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July 2005

Imperfectly competitive finance, seniority wages and economic growth[1]

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Abstract

If households and firms face different interest rates, there may be mutual gains in forming seniority wage contracts, which facilitate implicit saving by younger workers, who might otherwise save either little or nothing at all at low interest rates. A three-period OLG model is presented with monopolistic competition in the finance sector to endogenise the interest rate differences plus a Romer (1986) production technology to explain the growth rate. We find that growth may be higher under seniority wages than under spot wages, because of a Kaldorian effect working with an income distribution that favours higher (middle-aged) savers. Growth may even be higher under imperfectly competitive finance – *by prompting the formation of seniority wages* – than under perfectly competitive finance, which is an important result for the broader understanding of the relationship between financial sector competition and real activity.

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1. Introduction

An imperfection in one market may prompt another market to compensate in the way it operates. The best known example of this is found in implicit contract theory where the labour market responds to missing or inadequate insurance markets by allowing for state-contingent contracts where firms effectively insure more risk-averse workers against the uncertainty of consumption.[3] A lesser known example of this phenomenon comes under the general heading of the "forced-saving" explanation[4] of seniority wages, as stated by Neumark (1995) and developed by Arai (1997), where an optimal long-run labour contract substitutes for an absent saving market.[5] More generally, if workers desire rising consumption profiles and if the formal savings market is unable to satisfy these preferences, the labour market may meet this need by providing long-run contracts where wages rise with length of tenure.[6]

The present paper considers a less severe and more appealing case where the finance sector is not absent but imperfectly competitive. Imperfectly competitive finance (ICF), even in a perfect information world, will cause interest rate divergence. As one might expect, we find that the Pareto-optimality of seniority wage contracts is sustained, if workers would rather save at a preferential interest rate that is on offer to the firm than at their own. However, the main contribution of this paper is to embody this analysis within a fully consistent model of dynamic general equilibrium to show that seniority wages may raise the level of growth.

The full model has four components: (i) a three-period version of the Diamond (1962) overlapping model, (ii) a Romer (1986) production technology with constant returns to scale, generating endogenous growth, (iii) a model of ICF to determine the interest rate differences, and (iv) a model of labour market contracting. An interesting feature of the

[3] Azariadis (1975), Baily (1974) and Gordon (1974).

[4] See also Lowenstein and Sicherman (1991) and Frank and Hutchens (1993).

[5] Two other theoretical explanations for seniority wages, with which we not concerned, are that they reflect the costs and acquisition of human capital [Becker (1962) and that they serve as "delayed incentive mechanisms" [Lazear (1981]. See Hutchens (1989) for a review of these models.

[6] Even with a fully function savings market, a labour contract may ensure precommitment to an optimal plan in the presence of the time-consistency problem of under-saving that arises with hyperbolic discounting in Strotz (1955).

model is the interaction between growth and the seniority wage structure. On the one hand, a higher growth rate reduces both the incentive to form seniority wages and the size of any associated mark-up for seniority as a result of consumption smoothing.[7] On the other hand, seniority wages may also bring about a higher growth rate.

The explanation for this is as follows. Consider a spot wage regime with two generations of workers, young and middle-aged, where the young neither save nor borrow, because of a large interest rate spread, while the middle-aged always save inelastically for retirement through the finance sector. Turning to a long-run contract wage regime, we find that the young will still not formally save (or borrow), as a basic condition for this equilibrium, but the middle-aged will save even more, because the contract wage they receive must exceed the spot wage. The implication is higher aggregate saving, which translates into increased growth under the assumption of a Romer production technology. So, in addition to workers' private utility gains from a better rate of return, which is obtained implicitly through the wage contract, there is the macroeconomic externality of higher growth. Even so, regarding the first point, growth must not consequently be so high that the underlying incentive of seniority wages in implicit saving is undermined.

