

14.02 Spring 2011-Schedule (can change if needed)

Update: 01/26/11

The chapters below refer to the 5th edition of *Macroeconomics*, by Olivier Blanchard

Feb. 2	Lec 1: Introduction to Macro (Ch 1) and start Basic Definitions (Ch 2)	
Feb. 4	No recitation	
Feb. 7	Lec 2: Basic Definitions cont (Ch 2)	Pset 1 (Ch 1-3) distributed
Feb. 9	Lec 3: Goods Market (Ch 3)	
Feb. 11	Recitation	Pset 1 due, solutions posted; Pset 2 (Ch 4-5) distributed
Feb. 14	Lec 4: Financial Markets (Ch 4)	
Feb. 16	Lec 5: IS-LM (Ch 5)	
Feb. 18	Recitation	
Feb. 21	NO CLASS	President's Day
Feb. 22	Lec 6: IS-LM cont (Ch 5) and Liquidity Trap section pages 473-476	
Feb. 23	Lec 7: The Labor Market (Ch 6)	
Feb. 25	Recitation	Pset 2 due, solutions posted; Pset 3 (Ch. 6-7) distributed
Feb. 28	Lec 8: AS/AD (Ch 7)	
Mar. 2	Lec 9: AS/AD cont (Ch7)	
Mar. 4	Recitation	Pset 3 due, solutions posted; Pset 4 (Ch. 8-9) distributed
Mar. 7	Lec 10: Phillips Curve (Ch 8)	
Mar. 9	Lec 11: Inflation, Activity & Nominal Money Growth (Ch 9)	
Mar. 11	Recitation	Pset 4 due, solutions posted;
Mar. 14	Lec 12: Openness in Goods & Financial Markets (Ch 18)	
Mar. 16	<sup>Review</sup> Lec 13: The Goods Market in an Open Economy (Ch 19)	Pset 5 (Ch. 18-21) distributed [this should be a longer Pset given they have two weeks to do it]
Mar. 17	QUIZ 1 7:30 pm Walker Memorial 50-340	Quiz 1 covers chapters 1-9 [SR, MR and then PC]
Mar. 18	No recitation after quiz	
Mar. 21	SPRING VACATION	
Mar. 23		
Mar. 25		
Mar. 28		
Mar. 28	Lec 14: Output, the interest rate, and the Exchange Rate (Ch 20)	
Mar. 30	Lec 15: Exchange rate regimes (Ch 21)	
Apr. 1	Recitation	Pset 5 due, solutions posted; Pset 6 (Ch 26 ) distributed
Apr. 4	Lec 16: Fiscal Policy (Ch 26)	
Apr. 6	Lec 17: Fiscal Policy (Ch 26)	
Apr. 8	Recitation	Pset 6 due, solutions posted; Pset 7 distributed
Apr. 11	Lec 18: tbd	
Apr. 13	Lec 19: tbd	Pset 7 due, solutions posted
Apr. 14	QUIZ 2 7:30 pm room 54-340	Quiz 2 covers 18, 19, 20, 21, 26 (open economy and fiscal policy)

Apr 15	No recitation after quiz	
Apr. 18	NO CLASS	Patriot's Day
Apr. 20	Lec 20:	
Apr. 21	DROP DATE	
Apr. 22	Recitation	Pset 8 distributed
Apr. 25	Lec 21: tbd	
Apr. 27	Lec 22: tbd	
Apr. 29	Recitation	
May 2	Lec 23: tbd	
May 4	Lec 24: tbd	Pset 8 due; solutions posted
May 5	QUIZ 3 7:30 pm Walker Memorial 50-340	Quiz 3 covers material not in the book
May 6	No recitation after quiz	
May 9	Lec 25: tbd	
May 11	Lec 26: tbd	



## 14.02: PRINCIPLES OF MACROECONOMICS Spring 2011

### DESCRIPTION

The first part of the course provides an overview of macroeconomics in normal times: the determination of output, employment, unemployment, interest rates, and inflation. Monetary and fiscal policies are discussed, as are public debt and international economic issues. The second part of the course attempts to provide a framework to think about the recession that ensued from the recent financial crisis.

### FACULTY

Lecturer: Professor Francesco Giavazzi <mailto:giavazzi@mit.edu>

### HEAD TEACHING ASSISTANT

Anna Zabai [azabai@mit.edu](mailto:azabai@mit.edu)

Please refer to Anna (not professor Giavazzi!) for any ADMIN issues related to switching sections, textbooks, rescheduling and re-grading exams etc. Please refer to the other TAs (below) for questions related to the teaching.

### TEACHING ASSISTANTS

Joaquin Blaum <mailto:blaum@mit.edu>

Maya Eden [mayaeden@mit.edu](mailto:mayaeden@mit.edu)

Fernando Duarte <mailto:duarte@mit.edu>

Camilo Garcia [cgarci@mit.edu](mailto:cgarci@mit.edu)

### TWO ALTERNATIVE FORMATS

The course has two alternative formats. Both formats will cover the same topics, use the same textbook, and have the same required assignments, including quizzes and problem sets. As we receive more information on class enrollment, there may be changes in the number of sections and recitations.

**Lecture-Recitation:** You attend one-hour lectures on Mondays and Wednesdays, given by Professor Giavazzi, at 2 PM, in 54-100. You also attend a one-hour recitation on Fridays. During Friday recitations – which are *not optional* – instructors will go over weekly problem sets and review materials from the lectures. If you elect the Lecture - Recitation option, you may choose one of the following one-hour Friday recitations:

Date and Time	Room	TA until break	TA after break
tbd	tbd	Eden	Duarte
F 2 pm	tbd	Eden	Duarte
tbd	tbd	Eden	Duarte

**All-Section:** You attend one-hour sections on Mondays, Wednesdays, and Fridays, run



by a TA. If you elect this option, you may choose one of the following sections:

Date and Time	Room	Instructor until SB	Instructor after SB	TA until SB	TA after SB
MWF 10 am	1-246	Duarte	Eden	Eden	Duarte
MWF 11 am	1-246	Duarte	Eden	Eden	Duarte
MWF 1 pm	4-159	Duarte	Eden	Eden	Duarte

As we receive more information on class enrollment, we may need to make changes in recitations or sections. (If any one section is too large, we may ask students to move to different times.)

### **CHOOSING AN OPTION**

Until Friday, February 18th you may switch from the Lecture to the All-Section format, and from one recitation or section to another. Changing sections **DOES NOT REQUIRE** any paperwork with the Registrar or the Department of Economics. If you wish to switch sections please go to the "Membership page" in the 14.02 Stellar website and change the section you are assigned to so we can have accurate information on class sizes.

### **OFFICE HOURS**

All TA's will have office hours once a week. These office hours are open to students from all sections or recitations. The time and place of each TA's office hours will be posted on the 14.02 Stellar website on the "staff list" page.

### **READINGS**

The text for the course is the 5<sup>th</sup> edition of *Macroeconomics*, by Olivier Blanchard (both the updated version and the older version are fine). Please, get this edition. It will be at the Coop, and two copies will be on reserve at Dewey Library. If you have the 4<sup>th</sup> edition, it is not necessary to buy the new edition, as they are sufficiently similar. However, if you will be buying the book, you are encouraged to buy the new version.

In addition to the textbook, you should read the Economist, the weekly magazine, at least a couple of times a month. It provides a good coverage of current economic events, and it will help you relate what you learn in the course to the real world.

### **REQUIREMENTS (PROBLEM SETS AND QUIZZES)**

The course grade will be based on three quizzes and 8 problem sets. 90% of the grade will be determined by the grade on the quizzes. The remaining 10% will be given by the average grade of the 7 best problem set grades (your lowest score doesn't count towards your grade). Each quiz will be worth 30% of your final grade. The grade on each of the three quizzes will be standardized by the mean and the standard deviation of the 14.02 class. Each quiz will more or less cover the material in the lectures since the previous quiz. Each quiz will last 1½ hours. However, you should be ready to stay at the quiz location until 9:30, should unforeseen circumstances force us to start late.

**Quiz #1:** Thursday, March 17th, 2009, 7:30-9:00 PM, (Walker Memorial)



**Quiz #2:** Tuesday, April 14th, 2009, 7:30-9:00 PM, 50-340 (Walker Memorial)

**Quiz #3:** Thursday, May 5th, 2009, 7:30-9:00 PM, 50-340 (Walker Memorial)

Problem sets are due *on the due date*. We will not accept late problem sets under any circumstances. You will hand in the problem sets to the TA who is teaching recitations, in recitation. Alternatively, problem sets can be turned in at the 14.02 box available in E52-391 until 5pm on the problem set due date (be sure to place your problem set in the right stack or it will not count). Your TA will return problem sets during recitation. Alternatively, you can pick them up in the 14.02 pick-up box outside of E52-201.

We will use the 14.02 Stellar website to distribute problem sets and solutions, past exams, and other announcements. We will also use the 14.02-students public mailing list to distribute important announcements and room changes. The full schedule for classes, quizzes and problem sets is in a separate document in the "Materials" page of the 14.02 Stellar website.

### **COURSE POLICY**

Collaboration on problem sets is permitted, but please do write up your answers separately. On the other hand, collaboration during quizzes and the final exam is strictly prohibited, and is considered a breach of academic honesty. We will follow the procedures in the latest MIT Guidelines on Academic Honesty, which are given in detail in MIT's Policies and Procedures.

## Four examples to get a feel for the course

1. The "paradox" of saving
2. What is the "right" measure of unemployment ?
3. How is macroeconomics helping us get out of this recession, and what the cost might be
4. Why do banks go bankrupt?



### 1. The "paradox" of saving

#### Who is right?


- Your grandmother when she says you should start saving thinking about your future,
- Or John Maynard Keynes, the great British economist, who wrote that jobs cannot be created if people (or the government) don't spend

## 14.02 - Macroeconomics

Professor Francesco Giavazzi ([giavazzi@mit.edu](mailto:giavazzi@mit.edu) , E52-391c)

TA's:

Joaquin Blaum  
Maya Eden  
Fernando Duarte  
Camilo Garcia-Jimeno  
Anna Zabai (Head TA)



Printed weird

### Organization of the Course

24 classes + 2 (free) classes after the last Quiz

3 Quiz's: March 17, April 14, May 5

Two modes, identical material and Quiz's:

- 2 lectures (wth me) and a Friday recitation (with a TA)
- 3 classes (with a TA)

Part 1 – Macroeconomics: the basics

Textbook: O. J. Blanchard, *Macroeconomics*, 2010 edition

Part 2 – Models of the financial crisis

Readings:

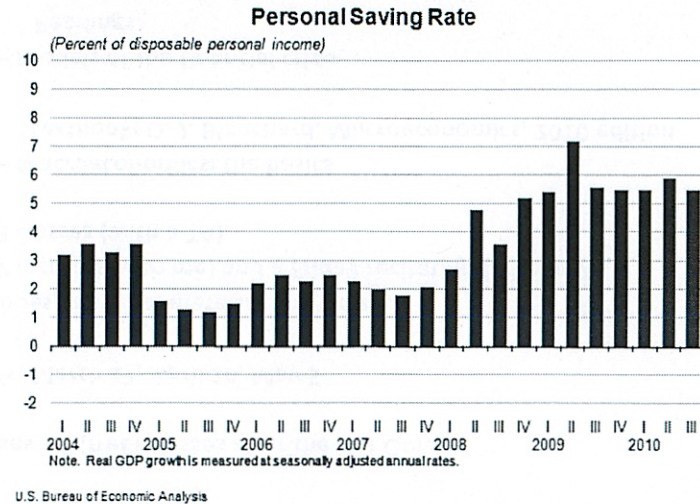
- Class Notes (to be posted on Stellar)
- Hyun Song Shin, *Risk and Liquidity*. Oxford University Press, 2010



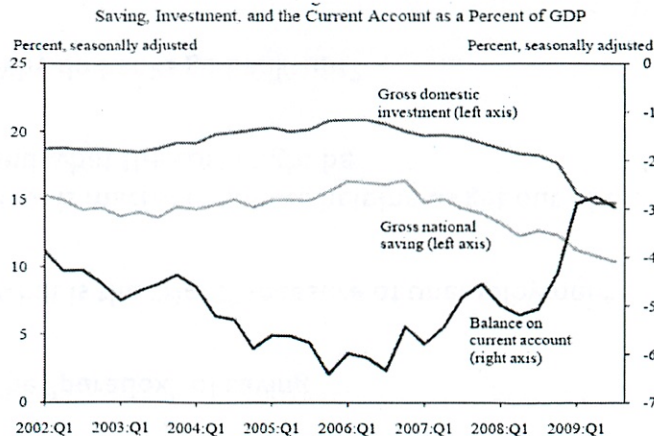
But what happens if a country doesn't save enough?

- In a "closed" economy: Savings = Investment
  - If you save less, you invest less, and output will be lower in the future
- But an "open" economy can borrow from the rest of the world:
  - Investment = Saving + Foreign Borrowing

## The paradox of Savings



In the US for a long time investment has been (partly) financed through foreign borrowing



Source: Department of Commerce (Bureau of Economic Analysis), National Income and Product Accounts Table 5.1.

## Households' spending (trillion 2005 US Dollars)

2006 9,074

2007 9,314 (+ 2,6%)

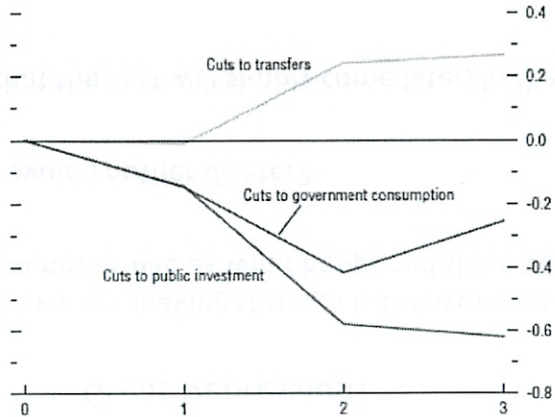
2008 9,290 (- 0,26%)

2009 9,237 (- 0,57%)

## What happens if the Government Saves by Spending Less

Figure 3.8. Impact on GDP of a 1 Percent of GDP Spending-Based Consolidation (Percent)

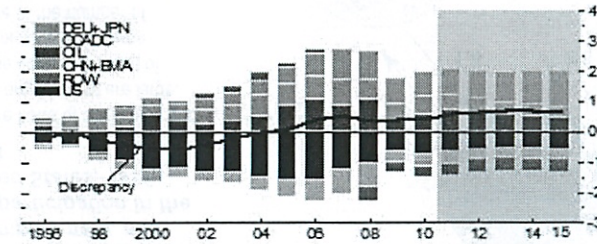
Fiscal consolidation based on cuts to government transfers is less contractionary than that based on cuts to government consumption or government investment. But the differences between the three spending types are within the margin of error.



Source: International Monetary Fund

## Saving Imbalances in the World

Figure 6. Global Imbalances<sup>1</sup> (Percent of world GDP)



Source: IMF staff estimates.

<sup>1</sup>CHN-BMA: China, Hong Kong SAR, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Province of China, and Thailand; DEU-JPN: Germany and Japan; OADC: Bulgaria, Croatia, Czech Republic, Estonia, Greece, Hungary, Ireland, Latvia, Lithuania, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Turkey, and United Kingdom; OIL: oil exporters; ROW: rest of the world; US: United States.

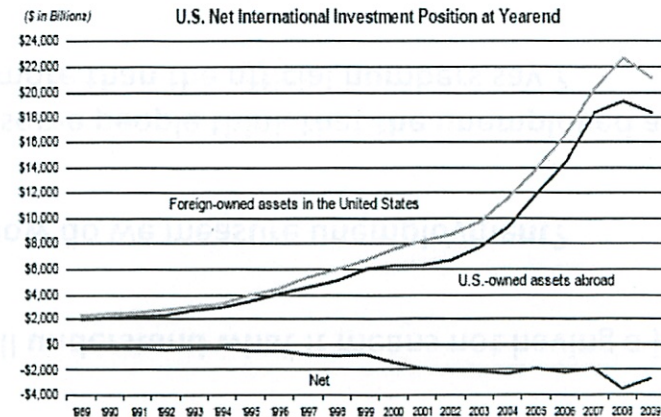
Source: International Monetary Fund

## The "paradox" of saving

So, who is right?

- your grandmother
- or John Maynard Keynes ?

## US foreign debt





What is the number of people out of work? 9% or 17% ?

