International Economics, Lecture 2
Life-Cycle Models and the Current Account

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Plan

- Ricardian Equivalence
- Overlapping Generations
- Unified Approach
- Applications

Introduction

- Lecture 1: First look at potential determinants of the current account.
- Today: Investigate "real determinants" other than output.
  - Fiscal policy.
  - Demographics.
  - Evidence.

Ricardian Equivalence - Plan

- Gather greater detail on national savings behaviour.
- First, understand the difference between household (private) and government (public) savings.
- Show how **Ricardian Equivalence** holds in the representative agent model.
- Consider ways to **break down** this relationship.

Borrow from Lecture 1

- Consider the two-period small open economy model.
- Introduce government that wants to finance spending, g_t, via:
  - Lump-sum taxes, τ_t.
  - One-period debt, d_t.
- Household budget constraint becomes:

$$\begin{aligned} c_1 + b_1 &= y_1 - \tau_1, \\ c_2 &= y_2 - \tau_2 + (1+r)b_1. \end{aligned}$$

- Intertemporal budget constraint:

$$c_1 + \frac{c_2}{1+r} = y_1 - \tau_1 + \frac{y_2 - \tau_2}{1+r}.$$

Government Budget Constraint

- Government budget constraint:

$$d_1 = g_1 - \tau_1,$$
$$d_2 = g_2 - \tau_2 + (1+r)d_1.$$

  - Relax assumption of budget balance each period.
  - Assume $d_0 = 0$.
  - Argue $d_2 = 0$ for the same reasons as b_2.
- **Government Intertemporal Budget Constraint** (IBC):

$$g_1 + \frac{g_2}{1+r} = \tau_1 + \frac{\tau_2}{1+r}.$$

  - NPV of government spending equals NPV of tax revenue.

Combine Government and Households

- Use government IBC in the household IBC:

$$c_1 + \frac{c_2}{1+r} = y_1 - g_1 + \frac{y_2 - g_2}{1+r}.$$

  - **Timing** of taxes and debt irrelevant for household allocations.
  - Only **level** of spending matters.
  - Not surprising, as only NPV matters.
  - Households save a tax cut today, expecting future tax increase.

- Timing of taxation does not affect national savings.

$$s_t = \underbrace{y_t - \tau_t - c_t}_{s_t^p} + \underbrace{\tau_t - g_t}_{s_t^g} = y_t - c_t - g_t,$$

  as any change in s_t^g is offset by an equal change in s_t^g.

- Combine with the investment separation result and immediately infer no impact on the CA either.

Ricardian Equivalence

- The **irrelevance** of fiscal policy for macroeconomic outcomes (including the current account).
- Equivalent argument for infinite horizon model.
- Requires assumptions:
  - Perfect credit markets.
  - Non-distortionary taxes.
  - Same planning horizon for households and government.
- Today: **Break Ricardian Equivalence** by altering the planning horizons for government and households:
  - Overlapping generations model.
  - Perpetual youth model.

Overlapping Generations

- SOE with generations that live two periods (young and old).
  - New generation is born every period.
  - Each generation consists of a continuum of members of measure one. Normalise population.
- Utility of person born in period-t:

$$U(c_t^y, c_{t+1}^o) = \ln c_t^y + \beta \ln c_{t+1}^o.$$

where c_t^y is consumption during youth and c_{t+1}^o is consumption of the same person in old age.

- Intertemporal budget constraint:

$$c_t^y + \frac{c_{t+1}^o}{1+r} = y_t^y - \tau_t^y + \frac{y_{t+1}^o - \tau_{t+1}^o}{1+r}.$$

Household Optimality

- Maximisation as before, now with Euler equation:

$$c_{t+1}^{o} = \beta(1+r)c_t^{y}.$$

- Substitute into the IBC to solve for c_t^y and c_t^o:

$$c_t^y = \frac{1}{1+\beta}\left[y_t^y - \tau_t^y + \frac{y_{t+1}^o - \tau_{t+1}^o}{1+r}\right],$$
$$c_{t+1}^0 = \frac{\beta(1+r)}{1+\beta}\left[y_t^y - \tau_t^y + \frac{y_{t+1}^o - \tau_{t+1}^o}{1+r}\right].$$

- Consume a **constant fraction** of PDV of lifetime wealth.

Aggregate Household Consumption

- No longer have a representative agent.
- Aggregate consumption follows:

$$c_t = c_t^y + c_t^o.$$

- Substitute results to show:

$$c_t = \frac{1}{1+\beta}\Big[(y_t^y - \tau_t^y) + \beta(1+r)(y_{t-1}^y - \tau_{t-1}^y) + \frac{y_{t+1}^o - \tau_{t+1}^o}{1+r} + \beta(y_t^o - \tau_t^o)\Big].$$

- For illustrative purposes we will make simplifying assumptions.

