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Velocity + Quantity Eqn M+I 3,4

Quantity Theory of Money (Review)

$P \rightarrow P = \frac{M^s}{m^o}$ in L.R. eq.

"M^s" M = set by gov't, banks.

m^o -

• increases with volume of real transactions / yr (proportional to real income y)

• increases with avg time each \$ held betw. transactions

or, decreases w/ # times / yr

each \$ changes hands, aka

"Velocity of Money."

Income Velocity of M $m = 5(3)$

$Y = \text{Nominal Income } [\$/\text{yr}]$
 \propto total transactions / yr.

$M = \text{Nominal M-Stock } [\$]$

$\frac{M}{Y}$ [yrs] \propto avg time each \$ is held

$V = \frac{Y}{M}$ [yrs⁻¹] = Income Velocity of M

\propto # times each \$ changes hands / yr.

= "Velocity" for short.

(Transaction Velocity

$T = \text{total transactions / yr}$

$V_T = \frac{T}{M} = \frac{\text{actual \# times avg \$ changes}}{\text{hands / yr.}}$

but T harder to measure, so rarely used.

$T \gg Y$, so $V \ll V_T$)

Quantity Equation

(M+I 3)

$$V = \frac{Y}{M} = \frac{PY}{M}, \quad y = Y/P$$

$$\Rightarrow \boxed{MV = PY}$$

Q-Eq'n
(Levels Form)

$$\Rightarrow \underline{P = \frac{MV}{Y}}$$

- $M \uparrow \rightarrow P \uparrow$
- $V \uparrow \rightarrow P \uparrow$
- $y \uparrow \rightarrow P \downarrow$

◆ Identically true since $V := \frac{Y}{M}$

◆ Reflects QTOM if $V \rightarrow V^* = \frac{Y}{M^0}$

Since then $P \rightarrow P^* = \frac{M}{M^0}$

Dynamic Form of Q-Eq'n:

Time 0: $(a+b)(c+d)$
 $\underline{MV = PY} = ac + ad + bc + bd$

Time 1:

$$\underline{(M + \Delta M)(V + \Delta V) = (P + \Delta P)(Y + \Delta Y)}$$

$$\Rightarrow \cancel{MV} + \underline{M\Delta V + V\Delta M + \Delta M\Delta V}$$
$$= \cancel{PY} + \underline{P\Delta Y + Y\Delta P + \Delta P\Delta Y}$$

$$\Rightarrow \frac{\Delta M}{M} + \frac{\Delta V}{V} + \cancel{\frac{\Delta M}{M} \frac{\Delta V}{V}}$$
$$\approx \frac{\Delta P}{P} + \frac{\Delta Y}{Y} + \cancel{\frac{\Delta P}{P} \frac{\Delta Y}{Y}}$$

$$\Rightarrow \boxed{\frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}}$$

Q-Eq'n
(Dynamic Form)

$$Q\text{-Eq'n: } \frac{\Delta M}{M} + \frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y}$$

Implications of Dynamic Q Eq'n.

$$\frac{\Delta P}{P} = \frac{\Delta M}{M} + \frac{\Delta V}{V} - \frac{\Delta Y}{Y}$$

Inflation =
Money growth
+ Velocity growth
- Real income growth.

Eg

$$\frac{\Delta M}{M} = 5\%$$

$$\frac{\Delta Y}{Y} = 3\%$$

$$\frac{\Delta V}{V} = 0 \quad (V = \text{const.})$$

$$\Rightarrow \frac{\Delta P}{P} = (+5\%) + (0) - (+3\%)$$

$$= \underline{+2\%}$$

But if $\frac{\Delta V}{V} = -4\%$, same $\frac{\Delta M}{M}$, $\frac{\Delta Y}{Y}$

$$\Rightarrow \frac{\Delta P}{P} = (+5\%) + (-4\%) - (+3\%)$$

$$= \underline{-2\%}$$

Similarly,

$$\underline{\frac{\Delta V}{V} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y} - \frac{\Delta M}{M}}$$

$$\underline{\frac{\Delta M}{M} = \frac{\Delta P}{P} + \frac{\Delta Y}{Y} - \frac{\Delta V}{V}}$$

Q. Eq'n \Rightarrow

If $V = \text{const.}$ ($\frac{\Delta V}{V} = 0$),

need $\frac{\Delta M}{M} = \frac{\Delta Y}{Y}$ for $\frac{\Delta P}{P} = 0$

— Milton Friedman "Monetarist" prescription for P-stability.

Inflationary Dynamics

Actual inflation driven by

1. Excess S or D for Money

Leads to Q.T. in Long Run.

2. Public's inflationary expectations

Gives π inertia

3. Microeconomic S & D shocks

Makes month-to-month π
very noisy.

