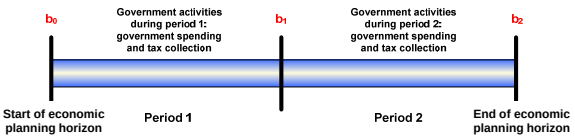
GOVERNMENT AND FISCAL POLICY IN THE TWO-PERIOD FRAMEWORK (CONTINUED)

OCTOBER 3, 2011

A DYNAMIC MODEL OF THE GOVERNMENT

- So far only consumers in our two-period framework
- Introduce government in very simple form
  - Exists for both periods
  - Has spending in each period it needs to finance – can be financed via
    - Taxes
    - Issuing government debt / assets



- Notation
  - g_1: real government spending in period 1
  - g_2: real government spending in period 2
  - b_0: government asset position at beginning of period 1 / end of period 0
  - b_1: government asset position at beginning of period 2 / end of period 1
  - b_2: government asset position at beginning of period 3 / end of period 2
  - r: real interest rate between periods

GOVERNMENT BUDGET CONSTRAINT(S)

- Adopt a lifetime view of the budget constraint(s)
  - All analysis conducted from perspective of beginning of period 1
  - Period-1 government budget constraint $g_1 + b_1 = t_1 + (1+r)b_0$
  - Period-2 government budget constraint $g_2 + b_2 = t_2 + (1+r)b_1$

Asset position at end of period 1 / beginning of period 2 the key link

Assume = 0 (no defaults + strictly increasing "utility")

  - Combine into lifetime budget constraint (LBC)
    - Solve period-2 budget constraint for b_1…
    - …and substitute into period-1 budget constraint

$$\underbrace{g_1 + \frac{g_2}{1+r}}_{\text{Present discounted value (PDV) of all lifetime government expenditure}} = \underbrace{t_1 + \frac{t_2}{1+r}}_{\text{Present discounted value (PDV) of all lifetime government income}} + (1+r)b_0$$

IMPORTANT: Government must balance its budget over its *lifetime*, not necessarily in each period

For graphical simplicity, will often assume $b_0 = 0$ (i.e., government begins life with zero net wealth).

Note this is a *different* assumption than $b_2 = 0$.

CONSUMER BUDGET CONSTRAINT(S)

- Introduce tax payments into consumer side of framework
  - All in real terms for simplicity – can cast in nominal terms by multiplying by *P*
  - Period-1 budget constraint $c_1 + t_1 + a_1 - a_0 = y_1 + ra_0$
  - Period-2 budget constraint $c_2 + t_2 + a_2 - a_1 = y_2 + ra_1$
  - Combine into lifetime budget constraint (LBC)
    - Solve period-2 budget constraint for a_1…
    - …and substitute into period-1 budget constraint

$$\underbrace{c_1 + \frac{c_2}{1+r}}_{\text{Present discounted value (PDV) of all lifetime expenditure}} = \underbrace{y_1 - t_1 + \frac{y_2 - t_2}{1+r}}_{\text{Present discounted value (PDV) of all lifetime disposable income (i.e., after-tax income)}} + (1+r)a_0$$

ECONOMY-WIDE RESOURCE FRONTIER

- **Consumer lifetime budget constraint**

$$c_1 + \frac{c_2}{1+r} = y_1 - t_1 + \frac{y_2 - t_2}{1+r} + (1+r)a_0$$

- **Government lifetime budget constraint**

$$g_1 + \frac{g_2}{1+r} = t_1 + \frac{t_2}{1+r} + (1+r)b_0$$

- **Summing the two yields economy-wide resource frontier**

$$c_1 + \frac{c_2}{1+r} = y_1 - g_1 + \frac{y_2 - g_2}{1+r} + (1+r)(a_0 + b_0)$$

  - **aka "production possibilities frontier" (PPF)**
  - **The GDP accounting equation in two-period form**

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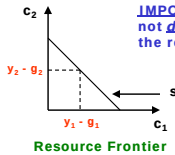

IMPORTANT: taxes do not *directly* appear in the resource frontier...

THEOREM (intermediate micro): If taxes are *lump-sum*, then consumer optimal choices can be obtained by analyzing *either* the consumer LBC *or* the economy-wide resource frontier (superimpose indifference map), and either approach will yield the same predictions.

