# Employment-Centred Stabilisation Policy Propelling the Economy to “Escape Velocity”

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# J. W. Forrester (2007)
# System dynamics – the next fifty years

“We need books from authors who are willing to be politically incorrect, who have the courage to attack sacred cows, and know how to show the public that the emperors have no clothes…System dynamicists must go behind the symptoms of trouble and identify the basic causes. At first, such arguments will be met with disbelief, scorn, and ridicule. To prevail, the battle must be sustained until public understanding begins to change.”

# Contents

# FM belongs to renown Goodwinian models

My paper refines and generalizes FM with delayed profit-sharing allowing capital investment lower than profit.

Although periodic dynamics arise via simple Andronov – Hopf bifurcation for large "humped" delays, the opponents' proposition that the wage-profit indexation triggers persistent economic cycles is incorrect.

The paper reveals detrimental effects of the profit-sharing rule for economic reproduction in the long run even when it alleviates oscillations.

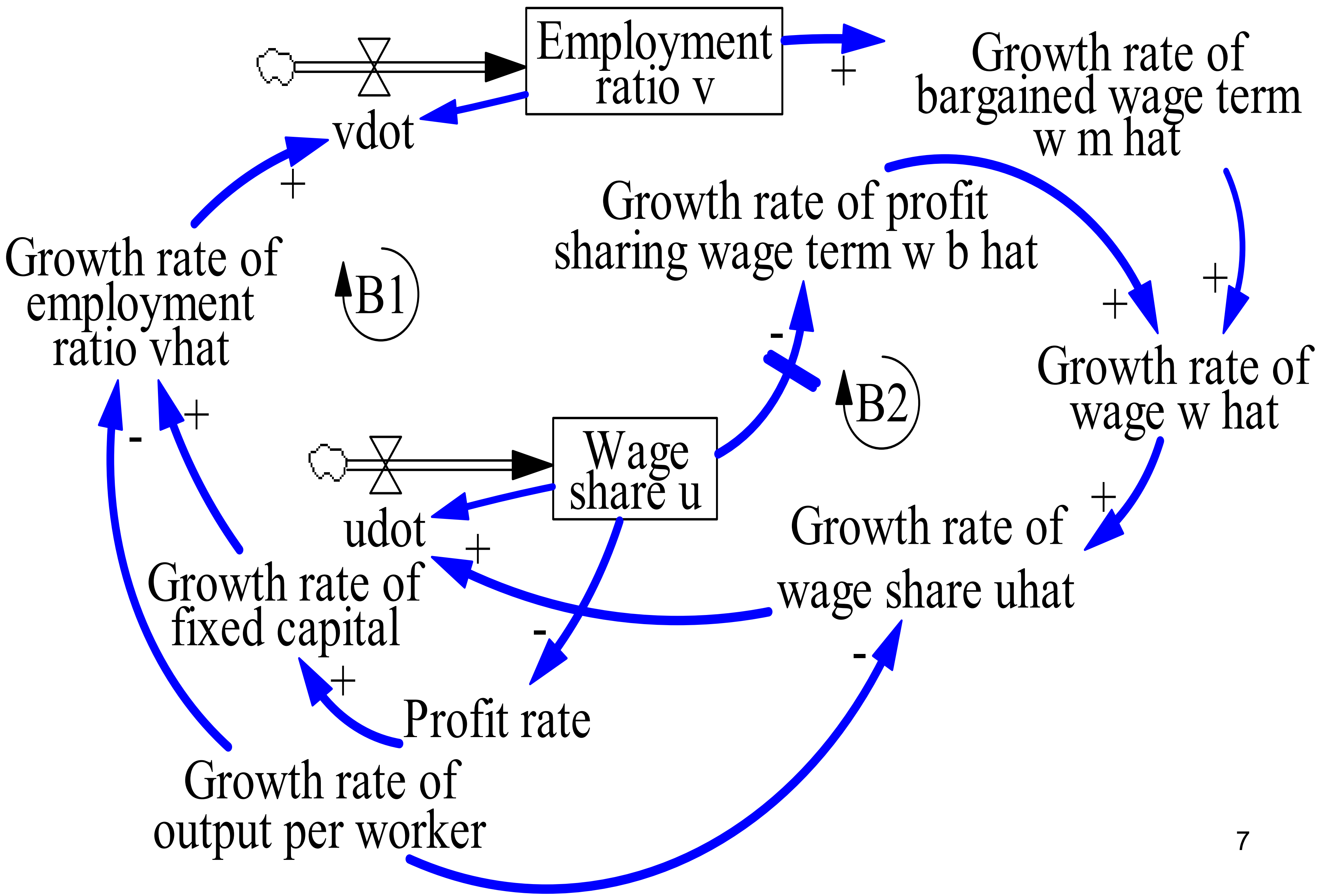
# Refining and encompassing FM

- This paper revises the equations for profit-sharing and bargained wage terms from the opponents’ model in two encompassing non-linear four-dimensional models.
- In the first, before second-order delay is added, a growth rate of profit is proportional to a gap between the indicated and current employment ratios.

