# Supposing a Control Law of Capital Accumulation for the Modern Italian Economy

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# This paper connection to an exposition in National Archaeological Museum, Athens

- "… Aeschylus, Sophocles, Euripides expressed the tragic character of human nature in its strive to overcome its prescribed course and reach eternity."
- "Classical philosophy focused on the structure and rules that govern the world…"

  This paper approach:

  - human beings are not supremely well-informed creatures as wrongly assumed by widely used macroeconomic models;
  - the system dynamics methodology focuses on basic structures and rules that are not outside the control of human beings (determinism is not fatalism).

# Relation to prior work

Endogenizing productivity growth is a classical way of extending Goodwin's model (1972).

I. The first one, following the famous Kaldor – Verdoorn law, links the productivity gains to the growth rate of production (e.g. Boggio 2006).

II. The second one relies on mechanization and the diffusion of knowledge embodied in equipment driven by the stock of fixed capital per labourer (e.g. Glombowski, Krüger 1984, van der Ploeg 1987).

III. This paper refines and blends both.

# CONTENTS

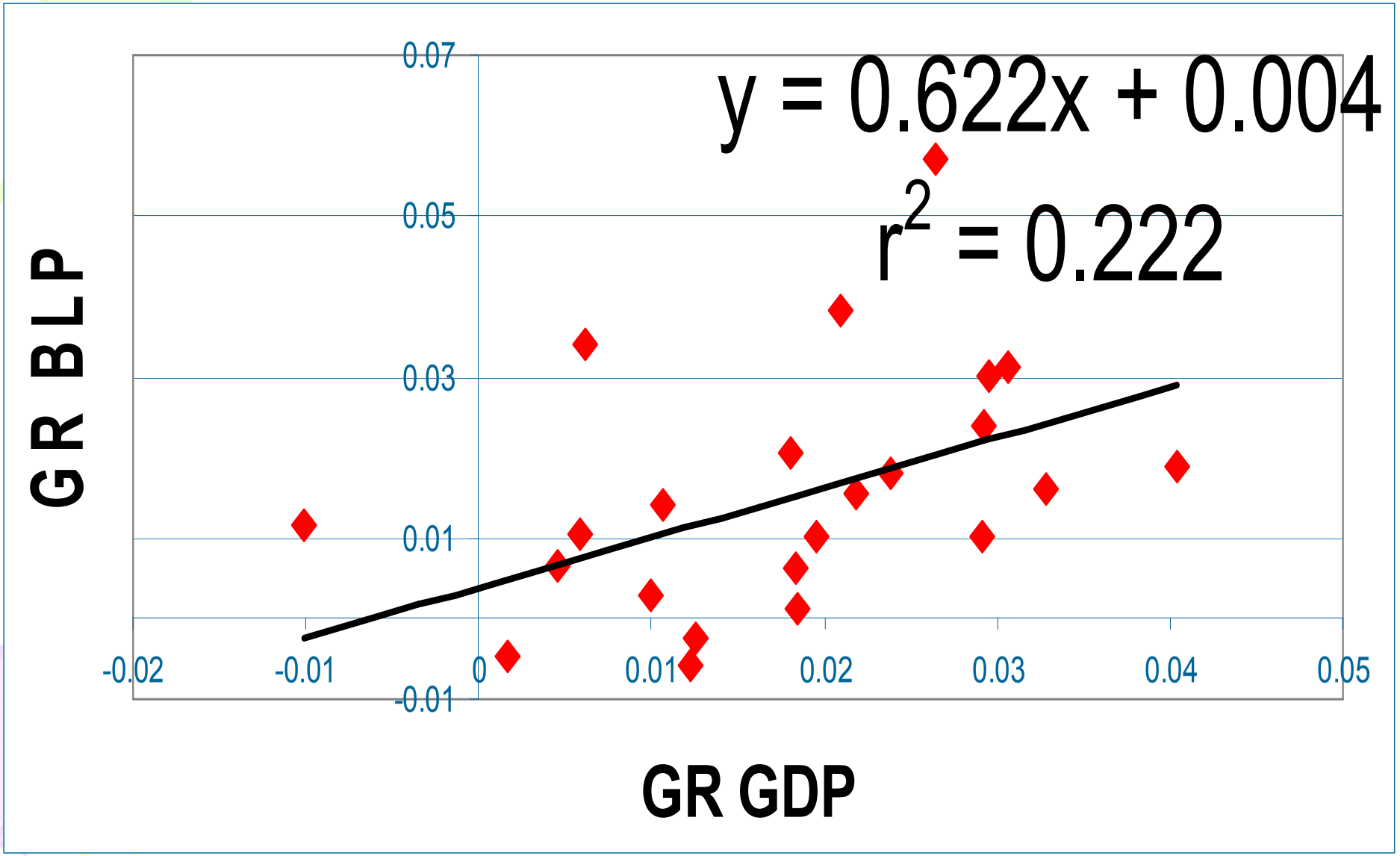
# Enigmas of Italian economy

I. How to reconcile direct relation between growth rates of net output and labour productivity and inverse relation between growth rates of employment ratio and labour productivity?

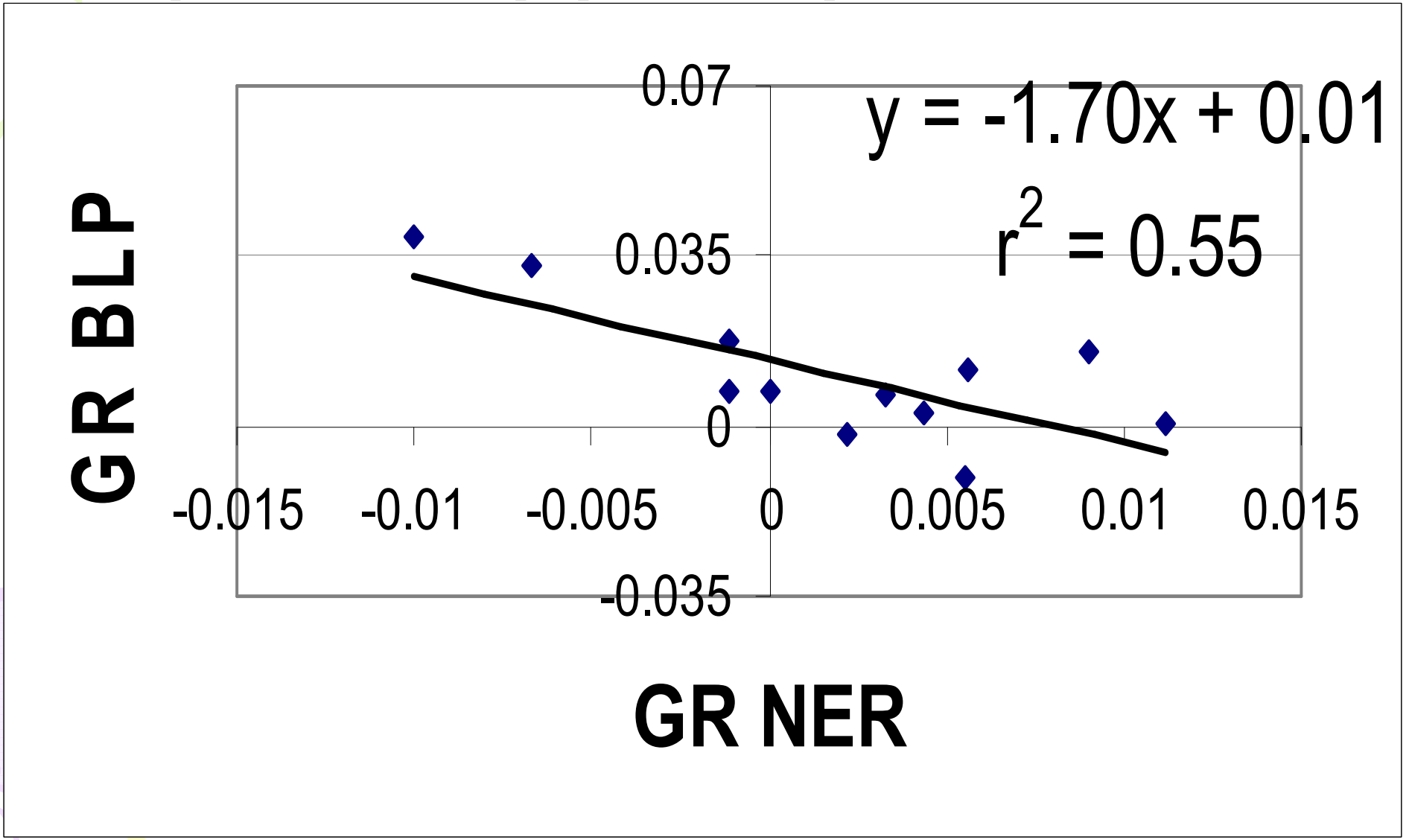
II. How to explain inverse relation of employment ratio with profitability?

III. Why profit rate secular increase goes hand in hand with profit investment share secular decline?

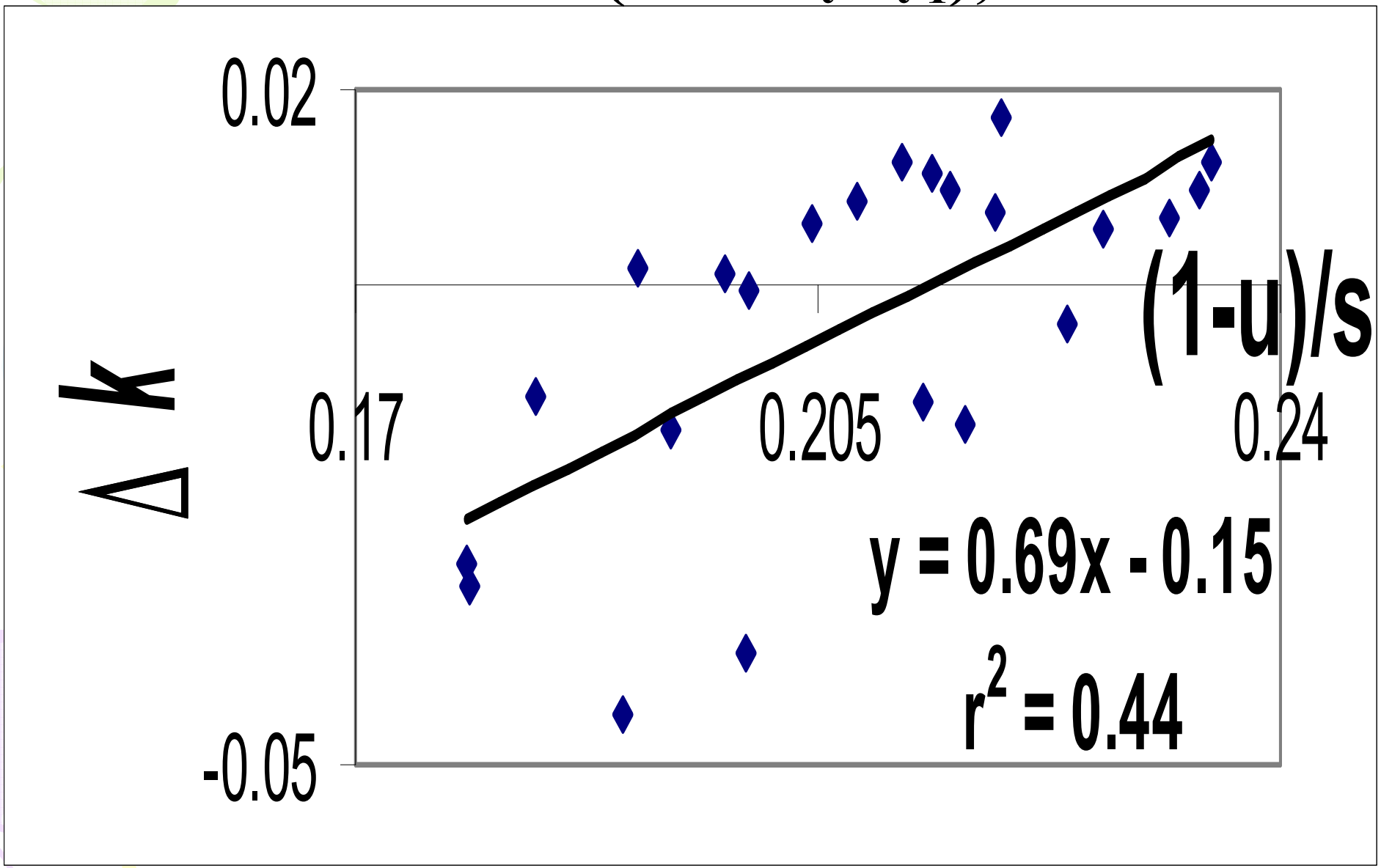
# Direct correlation of growth rates of GDP and of business labour productivity (GR BLP), 1994–2005