	Unemployed number usually reported (percent of labor force)	Number (million)	Average duration (weeks)	Unemployed plus discouraged (percent of LF)	Unemployed plus discouraged plus people on low hours (percent of LF)
2000	3,6	5	6	4	7
2008	6,1	7,5	10,5	7	12
2009	9,5	14,5	19	10,6	17,4
2010	9,0	14,0	21,2	10,4	17,0

Source: Bureau of Labor Statistics

### 3. Why this recession was less dramatic than the Great Depression?

- The recession we are leaving through is the worse one since the 1930s – still it is not as bad as what happened then. Why?
- How did we avoid another disaster?
- Could it be that the cost will simply come later, in the form of:
  - high inflation
  - high public debt
- And, by the way, why are “inflation” and “debt” bad ?

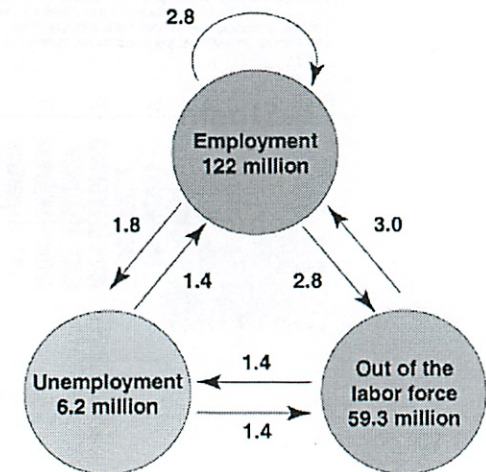
### 2. What is the “right” measure of unemployment ?

- We all understand what it means not having a job
- But how do we measure unemployment?
- Why some people think that the unemployed are many more than the official numbers say ?

## 6-1 A Tour of the Labor Market

Figure 6 - 2  
Average Monthly Flows Between Employment, Unemployment, and Nonparticipation in the United States, 1996–2003

(1) The flows of workers in and out of employment are large.  
(2) The flows in and out of unemployment are large relative to the number of unemployed. (3) There are also large flows in and out of the labor force, much of it directly to and from employment.

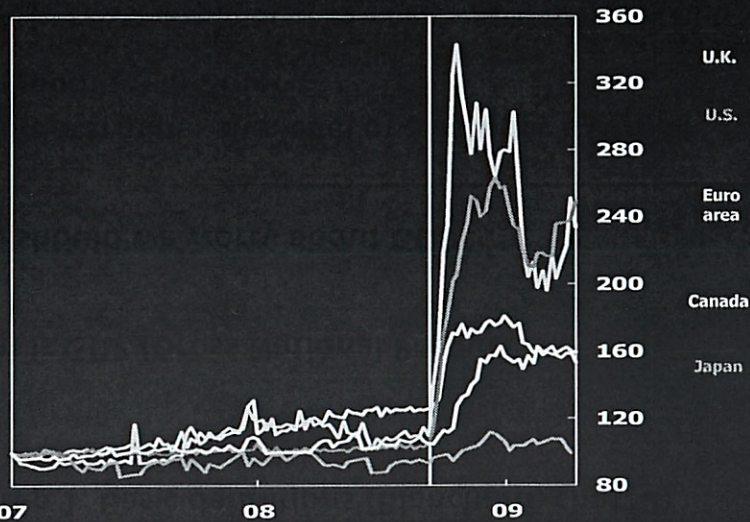


Source: Chapter 6 of your textbook



## Will it all end in a big inflation ?

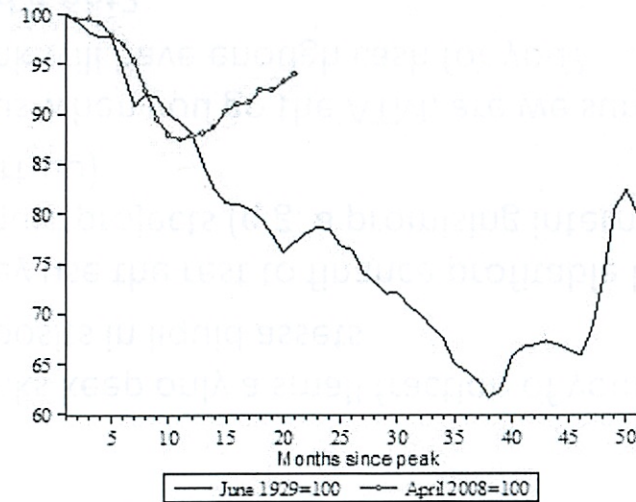
### "Money": 2007-2010



Source: IMF

## How did we avoid the 1930's ?

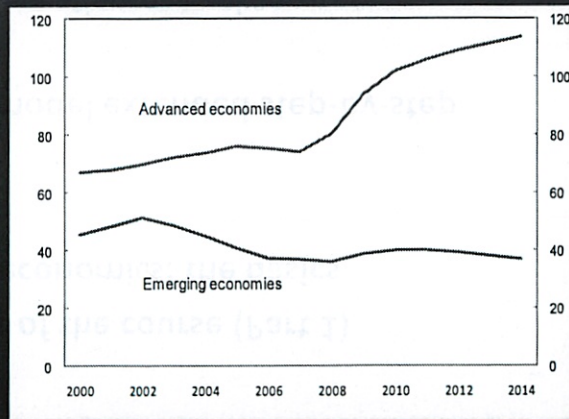
World industrial production (index)



Source: Eichengreen and O'Rourke, Vox-EU, March 2010

## Governments' Debt has Doubled: should we worry?

Public debt a percent of economies' income



Source: IMF

## How was the disaster avoided?

- Central banks created an unprecedented amount of money
- Governments increased public spending
  - paying cash to the unemployed
  - launching big infrastructures projects (e.g. the California high speed train)
  - giving cash to banks and corporations to avoid them going out of business (e.g. General Motors)



Now we need to start

## Structure of the course (Part 1)

### Macroeconomics: the basics

#### A single model extended step-by-step

- One equation, one unknown
- Two equations, two unknown
- Three equations, three unknowns

#### Step 1: Basic definitions (Blanchard, chpt. 2)

- What is GDP (Gross National Product)
- Why should we worry about GDP
- What determines the level of a country's GDP at each moment in time?

## 4. Why do banks go bankrupt?

London, 9/15/2007. Police help to disperse queues in front of Northern Rock branches



### Why can there be a “bank run”?

- Banks keep only a small fraction of your deposits in liquid assets
- They use the rest to finance profitable but illiquid projects (e.g. a promising internet start-up)
- Thus when you go the ATM, are we sure the bank will have enough cash for you?
- And if not?

Where do you find data on the 3 different definitions of GDP ?

## Gross Domestic Product (GDP)

- Economic Report of the President

- It is the total value of everything the economy produces in a year (it is a flow variable: units are "output per year")
- There are 3 ways to measure it
  - GDP = value of final sales of goods and services
  - GDP = value added by all firms in the economy
  - GDP = sum of all incomes in the economy
- Because the three measures use different statistical information they might not exactly match

NATIONAL INCOME OR EXPENDITURE  
TABLE B-1. Gross domestic product, 1960-2009

[Billions of dollars, except as noted; quarterly data at seasonally adjusted annual rates]

Year or quarter	Personal consumption expenditures				Gross private domestic investment							Change in private inventories
	Gross domestic product	Total	Goods	Services	Total	Fixed investment				Fed. deficit		
						Total	Nonresidential					
							Total	Structures	Equip-ment and software			
1960	520.4	331.8	177.0	154.8	79.9	75.7	48.4	19.0	29.8	26.3	3.2	
1961	544.9	342.2	178.9	163.4	79.2	75.2	48.9	18.7	29.1	25.4	3.0	
1962	586.7	383.3	198.0	174.4	88.1	87.9	51.1	26.8	32.3	29.0	6.1	
1963	617.8	382.7	198.2	184.6	93.8	88.1	56.0	21.2	34.8	32.1	5.6	
1964	685.0	411.5	212.3	198.2	102.1	87.2	63.0	23.7	38.2	34.3	4.9	
1965	719.1	443.8	229.7	214.1	118.2	109.9	74.9	28.3	40.5	34.2	9.2	
1966	786.7	480.8	248.8	233.3	131.3	117.7	85.4	31.8	54.0	32.3	15.8	
1967	832.4	507.8	256.0	248.9	129.8	118.7	88.4	21.5	54.9	32.4	9.9	
1968	909.8	558.0	284.8	273.4	141.2	131.1	97.4	33.6	59.0	36.7	9.1	
1969	984.4	605.1	304.7	300.4	150.4	147.3	104.7	37.1	67.6	42.6	9.2	

An economy consisting of only 2 firms:  
one produces steel, the other produces cars

	Steel company	Car company
Sales	100 \$	Sales 200 \$
Expenses		
- wages	80 \$	- wages 70 \$
		- steel 100 \$
Profits	20 \$	Profits 30 \$

GDP = sum of final sales = 200 \$  
 = sum of value added = 100 + (200 - 100) = 200 \$  
 = sum of all incomes = 50 \$ (profits) + 150 \$ (wages) = 200 \$

TABLE B-1. Gross domestic product, 1960-2009—Continued  
[Billions of dollars, except as noted; quarterly data at seasonally adjusted annual rates]

Year or quarter	Net exports of goods and services			Government consumption expenditures and gross investment				Final sales of domestic product	Gross domestic product	Gross national product	Gross domestic product	Percent change from preceding period	
	Net exports	Exports	Imports	Total	Federal							State and local	
					Total	National defense	Non-defense						
1960	4.2	27.0	22.8	111.5	64.1	53.3	10.7	47.5	523.2	522.2	6,208	3.9	3.2
1961	4.9	27.6	22.7	119.5	67.9	56.5	11.4	51.6	541.8	539.9	6,483	3.5	3.4
1962	4.1	28.1	25.0	130.1	75.2	61.1	14.1	54.9	578.8	581.6	6,887	7.5	7.7
1963	4.9	31.1	26.1	136.4	79.9	61.0	15.9	59.5	612.1	617.9	6,222	5.5	5.4
1964	6.9	35.0	28.1	143.7	78.4	66.2	18.2	64.8	658.9	656.7	6,646	7.4	7.2
1965	5.0	37.1	31.5	151.4	80.4	68.6	19.8	71.0	709.9	713.5	7,244	8.4	8.6
1966	3.9	40.8	37.1	171.6	82.4	71.7	20.8	79.2	774.1	783.9	7,928	9.5	9.9
1967	3.6	43.5	39.9	182.5	104.6	83.4	21.2	87.9	822.8	829.9	8,579	5.7	5.8
1968	1.4	47.9	46.8	200.3	113.3	88.2	27.0	96.0	900.9	906.5	9,159	9.3	9.6
1969	1.4	51.9	50.5	221.4	113.3	99.5	23.8	108.7	975.3	980.0	9,905	8.2	8.2



# Nominal and Real GDP

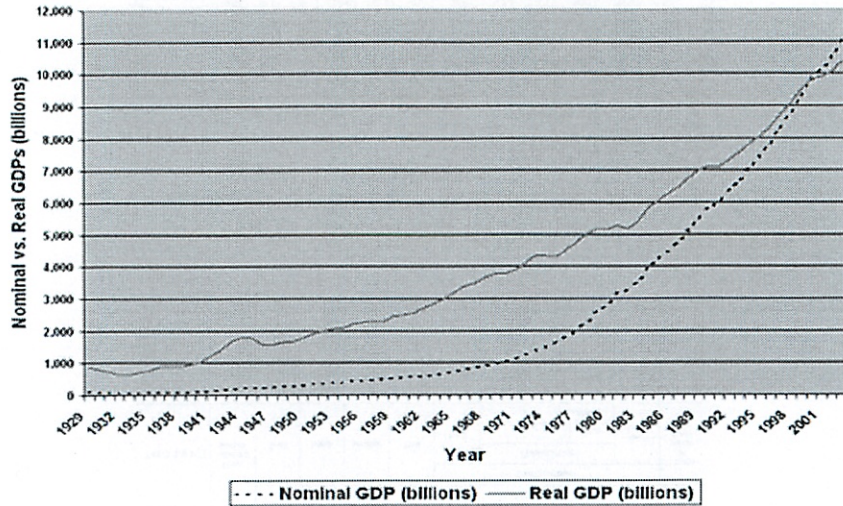


TABLE B-10. Gross value added by sector, 1960-2009  
(Billions of dollars; quarterly data at seasonally adjusted annual rates)

Year or quarter	Gross domestic product	Business <sup>1</sup>			Households and institutions			General government <sup>2</sup>			Amenities: quarterly housing value added
		Total	Nonfarm <sup>1</sup>	Farm	Total	Households	Nonprofit institutions serving households <sup>3</sup>	Total	Federal	State and local	
1960	526.4	419.8	401.7	18.2	44.5	32.6	12.0	62.0	33.0	28.9	39.9
1961	544.8	431.4	412.1	19.3	47.3	34.8	12.8	60.0	34.4	31.6	42.8
1962	565.7	453.9	445.5	18.4	51.0	37.0	14.0	70.7	36.5	34.2	46.0
1963	617.8	498.0	495.5	19.5	54.7	39.1	15.2	75.5	38.3	37.1	49.9
1964	661.6	524.9	507.5	17.3	57.7	41.2	16.5	81.7	40.7	40.4	51.6
1965	719.1	570.7	554.7	15.9	61.9	43.6	18.0	86.6	42.4	44.2	54.9
1966	792.7	624.3	603.5	20.8	66.9	46.7	19.4	93.9	45.8	48.6	59.2
1967	872.4	651.6	633.5	20.1	71.8	49.1	22.7	107.0	51.5	55.5	62.1
1968	938.8	713.5	693.0	20.5	75.5	51.9	25.6	119.8	55.5	62.5	65.8
1969	984.4	759.1	743.3	22.0	85.4	56.0	29.4	130.0	59.8	70.0	71.3
1970	1,038.3	802.2	778.5	23.7	92.8	59.8	32.8	143.5	64.0	78.5	76.7
1971	1,126.8	868.3	842.9	25.4	102.2	65.5	36.7	156.4	67.7	86.6	83.9
1972	1,227.8	931.1	927.5	23.7	111.4	70.8	40.5	169.4	71.5	97.8	91.1
1973	1,382.3	1,077.4	1,030.6	46.8	121.7	76.5	45.2	183.2	73.9	109.2	98.3
1974	1,499.5	1,164.5	1,120.3	44.2	131.6	83.0	48.6	201.3	79.6	117.8	106.8
1975	1,677.7	1,265.8	1,231.1	45.6	147.3	93.9	56.7	214.5	87.3	137.2	117.2
1976	1,824.6	1,420.7	1,377.7	43.0	160.5	98.7	61.8	242.5	93.8	149.7	126.6
1977	2,039.1	1,590.9	1,545.5	43.5	175.5	105.5	70.0	264.6	102.9	162.6	140.5
1978	2,291.8	1,808.4	1,758.7	50.7	196.9	121.3	75.6	297.5	117.8	185.5	155.5
1979	2,562.2	2,029.5	1,968.4	60.1	220.8	136.0	84.8	313.0	117.8	195.4	172.9
1980	2,786.1	2,186.1	2,134.7	51.4	251.5	155.5	97.0	346.5	131.2	217.3	198.8
1981	3,126.8	2,454.0	2,380.0	65.0	277.8	177.8	109.7	365.3	142.7	237.9	228.8
1982	3,252.2	2,514.9	2,454.5	60.4	319.3	196.7	122.7	418.0	161.2	257.7	255.7
1983	3,524.6	2,741.1	2,686.2	44.9	348.2	212.8	135.5	445.4	171.2	271.4	277.7
1984	3,930.0	3,065.5	3,031.3	64.2	390.3	231.0	149.3	485.1	192.1	301.1	301.3
1985	4,217.5	3,283.9	3,220.5	63.4	410.1	250.3	159.8	523.4	205.0	318.4	331.1
1986	4,401.1	3,451.5	3,402.1	65.5	432.2	268.0	174.3	556.3	212.8	340.7	349.6
1987	4,736.4	3,662.0	3,603.5	61.5	481.8	288.0	194.8	591.5	223.3	368.2	365.5
1988	5,103.4	3,940.2	3,878.4	60.7	529.7	313.1	216.6	639.6	234.8	395.9	415.1
1989	5,482.1	4,228.2	4,162.0	73.8	574.0	337.2	237.0	672.2	248.4	427.8	443.4
1990	5,800.5	4,453.9	4,378.6	77.3	624.0	363.0	250.6	727.7	258.8	463.9	477.8
1991	5,962.1	4,568.8	4,489.0	70.6	665.9	387.7	262.2	757.6	274.8	492.8	506.1
1992	6,242.3	4,828.2	4,748.3	65.0	711.1	425.3	282.0	801.9	282.0	511.9	526.6
1993	6,650.4	5,084.1	5,012.7	71.4	752.1	478.3	323.8	811.2	286.2	548.0	562.9
1994	7,055.2	5,425.2	5,341.3	83.9	803.0	491.2	336.7	858.9	285.2	574.7	602.6
1995	7,491.7	5,767.7	5,687.7	80.0	852.7	505.9	350.9	894.9	293.8	601.2	630.7
1996	7,898.5	6,050.2	5,956.9	93.3	897.0	518.8	377.2	911.3	287.5	623.7	671.1
1997	8,332.4	6,442.8	6,354.9	87.9	946.2	550.9	388.3	940.3	290.0	650.3	706.6
1998	8,791.6	6,819.9	6,721.6	79.2	1,010.1	593.9	429.2	972.5	292.5	680.0	745.3
1999	9,351.5	7,249.0	7,177.8	71.2	1,082.8	628.4	454.5	1,021.6	300.4	712.2	798.3
2000	9,951.5	7,715.5	7,641.9	73.6	1,157.2	673.5	493.7	1,078.8	315.1	763.7	849.9
2001	10,282.2	8,013.8	7,957.4	76.2	1,222.4	702.5	513.4	1,116.6	324.8	811.8	904.4
2002	10,642.3	8,132.8	8,060.5	72.3	1,290.0	748.0	517.0	1,211.4	358.6	856.6	932.5
2003	11,142.1	8,503.8	8,410.3	82.4	1,347.2	782.7	544.5	1,292.7	382.8	909.9	939.2
2004	11,857.8	8,964.8	8,856.4	119.3	1,427.8	826.0	578.0	1,375.3	412.8	947.3	995.7
2005	12,639.4	9,365.5	9,263.5	102.0	1,506.4	864.4	604.0	1,430.5	438.7	997.7	1,054.0
2006	13,298.9	10,284.1	10,191.1	93.1	1,602.9	924.9	678.1	1,512.0	460.6	1,061.3	1,138.8
2007	14,077.4	10,788.0	10,672.8	116.2	1,688.8	1,078.7	713.1	1,605.9	485.7	1,120.2	1,205.4
2008	14,441.4	10,853.1	10,821.0	132.1	1,798.9	1,048.7	751.2	1,698.4	515.2	1,173.2	1,300.5
2009	14,258.7	10,888.7	10,922.2	100.5	1,800.0	1,082.2	767.7	1,700.0	558.7	1,203.3	1,331.3