② and/or ③ can lead P away from

Q.T. equilibrium, but eventually

① will pull it back.

Price Controls

M+I 3.5, 3.6

- Why not fix prices by law?

Price Ceiling

- World War II

- Vietnam

1971-74

- Gas Prices

binding 1971-74, 1979

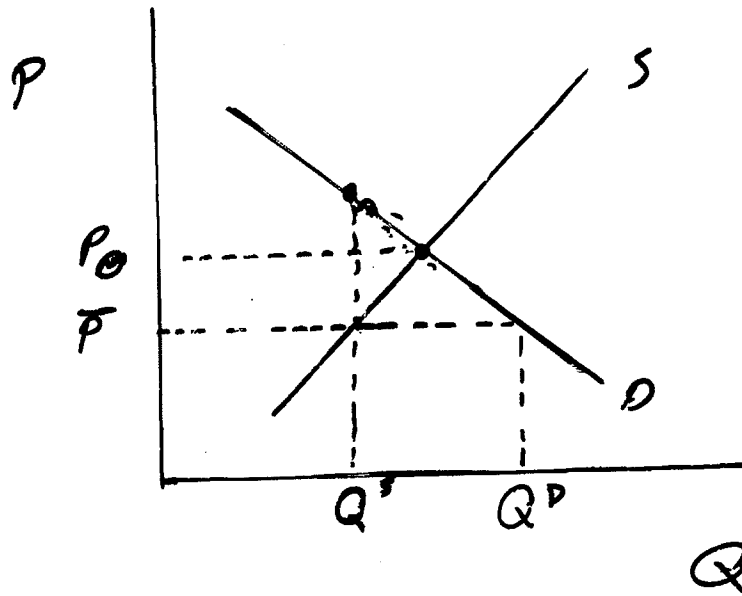
Price Floors

- New Deal 1930's

Price Ceiling

$$\bar{P} < P_0$$

$$\Rightarrow Q^D > Q^S @ \bar{P}$$



⇒ Suppressed Inflation

- Shortages $Q^D - Q^S$
- Quality Deterioration
- Rationing (WWII)
- Black Markets

