The Standard Macroeconomic Model

Before the Great Depression

- The term "Macroeconomics" did not come into general usage until after the Great Depression. Nonetheless, there <u>was</u> a body of theory that intended to explain the workings of the aggregate economy.

- This body of literature today is refered to as "classical theory", to distinguish it from much of what followed.

Classical theory combines 3 key elements:

- A theory of production and employment.
- A theory of money market equilibrium
- A theory of saving & investment equilibrium

We'll look at each component in turn.

Production & Employment

A. Output

Aggregate output (or GDP) described by a production function, which tracks how output is obtained from capital and labor:

$$Y = F(\bar{K}, N)$$

- Y: real GDP
- $\bar{K}$: capital inputs. The overbar denotes that the quantity is assumed to be fixed in the short-run.
- N: employment

B. Demand for workers

P – price received for each unit of output

w – money wages paid to each unit of labor.

r – interest paid to finance ownership of capital.

Profits are given by

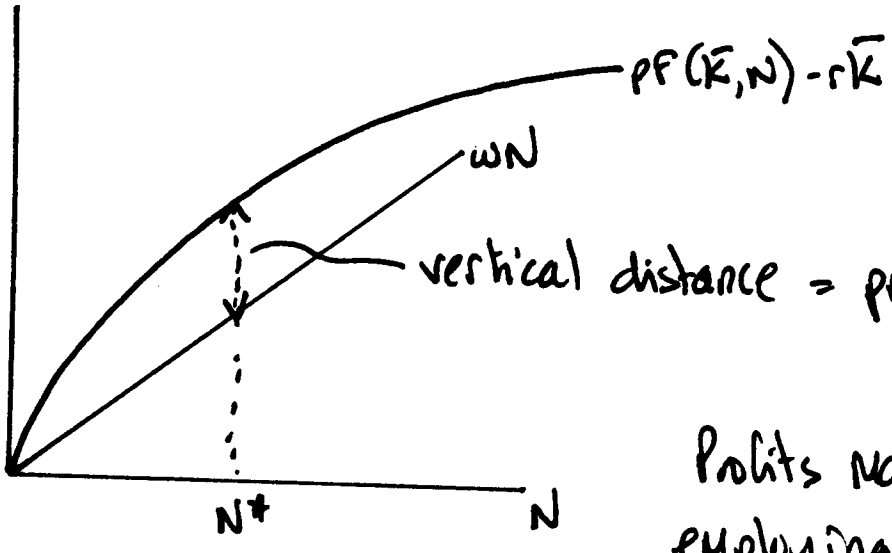
$$\text{Profits} = P \cdot Y - r\bar{K} - wN$$

$$= PF(\bar{K}, N) - r\bar{K} - wN$$

Amount of capital is fixed by assumption. So firms are faced with the decision of how many workers to hire in order to maximize profits.

$$\max_N \; PF(\bar{K}, N) - r\bar{K} - wN$$

- Graphical solution:



Profits maximized by employing N^*, where slopes of two lines are the same.

- Mathematical solution

$$\max_N \; pF(\bar{K},N) - r\bar{K} - wN$$

Differentiate with respect to N and set equal to zero:

$$p \cdot \frac{dF}{dN} - w = 0$$

$\frac{dF}{dN}$: change in output per unit change in labor: "marginal product of labor", MP_L

$p \cdot \frac{dF}{dN}$: change in value of output per unit change in labor, "marginal value product of labor", MVP_L.

NOTES

- The following notations are equivalent:

$$\frac{dY}{dN} \Longleftrightarrow \frac{dF(\bar{K},N)}{dN} \Longleftrightarrow F_N(\bar{K},N)$$

Sometimes, we won't bother writing out what F depends on:

$$\frac{dF}{dN} \Longleftrightarrow F_N$$

- F_N gives the slope at each point of the function F.
- pF_N gives the slope at each point of the function pF.
- We assume that $F(\bar{K},N)$ becomes flatter as N rises ("law of diminishing returns"). Hence, F_N (the marginal product) and pF_N (the marginal value product) both decline as N rises.

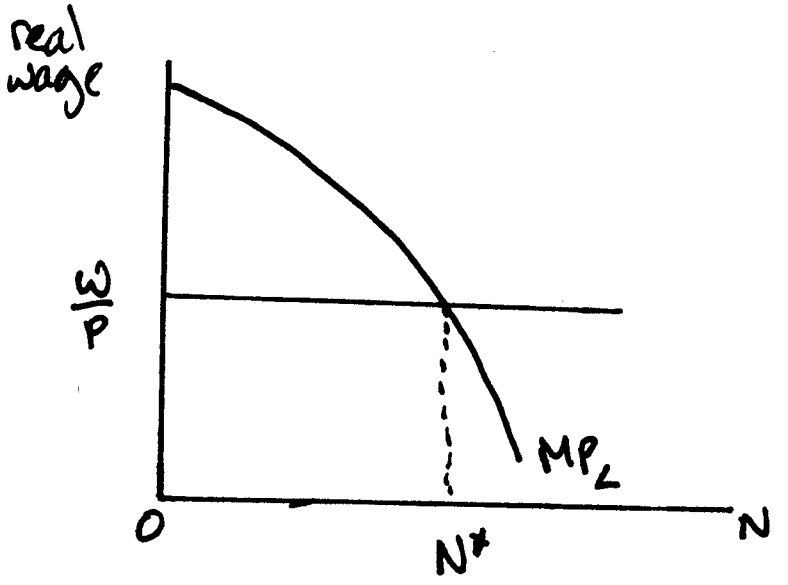
Our condition for profit maximization was to choose N so that

$$P F_N(\bar{K}, N) - w = 0.$$

It is convenient to write this as:

$$F_N(\bar{K}, N^*) = w/P$$

$$MP_L = \text{"real wage"}$$



↳ optimal employment given the real wage w/p.

