Preferences for Social Insurance: The Role of Job Security and Risk Propensity

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TECHNICAL APPENDIX

I. PREFERENCES FOR A REDISTRIBUTION POLICY TARGETING ALL CITIZENS

Suppose that the policy targets the entire society, i.e., both the employed and the unemployed citizens. Then, the expected government expenditure is:

$$\int \pi_i s\omega dF_i + \int (1-\pi_i)\, s\omega dF_i = s\omega$$

Recall that government expected revenue is: $\tau(t)\Pi\omega$. Then, the expected budget constraint of the government can be written as follows.

$$\tau(t)\Pi\omega = s\omega$$

Equivalently,

$$s = \Pi\tau(t) \tag{A1}$$

Therefore, voter i's preferred tax rate is the solution to the following maximization problem.

$$\max_t U_i(t) = \pi_i u((1-t)\omega_i + \tau(t)\Pi\omega) + (1-\pi_i)u(\tau(t)\Pi\omega) \tag{A2}$$

The corresponding FOC is:

$$U_i'(t) = \pi_i(-\omega_i + \tau'(t)\Pi\omega)u'((1-t)\omega_i + \tau(t)\Pi\omega) + (1-\pi_i)\tau'(t)\Pi\omega u'(\tau(t)\Pi\omega) = 0$$

That condition can be rewritten as:

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$$\tau'(t)\Pi\omega u'(\tau(t)\Pi\omega) = \frac{\pi_i}{1-\pi_i}(\omega_i - \tau'(t)\Pi\omega)u'((1-t)\omega_i + \tau(t)\Pi\omega) \tag{A3}$$

Therefore, voter i's preferred tax policy, t_i, is the tax rate t that solves equation (A3).

Note that, in addition to the tax policy t, the left-hand side (LHS) of equation (A3) depends exclusively on the average ex-ante wage ω and the aggregate parameter Π. Moreover, the LHS is a decreasing function of t. However, the right-hand side depends on voter i's characteristics π_i and ω_i. Our goal is to understand how the preferred policy t_i changes as voter i's characteristics change without affecting the aggregate parameters of the economy.

Define $h(\pi_i) = \frac{\pi_i}{1-\pi_i}$ and $f(\omega_i) = (\omega_i - \tau'(t)\Pi\omega)u'((1-t)\omega_i + \tau(t)\Pi\omega)$. Then, equation (A3) can be rewritten as:

$$\tau'(t)\Pi\omega u'(\tau(t)\omega) = h(\pi_i)f(\omega_i) \tag{A4}$$

Therefore,

$$f'(\omega_i) = u'((1-t)\omega_i + \tau(t)\Pi\omega) + (\omega_i - \tau'(t)\Pi\omega)(1-t)u''((1-t)\omega_i + \tau(t)\Pi\omega)$$

$$f'(\omega_i) > 0 \Leftrightarrow u'((1-t)\omega_i + \tau(t)\Pi\omega) > -(\omega_i - \tau'(t)\Pi\omega)(1-t)u''((1-t)\omega_i + \tau(t)\Pi\omega)$$

Now,

$$(\omega_i - \tau'(t)\Pi\omega)(1-t) = \omega_i(1-t) - (1-t)\tau'(t)\Pi\omega = \omega_i(1-t) + \tau(t)\Pi\omega - [\tau(t)\Pi\omega + (1-t)\tau'(t)\Pi\omega]$$
$$= \omega_i(1-t) + \tau(t)\Pi\omega - [\tau(t) + (1-t)\tau'(t)]\Pi\omega$$

Therefore, $(\omega_i - \tau'(t)\Pi\omega)(1-t) < \omega_i(1-t) + \tau(t)\Pi\omega$

Since u is strictly concave, $u''\big(\omega_i - \tau(t)(\omega_i - \Pi\omega)\big) < 0$. Therefore,

$$(\omega_i - \tau'(t)\Pi\omega)(1-t)u''((1-t)\omega_i + \tau(t)\Pi\omega) > (\omega_i(1-t) + \tau(t)\Pi\omega)u''(\omega_i(1-t) + \tau(t)\Pi\omega)$$

Thus,

$$f'(\omega_i) = u'((1-t)\omega_i + \tau(t)\Pi\omega) + (\omega_i - \tau'(t)\Pi\omega)(1-t)u''((1-t)\omega_i + \tau(t)\Pi\omega)$$
$$>$$
$$u'((1-t)\omega_i + \tau(t)\Pi\omega) + (\omega_i(1-t) + \tau(t)\Pi\omega)u''(\omega_i(1-t) + \tau(t)\Pi\omega)$$

