

Cole and Ohanian Paper on Great Depression:

Hoover: wage rises in manufacturing; belief that this would raise consumption. Their model accounts for 60 percent of output and employment fall.

Lots of other government interference. Government facilitated collusion and monopoly power by industry: this restricted output and competition. Productivity rose, but labour supply fell. Minimum wages; unemployment insurance; excess profits tax reduced investment.

By contrast, in agriculture real wages fell 25-30 percent. Employment and output unchanged. This sector was not interfered with.

“Between October 1929 and September 1930, industrial hours worked had declined by nearly 30 percent. Thus, the industrial sector was

severely depressed about a year into the Depression, before most of the large declines in the money supply emphasized by Milton Friedman and Anna Schwartz, and before most of the banking panics emphasized by Federal Reserve Chair Ben Bernanke."

RBC Shocks.

Financial intermediation: can't allocate resources to most productive uses.

Aggregate/idiosyncratic shocks. If shocks are idiosyncratic, then perhaps they wash out in aggregate.

Top 100 firms in US produce 30 percent of output. Idiosyncratic shocks to large firms matter. So shocks to large firms could cause business cycles.

RBC view of Great Depression and today: there is some shock to financial system (say), but recovery prevented by government policies. For example, Cole/Ohanian and Mulligan emphasize labour market interference.

Ramsey Model

$$\sum_{t=0}^{t=\infty} \beta^t u(c_t)$$

$$c_t + s_t = f(k_t)$$

$$k_{t+1} - k_t = i_t$$

Combining

$$k_{t+1} - k_t = f(k_t) - c_t$$

$$c_t = f(k_t) - k_{t+1} + k_t$$

$$\sum_{t=0}^{t=\infty} \beta^t u(f(k_t) - k_{t+1} + k_t)$$

Euler Equation/Capital Accumulation.

Get derivative w.r.t k_{t+1}

$$-\beta^t u'(f(k_t) - k_{t+1} + k_t) +$$

$$\beta^{t+1} u'(f(k_{t+1}) - k_{t+2} + k_{t+1})(1 + f'(k_{t+1})) = 0$$

$$-u'(c_t) + u'(c_{t+1})(1 + f'(k_{t+1})) = 0$$

$$u'(c_t) = \beta(1 + f'(k_{t+1}))u'(c_{t+1})$$

Set $u(c) = \log c$ and noting that $\beta = \frac{1}{1+\rho}$

$$\frac{c_{t+1}}{c_t} = \frac{1 + f'(k_{t+1})}{1 + \rho}$$

Two key equations describe the evolution of the economy:

$$\frac{c_{t+1}}{c_t} = \frac{1 + f'(k_{t+1})}{1 + \rho}$$

and

$$k_{t+1} - k_t = f(k_t) - c_t$$

$$\frac{c_{t+1}}{c_t} = \frac{1 + \alpha A k_{t+1}^{\alpha-1}}{1 + \rho}$$

$$f(k) = Ak^\alpha$$

In steady state, we know consumption will be constant when

$$\alpha A k_{t+1}^{\alpha-1} = \rho$$

$$\implies k^* = \left(\frac{\alpha A}{\rho} \right)^{\frac{1}{1-\alpha}}$$

Then from the production function, $f(k) = Ak^\alpha$, we can get equilibrium output, $Y = Ak^\alpha = A \left(\frac{\alpha A}{\rho} \right)^{\frac{\alpha}{1-\alpha}}$.