The crux of the analysis is that seniority wage contracts redistribute labour income from the young to the middle-aged. In the three-period overlapping generations model with ICF, we find that generally the young save either little or nothing, while the middle-aged save substantially in the absence of an expected retirement income. Thus, seniority wages may raise growth through the "Kaldorian" effect of redistributing labour income from individuals with low saving ratios to those with high ones.[8]

Taking this one stage further, we consider whether growth could even be higher under ICF, because of this accommodating response of establishing seniority wages, than

[7] Growth may be so high that households would rather borrow against their future income instead of implicitly saving through a rising wage-profile.
[8] In Kaldor (1957) workers save a lower proportion of their incomes than capitalists.

under competitive financial markets. We find that this indeed is a possibility for certain parameter values, of which an essential one is the low interest elasticity of saving that is required to minimise the effect of lower saving rates of interest under ICF.

The broad conclusion of the whole analysis is that if the labour market can respond to a poor market rate of return on formal saving by forming long-run wage contracts, there are both private gains from wage contracting and the possible externality of higher growth, so that the adverse effects of ICF are mitigated. The results of the paper are relevant to the wider literature on financial sector competition and growth. In a review article, Guzmann (2000) concludes that although monopolistic banking may alleviate the asymmetric information problems considered in partial equilibrium settings, adverse capital accumulation effects may dominate within dynamic general equilibrium. Pagano (1993) claims this is because monopsonistic rates of return reduce saving ratios. Nevertheless, we show that a seniority wage response to ICF has the countervailing effect of redistributing income from individuals with low saving ratios to those with high ones.

The rest of the paper is set up follows. In Section 2 the basics of the model are presented: a three-period overlapping-generations model with endogenous growth. Section 3 solves the model for the benchmark case of competitive finance (CF) with spot wages. Section 4 models ICF. Section 5 then considers the possibility that the labour market may respond by negotiating seniority wage contracts. Section 6 then solves the model with imperfect financial competition and seniority wages within general equilibrium. Section 7 presents the informal part of the analysis and Section 8 offers a brief conclusion.

2. Basics of the model

Production

We consider a version of the Romer (1986) endogenous growth model with constant returns to scale both in social capital and in the private factors of production. The output of firm *z* is

$$Y_t(z) = A k_t^{1-\alpha} K_t(z)^{\alpha} \left(L_t^Y(z) + L_t^M(z) \right)^{1-\alpha}, \text{ where } k_t \equiv \sum K_t(z) \Big/ \sum \left(L_t^Y(z) + L_t^M(z) \right) \qquad (1)$$

The constant, A, is a technology parameter. Labour is composed of two cohorts, young workers, L_t^Y, and equally productive middle-aged workers, L_t^M. Firm *z*'s capital stock is K_t(z) and a measure of the aggregate per capita capital stock is denoted k_t. The latter embodies knowledge spill-overs from firms' individual investments, $K_t(z)$. Each firm, being small, does not anticipate that its own choice of $K_t(z)$ has any effect on the aggregate per capita, k_t.

The firm faces the cost of an interest factor, R_t^F, on capital and (in the first part of the paper) a spot wage, w_t^S, on labour. Profit is maximized where the marginal product of capital equals the interest rate factor[9]:

$$\alpha A k_t^{1-\alpha} K_t(z)^{\alpha-1} \left(L_t^Y(z) + L_t^M(z) \right)^{1-\alpha} = R_t^F \qquad (2)$$

Applying symmetric equilibrium and using the definition in (1), the interest factor is solved as

$$R_t^F = \alpha A \qquad (3)$$

The spot wage is determined by the no-entry/exit condition for firms of zero profit in each period. In symmetric equilibrium, the spot wage is

$$w_t^S = (1-\alpha) A k_t \qquad (4)$$

There is neither population growth nor premature death, so that at any time the representative firm employs as many young as middle-aged workers, $L_t^Y(z) = L_t^M(z)$. Henceforth, we suppress the z-indexation notation.