Government Budget Constraint

- Flow government budget constraint:

$$d_t = (1+r)d_{t-1} + g_t - (\tau_t^y + \tau_t^o).$$

- As for households, can derive the intertemporal government budget constraint:

$$(1+r)d_{t-1} + \sum_{s=t}^{\infty} \frac{g_s}{(1+r)^{s-t}} = \sum_{s=t}^{\infty} \frac{\tau_s^y + \tau_s^o}{(1+r)^{s-t}}.$$

- Impose a transversality condition on government debt:

$$\lim_{T\to\infty} \frac{d_{T+t}}{(1+r)^T} = 0.$$

- Nothing changed from the standard government IBC, simply:

$$\tau_t = \tau_t^y + \tau_t^o.$$

Breaking Ricardian Equivalence I

- Suppose a special case. Endowments, tax policy and government spending are constant:

$$\{y_t^y, y_t^o, \tau_t^y, \tau_t^o, g_t\} = \{y^y, y^o, \tau^y, \tau^o, g\} \quad \forall t.$$

- We may then explicitly write down aggregate consumption as:

$$c = \left[\frac{1+(1+r)\beta}{1+\beta}\right]\left[y^y - \tau^y + \frac{y^o - \tau^o}{1+r}\right].$$

  - Constant consumption over time, without assuming $\beta(1+r) = 1$, as cross-section constant.

- Intertemporal government budget constraint becomes:

$$\tau^y + \tau^o = rd + g.$$

Breaking Ricardian Equivalence II

- Use government budget constraint in consumption equation (eliminate τ^o):

$$c = \left[\frac{1 + (1 + r)\beta}{1 + \beta}\right]\left[y^y + \frac{y^o - g - r\tau^y - rd}{1 + r}\right].$$

- Consumption now depends on tax / debt policies.
- Ricardian Equivalence **breaks down**.

Current Account

- How does fiscal policy affect the current account?
- Recall ca_t is one period change in stock of net foreign assets:

$$ca_t = b_t - b_{t-1}.$$

  - Claim on foreigners after netting out government debt:

$$b_t = b_t^p - d_t.$$

- How may we account for private assets during period-t?
  - Only the young can possibly hold a non-trivial stock of assets between periods t and $t+1$. They begin with no assets:

$$b_t^p = s_t^y.$$

  - The old must spend everything and decumulate all wealth held:

$$-b_{t-1}^p = s_t^o = -s_{t-1}^y.$$

  - Altogether private savings are therefore:

$$s_t^p = s_t^y + s_t^o = b_t^p - b_{t-1}^p.$$

Current Account and Fiscal Policy I

- ca_t is determined by savings of the young, and government:

$$ca_t = b_t - b_{t-1} = b_t^p - b_{t-1}^p - (d_t - d_{t-1}) = s_t^y - s_{t-1}^y - (d_t - d_{t-1}).$$

- Savings of the young:

$$s_t^y = y_t^y - \tau_t^y - c_t^y = \frac{\beta(y_t^y - \tau_t^y)}{1+\beta} - \frac{y_{t+1}^o - \tau_{t+1}^o}{(1+\beta)(1+r)}.$$

- Plug into the CA expression:

$$ca_t = \frac{\beta(\Delta y_t^y - \Delta \tau_t^y)}{1+\beta} - \frac{\Delta y_{t+1}^o - \Delta \tau_{t+1}^o}{(1+\beta)(1+r)} - (d_t - d_{t-1}).$$

Current Account and Fiscal Policy II

- Replace last term with the government budget constraint:

$$ca_t = \frac{\beta(\Delta y_t^y - \Delta \tau_t^y)}{1+\beta} - \frac{\Delta y_{t+1}^o - \Delta \tau_{t+1}^o}{(1+\beta)(1+r)} - rd_{t-1} - g_t + (\tau_t^y + \tau_t^o).$$

- Current account depends on:
  - Income profile.
  - Tax profile.
  - Level of government spending, taxation and debt.

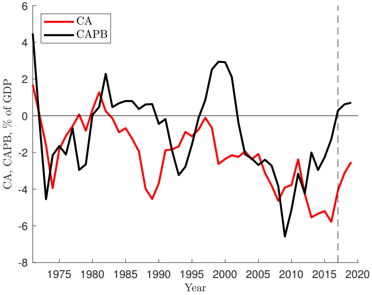
Twin Deficit Hypothesis

- Government budget deficits **cause** current account deficits:

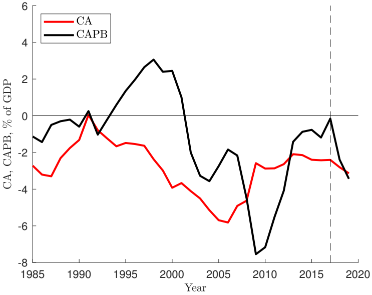
$$ca_t = \frac{\beta(\Delta y_t^y - \Delta \tau_t^y)}{1+\beta} - \frac{\Delta y_{t+1}^o - \Delta \tau_{t+1}^o}{(1+\beta)(1+r)} - rd_{t-1} - g_t + (\tau_t^y + \tau_t^o).$$

- Time series evidence for this, both the US and UK.

