

Behavioural Finance

Lecture 09 Out of Sequence... Behavioural Finance and Economics 02

Endogenous money: recap

- The money supply is determined mainly by the demands of the commercial sector, not by the government
- It can therefore expand and contract regardless of government policy
- Credit money carries with it debt obligations
 - whereas fiat or commodity money does not
 - therefore debt dynamics essential to monetary system
- Financial behaviour of commercial sector is thus a crucial part of the economic system.
- "Endogenous money" *prima facie* persuasive...
 - But some controversies in endogenous money...

Not a homogeneous field...

- Many disputes within endogenous money camp
 - Definition of money (also problem for exogenous case)
 - Origin of money (was state necessary for its creation, or irrelevant?)
 - "Degree of Horizontality": is credit system completely flexible to desires of borrowers, or are their limits?
 - Relation between money and credit
 - How credit system works to expand during booms/contract during slumps
 - Measurement of money...
 - And... do these disputes matter anyway? Or are they just semantics?

What is money?

- Means of payment & store of value...
 - Neoclassical economics sees purpose of economic system as consumption (Chick still influenced by this view in 1971)
 - Marx sees market economy as dominated by desire of capitalists to accumulate wealth:
 - "Accumulate! Accumulate! That is Moses and the prophets!" (Capital I, Ch 24.3: p. 558 [Progress Press])
 - Store of value and unit of account crucial here: what matters to capitalists is not consumption *per se*, but accumulation. Abstract unit by which to measure accumulation therefore vital
 - Main point of Marx's analysis of money:

What is money?

- "It must never be forgotten, that in capitalist production what matters is not the immediate use-value but the exchange-value, and, in particular, the expansion of surplus-value.
- This is the driving motive of capitalist production, and it is a pretty conception that—in order to reason away the contradictions of capitalist production—abstracts from its very basis and depicts it as a production aiming at the direct satisfaction of the consumption of the producers." (Theories of Surplus Value II, s 17.6)
 - "Store of value" an essential aspect of accumulation, therefore cannot be collapsed to consumption-oriented "means of payment" function...

Origin of Money

- Does it matter?
 - Reasonable argument that not important issue
 - Limitations relevant at origin of something (eg, airplane) might not affect what it evolves into (eg, rocket flight)
 - But beliefs re origins of money do affect how people define/interpret money today
- Two extreme positions
 - Money originated in commercial exchange
 - Money invented by the State for payment of taxes
 - Latter approach emphasises State role in creation of money ("Chartalism")
 - Former approach emphasises importance of credit in commercial system...

Keynes on money

- Most endogenous money theorists inspired by Keynes
- But Keynes's work confusing on role of money
- General Theory a fascinating but difficult book
- Difficulty caused by
 - Extent to which Keynes had not fully escaped his previous neoclassical training
 - Developmental nature of ideas
 - Debating approach often taken by Keynes—accept premise used by opponent and still show that opponent is wrong
- All these cloud question of whether GT/Keynes assumed exogenous or endogenous money...

Keynes on money

- Conventional Hicksian IS-LM: money supply exogenous
- "The schedule of the marginal efficiency of capital depends, however, partly on the given factors and partly on the prospective yield of capital-assets of different kinds; whilst the rate of interest depends partly on the state of liquidity-preference (i.e. on the liquidity function) and partly on the quantity of money measured in terms of wage-units.
- Thus we can sometimes regard our ultimate independent variables as consisting of (i) the three fundamental psychological factors, namely, the psychological propensity to consume, the psychological attitude to liquidity and the psychological expectation of future yield from capital-assets, (2) the wage-unit as determined by the bargains reached between employers and employed, and (3) the quantity of money as determined by the action of the central bank" (GT 246-247)

Keynes on money

- But contrary propositions to this also given: "The amount of cash that the banking system has created" (GT: 84):
 - "In Chapter 15 ... Keynes explicitly raises the issue of how a change in money supply comes about ... either as a counterpart to increased income ... or 'by a relaxation of the conditions of credit by the banking system' [GT: 200]..." (63)
 - "It will, therefore, be safe for us to take the latter case as typical..." (GT 200-201)
- So Keynes of the *General Theory* (1936) appears midway between the argument that the State controls the creation of money, and that the banking system does
 - Keynes 1937 rather different more obviously endogenous in thinking...
 - Discussed later in this lecture

