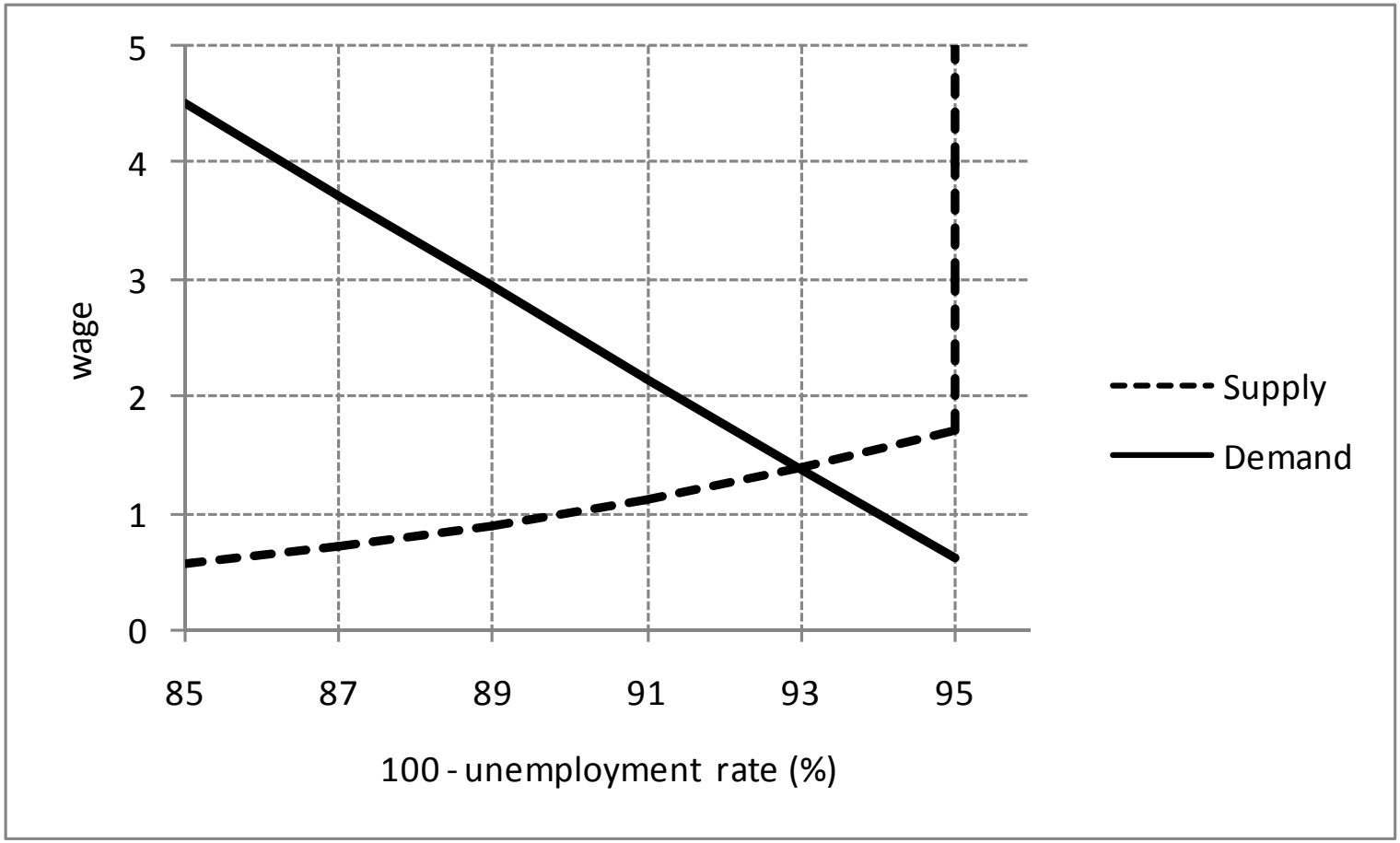
Domestic Commodity Markets

- Flexible prices ensure balance between supply and demand
  - supply = domestic + imports
  - demand =
    - intermediate consumption
    - households
    - government
    - investment
    - stock variations

Markets for Factors (labor, capital, land, natural resources)

- Reach balance between demands and supplies via wage (or rent) adjustments.
- Factor demand curves are downward-sloping reflecting the responses of production activities to changes in factor wages.
- Optional endogenous unemployment for labor
  - a wage curve (a supply curve) is upward-sloping until full employment is reached – see figure

Factor Market with Endogenous Unemployment



Markets for Factors – cont.

