Crecimiento economico
Class 16
Inflacion y crecimiento

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1 Growth and inflation

Basic ideas

- Inflation is bad for growth (?)
- Inflation and financial markets
  - risks
  - real returns
  - predictability
- Inflation and costs of transactions (shopping time)
- Hyperinflations
- Inflation and the payments system
  - Brazil handled this well
  - Checks in Brazil clear in 24 hours
- Inflation and costs of production

Early theory (Keynesian)

- The Phillips curve (or the Fisher curve, since he found the relation first)
- Short term positive relationship between output growth and inflation
- Concept of trade-off: high growth meant high inflation
- Said to be damand driven

- Output adjusted to meet demand

Early theory (Monetarist)

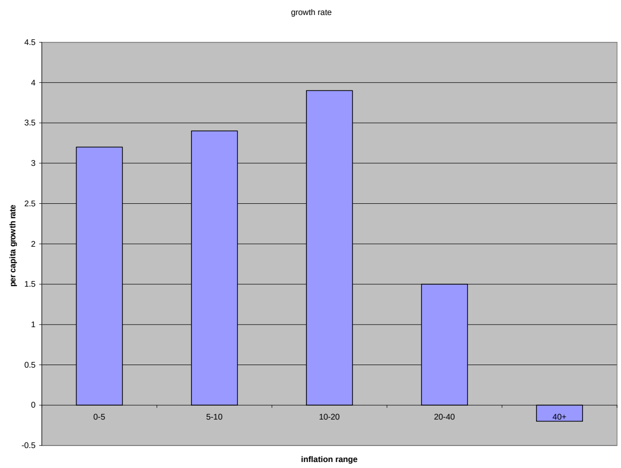
- A financial markets argument
- Money is an asset and should have a real return similar to other assets
- Changes in money growth (and inflation) increased uncertainty in markets
- Friedman and Schwartz on Monetary History
    - Sharp reductions in money resulted in recessions (1930's)
    - Contracted loans available from financial system
    - Expansions in money would not work as well ("pushing a string")

Early empirical results

- Wallich (1969)
- pooled time series cross section of 43 countries using two 5 year averages
    - Expected to find positive relationship
    - found negative instead
- Before the 1960, except for a few hyperinflations (very bad) inflation was low
    - Germany 1923
    - Hungary 1947
- relatively few countries with more than 20% inflation per year
- Big change in relationship above 20% per year
- Note: IMF studies found no relationship between inflation and output growth

Growth rates and inflation (1960-72)
Annual observations: 0-5: 415, 5-10: 194, 10-20: 88, 20-40: 29, 40+: 19
One of my favorite papers

- McCandless and Weber (1995): Some Monetary facts, *Minneapolis Federal Reserve Quarterly Review*
- Looked at long run correlations between
    - growth of money (different definitions) and inflation
    - inflation and real output growth



- Used large sample of countries (120 countries)
- Samples were long term averages (up to 20 years)
- Results
  - Inflation is highly positively correlated with all definitions of money in full sample and sub-samples
  - Inflation is uncorrelated with output growth over the whole sample
  - Inflation is positively correlated with output growth in the OECD countries
  - Inflation is negatively correlated with output growth in Latin America

Barro (1995) Bank of England paper (not in book with Sali-i-Martin)

- 100 countries from 1960 to 1990: consumer price indices
- Median inflation per decade: 1960's: 3.3%, 1970's: 10.1%, 1980's: 8.9%
- Mean inflation per decade: 1960's: 5.4%, 1970's: 13.3%, 1980's: 19.1%
- Standard deviation of mean: 1960's: 3.9%, 1970's: 7.5%, 1980's: 13.4%
- Growth rate of output: 1960's: 2.8%, 1970's: 2.3%, 1980's: 0.3%
- Found strong positive correlation between average inflation and standard deviation
- Inflation and growth (inflation <>15%): no relationship (very, very small negative and insignificant)

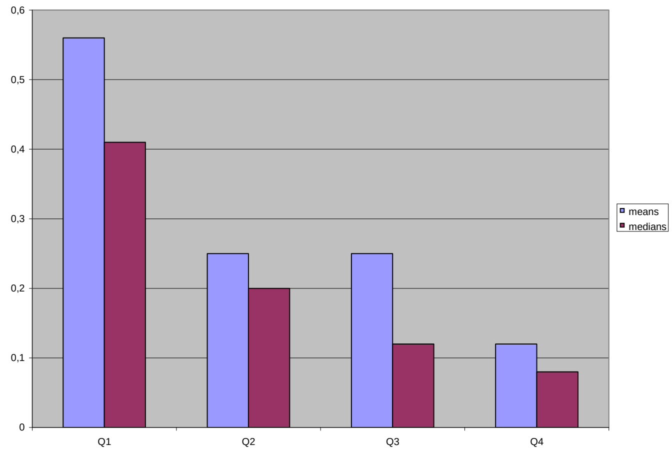
- Inflation and growth (full sample): negative relationship (clearly driven by high inflation countries)