C. Supply of Labor

- Workers supply labor to earn money to buy goods. What they give up is leisure.
- The more goods I can buy from a certain amount of work, the more leisure I am prepared to give up.

So, I will be willing to supply more labor the higher is w and the lower is p.

We can write the "labor supply curve" as some function

$$N^s = g\left(\frac{w}{p}\right)$$

which traces out a positive relationship between N^s and w/p.

NOTE: Imagine all jobs are 40 hrs. a week. At the aggregate level, we could then say that more people will choose to work as w/p rises.

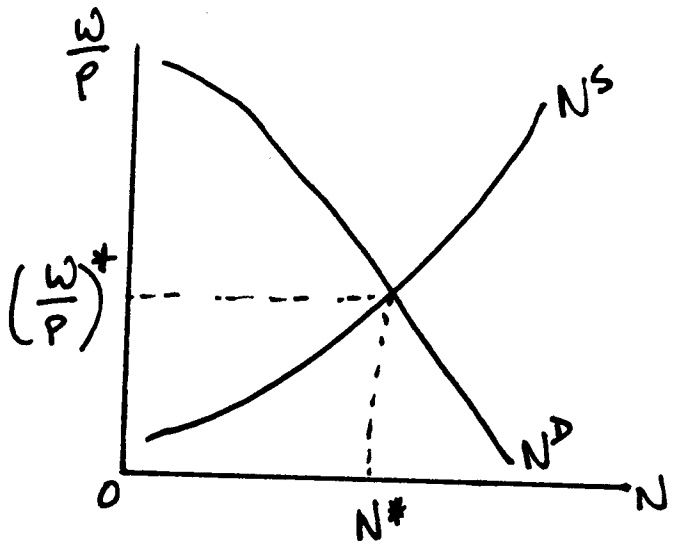
D. Labor market equilibrium.

Requires three things:

① At the given real wage, firms hire their optimal amount of labor: $F_N(\bar{K}, N^*) = \frac{w}{P}$

② At the given real wage, workers supply their optimal amount of labor: $g(\frac{w}{P}) = N^s$

③ The real wage must be at a level that ensures ① and ② are satisfied with $N^D = N^s$ (market clearing).



- Production technology and worker preferences jointly determine N^* and $(w/P)^*$.
- Given N^*, the production technology determines output, $y^* = F(\bar{K}, N^*)$.

Policy Implication: Tax Incentives

- In the classical model, output and employment are fully determined by the labor market equilibrium.
- So it follows that taxes distorting the incentives to hire and to work can have important consequences for output (and national income).

- Let t^e denote a tax paid by employers on each dollar of wages paid.

  Let t^w denote a wage income tax paid by workers.

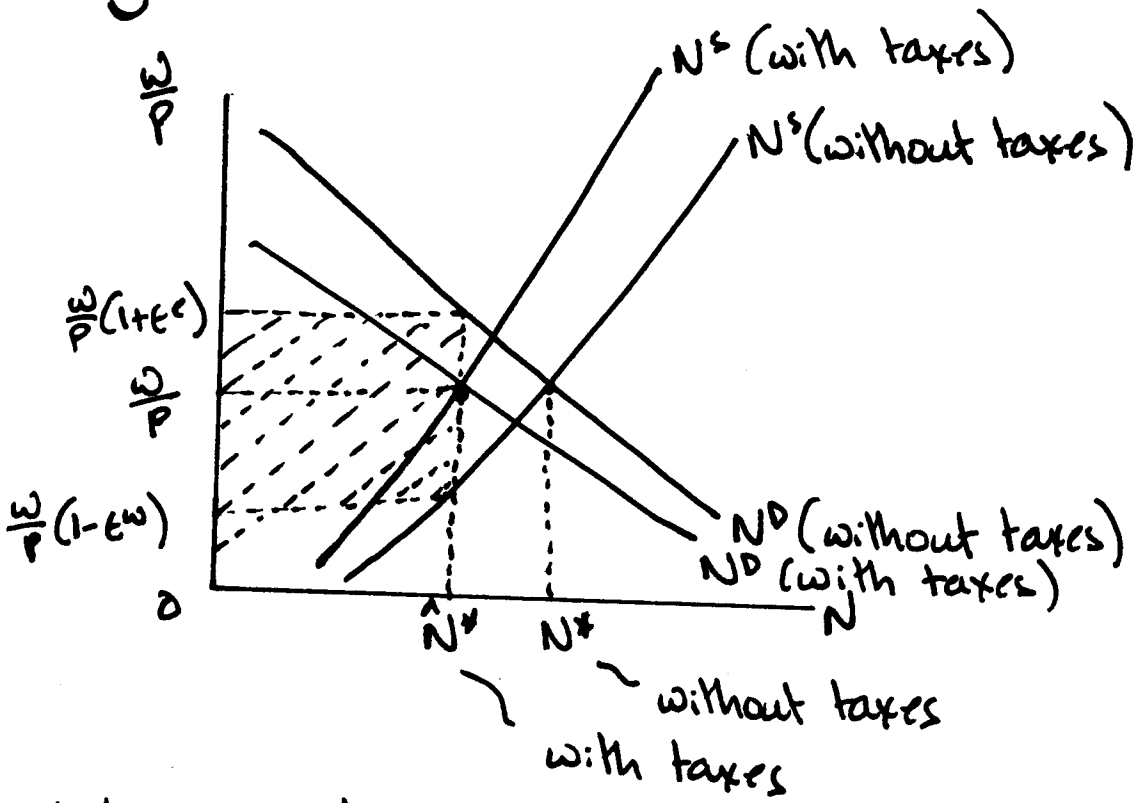
- Now, the optimality conditions are:

$$\text{hiring:} \quad f_N(\bar{K}, N) = \frac{w(1+t^e)}{P}$$

$$\text{supply:} \quad g\left(\frac{w(1-t^w)}{P}\right) = N^s$$

So, for any w/p, firms will hire fewer workers, and less labor is supplied: output goes down.

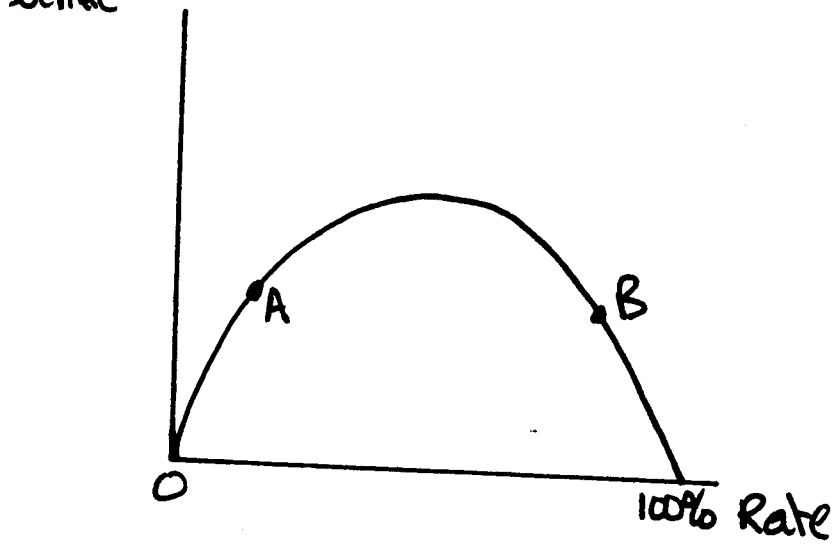
Graphically:



- shaded area is tax revenue raised.
- As tax rates rise, the <u>height</u> of the shaded area increases, but the <u>width</u> declines. Net effect on total tax revenue is <u>ambiguous</u>.
- The flatter the curves N^s & N^D, the more likely it is that an increase in tax rates induces a <u>decline</u> in the tax take.

Supply-side economics

- Ambiguity about the relationship between tax rates and tax revenue lies behind a major policy debate in the early 1980s.
  - if I have to pay 100% tax, I won't work, so the government gets no revenue.
  - if I pay 0%, I work a lot, but the government still gets no revenue
- Hence, there is an intermediate tax rate that maximizes revenue.



Laffer Curve

- Starting at A, an increase in the tax rate raises revenue.
- Starting at B, an increase in the tax rate reduces revenue.

Question: Are we at point A or point B?

- In the late 1970s, a small group of economists began to argue that the U.S. was at a position such as point B.

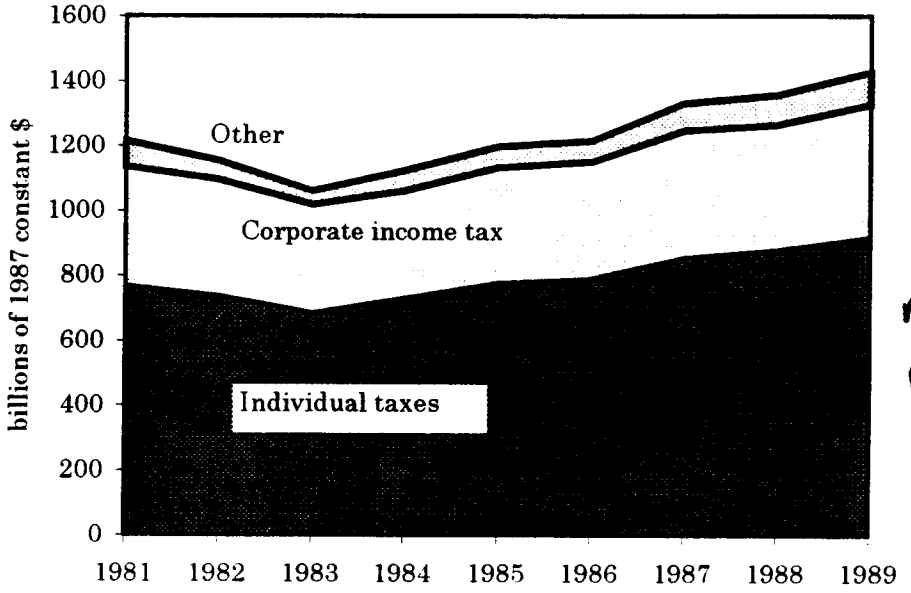
  - Robert Mundell (Columbia U.)
  - Art Laffer (U.S. Cal.)

- Inference: you can:

  a) cut the tax rate...
  in order to b) raise output & national income...
  and c) raise tax revenue...
  allowing you to d) raise government spending....
  and still e) cut the budget deficit!