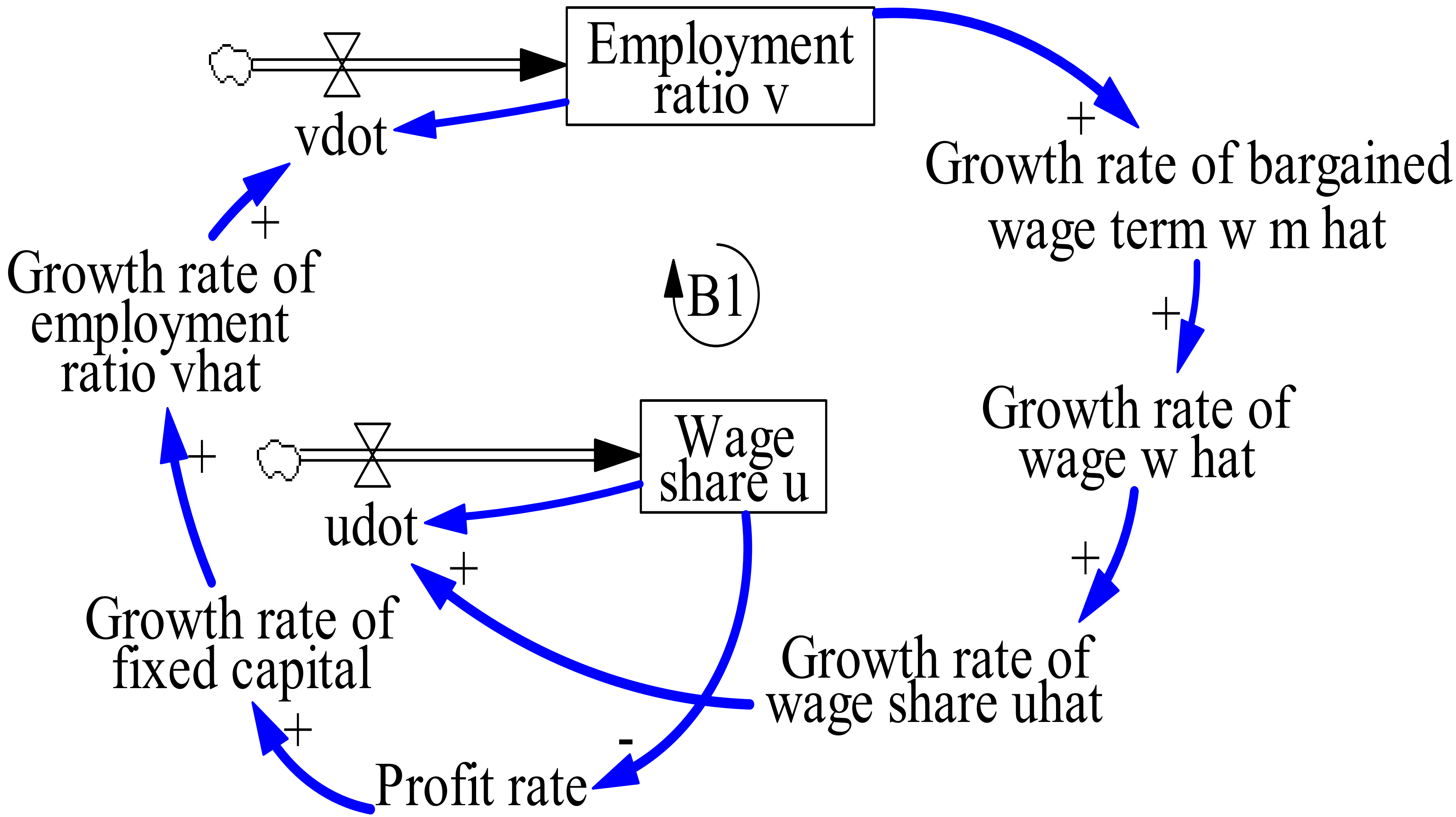
# Early and reinforced stabilisation policies

- In AM deviations of employment ratio and delayed profit rate from their stationary magnitudes define net change of relative wage.
- This proportional control is reinforced in modified AM shortening a transient to a distant target employment ratio.
- *Vensim* parametric optimization for both.

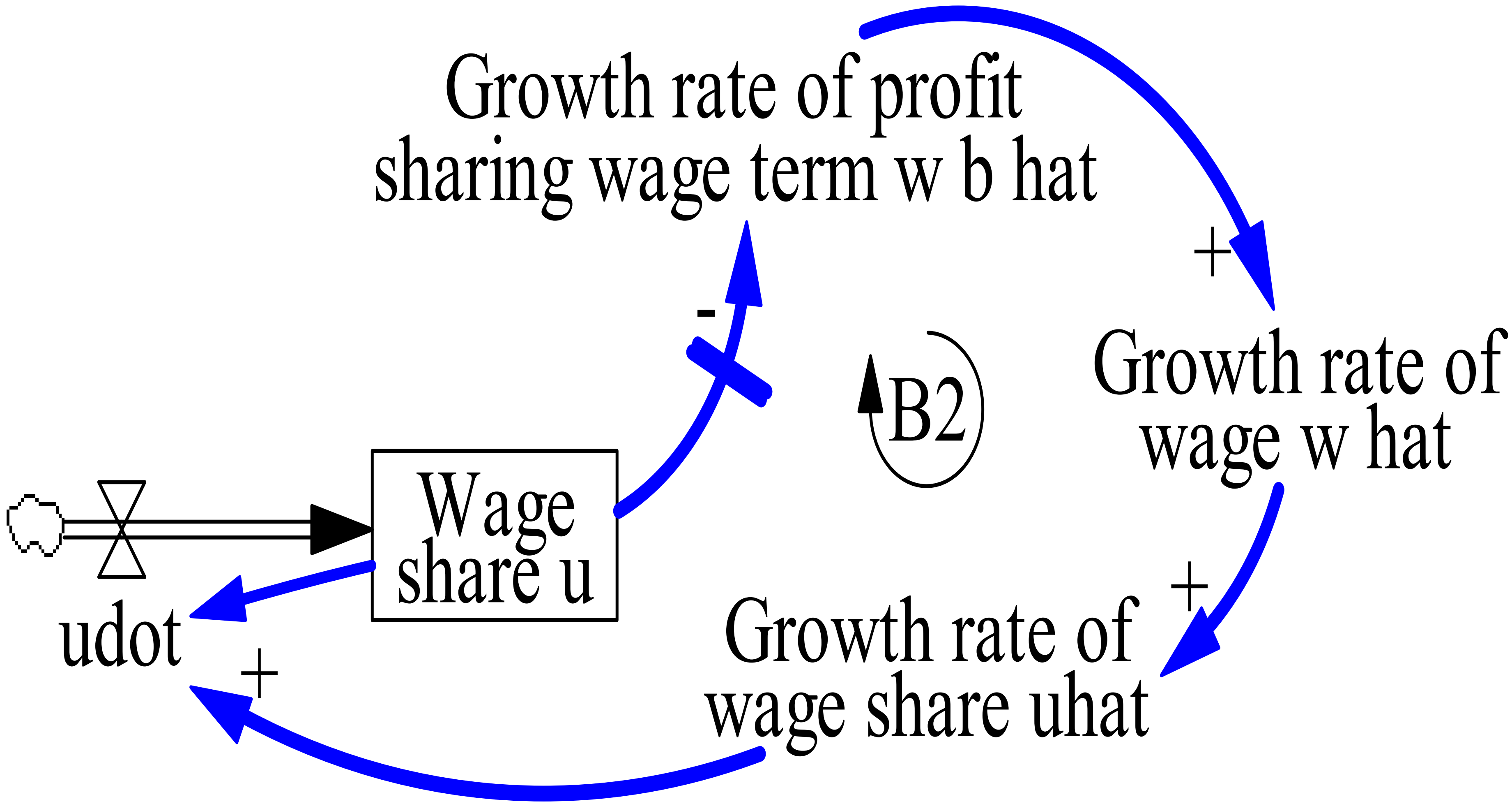
# The structure of FM with information delay