Keynes on money

- Dow argues significant structural changes to banking since Keynes's time that amplify endogenous position:
 - "Progression through the stages [of banking evolution] can be characterised by the increasing capacity of the banking system to create credit." (68)
 - (1) Commodity Money; (2) Fiat Money; (3) Fractional banking
 - Before stage four (circa Keynes): "banks have been able to increase the bank multiplier, and the speed with which the multiplier operates; but the multiple is still constrained by a given volume of bank reserves" (68)

Evolution of Banking

- Stage 4: "the central bank accepts the role of lender-of-last-resort in order to maintain confidence in the banking system. Now the banks are no longer constrained by a given stock of reserves. They are still subject to reserve requirements, and the central bank can influence the demand for reserves by manipulating [short term] interest rates. But if the banks are prepared to pay the required interest rate to borrow reserves, then there is no limit on their credit creation." (68)
 - "Limit on their credit creation" the essential point of the endogenous money case: there is no limit if some part of the banking system keeps zero reserves.
- Stage 5: Liability management...

Evolution of Banking

- "... liability management. Banks now more actively sought out lending opportunities, taking care of deposit funding by competing over deposit rates and by making increased recourse to the wholesale market." (68)
- "This period can be seen as close to the modern endogenous-money account", but Dow cautions that
- "even then, banks could not be said to have been passive, in that they themselves were creating much of the credit demand by opening up speculative opportunities in the wholesale market.
- Further, attempts by monetary authorities to curtail the growth of credit, if anything, further fuelled the process: the massive growth in the Eurodollar market can be seen to have resulted in large part from attempts to evade monetary control in Britain and the USA." (68-69)

Evolution of Banking

- Stage six: "securitization"—bundling loans to create marketable securities with income streams generated by the repayments. Also further disintermediation—"banks withdrew from lending in favour of the securities markets" (69)
- Stage seven: "market diffusion"—"The divide between banks and non-banks has been eroded by deregulation, as well as by market forces." (69)
 - "Thus, countering the disintermediation process of stage six, we now have the possibility of the liabilities of a wider range of institutions becoming so liquid as to be treated as money, so we need to consider their credit-creation process as well." (69)
- Next issue: how tenable is the extreme Post Keynesian horizontalist position that the banking system is completely passive and just supplies as much credit as the economy wants?

Passive Banking?

- Moore's position known as "Horizontalism"
 - Supply of credit by banks unlimited at going interest rates (short-term set by government, longer term partly market-affected)
 - Implies banks passively supply the credit desired by corporations/private borrowers
- Dow argues for some role of banks in setting supply
 - Not complete independence of supply from demand, but some control over terms and some limits...

Passive Banking?

- "[T]he supply of credit, and thereby of money, has become more endogenous over the last few decades. But the private sector is not homogeneous; there is no necessary reason for the banks (or credit-creators...) to accommodate all demand at the market interest rate." (69-70)
- Criticises Moore's emphasis of role of "lines of credit" in making supply elastic with statistics:
 - "in the UK, for example, from 1984 ... to 1992, the proportion [of overdrafts of total lending] had fallen from 22 per cent to 14 per cent... the evidence suggests that these, like the volume of credit as such, may also be rationed." (70)

Passive Banking?

- Essential qualification of Moore's position
 - Banks may limit credit creation in some economic circumstances
 - Willingness to lend may collapse during a slump
- Qualification doesn't alter endogeneity per se; just gives banks role in determination of credit creation process.
 - Banks/financial institutions as active players in endogeneity, rather than passive
 - Implies further pro-cyclical, cycle-leading role for credit
 - Financial institutions may help accelerate expansion of credit during a boom, accelerate its collapse during a slump.

Liquidity Preference and Endogenous Money

- "Liquidity preference may be characterised as a preference for short-term over long-term assets." (74)
 - Concept is feasible with completely demand-determined money supply; but Dow argues for banks to have a role in setting supply w.r.t. their own lending preferences
 - "[N]ot only are banks (and thereby the monetary authorities) given some control over the volume of credit ... but the theory of liquidity preference has been extended in a way Keynes only hinted at in 1937." (75)
 - Modelled clumsily by a series of diagrams...