An important theoretical result for the analysis of tax policy.

National Savings

- National savings = savings by consumers + savings by government + savings by firms
  - No firms in our model (yet..), so $s_1^{firm} = 0$
  - $s_1^{priv} = y_1 - t_1 - c_1$
  - $s_1^{govt} = t_1 - g_1$
  - $s_1^{nat} = s_1^{priv} + s_1^{govt} = y_1 - \cancel{t_1} - c_1 + \cancel{t_1} - g_1 = y_1 - c_1 - g_1$

Effects of Tax Policy

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- Policy Experiment: Is national savings affected by a decrease in t_1?
  - Suppose g_1 and g_2 do not change
  - Question 1: Effect on t_2?
  - Question 2: Effect of tax changes on consumers' optimal choice of period-1 consumption?

Crucial logic:
- Using intermediate micro theorem, NO EFFECT ON optimal c_1
  - Taxes are lump sum
  - Economy-wide resource constraint does not depend *directly* on taxes → optimal choice of c_1 unaffected by the change in tax policy

EFFECTS OF TAX POLICY

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Analyzing effects of changes in tax policy on optimal consumption choices is the key

- Policy Experiment: Is national savings affected by a decrease in t_1?
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  - Question 3: Effect of tax changes on period-1 national savings?
    - NONE – because neither g_1 nor c_1 changed

RICARDIAN EQUIVALENCE

- Ricardian Equivalence Theorem: For a given PDV of government spending, neither consumption nor national savings is affected by the precise timing of lump-sum taxes
- A benchmark result/concept in the theory of macroeconomic policy
- Economic Interpretation: Rational consumers understand that a tax cut in short run means a tax increase in the future (because PDV of government spending is unchanged)
  - Thus entire tax cut is saved by consumers in order to pay higher taxes in the future
  - Private savings and government savings move in exactly offsetting ways

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$s_1^{priv} = y_1 - t_1 - c_1$ ← Rises when t_1 decreases, *GIVEN* that we have *CONCLUDED* that c_1 does not change

$s_1^{govt} = t_1 - g_1$ ← Decreases when t_1 decreases

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  - **Private savings and government savings move in exactly offsetting ways**
- **Ricardian Equivalence is to tax theory as perfect competition is to basic economic theory**
  - **Prediction relies crucially on lump-sum taxes**

NATURE OF TAXATION

- **Lump-Sum Tax**
  - A tax whose total incidence (i.e., total amount paid) does not depend in any way on any decisions/choices an individual makes
  - Real-world examples: ?...

- **Taxes in our two-period framework so far**
  - **Lump-sum!** Total amounts t_1 and t_2 paid by consumer are independent of any of their decisions/choices

Period-1 budget constraint

$$c_1 + t_1 + a_1 - a_0 = y_1 + ra_0$$

Period-2 budget constraint

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Period-2 budget constraint

$$c_2 + t_2 + a_2 - a_1 = y_2 + ra_1$$

- **Proportional (aka distortionary) Tax**
  - A tax whose total incidence depends on decisions/choices an individual makes
  - In simple two-period framework: consumers only make consumption choices c_1 and c_2

τ is consumption tax *rate* (aka sales tax rate)

Period-1 budget constraint

$$(1+\tau_1)c_1 + a_1 - a_0 = y_1 + ra_0$$

Period-2 budget constraint

$$(1+\tau_2)c_2 + a_2 - a_1 = y_2 + ra_1$$

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Period-2 budget constraint: $(1+\tau_2)c_2 + a_2 - a_1 = y_2 + ra_1$

- Combine into consumer LBC

$$(1+\tau_1)c_1 + \frac{(1+\tau_2)c_2}{1+r} = y_1 + \frac{y_2}{1+r} + (1+r)a_0$$

PROPORTIONAL TAXATION

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Period-1 budget constraint: $(1+\tau_1)c_1 + a_1 - a_0 = y_1 + ra_0$