UK



US



Sources: OECD, CAPB refers to Cyclically Adjusted Primary Balance.

Twin Deficit Hypothesis

- Cross-country regression (19 OECD countries, 1981-1986):

$$ca_t/y_t = -3.55 + 0.78(\tau_t^y + \tau_t^o - g_t)/y_t.$$

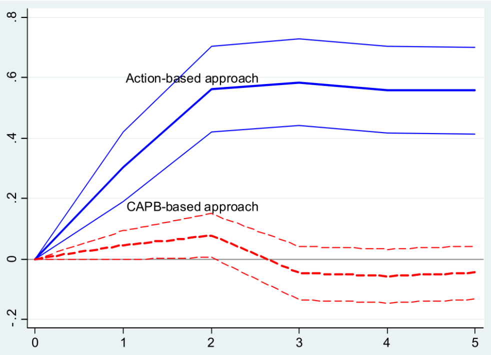
(taken from OR ch. 3).

  - Just a correlation, many potential omitted variables.
  - Reverse causality?
  - Coefficient sensitive to sample period.
- Bluedorn and Leigh (2011) exploit historical fiscal policy dataset.
  - "Narrative" approach of Romer and Romer (2010).
  - Directly identify exogenous fiscal expansions / contractions.

Bluedorn and Leigh (2011)

- 1% fiscal consolidation raises the current account balance-to-GDP ratio by 0.6pp within two years.

Impact of Fiscal Contraction on Current Account-to-GDP



Sources: Bluedorn and Leigh (2011), Figure 1. Fiscal shock is 1% of GDP, response measured in pp. Fine lines are ±1 SE bands. CAPB represnets Cyclcially-Adjusted Primary Balance.

Output Growth and the Current Account

- Use the OLG model, without fiscal policy:

$$\{\tau_t^y = \tau_t^o = g_t = d_t\} = 0 \quad \forall t.$$

- How does output growth affect the current account in this framework?
- Three simplifying assumptions:
  1. Earnings growth over lifetime:

$$y_{t+1}^o = (1+e)y_t^y.$$

  2. Young endowment growth:

$$y_{t+1}^y = (1+g)y_t^y.$$

  3. Interest rate:

$$\beta(1+r) = 1.$$

Implications for Output Growth

- In this context, we therefore have:
- Old endowment growth:

$$\frac{y^o_{t+1}}{y^o_t} = \frac{(1+e)y^y_t}{(1+e)y^y_{t-1}} = (1+g).$$

- Aggregate output growth:

$$\frac{y_{t+1}}{y_t} = \frac{y^y_{t+1} + y^o_{t+1}}{y^y_t + y^o_t} = \frac{\frac{y^y_{t+1}}{y^y_t} + \frac{y^o_{t+1}}{y^y_t}}{1 + \frac{y^o_t}{y^y_t}} = \frac{(1+g)+(1+e)}{1+\frac{1+e}{1+g}} = (1+g).$$

Implications for the Current Account

- Without fiscal policy (or investment), the current account equals the change in private savings:

$$ca_t = s_t^y - s_{t-1}^y = \frac{\beta}{1+\beta}(\Delta y_t^y - \Delta y_{t+1}^o).$$

- Using assumptions on endowment growth rates:

$$ca_t = \frac{\beta g}{1+\beta}(y_{t-1}^y - y_t^o) = \frac{\beta g}{1+\beta}\left[1 - \frac{y_t^o}{y_{t-1}^y}\right] y_{t-1}^y = -\frac{\beta g e}{1+\beta} y_{t-1}^y.$$

- While the current account as a fraction of GDP:

$$\frac{ca_t}{y_t} = -\frac{\beta g e}{1+\beta}\frac{y_{t-1}^y}{y_t^y + y_t^o} = -\frac{\beta g e}{1+\beta}\frac{1}{\frac{y_t^y}{y_{t-1}^y} + \frac{y_t^o}{y_{t-1}^y}} = -\frac{\beta}{1+\beta}\frac{g e}{2+g+e}.$$

Two Key Insights for the Current Account

- Use the final relationship:

$$\frac{ca_t}{y_t} = -\frac{\beta}{1+\beta}\frac{ge}{2+g+e}.$$

- An **increase** in lifetime earnings (assuming $g > 0$):

$$\frac{\partial(ca_t/y_t)}{\partial e} = -\frac{\beta}{1+\beta}\frac{g(2+g)}{(2+g+e)^2} < 0,$$

lowers aggregate savings. ($e < 0$ required for positive ca_t).