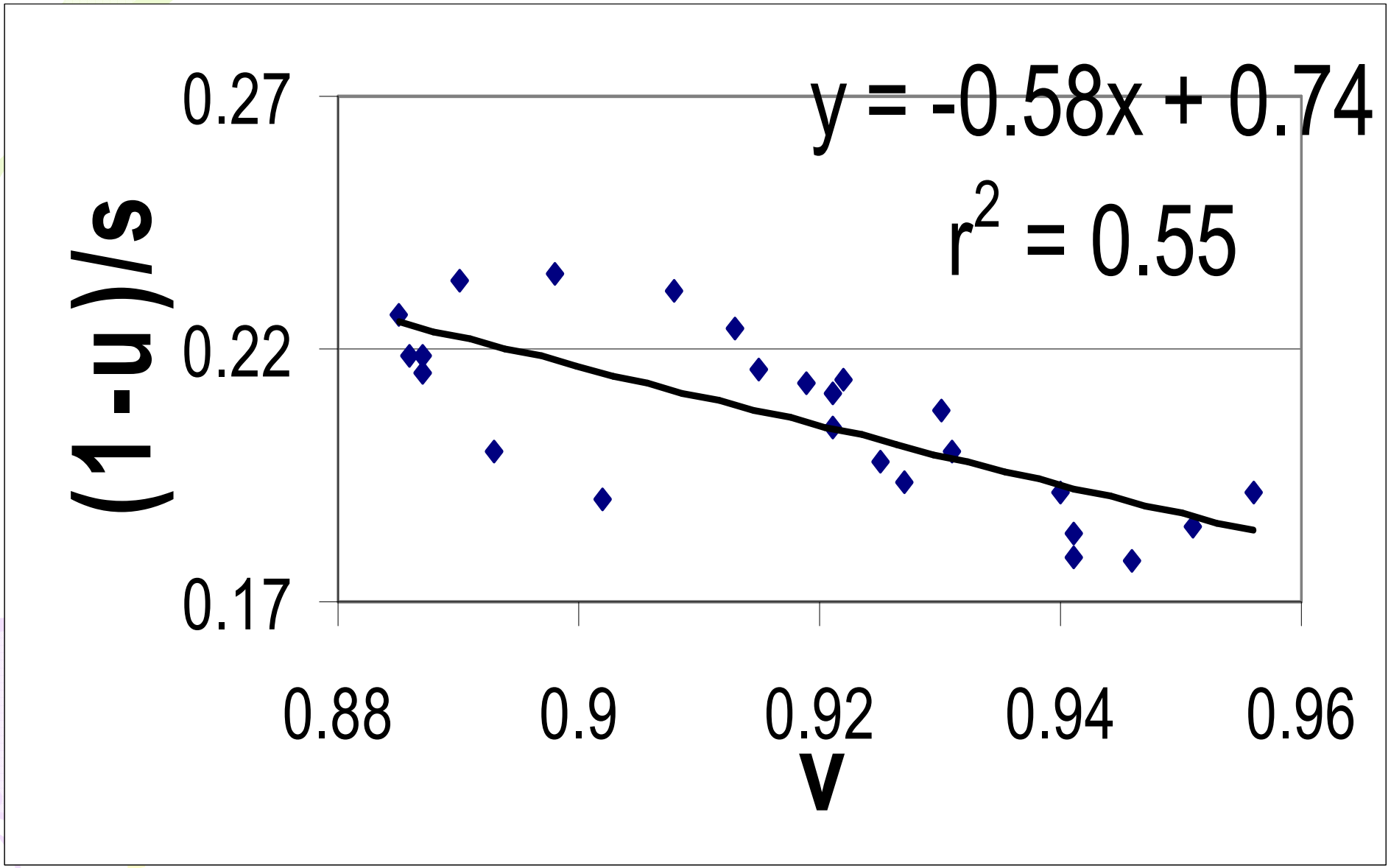
# Growth rates of national employment ratio (GR NER) and of business labour productivity (GR BLP), 1994–2005



# Profit rate (1-*u*)/*s* and increment of profit investment share ($\Delta k = k_t - k_{t-1}$), 1982-2004



# Employment ratio (*v*) and profit rate (1 – *u*)/*s*, 1980–2004



# Assumptions of HL

- Advanced capital does not include variable capital, capital of circulation and natural capital;
- two social classes (capitalists and labourers);
- the State enforces property rights; heterogeneous labour force and fixed assets;
- only one good is produced; production (supply) equals effective demand;
- only profits are partially saved and invested;

- steady growth in labour force;
- a growth rate of unit real labour compensation rises near full employment;
- a change in capital intensity and technical progress are not separable due to invention and innovation;
- during big cycle inputs with different efficiencies are used;
- labour qualification matches technological requirements;
- fixed assets and labour forces are complementary and are substitutes depending on labour income share and on employment ratio.

# Variables of Hypothetical Law (HL)

- ***K*** – net fixed assets (real)
- ***N*** – labour force
- ***L*** – employment
- ***P*** – GDP (real)
- ***k*** – profit investment share
- ***s = K/P*** – capital-output ratio
- ***v = L/N*** – employment ratio
- ***w*** – worker's real compensation
- ***a = P/L*** – labour productivity
- ***u = w/a*** – relative labour compensation
- ***(1 – u)/s*** – profit rate

## Technical progress function for Italy

$$\hat{a} = h_1 + h_2 K\hat{/}L + m\psi(\hat{v}),$$

$$\psi(\hat{v}) = \hat{v},$$

$$h_1 > 0, \;\; 1 > h_2 > 0,$$

$$m = 0, \text{ if } v = 0, \; m > 0, \text{ if } 0 < v < v_{\min},$$

$$m \approx -1.255 < -1, \text{ if } 1 > v \geq v_{\min} > 0;$$

## Technical progress function for the USA

$$\hat{a} = h_1 + h_2 K\,\hat{/}\,L + mSIGN(\hat{v})|\hat{v}|^j,$$

$$h_1 \geq 0, 1 \geq h_2 \geq 0, m \geq 0, 1 > j > 0.$$

# Mechanization function

$$\hat{K / L} = n_1 + n_2 u + n_3 (v - v_c),$$
$$n_1 < 0, n_2 > 0, n_3 < 0, 0 < v_c < v_a < 1;$$
for Italy $n_3 \approx -0.103 < 0$,
for the USA $n_3 > 0$.

**Modified Phillips Eq.**
**for real labour compensation**

$$\hat{w} = -g + rv + b\hat{K / L},$$
$$g > 0, r > 0,$$
for Italy $b = 0$,
for the USA $b > 0$.

# Investment functions

Investment ($\int\!\!\rightarrow$ stock fixed assets $K$)

$$\dot{K} = k[(1-u)P],\ 1 \geq k > 0.$$

Derivative of profit investment share in **HL** ($\int\!\!\rightarrow$ stock variable $k$)

$$\dot{k} = c_2\left(\frac{1-u}{s} - p_w\right),\ c_2 \geq 0, p_w > 0.$$

Profit investment share (auxiliary variable $k$) in **CL**

$$1 \geq k = c_0 - c_1 s > 0,\ c_0 > 0 \text{ and } c_1 > 0.$$

A.V.2

# Indirect broader evidence for the profit investment share equation in HL

Denmark, Germany, Great Britain, Greece, Ireland, Spain, and some Eastern European countries cut corporate income-tax rate.

Their authorities argue that they strive for hospitable investment climates and cannot help workers if they drive away the capital that employs and pays them in a globalized economy with mobile wealth and investment (Henry Olsen in *The Wall Street Journal*, July 21, 2008: 15).

"However, in such a world,…capital now can seek higher returns from abroad more easily than before, thus enhancing its position in a strategic bargain with labour" (Arjun Jayadev in *Cambridge Journal of Economics*, 2007, 31: 423).

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**A.V.2**

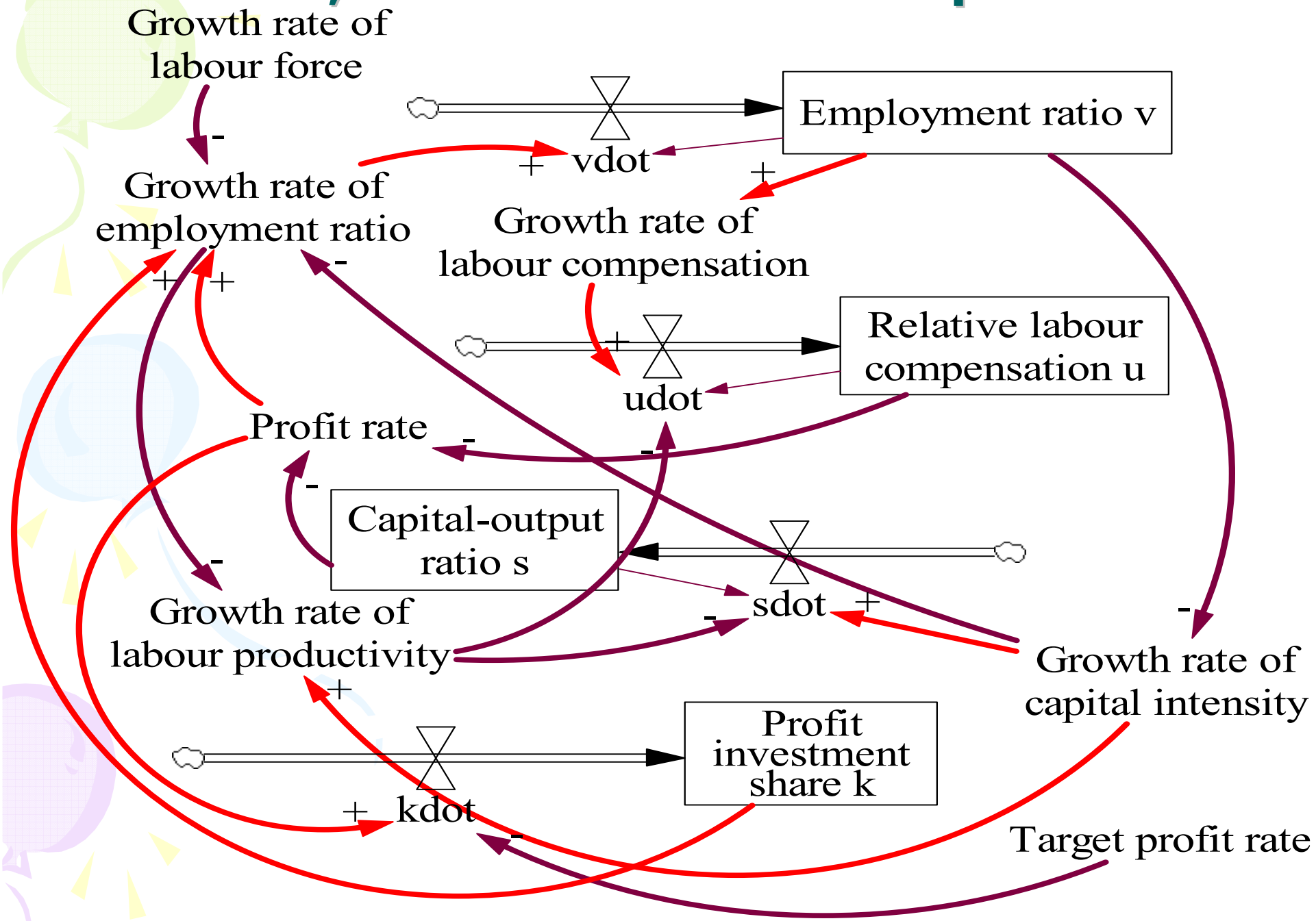
Olsen H. Europe has an economics lesson for Obama / The Wall Street Journal, July 21, 2008: 15.
Jayadev A. Capital account openness and the labour share of income / Cambridge Journal of Economics, 2007, 31, 423-443.
Ryzhenkov, 8/17/2008

