# Introducing Demographic Changes in a Kaldor-Keynesian Model of Growth and Distribution

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# What are the questions we should ask?

- Population aging: Is the decline in labor supply the main issue?

- Population aging: How different are retirees in terms of consumption and saving patterns relative to workers or capitalists?

- Population aging: If retirees behave differently in economic sense how will the demographic changes affect the growth and distribution dynamics?

# What are the numbers telling us?

## Old-age and total dependency rates for selected countries

Dependency Rates: $$d = \frac{Population\ 65+}{Population\ 14-65}$$

| | Germany | | Italy | | Japan | | USA | | India | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Old-age | Total | Old-age | Total | Old-age | Total | Old-age | Total | Old-age | Total |
| 2000 | 0.24 | 0.47 | 0.27 | 0.48 | 0.25 | 0.47 | 0.19 | 0.51 | 0.08 | 0.64 |
| 2025 | 0.38 | 0.60 | 0.43 | 0.62 | 0.50 | 0.71 | 0.28 | 0.57 | 0.12 | 0.48 |
| 2040 | 0.51 | 0.76 | 0.66 | 0.90 | 0.64 | 0.88 | 0.32 | 0.61 | 0.18 | 0.46 |
| 2050 | 0.50 | 0.76 | 0.69 | 0.95 | 0.71 | 0.97 | 0.33 | 0.61 | 0.22 | 0.50 |

**Source:** Author's calculations based on statistics from United Nations Population Database

# What are the numbers telling us?

## Population aging and effective labor

Required labor productivity growth
such that GDP per capita grows at 2% annually

$$\hat{X} - \hat{P} = (\hat{\varepsilon}_L + g_w) - \hat{P}$$

| Labour Productivity | Germany* | Italy | US | India | Japan |
|---|---|---|---|---|---|
| Fold Increase 1960-2000 | 2.6 | 3.3 | 1.9 | 2.6 | 4.8 |
| Annual growth 1960-2000 | 2.6% | 3.1% | 1.7% | 2.4% | 4.0% |
| | | | | | |
| Fold Increase 2000-2050 | 3.1 | 2.9 | 2.9 | 2.5 | 3.6 |
| Annual growth 2000-2050 | 2.3% | 2.2% | 2.2% | 1.8% | 2.6% |

**Source:** Author's calculations based on statistics from the United Nations Population Database for population forecasts and World Development Indicators Database 2006 for GDP

## What are the numbers telling us?
### Population Aging and Distributive Issues in a PAYGO system

- Let total consumption by workers and retirees come only from wages:

  $$L^* c_w + R^* c_R = \psi X$$ where $\psi$ is the wage share

- Dividing the above by labor force and then differentiating with respect to time we further obtain that:

  $$\lambda \hat{c}_w + (1-\lambda)(\hat{d} + \hat{c}_R) = \hat{\psi} + \hat{\varepsilon}_L$$

- Several scenarios/policies possible when dependency rates rise:
  - Productivity growth, lower consumption growth for either workers or retirees, income redistribution towards wages

# What are the numbers telling us?

## Population Aging and Distributive Issues in a PAYGO system

| United States | 2000 | 2015 | 2030 | 2050 |
|---|---|---|---|---|
| Total Consumption 15-64 | 5,614,864,922 | 8,677,109,903 | 12,242,598,194 | 19,733,224,659 |
| Total Consumption 65+ | 1,430,831,369 | 2,521,079,012 | 5,132,155,579 | 8,953,033,424 |
| Total Consumption by workers | 4,314,722,600 | 6,520,922,801 | 9,193,808,215 | 14,817,912,592 |
| Wage bill (as 60% of total GDP, where GDP/cap at 2%) | 5,816,103,657 | 8,972,860,071 | 13,380,227,690 | 21,760,069,971 |
| Savings by workers (Wage bill - Total consumption by workers only) | 1,501,381,057 | 2,451,937,270 | 4,186,419,476 | 6,942,157,379 |
| **Difference between wage surplus and consumption by 65+** | 70,549,688 | -69,141,742 | -945,736,103 | -2,010,876,044 |

**Source:** Author’s calculations based on statistics from the United Nations Population Database for population forecasts, World Development Indicators Database 2006 for GDP and Lee and Mason (2007) for estimates on consumption level by age groups

# Methodology Conundrums

- Population aging is a long-run issue
- Problems with long-run/short-run models i.e. how relevant are the supply/demand constraints
- Demand-driven macro models are short/medium-run models (Taylor 2004, Barbosa and Taylor (2006))
- Can we still reconcile the demand-driven model with the issue of population aging?