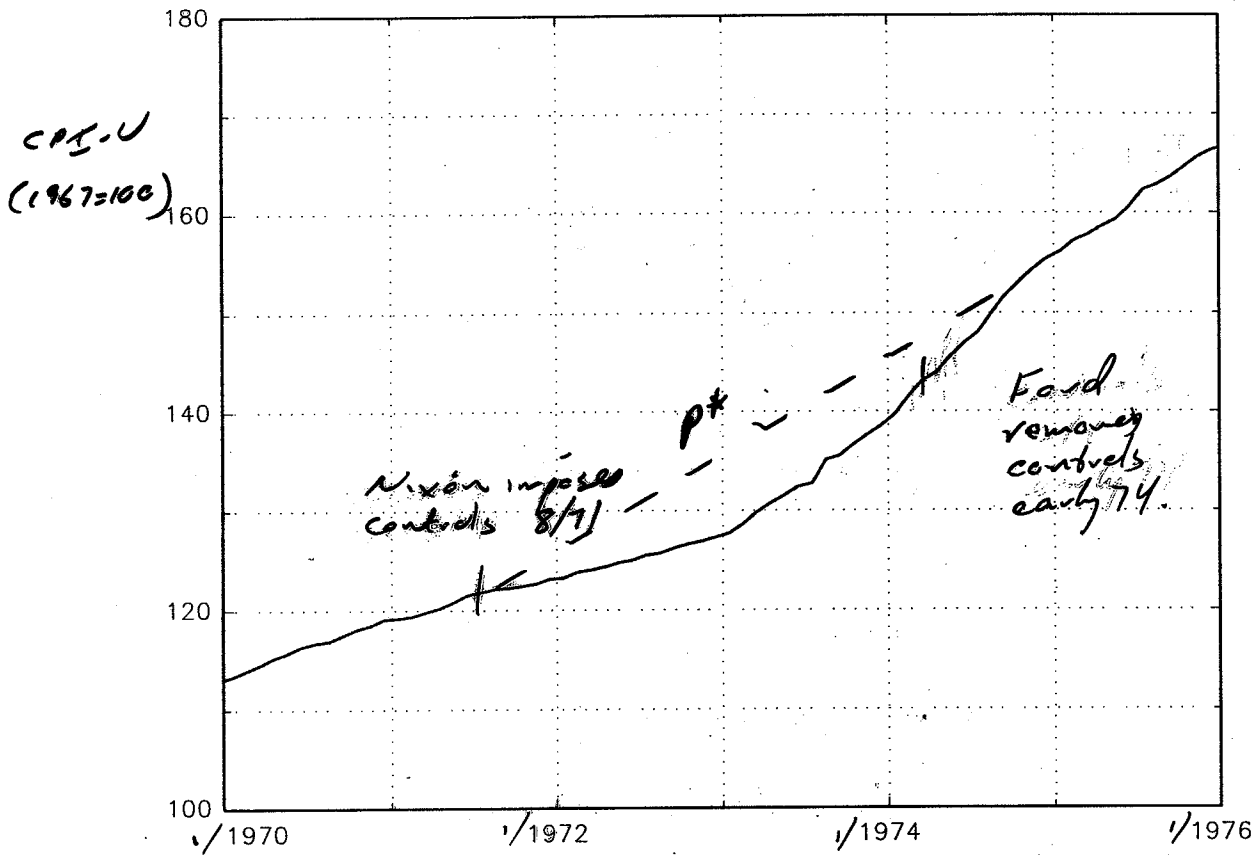
Some consumers willing to pay $> P_0$

WWII - Office of Price Admin. (OPA)

Vietnam / Nixon 1971-74

- gas shortages acute 1973.
- gas controls binding again 1979.

Nixon Price Control Period 1971-74



1972 -

Measured π hold low, shortages build.

1973 -

$P < P^*$, shortages acute, esp. gas in fall.

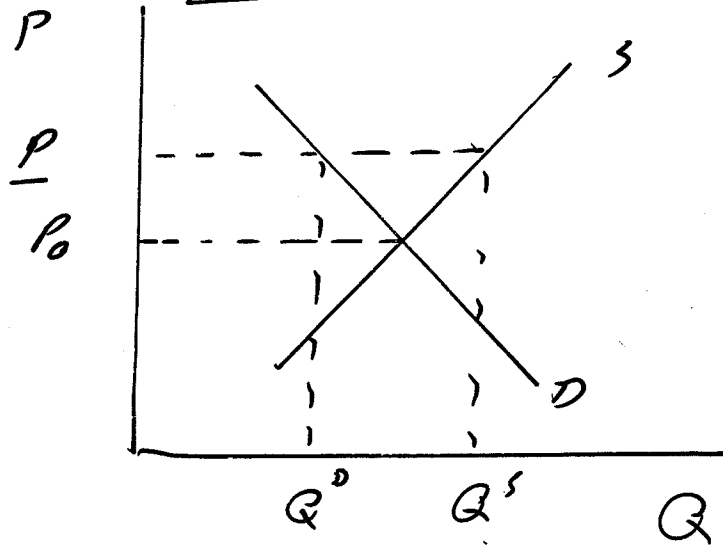
1974 -

P catches up to P^* . Measured $\pi > 10\%$, then falls abruptly after P catches up.

Price Floors

$$\underline{P} > P_0$$

$$\Rightarrow \underline{Q^S} > Q^D$$



\Rightarrow Suppressed Deflation

- Unsold Output
- Unemployment

New Deal, 1930's.

Price Floors in Great Depression (1929-wwII)

Herbert Hoover (29-33)

- Successfully urged industry not to cut wages
→ Real wages \uparrow as $P \downarrow$, Unemployment \uparrow
- Encouraged Trade Assns.
Maintained Prices, Cut Output.

(Lee Ohanian Macro Seminar Mon 10/12,
330-500, Ays 437
"Who or What caused the Great Depression?")

FDR New Deal (33-wwII)

- Nat'l Recovery Admin. (NRA)
imposed industrial controls
set min prices, cut output
- Ag. Adjustment Act
created "Market Orders" (Farm controls)
set min prices, cut output
- Wagner Act
majority of workers can force union,
union wages on all existing, new workers.
- Minimum Wage

Result = U remained high, Output depressed
throughout decade of 30's.