- Note: “Unemployment” is defined more broadly than in official statistics to include un- and under-employment
  - it should capture the scope for the existing labor force to generate a larger amount of effective labor (if the incentives to work were to improve)

Dynamics – Inter-Period Module

- Over time growth is due to
  - growth in factor stocks (shifting factor supply curves), determined by
    - investment and depreciation (capital stocks)
    - demography and schooling (labor)
    - exogenous trends (other factors)
  - growth in total factor productivity (TFP), with components that are
    - endogenous (government capital stocks -- infrastructure; labor force education; trade openness)
    - exogenous (trend term)

MDG “Production”

- Non-poverty MDGs are “produced” by a set of determinants:
  - MDG services per capita (supplied by government and non-government)
  - real per-capita consumption
  - evolution of other MDGs -- synergies
  - public infrastructure capital stocks
- In this project, poverty and inequality indicators will be generated through microsimulations.

Education

- MAMS tracks evolution of enrollment disaggregated into three levels (cycles: primary, secondary, tertiary).
- Educational outcomes – for each cycle, rates of intake, promotion, repetition, and drop out – are also functions of a set of determinants (including services per student)
  - treatment similar to MDGs

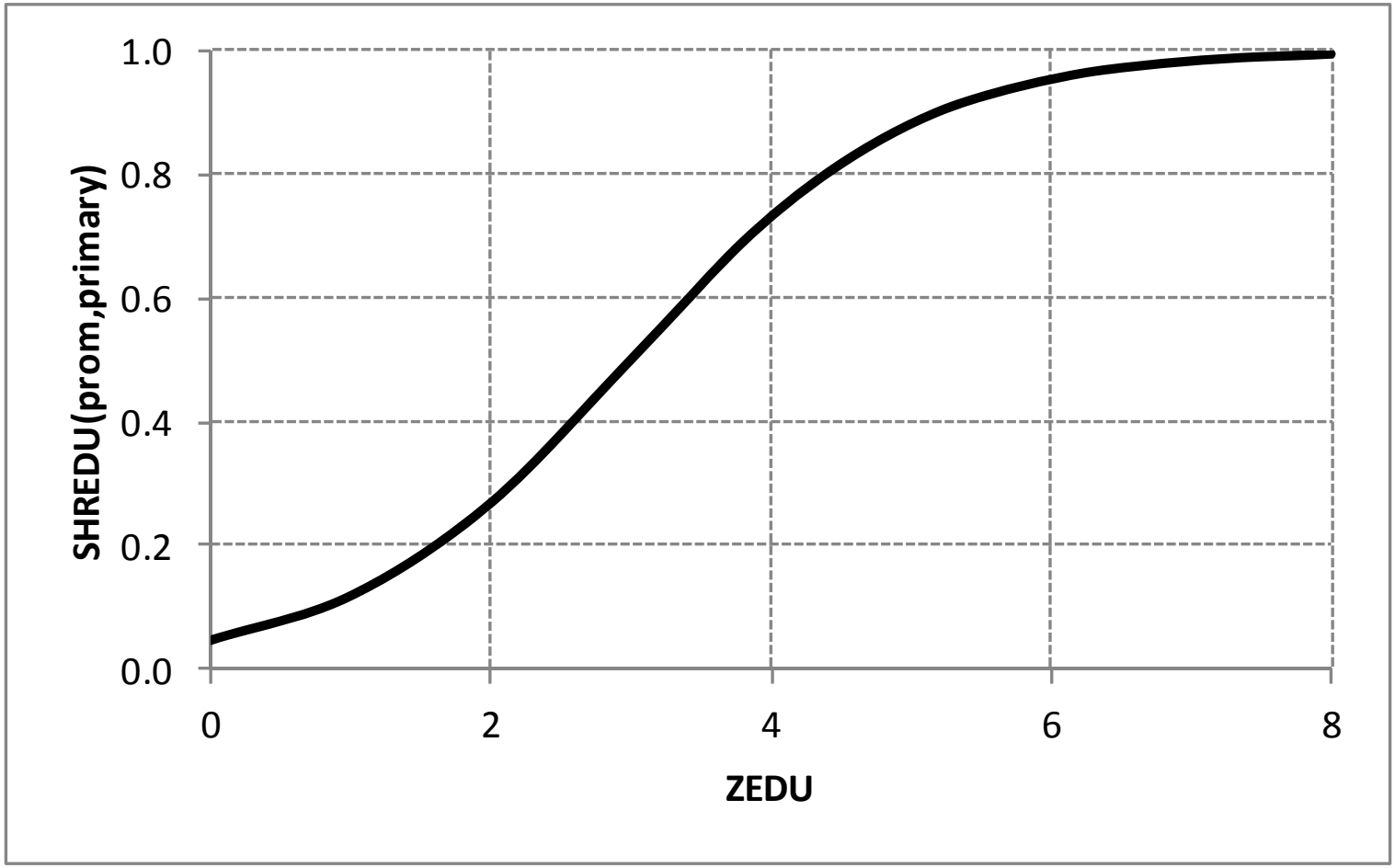
Education – cont.