# The 1st negative 2nd order loop in FM and GM



# The 2nd 1st order negative loop in FM (absent in GM)



# Strong assumptions in FM

- Constancy of capital-output ratio ($s$), growth rates of labour force ($n$) and productivity ($h$)
- The rate of accumulation $k$ is identically one

instead of $s(h + n) < k \leq 1$

- No workers' competition for jobs
- No induced innovations
- No direct and roundabout economy of scale
- Myopic rationality of labour and capital
- Linearity of equations of the extensive FM
- Weak non-linearity of the intensive FM

# Bargaining and profit sharing in FM

Growth rate of real wage sums up two terms

$\hat{w} = \hat{w}^m + \hat{w}^b.$

Wage-bargained term (Phillips equation)

$$\hat{w}^m = -g + rv, \; g > 0, \; r > 0.$$

Profit-sharing term

$$\hat{w}^b = e\frac{1-u}{s}, \; 0 < e < k\frac{h}{d} < k.$$

As the stationary $\hat{w}^m_a > 0$ ➔ $0 < e =$ const $< kT_3 = kh/d \leq k$. The paper (Fanti and Manfredi,1998) overlooks this restriction.

# FM with 2nd order information delay in the intensive form

$$\dot{z} = b(u - z)$$

$$\dot{y} = b(z - y)$$

$$\dot{u} = \left( -g + rv + e\frac{1-y}{s} - h \right) u$$

$$\dot{v} = \left( k\frac{1-u}{s} - h - n \right) v$$

# A stationary state in FM

$E_a = (z_a, y_a, u_a, v_a)$,

as in GM

relative wage $z_a = y_a = u_a = 1 – sd/k$,

•rate of surplus value $(1 – u_a)/u_a$,

•profit rate $(1 – u_a)/s_a = d/k$,

•growth rate of fixed capital and net output $d = h + n$, $d \geq h$;

not as in GM

employment ratio $v_a = v_G –(ed)/(kr) < v_G$, where $v_G = (g + h)/r$.

# Fanti and Manfredi, 1998

Proposition [1.1]. The existence of a profit-sharing rule within Goodwin-type economies does not modify the long term distribution ...but reduces the equilibrium level of the employment rate.

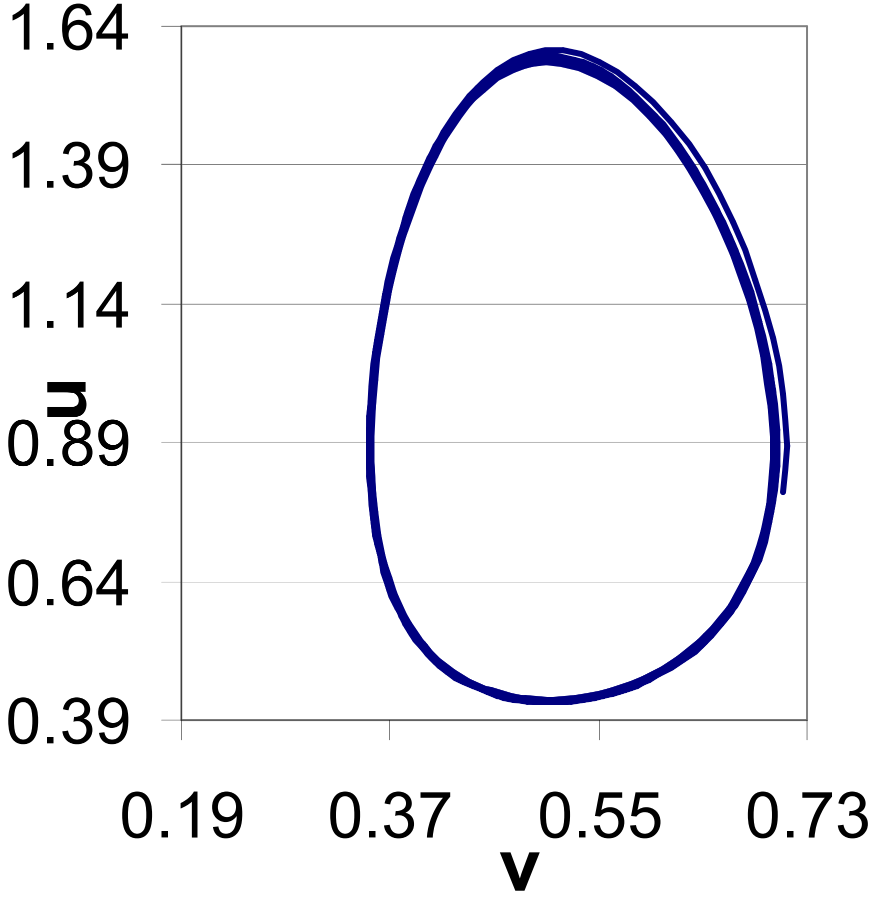
Proposition 1.2. Let the positive steady state $E_a$ exists, then it is asymptotically locally stable if the principal minor of third order in the Hurwitz matrix is positive