TABLE B-28. National income by type of income, 1960-2009  
(Billions of dollars; quarterly data at seasonally adjusted annual rates)

Year or quarter	National income	Compensation of employees						Proprietors' income with inventory valuation and capital consumption adjustments			Rental income of persons with capital investment	
		Wages and salary accounts			Supplements to wages and salaries			Total	Farm	Nonfarm		
		Total	Government	Other	Total	Employee contributions for employee pension and insurance funds	Employer contributions for new general insurance					
1960	473.9	296.4	272.5	49.2	223.7	21.6	14.3	9.3	30.7	10.6	40.1	17.0
1961	490.7	305.3	290.5	32.5	229.0	24.8	18.2	9.0	37.2	11.2	42.8	17.7
1962	529.9	327.1	296.4	56.3	243.0	27.8	18.6	11.2	55.3	11.2	44.1	18.6
1963	580.7	346.2	314.6	60.0	254.8	31.4	18.0	12.4	56.5	11.5	45.5	19.3
1964	601.4	370.7	327.8	64.9	272.9	32.9	20.3	11.8	59.4	9.8	49.8	19.4
1965	651.2	399.5	363.8	69.9	295.8	35.7	22.7	13.1	63.0	12.8	55.9	19.9
1966	710.1	442.7	400.3	78.4	321.8	42.3	25.8	18.8	68.2	13.0	60.2	20.5
1967	750.4	475.1	429.0	86.5	342.5	46.1	28.1	18.0	69.8	11.8	60.2	20.9
1968	812.2	524.3	472.0	98.7	375.3	52.3	32.4	20.0	74.7	11.7	62.5	20.6
1969	888.5	577.8	516.3	116.8	412.7	56.3	36.5	22.8	77.5	12.8	64.7	20.9
1970	923.5	617.2	551.8	112.2	434.3	60.7	41.0	23.9	79.5	12.9	66.8	21.1
1971	972.8	658.9	584.5	126.8	457.8	64.4	42.7	24.4	84.7	13.4	71.9	22.7
1972	1,116.3	725.1	636.8	137.9	500.9	66.4	56.2	31.2	96.0	17.0	79.0	23.1
1973	1,246.1	811.2	709.8	146.8	560.0	69.9	62.3	34.4	112.2	17.2	95.0	23.1
1974	1,341.5	880.2	772.3	168.5	611.8	118.0	73.8	44.7	113.5	23.5	90.0	24.0
1975	1,444.0	949.1	814.9	176.2	638.6	134.3	87.6	46.7	119.6	22.0	97.6	23.4
1976	1,578.9	1,056.3	989.7	198.8	718.8	150.6	105.2	54.4	132.2	17.2	115.0	23.1
1977	1,767.4	1,190.5	944.2	202.6	791.9	186.4	125.3	61.1	146.0	16.0	130.1	19.8
1978	1,927.2	1,255.5	1,120.5	220.0	868.0	214.9	142.3	71.5	157.5	18.8	138.7	20.8
1979	2,248.3	1,498.3	1,283.3	237.1	1,018.2	245.0	182.4	82.8	181.1	22.2	159.0	22.8
1980	2,431.0	1,647.8	1,373.4	263.5	1,112.0	274.2	195.2	89.9	173.5	11.7	161.8	20.5
1981	2,728.9	1,819.7	1,511.4	286.6	1,228.5	306.3	218.7	94.2	181.6	10.9	160.8	20.5
1982	2,851.4	1,918.6	1,587.5	307.5	1,380.0	312.1	222.4	109.8	174.8	13.3	161.5	20.1
1983	3,070.9	2,038.5	1,677.5	324.8	1,502.7	360.0	238.1	118.8	190.7	6.7	184.5	20.7
1984	3,481.1	2,296.4	1,844.9	248.1	1,698.9	400.5	261.3	131.0	201.3	20.0	181.3	40.0
1985	3,696.9	2,411.7	1,982.0	372.9	1,608.7	429.2	281.5	147.7	206.1	6.2	205.1	41.9
1986	3,971.5	2,502.3	2,102.3	292.7	1,700.1	456.3	297.6	153.6	216.8	22.4	194.4	39.8
1987	4,150.0	2,725.6	2,256.3	423.1	1,833.1	479.4	313.1	160.3	234.2	28.9	205.3	34.2
1988	4,522.2	2,842.2	2,420.8	452.0	1,967.2	507.7	341.2	168.2	248.8	26.5	222.3	34.8
1989	4,802.5	3,113.3	2,585.1	491.1	2,101.9	548.3	354.6	183.7	251.0	28.0	223.0	42.4
1990	5,068.5	3,326.3	2,741.2	519.0	2,222.2	595.1	378.6	206.5	305.1	32.2	233.0	49.8
1991	5,217.8	3,488.3	2,914.5	548.8	2,339.5	628.3	401.7	221.8	308.7	32.0	236.8	61.8
1992	5,517.1	3,611.4	2,967.9	572.0	2,385.8	677.6	448.2	234.4	314.0	34.8	239.2	64.5
1993	5,784.3	3,737.1	3,082.0	589.0	2,484.0	714.1	474.4	250.7	446.6	37.0	417.6	64.1
1994	6,101.1	3,888.6	3,146.5	618.5	2,670.0	761.3	505.0	281.5	470.5	35.6	434.9	67.9
1995	6,572.3	4,165.2	3,434.4	629.0	2,885.4	793.9	486.7	294.3	518.0	33.4	484.6	65.6
1996	6,931.7	4,331.3	3,620.0	684.1	3,059.9	771.4	488.0	314.8	563.7	34.8	528.9	67.0
1997	7,408.0	4,665.8	3,873.5	671.8	3,201.8	792.0	502.4	299.8	626.2	32.8	593.4	67.5
1998	7,878.6	5,027.2	4,180.9	703.2	3,479.7							

## A two-goods example

- nominal GDP year  $t$  =  $P_{1t} Y_{1t} + P_{2t} Y_{2t}$
- nominal GDP year  $t+1$  =  $P_{1t+1} Y_{1t+1} + P_{2t+1} Y_{2t+1}$
- GDP in year  $(t+1)$  at year  $t$  prices  
 $P_{1t} Y_{1t+1} + P_{2t} Y_{2t+1}$



14.02

2/2

Maya

- TAs looking for a job so can't give as much support as they would like
- (Being in the all recitation format may be a mistake)
- Person writing P-set has a lot of experience  
Joquin Blum
- Our section Maya Eden + Fernando Duarte  
↳ her first time teaching today
- 3 quizzes
- going to be large focus on financial crisis - part 2
  - class notes
  - Risk and Liquidity essay

- 
1. "paradox" of saving
  2. What is the right measure of unemployment
  3. How does macro get us out of recession
  4. Why ~~does~~ do banks go bankrupt

2

(lecture too basic -

- lecturer going over + over stuff)

In global economy can borrow \$ from other countries if not enough savings domestically

(I know all of this already)

~~Recession~~ Recession not as bad

- should we ask not who to blame, but who to credit?

TA: We have no idea what caused this crisis + 1930s  
- bad lending was only part of the issue

TA: thought fixed by ↑ public spending

Will it all end in a big inflation?

## GDP

denote in \$

Output per year

3 ways to measure

- value of final sales of goods + services

- sum of all value adds

- sum of all incomes



(3)

Each method adds up to be more or less the same  
- but some variation in real life

## From nominal to real GDP and the Chain Index

You can compute the change in real GDP from year  $t$  to year  $t + 1$  in two alternative ways

$$\frac{Y_{t+1}}{Y_t} = \frac{P_t Y_{t+1}}{P_t Y_t}$$

letters mean:

or

$$\frac{Y_{t+1}}{Y_t} = \frac{P_{t+1} Y_{t+1}}{P_{t+1} Y_t}$$

$Y = \text{good}$  a?  
price?

the two ways of computing it are obviously identical.

But now let there be two goods in the economy,  $Y_1$  and  $Y_2$ . Then the two ways of computing the change in real GDP from year  $t$  to year  $t + 1$  are no longer identical:

$P = \text{price}$

$$\left(\frac{Y_{t+1}}{Y_t}\right)' = \left(\frac{P_{1,t} Y_{1,t+1} + P_{2,t} Y_{2,t+1}}{P_{1,t} Y_{1,t} + P_{2,t} Y_{2,t}}\right)$$

$$\left(\frac{Y_{t+1}}{Y_t}\right)'' = \left(\frac{P_{1,t+1} Y_{1,t+1} + P_{2,t+1} Y_{2,t+1}}{P_{1,t+1} Y_{1,t} + P_{2,t+1} Y_{2,t}}\right)$$

if you divide through  $\left(\frac{Y_{t+1}}{Y_t}\right)'$  by  $P_{1,t}/P_{2,t}$  and  $\left(\frac{Y_{t+1}}{Y_t}\right)''$  by  $P_{1,t+1}/P_{2,t+1}$  you

can verify that the two ways of computing the change in real GDP from year  $t$  to year  $t + 1$  are equal only if  $P_{1,t}/P_{2,t} = P_{1,t+1}/P_{2,t+1}$ . Since the relative price of goods changes over time, this condition will in general not be satisfied. Thus the two expressions will give you two different



changes in real GDP. The chain index addresses the problem by simply defining the change in GDP as the weighted average of the two

$$g_{(01/00)} = .5 \left[ \left( \frac{Y_{t+1}}{Y_t} \right)' + \left( \frac{Y_{t+1}}{Y_t} \right)'' \right]$$

Finally it is customary to compute the change in real GDP using an index that is (arbitrarily) set to be equal to 100 in a "base" year, say the year 2000:

$$\text{chain index}_{2000} = 100$$

$$\text{chain index}_{2001} = 100 * g_{(01/00)}$$

TABLE B-7. Chain-type price indexes for gross domestic product, 1960-2009

[Index numbers, 2005=100, except as noted; quarterly data seasonally adjusted]

Year or quarter	Gross domestic product	Personal consumption expenditures			Gross private domestic investment					
		Total	Goods	Services	Total	Fixed investment				Residential
						Total	Nonresidential			
							Total	Structures	Equip-ment and software	
1960	18.604	18.606	29.144	13.581	26.607	25.530	33.979	11.516	54.445	12.962
1961	18.814	18.801	29.253	13.827	26.533	25.449	33.783	11.446	54.146	12.983
1962	19.071	19.023	29.404	14.090	26.548	25.465	33.789	11.537	53.678	13.003
1963	19.273	19.245	29.548	14.306	26.463	25.391	33.784	11.636	53.581	12.901
1964	19.572	19.527	29.571	14.573	26.613	25.545	33.955	11.801	53.568	13.003
1965	19.928	19.810	30.236	14.846	27.037	25.991	34.342	12.143	53.607	13.372
1966	20.493	20.313	30.953	15.277	27.592	26.528	34.854	12.580	53.749	13.857
1967	21.124	20.824	31.499	15.786	28.320	27.271	35.741	12.973	54.940	14.339
1968	22.022	21.636	32.597	16.468	29.378	28.367	36.999	13.621	56.416	15.100
1969	23.110	22.616	33.860	17.326	30.770	29.767	38.527	14.518	57.965	16.144
1970	24.328	23.674	35.152	18.287	32.072	31.047	40.348	15.473	60.119	16.666
1971	25.545	24.680	36.208	19.285	33.671	32.611	42.246	16.664	61.905	17.632
1972	26.647	25.525	37.135	20.103	35.077	34.009	43.673	17.663	62.651	18.703
1973	28.124	26.901	39.350	21.079	36.972	35.888	45.355	19.247	63.716	20.359
1974	30.668	29.703	44.261	22.868	40.648	39.422	49.733	21.910	68.414	22.460
1975	33.577	32.184	47.837	24.836	45.666	44.361	56.981	24.534	78.523	24.547
1976	35.506	33.950	49.709	26.558	48.190	46.932	59.719	25.741	83.143	26.124
1977	37.764	36.155	52.363	28.560	51.606	50.616	63.905	27.973	88.063	28.759
1978	40.413	38.687	55.576	30.779	56.030	54.891	69.078	30.675	92.731	32.281
1979	43.773	42.118	60.832	33.353	61.099	59.866	73.606	34.238	98.610	35.902
1980	47.776	46.641	67.644	36.805	66.636	65.469	80.098	37.421	107.032	39.789
1981	52.281	50.810	72.669	40.558	73.154	71.551	87.832	42.567	114.681	43.036
1982	55.467	53.615	74.650	43.712	76.899	75.468	92.670	45.327	119.155	45.340
1983	57.655	55.923	75.997	46.433	76.706	75.349	91.843	44.757	119.406	46.380
1984	59.623	58.038	77.435	48.850	77.256	75.790	91.621	45.147	118.264	47.714
1985	61.633	59.938	78.677	51.053	78.047	76.744	92.340	46.219	118.221	48.944
1986	63.003	61.399	78.309	53.378	79.737	78.579	93.908	47.106	120.094	50.994
1987	64.763	63.589	80.827	55.413	81.263	80.036	94.753	47.863	120.750	53.079
1988	66.990	66.121	82.958	58.127	83.120	82.111	95.857	49.895	122.256	54.913
1989	69.520	68.994	86.150	60.844	85.107	84.099	98.890	51.848	123.786	56.680
1990	72.213	72.147	89.678	63.812	86.747	85.808	100.783	53.522	125.389	58.011
1991	74.762	74.755	91.870	66.586	87.961	87.082	102.341	54.491	127.178	58.771
1992	76.537	76.954	92.978	69.240	87.672	86.831	101.488	54.502	125.681	59.486
1993	78.222	78.643	93.786	71.299	88.673	87.838	101.540	56.103	124.408	61.890
1994	79.667	80.265	94.740	73.205	89.628	89.023	102.029	58.089	123.685	64.069
1995	81.533	82.041	95.625	75.370	90.640	90.060	102.247	60.601	122.265	66.403
1996	83.083	83.826	96.676	77.479	90.455	89.817	101.054	62.141	119.323	67.828
1997	84.554	85.395	96.563	79.817	90.120	89.589	99.775	64.516	115.788	69.557
1998	85.507	86.207	95.106	81.695	89.109	89.756	97.997	67.480	110.641	71.412
1999	86.766	87.596	95.603	83.515	88.989	88.700	95.173	69.559	107.406	74.151
2000	88.648	89.777	97.520	85.824	89.954	89.751	96.219	72.298	106.114	77.415
2001	90.654	91.488	97.429	88.429	90.748	90.553	95.788	76.087	103.603	80.994
2002	92.113	92.736	96.430	90.807	91.118	90.924	95.363	79.292	101.494	83.002
2003	94.099	94.622	96.380	93.692	92.411	92.301	95.355	82.174	100.267	86.953
2004	96.769	97.098	97.867	96.687	95.632	95.541	96.834	88.441	99.697	93.296
2005	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
2006	103.263	102.746	101.508	103.411	104.371	104.419	103.534	112.922	100.194	106.081
2007	106.221	105.502	102.789	106.964	106.677	106.718	105.209	121.275	100.715	107.513
2008	108.481	109.031	106.150	110.582	107.355	107.551	107.897	125.207	101.456	105.779
2009 P	109.754	109.252	103.632	112.221	106.458	106.114	107.510	122.759	102.010	100.687