# Special cases of HL intensive form

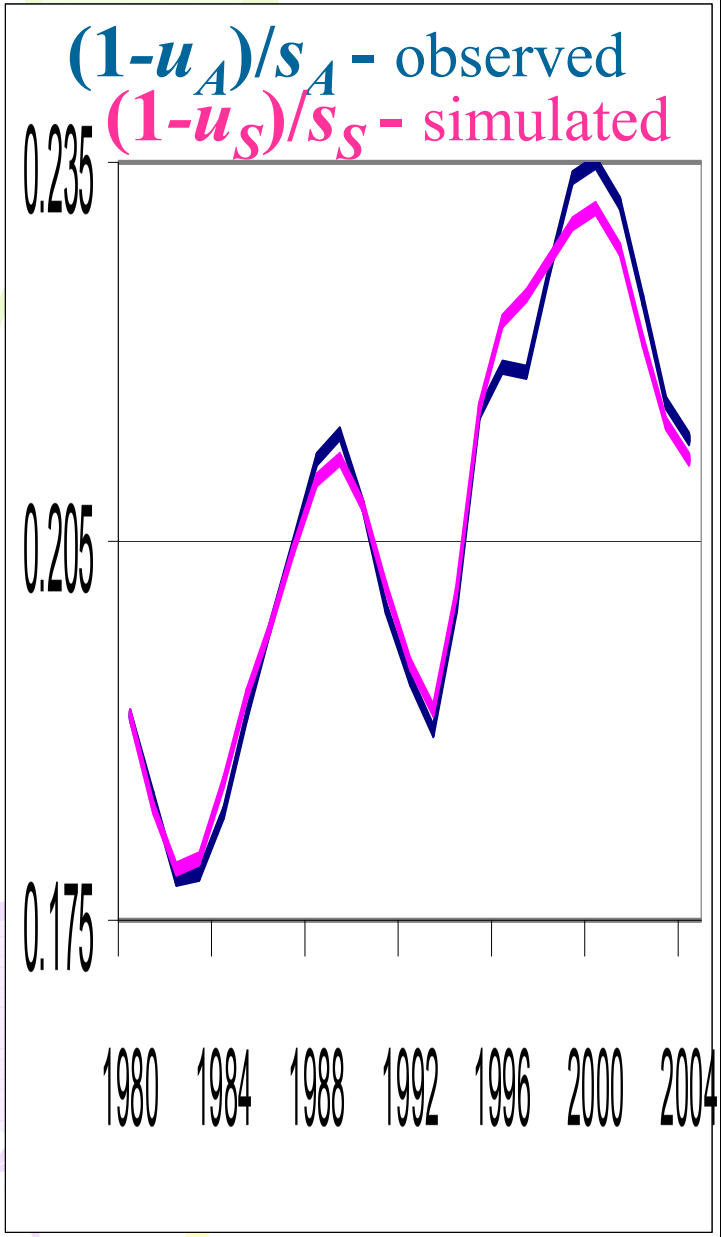
1. Goodwin model (1967), Ploeg (1985) neoclassical model, Boggio's (2006) Goodwinian model with alleged increasing returns, Manfredi – Fanti (2000) model.

2. Simplified HL generalizes local behaviour of Ploeg's neoclassical model (1983) and Kennedy – Goodwin model (1981) as its reproduces their behavioural patterns and generates new ones.

# Stocks, flows and causal loops of HL

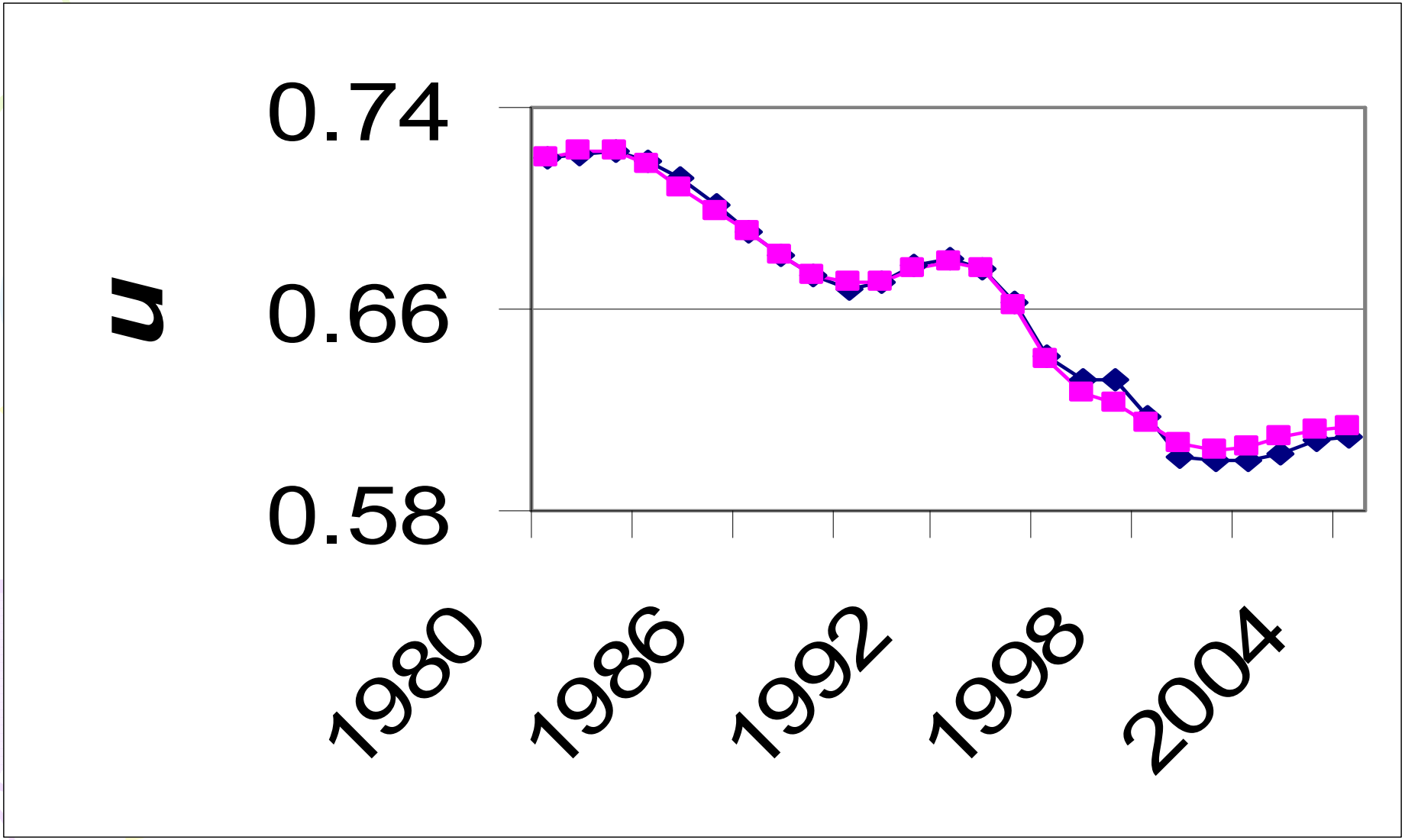


# Historical fit of HL, Italy, 1980-2004



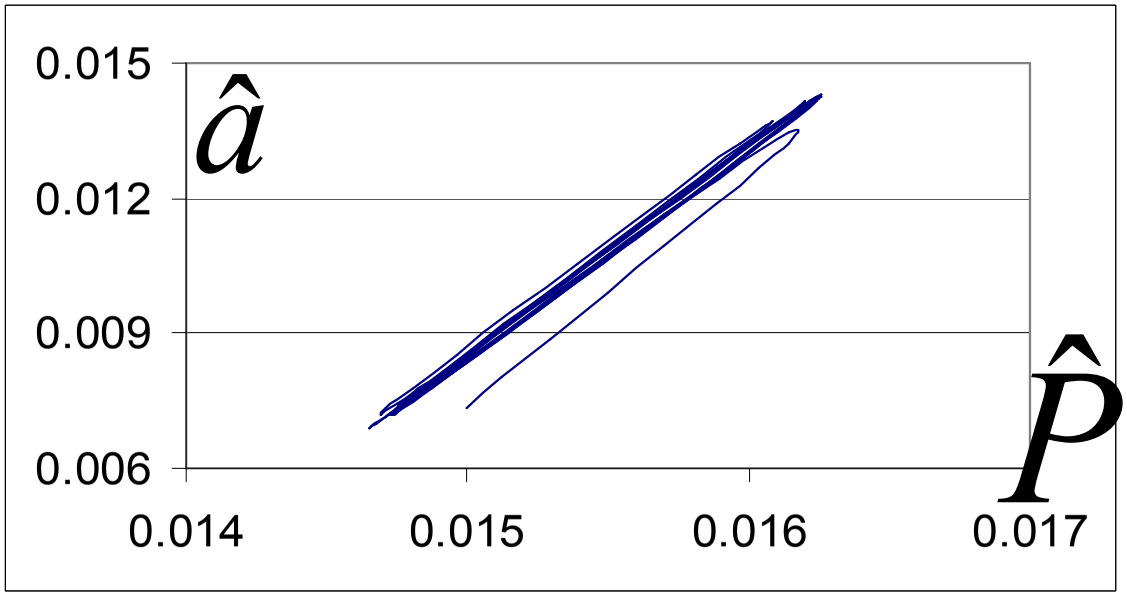

| Variable | RMSPE (%) | $U^M$ | $U^S$ | $U^C$ |
|---|---|---|---|---|
| Profit rate, $(1-u)/s$ | 1.04 | 0.00 | 0.15 | 0.85 |
| Employ-ment ratio, $v$ | 0.07 | 0.00 | 0.00 | 1.00 |
| Profit invest-ment share, $k$ | 0.69 | 0.00 | 0.09 | 0.91 |