- MDG 2 is defined as
  - net or on-time primary completion rate
  - share of population in primary school cohort that would complete primary schooling on time if current net intake rates and promotion rates were to prevail during the full cycle (next six years)
  - product of (a) 1st grade net intake rate, and (b) promotion rates for each primary grade
- Depending on schooling, former students and non-students enter different educational segments of the labor force.

Elasticities and Determinants of MDG Outcomes

MDG	Service per capita or student	Consump-tion per Capita	Wage incen-tives	Public infra-structure	Other MDGs
2–Primary schooling	X	X	X	X	4
4-Under-five mortality	X	X		X	7w,7s
5-Maternal mortality	X	X		X	7w,7s
7w-Water	X	X		X	
7s-Sanitation	X	X		X	

Example: Logistic Function Student Behavior



Government Policy Tools

- Level and composition of government spending (by function)
  - for example,
    - education – MDG 2
    - health – MDGs 4 and 5
    - water and sanitation – MDGs 7w and 7s
- Financing of government spending
  - taxes
  - Borrowing domestic/borrowing
  - transfers from RoW

Key Performance Indicators

- Evolution over time for
  - macro aggregates such as private and government consumption, private and government investment, exports, imports, value-added, and taxes
    - all indicators may be national totals or disaggregated
  - domestic and foreign debt stocks
  - MDG indicators (poverty, non-poverty MDGs)
  - educational composition of labor force

Steps in Scenario Analysis

1. Base scenario
   - business-as-usual or projected future evolution; allows imposing GDP growth
2. Non-base scenarios
   - change in policy tools
   - change in parameters beyond government control (ex: aid, world prices, and/or productivity)
3. Analyze and validate
   - explain the differences between non-base and the base scenario
   - if needed, adjust data, model, or simulation design – informal validation.
   - write paper or policy note

Questions Often Addressed by Non-Base Scenarios

- What happens if the government …
  - expands services in one or more areas with additional financing provided by
    - (a) foreign grants,
    - (b) domestic taxes, or
    - (c) domestic borrowing?
  - contracts in one area and expands in another within the limits of fiscal space?
  - becomes more/less productive, adjusting one or more types of spending or financing in response?