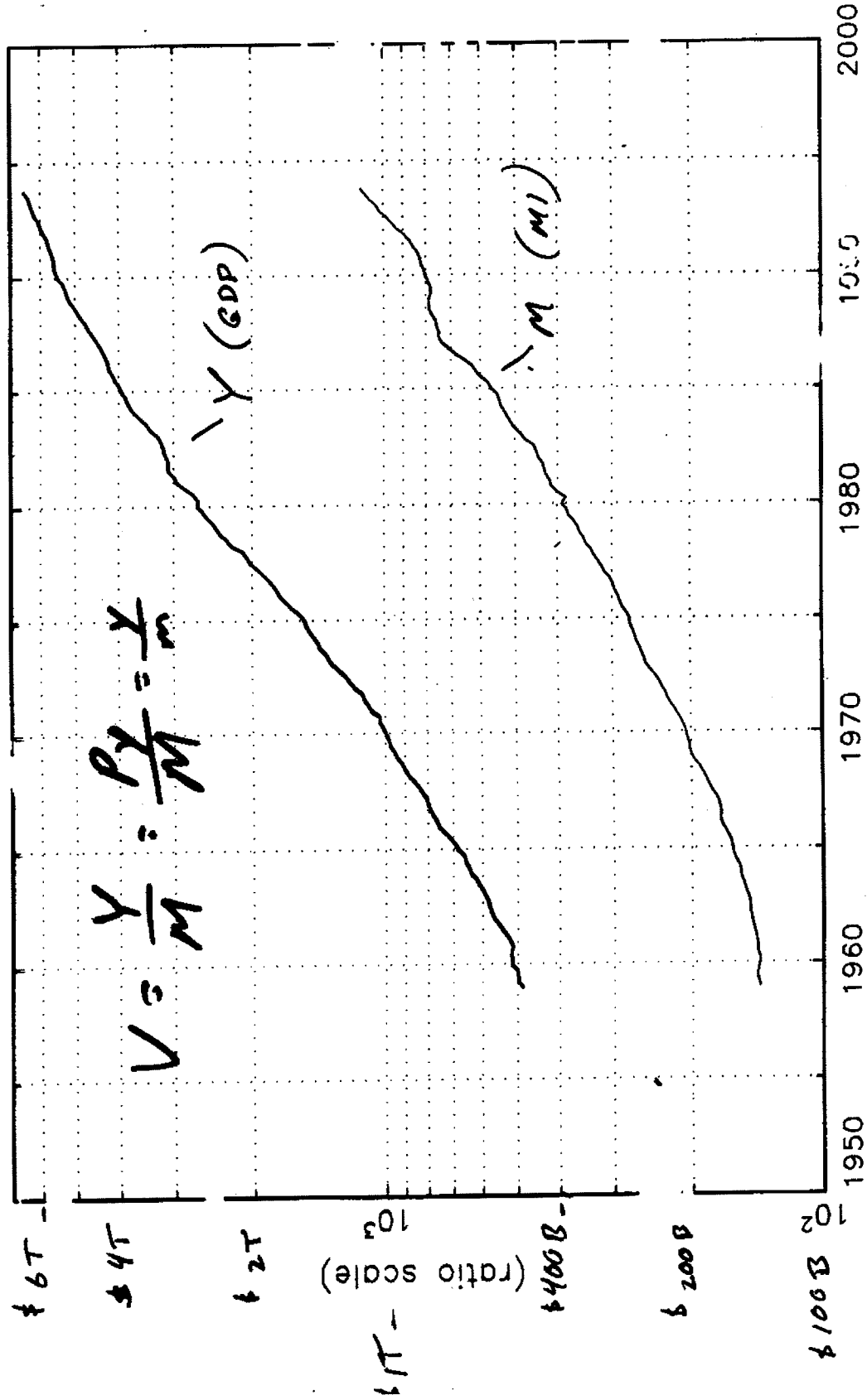
Apart from transitory deviations

from Q. T. equilibrium $P = M/m^D$

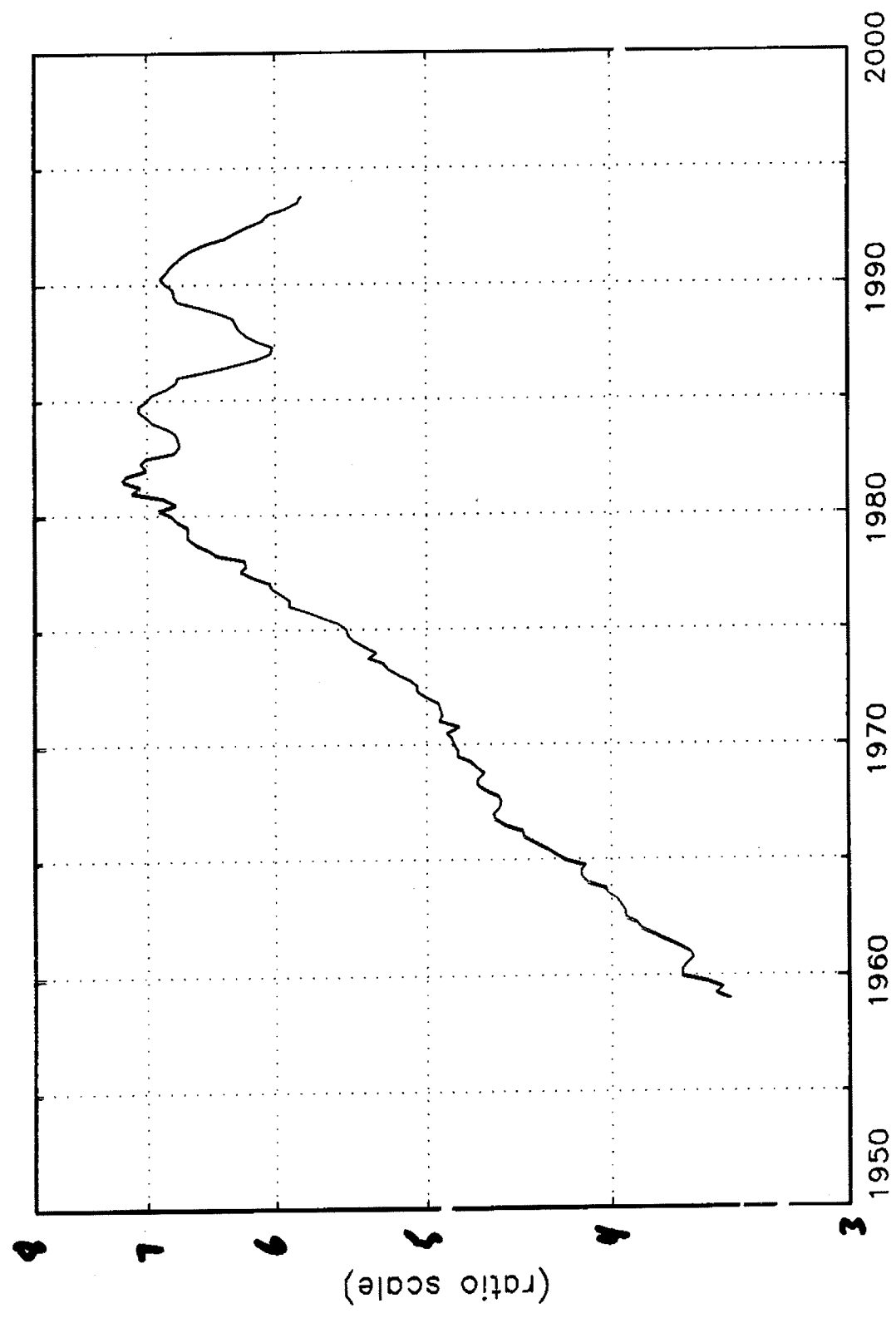
does V change?

If so, why?