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- Combine into consumer LBC

$$(1+\tau_1)c_1 + \frac{(1+\tau_2)c_2}{1+r} = y_1 + \frac{y_2}{1+r} + (1+r)a_0$$

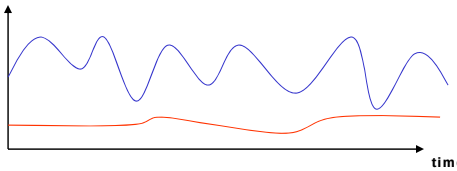
- Slope is $-\left(\frac{1+\tau_1}{1+\tau_2}\right)(1+r)$
- Non-lump-sum taxes: optimal consumption choices must be determined using consumer LBC, not economy's resource frontier (i.e., intermediate micro theorem does not apply)
- Changes in tax ***rates*** do affect optimal consumption choices because they change slope of consumer LBC
- Ricardian Equivalence Theorem does not apply
  - Changes in tax rates ***do*** affect national savings

RICARDIAN EQUIVALENCE?

- So why the fascination with Ricardian Equivalence?
- A benchmark result/concept in the theory of macroeconomic policy
  - Effects of actual policy proposals can be compared to the Ricardian Equivalence benchmark
  - In practice, *does* seem like tax rebates are sometimes saved

RICARDIAN EQUIVALENCE?

- So why the fascination with Ricardian Equivalence?
- A benchmark result/concept in the theory of macroeconomic policy
  - Effects of actual policy proposals can be compared to the Ricardian Equivalence benchmark
  - In practice, *does* seem like tax rebates are sometimes saved
- At aggregate level, total tax collections sometime "seem" lump-sum (i.e., independent of aggregate macroeconomic activity)



GDP (or any aggregate measure of real activity…ie, consumption) moves up and down over time…

…but total tax revenue of the government fluctuates very little

- Ricardian Equivalence
  - Is a theoretical benchmark
  - Is an empirical benchmark

Ricardian Equivalence is about the (lack of) effects of ***changes in tax policy***, holding total government liabilities fixed. If g_1 and/or g_2 change, Ric. Equiv. does ***not*** apply.

INFINITE-PERIOD FRAMEWORK

OCTOBER 3, 2011

BASICS

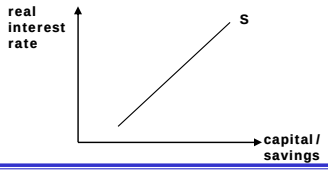
- Modern workhorse macroeconomic frameworks feature an infinite number of periods
  - A more realistic (?) view of time
- Especially useful for thinking about asset accumulation and asset pricing
  - The intersection of modern macro theory and modern finance theory
- Here, suppose just one real asset
  - Call it a "stock" – i.e., a share in the S&P 500
  - (In Chapter 14, two nominal assets: bonds and money)
- Index time periods by arbitrary indexes t, $t+1$, $t+2$, etc.
  - Important: all analysis conducted from the perspective of the very beginning of period t...
  - ...so an "infinite future" (period $t+1$, period, $t+2$, period $t+3$, ...) for which to save

THE THREE MACRO (AGGREGATE) MARKETS

Many **different** ***types*** **of assets exist…hence many different** ***types of financial markets***

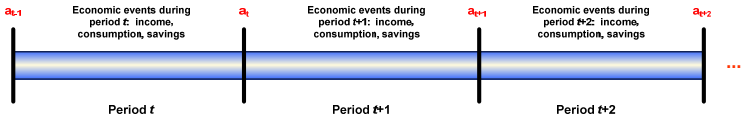
1. **Stock markets (Chapter 8)**
2. **Real-estate markets (Practice Problem Set 5)**
3. **Bond markets (Chapter 14)**
4. **Money markets (Chapter 14)**

- **Capital / Savings / Funds / Asset Markets (aka Financial Markets)**
  - **Supply derived from C-S framework**



BASICS

- **Timeline of events**



- **Notation**
  - c_t: **consumption in period** t
  - P_t: **nominal price of consumption in period** t
  - Y_t: **nominal income in period** t **("falls from the sky")**
  - a_{t-1}: **real wealth (stock) holdings at beginning of period** t **/ end of period** t**-1**

The "defining features" of stock

  - S_t: **nominal price of a unit of stock in period** t
  - D_t: **nominal dividend paid in period** t **by each unit of stock held at the start of** t