The investment-savings equality with full depreciation within each period is

[9] It is the interest *factor* that is equal to the marginal product of capital, because in addition to the interest *rate*, which is the marginal cost of borrowing, there is also the depreciation cost at the rate of 100% over the period.

$$k_{t+1} = \frac{s_t^Y + s_t^M}{2}, \tag{5}$$

where s_t^Y and s_t^M are the respective savings of the representative young and middle-aged households.[10]

Households

As implied, households work for two periods when they are *young* and *middle-aged*, but are retired for a third period when they are *old*. They derive utility from consumption in each of these three periods, c_t^Y, c_{t+1}^M and c_{t+2}^O in the CES function,

$$V_t^N = \left(c_t^{Y\,\frac{\sigma-1}{\sigma}} + (1+\theta)^{-1} c_{t+1}^{M\,\frac{\sigma-1}{\sigma}} + (1+\theta)^{-2} c_{t+2}^{O\,\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{6}$$

where σ, $\sigma > 0$, is the intertemporal elasticity of substitution and θ, $\theta \geq 0$, is the rate of time-preference. The intertemporal budget constraint is

$$c_t^Y + \frac{c_{t+1}^M}{R_{t+1}^N} + \frac{c_{t+2}^O}{R_{t+1}^N R_{t+2}^N} = w_t^Y + \frac{w_{t+1}^M}{R_{t+1}^N} \tag{7}$$

where R_{t+1}^N and R_{t+2}^N are the household's interest factors used to discount income and consumption over the respective periods *t* to *t+1* and *t+1* to *t+2*. Wages, w_t^Y and w_{t+1}^M, are paid to households for inelastically supplied units of work in each of the first two periods and then pensionless retirement follows in the third period of old age.[11]

3. Solution with competitive finance (CF)

The implication of CF in a perfect information model, such as this, is the existence of a single interest factor, R_t^*, facing all the agents of the economy. Maximization of (6) subject to (7) yields solutions for household saving/borrowing for each of the first two periods:

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[10] More generally, $k_{t+1} = \dfrac{(1+n)s_t^Y + s_t^M}{2+n}$, where n is the population growth rate.

$$s_t^Y = \frac{\left(1+(1+\theta)^{-\sigma} R_{t+2}^{*\ \sigma-1}\right) w_t^Y - (1+\theta)^{\sigma} R_{t+1}^{*\ -\sigma} w_{t+1}^M}{1+(1+\theta)^{-\sigma} R_{t+2}^{*\ \sigma-1} + (1+\theta)^{\sigma} R_{t+1}^{*\ 1-\sigma}} \tag{8}$$

$$s_{t+1}^M = \frac{(1+\theta)^{-\sigma} R_{t+2}^{*\ \sigma-1}\left(R_{t+1}^* w_t^Y + w_{t+1}^M\right)}{1+(1+\theta)^{-\sigma} R_{t+2}^{*\ \sigma-1} + (1+\theta)^{\sigma} R_{t+1}^{*\ 1-\sigma}} \tag{9}$$

According to equation (9) middle-aged households always save ($s_{t+1}^M > 0$), but equation (8) shows that young households may either save or borrow.

The model is relatively straightforward to solve if a logarithmic form is used for the utility function where $\sigma = 1$. Equations (3)-(5), (8) and (9) determine the growth factor as

$$G_{t+1} = \frac{(1-\alpha)A\left((3+\theta) - (1+\theta)^2 (\alpha A)^{-1} G_{t+1} + \alpha A G_t^{\ -1}\right)}{2\left(2+\theta+(1+\theta)^2\right)}$$

Its steady-state, where $G = G_{t+1}, G_t$ and where $G = w_{t+1}^S \big/ w_t^S$, is solved as a quadratic:

$$G = (1-\alpha)A\left[\frac{3+\theta}{D} + \left(\left(\frac{3+\theta}{D}\right)^2 + \frac{\alpha}{1-\alpha}\left(\frac{1}{D}\right)\right)^{\frac{1}{2}}\right],\ D \equiv 8+4\theta+2(1+\theta)^2\left(1+\alpha^{-1}\right) \tag{10}$$

According to equation (8), where $\sigma = 1$, the young will save (borrow) if $G < (>) \dfrac{(2+\theta)}{(1+\theta)^2}\alpha A$. Equation (10), after some manipulation, shows the condition for young saving (borrowing) to be

$$\alpha > (<0) \frac{(1+\theta)^2 + 2(2+\theta)}{(1+\theta)^2 + 2(2+\theta)(3+\theta) + \left(\frac{2+\theta}{1+\theta}\right)^2 \left(10+8\theta+2\theta^2\right)} \tag{11}$$

Saving requires a relatively high value for the capital share parameter, α, both because it determines the marginal product of capital, the interest factor in equation (3), and because it negatively affects the marginal product of labour, the wage in equation (4), which determines the volume of saving and, hence, the level of growth. The value

[11] This assumption is not crucial but convenient for the analysis.