Liquidity Preference and Endogenous Money

- "[T]he limitations of a diagrammatic representation of a non-deterministic organic process become very clear. This framework is being offered here as an aid to thought, but it can only cope with one phase of the process, not with the feedbacks." (74)
 - **Dynamic** models are needed to represent feedback effects
- Basic impact of Dow's framework is to reintroduce notion of a credit institutions having some active role in setting supply of credit and money
 - "The volume of credit is thus shown to be jointly determined by the central bank, the banks and the non-bank public." (78)

The Circuit Approach

- Major advance made by European "Monetary Circuit" school
- Basic focus is the "circuit" by which debt-based money is created when loan made
- Like Monetary Post Keynesian approach, Circuitist school emphasises that monetary economy is **fundamentally** different to barter economy
 - Can't treat monetary economy by just tacking money onto commodity model
- Unlike strict horizontalist approach, see banks as active agents in system...
 - Major writer Augusto Graziani (University of Rome)

Circuitist: creation of money

- Ignore creation of fiat ("outside") money by government and focus on creation of debt-based money by banking system
 - "the money stock is increased or decreased by means of debt and credit operations taking place between the Central Bank and commercial banks. The ideal model of the theory of the circuit therefore resembles the so-called *Wicksellian model of a pure credit economy*, with the addition of a Central Bank." (3)
 - But money seen as essentially different to credit:
 - "If in a credit economy at the end of the period some agents still owe money ... a final payment is needed, which means that no money has been used." (3)

Conditions for money

- (1) Must be a token (otherwise a barter model if a commodity)
 - "The starting point of the theory of the circuit, is that a true monetary economy is inconsistent with the presence of a commodity money.
 - A commodity money is by definition a kind of money that any producer can produce for himself. But an economy using as money a commodity coming out of a regular process of production, cannot be distinguished from a barter economy.
 - **A true monetary economy must therefore be using a token money, which is nowadays a paper currency" (3)**

Conditions for money

- (2) Must be "money has to be accepted as a means of final settlement of the transaction (otherwise it would be credit and not money)." (3)
- (3) Must not grant "rights of seignorage" (agents can't create it indefinitely at negligible cost [as formally Governments can with fiat money])
 - If seller A & buyer B accept "tokens" issued by Bank C as final settlement, can't have C use its own tokens to be a buyer
 - Like paying for goods with "IOU"s

Conditions for money

- "The only way to satisfy those three conditions is to have payments made by means of promises of a third agent" (3)
 - Essential point in circuitist case (and endogenous money in general): transactions are all 3 sided—buyer, seller, *banker*. Banks are an essential aspect of capitalism:

Conditions for money

- "When an agent makes a payment by means of a cheque, he satisfies his partner by the promise of the bank to pay the amount due.
- Once the payment is made, no debt and credit relationships are left between the two agents. But one of them is now a creditor of the bank, while the second is a debtor of the same bank.
- This insures that, in spite of making final payments by means of paper money, agents are not granted any kind of privilege.
- For this to be true, any monetary payment must therefore be a *triangular transaction*, involving at least three agents, the payer, the payee, and the bank. Real money is therefore credit money." (3)
- Second essential point of this school: *the minimum number of agents in a capitalist economy is three:*

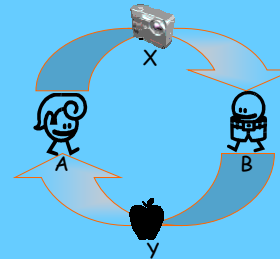
Conditions for money

- (1) Seller A with commodity X to sell;
- (2) Buyer B with money in a bank account; AND
- (3) Bank C that records transfer from B's account to A
 - Essentially different to neoclassical "barter" vision of money as "the money commodity"
 - Buyer/Seller A has commodity X, wants Y;
 - Buyer/Seller B has commodity Y, wants X;
 - They work out exchange ratio in terms of "money" commodity Y
 - No bank involved
 - Interesting model of primitive village
 - But not a model of capitalism