# Observed (blue) and simulated (violet) relative labour compensation (*u*), Italy, 1980–2004

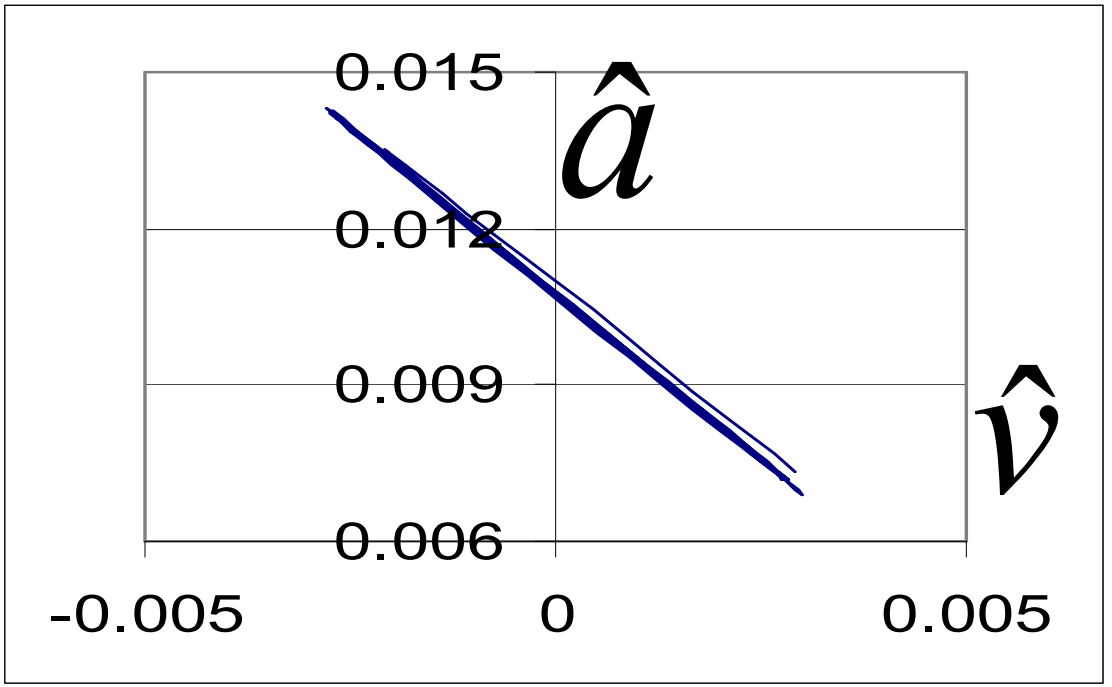


# Inertia Scenario I, 2004–2200

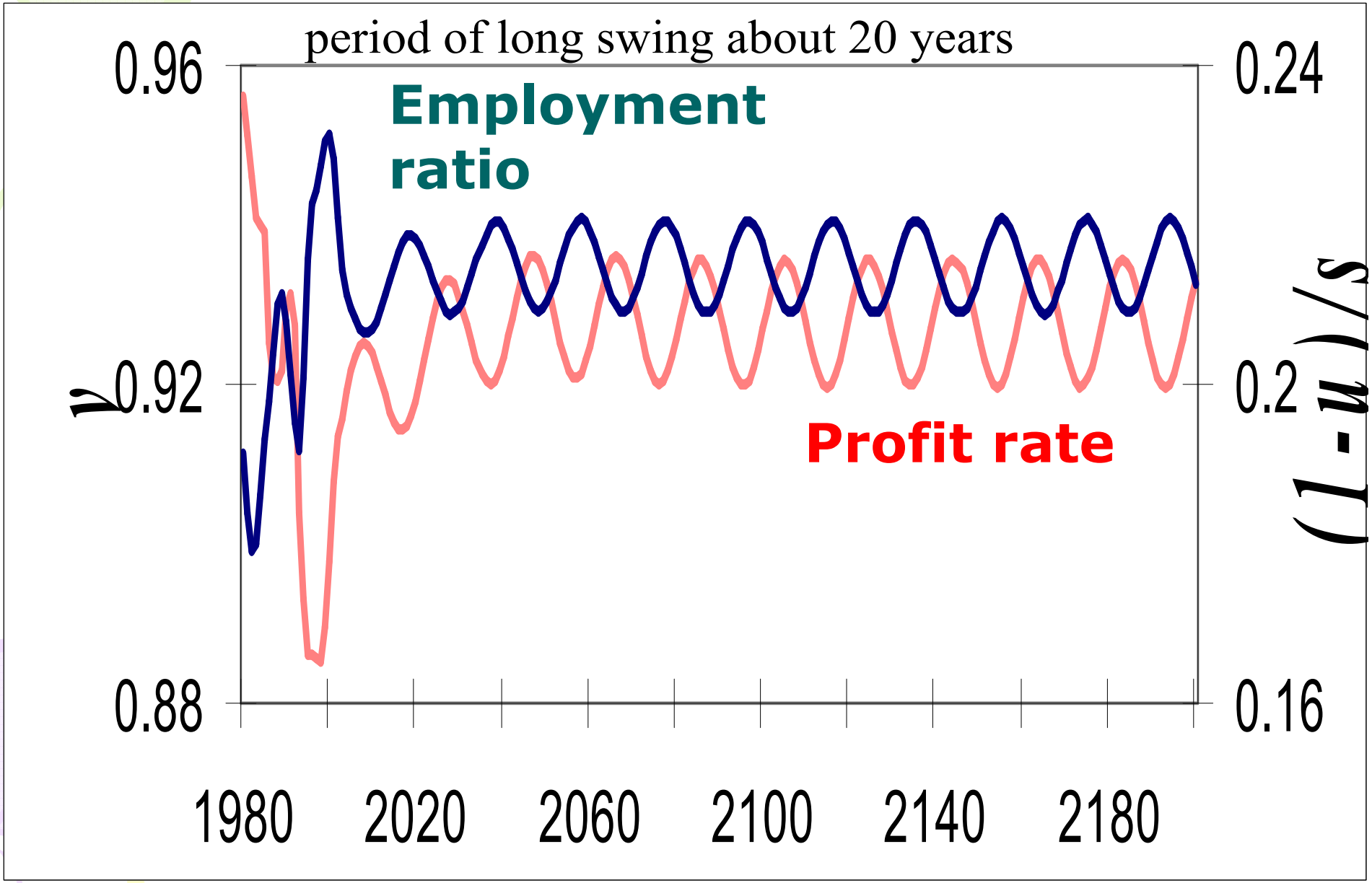
Direct relation of growth rates of GDP ($\hat{P}$) and labour productivity ($\hat{a}$)



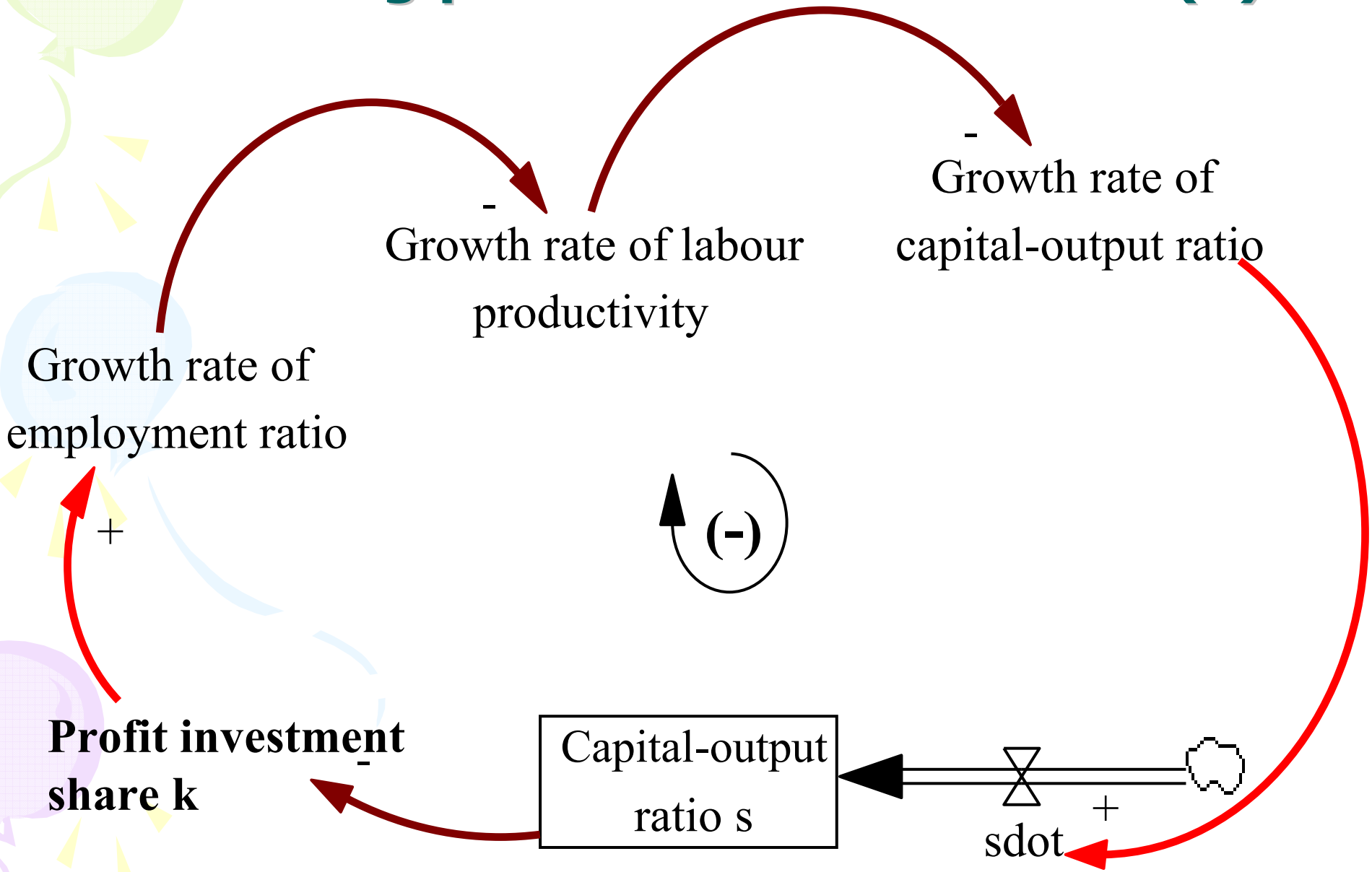

Inverse relation of growth rates of employment ratio ($\hat{v}$) and labour productivity ($\hat{a}$)