$\alpha \approx 0.33$ for a Cobb Douglas production technology has some general appeal as the stylized value for the empirically stable share of capital income.

Proposition 1: If $\alpha \approx 0.33$*, the young will always save if there is CF.*

Expressing the RHS of equation (11) as $\alpha^C = f(\theta)$, we calculate $f(0) = 0.094$, $f(1) = 0.137$, $f(2) = 0.146$, $f(3) = 0.165$, $f(4) = 0.172$ and $f(\infty) \rightarrow 0.2$. Although $f(\theta)$ is a high-order polynomial function in θ, suggesting the possibility of multiple local maxima, the calculations at suggest that it is, at least, approximately monotonic and with all values well below 0.33. $\|$

4. Imperfectly competitive finance ICF

We now depart from the customary benchmark of CF and consider the determination of interest rates in a world with a finite number of finance firms acting as Nash-Cournot players. This will generally cause interest rate spreads, as well as a possible equilibrium where the young may not engage with the finance sector at all: the deposit interest factor may be too low to induce saving, while the loan interest factor may be too high for them to want to borrow. There are three possibilities and associated parameter conditions: equilibria where young households (i) save, (ii) borrow and (iii) do neither.

ICF also implies the generation of profits, and the fullest analysis should take their return to households into account. Nevertheless, we shall abstract from this issue here, not because it is insignificant but because it is important enough to merit a separate formal analysis. This was undertaken as a sole focus in Roberts (2005), yielding results that, in this present analysis, are to be drawn upon discursively later rather than formally at the outset. To incorporate profit return into the main analysis would create a two-headed monster of a paper that we wish to avoid. Later, we hope to convince the reader that the issue of profit return *per se* will not affect the main qualitative analysis of the paper, but that *the way* in which profits are returned will have some bearing upon the quantitative parameter conditions underlying a seniority wage equilibrium - either positively, negatively or neither.

Case 1. An equilibrium where young households save, $s_t^Y > 0$

There are N finance firms, indexed $z = 1,..N$. Each one issues $s_t^Y(z)$ deposits to the young, where $s_t^Y \equiv \sum_{z=1}^{N} s_t^Y(z)$, and $s_t^M(z)$ deposits to the middle-age, where $s_t^M \equiv \sum_{z=1}^{N} s_t^M(z)$. We rule out the possibility of price-discrimination within the deposit market, so that each finance firm issues $s_t(z)$ deposits, $s_t(z) = s_t^Y(z) + s_t^M(z)$, at the same interest factor R_{t+1}^L [12], to both generations where $s_t \equiv \sum_{z=1}^{N} s_t(z)$.

Each finance firm creates $s_t(z)$ deposits in order to make $i_t(z)$ loans to firms, which are charged at a different interest factor. This interest factor on loans is taken as given, as if the loan market were fully competitive, which is consistent with the feature that investment demand is perfectly elastic at αA in equation (3). There is an incentive for financial intermediation between households and firms if the rate of profit is positive, $\alpha A - R_{t+1}^L > 0$. Profit maximization implies that all funds loaned out, precluding the possibility that $i_t(z) < s_t(z)$, while feasibility requires that loans cannot exceed funds, ruling-out $i_t(z) > s_t(z)$, so that, in sum, $i_t(z) = s_t(z)$.

There is a perception by each finance firm that its individual supply of funds, $s_t(z)$, affects the aggregate supply, s_t, which in turn determines R_{t+1}^L through the inversion of the aggregate savings function, $R_{t+1}^L = R^L(s_t)$ [13]. The profit function,

$$\Omega_{t+1}(z) = \left(\alpha A - R_{t+1}^L(s_t)\right)s_t(z), \tag{12.1}$$

is maximized with respect to $s_t(z)$ where

[12] An implication of price discrimination between savers is that middle-aged households would receive a lower deposit rate of interest, because their interest elasticity of saving is lower than that of young households.