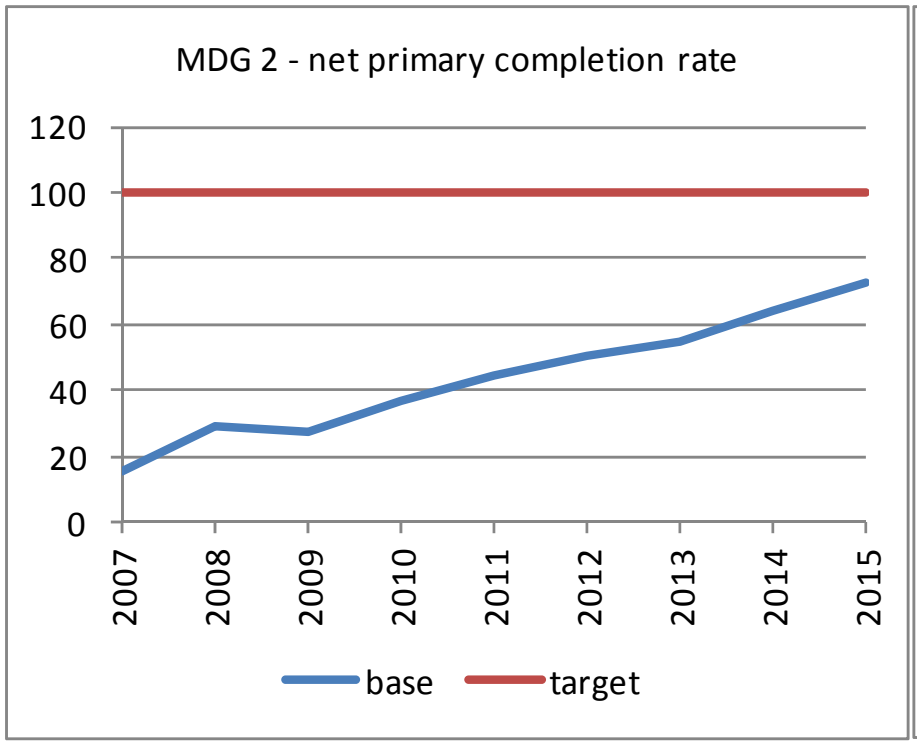
Examples of Other Scenarios

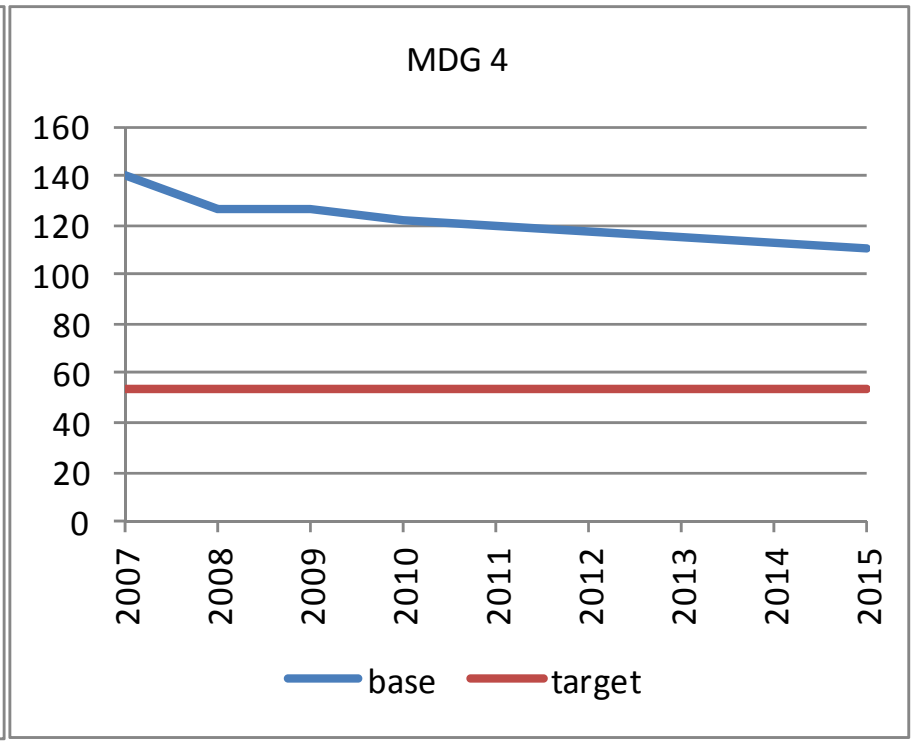
- What happens if …
  - change in tax policy
  - change in world export and/or import prices
  - foreign debt relief
  - change in population growth and age structure (with or without extra government spending on family planning)
  - alternative patterns of productivity growth in non-government activities

Example Scenarios using Uganda Data