From the capital accumulation equation, we have (since k is constant in steady state).

$$f(k_t) = Ak_t^\alpha = k_{t+1} - k_t + c_t = c_t$$

Capital Taxation

Steady state condition now becomes

$$(1 - \tau)\alpha A k_{t+1}^{\alpha-1} = \rho$$

The capital stock then becomes

$$\implies k^* = \left(\frac{(1 - \tau)\alpha A}{\rho} \right)^{\frac{1}{1-\alpha}}$$

If there were l workers (as opposed to one), then the production function would be $Y = Ak^\alpha l^{1-\alpha}$. Steady state condition now becomes

$$(1 - \tau)\alpha Ak^{\alpha-1}l^{1-\alpha} = \rho$$

$$\Rightarrow k^* = \left(\frac{(1 - \tau)\alpha Al^{1-\alpha}}{\rho} \right)^{\frac{1}{1-\alpha}} = \left(\frac{(1 - \tau)\alpha A}{\rho} \right)^{\frac{1}{1-\alpha}} l$$

$$w = (1 - \alpha)Ak^\alpha l^{-\alpha}$$

$$w = (1 - \alpha)A \left(\frac{(1 - \tau)\alpha A}{\rho} \right)^{\frac{\alpha}{1-\alpha}} l^\alpha l^{-\alpha}$$

$$\Rightarrow w = (1 - \alpha)A \left(\frac{(1 - \tau)\alpha A}{\rho} \right)^{\frac{\alpha}{1-\alpha}}$$

Taxation on capital lowers wage (tax incidence).

Capital Taxation.

- Overall: a tax in inputs – capital and labour – distorts production. The most efficient tax is on *consumption*.
- Tax avoidance (stock options/dividends) and labour. If no tax on capital, people can take stock options instead.
- Capital gains tax: lock-in affects startups (inefficient).
- Labour and capital are complements. So a high tax on labour can reduce also affect capital accumulation and FDI.
- There are various types of capital (real estate, estates, capital gains etc). Although

the theory suggests a tax on capital is inefficient, property taxation is widely regarded as being efficient (since it is approximately inelastically supplied).

- If there was a strong precautionary savings, than a tax on capital might be efficient (since people are saving anyway).
- Today income from rich is mainly labour income (different in past). Meanwhile, pensioners etc hold stocks.

Financial Crisis.

Readings: Markus Brunnermeier, “Deciphering the Liquidity and Credit Crunch 2007–2008” Journal of Economic Perspectives (JEP), Winter 2009.

Anil Kashyap et al, “A Macroprudential Approach to Financial Regulation.” JEP, Winter 2011.

Traditional funding model: banks funded mainly by depositors. Now: money markets, commercial paper, repos etc. All effectively represent issuance of *short-run IOUs*. With a repo, for example, I typically receive an overnight loan and offer collateral. If you demand more collateral, that is referred to as a “hair-cut.” Haircuts make it harder to get funding: for any given level of collateral I can offer, I can

now borrow less. Commercial paper is typically issued for 30 days. Asset-backed paper is backed by assets, typically mortgage related assets. This asset backed market almost collapsed completely during crisis, as a result of perceived falls in asset quality.

Money market funds are big purchasers of commercial paper. In turn, institutional investors (like pension funds) invest in money market funds.

Key point: in all cases, there's a maturity mismatch. Banks arbitrage across the yield curve: they borrow short and lend long.

Why short-run debt? See next slide. Main thing: it's cheap. There is little inflation risk and you can demand your money back quickly. In corporate finance, short-run debt is used as a solution to agency problems: it keeps banks

on straight and narrow (i.e., short-run debt provides a discipline device that forces management to engage in profitable projects providing cash flow. If they are not doing a good job, they will have their funding withdrawn by market).

Why lever up? Short run debt is a cheap way to finance (tax benefits also), especially for large banks facing competition (note apparent failure of Modigliani-Miller theorem here.) Unlike car companies, say, large banks can only compete on price of funding. Equity more expensive (it is down in the pecking order and asymmetric information makes it relatively expensive).

Why short-run debt?

MM theorem. Banks only compete on cost of funding (not like clothes, say).

- Short-run debt is cheap (no inflation premium).
- Monetary policy affected short-run and hence made short-run debt cheap.
- Tax deductible.
- Global savings glut: demand for safe and liquid securities.
- Asymmetric information: this makes it expensive to raise equity. There is an adverse

selection problem with equity issuances; if there is a problem within the firm, the management might want others to “share” burden and therefore issue equity. (Why do so, if prospects are great?) With equity, the management is under no pressure to repay anyone (by contrast with debt.) Knowing this, equity is more expensive than debt.