Commodity money just "n+1" barter economy

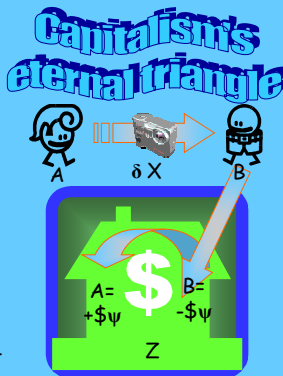
- Barter economy: 2 sided, 2 commodity exchanges:
 - person A gives person B δ units of commodity X
 - in return for ψ units of commodity Y
- Calling one "the money commodity" simply semantics



- 1st essential insight
 - Money a non-commodity
 - "A true monetary economy must therefore be using a token money, which is nowadays a paper currency." (3)

Three agents minimum for money economy

- Monetary economy: 3 sided, single commodity, financial exchanges:
 - person A gives person B δ units of commodity X
 - in return for person B having bank Z transfer ψ currency units from B's account A's account
- Not only are all exchanges 3-sided;
- also can't lump firms & banks together
 - Fulfil essentially different roles in capitalist system:



Conditions for money

- "[B]anks and firms must be considered as two distinct kinds of agents.
- Firms are present in the market as sellers or buyers of commodities and make recourse to banks in order to perform their payments; banks on the other hand produce means of payment, and act as clearing houses among firms.
- In any model of a monetary economy, banks and firms cannot be aggregated into one single sector." (4)
- So far so good:
 - Very different credit-based view of economy developed from first principles
 - Monetary economy fundamentally different to barter economy
- But...

Not so good

- Problems arise when Graziani (& supporters) try to develop model of economy from this foundation
 - Insights require dynamic maths to model properly
 - Like most economists, Graziani doesn't know the required maths
 - Confuses stocks & flows in verbal model of circuit
 - Time-based verbal model of sequence of transactions leading to creation and destruction (?) of money:
 - Simplest model: only capitalists, workers, & banks
 - Reaches false conclusions easily corrected by dynamic model
 - Questionable or false steps in model shown by (?)

The money process (Model 1: only one bank)

- Model aggregates
 - Firms into commercial sector
 - Labour into household sector
 - Banks into banking sector
- Model sequence
 - Banks grant firms right to finance:
 - "The first step in the economic process is the decision taken by banks of granting credit to firms in order to enable them to start production" (4)
 - Loan entirely to enable firms to hire workers (?):
 - "If we consider firms as a whole, their only external purchase is labour force. All other exchanges being internal transactions, no further monetary payment is required. (?) Only at the end of the production process firms buy capital goods to be used in the following period."

The money process (Model 1: only one bank)

- Firms hire labour at wage rate determined by negotiation (amount of labour hired omitted from model—implicit that hiring reflects firms' expectations of profit)
- Firms **instantly** pay all borrowed money to workers as wages (?)
- Workers deposit wages in bank accounts
- Workers now creditors of banks, firms debtors to banks
 - "Wage-earners have thus to choose between placing their savings in securities, or keep them in liquid form in bank deposits (Keynes, 1937b).
 - As long as money wages are not spent, an amount of money equal to the wage bill is in existence (?).
 - The total amount of money is a debt of the firms to the banking sector and a credit of wage-earners to the same sector." (?) (5)

The money process (Model 1: only one bank)

- Workers either spend wages or buy corporate bonds
 - Either activity extinguishes firms' debt to banks
 - "Money which is spent on the commodities market, as well as money spent on securities issued by firms, goes back to firms, and will be available for repaying debts to the banking system." (5)
 - This therefore destroys (?) money created at start of cycle
 - "As soon as firms repay their debt to the banks, the money initially created is destroyed." (?)
- A dilemma arise: how can capitalists make a profit?...

The money process (Model 1: only one bank)

- "If the expenditure of wage-earners equals the whole of their wages, ..., firms get back the whole of their expenditure and they are able to repay fully their debt to the banks. In that case, the monetary circuit is closed without losses..."
- "If on the other hand, wage-earners decide to keep part of their savings in the form of liquid balances (that is, banking deposits), firms will get back from the market less money than they have initially injected in it."
- In the terminology of circuit theory, there has been a loss in the circuit and firms will be unable to repay to the banks the whole of their debt." (?)
 - So workers have to spend all their wages for firms to be able to repay their debt?
 - And what about interest? How do they pay that???