- An **increase** in output growth (assuming $e > 0$):

$$\frac{\partial(ca_t/y_t)}{\partial g} = -\frac{\beta}{1+\beta}\frac{e(2+e)}{(2+g+e)^2} < 0,$$

lowers aggregate savings.

Demographics and the Current Account

- How do **demographic** changes affect the current account in the OLG model?
- Assume generation born at time period-t has N_t members:

$$N_t = (1+n)N_{t-1}.$$

- Lower case variables will represent per-capita variables.
- Current account-to-GDP ratio:

$$\frac{ca_t}{y_t} = \frac{(N_t - N_{t-1})s^y}{N_t y^y + N_{t-1} y^o} = \frac{ns^y}{(1+n)y^y + y^o}.$$

assuming constant per-capita endowment and savings.

Third Insight for the Current Account

- From previous:

$$\frac{ca_t}{y_t} = \frac{ns^y}{(1+n)y^y + y^o}.$$

- Consider altering the rate of population growth:

$$\frac{\partial ca_t/y_t}{\partial n} = \frac{s^y(y^y + y^o)}{[(1+n)y^y + y^o]^2} > 0.$$

  assuming $s^y > 0$.

- A higher population growth rate increase the number of young savers, relative to old dissavers (provided the young save).

Conclusions - OLG Framework

1. Increase in earnings growth leads to a current account deterioration.
    - Provided output growth rate is positive.
    - Smooth income gain over lifetime.
2. Impact of an increase in output growth depends on earnings growth.
    - If earnings decline over an individuals lifetime there is a current account improvement.
    - The savings of the young more than compensate dissavings of the old.
    - The opposite prediction of the representative agent model.
3. Increase in population growth lease to a current account improvement.
    - Provided young savings are positive.
    - Increased proportion of young savers relative to old dissavers.

Unified Approach

- Aim: A unified approach integrating the OLG framework with infinitely lived households.
  - Straightforward: Add bequests to the OLG model.
  - More complex: Perpetual Youth model.

Bequest Motive

- Households care about the welfare of future generations.
  - E.g. Parents care about the happiness of their children.
  - This is enough show that they therefore care about all future generations.
- For simplicity assume non-overlapping generations, where a family line (dynasty) is infinite, but a single household lives for a single period.
- Utility is gained from current consumption and the welfare of children:

$$U_t = u(c_t) + \beta U_{t+1},$$

where $\beta \in (0, 1)$.

Budget Constraint with Bequests

- Individuals face period-t budget constraint of:

$$c_t + h_t = y_t - \tau_t + (1+r)h_{t-1},$$

  where the new variable h_t represents a bequest left by households to their offspring.

- We will impose one addition condition:

$$h_t \geq 0,$$

  such that households may leave positive bequests, but not debt.

- Children are not responsible for the debt of their parents.

Move to Infinite Horizon

- We recover the standard IBC for each dynasty:

$$\sum_{s=t}^{\infty} \frac{c_s}{(1+r)^{s-t}} = (1+r)h_{t-1} + \sum_{s=t}^{\infty} \frac{y_s - \tau_s}{(1+r)^{s-t}},$$

  associated with a standard TVC.

- Turning to household utility, this may be rewritten:

$$\begin{aligned}
U_t &= u(c_t) + \beta U_{t+1}, \\
U_t &= u(c_t) + \beta u(c_{t+1}) + \beta^2 U_{t+2}, \\
&\ldots \\
U_t &= \sum_{s=t}^{\infty} \beta^{s-t} u(c_s) + \lim_{s\to\infty} \beta^{s-t} U_s, \\
U_t &= \sum_{s=t}^{\infty} \beta^{s-t} u(c_s).
\end{aligned}$$

  using a limiting assumption.

What has changed?

- Same intertemporal budget constraint:

$$\sum_{s=t}^{\infty} \frac{c_s}{(1+r)^{s-t}} = (1+r)h_{t-1} + \sum_{s=t}^{\infty} \frac{y_s - \tau_s}{(1+r)^{s-t}},$$

- Same utility function:

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} u(c_t).$$

- Although each generation only cares about their immediate successor, act as if they are infinitely lived.
- **Limiting condition** for bequests:

$$h_t \geq 0 \quad \forall t.$$

Ricardian Equivalence and Bequests

- If changes to taxation and government debt are "sufficiently small" households will simply undo any action by the government in the form of inter-generational bequests.
- However $h_t \geq 0$ constraint may sometimes bind.
  - Instead of borrowing from future generations $h_t = 0$, as the constraint binds. A wedge is introduced between the model of an infinitely lived household and the model with bequests.
  - Ricardian Equivalence fails, at a "**corner solution**".

Example

- Assume that initially the bequest constraint is binding, $h_t = 0$, perhaps because output grows quickly.
- Then the optimal level of consumption is given by:

$$c_t = y_t - \tau_t + (1 + r)h_{t-1}.$$

- Households already want to borrow from future generations to smooth utility over time, but are prevented from doing so.
- An increase in the current level of taxation will lead to a fall in current consumption.
- Households are **unable to smooth** tax changes out over time.
- Ricardian Equivalence **fails**.