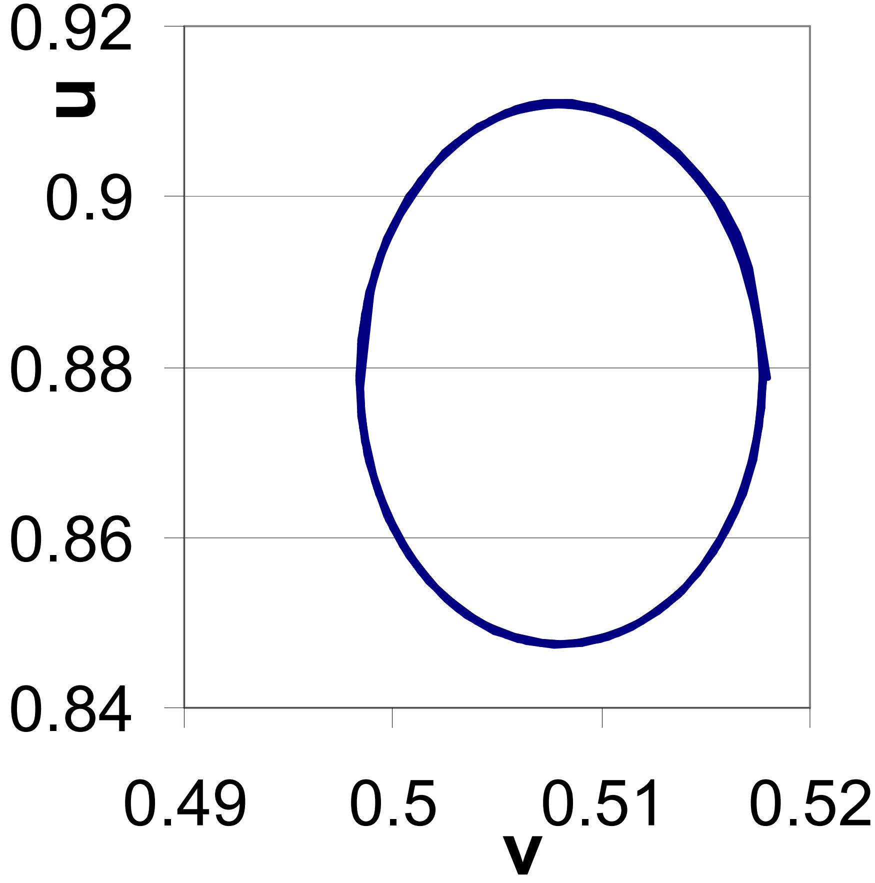
$$\Delta_3 = b^3 emu_a(2b^2 - bmeu_a - 2mrv_a u_a k) > 0.$$