- (different guy)
- (going to give 2nd chance)
- quizzing us on what Maya said
- Macro: country-level ~~and~~ and inter country aggregate trends
- aggregate income = GDP
- gross  $\rightarrow$  does not subtract loss of capital  $\rightarrow$  depreciation
- (he is not using slides)
- again 2 ways to measure
  - only add up final goods
    - no double counting ingredients
- (Nils is in the class!)
- imports don't ~~count~~ count
  - like if import tires for a car - don't count tires
- exports count of course
- or count value added at each step of production
  - wages and profits are the value add

$$\text{Wages} + \text{Profits} = \text{GDP}$$

②

Compute in \$

- so can compare different goods

Inflation

- Real GDP - adjusted for inflation

- Nominal GDP  $\rightarrow$  expressed in current vs dollars

$$GDP = \sum_j q_j \times p_j$$

To ~~adjust~~ adjust - use prices of other period

- but quantities actually produced then

$$GDP_{2011}^{2000} = \sum_j q_j^{2011} \cdot p_j^{2000} \quad \leftarrow 2011's \text{ GDP in } 2000 \text{ dollars}$$

$$GDP_{2000}^{2000} = \sum_j q_j^{2000} \cdot p_j^{2000} \quad \leftarrow \text{nominal GDP for } 2000$$

↓ now can compare

Problem converting nominal  $\rightarrow$  real

- relative prices may change

- but relative values may change between items in the market basket

Year	Apples	P Apples	Oranges	P Orange	Nominal GDP	Real GDP Base=1
1	10	\$1	5	\$2	\$20	\$20
2	15	\$2	8	\$2	\$46	\$31



3

Real GDP 2

---

\$30  
\$46

$$r_1 = \frac{30-20}{20} = 55\%$$

Increase in GDP

$$r_2 = \frac{46-30}{30} = 50\%$$

- How much did real output rise?

~~ma~~

Choosing a diff basis gives diff weights to state

You usually avg the 2 "chain method"

How does quality fit into this?

Cell phones much better in 2011 than 2000 - but same price

So how to take account in this

Book discusses this "hedonic prices"



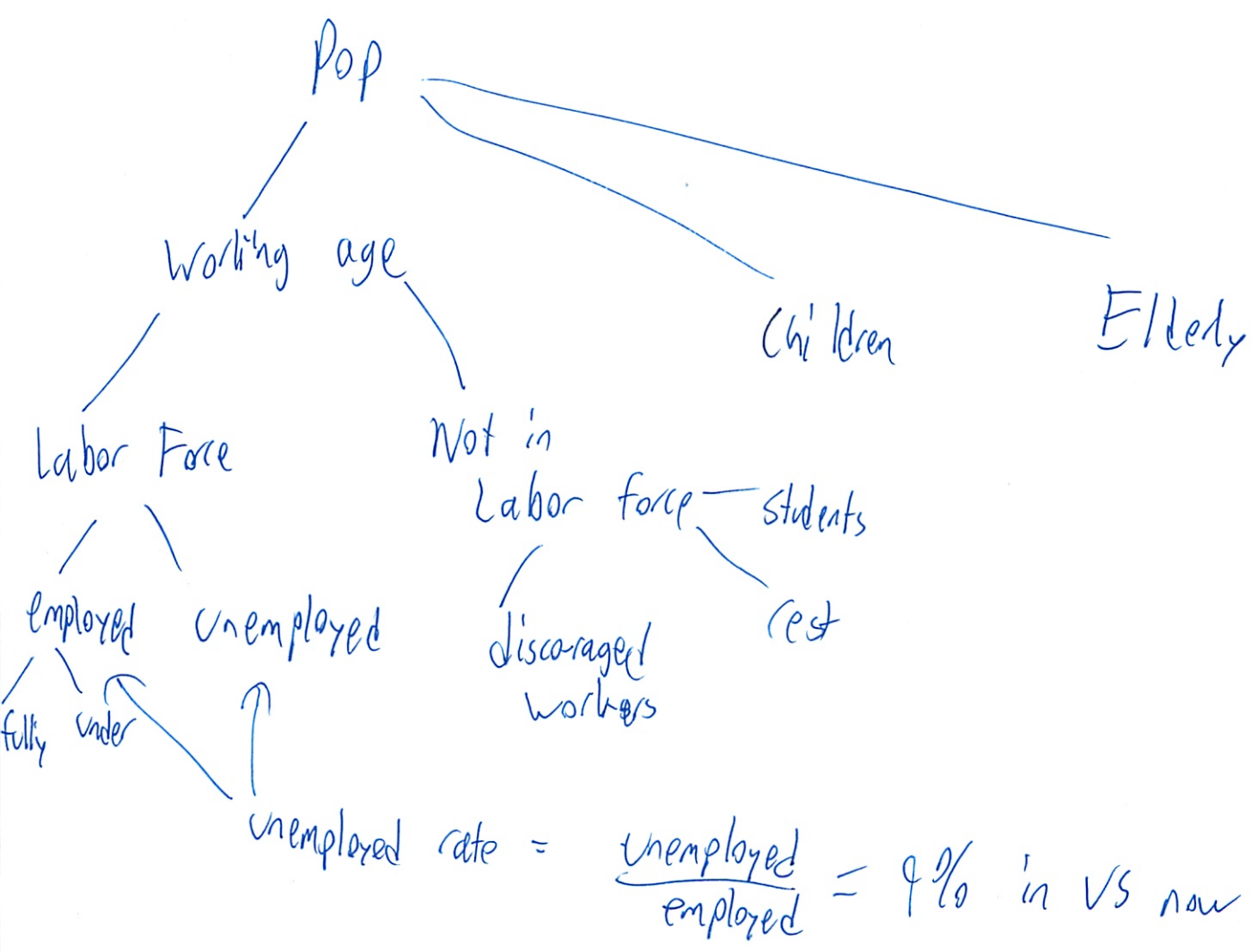
Not change in CPI market basket makeup

This is all GDP - not the CPI actual measure - something different

4

# Unemployment

- talked a lot about today
- (and we covered Wed w/ Maya)
- lots of people not in labor force



Why do we care?

- efficiency loss
- welfare concern - psychological
- political



5

# Inflation

General rise in price level  
(Here is the market basket thing)

Define a list of goods + services avg household consumes

CPI = Consumer Price Index

Or GDP deflator

- ratio of  $\frac{\text{nomial GDP}}{\text{real GDP}}$  - index value

Year 1	Year 2	
$\frac{20}{20} = 1$	$\frac{31}{21} = 1.5$	← 50% inflation

3rd TA : Fernando

- MIT Undergrad
- 6th year grad

- so 10th year here

Powerful class

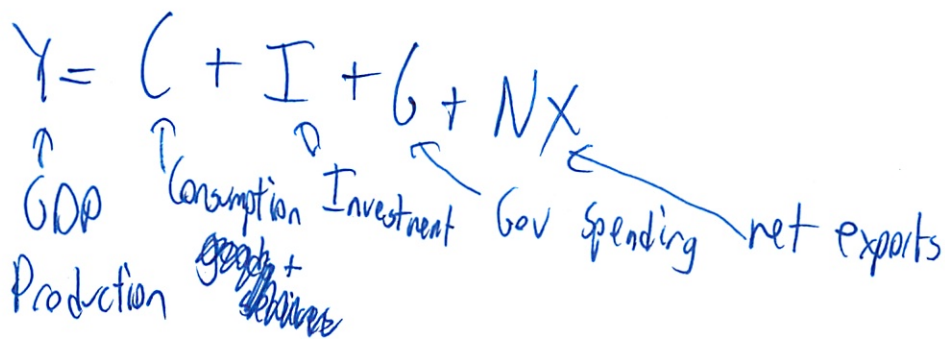
- just linear equations

(I like this TA)

Today Consumption

Investment + Savings

Consumption



Consumption - goods + services produced domestically

Investment - A spent today to gain future investment  
 ↳ not stock

Gov Spending - Spending on projects, except transfer payment, produced domestically



② Think of entire US as 1 person

$$NX = \text{Exports} - \text{Imports} = X - I$$

⊕ trade surplus

⊖ trade deficit

US today  $\frac{NX}{Y} \approx -5\%$

NX will be taught later  
↳ simplify for now

Consumption

$$\frac{C_{us}}{Y_{us}} \approx 70\%$$

$$\frac{C}{Y} > 70\%$$

- tax emborg  
- small countries

$$\frac{C_{china}}{Y_{china}} \approx 45\%$$

$$C = C(Y_D)$$

$Y_D$  = disposable income

$$= \underset{\substack{\uparrow \\ \text{income}}}{Y} - \underset{\substack{\uparrow \\ \text{taxes}}}{T}$$

- Some people also take out mortgage, etc  
- we will leave in

③ Higher income = higher  $Y_0$   
 $\uparrow I = \uparrow Y_0$

$$C = C(Y_0) = C_0 + C_1 \cdot Y_0$$

$\uparrow$  Autonomous Spending  
 $\oplus$

propensity to consume  
 $< 1$

Keynes

$<$  can be  $> 1$  for a short time  
Changes a lot over time  
Different for diff people

How make decision?

- in real terms (just amount)
- how you think your income will change
- retirement plans

Friedman

$$C = C_0 + C_w \cdot W$$

$\uparrow$  expected wealth  
over your lifetime

Permanent  
income  
hypothesis

- You try to smooth  
out over your  
life

Empirically: its somewhere in the middle

~~can~~

⑨ Investment ~~MA~~

- fixed  $I = \bar{I}$
- don't worry about now

Gov Spending

- fixed  $G = \bar{G}$
- don't worry about now

NX  
= 0 for now

$$Y = C + \bar{I} + \bar{G}$$

$$Y = \underbrace{C_0 + C_1(Y - T)}_{\text{demand}} + \bar{I} + \bar{G} \quad \text{in equilibrium condition}$$

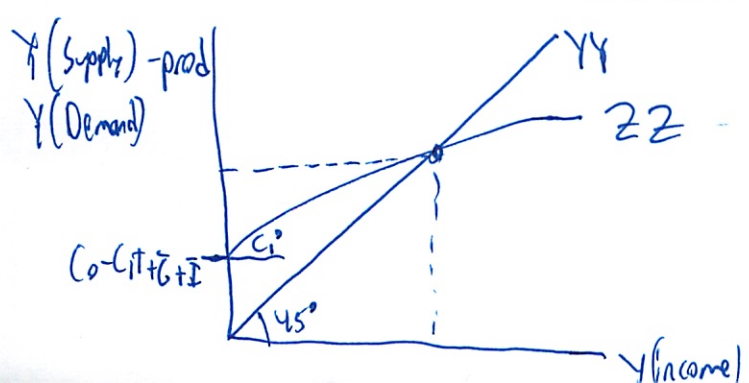
Production  
(supply of goods)

demand

$$= C_0 + C_1 Y - C_1 T + \bar{I} + \bar{G}$$

(good TA - very well organized)

- math basis
- not much real-world forces - here and now)



①  $Z = C_0 + C_1 Y - C_1 T + \bar{I} + \bar{G}$   
Demand Income

②  $Y = Y$   
Prod Income  
in equilibrium  
 $Y = X$   
can measure GDP either way



5

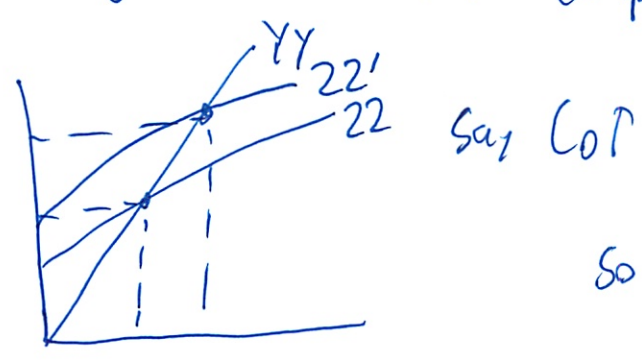
$T - \bar{G} = \text{gov budget}$

Graph equilibrium

$$Y = \frac{1}{1 - C_1} [C_0 - C_1 T + \bar{I} + \bar{G}]$$

$\uparrow Y$  as a fn of the other variables

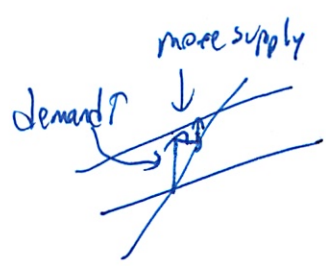
Want to understand how GDP changes if we change the different components of demand



So more production

Production goes up, so income goes  $\uparrow$ , so  $D \uparrow$ , so people want to consume more, so demand goes  $\uparrow$ , so production  $\uparrow$ , repeat

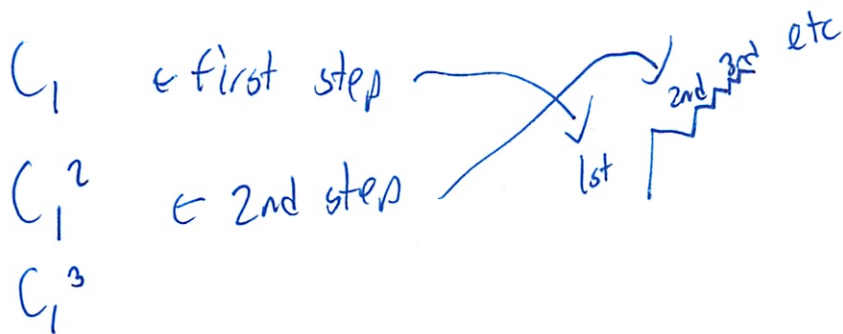
- initial shock
- effects everything
- graph shows equilibrium



(nice graphic!)

go towards equilibrium will converge

6



So amt ~~to~~ income will ↑ by is

$$1 + C_1 + C_1^2 + C_1^3 + \dots$$

(Never did this Hs)

Geometric series

$$\frac{1}{1 - C_1}$$

↑ coefficient in equation

(Very interesting!)