Now,

$$u'((1-t)\omega_i + \tau(t)\Pi\omega) + (\omega_i(1-t) + \tau(t)\Pi\omega)u''(\omega_i(1-t) + \tau(t)\Pi\omega) > 0$$
$$\Leftrightarrow$$
$$1 > \frac{-(\omega_i(1-t) + \tau(t)\Pi\omega)u''(\omega_i(1-t) + \tau(t)\Pi\omega)}{u'((1-t)\omega_i + \tau(t)\Pi\omega)} = RRA(\omega_i(1-t) + \tau(t)\Pi\omega)$$

Therefore, if the coefficient of relative risk aversion of citizens is smaller than one, i.e., agents are not too risk averse, then the RHS of (A4) is an increasing function in income (whether $h(\pi_i)$ is increasing or, as in M&W 2003[1], constant) and, thereby, the preferred tax policy must decrease as income increases. This is the traditional M&R (1983)[2] result.

Suppose, now, that the CRRA is greater than one. Furthermore, suppose that unemployment risk is homogeneous as in M&W (2003). We will show next that if the CRRA is high enough, then there will be preference ordering reversal for a incomes above the mean income.

Recall that:

$$f'(\omega_i) = u'((1-t)\omega_i + \tau(t)\Pi\omega) + (\omega_i - \tau'(t)\Pi\omega)(1-t)u''((1-t)\omega_i + \tau(t)\Pi\omega)$$

Then,

$$f'(\omega_i) < 0 \Leftrightarrow 1 < (\omega_i - \tau'(t)\Pi\omega)(1-t)\frac{-u''((1-t)\omega_i + \tau(t)\Pi\omega)}{u'((1-t)\omega_i + \tau(t)\Pi\omega)}$$

$$\Leftrightarrow 1 < \frac{(\omega_i - \tau'(t)\Pi\omega)(1-t)}{(1-t)\omega_i + \tau(t)\Pi\omega}\frac{-((1-t)\omega_i + \tau(t)\Pi\omega)u''((1-t)\omega_i + \tau(t)\Pi\omega)}{u'((1-t)\omega_i + \tau(t)\Pi\omega)}$$

$$\Leftrightarrow 1 < \frac{(\omega_i - \tau'(t)\Pi\omega)(1-t)}{(1-t)\omega_i + \tau(t)\Pi\omega}RRA((1-t)\omega_i + \tau(t)\Pi\omega)$$

$$\Leftrightarrow RRA((1-t)\omega_i + \tau(t)\Pi\omega) > \frac{(1-t)\omega_i + \tau(t)\Pi\omega}{(\omega_i - \tau'(t)\Pi\omega)(1-t)}$$

But,

$$\frac{(1-t)\omega_i + \tau(t)\Pi\omega}{(\omega_i - \tau'(t)\Pi\omega)(1-t)} = \frac{1 + \frac{\tau(t)}{1-t}\Pi\frac{\omega}{\omega_i}}{1 - \tau'(t)\Pi\frac{\omega}{\omega_i}} = \frac{\frac{\omega_i}{\omega} + \frac{\tau(t)}{1-t}\Pi}{\frac{\omega_i}{\omega} - \tau'(t)\Pi}$$

Now, for $\omega_i \geq \omega$,

$$\frac{\omega_i}{\omega} - \tau'(t)\Pi \geq 1 - \tau'(t)\Pi \geq 1 - \Pi \Rightarrow \frac{1}{\frac{\omega_i}{\omega} - \tau'(t)\Pi} \leq \frac{1}{1-\Pi}$$

and

[1] Moene, Karl O., and Michael Wallerstein. 2003. "Earnings inequality and welfare spending – A disaggregated analysis." *World Politics* 55, n. 4: 485–516.
[2] Meltzer, Allan H., and Scott F. Richard. 1981. "A Rational Theory of the Size of Government." *Journal of Political Economy* 89, n. 5: 914–927.

$$\frac{\omega_i}{\omega}+\frac{\tau(t)}{1-t}\Pi \leq \frac{\widetilde{\omega}}{\omega}+\frac{\tau(t)}{1-t}\Pi \leq \frac{\widetilde{\omega}}{\omega}+\frac{\tau(t_{max})}{1-t_{max}}\Pi$$