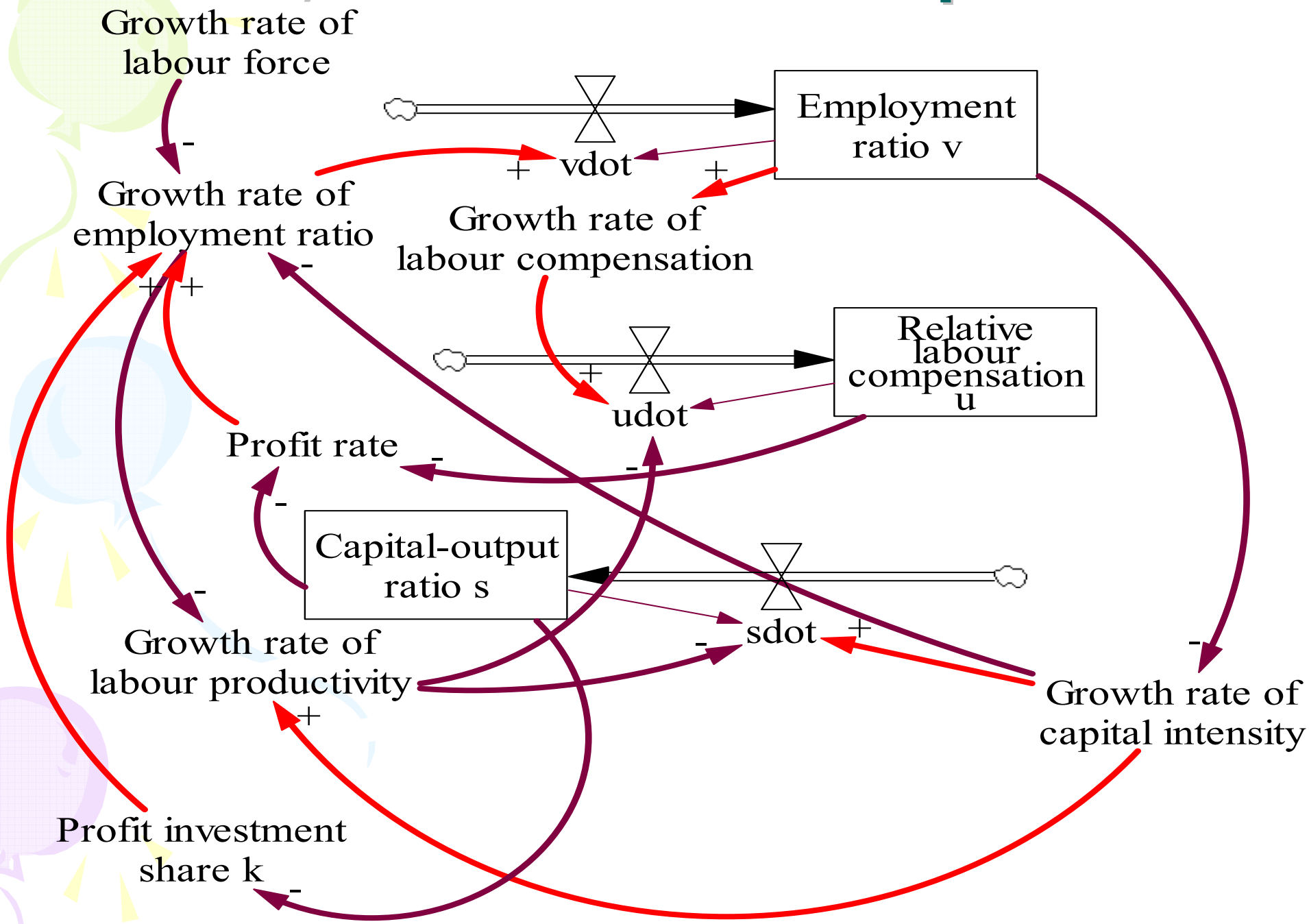
# Profit rate (right scale, blue) and employment ratio, Inertia scenario I, 1980-2200



# Negative 1st order loop (for $m < 0$) controlling profit investment share ($k$)



# Stocks, flows and causal loops of CL

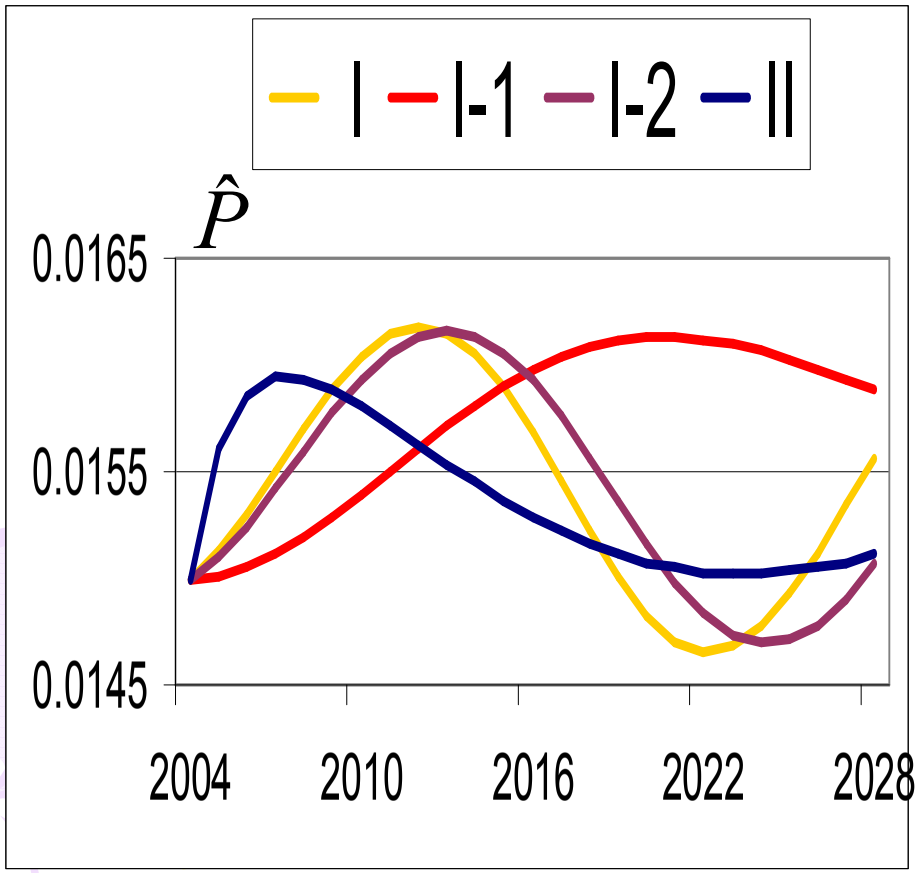


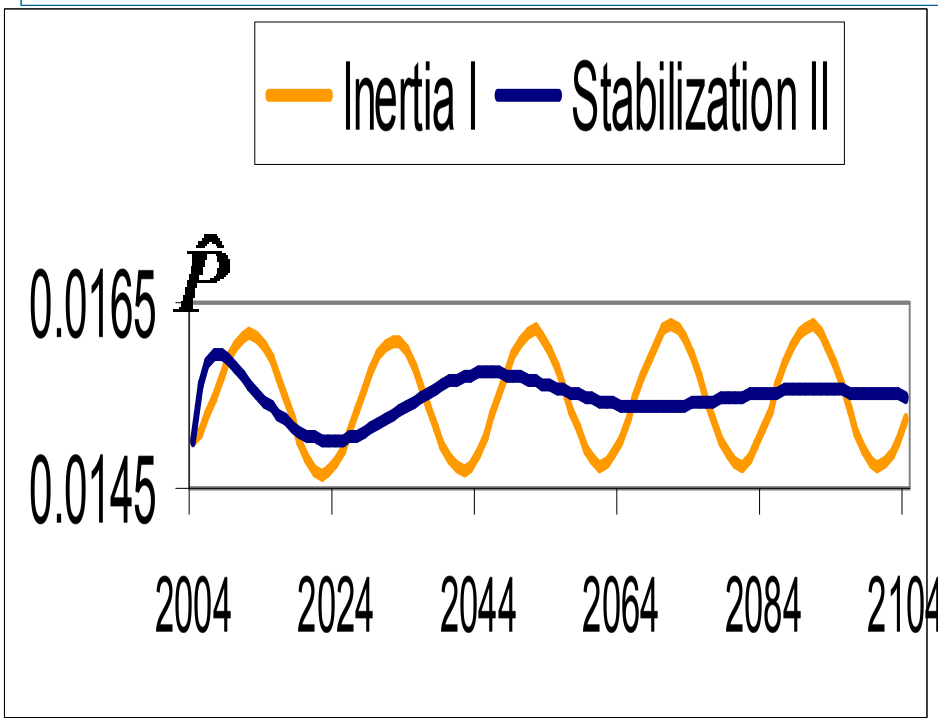
# Long swings in scenarios

Period (years) in scenarios, 2004–2200

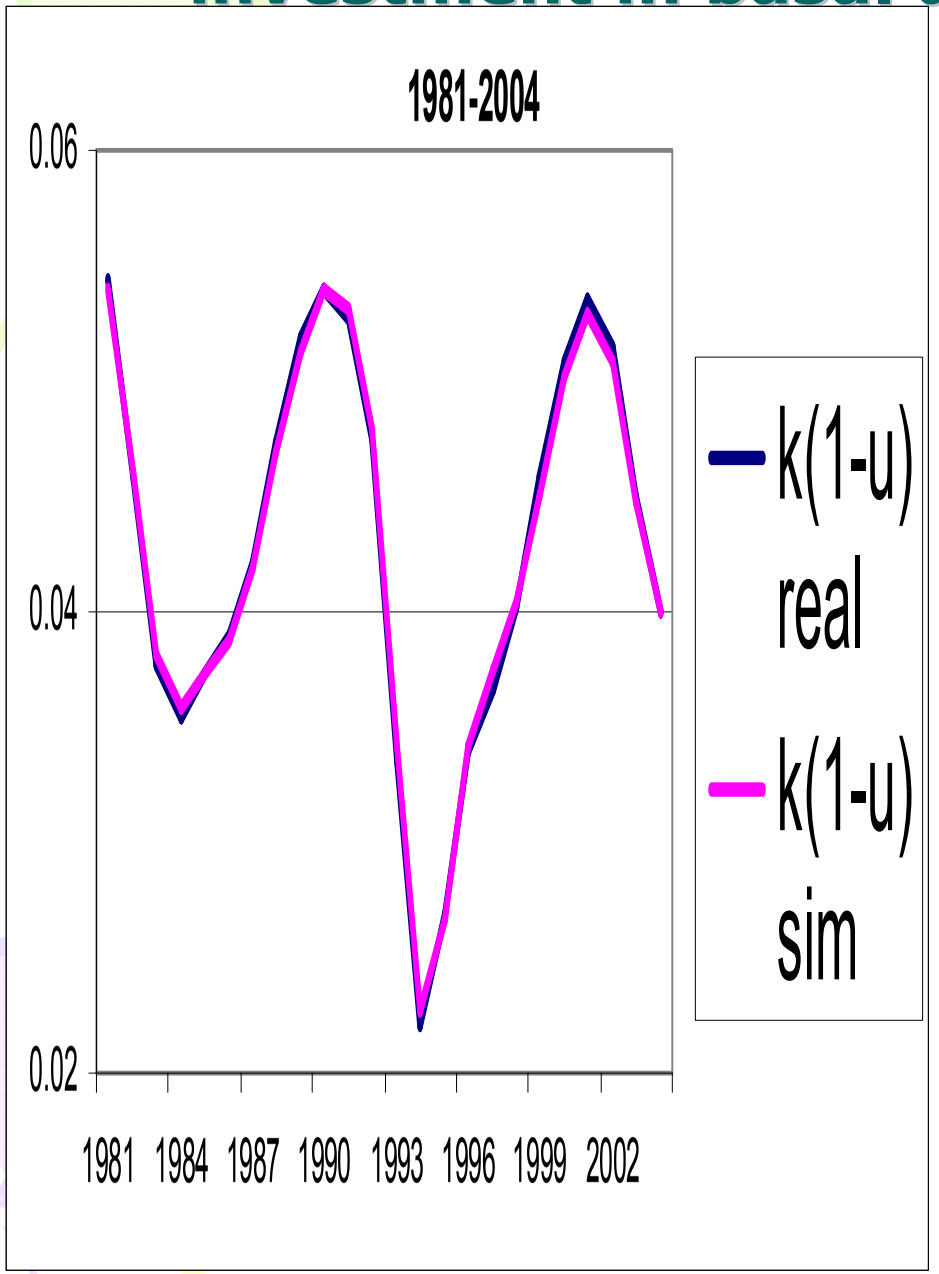
| | I | I–1 | I–2 | II | II for $m = m_0$ |
|---|---|---|---|---|---|
| $c_2$ | 0.5 | 0 | 0.4 | - | - |
| $c_0$ | - | - | | 2.5 | 2.5 |
| $c_1$ | - | - | | 1.3 | 1.3 |
| **Period** | **19–20** | **33–34** | **21** | **39–45** | **35** |