The money process (Model 1: only one bank)

- Wages not spent or invested stays in economy in workers' bank accounts
 - "At the end of the cycle, money initially created will not be totally destroyed, and a part of it will be still in existence in the form of a debt of firms to the banks.
 - If banks decide to grant firms the same amount of credit as they initially did, the total money stock in existence will increase.
 - In fact, the money stock will now be equal to the wage bill paid at the beginning of the new cycle plus the amount of deposits carried on by wage-earners from the previous one." (5-6)
 - And if workers do spend all their wages?

The money process (Model 1: only one bank)

- Then money ceases to exist! (?)
 - "Thus, the stock of money in existence depends on the rate at which money is currently created and destroyed."
- If money is to persist in the system...
 - "An assumption is therefore required for the existence of a money stock, namely that *wage-earners spend their money incomes gradually over time*. This may well seem an assumption of irrational behaviour, if no uncertainty is present. **It is however a necessary assumption, if we do not want the velocity of circulation to become infinite and money to disappear altogether from the system.**" (?)

The money process (Model 1: only one bank)

- "As soon as firms repay their debt to the banks, the money initially created is destroyed."
- "If ... wage-earners decide to keep part of their savings in the form of liquid balances ... firms will get back from the market less money than ... initially injected in it... there have to be unable to repay to the bank ... their debt."
- "An assumption is therefore required ... *wage-earners spend their money incomes gradually over time*. This may well seem an assumption of irrational behaviour..."
- Capitalists can't borrow money & make a profit?
 - What's happening in the real world then?
- Money destroyed when debt repaid?
 - Even seen a banker tear up a \$100 bill?
- Spending your income gradually over time is irrational???

Problems in Circuitist modelling...

- Subsequent Circuitists reach same impasse as Graziani
 - Bellofiore (et al.)
 - "Assuming a propensity to consume equal to one, firms would always get back the money wage bill and repay the banks (interest apart)." (408)
 - "For the sake of simplicity, we exclude the payment of interest to the banks" (410)
 - "Profits are gained in real terms..."
 - "As shown above, in the basic circuit approach (describing a closed economy with no government expenditure), firms in the aggregate can only obtain the wage bill they advanced to workers (wN) and, as a result, it is impossible for *all firms* to obtain money profits." (410)
- What? Then what about all those real world balance sheets?

Problems in Circuitist modelling...

- What we have here is a failure to think clearly...
- Rochon puts dilemma well:
 - "The existence of monetary profits at the macroeconomic level has always been a conundrum for theoreticians of the monetary circuit... not only are firms unable to create profits, they also cannot raise sufficient funds to cover the payment of interest. In other words, how can M become M' ?" (Rochon in Fontana & Realfonzo 2004: 125).
- Problem comes from a failure to think dynamically about finance
 - Keynes had it right in 1937 ("Alternative theories of the rate of interest");

Keynes on the "revolving fund of finance"

- "Planned investment—i.e. investment *ex-ante*—may have to secure its "financial provision" *before* the investment takes place; that is to say, before the corresponding saving has taken place."
- "This service may be provided either by the new issue market or by the banks ;—which it is, makes no difference." (246)
- Reflections on the *General Theory*, with
 - Transactions;
 - Speculative; &
 - Precautionary demands for money
 - But now Keynes realises there is a 4th, crucial, demand:

Keynes on the "revolving fund of finance"

- "let us call this advance provision of cash the 'finance' required by the current decisions to invest.
- Investment finance in this sense is, of course, only a special case of the finance required by any productive process;
- but since it is subject to special fluctuations of its own, *I should (I now think) have done well to have emphasised it when I analysed the various sources of the demand for money.*" (247; emphasis added)
- So finance demand for money a prelude to investment, which in turn determines savings
 - "It is, to an important extent, the 'financial' facilities which regulate the pace of new investment." (248)

Keynes on the "revolving fund of finance"

- What did Keynes think happened to an initial loan?
 - It could continue to circulate indefinitely, financing a multitude of investments (and profits) over time:
- "If investment is proceeding at a steady rate, *the finance ... required can be supplied from a revolving fund of a more or less constant amount*, one entrepreneur having his finance replenished for the purpose of a projected investment as another exhausts his on paying for his completed investment."
- Only if investment is rising will the fund need to rise:
 - "But if decisions to invest are (e.g.) increasing, the extra finance involved will constitute an additional demand for money." (247)
- Keynes's reasoning shows Circuitists have confused a stock (an initial loan) with a flow (the spending that loan can finance over time)...