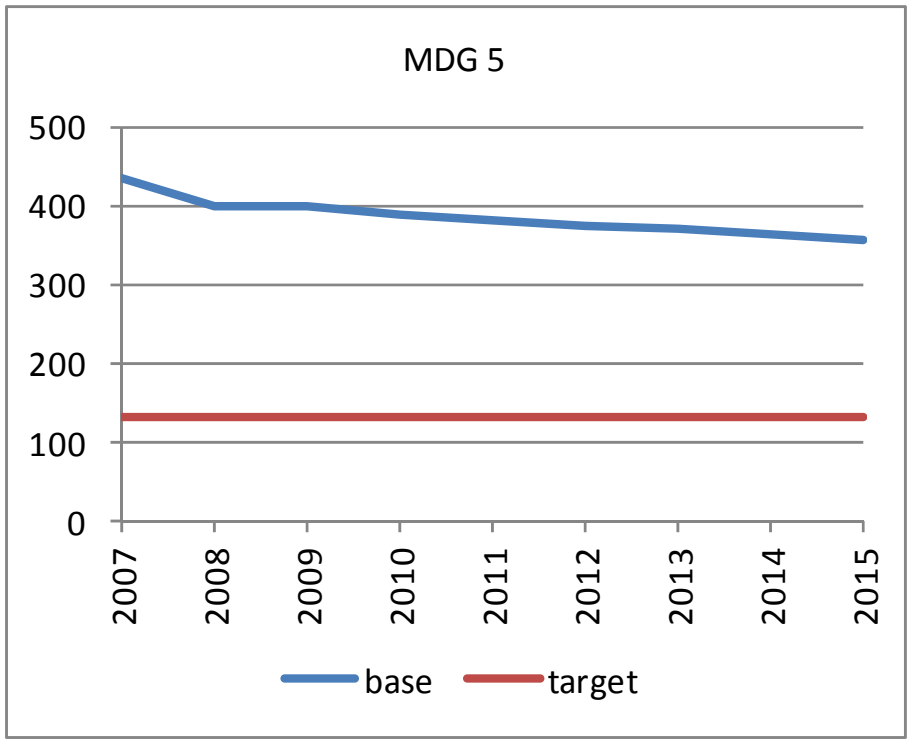
- The baseline is a benchmark for comparison
  - from Matovu et al. (2011); base year=2007
- **aid-hd**: increase in grant aid (10% GDP 2011-2015); fiscal space used for HD.
- **aid-infra**: same aid increase as aid-hd; fiscal space used for infrastructure.
- **mdg2-tfr**: targeting MDG 2 using government spending in primary education as policy tool foreign transfers as financing mechanism.
- **tfp-agr**: 50% increase in TFP agriculture 2011-2015.