More recent theory

- Bencivenga and Smith (2003)
- High inflation causes high nominal interest rates: banks cannot adequately insure against liquidity needs of depositors and are not used
- This correlates with relatively low use of banks in high inflation countries (Argentina in 1980's)
- Empirical results
  - low nominal interest rates correlated with low levels of real investment (including in deflation)
  - at low nominal rates, banks hold more cash (not costly): for example Japan
  - results in low investment rates
  - medium inflations correlated with higher investment, higher bank lending
  - high inflations correlated with lower investment
    - interest rates do not rise as much as inflation
    - lower real returns on lending

Inflation and financial crises

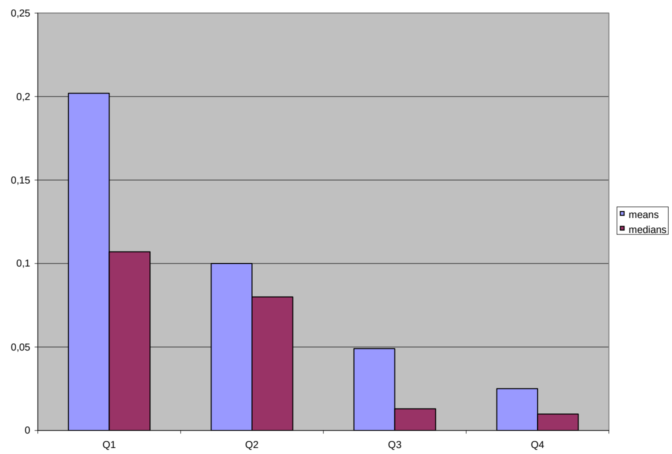
- High and sustained inflation rates are correlated with financial crises
- Banking or financial crises have short run effect on output: some have had long run effects
- Bank runs are more likely with inflation
  - more difficult to tell the real condition of the bank
  - variances increase with inflation
- Evaluation of bank risks are more difficult (with costly verification)
- Higher interest rates makes for an adverse selection problem
  - only the owners of riskier projects will want to borrow
  - riskier projects with higher returns if successful
  - but with high probability of failure
- Deflation can be a problem but is much less studied



Stock market size and growth

- Countries with higher income and higher growth have larger financial markets
- Relatively larger financial markets makes it easier to grow (better allocate capital)
- Higher inflation is negatively correlated with the size of the financial markets
- Some potential measures of size of financial
  - stock market capitalization/GDP
  - total value traded/GDP
  - total value traded/capitalization (a measure of liquidity)
  - some measure of return volatility
- The relationship between these and inflation were tested by
  - Boyd, Levine, Smith (2001)

Stock market capitalization / GDP
Inflation rates per quantile (mean,median):
Q1: 1.036,1.036, Q2: 1.066, 1.065, Q3: 1.116, 1.114, Q4: 1.325, 1.247
Total stocks traded / GDP
Inflation rates per quantile (mean,median):
Q1: 1.036,1.036, Q2: 1.066, 1.065, Q3: 1.116, 1.114, Q4: 1.325, 1.247
Return on equity (eqrate)



- For 16 countries with low inflation ($R^2adj = .52$)

$$eqrate = 1.932 - .855cpirate + 3.332initial - .504bmp + .038revc$$

- for 17 countries with high inflation ($R^2adj = .99$)

$$eqrate = .005 + 1.026cpirate + 7.637initial - .003bmp - .144revc$$

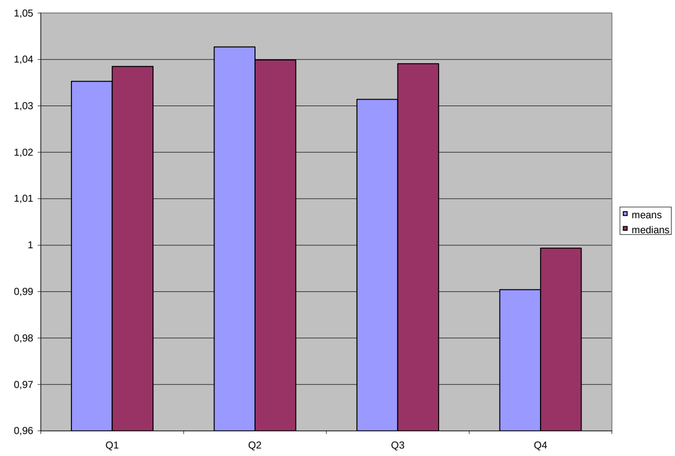
- where
  - *cpirate* is the inflation rate,
  - *initial* is gdp in 1980,
  - *bmp* is black market premium,
  - and *revc* is the number of coups and revolutions