Therefore, for $\omega_i \geq \omega$,

$$\frac{\frac{\omega_i}{\omega}+\frac{\tau(t)}{1-t}\Pi}{\frac{\omega_i}{\omega}-\tau'(t)\Pi} \leq \frac{1}{1-\Pi}\left[\frac{\widetilde{\omega}}{\omega}+\frac{\tau(t_{max})}{1-t_{max}}\Pi\right]=\frac{\Pi}{1-\Pi}\left[\frac{\widetilde{\omega}}{\Pi\omega}+\frac{\tau(t_{max})}{1-t_{max}}\right]$$

Let $m(\omega_i,t)=\frac{1}{1-\Pi}\left[\frac{\omega_i}{\omega}+\frac{\tau(t)}{1-t}\Pi\right]$. Then,

If, for $\omega_i \geq \omega,\ RRA((1-t)\omega_i+\tau(t)\Pi\omega) > m(\widetilde{\omega},t_{max})$, then $f'(\omega_i)$ is a decreasing function of ω_i in the range $[\omega,\widetilde{\omega}]$. Therefore, the preferred tax rate $t(\omega_i)$ is an increasing function of ω_i in that range. In particular, there is preference ordering reversal for citizens with income above the average income, in spite of the fact that the policy is pure redistribution and the risk of losing one's job is identical for all citizens.

The main rationale for that result is that pure redistribution plays the role of an imperfect substitute to unemployment insurance, when such policy does not exist, and richer citizens are exposed to higher consumption changes if they lose their jobs. Therefore, they are particularly favorable to the redistribution policy.

II. Calculations' details

Preferences for a policy targeting the employed citizens

$$\max_t\ (1-t)\omega_i+\frac{\Pi}{\overline{\Pi}}\tau(t)\omega$$

Since the objective function is strictly concave in t, the FOC determines voter i's preferred policy.

FOC:

$$\frac{\partial}{\partial t}:-\omega_i+\frac{\Pi}{\overline{\Pi}}\tau'(t)\omega=0 \Rightarrow \tau'(t)=\frac{\overline{\Pi}}{\Pi}\frac{\omega_i}{\omega}$$

Therefore, i's preferred policy is:

$$t_i^*(\omega_i)=(\tau')^{-1}\left(\frac{\overline{\Pi}}{\Pi}\frac{\omega_i}{\omega}\right)$$

Since $(\tau')^{-1}$ is decreasing, the higher i's income, the lower i's preferred tax rate. This is the traditional ordering (M&R, 1981).

PREFERENCES FOR A POLICY TARGETING THE UNEMPLOYED CITIZENS

$$\max_t U_i(t) = \pi_i u((1-t)\omega_i) + (1-\pi_i) u\left(\frac{\Pi}{1-\overline{\Pi}}\tau(t)\omega\right)$$

FOC:

$$U_i'(t) = \pi_i[-\omega_i]u'[(1-t)\omega_i] + (1-\pi_i)\frac{\Pi}{1-\overline{\Pi}}\tau'(t)\omega u'\left[\frac{\Pi}{1-\overline{\Pi}}\tau(t)\omega\right] = 0$$

$$\frac{\Pi}{1-\overline{\Pi}}\tau'(t)\omega u'\left(\frac{\Pi}{1-\overline{\Pi}}\tau(t)\omega\right) = \frac{\pi_i}{1-\pi_i}\omega_i u'((1-t)\omega_i)$$

Define $h(\pi_i) = \frac{\pi_i}{1-\pi_i}$ and $f(\omega_i) = \omega_i u'\big((1-t)\omega_i\big)$.

Then the FOC rewrites as:

$$\frac{\Pi}{1-\overline{\Pi}}\tau'(t)\omega u'\left(\frac{\Pi}{1-\overline{\Pi}}\tau(t)\omega\right) = h(\pi_i)f(\omega_i)$$

THE HOMOGENEOUS JOB SECURITY CASE WITH HIGH RISK AVERSION

Suppose $\pi_i =: \pi, \forall i$. In this case, $\Pi = \overline{\Pi} = \pi$, $\frac{\Pi}{1-\overline{\Pi}} = \frac{\pi}{1-\pi}$, and $h(\pi_i) = \frac{\pi_i}{1-\pi_i} = \frac{\pi}{1-\pi}, \forall i$.

Therefore, the FOC becomes:

$$\tau'(t)\omega u'\left(\frac{\pi}{1-\pi}\tau(t)\omega\right) = f(\omega_i)$$

Since the CRRA coefficient is higher than 1, function f is strictly decreasing in ω_i.