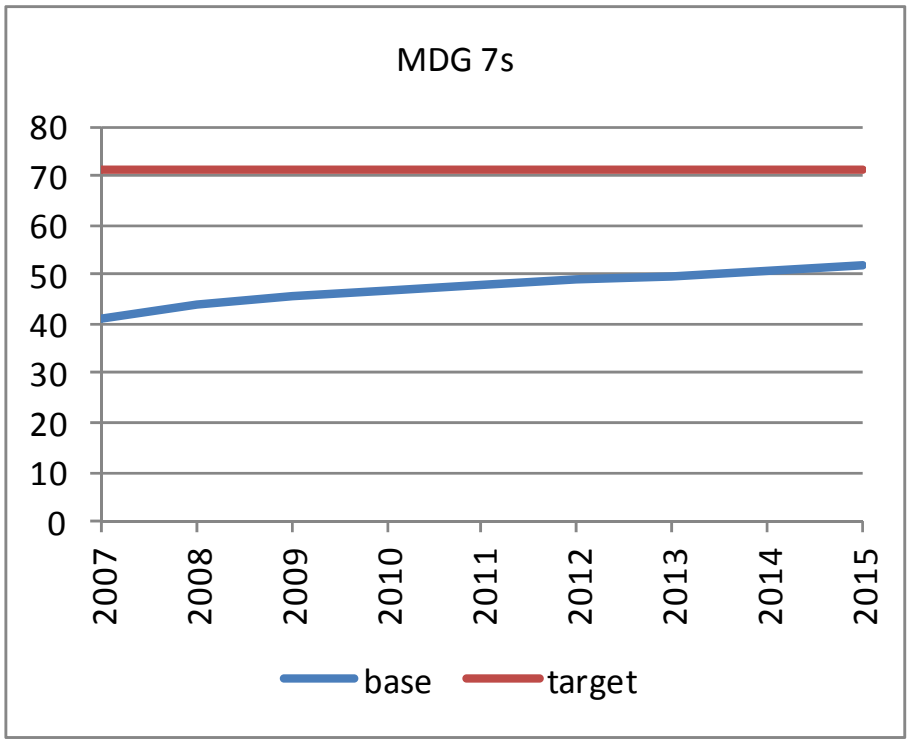
Baseline Scenario



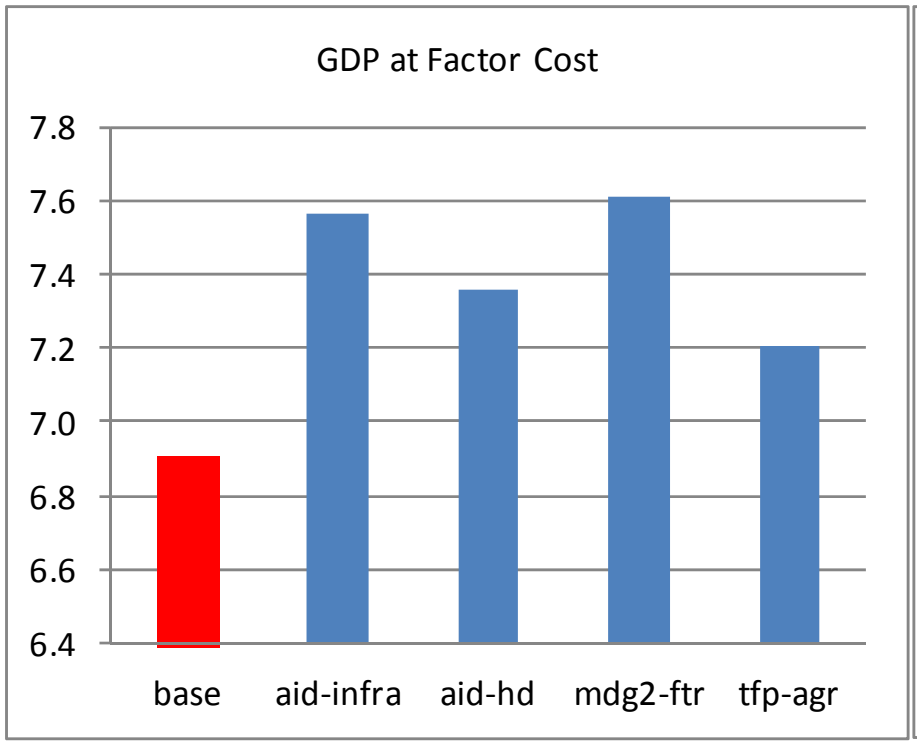


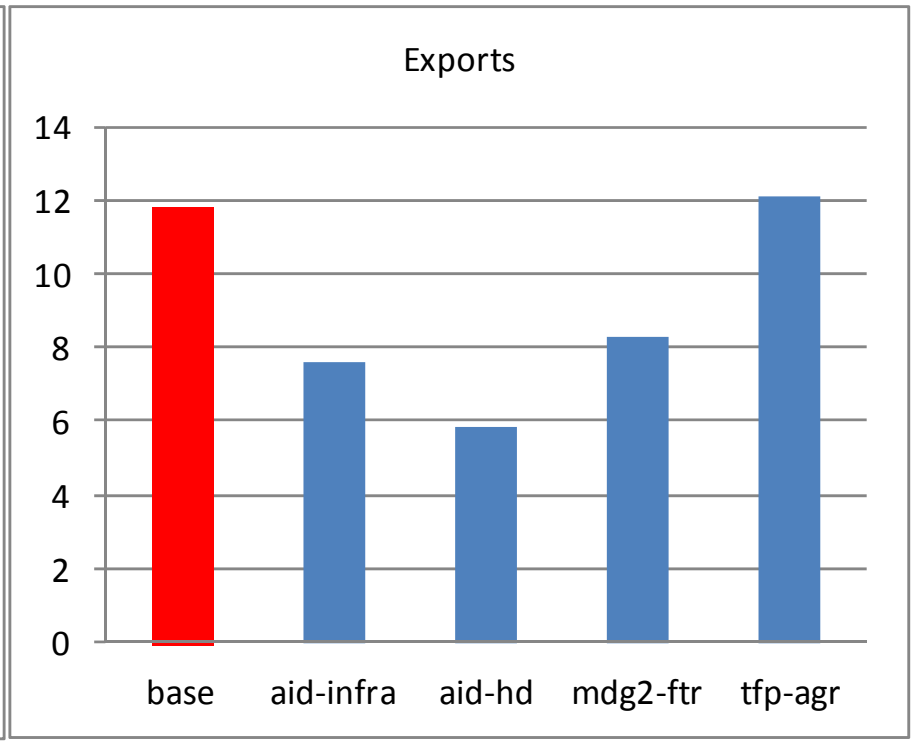
Baseline Scenario – cont.