# Propositions 1.3-1.6

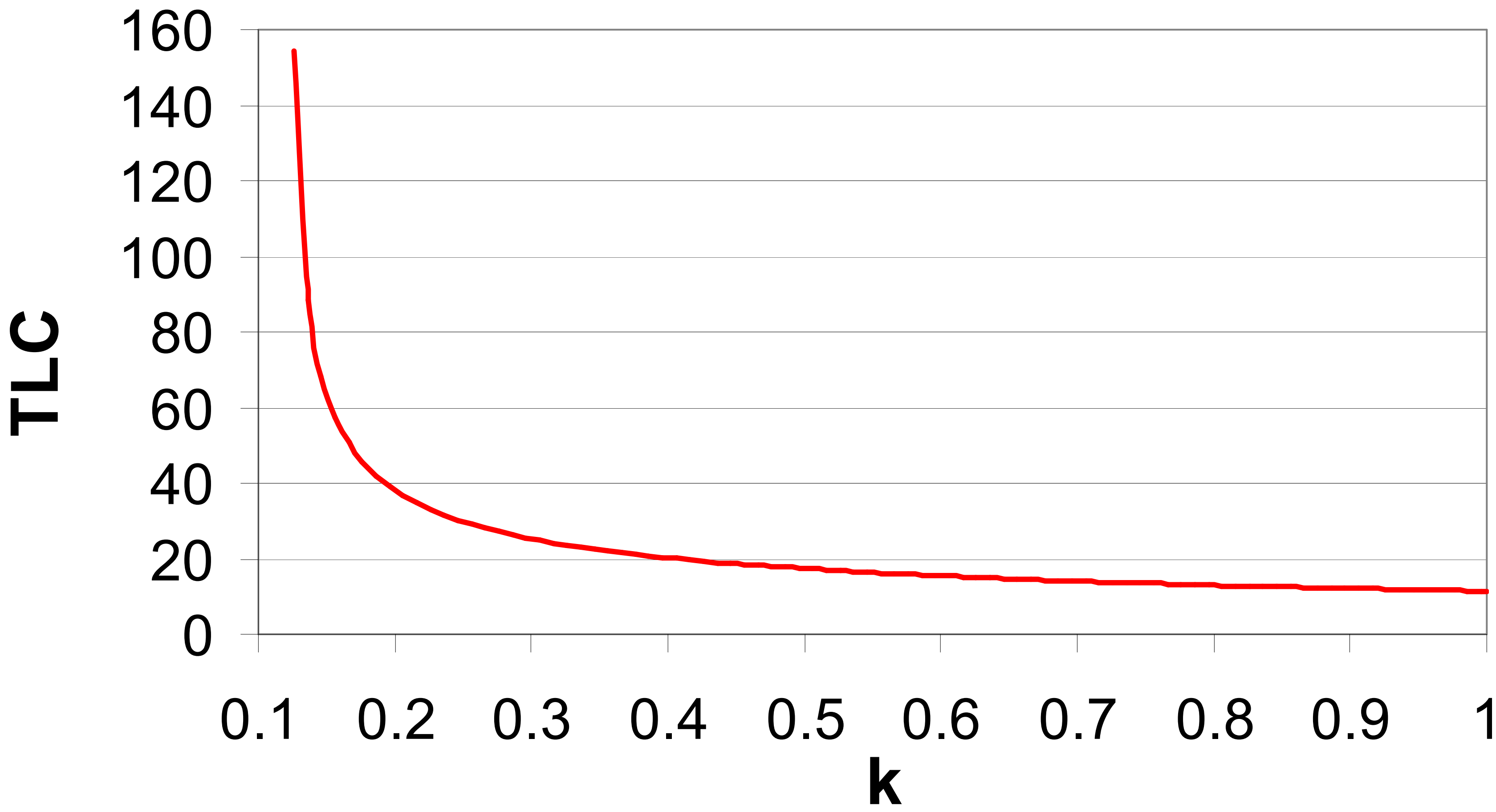
- When a magnitude of the control parameter $b$ becomes critical ($b_h$), the latter inequality turns into equity,
- steady state $E_a$ loses stability and a closed orbit is born as a result of simple Andronov – Hopf bifurcation.
- The average delay of second order $T_h = 2/b_h$ is a critical lag.
- The approximation for the period of a closed orbit is $T_{LC} = 2\pi/b_h < T_G$ .

On the left, the inappropriate “limit cycle” (Fanti and Manfredi, 1998: 392–393); on the right, closed orbit  in economic region. Both counter-clockwise



P. 1.7. If the rate of accumulation ($k$) decreases, the critical lag and period of a cycle increase for $sd < k \leq 1$. Proved by differentiating.



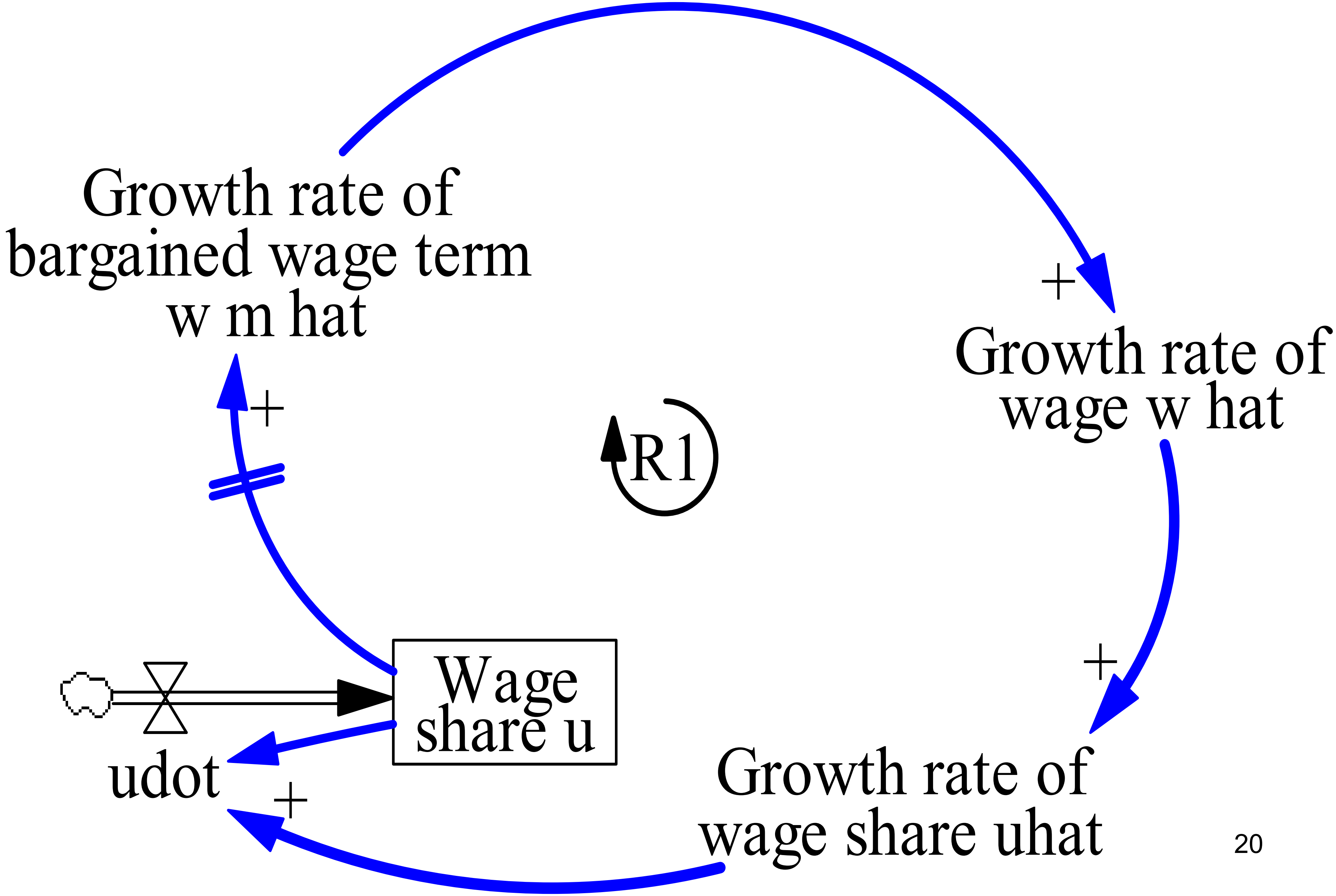
# Neglected importance of accumulation rate in determining cyclical dynamics in FM