- These ideas, pushed prominently by the editorial staff of the <u>Wall Street Journal</u>, became central to the 1980 Reagan presidential campaign.

Federal Tax Revenues, 1981-89



US Office of Management and Budget, Historical Tables.

Data suggest an initial decline in tax revenue after the Reagan tax cuts, with them eventually rising back to their previous level by 1985.

Q: To what extent did the decline in tax revenues 1982-85 contradict supply-siders claims?

Q: What fraction of the rise in revenues after 1985 can be attributed to the stimulating effect, if any, of the tax cuts as predicted by supply siders.

These questions continue to lie behind a vicious on-going debate: the answers are relevant to todays debates over tax cuts.

The Money Market

The classical model of the money market begins with a simple accounting identity — something that is true by definition. It then makes some assumption to turn this into a theory.

- Make the following definitions:

  M = stock of money in the economy.

  V = the rate at which money turns over in the course of making transactions.

Then MV = Total expenditure in the economy,

$= PY$, gross national income in nominal terms.

The identity,

$MV = PY$ is the equation of exchange

Many held that V, the velocity of circulation, was determined by payment habits and the technology of payments and could be regarded as fixed in the short run.

So, we have the so-called "quantity theory of money":

$$P = \frac{\bar{Y}}{\bar{V}} M \quad , \quad \text{where } \bar{Y} \text{ was determined in the labor market.}$$

For any given $\bar{Y}/\bar{V}$, which for purposes of analyzing money could be viewed as a given, the price level depends only on the money supply.

The money supply is a <u>policy choice variable</u>, and so can be taken as given. Hence, the classical theory states that the price level is whatever level it needs to be to ensure consistency with the equation of exchange.

<u>Cambridge Money Demand Equation</u>

The previous explanation of the price level was due to the American theorist, Irving Fisher, who was at Yale in the 1920s.

- It seems a little mechanical.
- Where's money demand + supply?
- What <u>MECHANISM</u> causes prices to change?

An alternative formulation of the quantity theory of money is due to A. Marshall at Cambridge Univ., U.K.

- people hold money to facilitate making transactions.
- so, the demand for money is probably proportional to expenditure:

$$M^D = k P \bar{y}$$

- the monetary authorities (the Fed in the US, central banks) - using mechanisms we will talk about later, control the supply of money, M^S.
- market equilibrium equates

$$M^S = M^D = k P \bar{y} = M$$

or

$$P = \frac{1}{k \bar{y}} M$$

Cambridge equation highlights the mechanism by which prices rise:

Imagine monetary authorities raise M.

For given P and $\bar{y}$, the equation says

k must rise, say to k'.

- But $k' > k$ – people don't want to hold this large a proportion of their expenditure in money.
- So to get rid of their excess holdings of money, people spend it: the demand for goods goes up.
- But the supply of goods, $\bar{Y}$, is fixed by the labor market, so the price of goods are driven up. Equilibrium is restored only when P has risen in proportion to M.

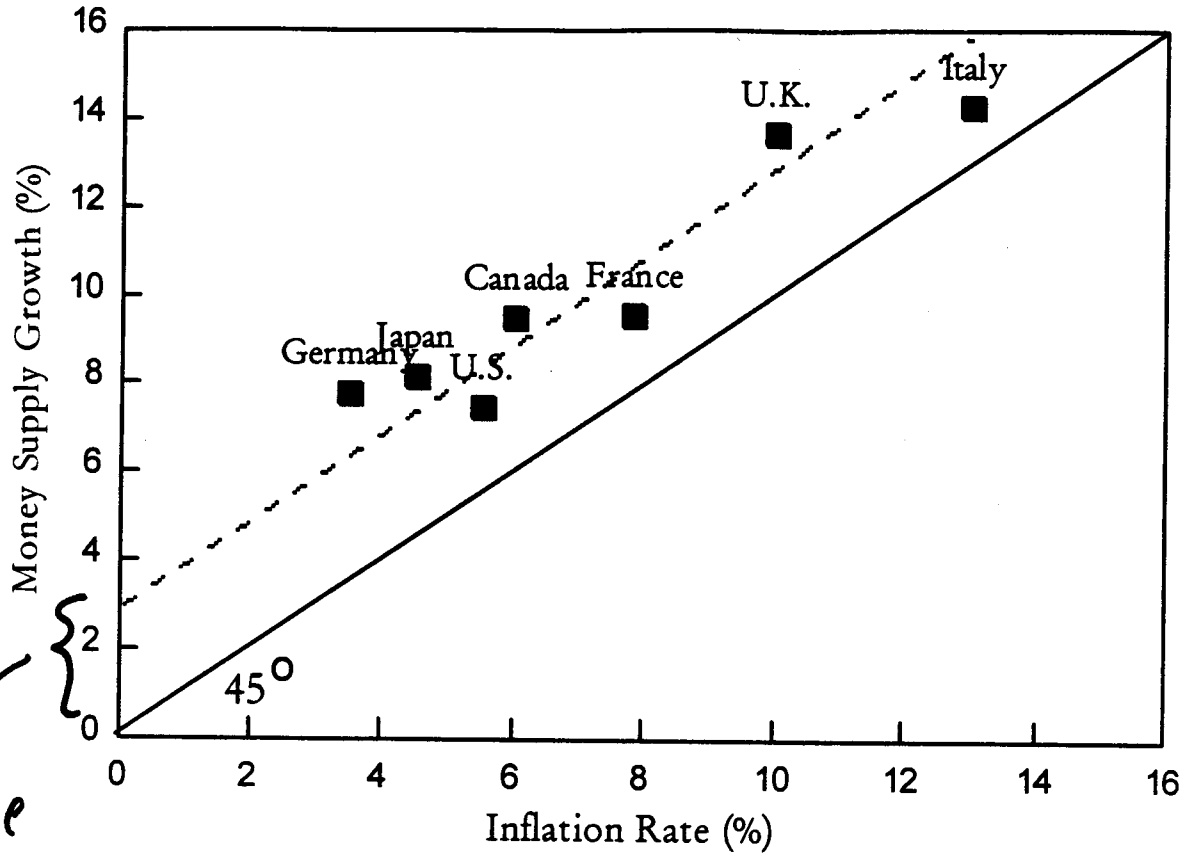
Prediction of The Quantity Theory.