M1, Nominal GDP



M1 velocity = $\frac{Y}{M}$

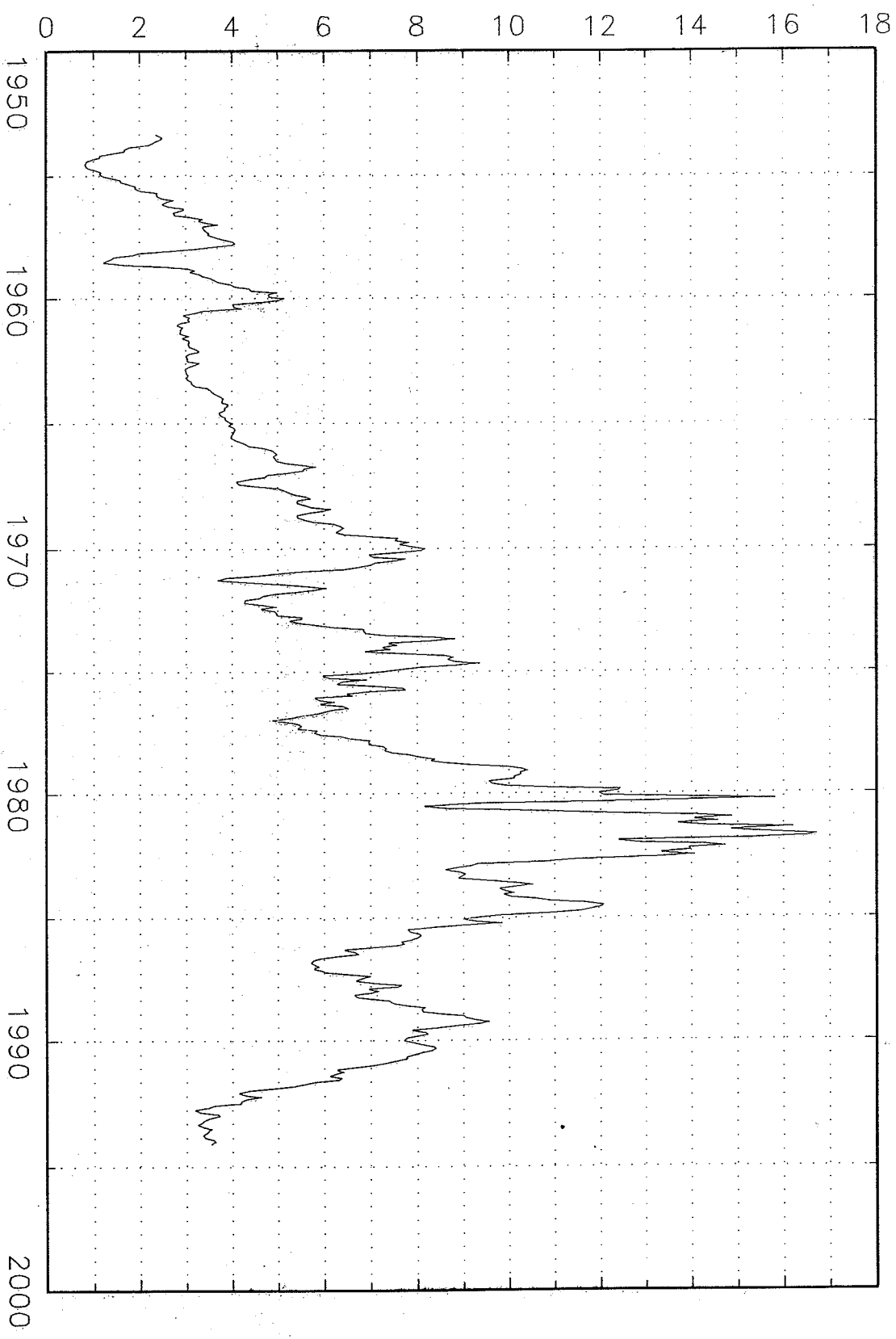


Why does V change?

Nominal interest rate R
= opportunity cost of holding M .

$R \uparrow \rightarrow V \uparrow, m^d \downarrow$

1-Year US Treasury Bill Rate (%)

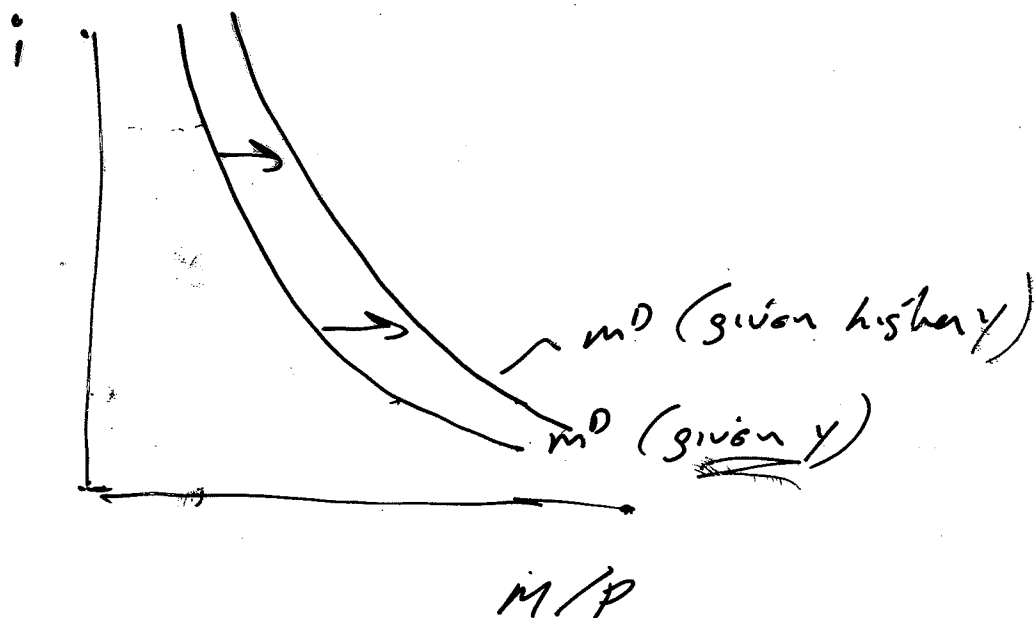


Money Demand $m^D(y, i)$
(for real money balances)

i = nominal interest rate on loans
= opportunity cost of holding M
if M pays no interest.

$m^D \uparrow$ with y ,

$m^D \downarrow$ with i .