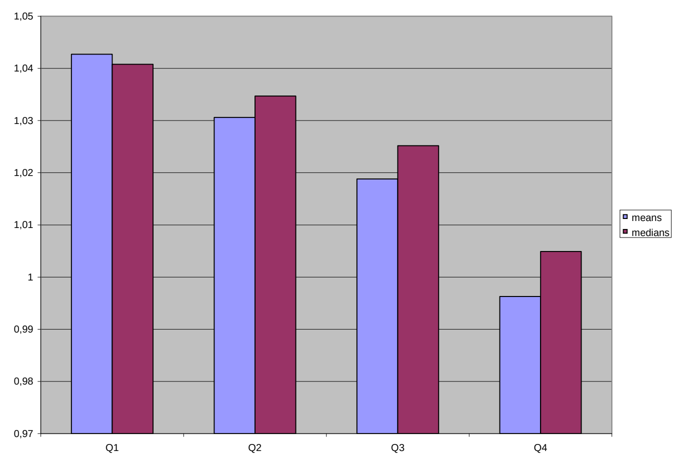
Debt returns and inflation (1)

- Sample of 68 countries (medium term averages): Gross real money market rates
- inflation (means,medians):
  - Q1: 1.028, 1.023, Q2: 1.033, 1.033, Q3: 1.063, 1.058, Q4: 1.318, 1.238

Debt returns and inflation (2)

- Sample of 68 countries (medium term averages): Gross real treasury bill rate


1,05
1,04
1,03
1,02
1,01
1
0,99
0,98
0,97
0,96
Q1
Q2
Q3
Q4
means
medians


1,05
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Q1
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means
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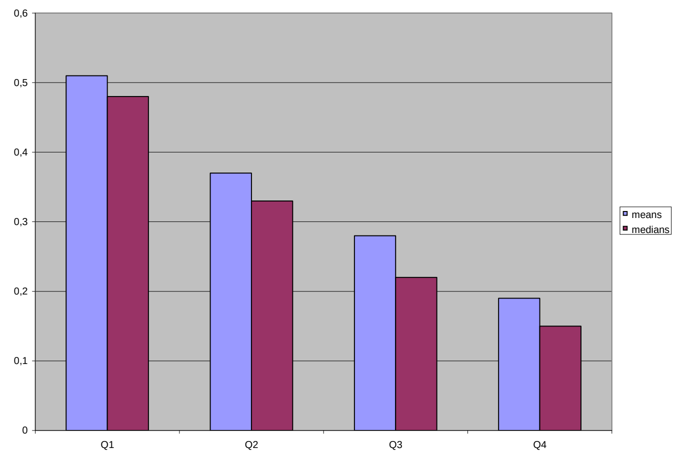


- inflation (means,medians):
  - Q1: 1.028, 1.023, Q2: 1.033, 1.033, Q3: 1.063, 1.058, Q4: 1.318, 1.238

Inflation and the banking industry

- Commercial bank lending to the private sector by quantile (1980-95)

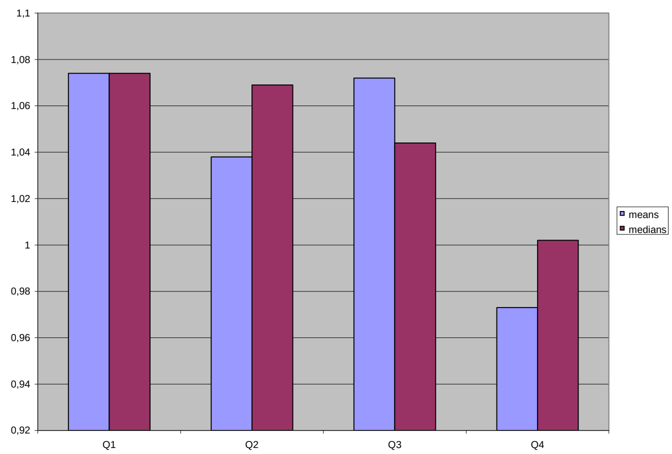
Inflation and the banking industry

- Real return on commercial bank equity (1995-1999)