Perpetual Youth Model

- Assume a small open economy.
- Move from a 2-period OLG model to one with (potentially) infinitely lived overlapping households.
- Results will depend on cohorts and population size.
- Here we study a simplified version by Weil (1989).

Households

- Households distinguished by age (birth cohort), ν.
- Cohorts care about their own (discounted) utility, such that the period-t utility of cohort ν is:

$$U_t^\nu = \mathbb{E}_t \sum_{s=t}^{\infty} \beta^{s-t} \ln c_s^\nu.$$

- Maximisation subject to an IBC:

$$\sum_{s=t}^{\infty} \frac{c_s^\nu}{(1+r)^{s-t}} = (1+r) b_{t-1}^\nu + \sum_{s=t}^{\infty} \frac{y_s - \tau_s}{(1+r)^{s-t}}.$$

  - y_t and τ_t change over time, but not between cohorts.
  - Cohorts are born with no initial wealth, $b_{\nu-1}^\nu = 0$.

Population Dynamics

- Total population evolves according to:

$$N_{t+1} = (1+n)N_t.$$

- Normalise the size of the first cohort born to $N_0 = 1$.
- The total population is comprised of:

$$N_t = 1 + N_1 - 1 + N_2 - N_1 + \cdots + N_t - N_{t-1},$$
$$N_t = \underset{\nu=0}{1} + \underset{\nu=1}{n} + \underset{\nu=2}{n(n+1)} + \cdots + \underset{\nu=t}{n(n+1)^{t-1}} = (1+n)^t.$$

where terms are collected to highlight the size of each cohort.

Aggregate Consumption

- The optimal solution for a single cohort, ν, has the usual form:

$$c_t^{\nu} = (1-\beta)\left[(1+r)b_{t-1}^{\nu} + \sum_{s=t}^{\infty} \frac{y_s - \tau_s}{(1+r)^{s-t}}\right].$$

- Using the population dynamics as outlined above:

$$c_t = (1-\beta)\left[(1+r)b_{t-1} + \sum_{s=t}^{\infty} \frac{y_s - \tau_s}{(1+r)^{s-t}}\right],$$

where c_t is aggregate consumption and b_{t-1} are represents financial wealth. Both are in per capita terms and given as:

$$c_t = \frac{c_t^0 + nc_t^1 + n(1+n)c_t^2 + \cdots + n(1+n)^{t-1}c_t^t}{(1+n)^t},$$

$$b_{t-1} = \frac{b_{t-1}^0 + nb_{t-1}^1 + n(1+n)b_{t-1}^2 + \cdots + n(1+n)^{t-2}b_{t-1}^{t-1}}{(1+n)^t}.$$

Aggregate Financial Assets

- Question: How does per capita financial wealth evolve?
- Consider the period-t budget constraint facing cohort ν:

$$b_t^\nu + c_t^\nu = (1+r)b_{t-1}^\nu + y_t - \tau_t.$$

- Apply the linear aggregation procedure:

$$(1+n)b_t + c_t = (1+r)b_{t-1} + y_t - \tau_t,$$

where:

$$(1+n)b_t = (1+n)\frac{b_t^0 + nb_t^1 + \cdots + n(1+n)^{t-1}b_t^t + n(1+n)^t b_t^{t+1}}{(1+n)^{t+1}},$$

and final trivial term in numerator $n(1+n)^t b_t^{t+1} = 0$ has been added.

First Order Difference Equation

- Use policy function to eliminate per capita consumption from the budget constraint:

$$(1+n)b_t = \beta(1+r)b_{t-1} + y_t - \tau_t - (1-\beta)\left[\sum_{s=t}^{\infty} \frac{y_s - \tau_s}{(1+r)^{s-t}}\right].$$

- The path of net financial assets depends on the evolution of income and taxation.
- With constant endowment, $\bar{y}$, and taxes, $\bar{\tau}$, per person:

$$(1+n)b_t = \beta(1+r)b_{t-1} + \left[\frac{\beta(1+r)-1}{r}\right](\bar{y} - \bar{\tau}).$$

Stationary Point

- The stationary point arises where $b_t = b_{t-1} = \bar{b}$. Hence:

$$\bar{b} = \frac{(1+r)\beta - 1}{(1+n) - (1+r)\beta} \cdot \frac{\bar{y} - \bar{\tau}}{r}.$$

- This is associated with consumption per capita at:

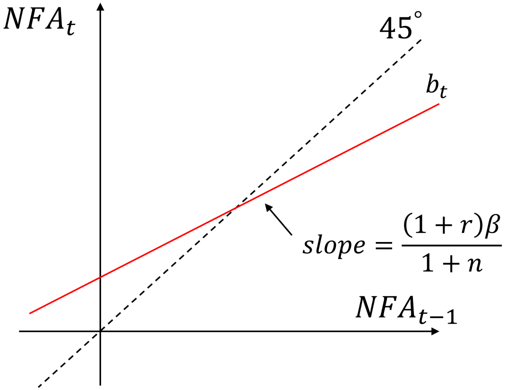
$$\bar{c} = \frac{n(1+r)(1-\beta)}{(1+n) - (1+r)\beta} \cdot \frac{\bar{y} - \bar{\tau}}{r}.$$

- Notice existence relies upon assuming $1 + n > (1+r)\beta$ such that population grows more quickly than assets accumulate.
- For now, assume no government sector, with $\bar{\tau} = 0$.