For a more realistic rate of accumulation *k* (about 12.62–30% of profit, as opposed to 100% in original FM), critical lag for simple Andronov – Hopf bifurcation is too high being outside economic range (about 8 – 49.12 years, as opposed to 3.64 in original FM) when magnitudes of the other parameters remain the same as basal.

# Long run distribution is left inalterable in FM compared with GM only in *relative* terms!

As the proposed stabilisation policy reduces long run employment ratio ($v_a$ < $v_G$) of steady growing labour force ($N$), the economic output ($P$), surplus value ($S/a$), total wage ($wL$), consumption per head ($wv$) and profit ($M$) are, as a rule, lower than their counterparts in GM.

# The additional 1st order positive loop in AM



# The main policy rule in AM without information delay

Owners of capital, state officials under pressure of workers' parties, trade-unions and grass-root organisations agree on growth rate of profit depending on indicated ($X_1$) and current ($v$) employment ratios

$$\hat{M} = \hat{P} - \frac{\dot{u}}{1-u} = c_2(X_1 - v),$$

target employment ratio

$$X = X_1 - \frac{d}{c_2},\ v < 1 < X_1;\ c_2 = \text{const} > 0,$$

$d$ is stationary growth rate of net output ($P$).

# Equation for net change of relative wage with 2nd order delay in AM

$$\dot{u} = \left[ k\frac{1-y}{s} + c_2(v - X_1) \right] \frac{1-y}{y} u$$

The other three ODEs as in FM

# Wage components growth rates in AM

| | |
|---|---|
| Bargained term $\hat{w}^m$ | $c_2(v - X_1)\dfrac{1-y}{y} + c_1$ |
| Profit sharing term $\hat{w}^b$ | $h + k\dfrac{(1-y)}{s}\dfrac{(1-y)}{y} - c_1$ |

Equation for growth rate of wage

$$\hat{w} = \hat{u} + h = \hat{w}^m + \hat{w}^b$$

# Properties of AM stationary state

$$z_b = y_b = u_b = u_a \text{ as in FM}$$

$$v_b = X > v_a \text{ higher than in GM and FM}$$

$$\hat{w}^m = \hat{w}^b = h/2 \text{ (for chosen } c_1\text{)}$$

# Conditions of FM-AM local equivalence in linear approximation at $E_a$=$E_x$

$$c_2 = \frac{r}{m_a'}$$

$$e = k m_a'$$

$$1 > X_1 = v_G > 0,\ 1 > X = v_a > 0$$

# Proposition 2.1 for AM

Let the positive stationary state $E_X$ exists, then it is asymptotically locally stable if the principal minor of third order in the Hurwitz matrix is positive ($\Delta_3 > 0$), when a magnitude of the control parameter lies within limits

$$0 < c_2 < \frac{b(2b-d)}{2dX}$$

# Proposition 2.6 for AM

The second order delay of relative wage, equal to the critical lag for simple Andronov – Hopf bifurcation in FM ($T_h = 2/b_h$), poses no threat to stability of stationary state in AM if

$$0 < c_2(b_h) < \frac{b_h(2b_h - d)}{2dX}.$$

The possibility of such a choice is guaranteed by the fact that $b_h >> d/2$.

# A reinforced stabilisation policy via modified proportional control

$$\dot{u} = \left[ c_2(v - X) + qk\left( \frac{1-y}{s} - \frac{d}{k} \right) \right] \frac{1-y}{y} u$$

where $q \geq 1$, $q = 1$ in AM.

# Proposition 3-2.1 for modified AM

Let the positive stationary state $E_X$ exists, then it is asymptotically locally stable if the principal minor of third order in Hurwitz matrix is positive ($\Delta_3 > 0$), when a magnitude of the control parameter is positioned within the interval

$$0 < c_2 < \frac{b(2b - qd)}{2dX}.$$

# Proposition 3-2.6 for modified AM

The second order delay of relative wage, equal to the critical lag for simple Andronov – Hopf bifurcation in FM ($T_h = 2/b_h$), poses no threat to the stability of stationary state in the modified AM if a magnitude of the control parameter $c_2$ is selected within the given (non-empty) interval (see the previous slide).