Keynes on the "revolving fund of finance"

- "It is possible, then, that confusion has arisen between credit in the sense of 'finance,' credit in the sense of 'bank loans' and credit in the sense of 'saving.'
- I have not attempted to deal here with the second.
- It should be observed that a confusion between the first and the last would be one between a flow and a stock.
- Credit, in the sense of 'finance,' looks after a flow of investment. It is a revolving fund which can be used over and over again. It does not absorb or exhaust any resources. The same 'finance' can tackle one investment after another." (247)
- So rather than money being destroyed when debt is repaid, money circulates indefinitely: amount of money (**stock**) doesn't limit uses over time (**flow**)

Keynes & the Circuitists

- Keynes clearly thinking in terms of endogenous money:
 - "“financial provision” before the investment takes place; that is to say, before the corresponding saving has taken place... may be provided either by the new issue market or by the banks ;—which it is, makes no difference.” (246)
 - "if the banking system chooses to make the finance available and the investment projected by the new issues actually takes place, the appropriate level of incomes will be generated out of which there will necessarily remain over an amount of saving exactly sufficient to take care of the new investment.
 - The control of finance is, indeed, a potent, though sometimes dangerous, method for regulating the rate of investment (though much more potent when used as a curb than as a stimulus).
 - *Yet this is only another way of expressing the power of the banks through their control over the supply of money—i.e. of liquidity.*" (248; emphasis added)

Keynes & the Circuitists

- Graziani & Circuitists
 - initial (stock of) money limits (flow) of income that can be generated
- Keynes
 - stock of new money can finance indefinite flow of income
- Keynes clearly right, Circuitists wrong
 - Major Circuitist insights still valid
 - Money as token
 - "3-sided" exchange
 - Later, how to model Keynes's insight
 - Now, continue on with Circuitist's triangular model...
 - Multiple banks & the banking system:

The money process (Model 2: multiple banks)

- With more than one bank, possibility that money paid by one agent (with debt to bank A) may be deposited by recipient in bank B
- Thus Bank A has a debt to Bank B
 - Each bank needs reserves equivalent to own share of credit market
- How does Bank A repay Bank B?
 - Third party again needed, otherwise Bank A would repay with promise to repay... the Central Bank:
 - "Just as single agents use bank deposits, namely promises to pay issued by banks, *single banks use promises to pay issued by the Central Bank.* The role of the Central Bank is in fact [that] of acting as third party between single banks so far as their reciprocal payments are concerned." (9)

The money process (Model 3: Central Bank)

- Without a government sector in the model,
 - "reserves can only be created if the Central Bank opens credit positions with single commercial banks. The total amount of reserves is therefore a *debt of commercial banks towards the Central Bank*, just as the total amount of deposits is a debt of firms towards commercial banks." (10)
- With a government sector
 - "[T]he possibility exists for the Central Bank to create money in order to finance the Government deficit. Central Bank money thus created is no longer a debt of commercial banks, but a *debt of the Government towards the Central Bank.*" (10)
- Every transaction has 3 partners
 - Two for exchange
 - One for double-entry book-keeping

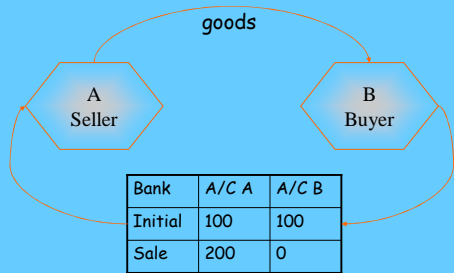
Putting a foot wrong

- Up to this stage, Circuitists have
 - Structured model of money/credit creation process
 - Where model depends on **rate of change of** worker spending for creation of money
 - Next stage *should* have been to create dynamic model of money creation process
 - Move from double-entry book-keeping approach to rate of change approach
 - Instead, Graziani works out income distribution and price relations using simultaneous equations
 - But these equations represent "steady state" or equilibrium outcome—not ones involving dynamics
 - Kaleckian identities thus incompatible with underlying Circuitist schema.
- **Ignore** maths in Graziani paper—wrong method, wrong conclusions re money...