Indeed, $f'(\omega_i) = u'\big((1-t)\omega_i\big) + (1-t)\omega_i u''\big((1-t)\omega_i\big)$; therefore, $f'(\omega_i) < 0$ if and only if: $-\frac{(1-t)\omega_i u''((1-t)\omega_i)}{u'((1-t)\omega_i)} = CRRA\big((1-t)\omega_i\big) > 1$.

Now, suppose there is an increase exclusively in voter i's wage ω_i, that does not affect the aggregate parameters of the economy π and ω. Then, the right-hand side of the FOC decreases. Since u and τ are strictly concave functions, u' and τ' are strictly decreasing, and it must be the case that the preferred taxation $t_i^* = t(\omega_i)$ increases.

THE HETEROGENEOUS JOB SECURITY CASE WITH HIGH RISK AVERSION

Suppose now that $h(\pi_i) = h\big(\pi(\omega_i)\big)$ is an increasing function of income. Recall the first order condition:

$$\frac{\Pi}{1-\overline{\Pi}}\tau'(t)\omega u'\left(\frac{\Pi}{1-\overline{\Pi}}\tau(t)\omega\right) = h\big(\pi(\omega_i)\big)f(\omega_i) = \frac{\pi_i}{1-\pi_i}\omega_i u'((1-t)\omega_i)$$

A NUMERICAL EXAMPLE

$$u(\omega_i) = \frac{1}{1-R}{\omega_i}^{1-R}, \qquad R > 1.$$

$$\pi_i = \alpha\frac{\omega_i}{\widetilde{\omega}}, \qquad \alpha, 0 < \alpha < 1$$

Then,

$$h\big(\pi(\omega_i)\big) = \frac{\alpha\frac{\omega_i}{\widetilde{\omega}}}{1-\alpha\frac{\omega_i}{\widetilde{\omega}}} = \frac{\alpha\omega_i}{\widetilde{\omega}-\alpha\omega_i}$$

And,

$$u'(\omega_i) = {\omega_i}^{-R}$$

Thus,

$$f(\omega_i) = \omega_i((1-t)\omega_i)^{-R} = (1-t)^{-R}{\omega_i}^{1-R}$$

Therefore,

$$RHS(\omega_i) = h\big(\pi(\omega_i)\big)f(\omega_i) = (1-t)^{-R}\frac{\alpha{\omega_i}^{2-R}}{\widetilde{\omega}-\alpha\omega_i}$$

Taking derivatives,

$$RHS'(\omega_i) = (1-t)^{-R}\frac{\alpha(2-R){\omega_i}^{1-R}(\widetilde{\omega}-\alpha\omega_i) - \alpha{\omega_i}^{2-R}(-\alpha)}{(\widetilde{\omega}-\alpha\omega_i)^2}$$

$$= (1-t)^{-R}\alpha{\omega_i}^{1-R}\frac{(2-R)(\widetilde{\omega}-\alpha\omega_i)+\alpha\omega_i}{(\widetilde{\omega}-\alpha\omega_i)^2}$$

Then, the sign of $RHS'(\omega_i)$ is the same as $(2-R)(\widetilde{\omega}-\alpha\omega_i)+\alpha\omega_i$.

(i) Since $(\widetilde{\omega}-\alpha\omega_i) > 0$ and $\alpha\omega_i > 0$, if $R < 2$, then $(2-R)(\widetilde{\omega}-\alpha\omega_i)+\alpha\omega_i > 0$ and $RHS'(\omega_i) > 0$.

(ii) More generally, $RHS'(\omega_i) < 0 \Leftrightarrow 2-R < -\frac{\alpha\omega_i}{\widetilde{\omega}-\alpha\omega_i} \Leftrightarrow R > 2+\frac{\alpha\omega_i}{\widetilde{\omega}-\alpha\omega_i} = 2+h\big(\pi(\omega_i)\big)$

Now, $\max h\big(\pi(\omega_i)\big) = h\big(\pi(\widetilde{\omega})\big) = \frac{\alpha}{1-\alpha}$.

Therefore, if $R > 2 + \frac{\alpha}{1-\alpha}$, then it must be the case that $RHS'(\omega_i) < 0$.

NOTE: For $2 \leq R \leq 2 + \frac{\alpha}{1-\alpha}$, then, there exists $\widehat{\omega}$ such that:

If $\omega_i < \widehat{\omega}$, then $RHS'(\omega_i) < 0$.