## *One-parameter policy optimization in AM*

**Maximize**

$$\left[ -\int_{1958}^{2021} |v - X| dt - 10^5 \, IF\ THEN\ ELSE(v > X, 1, -1) \right]$$

subject to

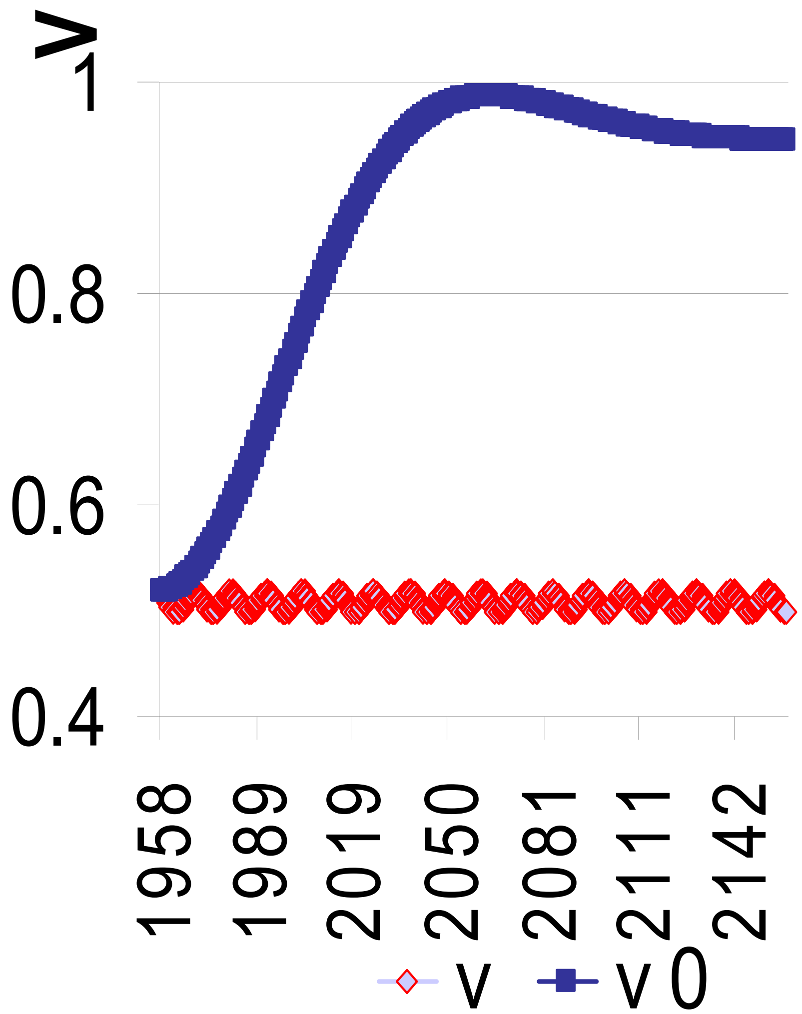
$$\dot{x} = f[x(t), c_2],$$

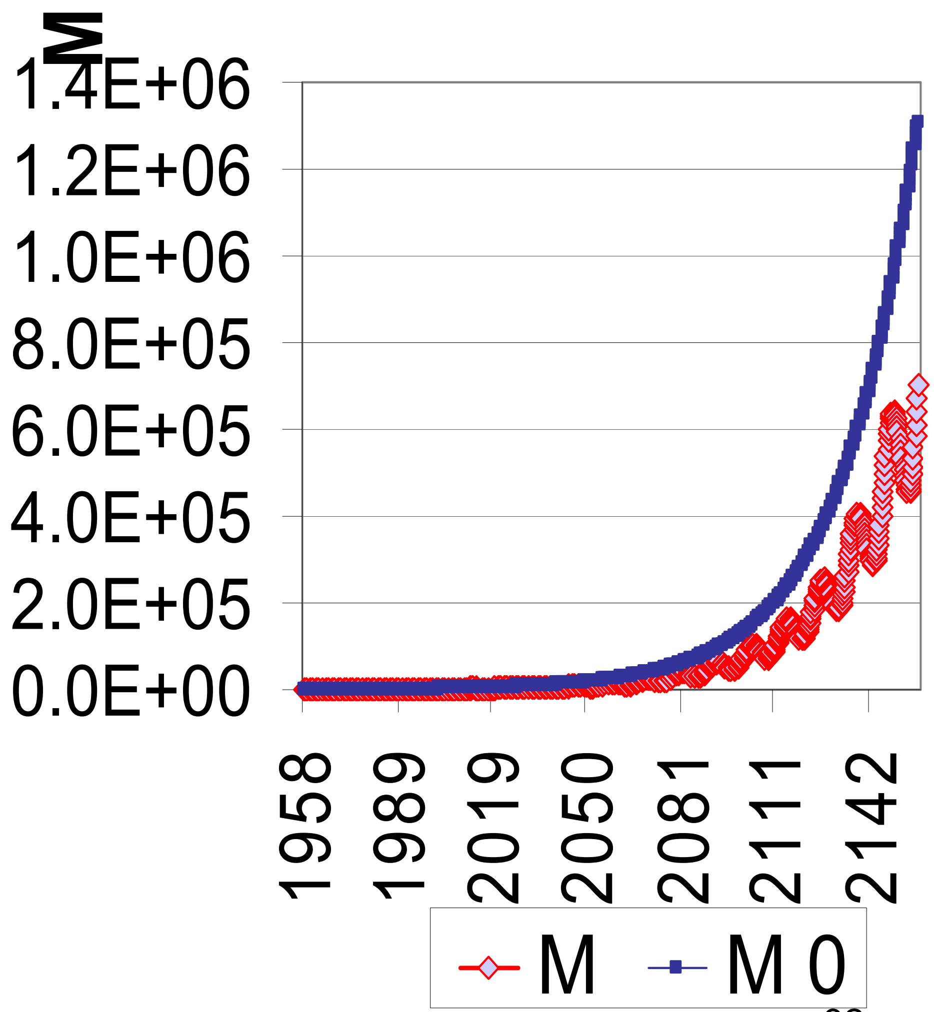
given initial $x_0$, $X = 0.95$,

$$0.01 \le c_2 = 0.045 \le 1.5.$$

Parameter found $c_2$ =0.0381.