a) Inflation is caused solely by growth in the money supply.

b) More generally (because $\bar{Y}$ is growing over time along its trend, we have

$$\underbrace{\pi = \frac{dP}{P}}_{\text{inflation}} = \frac{dM}{M} - \frac{d\bar{Y}}{\bar{Y}}$$

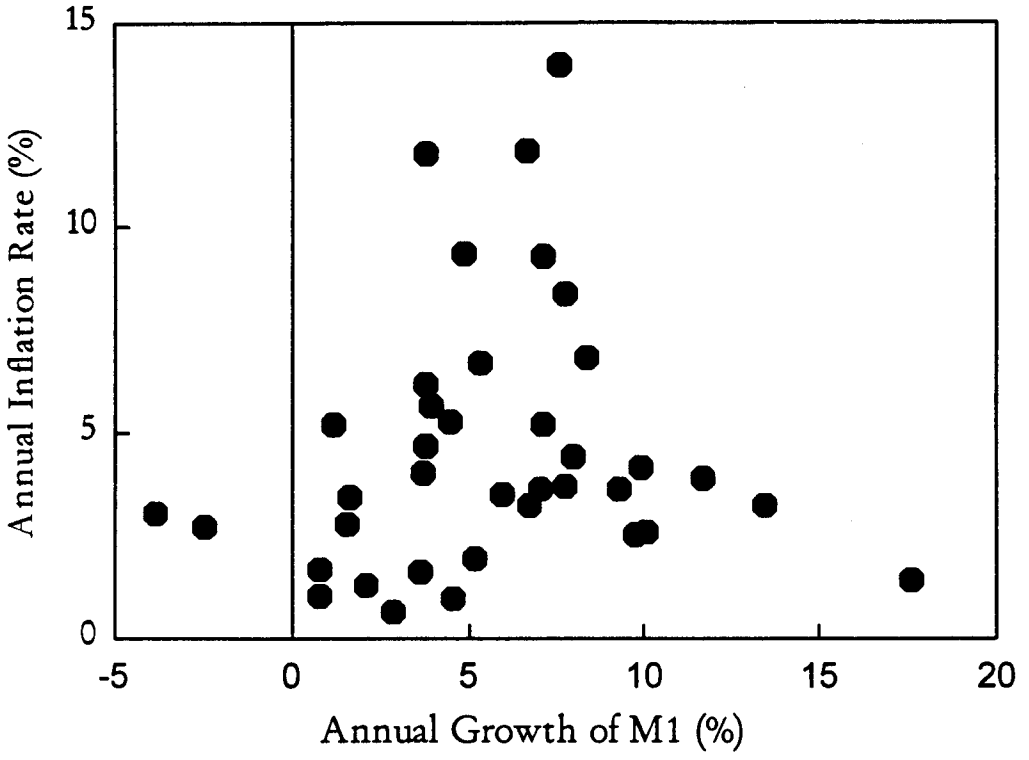
= excess of money supply growth over trend rate of growth of output (GDP).



average GDP growth rate.

Inflation and Money Supply Growth
1973-1990

Quantity theory works quite well over a long period of time, such as the 17 year-averages depicted here.



US Money Supply Growth and Inflation – annual data 1960-1997.

The quantity theory does not work very well over short-periods of time, such as one year.... at least when inflation is low. But see Froyen, p. 67. for evidence in cases of high inflation.

Savings and Investment.

- Third component of the classical model is a market equilibrium for savings and investment. This determines in the interest rate.

We first need to write down some national income accounting identities.

$$Y = E = C(r, y-t) + I(r) + G$$

- Y: national income
- E: expenditure
- $y-t$: personal disposable income
- $C(r, y-t)$: consumption and investment depend negatively on the real rate of interest.
- G: government expenditure

NOTE: For the moment we are going to ignore trade. This is reasonable for thinking about the time of classical macroeconomics, when trade was much less important than it is now.

Defining savings

National saving = personal saving + government saving

= excess of personal income over personal consumption

+ excess of government income over government expenditure.