CoP  
So  $\frac{1}{1 - C_1}$  is  $> 1$

Called the multiplier

Why people say the gov should spend more \$  
if  $C_1$  is very high, gov spending has very  
large effect

In practice  $C_1$ , I adjusts

Michael Plasmeyer

81

2/11

## 14.02 Principles of Macroeconomics

### Problem Set # 1

Due: Feb 11, 2011

Feb 7, 2011

#### 1 True/False/Uncertain [30 points]

Please state whether each of the following claims are True, False or Uncertain, and provide a brief justification for your answer

1. "A firm produces \$1,000 worth of plastic materials, but is then unable to sell them. In this case, GDP remains unchanged. [6 points]
2. "An increase in the price of a product imported from Belgium into the US - holding all other prices and quantities fixed - will increase both the CPI and the GDP deflator in the US" [6 points]
3. "If a firm in the US buys a new machine from a foreign supplier, then GDP in the US will increase" [6 points]
4. "If we are interested in computing the growth rate of real GDP, then the choice of the base-year is irrelevant" [6 points]
5. "A firm produces \$200 worth of plastic materials, and sells it to a producer of plastic toys, who uses half of it to produce \$350 worth of toys (which are immediately sold to consumers) and stores the rest. In this case, inventories go up by \$100, consumption goes up by \$350, and GDP increases by \$550," [6 points]

#### 2 Macro Data [40 points]

Suppose that there are only 3 goods in the economy: *A*, *B*, and *C*. We have yearly data on prices (*p*) and quantities produced (*q*) for each good for the



period 1991-1994

	$P_A$	$Q_A$	$P_B$	$Q_B$	$P_C$	$Q_C$
1991	1	100	2	100	20	1
1992	1.1	95	2	110	25	1
1993	1.2	90	2.05	110	30	1
1994	1.2	90	2.05	110	40	1

1. Compute nominal GDP for each year [7 points]
2. Compute, for each year in the sample, real GDP with base-year 1991. [7 points]
3. Do you think that nominal GDP is good indicator of the change in economic activity between 1993 and 1994? Or do you think that real GDP is better? Explain [4 points]
4. Compute the GDP deflator and the inflation rate for each year [note: you can only compute the inflation rate from 1992 on] [7 points]
5. Suppose that the basket of goods used by the Government to compute the CPI consists of 2 units of good A, and 1 unit of good B (note: good C is not included in the basket). Using 1991 as the base-year, compute the CPI and also the CPI based inflation rate for each year. [note: you can only compute the inflation rate from 1992 on] [7 points]
6. Explain the difference between the two measures of inflation you computed (ie CPI based, and GDP deflator based) for the year between 1993 and 1994. If good C was a luxury good which is consumed by only a very small fraction of the population, which measure of inflation would be preferable? [8 points]

### 3 The Goods Market [30 points]

Consider the model of the Goods Market studied in Chapter 3 of the textbook. Suppose a consumption function of the form  $C = c_0 + c_1 Y^d$ , where  $Y^d$  stands for disposable income, and  $c_0$  and  $c_1$  are parameters. Assume investment (I), government spending (G) and taxes (T) to be given exogenously.

1. State an expression for the demand for goods (denote it by Z). State the equilibrium condition for the goods market. [6 points]
2. Using these two equations, derive an expression for the equilibrium level of output. [6 points]
3. What is the effect on output of a \$1 increase in government spending? How do we call this effect? [6 points]

4. Assume that investment is now given by  $I = i_0 + i_1Y$ . Re-derive an expression for the equilibrium level of output. [6 points]
5. What is the effect on output of a \$1 increase in government spending? How does this effect compare to the one found in part 3? Explain any difference. [6 points]

1. According to one website - the production of a durable good that is not sold is treated as the sale of the good to that company and counted.  
One would have to watch out for this with all the different methods to calculate GDP
2. GDP deflator - No - Imports not counted  
CPI - Yes, if it is sold to consumers
3. No. ~~Imports~~ don't count, import offsets export
4. ~~True~~, The base year just gives you a good place to compare from.
5. False. GDP only increases \$<sup>450</sup>~~350~~, - assuming that the rest of the plastic will be used this year.



②

2.a. I assume all goods are final

1991	$1 \cdot 100 + 2 \cdot 100 + 20 \cdot 1 = \$320$
1992	$1 \cdot 95 + 2 \cdot 110 + 25 \cdot 1 = \$349.5$
1993	$1 \cdot 90 + 2 \cdot 05 \cdot 110 + 30 \cdot 1 = \$363.5$
1994	$1 \cdot 90 + 2 \cdot 05 \cdot 110 + 40 \cdot 1 = \$373.5$

b.

1991	$\$320$	Use 1991 prices, but current Q
1992	$1 \cdot 95 + 2 \cdot 110 + 20 = \$335$	
1993	$1 \cdot 90 + 2 \cdot 110 + 20 = \$330$	
1994	$1 \cdot 90 + 2 \cdot 110 + 20 = \$330$	

c. Real GDP is always the best measure of economic output/activity, because it removes inflation

d. 
$$\text{GDP Deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} = \text{index value}$$
 change is the inflation rate

1991	$\frac{320}{320} \rightarrow 100$ baseline
1992	$\frac{349.5}{335} \rightarrow 104.32$
1993	$\frac{363.5}{330} \rightarrow 110.15$

③

$$1994 \quad \frac{373.5}{330} \rightarrow 113.18$$

Inflation

$$1991 \rightarrow 1992 = \frac{104.32 - 100}{100} = 4.32\%$$

$$1992 \rightarrow 1993 = \frac{110.15 - 104.32}{104.32} = 5.58\%$$

$$1993 \rightarrow 1994 = \frac{113.18 - 110.15}{110.15} = 2.75\%$$

e. CPI

~~X~~ 1991  $2.1 + 1.2 = 4$  baseline

1992  $2.1 + 1.2 = 4.2$

-3 1993  $2.1 + 2.05 = 4.45$

1994  $2.1 + 2.05 = 4.45$

Inflation

$$1992 \quad \frac{4.2 - 4}{4} = 5\%$$

$$1993 \quad \frac{4.45 - 4.2}{4.2} = 5.95\%$$

$$1994 \quad \frac{4.45 - 4.45}{4.45} = 0\%$$

(4)

f. The consumer price index only counts what consumers buy. If C was a lux good then we might not want to count it so CPI would be better. The book also says that CPI also counts goods imported and consumed, so a large jump in oil can make the 2 measures diverge.



5

$$3. C = C_0 + C_1 Y^d$$

$\uparrow$  disposable

$$Z = C_0 + C_1 (Y - \bar{T}) + \bar{I} + \bar{G}$$

$C_0$  = consumption if no income

$C_1$  = marginal propensity to consume

Equilibrium

$$Y = Z$$

$$b. Y = C_0 + C_1 (Y - \bar{T}) + \bar{I} + \bar{G}$$

$$Y = C_0 + Y C_1 - C_1 \bar{T} + \bar{I} + \bar{G}$$

$$Y(1 - C_1) = C_0 - C_1 \bar{T} + \bar{I} + \bar{G}$$

$$Y = \frac{C_0 - C_1 \bar{T} + \bar{I} + \bar{G}}{1 - C_1}$$

$$= \frac{1}{1 - C_1} \left[ \underbrace{C_0 - C_1 \bar{T} + \bar{I} + \bar{G}}_{\text{autonomous}} \right]$$

c) It is in the autonomous spending range - it does not depend on output.

~~But this does not sound right, why does the multiplier not figure in?~~

(56)

Yes - but it will be multiplied by the multiplier

$$\text{So } \frac{1}{1-c_1} \cdot \$1$$

So output at first is \$1 as gov spends the \$1  
Then the income from the first expansion of production  
is \$1

The second round increase in demand is  $c_1 \cdot \$1$

leading to a second round ↑ in production of  $\$1 \cdot c_1$   
etc

Total increase

$$1 + c_1 + c_1^2 + \dots + c_1^n = \frac{\$1}{1-c_1}$$

6

$$I = i_0 + i_1 Y$$

$$Z = C_0 + C_1(Y - \bar{T}) + i_0 + i_1 Y + \bar{G}$$

$$Z = Y$$

$$Y = C_0 + C_1(Y - \bar{T}) + i_0 + i_1 Y + \bar{G}$$

$$Y = C_0 + C_1 Y - C_1 \bar{T} + i_0 + i_1 Y + \bar{G}$$

$$Y(1 - C_1 - i_1) = C_0 - C_1 \bar{T} + i_0 + \bar{G}$$

$$Y = \frac{1}{1 - C_1 - i_1} (C_0 - C_1 \bar{T} + i_0 + \bar{G})$$

e.  $\bar{G}$  is still in the autonomous spending region and it still sounds wrong!

larger!

But now with a smaller multiplier  $\bar{G}$  increase

3 will be less because some of the extra income will go to savings, Total effect is now

$$\frac{1}{1 - C_1 - i_1}$$



14.02 Principles of Macroeconomics  
Solutions to Problem Set # 1  
Due: Feb 11, 2011

Feb 7, 2011

**1 True/False/Uncertain [30 points]**

Please state whether each of the following claims are True, False or Uncertain, and provide a brief justification for your answer

1. "A firm produces \$1,000 worth of plastic materials, but is then unable to sell them. In this case, GDP remains unchanged. [6 points]

**ANSWER.** FALSE. Even if no other firm decides to buy the plastic materials, GDP goes up by \$1,000 (or whatever value added was in the production of the plastic materials). Inventories go up by \$1,000.

2. "An increase in the price of a product imported from Belgium into the US - holding all other prices and quantities fixed - will increase both the CPI and the GDP deflator in the US" [6 points]

**ANSWER.** FALSE. The GDP deflator includes only domestically produced goods. The CPI will be affected as long as US consumers buy the Belgian product, and this product is included in the basket used to compute the index.

3. "If a firm in the US buys a new machine from a foreign supplier, then GDP in the US will increase" [6 points]

**ANSWER.** FALSE. Investment and imports go up by the same amount, and thus GDP in the US remains unchanged.

4. "If we are interested in computing the growth rate of real GDP, then the choice of the base-year is irrelevant" [6 points]

**ANSWER.** UNCERTAIN. If we are using a chain-type index, the statement is true (see appendix of Chapter 2 in the textbook). If we are using the standard real GDP, then the statement is FALSE.

5. "A firm produces \$200 worth of plastic materials, and sells it to a producer of plastic toys, who uses half of it to produce \$350 worth of toys (which are immediately sold to consumers) and stores the rest. In this case, inventories go up by \$100, consumption goes up by \$350, and GDP increases by \$550," [6 points]

**ANSWER.** False. GDP increases by \$450, as  $Y = C + I + \text{INVENTORIES} + G + X - M$ , and  $C$  is increasing by \$350, and inventories is increasing by \$100.

## 2 Macro Data [40 points]

Suppose that there are only 3 goods in the economy:  $A$ ,  $B$ , and  $C$ . We have yearly data on prices ( $p$ ) and quantities produced ( $q$ ) for each good for the period 1991-1994

	$P_A$	$q_A$	$P_B$	$q_B$	$P_C$	$q_C$
1991	1	100	2	100	20	1
1992	1.1	95	2	110	25	1
1993	1.2	90	2.05	110	30	1
1994	1.2	90	2.05	110	40	1

1. Compute nominal GDP for each year [7 points]

**ANSWER.**

$$\text{GDP}_{1991} = 1 * 100 + 2 * 100 + 20 * 1 = 320$$

$$\text{GDP}_{1992} = 1.1 * 95 + 2 * 110 + 25 * 1 = 349.5$$

$$\text{GDP}_{1993} = 1.2 * 90 + 2.05 * 110 + 30 * 1 = 363.5$$

$$\text{GDP}_{1994} = 1.2 * 90 + 2.05 * 110 + 40 * 1 = 373.5$$

2. Compute, for each year in the sample, real GDP with base-year 1991. [7 points]

**ANSWER.**

$$\text{RGDP}_{1991} = 1 * 100 + 2 * 100 + 20 * 1 = 320$$

$$\text{RGDP}_{1992} = 1 * 95 + 2 * 110 + 20 * 1 = 335$$

$$\text{RGDP}_{1993} = 1 * 90 + 2 * 110 + 20 * 1 = 330$$

$$\text{RGDP}_{1994} = 1 * 90 + 2 * 110 + 20 * 1 = 330$$

3. Do you think that nominal GDP is good indicator of the change in economic activity between 1993 and 1994? Or do you think that real GDP is better? Explain [4 points]

**ANSWER.** Between 1993 and 1994, quantities remained fixed. Nominal GDP, however, increased because the price of good  $C$  increased. We would like an indicator of economic activity that is not affect by such changes in

prices. Real GDP, by using constant prices, is not subject to this problem, and, as seen in the previous question, remains constant between these two years.

4. Compute the GDP deflator and the inflation rate for each year [note: you can only compute the inflation rate from 1992 on] [7 points]

**ANSWER.**

$$GDPdef_{1991} = 1 ; GDPdef_{1992} = 349.5/335 = 1.0433 \quad GDPdef_{1993} = 363.5/330 = 1.1015$$

$$GDPdef_{1994} = 373.5/330 = 1.1318$$

(these numbers can also be expressed in scale of 100, for example  $GDPdef_{1994} = 113.18$ )

Define inflation as the growth rate in prices, that is  $\pi_t = (P_t - P_{t-1})/P_{t-1}$

$$\pi_{1992} = \frac{1.0433-1}{1} = 0.0433 ; \pi_{1993} = \frac{1.1015-1.0433}{1.0433} = 0.055785$$

$$\pi_{1994} = \frac{1.1318-1.1015}{1.1015} = 0.027508$$

(these numbers can also be expressed as percentages, for example  $\pi_{1994} = 2.7508\%$ )

5. Suppose that the basket of goods used by the Government to compute the CPI consists of 2 units of good A, and 1 unit of good B (note: good C is not included in the basket). Using 1991 as the base-year, compute the CPI and also the CPI based inflation rate for each year. [note: you can only compute the inflation rate from 1992 on] [7 points]

**ANSWER.**

$$CPI_{1991} = 1 ; CPI_{1992} = \frac{2*1.1+1*2}{2*1+1*2} = 1.05 ; CPI_{1993} = \frac{2*1.2+1*2.05}{2*1+1*2} = 1.1125 ;$$

$$CPI_{1994} = \frac{2*1.2+1*2.05}{2*1+1*2} = 1.1125$$

$$\pi_{1992} = \frac{1.05-1}{1} = 0.05 ; \pi_{1993} = \frac{1.1125-1.05}{1.05} = 0.059524$$

$$\pi_{1994} = \frac{1.1125-1.1125}{1.1125} = 0$$

6. Explain the difference between the two measures of inflation you computed (ie CPI based, and GDP deflator based) for the year between 1993 and 1994. If good C was a luxury good which is consumed by only a very small fraction of the population, which measure of inflation would be preferable? [8 points]

**ANSWER.** The GDP deflator based inflation takes into account all three goods, while the CPI based inflation only considers goods A and B. CPI based inflation between 1993 and 1994 is zero because the prices for both A and B are constant. GDP deflator based inflation is positive, because the price of good C is increasing. If good C was consumed by only a very small fraction of the population, then the CPI based inflation would be a better measure of the increase in the cost of living for the representative household.



### 3 The Goods Market [30 points]

Consider the model of the Goods Market studied in Chapter 3 of the textbook. Suppose a consumption function of the form  $C = c_0 + c_1 Y^d$ , where  $Y^d$  stands for disposable income, and  $c_0$  and  $c_1$  are parameters. Assume investment (I), government spending (G) and taxes (T) to be given exogenously.

1. State an expression for the demand for goods (denote it by Z). State the equilibrium condition for the goods market. [6 points]

ANSWER.

$$Z = C + I + G = c_0 + c_1(Y - T) + I + G$$

$$Z = Y$$

2. Using these two equations, derive an expression for the equilibrium level of output. [6 points]

ANSWER.

$$Y = \frac{1}{1 - c_1} [c_0 - c_1 T + I + G]$$

3. What is the effect on output of a \$1 increase in government spending? How do we call this effect? [6 points]

ANSWER. Output increases by  $1/(1 - c_1)$ . This effect is called multiplier.

4. Assume that investment is now given by  $I = i_0 + i_1 Y$ . Re-derive an expression for the equilibrium level of output. [6 points]

ANSWER.

$$Y = c_0 + c_1(Y - T) + i_0 + i_1 Y + G$$

$$Y = \frac{1}{1 - c_1 - i_1} [c_0 - c_1 T + i_0 + G]$$

5. What is the effect on output of a \$1 increase in government spending? How does this effect compare to the one found in part 3? Explain any difference. [6 points]

ANSWER. The effect is now  $\frac{1}{1 - c_1 - i_1}$ , which is larger than the effect (or multiplier) found in part 3. The reason is that increases in output now generate both increases in consumption AND investment. Thus, by having an investment function which is sensitive to output, the multiplier effect is larger.