# Better use of labour force and higher profit in AM than in FM: (v 0, v), (M 0, M)



# Two-parameters policy optimization in modified AM

**Maximize**

$$\left[ -\int_{1958}^{2021} \left| v - X \right| dt - 10^5 \, IF\ THEN\ ELSE(v > X, 1, \text{-}1) \right]$$

subject to

$$\dot{x} = f[x(t), c_2, q],$$

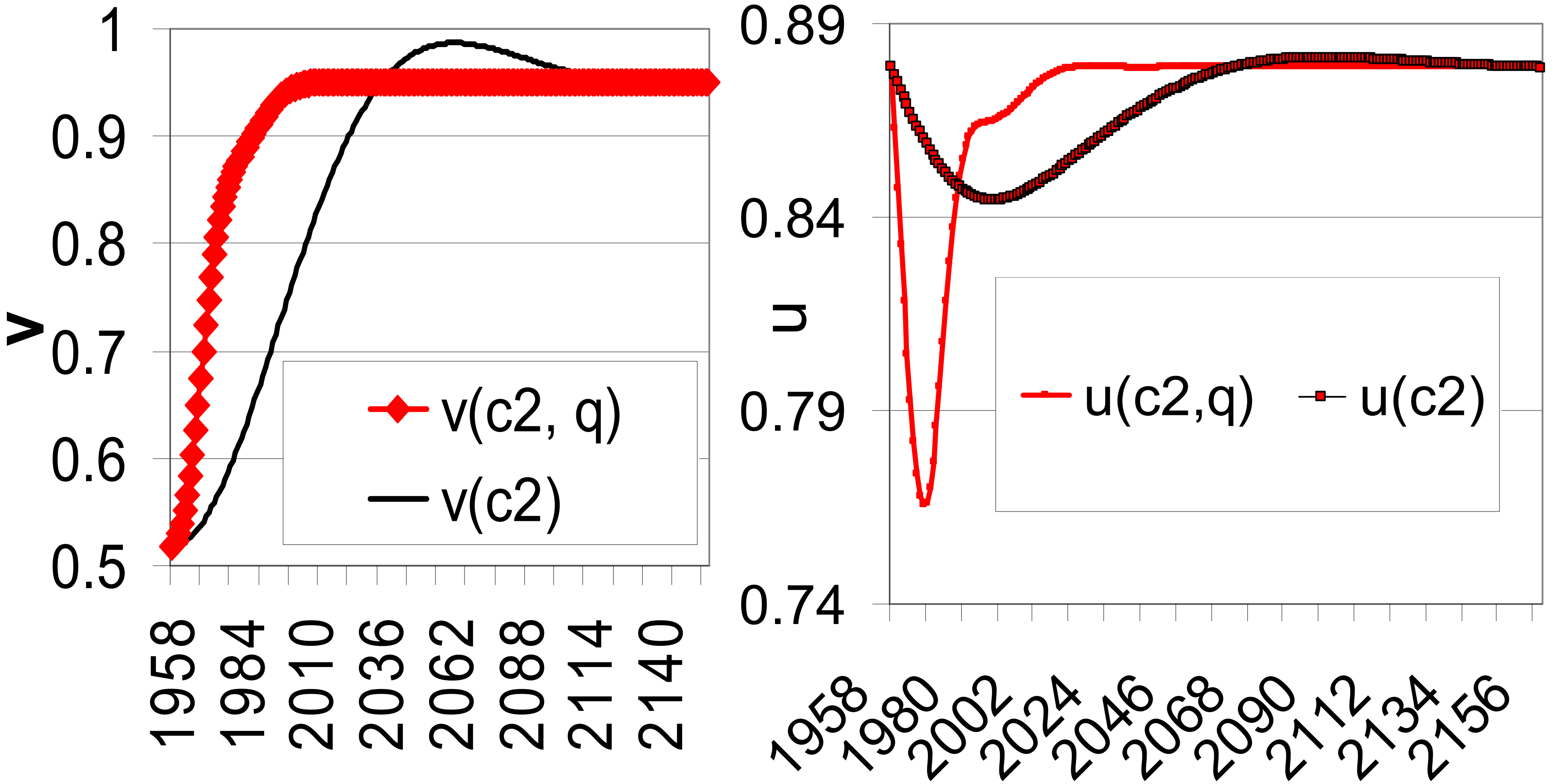
given initial $x_0$, $X = 0.95$,

$$0.01 \le c_2 = 0.2 \le 1.5,$$

$$0.5 \le q = 2 \le 5.$$

Parameters found $c_2$ =0.3028, $q$ = 3.0411.

# Dynamics in modified AM compared with AM: effects of reinforced stabilisation policy on employment ratio (*v*), relative wage (*u*)



# Conclusion

The importance of rate of accumulation ($k$) is disregarded in FM hence the opponents' proposition on delayed profit indexation as main trigger of persistent business cycle is premature.

FM includes the embryonic stabilisation policy via profit-sharing without targeting employment.

Deficiencies of that stabilisation policy: chronic mass unemployment, squeezed total wages ($wL$) and low profits ($M$).

FM basic cycle is disappeared in AMs because of combination of feed-back and feed-forward control.

# Viable alternative to austerity trap

**Improvements in relation to FM:**

strong gains in employment, increased total wage, profit and output, higher working class' living standard; far better use of economic potential.

**Extreme condition tests prompted by FM strengthen confidence in the invented policy rules in papers (Ryzhenkov 2005, 2012).**

Growth of profit ought to be not mainly determined by several hundreds of most powerful TNCs.

**Target employment ratio has to be a decisive factor of growth rate of profit for the labourers' and unemployed lasting benefit!**

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