# The Model - Assumptions

- Capital stock (wealth) is divided among the three private sectors: retirees, workers and firms

$$K = (\alpha_w + \alpha_R + \alpha_f)K$$

- Consequently, operating surplus which occurs at the profit rate, *r,* is distributed according to the share of capital stock that each institutional sector holds

$$\Pi = rK = r(\alpha_w + \alpha_R + \alpha_f)K = r(K_w + K_R + K_f) = \Pi_w + \Pi_R + \Pi_f$$

# The Model - Assumptions
# The Social Accounting Matrix

| | *Output Costs* | *W* | *R* | *F* | *Gov* | *I* | *Total* |
|---|---|---|---|---|---|---|---|
| | | $PC_w$ | $PC_R$ | | $PG$ | $PI$ | $PX$ |
| W | $wbX$ | | | $\alpha_w(1-t_\pi)\Pi$ | | | $Y_w$ |
| R | | | | $\alpha_R(1-t_\pi)\Pi$ | $qR$ | | $Y_R$ |
| F | $\pi PX$ | | | | | | $Y_B$ |
| Gov | | $T_w$ | | $T_\pi$ | | | $Y_{gov}$ |
| *Flows of Funds* | | | | | | | |
| Savings | | $S_w$ | $S_R$ | $S_\pi$ | $S_g$ | $-\sum S$ | *0* |
| *Total* | $PX$ | $Y_w$ | $Y_R$ | $Y_B$ | $Y_{gov}$ | *0* | |

# The Model
# Investment and Savings Balance

- Independent investment demand function (Kalecki, Kaldor, Steindl):

$$g^i = g_0 + \beta_1 r + \beta_2 u = g_0 + (\beta_1 \pi + \beta_2)u$$

- Savings by each sector:

$$S_w = s_w(1-t_w)(1-\pi)X + \alpha_w(1-t_\pi)\pi X$$

$$S_\pi = \alpha_\pi(1-t_\pi)\pi X$$

$$S_g = [t_w(1-\pi) + t_\pi \pi]X - G = [t_w(1-\pi) + t_\pi \pi]X - qR - C_g$$

$$S_R = C_R - qR - \alpha_R(1-t_\pi)\pi X$$

# The Short-run Model

- Kaleckian price level as a function of a fixed nominal wage, labor-output ratio, and a fixed markup.
- Five endogenous variables $u, r, P, X, L$ being solved for using the following equations

$$P = (1+\tau)wb = \frac{1}{1-\pi}wb$$

$$L = X / \varepsilon_L$$

$$u = X / K$$

$$r = (\Pi / K) = (\Pi / X * K / X) = \pi u = (1-\psi)u$$

$$g^i + \gamma_G - g^s = 0$$

# The Short-run Model

- Capacity utilization comes from the macro balance:

$$u = \frac{g_0 + \gamma_G}{(1-\pi)(1-t_w)s_w + \pi(1-\alpha_R)(1-t_\pi) - m\alpha_R - (\beta_1\pi + \beta_2)}$$

- Higher expenditures with social security benefits, as well as a higher share of wealth in the hands of retirees stimulates economic activity through the effective demand channel.

- How about fiscal policy implications? In a demand-driven growth model higher social security contribution tax on wages or profits has a negative impact on demand and therefore output.

# The Short-run Model: Changes in Income Distribution

$$u = \frac{g_0 + \gamma_G}{(1-\pi)(1-t_w)s_w + \pi(1-\alpha_R)(1-t_\pi) - m\alpha_R - (\beta_1\pi + \beta_2)}$$

- Profit-led growth if $du/d\pi > 0$ likely when, saving rates from wages are large, profit rate effect on investment demand is strong, and ***retirees hold a large share of capital stock***!
  - A fully-funded system increases the chances of a profit-led regime
- Wage-led growth if $du/d\pi < 0$
  - A PAYGO system is likely to be associated with a wage-led regime

# Extensions to the Medium-run

- A Kaldor-Verdoorn technical progress function:

$$\dot{\varepsilon}_L = \varepsilon_L(\gamma_0 + \gamma_u u + \gamma_\psi \psi)$$

- A Barbosa-Taylor (2006) income distribution relation:

$$\dot{\psi} = \psi(\hat{\omega} - \hat{\varepsilon}_L) = \psi(\delta + \delta_u u + \delta_\psi \psi)$$