- Signal of confidence/Discipline device. Short-run debt solves agency problem within firm. If management start wasting money, investors can simply refuse to rollover debt. This keeps management on straight and narrow.

Example of Bank's Balance Sheet

Assets

Sovereign debt: 100

Liabilities

Debt 90

Capital 10

Leverage ratio is $\frac{100}{10} = 10$. If the leverage ratio is x , then a fall in asset values greater than $\frac{100}{x}\%$ leads to insolvency. Leverage ratios of 30 were common prior to crisis. Today, European banks are highly exposed to changes in the values of sovereign debt – which is declining in value.

If asset values fall to 90, balance sheet becomes

Assets

Sovereign debt: 90

Liabilities

Debt 90

Capital 0

Bank has no equity/capital left. Despite only a 10% fall in asset values, the bank is almost insolvent. (Here, insolvency means debt value exceeds asset value). Such a bank will be very reluctant to lend and becomes a “zombie bank.” (In this case, leverage is not defined; it is $\frac{90}{0}$ or infinite).

If assets rise to 110, balance sheet becomes

Assets Sovereign debt: 110

Liabilities Debt 90 Capital 20

Capital rises from 10 to 20. So shareholders receive 100% return on equity. Leverage works both ways. Leverage ratio is now $\frac{110}{20} = 5.5$. All else constant, rising asset values lead to lower leverage.

How do banks lever up? Keep capital fixed, issue short-run debt and buy more assets.

Assets (and not capital) are the margin of adjustment.

Doug Diamond: “Financial crises are always and everywhere related to short-run debt.”

Losses on subprime made investors wary of lending. Adverse selection problem.

Rollover risk. Banks couldn't roll over short-run debt. They have three options:

- Borrow money on money or interbank markets.
- Raise capital.
- Delever i.e., sell assets.

I discuss each in turn.

Money markets and interbank markets.

Interbank markets are markets where banks can lend to each other for typically 30 to 60 days. Libor-OIS spread and TED spread are measures of price of funding on these markets. High values reflect stress in these markets.

Short-run funding dried up and TED spread rose: Greater credit risk and banks themselves feared liquidity problems. Banks engaged in *precautionary hoarding* for fear they might be next.

Money markets buy short-run financial and non-financial commercial paper. But after losing money on Lehman commercial paper, money markets became dysfunctional and wary of all risk. Eventually there was some FED intervention here.

They also become wary of lending to non-financial firms: in other words, things spilled over to real economy.

With this lack of funding, there were apparent arbitrage opportunities, e.g. covered interest rate parity condition failed. TIPs. CIP. Investors must go somewhere: in a flight to quality money markets purchased large quantities of Treasuries: Treasuries yield fell.

Banks in trouble find it hard to raise equity.
Why?

Debt Overhang Problem.

Any equity will simply be used to pay of debtholders, not investment.

Need for liquidity.

Only solution: sell illiquid assets to repay debt, but you won't get much for them in "fire sale" since prices of these fall substantially. In addition, reduce loan growth.

Externality: The sales impair others' balance sheets; thus, illiquidity can lead to insolvency. In this sense, problem for few becomes systemic.

Fire sale.

Expectations of fire sale can freeze market: if I think there will be another fire sale next week (markedly cheaper assets in future), I won't buy today. Following on from this, expectations that the gov will purchase assets next week, will reduce the ferocity of today's fire sale.

Important point. Because of fire sales, cheap assets were available at fire sale prices (providing large internal rate of returns.) These good opportunities made solvent and liquid agents reluctant to lend at relatively low rates in money market funds etc. This made those funds even more dysfunctional and raise rates further. Again, there is a spillover to real economy since solvent agents will buy assets in fire sales – and not lend to real economy.