Maya's Back

Can't write on the board - allergic to chalk  
 Can't get projector to work

Precautionary savings

- does savings change w/ uncertainty

- Risk adverse people

$$t=1 \quad y=50$$

$$t=2 \quad y=50+\sigma$$

↑ uncertainty

$\sigma$  large = lots of uncertainty

$\sigma=0 \rightarrow$  no uncertainty

So why save? ~~then~~

"Consumption smoothing ~~model~~ <sup>motivation</sup>"

Newsweek article  $\rightarrow$  since uncertainty now

So stimulus won't be effective

People will just save

- lower  $C_1$  marginal propensity to consume

② (projector fixed)

$\theta$  is an increasing function of  $\Delta$

Saves  $\theta(\Delta)(50+I)$

Spends  $(1-\theta(\Delta))(50+I)$

Derivative w/ respect to  $I$

$(1-\theta(\Delta))$   
low when  $\Delta$  (and thus  $\theta(\Delta)$ ) is high

Markiew

$\theta$  is  $(\Delta, I)$

$t=1$   $I$

~~$t=1$~~

$t=2$   $\begin{cases} 2I + \Delta & p=.5 \\ I - \Delta & p=.5 \end{cases}$

$$\frac{\partial \theta}{\partial I} \leq 0$$

$$\frac{\partial^2 \theta}{\partial \Delta \partial I} < 0$$

'increasing' income is more 'important'  
in a time w/ lot of uncertainty

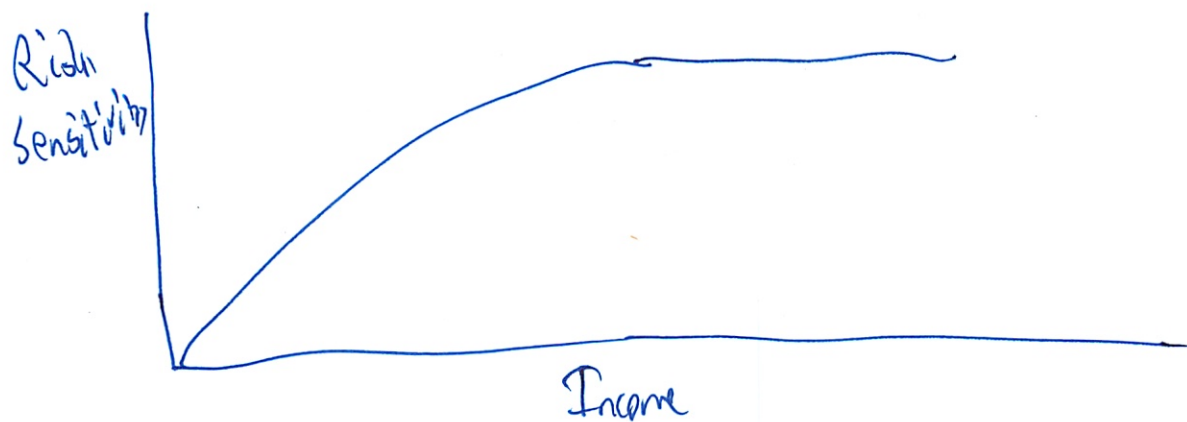
← two types



③

More risk can be taken if wealthy

Risk aversion curve



← From my memory

All this makes a lot of assumptions

Mankiw is making 2nd order arg

- the extent which they save less will decline

How does Stimulus package work?

If only changing current income - effects?

- ~~they will~~ if there is uncertainty will save the extra \$

So argument is in changing permanent income

Or changing perceived permanent income?

Do people take into account what happens in the future  
(she didn't know details about Obama stim)

(Over 15 min early)

## The liquidity trap

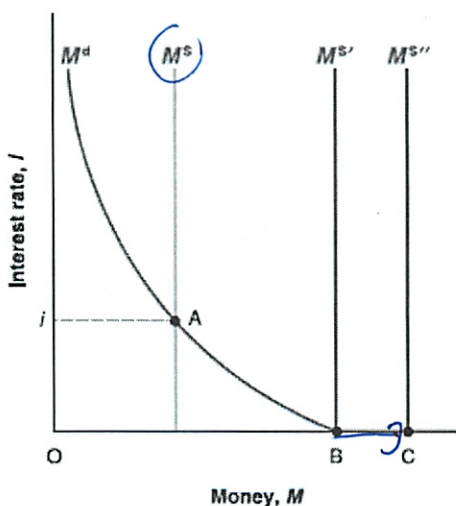
In the previous section, we assumed that the central bank could always affect the interest rate, by changing the money supply. However, there is a limit to what the central bank can do: It cannot decrease the nominal interest rate below zero.

Go back first to our characterisation of the demand and the supply of money in Section 4.1. There we drew the demand for money, for a given level of income, as a decreasing function of the nominal interest rate. The lower the nominal interest rate, the larger the demand for money – equivalently, the smaller the demand for bonds. What we did not ask is what happens when the interest rate goes down to zero. The answer: Once people hold enough money for transaction purposes, they are then indifferent between holding the rest of their financial wealth in the form of money or in the form of bonds. The reason they are indifferent: Both money and bonds pay the same nominal interest rate: zero. Thus, the demand for money is as shown in Figure 4.6:

- As the nominal interest rate decreases, people want to hold more money (and thus fewer bonds): The demand for money therefore increases.
- As the nominal interest rate becomes equal to zero, people want to hold an amount of money at least equal to the distance OB. This is what they need for transaction purposes, but they are willing to hold even more money (and therefore hold fewer bonds) because they are indifferent between money and bonds. Therefore, the demand for money becomes horizontal beyond point B.

Now consider the effects of an increase in the money supply:

- Consider a case in which the money supply is  $M^s$ , so the nominal interest rate consistent with financial market equilibrium is positive and equal to  $i$ . (This is the case we considered in Section 4.1.) Starting from that equilibrium in Figure 4.6, an increase in the money supply – a shift of the  $M^s$  line to the right – leads to a decrease in the nominal interest rate.
- Now consider a case in which the money supply is  $M^{s'}$ , or the case where the money supply is  $M^{s''}$ , so the equilibrium is given at point C. In either



case, the initial nominal interest rate is zero; and, in either case, an increase in the money supply has no effect on the nominal interest rate. Think of it this way:

Suppose the central bank increases the money supply. It does so through an open market operation in which it buys bonds and pays for them by creating money. Because the nominal interest rate is zero, people are indifferent to how much money or how many bonds they hold, so they are willing to hold fewer bonds and more money at the same nominal interest rate: zero. The money supply increases but with no effect on the nominal interest rate – which remains equal to zero.

In short: Once the nominal interest rate is equal to zero, expansionary monetary policy becomes powerless. Or, to use the words of Keynes, who was the first to point out the problem, the increase in money falls into a liquidity trap: People are willing to hold more money (*more liquidity*) at the same nominal interest rate.

What can a central bank do to expand the money supply if the economy is stuck in a liquidity trap? How can the central bank put more money into the economy in order to boost spending and increase output? An extreme form of expansionary monetary policy when nominal interest rates are close to zero is the purchase of assets like government and corporate bonds by the central bank – a policy often known as quantitative easing. This does not involve printing more banknotes. Instead the central bank pays for these assets by creating money electronically and crediting the accounts of the companies it bought the assets from. This extra money supports more spending in the economy.

↳? same as before

(I did not ~~think~~ know this before)

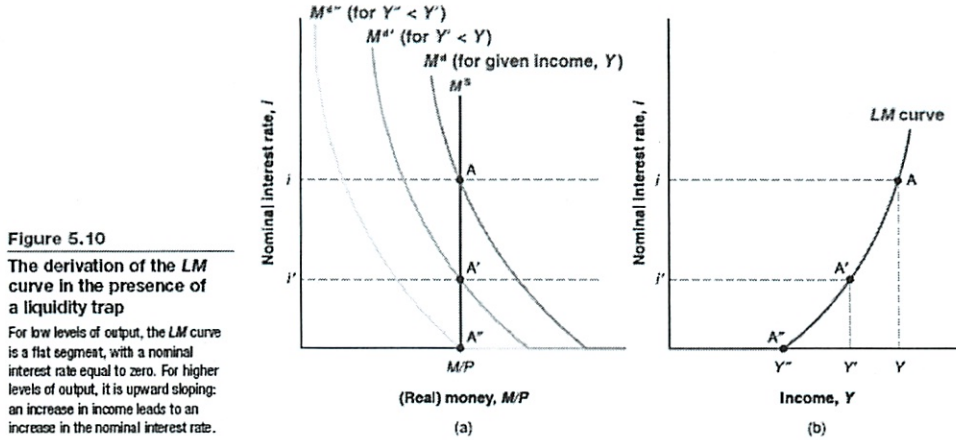
(Describes a lot)



## 5.5 IS-LM AND THE LIQUIDITY TRAP

Let's now turn to the IS-LM model and see how it must be modified to take into account the liquidity trap.

When deriving the LM curve as shown in the two panels of Figure 5.4, we have shown that the LM curve gives, for a given real money stock, the relation between the nominal interest rate and the level of income implied by equilibrium in financial markets. There, we avoided drawing the LM curve for low income levels. To derive the LM curve for all levels of income, Figure 5.10(a) looks at equilibrium in the financial markets for a given value of the real



In words: When the nominal interest rate is equal to zero, the economy falls in a liquidity trap. The central bank can increase liquidity – that is, increase the money supply. But this liquidity falls into a trap: The additional money is willingly held by financial investors at an unchanged interest rate, namely zero. If, at this zero nominal interest rate, the demand for goods is still too low, then there is nothing further monetary policy can do to increase output.

But is it companies can't borrow since bond rate so low

- No can always pay more

## 14.02 Reading

2/2

(going to try not to take many notes)

(I always say that)

hedonic pricing - take into account benefit provide

- US Gov uses in inflation calculation

Current population survey (CPS) for unemployment

unemployment - resources not used appropriately

$$\text{GDP deflator } P_t = \frac{\text{Nominal GDP}_t}{\text{Real GDP}_t} = \frac{\$Y_t}{Y_t}$$

$$\text{Nominal GDP} = \text{GDP deflator} \cdot \text{real GDP}$$

CPI - goods consumed in US (inc exports)

inflation - important b/c not everything is auto indexed to inflation

- prices + wages don't rise proportionally

- people move up tax brackets

- when uncertain investment decisions harder

deflation some problem

② Chap 3

↳ went over in recitation

$$Z = C + I + G + X - IM$$

$$C = C_0 + c_1 Y_0$$

endogenous - depend on other variables

exogenous - treated as given

T, G fiscal policy

Solve

$$Y = \frac{1}{1-c_1} [C_0 + \bar{I} + G - c_1 T]$$

└───┘  
multiplier

ZZ = relationship b/w demand + income

$$\frac{1}{1-c_1} = \text{geometric series} = 1 + c_1 + c_1^2 + \dots + c_1^n$$

theoretically right away

study of dynamics - but takes some time

$$\begin{aligned} \text{private savings } S &\equiv Y_0 - C \\ &= Y - T - C \end{aligned}$$

$$\text{public savings} \equiv T - G \quad \begin{array}{l} \text{-surplus} \\ \text{-deficit} \end{array}$$



3

\* Production = demand \*

\* Investment = savings \* IS relation

$(1 - c_1)$  = propensity to save

$$Y = \frac{1}{1 - c_1} [C_0 + \bar{I} + G - c_1 T] \leftarrow \text{same eq as before}$$

Gov's effects limited

- slow
- investment + imports respond
- anticipation
  - ↳ esp if tax cut permanent (recitation)
- bumps up inflation
- large debt

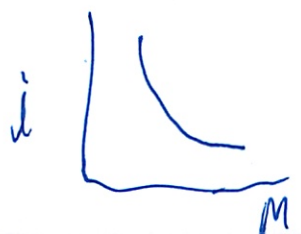
3/16 actually is different - should have did more detailed notes

## Chap 4 Financial Markets

Money - no interest but liquid  
Bonds - pay interest  $i$  but illiquid ) do both

Money market is like bonds

$$M^d = \text{demand for money} = \$ Y \overset{\text{of function}}{L}(i)$$



⊖  
negative effect

④

How determine  $i$ ?

- checkable deposits
- currency from central bank

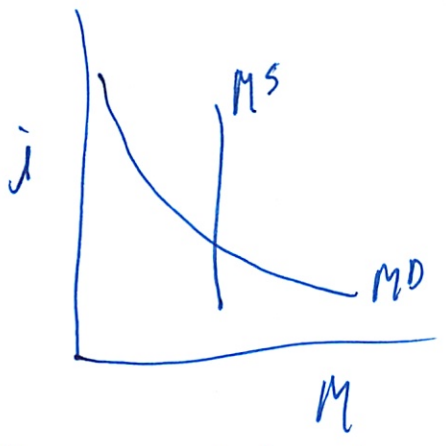
Money supply = money demand

$$M = PY L(i)$$

LM relation

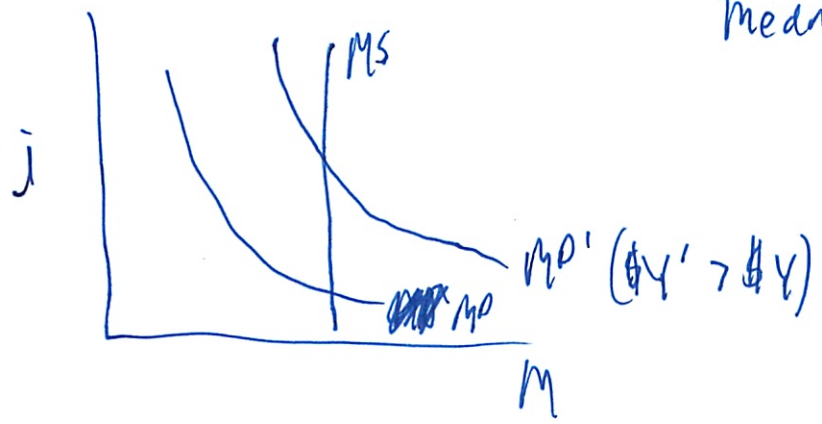
Velocity =  $\left(\frac{Mc}{PY}\right)^{-1}$  = # of transactions for given amt \$

If just gov - M supply is fixed



Higher nominal incomes shift curve out

means higher interest rate



Increase in M supply lowers interest rates

## ⑤ Open Market Operations

Fed changes money supply by buying bonds  
↑ or any central bank

- creates \$ to pay for them

Sells bonds and removes the \$ it gets back

- Expansionary - Expands supply of \$
- Contractionary - shrinks

(How is quantitative easing different than this?)

interest rate is inferred from bond prices

Treasury bills / T-bills - bonds < 1 year

$$i = \text{rate of return} = \frac{100 - \$P_B}{\$P_B}$$

\$P\_B = \text{price of bond today}

The higher the price of the bond, the lower the interest rate

$$\$P_B = \frac{100}{1+i}$$

↑ Price of \$100 ~~and~~ one-year bond today

News: bond markets ↑ = bond prices ↑ = interest rate ↓

When central gov buys bonds their prices go ↑, interest rate ↓

Central bank in practice targets an interest rate → sets M supply

This was about short-term interest rates



# ⑥ Checkable Deposits

banks = financial intermediaries

- get deposits
- loan \$
- but keep some in reserves set by reserve ratio

also hold bonds + central bank's \$

(won't talk about ~~central~~ bank loans - I thought that was important)

$$\left[ \begin{array}{l} \text{Peoples' demand for currency} \\ + \\ \text{Banks demand for reserves} \end{array} \right] = \text{demand for central bank } M$$

$$M^d = \theta Y L(i)$$

⊖

$$C U^d = c M^d$$

↑ currency      ↑ proportion held in CU

$$D^d = (1-c) M^d$$

↑ checkable deposits

$$R = \theta D^d$$

↑ reserve ratio demand for reserves

$$R^d = \theta (1-c) M^d$$

- people must decide
1. How much  $M$  to hold
  2. " " in  $CU$  and  $D$

7

Demand for Central Bank Money

$$M^d = CU^d + R^d$$

$$M^d = cM^d + \theta(1-c)M^d$$

$$= [c + \theta(1-c)]M^d$$

$$= [c + \theta(1-c)] \$ Y L(i)$$

Determination of interest rate

(supply of money)  
 $M = M^d$  ← demand for money

$$= [c + \theta(1-c)] \$ Y L(i)$$

### 4.4 Alternative Ways to Look at Equilibrium

Think of supply + demand for bank reserves

$$M - CU^d = R^d$$

$$M^d = CU^d + R^d$$

$$M = M^d$$

Since this is the federal funds market  
gov changes federal funds rate

② Other way

equality of overall supply + demand for  $M$

$$\frac{1}{[c + \theta(1-c)]} H = \frac{1}{Y} L(i)$$

Supply of money = demand for money

Must ~~still~~ stay equal

↑ money multiplier

multiplies central bank money to total  $M$

$$M = \underline{\text{high powered money}} = \underline{\text{monetary base}} = \text{central bank money}$$

↳ since any increase is multiplied

(This is what I remember bank loans doing) from HS AP class

↳ but it is buying bonds, not making loans

Geometric series again

(More detail was in this last section b/c I was unsure)