Inflation and volatility of asset returns

- Boyd, Levine, Smith (2001)
  - long term averages and standard errors of inflation
  - found 98% correlation between the two series
- Barnes, Boyd, Smith (1999) found 99% correlation of above using different data set
- Boyd and Champ (2003)
  - partial correlations between inflation rate and standard errors of 10 different interest rate measures
  - used regression: all the coefficients on inflation were significantly positive

A model of mine on inflation and output in stationary state



- Central banks act as if they believe monetary policy has short term effects on output
  - Quite a few studies find this kind of result
  - VARs: monetary impulse has positive output response
- Sims and causality
  - First: money causes output
  - Second: adding interest rates removes causal relationship
- Instability of estimated demand equations for money
- How to get a model that can speak to these issues
  - a model that does not need sticky prices nor wages
  - a model without information problems

Model

- Cash in advance money
  - current money wages can be used to buy current consumption
  - but at a goods search cost (loss of leisure)
- Firms that borrow to cover wage bill (working capital)
- Financial system that takes deposits and lends to firms
  - Households deposit in banks

    - in period in which loans are made
    - in period previous to when loans are made (limited participation)
  - Loans are riskless for bank

- Monetary injection can go to households or to FIs

Households (in basic model)

- Maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\ln c_t^i + A \ln \left(1 - h_t^i - v\left(\eta_t^i\right)\right)\right]$$

- subject to

$$c_t^i = \frac{m_{t-1}^i}{P_t} + \eta_t^i w_t h_t^i + \chi(g_t - 1)\frac{M_{t-1}}{P_t} - \frac{n_t^i}{P_t}$$

$$\frac{m_t^i}{P_t} + k_{t+1}^i = \left(1 - \eta_t^i\right) w_t h_t^i + r_t k_t^i + (1-\delta) k_t^i + r_t^n \frac{n_t^i}{P_t}$$

- where the time cost of spending η_t^i fraction of current wage income is

$$v\left(\eta_t^i\right) = a\left(\eta_t^i\right)^{\varphi}$$

Households (in limited participation model)

- Maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\ln c_t^i + A \ln \left(1 - h_t^i - v\left(\eta_t^i\right)\right)\right]$$

- subject to

$$c_t^i = \frac{m_{t-1}^i}{P_t} + \eta_t^i w_t h_t^i + \chi(g_t - 1)\frac{M_{t-1}^s}{P_t}$$

$$\frac{m_t^i}{P_t} + k_{t+1}^i + \frac{n_{t+1}^i}{P_t} = \left(1 - \eta_t^i\right) w_t h_t^i + r_t k_t^i + (1-\delta) k_t^i + r_t^n \frac{n_t^i}{P_t}$$

- same time cost of spending η_t^i fraction of current wage income

Firms

- Production function is

$$Y_t = \lambda_t K_t^{\theta} H_t^{1-\theta}$$

- technology, λ_t, follows the path

$$\ln \lambda_t = \gamma \ln \lambda_{t-1} + \varepsilon_t^{\lambda}$$

- Perfectly competitive factor markets give

$$r_t^f w_t = (1-\theta)\,\lambda_t K_t^{\theta} H_t^{-\theta}$$

and

$$r_t = \theta \lambda_t K_t^{\theta-1} H_t^{1-\theta}$$

Financial intermediaries

- Budget constraint of the FIs

$$N_t + (1-\chi)\,(g_t - 1) M_{t-1}^S = P_t w_t H_t$$

- The zero profit condition (this is very important) is

$$r_t^n N_t = r_t^f P_t w_t H_t$$

- The monetary policy rule of the monetary authority follows the process

$$M_t^S = \overline{g} g_t M_{t-1}^S$$

In the basic model $M_t^S = M_t$ and in the limited participation version $M_t^S = M_t + N_{t+1}$.

- g_t follows the process,

$$\ln g_t = \pi \ln g_{t-1} + \varepsilon_t^g$$

Stationary states

- Three economies are shown in each graph (except for the graph of η).
  - A graph for the case where wages cannot be spent until the next period, $\eta = 0$,
  - for the case where they can only be spent in the current period and there are no labor costs to spending quickly, $\eta = 1$ and $a = 0$, and
  - for the case where there are labor costs for spending current wages in the current period.
- Parameters are $\beta = .99$, $\delta = .025$, $\theta = .36$, $A = 1.72$ for all economies
- for the economy with labor costs for spending in the current period, $a = .056$
  - $\varphi = 1.5$ for the economy with $\chi = 0$ and $\varphi = 1.3$ for the economy with $\chi = 1$