Steady State - Existence

- Existence requires $1 + n > (1 + r)\beta$, to ensure the difference equation crosses the 45 degree line. "Small enough" slope.

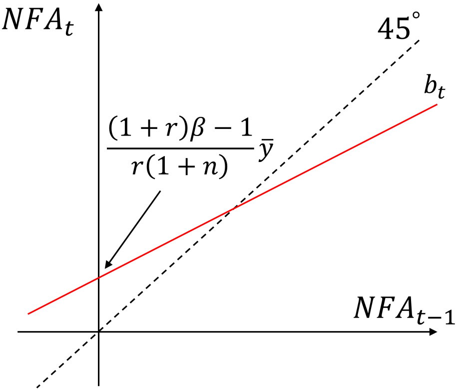
Perpetual Youth Model



Steady State - Sign

- $\bar{b}$ may be positive or negative. Depends critically on intercept term, whether $(1+r)\beta > 1$ (as shown below) or not.

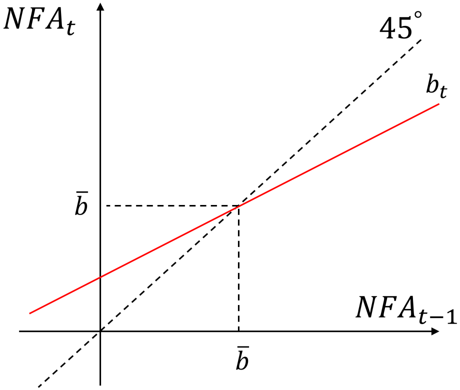
Perpetual Youth Model



Steady State - Location

- $\bar{b}$ arises at the single crossing point, where $b_t = b_{t-1}$ and the system is therefore stationary.

Perpetual Youth Model



Income (Endowment) Shock

- Assuming, as above, that $\bar{b} > 0 \leftrightarrow (1+r)\beta - 1 > 0$.
- Higher (permanent) income per person increases $\bar{b}$.
  - Algebraically:

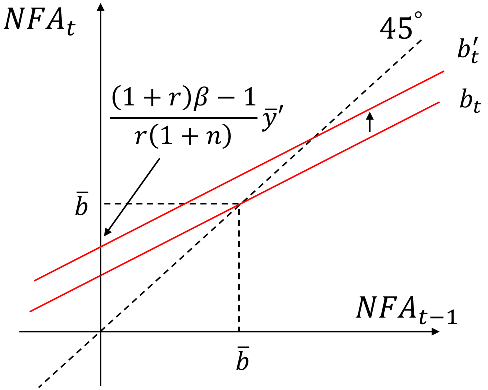
$$\frac{\partial \bar{b}}{\partial \bar{y}} = \frac{(1+r)\beta - 1}{(1+n) - (1+r)\beta} \cdot \frac{1}{r} > 0,$$

  - Intuitively: With $(1+r)\beta - 1 > 0$ households are **patient**. Higher wealth allows households to save more in early life. $\bar{b}$ **rises**.

Income (Endowment) Shock - Difference Equation

- Income shock causes an upwards shift in the difference equation. Intercept increases.

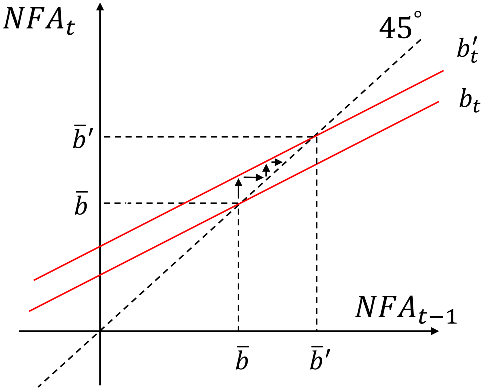
Perpetual Youth Model - Income Shock



Income (Endowment) Shock - New Steady State

- Net Foreign Asset position increases until we converge to the new steady state position.

Perpetual Youth Model - Income Shock



Does Ricardian Equivalence Hold?