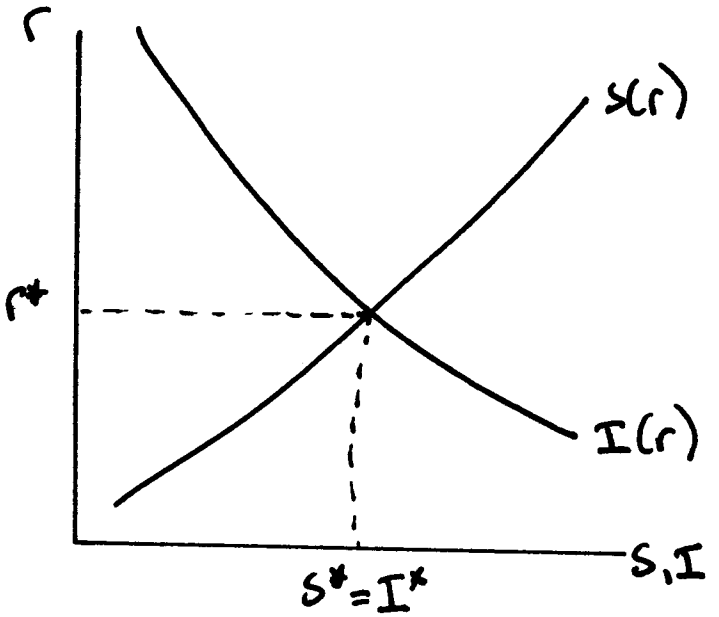
$$S = S^P + S^G$$

$$= [(Y-T) - C(r, y-t)] + [T-G]$$

$$= Y - C(r, y-t) - G$$

$$= I.$$

- When there is no trade, savings = investment by definition.
- But there is also a <u>behavioral</u>, equilibrium relationship
  - $S(r)$: saving (the supply of loanable funds) is an increasing function of the interest rate
  - $-I(r)$: the demand for loanable funds, is a declining function of the interest rate.



Equilibrium in the market for loanable funds.

Bringing all three components together:

The Classical System.

① Labor market equilibrium:

$$N^D(\tfrac{w}{p}) = N^S(\tfrac{w}{p}) = N^*,$$

determines the real wage w/p, and employment, N^*

② Production technology,

$$Y^* = F(\bar{K}, N^*),$$

then determines output, or "aggregate supply", Y^*.

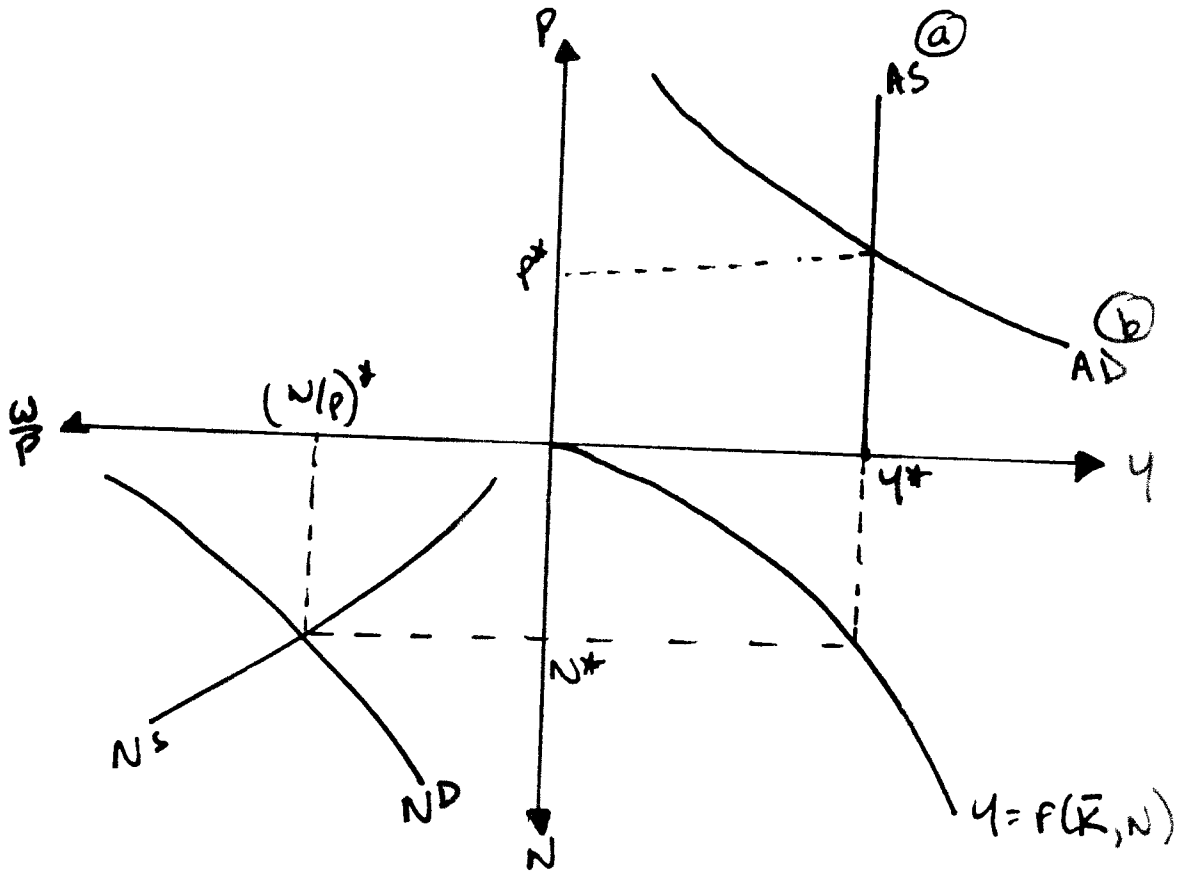
③ Money market,

$$P = \frac{Y^*}{V} M$$

then defines the price level given any policy choice for M.

④ Given Y^*, G and T, the real interest rate adjusts to equate saving and investment.