[13] The monotonic relationship between the interest factor and saving allows us to make this inversion.

$$\alpha A - R_{t+1}^{L}(s_t) - \frac{\partial R_{t+1}^{L}}{\partial s_t} s_t(z) = 0$$

In symmetric equilibrium, where $s_t(z) = s_t / N \quad \forall z$,

$$\alpha A - R_{t+1}^{L}(s_t) - \frac{\partial R_{t+1}^{L}}{\partial s_t} \frac{s_t}{N} = 0$$

If we use the following definition for the interest elasticity of aggregate saving,

$$\varepsilon_{t+1} \equiv \frac{\partial s_t}{\partial R_{t+1}^{L}} \frac{R_{t+1}^{L}}{s_t} > 0, \tag{13.1}$$

there is a succinct expression for the solution for the deposit interest factor,

$$R_{t+1}^{L} = \frac{\alpha A}{1 + \left(N \varepsilon_{t+1}\right)^{-1}}, \qquad \text{subject to } R_{t+1}^{L} \geq R_{t+1}^{L,MIN} \tag{14.1}$$

The inequality constraint in equation (14.1) reflects the condition that the deposit interest factor must be bounded from below, since a nominal interest factor cannot fall below unity – unless there is confiscation of some of the principal saved, which implies that the real interest factor cannot fall below the inverse of the price inflation factor.[14]

Imperfect competition, where $N < \infty$ (and $\varepsilon_{t+1}^{S} < \infty$), is necessary and sufficient for an interest rate spread, $R_{t+1}^{L} < \alpha A$. For R_{t+1}^{L} in equation (14.1) to be an equilibrium in this particular case, it must be consistent with saving by young households, $s_t^{Y} > 0$, which is now checked.

An analytical example of Case 1 where $\sigma = 1$

If there is a unitary elasticity of intertemporal substitution, $\sigma = 1$, household savings in equations (8) and (9) become

$$s_t^{Y} = \frac{(2+\theta) w_t^{S} - (1+\theta)^2 R_{t+1}^{L\;-1} w_{t+1}^{S}}{2 + \theta + (1+\theta)^2} \qquad\qquad s_t^{M} = \frac{R_t^{L} w_{t-1}^{S} + w_t^{S}}{2 + \theta + (1+\theta)^2},$$

[14] Presumably, the rate of return should not be so low that households would be indifferent to hoarding cash. Apart from the relative security risks of cash and deposits, the relative illiquidity of the latter may also encourage precommitment to a saving plan.

Adding these together, the aggregate saving elasticity is found to be

$$\varepsilon_t = \frac{(1+\theta)^2 R_{t+1}^{L\ -1} G_{t+1}}{3+\theta+R_t^L G_{t-1}^{\ -1} - (1+\theta)^2 R_{t+1}^{L\ -1} G_{t+1}} \qquad \text{where } G_{t+1} \equiv w_{t+1}^S \big/ w_t^S$$

Note that this elasticity reflects only a discounting effect of the rate of interest in the saving function of the young, since income and substitution effects cancel out in the logarithmic utility function (for both generations).

In the steady-state, the point of zero saving by the young is determined where $R/G = (1+\theta)^2 \big/ (2+\theta)$. Substituting this value into the aggregate saving elasticity gives the critical elasticity value of $\varepsilon = \varepsilon(\theta) \equiv \dfrac{(2+\theta)^2}{2+\theta+(1+\theta)^2}$, which implies a deposit interest factor in equation (14.1) of $R^L = \dfrac{\alpha A}{1+\left(N\varepsilon(\theta)\right)^{-1}}$. Saving by the young in a steady-state, therefore, requires that

$$G < \frac{(2+\theta)\alpha A}{(1+\theta)^2\left(1+\left(N\varepsilon(\theta)\right)^{-1}\right)}, \tag{15.1}$$

The growth factor, G, and the rate of time-preference, θ, must be low relative to the number of finance firms, N.