Review

$$Y = C + \bar{I} + \bar{G} + \cancel{NX} \rightarrow 0$$

(Production)

← identity

$$C = C_0 + C_1 Y_D$$

← behavioral

$$Y_D = Y - t$$

Types of equations

1. Behavioral - assume people behave like this
2. Identity - define to be true ( $\equiv$ )
3. Equilibrium

Types of variables

a) Exogenous

- given

b) Endogenous

- outcomes

-  $Y, C, Z$

$$Y_{\text{Production}} = Y_{\text{well ? Income}}$$

~~Exam~~

②

Demand  $\equiv Z$  or 'is Z demand' that may be more correct actually  $\leftarrow$  identity

$$C + \bar{I} + \bar{G} = Z$$

$$C_0 + c_1(Y - T) + \bar{I} + \bar{G} = Z$$

$$Z = Y$$

$\leftarrow$  equilibrium

$$Y = \frac{1}{1 - c_1} (C_0 + \bar{I} - c_1 T + \bar{G})$$

### Investment + Savings

$$S \equiv Y - T - C$$

$\uparrow$  Private savings

$$T - G \equiv \text{public savings}$$

$\oplus$  surplus

$\ominus$  deficit

$$Y - T - C = \bar{I} + \bar{G} - T$$

$$\underbrace{SP + SG}_{\text{total Savings}} = \underbrace{\bar{I}}_{\text{investment}}$$

total Savings = investment

"IS Model"

Might be temp. time lag  
Closed economy

### ③ Money Markets

- difference b/w nominal + real
- Real  $\rightarrow$  expressed in units of goods
- Nominal  $\rightarrow$  " " " " \$

$M^d$  = money demand

Currency demand  
 $= \underset{\text{Nominal}}{\$Y} \cdot L(i)$

$i$  = nominal interest rate

- rate at which convert \$ from today to tomorrow

Bond Treasury Bill	FV = \$100 M = 1 year <del>coupon</del>	5%	← every quarter pay 5% of face value ← not last quarter I believe
		5%	
		5%	
		<del>5%</del>	

← Sold today at a certain price  
 - adjusts

$i$  = rate of change of the price =  $\frac{100 - \$P_B}{\$P_B}$

if  $P_B$  was 50

$i$  would be 100% or double



9

Interest rates  $\geq 0$

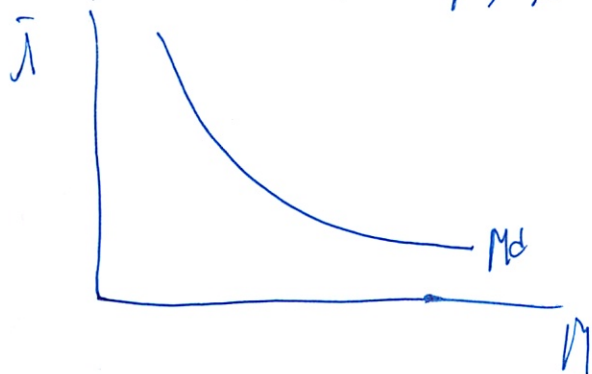
$L()$  function - need to decide how much cash vs T-Bills

- cash = liquid ~~get interest~~

- bond = get interest, but illiquid

$L$  stands for liquidity

When  $\bar{i}$  goes up, you are more willing to hold bonds



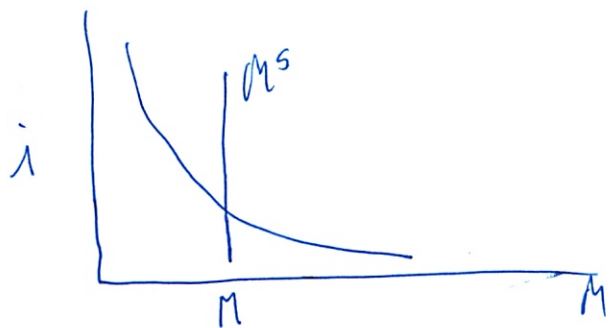
Higher income  $\rightarrow$  want to hold more  $\$$

gap = amt  $\$$  increased

$M^s$  = money supply

Decided by gov (exogenous)

=  $M$



5

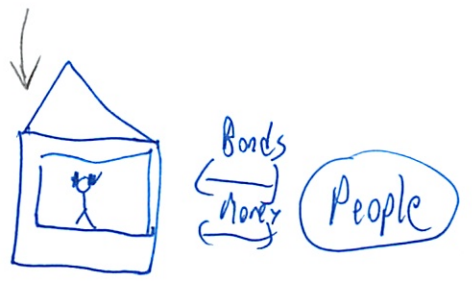
$$M = A \cdot Y \cdot L(i)$$

"LM model"  
Liquidity - money

Gov decides M by deciding i  
- uses chart

- > Central bank of the US
  - The "Fed"
  - Open Market Operations

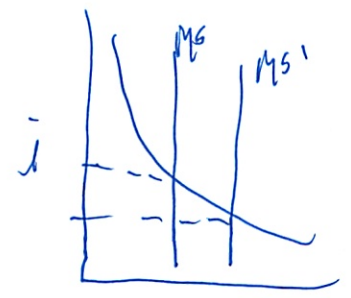
Ben Bernanke sits at the discount window



Says "I ~~don't~~ want people to own money, not bonds"

buys bonds "expansionary" ↙

- keeps paying more till people want to sell
- as he buys <sup>bonds</sup> prices goes ~~up~~ up
- and interest rates go down

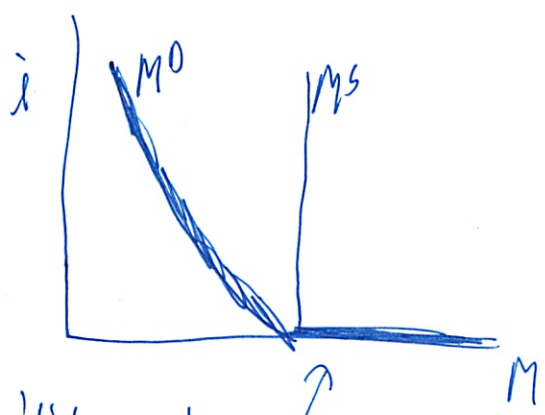


- (6)  $M^s \uparrow$      $\# P_B \uparrow$      $i \downarrow$     expansionary  
 $M^s \downarrow$      $\# P_B \downarrow$      $i \uparrow$     contractionary

Now changing  $i$  does not effect real econ in our model

Today interest rate = 0

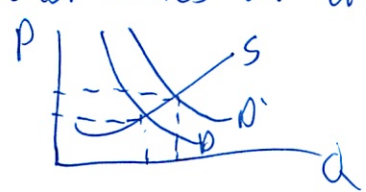
- So extra  $M$  in will be "useless"



- Liquidity trap
- at the lower bound

Quantitative Easing

- can't lower interest rate
- but ~~can~~ gov can still effect econ
- gov buys all sorts of things in addition
  - corp bonds
  - long-term bonds
  - offer enough  $\$$  till people want to sell
- lower interest rates on all those other bonds





(P-set not due Fri 11)

IS-LM model

IS

- equilibrium in goods markets

$$Y = Z$$

Production      Demand

$$S = \bar{I}$$

Savings      Investment

IM

- equilibrium in financial/money market

$$M^S = M^D$$

Money Supply      Money demand

Dependencies IS

$$C = C_0 + C_1 Y^D$$

$$Y^D = Y - T$$

$$Z = C + \bar{I} + \bar{G}$$

$$Y = Z$$

Exog  $\bar{I}, \bar{G}, \bar{T}$

Endog  $C, Y, Z, Y^D$

Dependencies IM

$$M^D = \# Y \cdot L(i)$$

$$M^S = M$$

$$M^S = M^D$$

Exog  $\# Y^D, M$

Endog  $M^S, M^D, i$

don't know which are which until told

but can guess

Refine

$$C = C(Y, T)$$

$T$  just a function of  
could be anything  
does not have to be linear

$$I = I(Y, r)$$

$r$  real interest rate  
 $\uparrow$  Companies are doing the investment  
when they see higher income  $\rightarrow$  will lead to more sales  
 $r$  is the cost of borrowing

$$\left[ \begin{array}{l} \bar{i} = \text{nominal interest rate} \\ r = \text{real interest rate} \\ r = \bar{i} - \text{inflation} \end{array} \right]$$

$$\bar{i} \geq 0$$

Can  $r$  be  $< 0$ ?

Some goods are perishable - investment won't work out  
- if pest

- then negative real interest rates

- Have less goods a year for now

With the money you can just keep it in your pocket

for now just assume inflation = 0

$$\text{So } r = \bar{i}$$

Firms exist because people think returns from operations will be higher than bonds

③

Investment ~~it~~ comes from other people's savings  
When interest rates go up, projects become less viable

So Equation

$$Y = C(Y-T) + I(Y, i) + \bar{G}$$

Supply of goods Demand for goods = Z Exog  $T, \bar{G}, i$   
Endog  $C, Y$

~~the~~ here  $i$  is exogenous since it is not a focus of the model

Money demand

Can have → currency - liquid      So need both  
                  ↓ bonds - get interest

$$M^d = P \cdot Y \cdot L(i)$$

If interest rates high → bonds more attractive

If you have more income you will demand more money.

Must convert nominal to real

- factor of conversion is price

$$P \cdot Y = P \cdot Y$$

price ↑ real income



4

$$\frac{M}{P} = Y \cdot L(i)$$

Exog  $\$Y, M, P, Y$

Endog  $M^s, M^d, i$

When price of money goes up want to hold more money  
"price-balances"

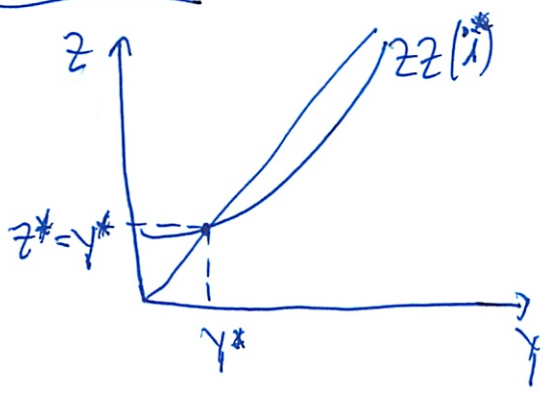
Here the goal is to figure out  $i$

$$\frac{M}{P} = \frac{\$4.50}{2 \text{ coffees}} = \text{price of a coffee / real income}$$

But now want  $i$  and  $Y$  at same time

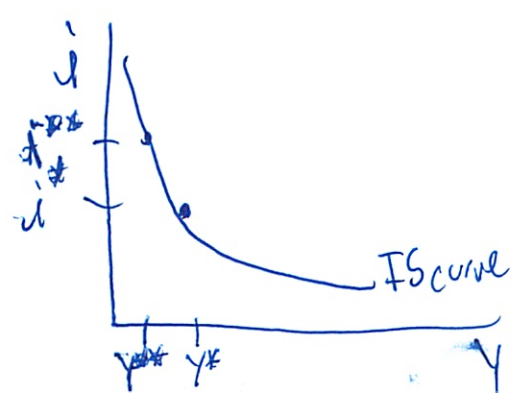
- so can show that both models are compatible

### IS-LM model



$z$  is def. increasing in  $Y = z = z(i)$  curve for given  $i$

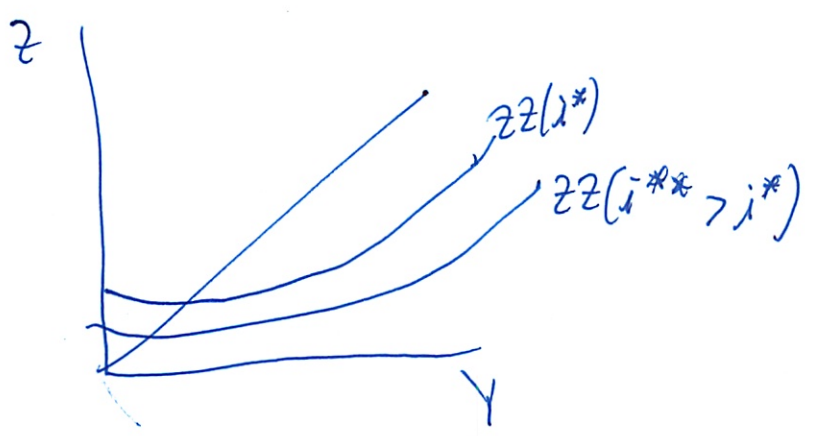
Assumed functions - so does not have to be straight line



$$i^* \approx z i^*$$

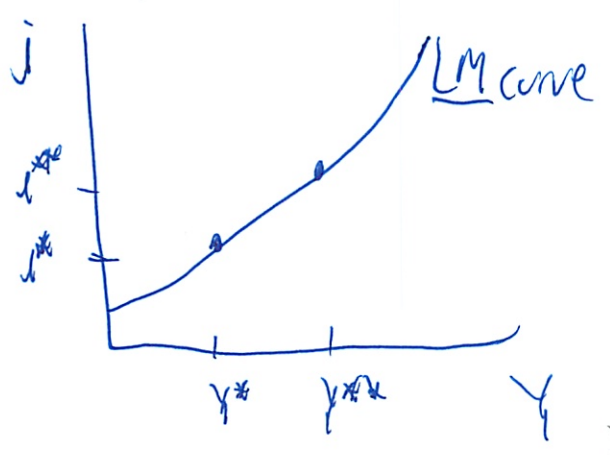
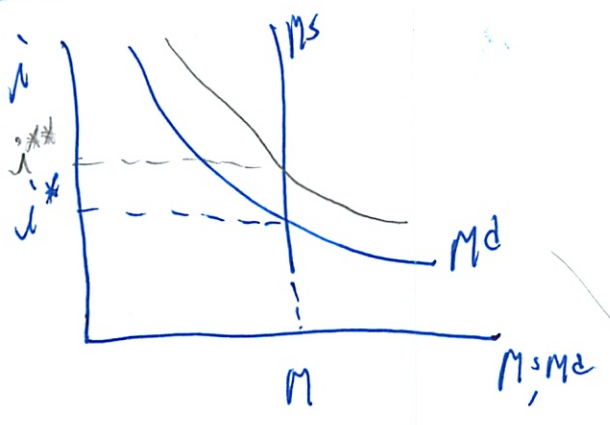
Any point is equilibrium in Goods market

5

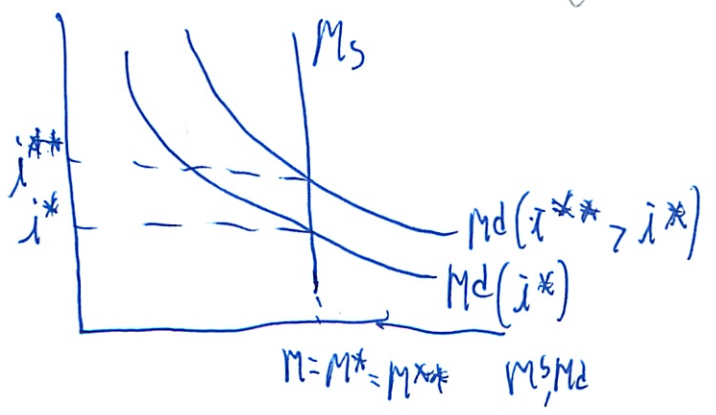


$z$  curve shifts up and down as move  $i$

~~LM~~ LM

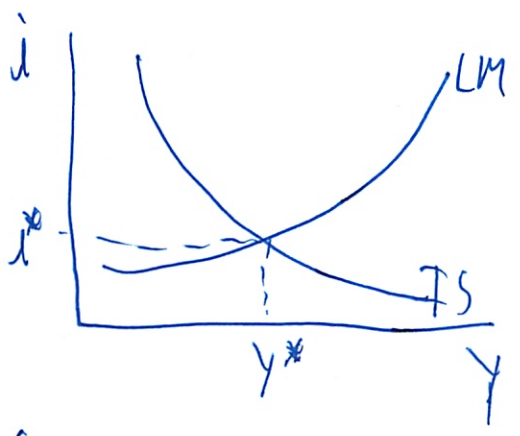


oh did it below



6

So to bring it all together



$i, Y$  'endogenous'  
So see their equilibrium

(Need to read the book on this)



14.02

2/18

Qv:

1. Investment

- spending  $\Delta$  now to  $\uparrow$  future production

2- Yes. Savings = investment.