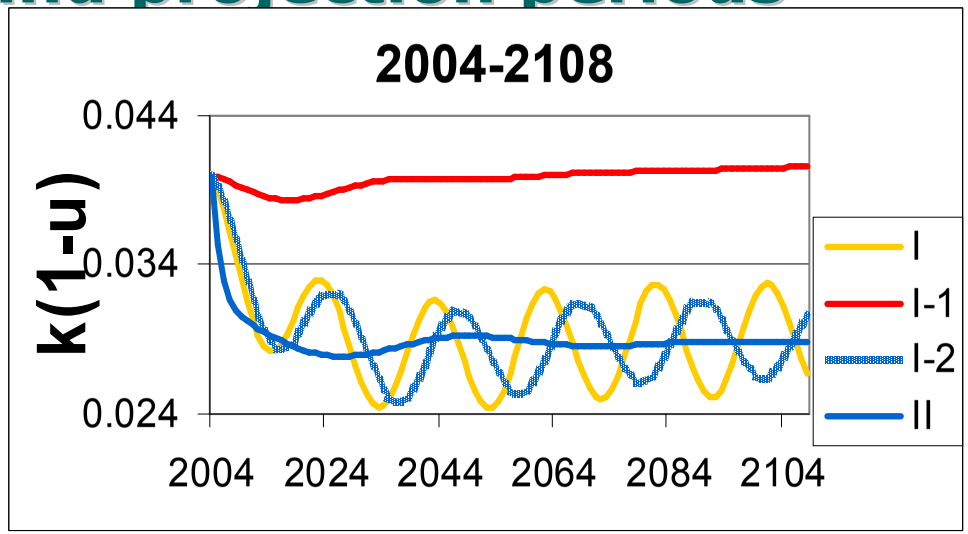
Hopf bifurcation in CL, $m_0 \approx -0.78$

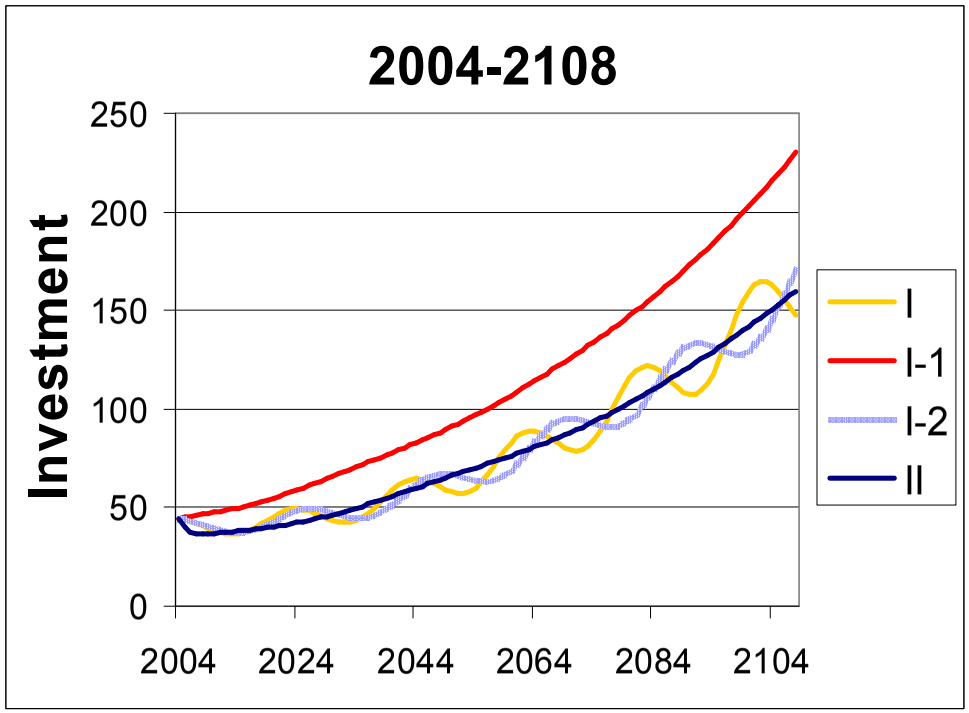



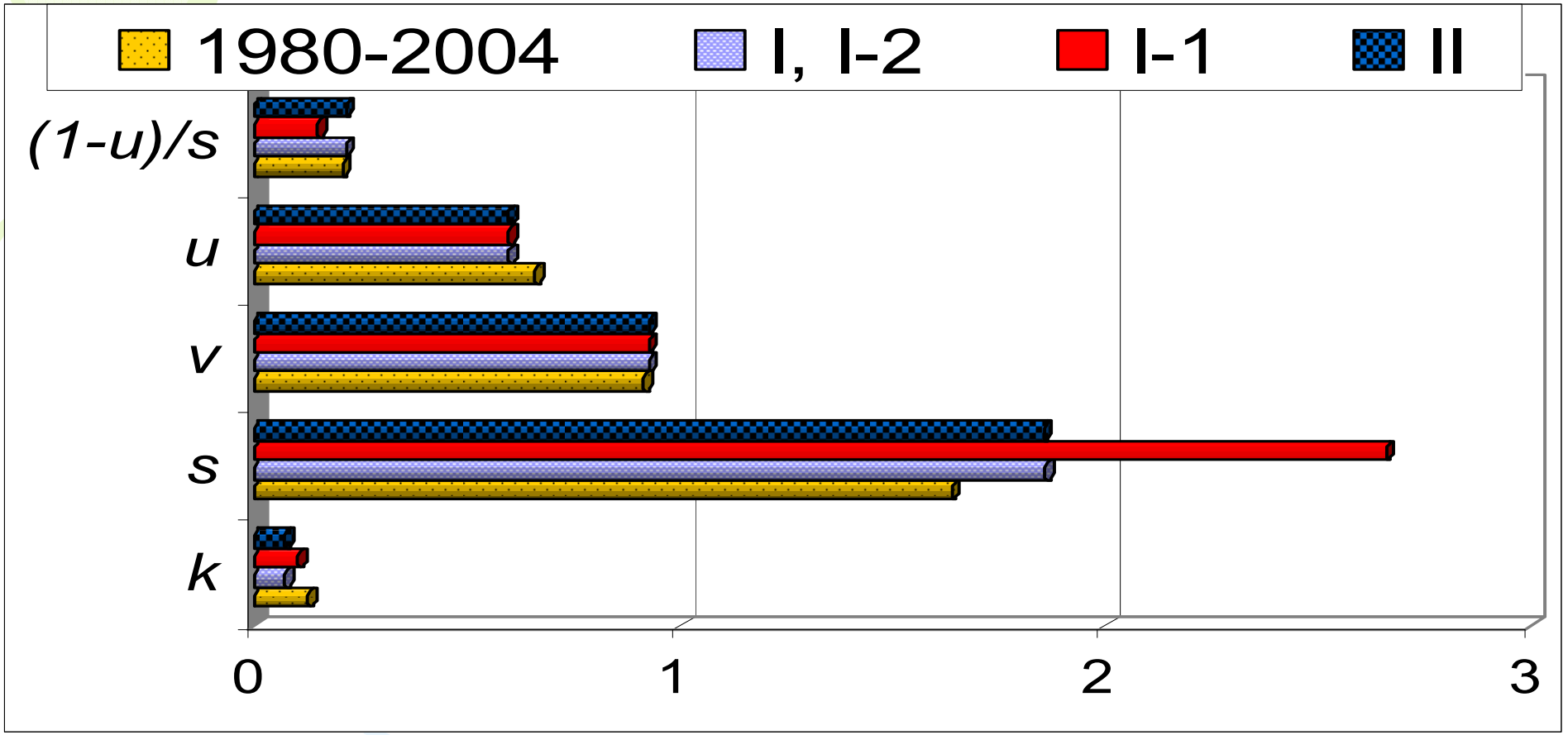
# Net investment share *k*(1-*u*) in GDP and investment in basal and projection periods



# Stationary magnitudes in four scenarios vs average magnitudes in 1980-2004



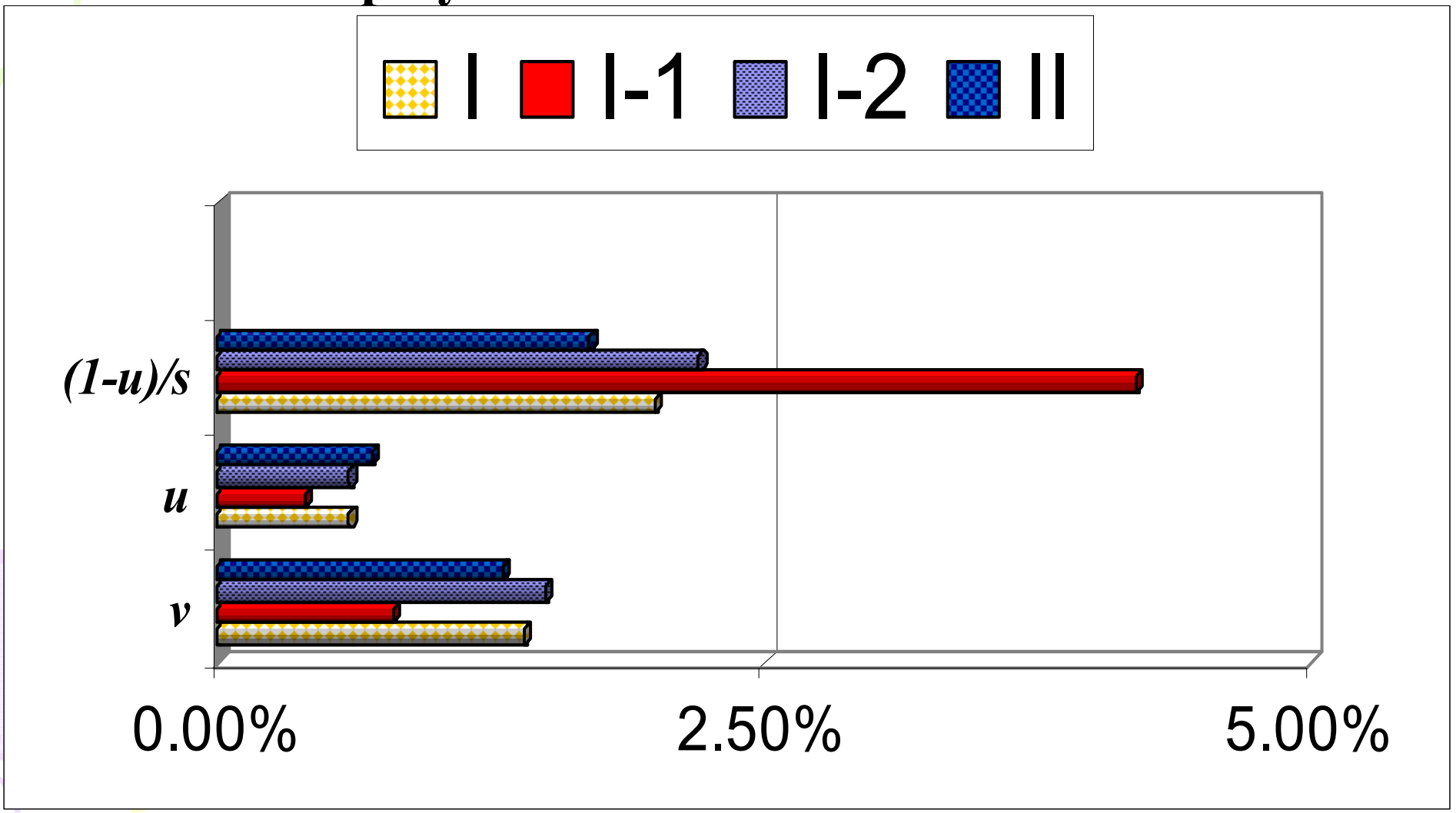

| Profit investment share ($k$) | Capital-output ratio ($s$) | Employment ratio ($v$) | Relative labour compensation ($u$) | Profit rate $((1-u)/s)$ |
|---|---|---|---|---|