The problem

- Circuitist logic leads inevitably to a need for one component of their system (worker's expenditure) to have a "rate of change with respect to time" rather than an equilibrium value
 - **But in equilibrium all rates of change are zero**
 - Equilibrium analysis thus inappropriate for circuitist case
 - E.g., of course money plays no role in setting money prices in equilibrium—because in equilibrium (in their model) there is no money!
 - Instead, have to use dynamic methods...
 - OK, brace yourselves for some maths!
 - But first some graphical representations...

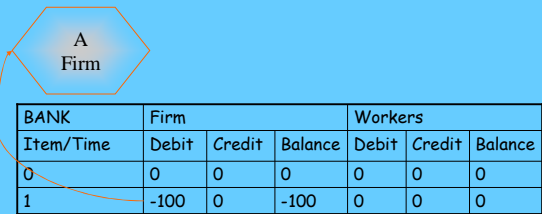
Three-cornered exchange the rule



- A accepts Bank's promise to pay as **full discharge** of B's obligation to pay A for commodity.

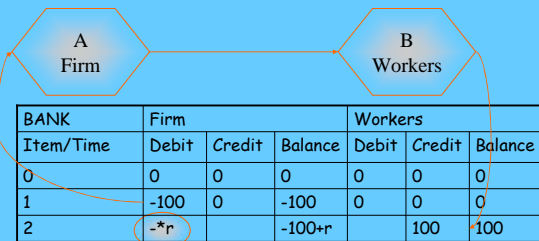
Initial model in graphical form

- Bank extends credit to firm



Initial model in graphical form

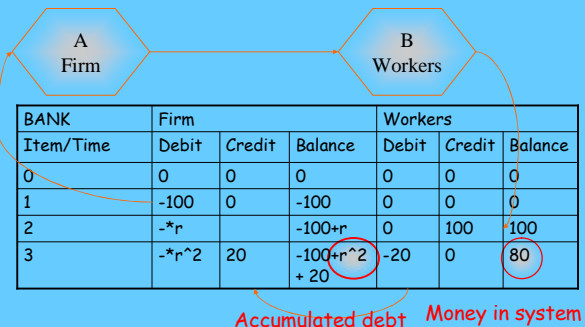
- Bank extends credit to firm
- Firm hires workers



Interest accrues

Initial model in graphical form

- Bank extends credit to firm
- Firm hires workers
- Workers buy some goods & bonds



Modelling workers' expenditure, money

- Basic and realistic assumption that "wage-earners spend their money incomes gradually over time..."
 - E.g., "Workers spend $a\%$ of their wages per unit of time"
 - "% rate of change of their money account wage per week is a "
 - "Rate of change of money wage account is a per week"
- Mathematically:

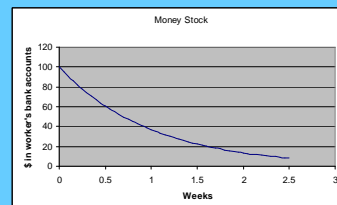
This can be solved for M using integration: $\frac{dM}{dt} = -aM$

$$\frac{dM}{M} = -a \times dt \rightarrow \int \frac{dM}{M} = \int -adt \rightarrow \ln(M) = -a \times t + c \rightarrow M = e^{-at+c} = C_0 e^{-at}$$

- C_0 is initial stock of money $M(t) = 100 \times e^{-t}$
- Let's try $C_0=100, a=1$:

Modelling workers' expenditure, money

- Balance in accounts (and thus money) from initial deposit of 100 is:



- Inverse dynamic needed for accumulating additional debt of firm (interest on 100 at $r\%$ per time period, compounded)

A modelling dilemma

- Circuitist foundations well thought out
 - But when it comes to mathematical modelling, they fall back on familiar methods of simultaneous equations
 - Simultaneous equations incompatible with their basic insights
- Common problem, even in non-neoclassical economics: *economists use wrong tools for the job because they don't know the right tools*
 - Right tool for this sort of analysis is "ordinary differential equations" (ODE)
 - Essential tool for analysing dynamic processes
 - Not taught in our Quantitative subjects (nor at most other universities...)
- Some insights from previous ODE:

ODE Insights

- Process involves a single bank-firm loan and its aftermath
- Clearly these are occurring all the time
- In a growing economy, these would be positive
 - A "rate of change function" for new debt issues
- Firms must aim to make a profit out of this
 - Level of borrowing function of expected profits
- Whole model must "tie back into itself"
 - Investment—Rate of change of Capital—Profit—Investment
 - current model is incomplete
- Two more related insights from other economists:

Additional insights for Circuitist approach

- Minsky: debt must always be growing in growing economy
 - "If income is to grow, the financial markets, where the various plans to save and invest are reconciled, must generate an aggregate demand that, aside from brief intervals, is ever rising.
 - For real aggregate demand to be increasing, ... it is necessary that current spending plans, summed over all sectors, be greater than current received income and that some market technique exist by which aggregate spending in excess of aggregate anticipated income can be financed.
 - It follows that over a period during which economic growth takes place, at least some sectors finance a part of their spending by emitting debt or selling assets." (Minsky 1963 [1982])

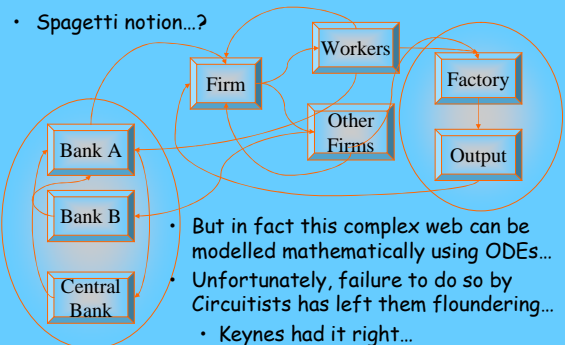
Additional insights for Circuitist approach

- Marx: sum of excess demands of producers/consumers negative in a capitalist economy
 - "The capitalist throws less value in the form of money into the circulation than he draws out of it... Since he functions ...
 - as an industrial capitalist, his supply of commodity-value is always greater than his demand for it. If his supply and demand in this respect covered each other it would mean that his capital had not produced any surplus-value...
 - His aim is not to equalise his supply and demand, but to make the inequality between them ... as great as possible." (Marx 1885)
 - Bank debt needed to balance (as per Minsky)
 - **Expanding debt a basic feature of growing capitalist economy**

Weaknesses in circuitist approach

- No proper consideration of production in Graziani
 - Clearly workers produce output after hired
 - Output must be "priced" and sold
 - Physical surplus must be "monetized"
 - For profitable economy, sale price must exceed cost of production
- Circuitist model as laid out by Graziani (and also much as developed to date) therefore only one step in overall dynamic process
- Basic flowchart of full process...

Full flowchart of circuitist model

- Spagetti notion...?
 
 - But in fact this complex web can be modelled mathematically using ODEs...
 - Unfortunately, failure to do so by Circuitists has left them floundering...
 - Keynes had it right...
 - Let's bring the two together using modern modelling tools:

Modelling endogenous money dynamically

- Capitalist has bright idea... 
- Approaches bank for finance... 
- Bank grants loan & opens TWO accounts:
 - Credit account gives money to capitalist... 
 - Debit account records capitalist debt 
- Loan necessarily has two components
 - Interest paid on outstanding balances
 - Both *credit and debit*
 - Loan **must** be repaid

Modelling endogenous money dynamically

- So we have a minimum of 5 accounts
 - Capitalist Credit or Deposit Account
 - Money paid in here
 - Interest on balance
 - Repayments out of here to Banker
 - Capitalist Debt or Loan Account
 - Debt recorded here
 - Interest on balance
 - Banker Principal or Reserve Account
 - Records repayment of Debt
 - Banker Income Account
 - Records incoming and outgoing interest payments
 - And Workers or Household Deposit account for wages

Modelling endogenous money dynamically

- So how do we model dynamically?
 - You *should* know
 - Isn't the economy dynamic?
 - But you've never been taught how...
- Next lecture:
 - How to model a dynamic process
 - Applied to modelling the "Monetary Circuit of Production"