- A medium-run extension for capacity utilization

$$\dot{u} = u(\theta_g \gamma_g + \theta_\alpha \alpha_R + \theta_\psi \psi)$$

# Extensions to the Medium-run
# The Case of a Profit-led Economy

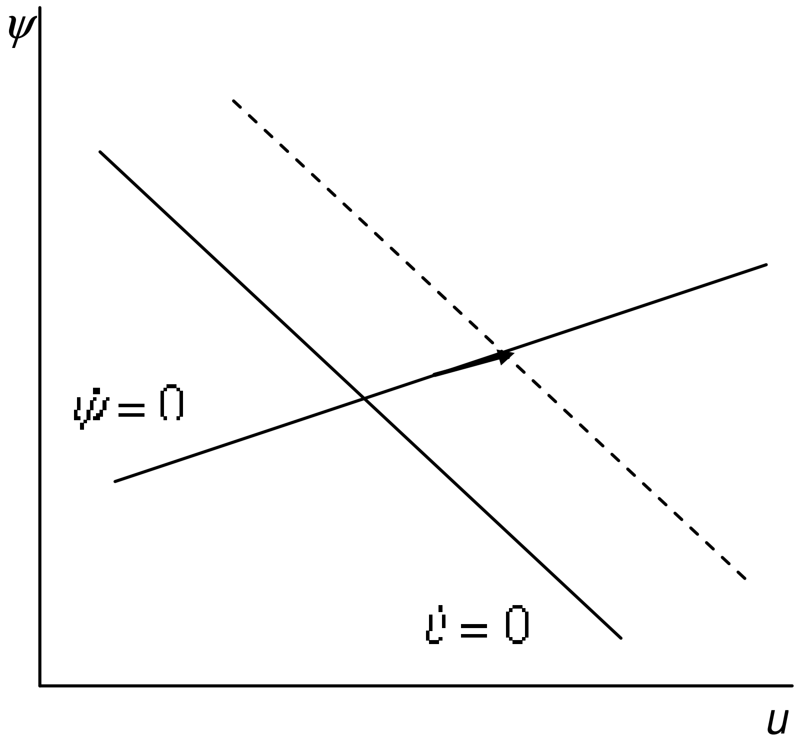


Figure 2a: Profit-led and profit squeeze

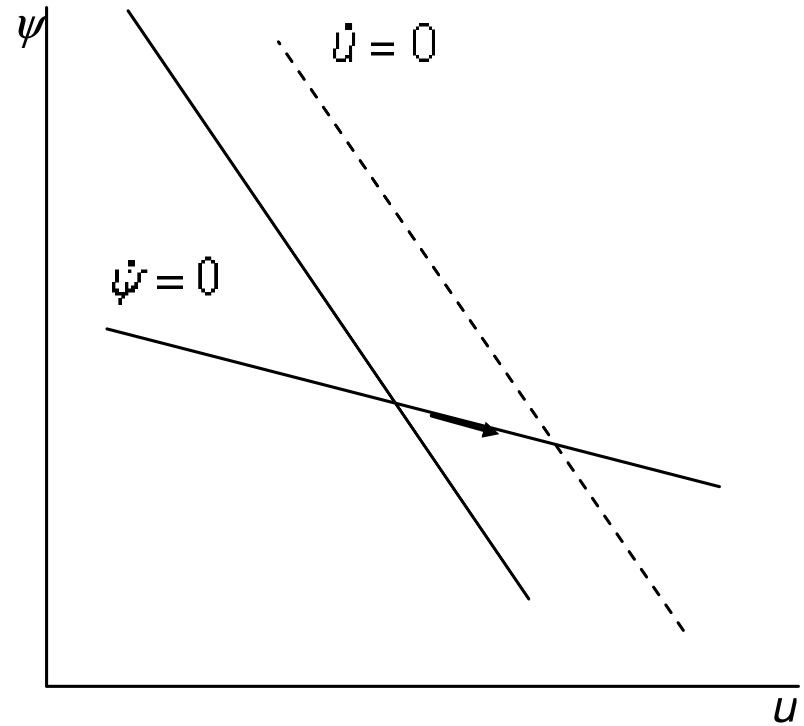


Figure 2b: Profit-led and forced savings

Demand-driven/profit squeeze?

Supply-driven/forced savings?

# Extensions to the Medium-run Implications of Demographic Changes

- ***Direct impact*** on demand through the wealth effect or as a result of higher social security benefits.
  - Profit-squeeze case: limited expansionary effects because a rise in the wage share lowers profitability in medium run.
    - Old-age income given by

$$Y_R = (e^* \omega)R + \alpha_R \pi X$$

    - Dividing it by output and multiplying the first term of r.h.s by L/L:

$$Y_R / X = e^* (1-\pi)^* d + \alpha_R \pi$$

# Extensions to the Medium-run Implications of Demographic Changes

- ***Indirect impact*** on demand through a change in fiscal stance:
  - Forced savings case: income redistribution towards wages will only set off an inflationary reaction if higher taxes on profits are passed into higher markups and therefore higher prices.
  - The distributive schedule in the end will not shift (unless the inflationary reaction overshoots). Old-age income given by:

$$Y_R / X = e * [1/(1+\tau)] * d + \alpha_R \tau /(1+\tau)$$

# Extensions to the Medium-run Implications of Productivity Growth

- Higher productivity growth shifts the equilibrium downwards and to the right in a profit-led regime

- The wage share declines because higher output per worker exceeds the increase in real wages or in other words not all productivity gains are passed into wages.

- The policy question is how to redistribute the increase in output per worker more equitably especially when pensions come from current wages.

- In the profit squeeze case: government non-pensions expenditures could go up (the effective demand shift outwards). Such policy would not work however in the forced savings case due to inflationary pressures which would cut into the real wages.

# Conclusions and Extensions

- Population aging will play an important role for the growth-distribution dynamics if old people behave differently in economic sense.
- Demand-driven, medium-run models can still be relevant
- Redistributive policies directed to deal with demographic changes must take into account the type of growth regime that is in place
- Institutions could play an important role
- Extensions:
  - Bring in the financial side
  - Two-sector models given expected changes in consumption patterns