M^culloch (1997) m^D estimates

$$m^D = (\text{const}) \underline{y^{.42}} \underline{\exp(-.028 R)}$$

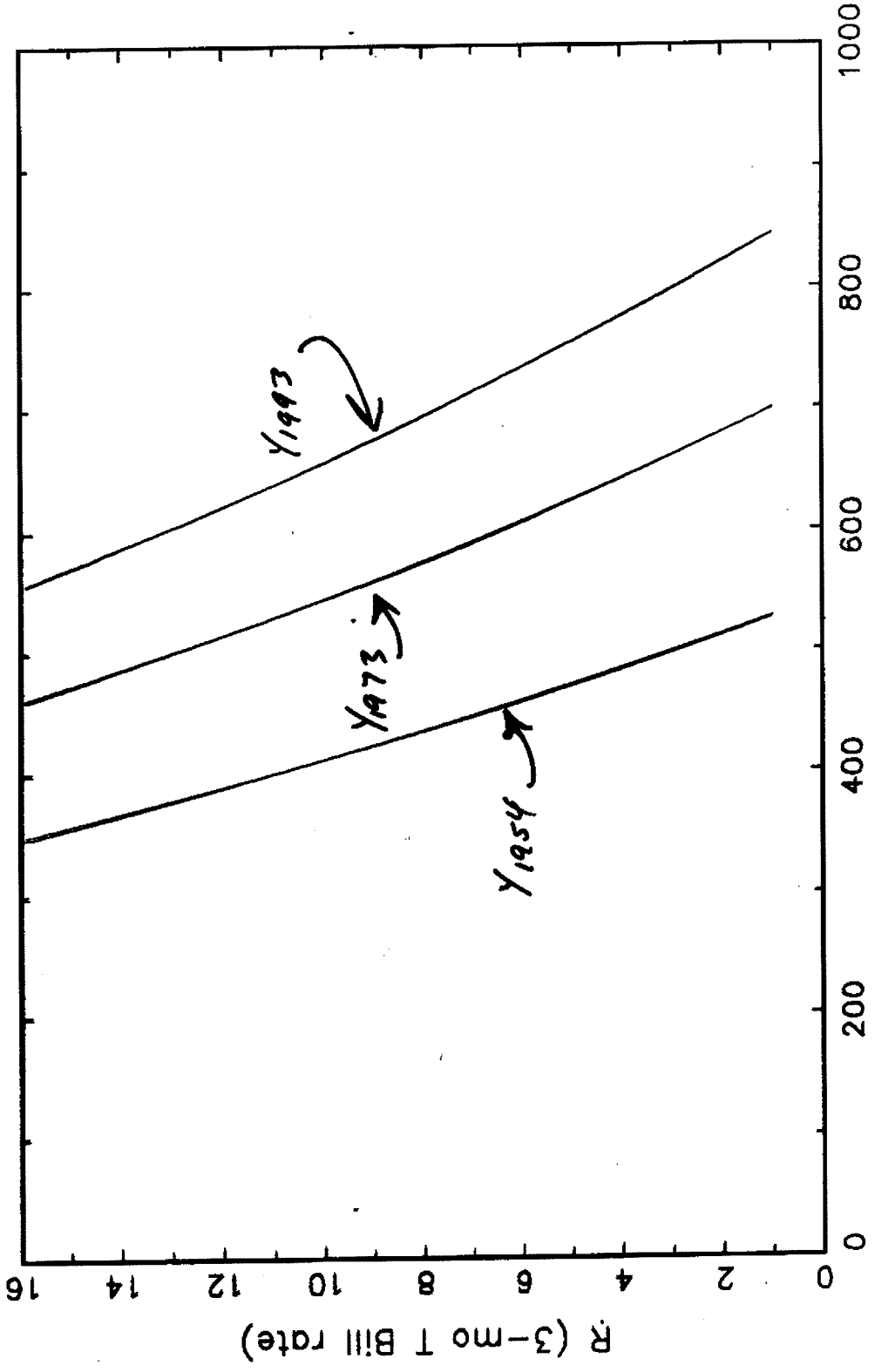
(R in %/yr)

$$\Rightarrow \underline{V = \frac{Y}{M} = \frac{Y}{m} = (\text{const}) y^{.58} \exp(.028 R)}$$

so $V \uparrow$ as $y \uparrow$ or $R \uparrow$,

uptrend in $y \Rightarrow$ uptrend in V

Real M1 Demand $m^p(\gamma, R)$



M/P, \$ billions (1987)

Why does i change?

The Fisher Equation

Irving Fisher 1930

$$i = r + \pi^e$$

i = Nominal interest rate

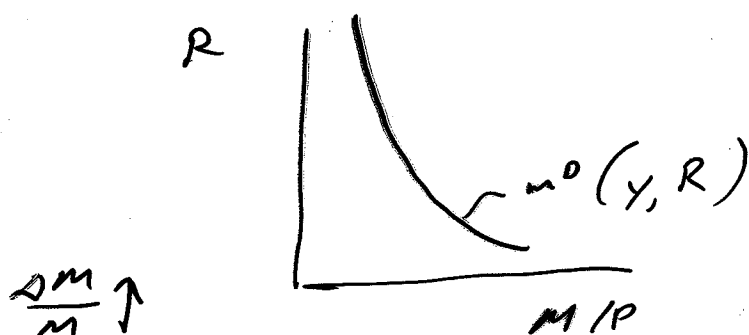
r = real interest rate

π^e = expected inflation

- r determined in L.R. by savings, investment, independently of π, π^e (Ch. 19)
 - π^e determined by past π by Adaptive Learning
- \Rightarrow feedback from π to i, V