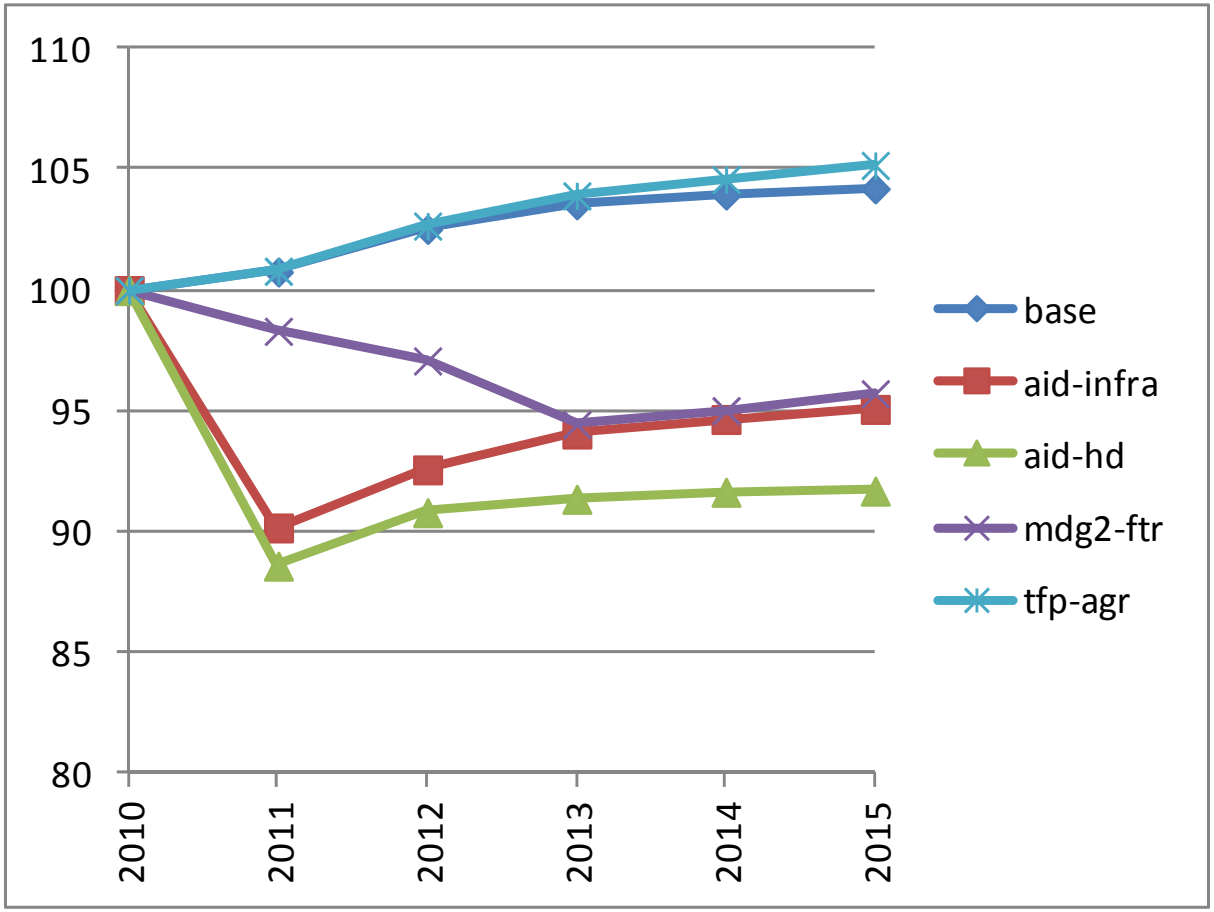


Macro Results (average growth rate; percent, 2010-2015)