Case 3. An equilibrium where young households borrow, $s_t^Y < 0$

In this case, $s_t^Y < 0$, while $s_t^M > 0$. There is now scope for a kind of price discrimination across households, not on the basis of their age, but on whether they save or borrow. There is also the potential of price discrimination in the loans market, since firms and households may be charged at different interest factors, αA and R_{t+1}^H.

Intermediation both between the personal sector and the corporate sector households and between the middle-aged and young requires the profit incentives in $R_{t+1}^L < \alpha A < R_{t+1}^H$. Feasibility plus the absence of unexploited profit opportunities in this case ensures, $i_t(z) - s_t^Y(z) = s_t^M(z)$, so that profit for each firm z is

$$\Omega_{t+1}(z) = \left(R^H_{t+1}(s^Y_t) - \alpha A\right)s^Y_t(z) + \left(\alpha A - R^L_{t+1}(s^M_t)\right)s^M_t(z) \tag{12.3}$$

Maximization with respect to both $s^Y_t(z)$ and $s^M_t(z)$ yields two first-order conditions,

$$\alpha A - R^L_{t+1}(s_t) - \frac{\partial R^L_{t+1}}{\partial s^M_t(z)} s^M_t(z) = 0, \qquad R^H_{t+1}(s^Y_t) - \alpha A + \frac{\partial R^H_{t+1}}{\partial s^Y_t(z)} s^Y_t(z) = 0,$$

which in symmetric equilibrium are

$$\alpha A - R^L_{t+1}(s^M_t) - \frac{\partial R^L_{t+1}}{\partial s^M_t}\frac{s^M_t}{N} = 0, \qquad R^H_{t+1}(s^Y_t) - \overline{R}^F_{t+1} + \frac{\partial R^H_{t+1}}{\partial s^Y_t}\frac{s^Y_t}{N} = 0 \cdot$$

The interest elasticity definitions,

$$\varepsilon^M_{t+1} \equiv \frac{\partial s^M_t}{\partial R^L_{t+1}}\frac{R^L_{t+1}}{s^M_t} > 0, \qquad \varepsilon^Y_{t+1} \equiv \frac{\partial s^Y_t}{\partial R^H_{t+1}}\frac{R^H_{t+1}}{s^Y_t} < 0 \tag{13.3}$$

are used in the solutions,

$$R^L_{t+1} = \frac{\alpha A}{1 + \left(N\varepsilon^M_{t+1}\right)^{-1}} \quad \text{subject to } R^L_{t+1} \geq R^{L,MIN}_{t+1} \quad \text{and} \quad R^H_{t+1} = \frac{\alpha A}{1 + \left(N\varepsilon^Y_{t+1}\right)^{-1}} \tag{14.3}$$

Monopsonistic power in the saving market (where $N < \infty$ and $\varepsilon^M_{t+1} < \infty$) again guarantees that $R^L_{t+1} < \alpha A$; while now monopolistic power in the household loans market (where $N < \infty$ and $-\infty < \varepsilon^Y_{t+1} < 0$) causes $R^H_{t+1} > \alpha A$.

A unitary elasticity of intertemporal substitution causes the middle-aged to save inelastically ($\varepsilon^M_{t+1} = 0$). Consequently, the saving interest factor is driven down to the minimum, $R^L_{t+1} = R^{L,MIN}_{t+1}$ in equation (14.3). Again, there is a need to see if the other solution in (14.3), R^H_{t+1}, is consistent with borrowing by the young, $s^Y_t(z) < 0$.

An analytical example of the case where young households borrow where $\sigma = 1$

The solution for the loan interest factor is quite straightforward in the monopoly case where $N = 1$:

$$R_{t+1}^{H} = (1+\theta)\sqrt{\frac{\alpha A G_{t+1}}{2+\theta}}$$

Substituting this into the young's saving/borrowing function, we find that there will be borrowing if

$$G > \frac{(2+\theta)\alpha A}{(1+\theta)^2}$$

This condition for borrowing by the young, where $N = 1$, turns out to be the same as the condition for borrowing by the young for the $\sigma = 1$ case of equation (8), where $N \to \infty$ and for *a given growth factor*. Since saving is a monotonic function of N through equations (8), where $\sigma = 1$, and (14.3), borrowing in both cases of $N = 1$ and $N \to \infty$ implies borrowing for all values of N. The underlying intuition is that if young households would borrow in the competitive case, it would never be beneficial for ICF firms to manage monopolistic power in such a way as to lose customers (to non-engagement), since there are always extra profits to be made in retaining borrowers.[15]