- No. To see why, return to our stationary point prior to abstracting from the government sector:
$$\bar{b} = \frac{(1+r)\beta - 1}{(1+n) - (1+r)\beta} \cdot \frac{\bar{y} - \bar{\tau}}{r},$$
$$\bar{c} = \frac{n(1+r)(1-\beta)}{(1+n) - (1+r)\beta} \cdot \frac{\bar{y} - \bar{\tau}}{r}.$$
- Next, write down the period-t government budget constraint in per capita terms:
$$(1+n)d_t = (1+r)d_{t-1} + g_t - \tau_t.$$
- Suppose a special case. Constant, endowments, government spending is zero, but the government starts with some initial level of debt, d, financed through a constant uniform tax rate:
$$\{y_t, g_t, \tau_t\} = \{\bar{y}, 0, \bar{\tau}\} \forall t.$$

  such that:
$$(n - r)d = -\bar{\tau}.$$

Public Debt

- Finally, observe how consumption and net foreign assets respond by substituting in this initial public debt level:

$$\bar{b} = \frac{(1+r)\beta - 1}{(1+n) - (1+r)\beta} \cdot \frac{\bar{y} + (n-r)d}{r},$$
$$\bar{c} = \frac{n(1+r)(1-\beta)}{(1+n) - (1+r)\beta} \cdot \frac{\bar{y} + (n-r)d}{r}.$$

- A (tax-financed) increase in **initial** government debt **increases** consumption, provided $n > r$.

- A (tax-financed) increase in **initial** government debt **increases** private net foreign assets, assuming a household savings motive, $(1+r)\beta > 1$, and $n > r$.

- Initial government debt **acts as net wealth** in the economy, provided new entrants arrive "quickly enough" as the associated future tax burden is partially borne by individuals who are not alive when the bond is issued.

Extensions

- Large established literature, we covered Weil (1989) as in OR.
- Homework follows setting akin to Blanchard (1985).
  - This is a general equilibrium analysis which develops the microeconomic concept of discounting due to fear of survival, presented in Yaari (1965).
  - Death complicates asset markets, which now require annuities.
- More recent extensions in the literature include Gertler (1999). This enriches the life-cycle structure, adding a retirement probability, ω.

Applications

- Empirical exercise. Decomposition of the trade balance, following Lane and Milesi-Ferretti (2001).
- Accounting for drivers of the global fall in real interest rates, following Rachel and Smith (2017). (Secular Stagnation).
- Modelling exercise, to capture both shifts, following Ferrero (2010).

Trade Balance Decomposition

- Lane and Milesi-Ferretti (2001): Real determinants of NFA position (GDP growth, demographics and fiscal policy differentials). Run regression:

$$NFA_{i,t} = \alpha_i + \gamma_t + X_{i,t}\beta + \varepsilon_{i,t},$$

  where $X_{i,t} = \begin{bmatrix} Y_{i,t}^{PC} & GDEBT_{i,t} & DEM_{i,t} \end{bmatrix}$.
- Econometric problems?
  - See comments by Forbes.
  - Endogeneity. GDP growth (or US share of world GDP) is endogenous. Fiscal policy and demographics can influence GDP.
  - Omitted variable bias. Investment?
- Huge contribution: Dataset. (Now Generation II).

Results

- For industrial countries.

	(1) CUMCA 1970-98	(2) CUMCA 1980-98	(3) CUMCA/IIP 1970-98	(4) CUMCA/IIP 1980-98
$Y_{i,t}^{PC}$	0.91	0.91	0.90	0.89
	(12.63)**	(7.26)**	(12.55)**	(6.71)**
$GDEBT_{i,t}$	-0.125	-0.05	-0.124	-0.07
	(3.1)**	(0.9)	(3.01)**	(1.1)
$DEM_{i,t}^{\dagger}$	30.1	2.3	22.1	4.2
	(0.00)**	(0.51)	(0.00)**	(0.24)
Adj-R^2	0.89	0.91	0.89	0.93
N	516	389	516	382
Countries	22	22	22	22

Source: Lane and Milesi-Ferretti (2001), Table 2. Dynamic OLS. *(**) denotes significant at 5% (1%) level. CUMCA denotes NFA by cumulatve current account method. † reports the χ^2 statistic for joint null hyphothesis of demographic variables.

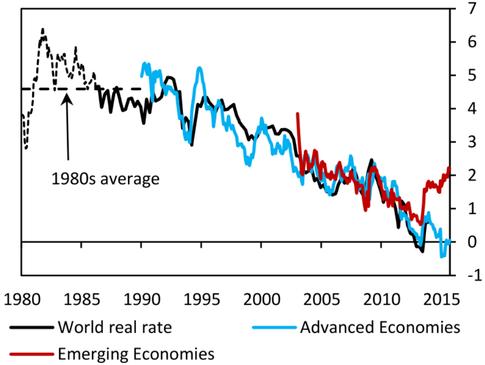
Rachel and Smith (2017) - Secular Stagnation

- Rachel and Smith (2017) decompose changes in global real interest rates.
- Accounting exercise: Precisely the factors we have discussed in the past two lectures.
- **Demographics and growth** make up the bulk of the movement.