⑤ Given w/p and p have been determined, this implies a determined value for the nominal wage, w.



Notes:

(a) labor market equilibrium determines how many goods are supplied. We say the aggregate supply curve (a plot of P against Y, just like in microeconomics) is vertical at Y^*.

(b) Money market equilibrium defines a negative relationship; $Y = \frac{M}{KP}$, between price and consumer purchases. This is the classical aggregate demand curve.

Note that we did not draw the determination of ~~output~~ the real rate of interest in the diagram. The interest rate can be viewed as a residual: given the level of Y^*, preferences about saving and investment, the interest rate is whatever is necessary to equate saving and investment.

Causes of Fluctuations in Output.

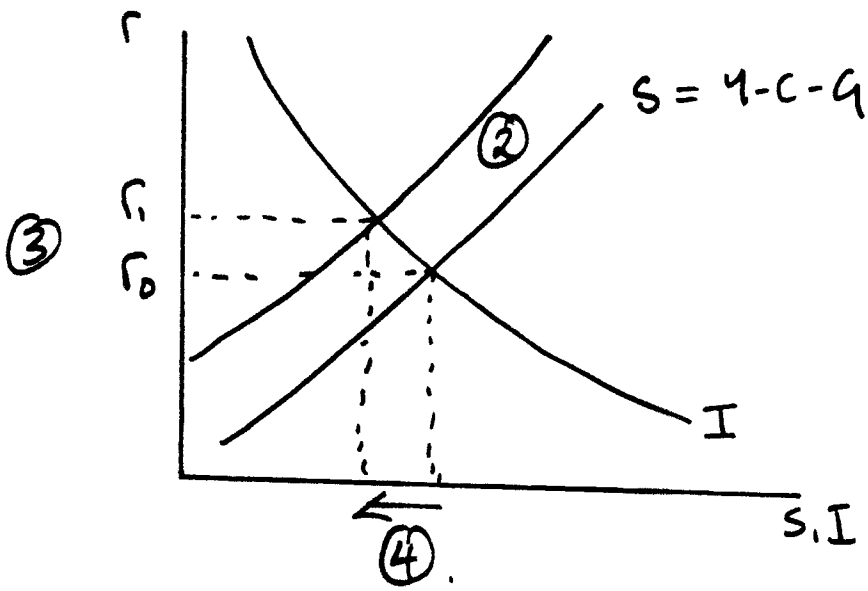
Y^* depends only on labor supply & demand, and the production function. This limits what we can say about the causes of output fluctuations:

1) Changes in $\bar{K}$ (over time, due to investment)
2) Changes in knowledge ("technical change")
   $Y_1^* = A_1 F(\bar{K}, N^*)$, $Y_2^* = A_2 F(\bar{K}, N^*)$
   If $A_1 > A_2 \Rightarrow Y_1^*$ embodies 'better technology'
   $\Rightarrow$ more output for given inputs.
3) Changes in preferences about how much labor to supply or demand given any real wage.
   — tax distortions affecting incentives to work.

Policy Implications.

Fiscal policy I: Government Spending

G appears only in the saving-investment part of the model, so we can look at this in isolation.



① Increase in G reduces national saving...
② ... shifting S(·) to the left.
③ This raises the real interest rate, and...
④ reduces investment.

So, increasing government expenditure

1) Has no stimulating effect on todays output, Y;
2) Reduces investment, I.
3) This will, of course, reduce future values of K, and so lower future values of Y*.
4) Conclusion: government expenditure has no stimulating effect today, but ~~now~~ reduces future national income, unless the extra G is used to provide public capital (e.g. roads) to build a better production function.

Government expenditure & crowding out.

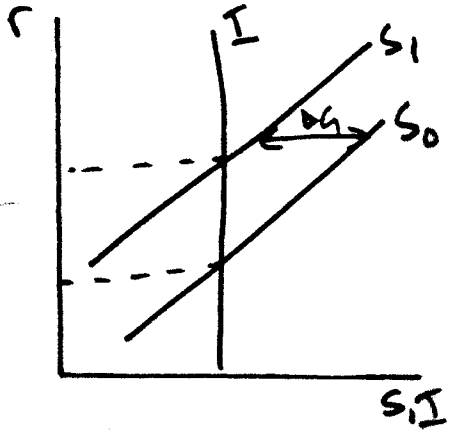
In the classical model, we have

$$y^* = C + I + G$$

y^*: determined in labor market.

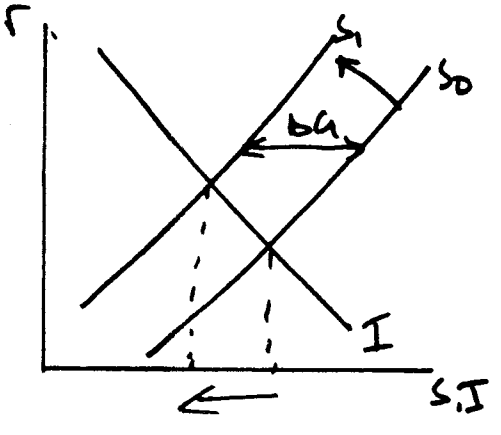
$C + I + G$: so if G goes up, either C or I, or both, must go down.

This has led to empirical concerns about how much investment is crowded out by government expenditure.