Velocity Boost Inflation

$$\pi = \frac{\Delta M}{M} + \frac{\Delta V}{V} - \frac{\Delta Y}{Y} \quad - \text{Q Eq'n}$$



→ π ↑ → π^e ↑ (by AE)
→ i ↑ (by Fisher eq'n)
→ m^d ↓
→ V ↑ (since $V = \frac{Y}{m}$)
→ $\frac{\Delta V}{V} > 0$ as V ↑

→ extra inflation during transition

$$\pi > \frac{\Delta M}{M} - \frac{\Delta Y}{Y} \text{ as } V \uparrow.$$

Velocity Drag Deflation

$$\frac{\Delta M}{M} \downarrow \rightarrow \pi \downarrow \rightarrow \pi^e \downarrow \quad (\text{by AE})$$

$$\rightarrow i \downarrow \quad \text{by Fisher Eq'n}$$

$$\rightarrow m^o \uparrow$$

$$\rightarrow V \downarrow$$

$$\rightarrow \frac{\Delta V}{V} < 0 \quad \text{as } V \downarrow$$

$$\Rightarrow \underline{\pi < \frac{\Delta M}{M} - \frac{\Delta V}{V} \text{ as } V \downarrow.}$$

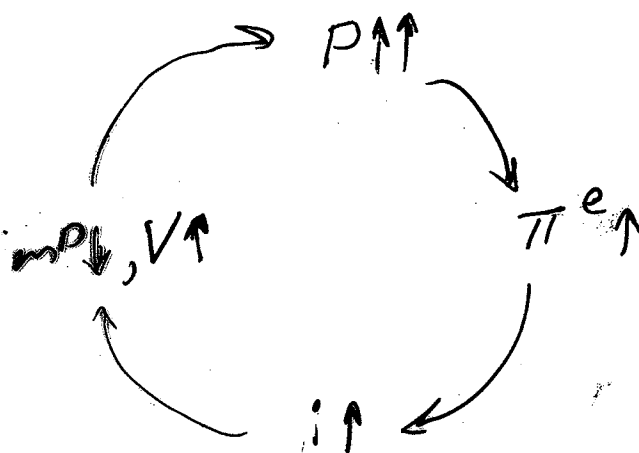
May result in unintended deflation.

Self-Generating Inflation

Possible in theory with Fiat M.

Suppose $\frac{\Delta M}{M} = \frac{\Delta Y}{Y}$, so $\pi = 0$ if $V = \text{const}$,

but supply shock pushes $P \uparrow$.



Vicious Circle of

Self-Generating π .

when

- π^e responds quickly to π

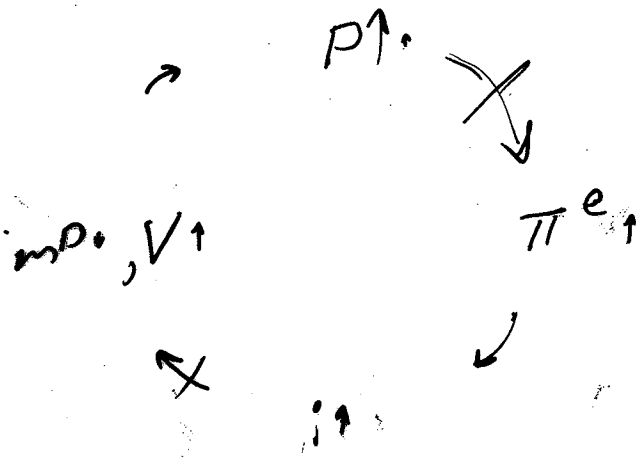
and

- M^D responds strongly to π^e , R

Self-Generating Inflation

Possible in theory with Fiat M.

Suppose $\frac{\Delta M}{M} = \frac{\Delta Y}{Y}$, so $\pi = 0$ if $V = \text{const}$,
but supply shock pushes $P \uparrow$.



P stable when

- π^e responds slowly to π
- m^D responds weakly to i

In practice, runaway π always
associated with runaway $\Delta M / M$.

Why do gov'ts often allow $\frac{\Delta M}{M} > \frac{\Delta Y}{Y}$,
 $\pi > 0$?

3 Motives for $\frac{\Delta M}{M}, \pi$:

1. Inflationary Finance

M+I 5

2. Stimulate y , reduce Unemployment

M+I 6

3. Reduce r and/or i .

M+B 19, 21