Global Real Interest Rates

- Fallen substantially since 1980s. Big question: why?

Long Run 'Real' Rates

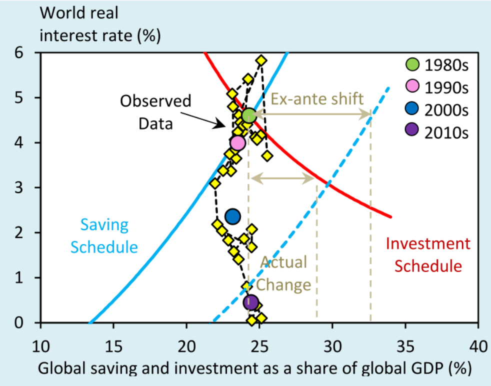


Source: Rachel and Smith (2017).

Savings and Investment

- Investment (as % of GDP) largely unchanged in this time, **both** savings and investment curve shifts form part the story.

Savings and Investment Shifts

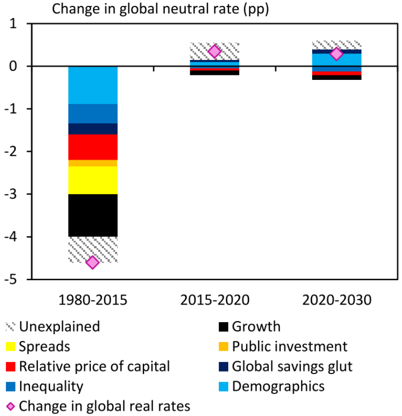


Source: Rachel and Smith (2017).

Rachel and Smith (2017)

- Detailed accounting exercise.

Impact of Fiscal Contraction on Current Account-to-GDP

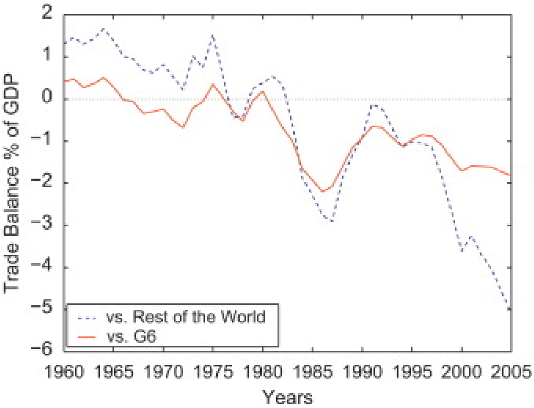


Source: Rachel and Smith (2017).

Ferrero (2010) - US Trade Balance

- Substantial part of the fall in US trade balance is with G6 economies.

US Trade Balance vs. G6

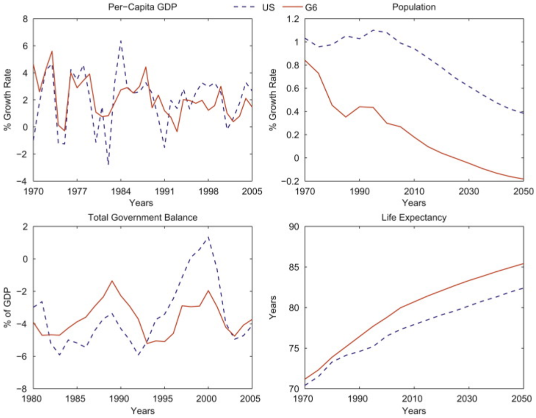


Source: Ferrero (2010).

Ferrero (2010) - Are Real Factors Different?

- Important demographic, productivity and fiscal differences between US and G6. Do these explain trade deficits?

'Real' Differences

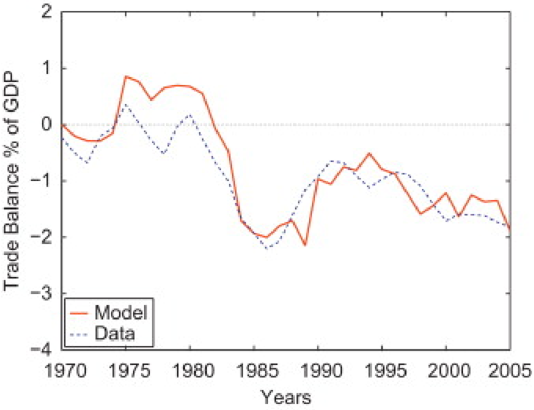


Source: Ferrero (2010).

Ferrero (2010) - Model Simulation

- Calibrate variant of Gertler (1999) model for the US and G6 in 1970 and 2030. Observe the differences. Does very well!

Long Run 'Real' Rates



Source: Ferrero (2010).

Summary

- Discussed the implications of fiscal policy in an open economy.
- Shown that Ricardian Equivalence fails in the OLG and perpetual youth models.
- Next lecture: multiple goods, the real exchange rate and the terms of trade.

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