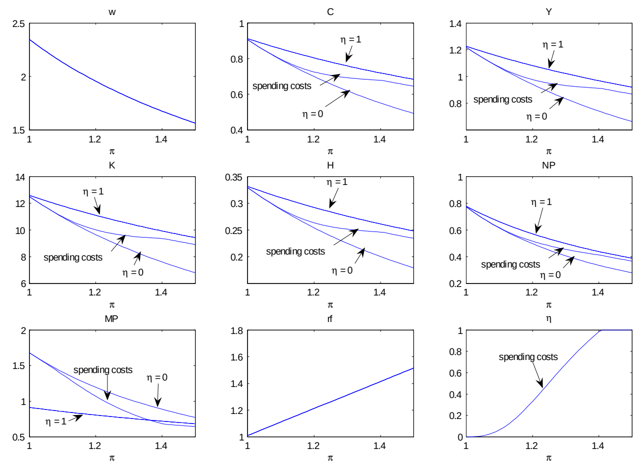


Figure 1: Stationary states when $\chi = 1$

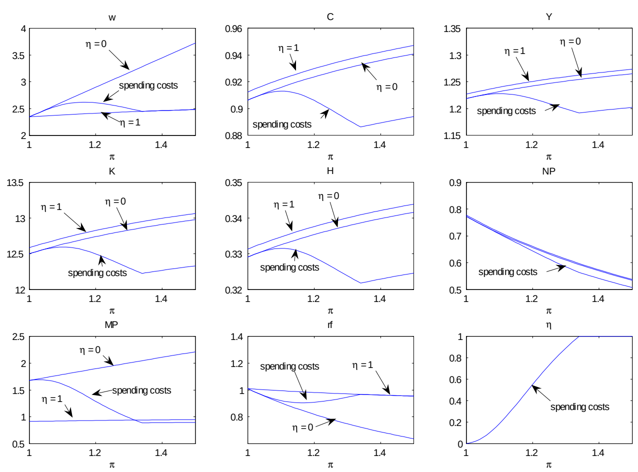


Figure 2: Stationary states when $\chi = 0$

Stationary states (money transfers to households)
Stationary states (money transfers to FIs)
Conclusions

- Model can produce positive output responses to monetary shock
  - Depends on who money is injected into economy
  - Both in stationary states and in short term dynamics
- Money injections into financial system work as subsidy to production
  - lowers interest rate on working capital loans
- Money injections to household work as tax
- This is different from the limited participation models of Fuerst and Christiano
  - Their banks are not competitive
  - They pay back "profits" from money injections as lump sum dividends
- Results are robust to a number of formulations of the model
  - basic or limited participation
  - with changes in velocity (which puts limits on gains from subsidy)

Conclusions (2)

- Estimated money demand equations are likely to be "unstable"
  - for economies which have used both monetary policy and seigniorage
  - because there are at least two underlying money demands
  - changes in policy (monetary or seigniorage) changes weights (and therefore signs)
- Also suggests why money ceased to cause output when interest rates are added (Sims)
  - interest rates better capture the monetary policy side
  - cleaner signal than monetary aggregates
- Also suggests why central bankers prefer interest rate rules
  - over monetary aggregate rules
  - points to the amount of subsidy they provide to the financial system

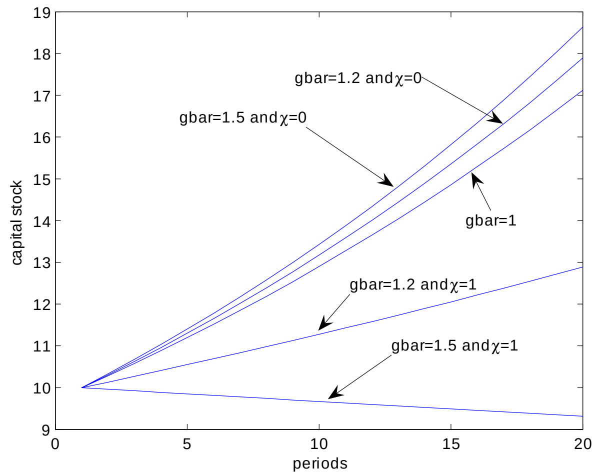


Figure 3: Time paths of capital stock

Inflation and Growth

- My paper: A Model of Inflation and Growth
- Similar to the above paper but with AK production function
- Look for balanced growth paths
- Money injections can go to households ($\chi = 1$) or to the financial system ($\chi = 0$)
- Look only at extreme values for χ
- Balanced growth paths given in following graph
- $gbar$ = gross inflation rate

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