If $\omega_i = \widehat{\omega}$, then $RHS'(\omega_i) = 0$.

If $\omega_i > \widehat{\omega}$, then $RHS'(\omega_i) > 0$.

More precisely, $\widehat{\omega}$ is such that $R = 2 + \frac{\alpha\widehat{\omega}}{\widetilde{\omega}-\alpha\widehat{\omega}} \Leftrightarrow \widetilde{\omega}R - \alpha\widehat{\omega}R = 2\widetilde{\omega} - 2\alpha\widehat{\omega} + \alpha\widehat{\omega} = 2\widetilde{\omega} - \alpha\widehat{\omega} \Leftrightarrow (R - 2)\widetilde{\omega} = (R-1)\alpha\widehat{\omega} \Leftrightarrow \widehat{\omega} = \frac{1}{\alpha}\frac{R-2}{R-1}\widetilde{\omega}$.

Then,

$R = 2 + h\big(\pi(\widehat{\omega})\big)$ and $RHS'(\widehat{\omega}) = 0$. Since h and π are increasing functions, so is $2 + h\big(\pi(\omega)\big)$. Therefore,

If $\omega_i < \widehat{\omega}$, then $2 + h\big(\pi(\omega_i)\big) < R \Leftrightarrow R > 2 + h\big(\pi(\omega_i)\big) \Leftrightarrow RHS'(\omega_i) < 0$:

reversed preferences

If $\omega_i > \widehat{\omega}$, then $2 + h\big(\pi(\omega_i)\big) > R \Leftrightarrow R < 2 + h\big(\pi(\omega_i)\big) \Leftrightarrow RHS'(\omega_i) > 0$:

traditional preferences

THE ROLE OF AGGREGATE CONSUMER CONFIDENCE

$$\frac{\Pi}{1-\overline{\Pi}}\tau'(t)\omega u'\left(\frac{\Pi}{1-\overline{\Pi}}\tau(t)\omega\right) = h\big(\pi(\omega_M)\big)f(\omega_M) = \frac{\pi_M}{1-\pi_M}\omega_M u'((1-t)\omega_M) \tag{5”}$$

Let $g(\theta) = \theta u'(\theta\tau(t))$.

Then, $g'(\theta) = u'(\theta\tau(t)) + \theta\tau(t)u''\big(\theta\tau(t)\big) < 0 \Leftrightarrow 1 < -\frac{\theta\tau(t)u''(\theta\tau(t))}{u'(\theta\tau(t))} = RRA\big(\theta\tau(t)\big)$, which is true.

Thus, $g\left(\frac{\Pi}{1-\overline{\Pi}}\omega\right) = \frac{\Pi}{1-\overline{\Pi}}\omega u'\left(\frac{\Pi}{1-\overline{\Pi}}\tau(t)\omega\right)$ is a decreasing function of $\frac{\Pi}{1-\overline{\Pi}}$.

Therefore, the LHS is:

$$\tau'(t)g\left(\frac{\Pi}{1-\overline{\Pi}}\omega\right)$$

Thus, if overall economic confidence decreases, the LHS increases.

Consider now the equilibrium policy that solves to FOC after a decrease in $\frac{\Pi}{1-\overline{\Pi}}$:

$$\tau'(t)g\left(\frac{\Pi}{1-\overline{\Pi}}\omega\right) = \frac{\pi_M}{1-\pi_M}\omega_M u'((1-t)\omega_M)$$

If t did not change, we would have an increase in the LHS and a decrease in the RHS, due to the shock (reducing $\frac{\pi_M}{1-\pi_M}$). This not possible. If there were a decrease in t, that would further increase the LHS and further decrease the RHS, which is also impossible. Therefore, $t = t_M$ must increase.

DISTRIBUTION OF RISK AND PREFERENCES FOR REDISTRIBUTION EXAMPLE

$$u(\omega_i) = \frac{1}{1-R}\omega_i{}^{1-R}, \qquad R > 1.$$

$$\pi_i(\beta) = \alpha\left(\frac{\omega_i}{\widetilde{\omega}}\right)^{\beta}, \qquad 0 < \alpha < 1, \qquad \beta > 0.$$

Then,

$$h(\pi(\omega_i)) = \frac{\alpha\left(\frac{\omega_i}{\widetilde{\omega}}\right)^{\beta}}{1-\alpha\left(\frac{\omega_i}{\widetilde{\omega}}\right)^{\beta}} = \frac{\alpha\omega_i^{\beta}}{\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}}$$