# Variation in four scenarios over 2004-2044

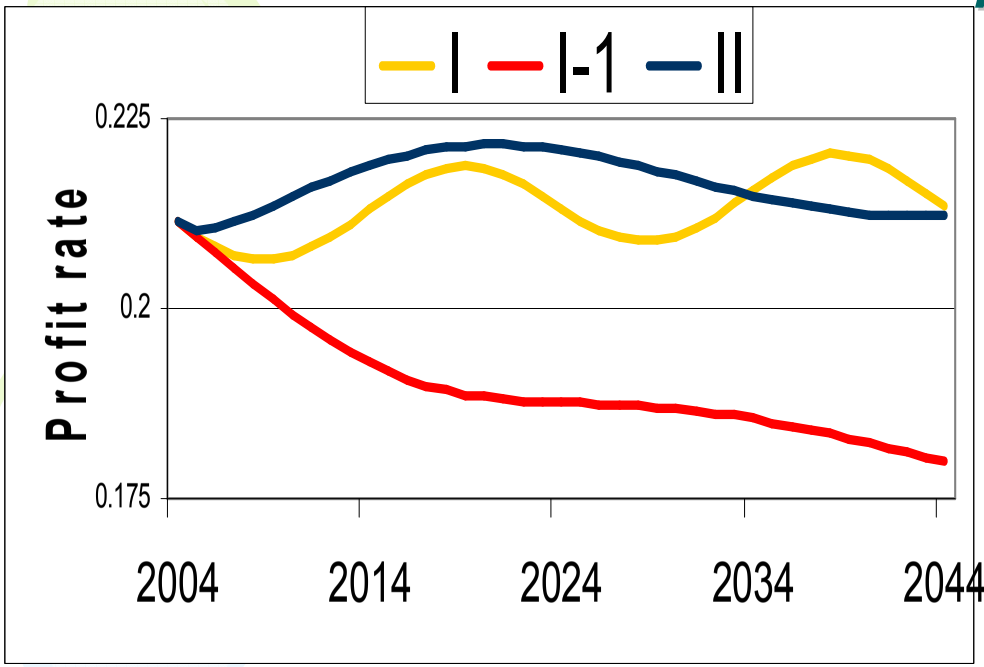
**Profit rate $(1 - u)/s$**

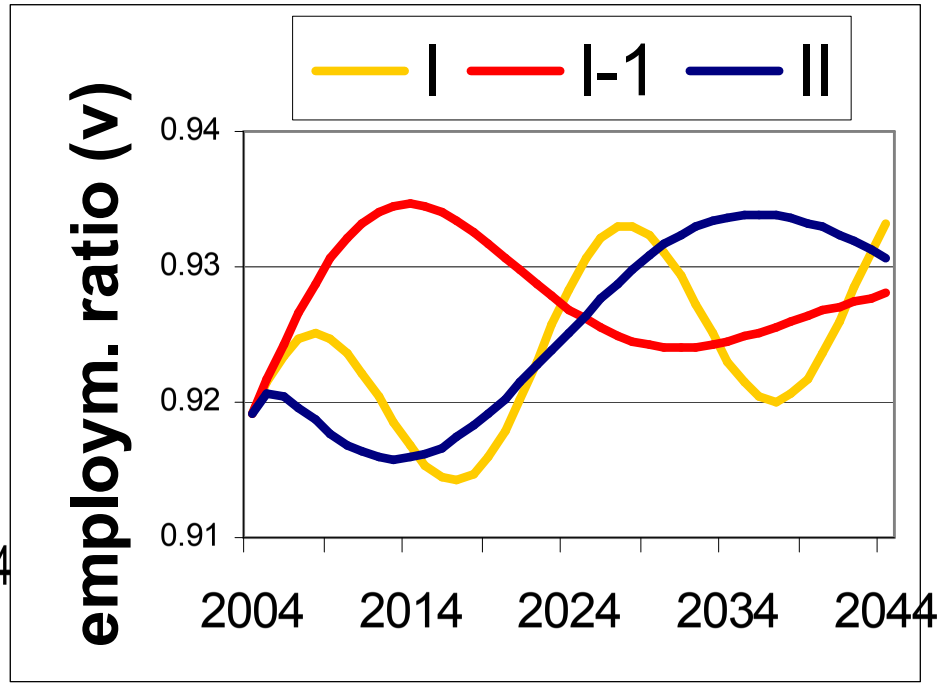
**Relative labour compensation $u$**

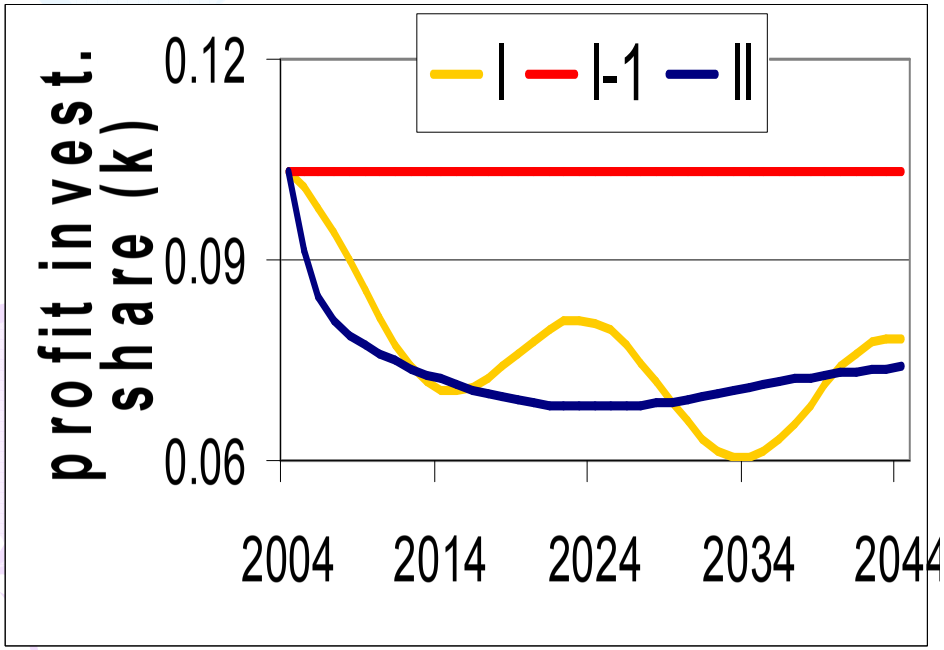
**Employment ratio $v$**

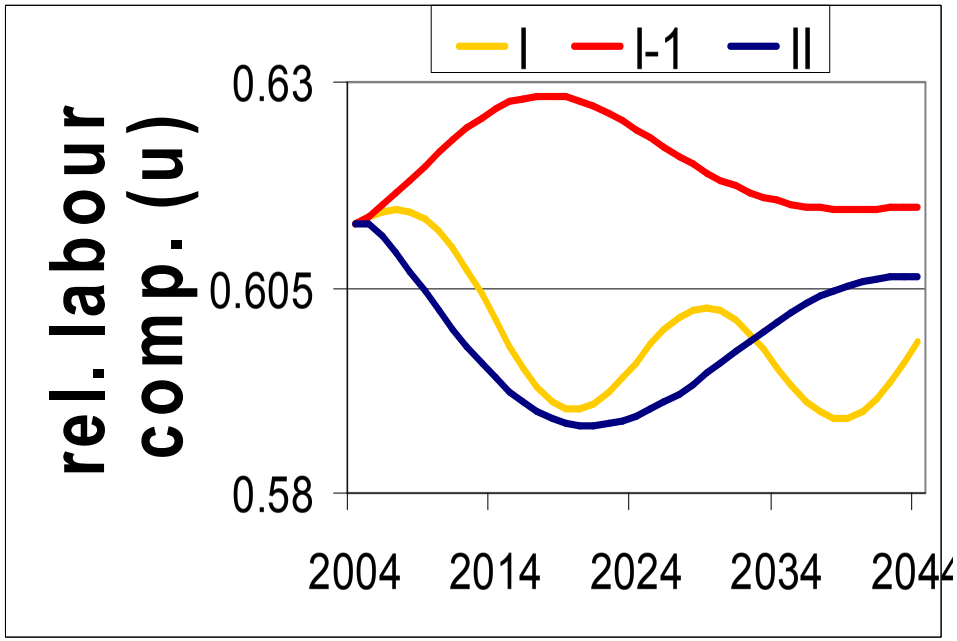


# Scenarios Inertia I, I-1, II, 2004-44

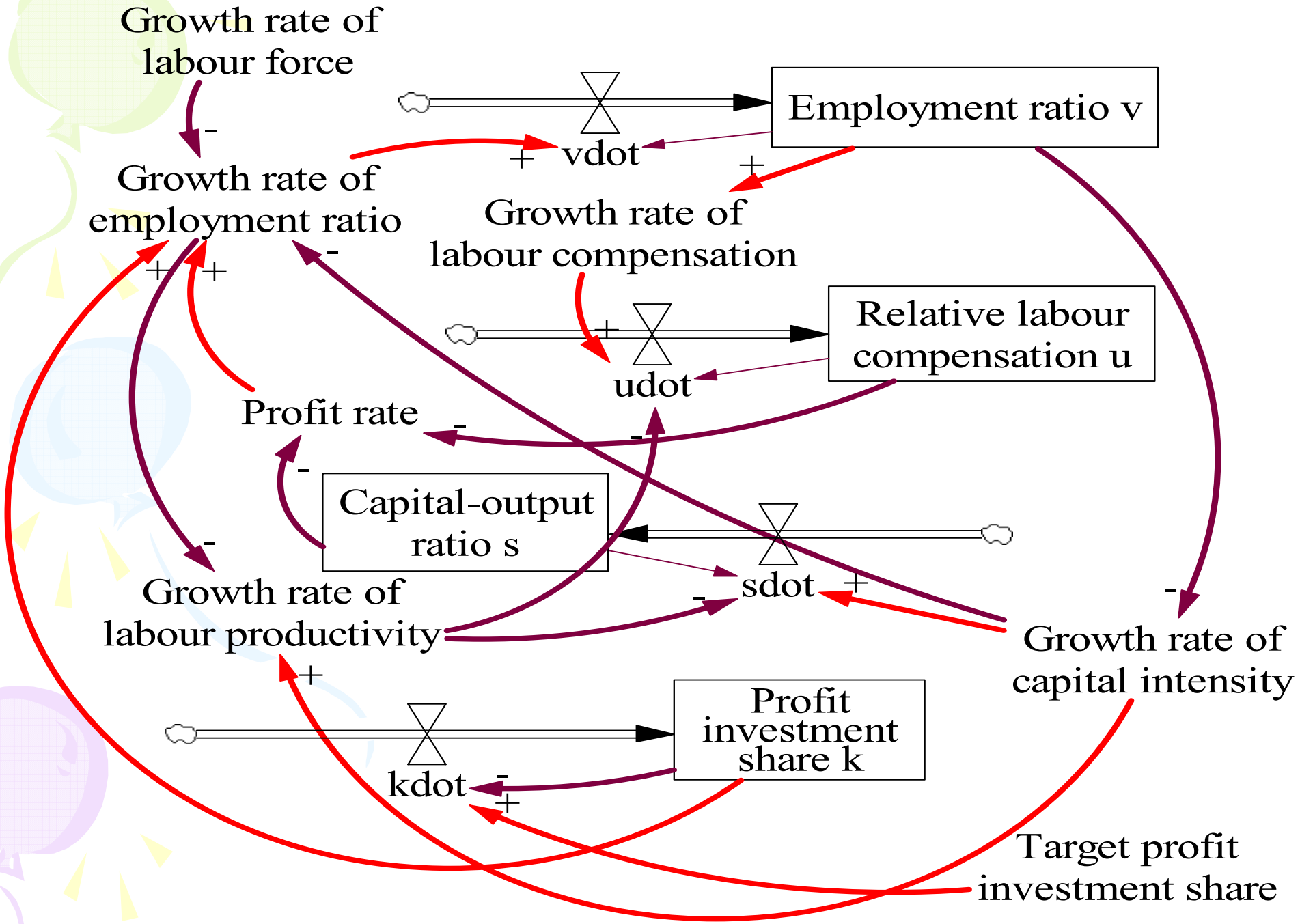


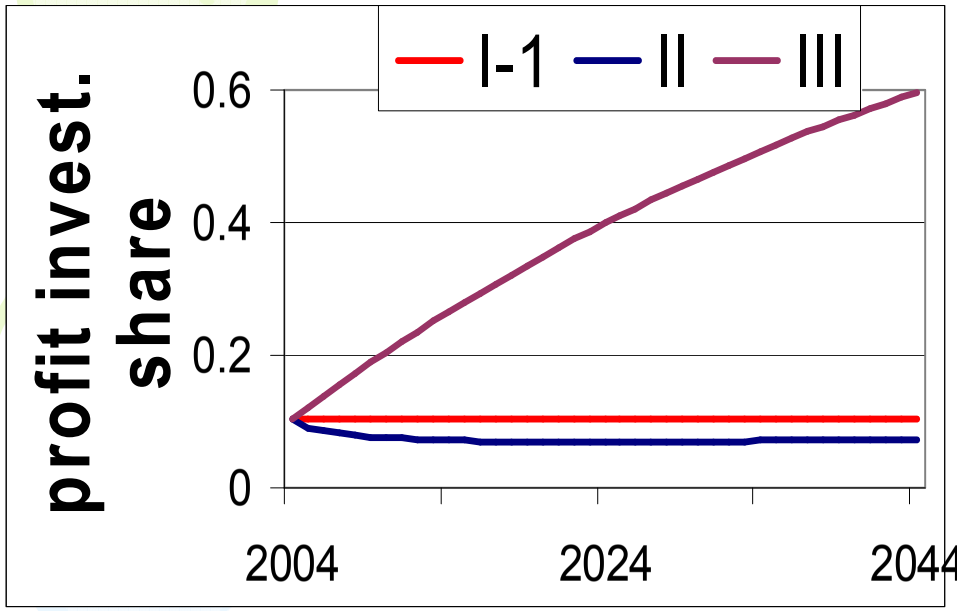



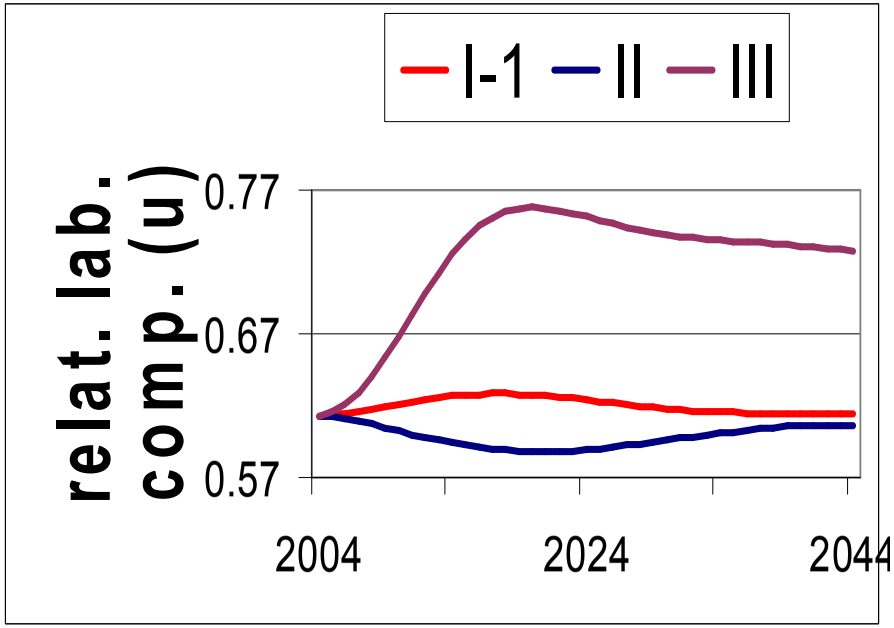



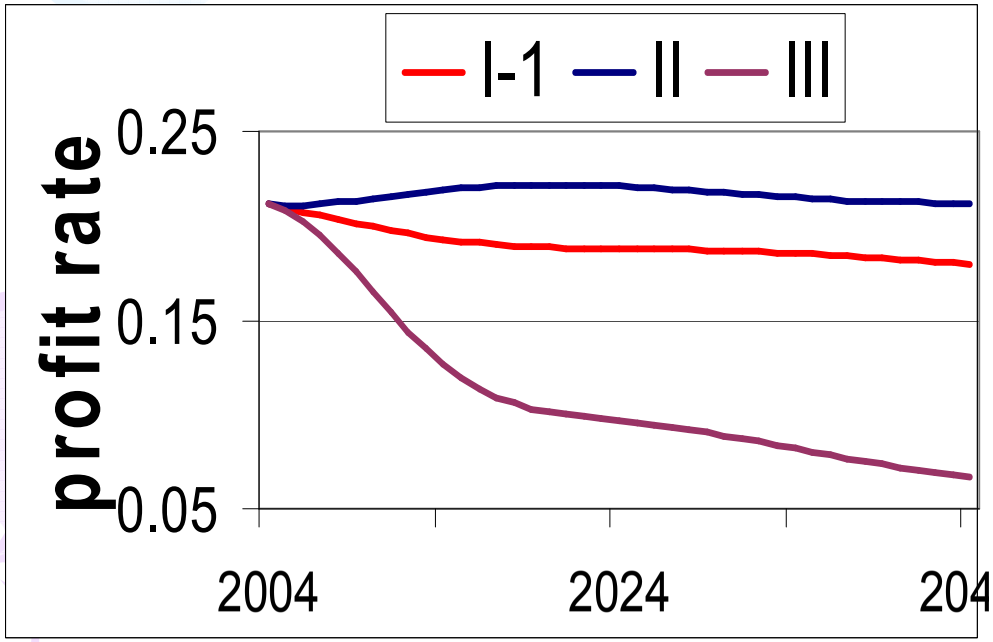
# Incorporating Golden Rule of Accumulation

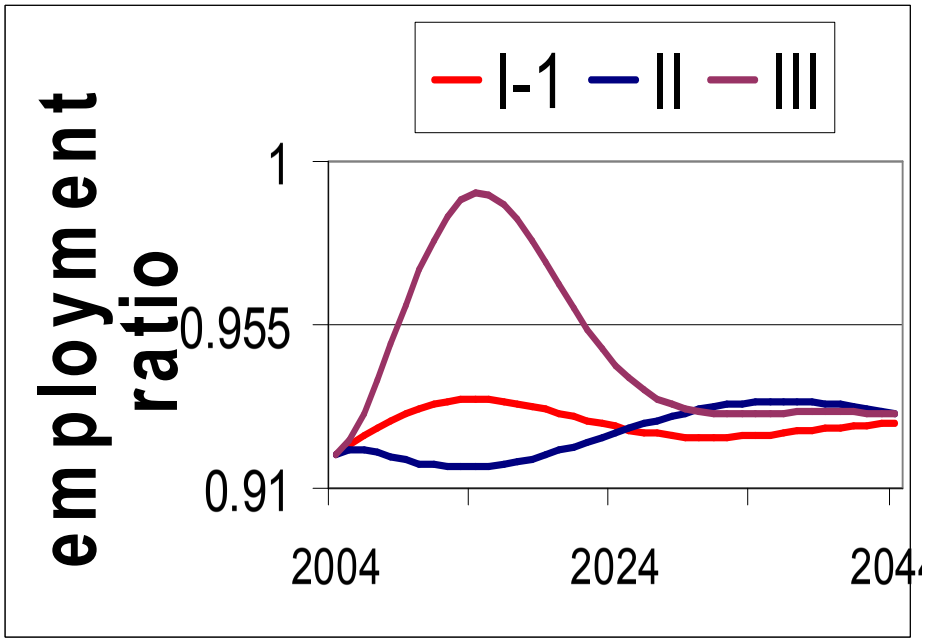


# Golden rule of accumulation (scenario III) investment policy and consequences, 2004-2044



# Conclusion

**This paper** offers *deterministic* and *probabilistic* forms of **HL** for the modern Italian economy that

**reconciles** *direct relation* between growth rates of net output and labour productivity, *inverse relation* between growth rates of employment ratio and labour productivity, and *direct relation* between profit rate and increment of profit investment share;

**reconstructs** 'Ricardian' inverse relationship between growth of employment and returns;

**uncovers and makes clear** the secular tendency of relative labour compensation to fall;

**unveils** structural roots of these and other regularities (for parameters $m < -1$ and $n_3 < 0$ of technical progress and mechanization functions).

**This paper** also

**supposes** **CL** of capital accumulation by establishing the explicit inverse relation between profit investment share (***k***) and capital-output ratio (***s***);

**proves** that a secular decline in profit investment share (***k***) mitigates the tendency of profit rate to fall;

**exposes** fallacy of neoclassical golden rule of accumulation;

**reveals and clarifies** paradox why labourers are more interested in more vigorous capital investment in domestic economy than capitalists;

**explains** why finding suitable compromise of material interests of two main social classes in Italy as a part of the modern world with financial openness is complicated.

A.V.1

# HL and CL are capable alternatives to cherished "*mainstream*" macroeconomic models that have fallen victim to economic reality

"…the macroeconomic models now in use in central banks [and in universities]… certainly do not provide them with the right tools to be successful [in fight against financial upheavals and recession]…

They will have to use other intellectual constructs to succeed" (Paul De Grauwe in *Financial Times*, July 23, 2008: 9).

## Слайд 35

**A.V.1** Paul De Grauwe. Cherished myths have fallen victim to economic reality / The Financial Times, Jyly 23, 2008: 9.
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- Main data sources: Economic Report of the President 2007, Table B109; Timmer et al. 2005; OECD. 2005.