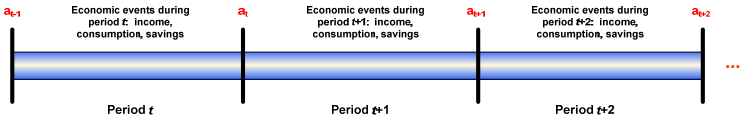
  - π_{t+1}: **net inflation rate between period** t **and period** t**+1**

$$\pi_{t+1} = \frac{P_{t+1} - P_t}{P_t} \left(= \frac{P_{t+1}}{P_t} - 1 \right)$$

  - y_t: **real income in period** t **(** $= Y_t / P_t$**)**

BASICS

- **Timeline of events**



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  - D_{t+1}: nominal dividend paid in period t by each unit of stock held at the start of $t+1$
  - π_{t+2}: net inflation rate between period $t+1$ and period $t+2$

$$\pi_{t+2} = \frac{P_{t+2} - P_{t+1}}{P_{t+1}} \left(= \frac{P_{t+2}}{P_{t+1}} - 1 \right)$$

  - y_{t+1}: real income in period $t+1$ ($= Y_{t+1} / P_{t+1}$)

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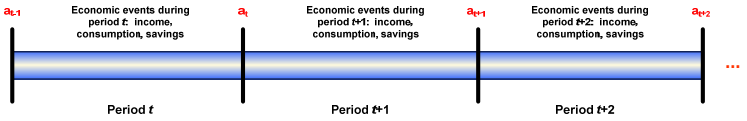

- **Notation**
  - And so on for period $t+2$, $t+3$, etc...

SUBJECTIVE DISCOUNT FACTOR

- Infinite number of periods a more serious view of time
- Impatience potentially an issue when taking a serious view of time
- Individuals (i.e., consumers) are impatient
  - All else equal, would rather have *X* utils today than identical *X* utils at some future date
  - An introspective statement about the world
  - An empirical statement about the world

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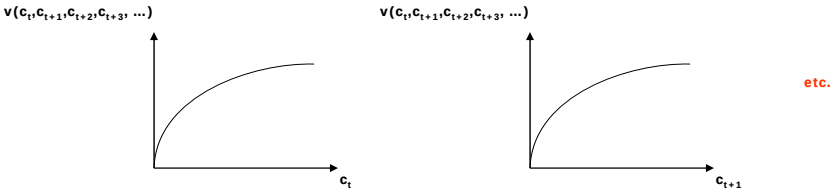
  - An introspective statement about the world
  - An empirical statement about the world
- Subjective discount factor
  - A simple model of consumer impatience
  - β (a number between zero and one) measures impatience
    - The lower is β, the less does individual value future utility
  - Simple assumption about how "impatience" builds up over time
    - Multiplicatively: i.e., discount one period ahead by β, discount two periods ahead by β^2, discount three periods ahead by β^3, etc.
    - Do individuals' impatience really build up over time in this way?...limited empirical evidence so really don't know...

UTILITY

- Preferences $v(c_t, c_{t+1}, c_{t+2}, \ldots)$ with all the "usual properties"
  - Lifetime utility function
  - Strictly increasing in c_t, c_{t+1}, c_{t+2}, c_{t+3}, …
  - Diminishing marginal utility in c_t, c_{t+1}, c_{t+2}, c_{t+3}, …



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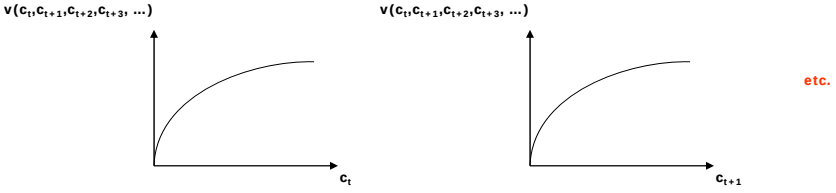

- Lifetime utility function additively-separable across time (a simplifying assumption), starting at time t

$$v(c_t, c_{t+1}, c_{t+2}, c_{t+3}, \ldots) = u(c_t) + \beta u(c_{t+1}) + \beta^2 u(c_{t+2}) + \beta^3 u(c_{t+3}) + \ldots$$

- Utility side of infinite-period framework no different than Chapter 1 model – except no longer possible to represent graphically

NEXT TIME

THE WORKINGS OF THE INFINITE-PERIOD FRAMEWORK

RELATIONSHIP BETWEEN
MACROECONOMICS AND FINANCE