And,

$$u'(\omega_i) = \omega_i{}^{-R}$$

Thus,

$$f(\omega_i) = \omega_i((1-t)\omega_i)^{-R} = (1-t)^{-R}\omega_i{}^{1-R}$$

Therefore,

$$RHS(\omega_i) = h(\pi(\omega_i))f(\omega_i) = (1-t)^{-R}\frac{\alpha\omega_i{}^{1+\beta-R}}{\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}}$$

Taking derivatives,

$$RHS'(\omega_i) = (1-t)^{-R}\frac{\alpha(1+\beta-R){\omega_i}^{\beta-R}\left(\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}\right)-\alpha{\omega_i}^{1+\beta-R}\left(-\alpha\beta\omega_i^{\beta-1}\right)}{\left(\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}\right)^2}$$

$$= (1-t)^{-R}\alpha{\omega_i}^{\beta-R}\frac{(1+\beta-R)\left(\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}\right)+\alpha\beta\omega_i^{\beta}}{(\widetilde{\omega}-\alpha\omega_i)^2}$$

Then, the sign of $RHS'(\omega_i)$ is the same as $(1+\beta-R)\left(\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}\right)+\alpha\beta\omega_i^{\beta}$.

(i) Since $\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}>0$ and $\alpha\beta\omega_i^{\beta}>0$, if $R<1+\beta$, then $(1+\beta-R)\left(\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}\right)+\alpha\beta\omega_i^{\beta}>0$ and $RHS'(\omega_i)>0$.

(ii) More generally, $RHS'(\omega_i)<0 \Leftrightarrow 1+\beta-R<-\frac{\alpha\beta\omega_i^{\beta}}{\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}} \Leftrightarrow R>1+\beta+\frac{\alpha\beta\omega_i^{\beta}}{\widetilde{\omega}^{\beta}-\alpha\omega_i^{\beta}}=1+\beta+\beta h\big(\pi(\omega_i)\big)$

Now, $\max h\big(\pi(\omega_i)\big)=h\big(\pi(\widetilde{\omega})\big)=\frac{\alpha}{1-\alpha}$.

Therefore, if $R>1+\beta+\beta\frac{\alpha}{1-\alpha}$, then it must be the case that $RHS'(\omega_i)<0$.

NOTE: For $1+\beta\leq R\leq 1+\beta+\beta\frac{\alpha}{1-\alpha}$, then, there exists $\widehat{\omega}$ such that:

If $\omega_i<\widehat{\omega}$, then $RHS'(\omega_i)<0$.

If $\omega_i=\widehat{\omega}$, then $RHS'(\omega_i)=0$.

If $\omega_i>\widehat{\omega}$, then $RHS'(\omega_i)>0$.

More precisely, $\widehat{\omega}$ is such that $R=1+\beta+\beta\frac{\alpha\widehat{\omega}^{\beta}}{\widetilde{\omega}^{\beta}-\alpha\widehat{\omega}^{\beta}} \Leftrightarrow \widetilde{\omega}^{\beta}R-\alpha\widehat{\omega}^{\beta}R=(1+\beta)\widetilde{\omega}^{\beta}-(1+\beta)\alpha\widehat{\omega}^{\beta}+\beta\alpha\widehat{\omega}^{\beta}=(1+\beta)\widetilde{\omega}^{\beta}-\alpha\widehat{\omega}^{\beta} \Leftrightarrow \big(R-(1+\beta)\big)\widetilde{\omega}^{\beta}=(R-1)\alpha\widehat{\omega}^{\beta}$

$$\Leftrightarrow \widehat{\omega}=\left[\frac{1}{\alpha}\frac{R-(1+\beta)}{R-1}\right]^{\frac{1}{\beta}}\widetilde{\omega}$$

Alternatively,

(i) If $\beta>R-1$, then $RHS'(\omega_i)>0$ and we have the traditional ordering.

(ii) If $\beta<(1-\alpha)(R-1)$ then $RHS'(\omega_i)<0$ and we have the reversed ordering.

This last result follows from:

$R>1+\beta+\beta\frac{\alpha}{1-\alpha} \Leftrightarrow \beta\left(1+\frac{\alpha}{1-\alpha}\right)<R-1 \Leftrightarrow \beta\frac{1}{1-\alpha}<R-1 \Leftrightarrow \beta<(1-\alpha)(R-1)$.

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