Household's savings is the source of firms' investment

3. For gov ~~the~~ does savings = investment?

No - gov ~~them~~ can run deficit/surplus

4. For econ as ~~the~~ whole savings = investment?

! Not sure

Think no - since gov is part of econ, but ~~and~~ not true for them

Ans

1. That is for physical capital investment

What is investment in inventory?

- produce excess goods today (current period)
- can ~~are~~ sell excess goods tomorrow (future)

Sale of <sub>existing</sub> house is just a transfer

New house is investment

2

2. No

Firms Can

save or investment  
↑                    ↑  
hold cash        buy bonds

Households - Same

~~not all ca~~

Cash does not power investment  
and ~~usually~~ <sup>sometimes</sup> transfer - not investment

(I want to check on this - vs high school classes)

~~After 2 pages~~

3. Gov has power to tax

Or can sell Treasuries (bonds - promise to repay)

Gov savings = 'income not spent on consumption'

4. ~~In~~ In closed economy yes

If we want to save - only way is through investment

That is what borrowing is

- someone else's lending

(This is what I was thinking above)

When hold cash - just way to transfer goods b/w people

\$ solves this aggregate economy

Think about it w/ com - can consume, plant, or store

Saving cash does not mean anything (Interesting)

③

A loan - did not create any goods

Only transferred goods

Investment is mostly in private sectors  
- but could be gov

5. Write eq b/w  $S_{gov}$ ,  $I_{gov}$ ,  $G$ ,  $T$   
Consumption

$$S_{gov} = T - G - I_{gov}$$

$I$  is a form of savings

My ans is for non productive savings

She removed  $I_{gov}$  - she is unsure

$$S_{gov} = T - G$$

6. Eq for  $Y$ ,  $C$ ,  $T$ ,  $I_{priv}$ ,  $S_{priv}$

This is the LS-IM model?

She removed  $I_{priv}$   
- type of savings  
- not all savings

$$S_{priv} = Y - T - C$$



9

7.  $\uparrow T$   $S_{gov}$ ?

~~$\uparrow$~~   $\uparrow$

8.  $\uparrow T$   $S_{priv}$ ?

$\downarrow$

9.  $\uparrow T$   $I$ ?

know on aggregate investment = savings

$$I = S_{gov} + S_{priv}$$

$$= \uparrow + \downarrow$$

So what happens?

Ambiguous - which is bigger

Could look at empirically

$\uparrow T$  is not exogenous

So hard to measure

Respond to circumstances - not just create them

goods and financial markets together  
 how output and interest rates are determined

LS-IM - fundamental short-term algorithm

5.1 IS/Goods

$$Z = C(Y-T) + \bar{I} + G$$

interest rates do effect changes for goods

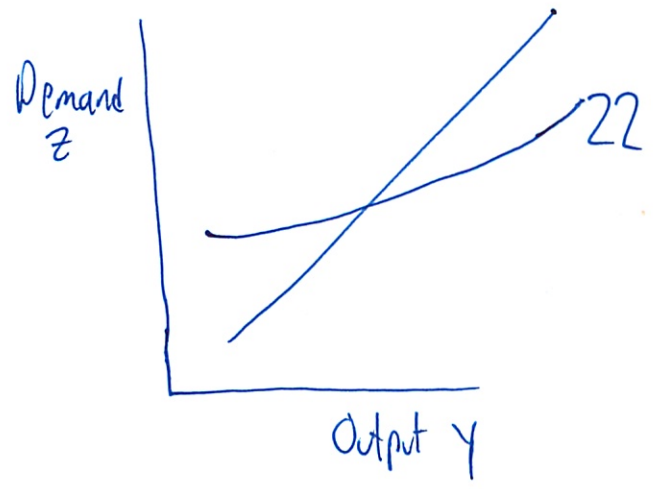
Investment depends on ~~sales~~

- level of sales - if sales pick up need to ↑ prod

- interest rate  $I = I(Y, i)$   
 (+) (-)

- Still assuming investment inventory is 0

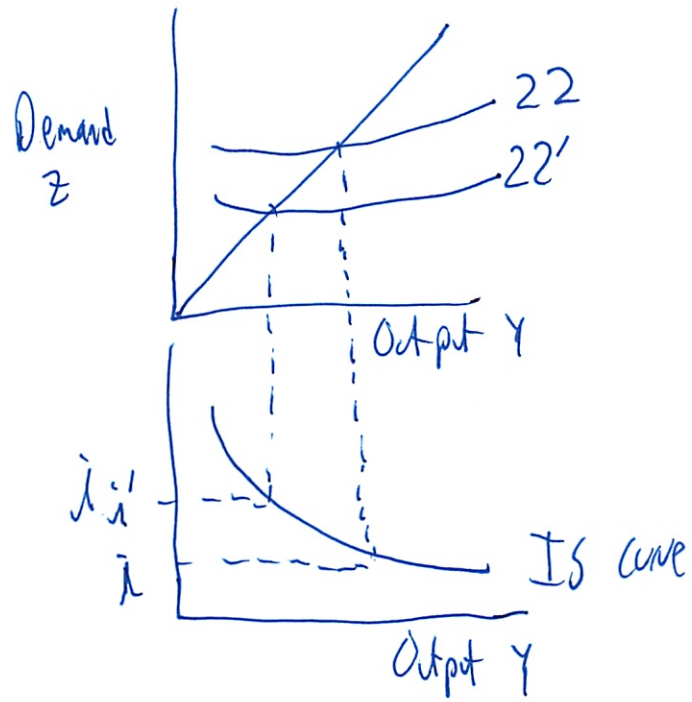
$$Y = C(Y-T) + I(Y, i) + G$$



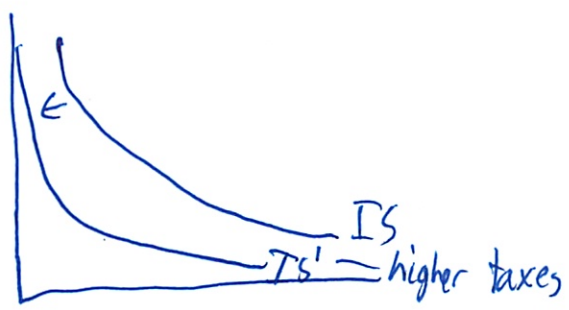
↑ upward sloping  
 Since consumption + investment relationship not linear  
 - but fairly flat

2)

Higher interest rates =  $\downarrow I_a$   $\downarrow C$   
multiplier effect



Changing  $G$  or  $T$  shifts IS curve



$\uparrow$  taxes =  $\downarrow Y_0^{*} = \downarrow C = \downarrow Y$

Or also changing consumer confidence

### 5.2 LM/Financial Markets

$$M^s = M^d$$

~~M = Y L(i)~~

$$M = Y L(i)$$

$L$  function of nominal income and interest rate



3

in this chap assume gov controls  $\$$  supply directly

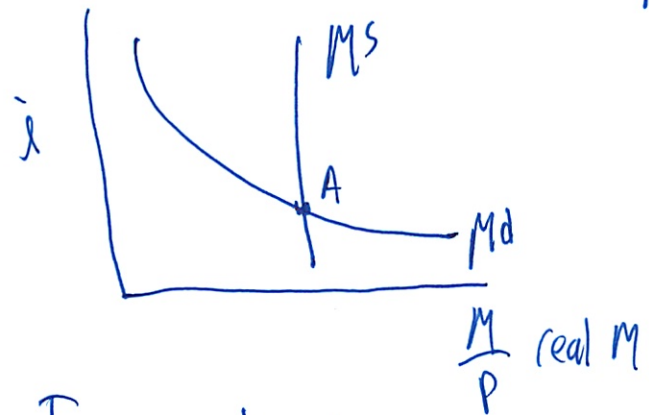
More convenient to write in terms of real  $\$$

$$\frac{M}{P} = Y L(i)$$

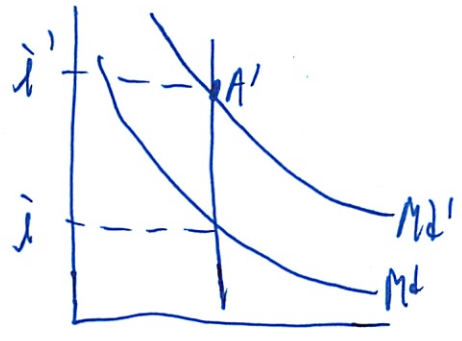
$i$  price level

so changing good level does not change this

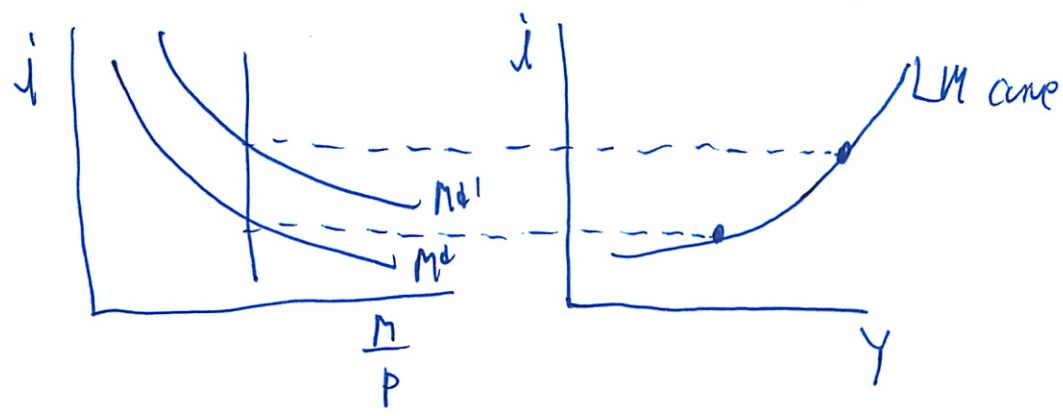
Demand for  $M$  in terms of  $\frac{M}{P}$  quantity of goods can buy with



Increase in income means  $\uparrow$  demand for money



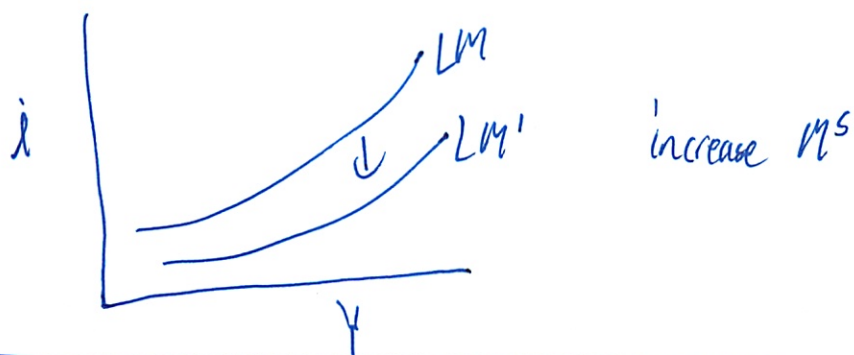
Goes up until  $\uparrow Y$  and  $\uparrow i$  (which means people want less  $M$ ) cancel out and go to equilibrium



4

$$\downarrow \frac{M}{P}$$

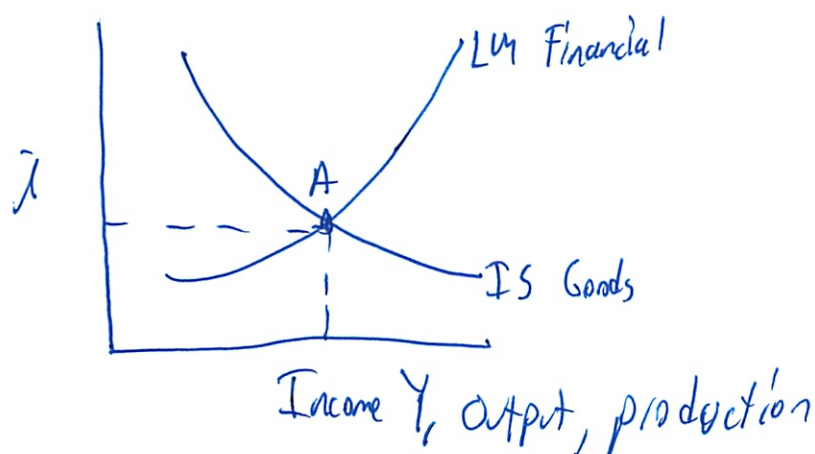
If  $M^s \uparrow$  then LM curve shifts down



### 5.3 Together

$$\underline{IS} \quad Y = (Y - T) + I(Y, i) + G$$

$$\underline{LM} \quad \frac{M}{P} = Y L(i)$$



(did we do this in H5? - think but diff name)  
 this rolls a lot of effects into 1 graph

### Fiscal Policy

- gov spending + taxing
- $\downarrow$  spending,  $\bar{T}$  = fiscal contraction

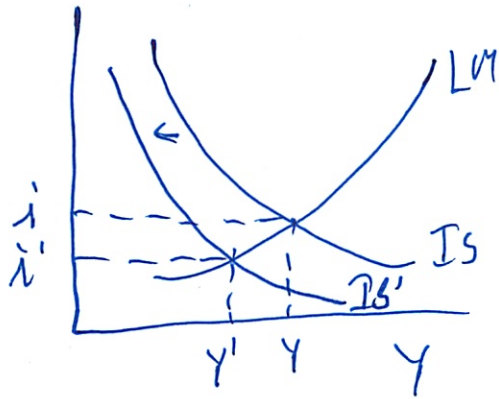
5

Always ask

1. How does change affect equilibrium, IS, LM?

2. Where does equilibrium go as curves shift?

Increase in taxes



Only exogenous values change

Pay close attention to shift of curve vs shift along curve

Can't tell how  $Y$  will change / which effect is bigger

- lower output/sales =  $\downarrow$  investment

- but  $\uparrow i = \uparrow$  investment

Gov also outcrowds private investment w/ its debt bonds

But raising taxes to pay bonds  $\downarrow$  ~~consumption~~  $\downarrow Y$   $\downarrow$  Private  $S$

So total  $S$  may go  $\downarrow$  [depends which effect is bigger]

(So what did they find empirically?)

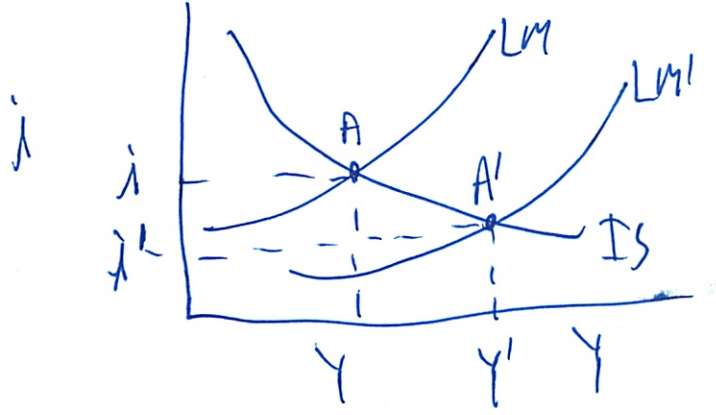


# 6) Monetary Policy

- changing the M supply
- assuming price level is fixed

## Gov $\uparrow$ MS

- through open market operations



Note how IS curve does not shift, but the lower interest rate means a shift along the curve, and  $\uparrow Y$

## 5.4 Policy Mix

- monetary + fiscal policy

		IS	LM	Output (Y)	$i$
fiscal	$\uparrow T$	$\leftarrow$	—	$\downarrow$	$\downarrow$
	$\downarrow T$	$\rightarrow$	—	$\uparrow$	$\uparrow$
	$\uparrow G$	$\rightarrow$	—	$\uparrow$	$\uparrow$
	$\downarrow G$	$\leftarrow$	—	$\downarrow$	$\downarrow$
monetary	$\uparrow M$	—	$\downarrow$	$\uparrow$	$\downarrow$
	$\downarrow M$	—	$\uparrow$	$\downarrow$	$\uparrow$

Sometimes contractary fiscal (to fix deficit) but expansionary monetary

## ① 5.5 Does it fit the facts?

does not move instantly

- Some dynamics

things take time to adjust

look at econometrics

- ~~non~~ center line is best estimate

- confidence band - 60% prob inside

### 1% ↑ federal funds rate

retail sales ↓

production ↓

- but 3 months later to start

- 2 years for full effect

slow + steady ↓ employment

- a one year hop in unemployment rate

price level barely ↓

- model says it does not change

- shows how LS-IM model breaks down in medium run