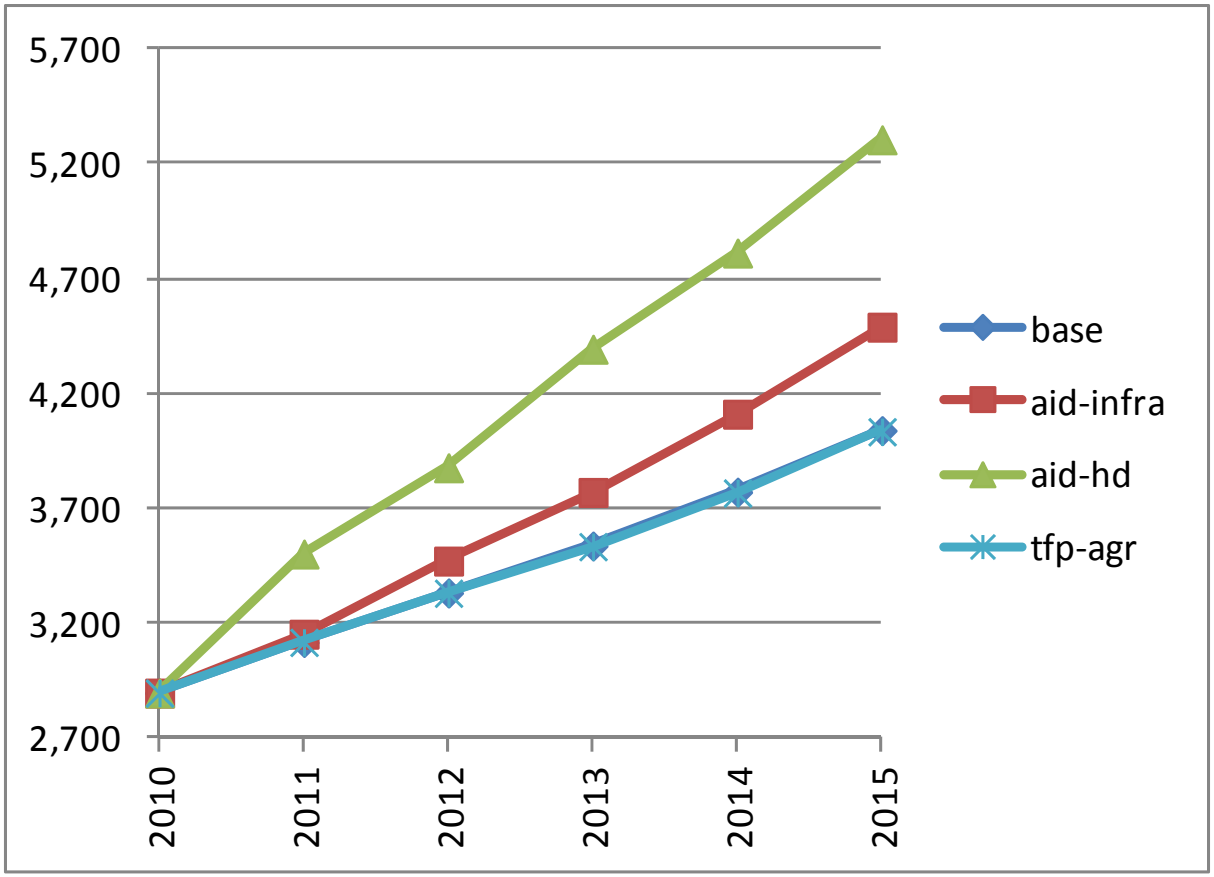




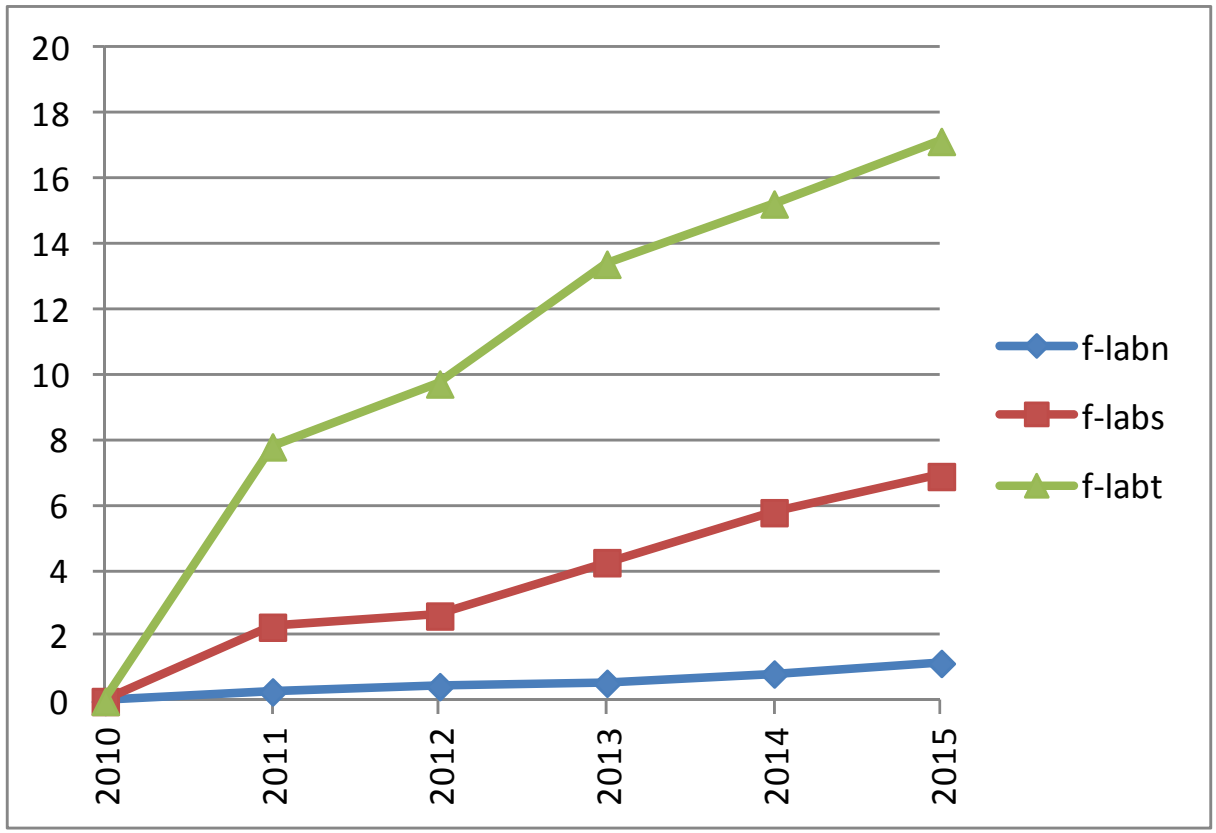
The Real Exchange Rate (index, 2010=100)



Total Current Government Spending (LCU at 2007 prices)



Real Wages **aid-hd** Scenario (percent deviation from base, 2010-2015)



Alternative Scenarios: MDGs