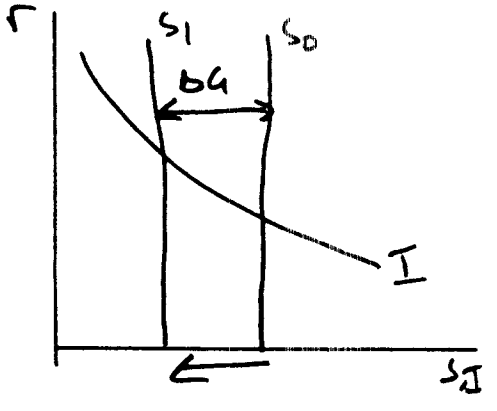
NO CROWDING OUT

If investment is not sensitive to r, then C declines by full amount of change in G.



PARTIAL CROWDING OUT

If both C and I are sensitive to r, then both C and I decline when G rises.



FULL CROWDING OUT

If C is not sensitive to change in r, then I declines by full amount of increase in r.

The classical model leads to two anti-government positions:

1) Full crowding out: any increases in G today are at the expense of investment, and therefore lead to worsening future prosperity.

2) No crowding out: any increases in G today are at the expense of consumption. "private individuals know how to spend their money more wisely than does the government.

Both positions argue for small government.

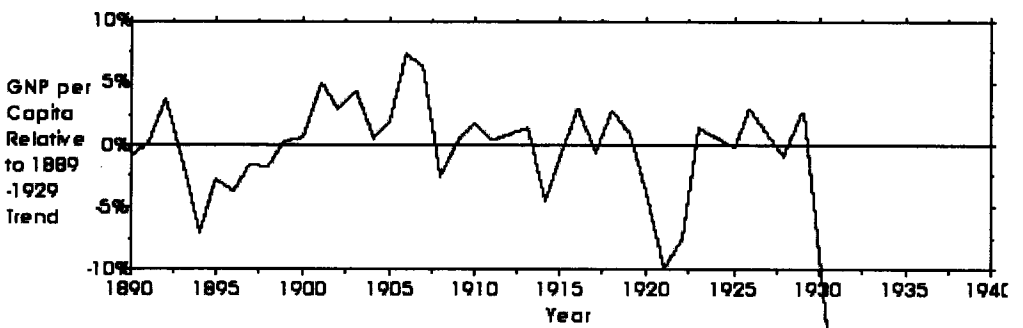
This seems like an easy empirical question to answer: simply plot investment against the budget deficit and look at the relationship. It turns out that this is actually quite a difficult thing to do; material on line explores why: the <u>identification problem</u>.

Monetary policy

An increase in the money supply, according to the quantity theory of money, only serves to raise the price level. So monetary policy - manipulating the supply of money in the economy - cannot be used to influence the state of the economy.

EVALUATION

THE CLASSICAL MODEL AND THE GREAT DEPRESSION



THIS GRAPH captures the key features of the Great Depression I want to talk about:

- the depth of the downturn.
- the duration of the depression.

How does the classical model explain these?

Recall:

- Output determined entirely by production function and the interaction of the supply & demand for labor.

- So we require a very large and sustained leftward shift in the labor demand and/or supply curves.

  - in fact, real wages went <u>up</u> in the early '30s (P fell more than w), so we need to concentrate on why the labor <u>supply</u> curve shifted so far to the left.

Hard to think: what might have caused the shift
why the shift lasted so long.

- It's also valuable to note that classical economists around 1930-31, trained in the idea that w/p is flexible, anticipated a recovery all the time.
  - examples on web site.

- The classical model treats all unemployment as voluntary: "given the current real wage, all workers are supplying the optimal amount of labor."

Some case study readings of family experiences are on the web site.

The Classical Model - Summary

Three components to the model:

① Labor market equilibrium

- complete wage flexibility ensures market clearing in the labor market
- once employment is determined, then output is given according to the production function.

Output fluctuations therefore must be explained either by shocks to employment or technology.

Shocks to employment: changes in preferences
distortionary taxes
regulations on employment
- minimum wage
- health costs

Shocks to production: changes in capital stock
(too long term?)
changes in efficiency
(but what does it mean).

② Money market equilibrium

- Take the simple identity $MV = PY$
- Impose assumption that $Y = \bar{Y}$ is determined elsewhere
- Impose assumption that $V = \bar{V}$, by 'habit.'
- Then you get the <u>quantity theory of money</u>:
  - price level proportional to money supply
  - inflation caused by money supply growth.
- A less mechanical derivation is the so-called Cambridge (UK) version of the theory, which tells a story about the demand for goods.
- This second version provides some insight into how we can interpret the quantity theory as a theory of aggregate demand.

- Quality of predictions { long-run vs. short-run; high vs. moderate inflation.

③ Savings + Investment.

- Given output $\bar{Y}$, the interest rate affects household saving decisions.
- Total savings are the sum of household and government saving.
- So <u>fiscal policy</u> also affects savings.

  Most important feature is that a rise in $(G-T)$ can raise the interest rate and <u>crowd out</u> investment.
- The extent of crowding out depends on the relative sensitivity of household saving (supply) and firm investment (demand) to changes in the interest rate.

What the classical model provides insights about:

- the consequences of distortionary taxes in the labor market.
- the so-called "supply side" debate.
- relationship between interest rates and government budget deficits.
- long-run relationship between inflation + monetary policy.
- IMF structural adjustment program.
- consequences of regulations affecting productivity of labor and/or capital.

Where the classical model falls short:

- predominantly in its short-run predictions
  - inflation + money growth not highly correlated in short run.
  - big fluctuations in labor market supply + demand seem implausible
  - this is particularly a problem for the Great Depression.