Furthermore, if the level of growth is not given but endogenous, the fall in (the positive level of) borrowing, caused by ICF, is reduced. If the young borrow in order to finance current expenditure for consumption and not for investment in human capital and as middle-aged saving is holds up under the $\sigma = 1$ assumption, ICF in this case raises aggregate net household saving. This, in turn, increases growth, which causes a rise in borrowing for consumption-smoothing, mitigating the effect of higher interest rates.

Summary of the results of the ICF model

We summarise the two results above of cases (i) and (iii) with $\sigma = 1$, and deduce a third intermediate case.

Case 1. Young households save in the low growth case where $G < \dfrac{(2+\theta)\alpha A}{(1+\theta)^2\left(1+\left(N\varepsilon(\theta)\right)^{-1}\right)}$

[15] For the same reason, if price discrimination were allowed in the deposit market, young households would never be offered a deposit rate of interest that was so low that they would opt out of financial saving altogether.

Case 2. Young households do not engage with the finance sector in the intermediate growth case where $\frac{(2+\theta)\alpha A}{(1+\theta)^2\left(1+\left(N\varepsilon(\theta)\right)^{-1}\right)} < G < \frac{(2+\theta)\alpha A}{(1+\theta)^2}$

Case 3. Young households borrow in the high growth case where $G > \frac{(2+\theta)\alpha A}{(1+\theta)^2}$

Note that the intermediate range of values for non-participation increases as N decreases, so that this *Case 2* may typify what we may call the more severe case of ICF. Finally, these values have been calculated for *a given level of growth*. *Appendix 2* shows that where growth is endogenous, households will save under ICF with spot wages, where $N=1$, $\sigma=1$ and $\alpha=1/3$, if, approximately, $\theta<1.9$. If $\theta>1.9$, young households will neither save nor borrow according to *Proposition 1*.

5. Seniority wages

Arai (1997) showed that where financial markets are absent, a worker-household may able to reach its optimal consumption profile through negotiating a long-run wage labour contract with its employer.[16] Preferences for a rising consumption profile would be fulfilled by a wage contract with a seniority structure. The purpose of this section is to show that this rationale for seniority wage contracts is also sustained where financial markets are present but imperfectly competitive in the way described immediately above.

The contract

The worker-household, as before, is concerned with the maximization of the utility function in equation (6). Instead, the firm, as the other negotiating party is concerned with two-period profit,

$$\Pi_t^F = B_t\left(L_t^Y + \overline{L}_{t-1}^Y\right)^{1-\alpha} - w_t^{CY}L_t^Y - \overline{w}_t^M\,\overline{L}_{t-1}^Y + \frac{B_{t+1}\left(\hat{L}_{t+1}^Y + L_t^Y\right)^{1-\alpha} - \hat{w}_{t+1}^Y\hat{L}_{t+1}^Y - w_{t+1}^{CM}L_t^Y}{R_{t+1}^F},$$

where $B_t \equiv A\hat{k}_t^{\,1-\alpha}K_t^{\,\alpha}$, (17)

[16] Arai (1997) also considers some additional issues relating to imperfect information.

An intertemporal profit linkage arises from the fact that each cohort of workers is employed for two-periods. The assumption of constant population without premature death ensures that the cohort size of middle-aged workers in any period is equal cohort size of young workers in the previous period: $L_t^M = L_{t-1}^Y$, $L_{t+1}^M = L_t^Y$.

At the start of each time period t, the firm negotiates wages with the new influx of young workers, L_t^Y, alone with respect to their current and prospective wages $\left(w_t^{CY}, w_{t+1}^{CM}\right)$. The wage $\overline{w}_t^M$ of middle-aged workers, $\overline{L}_{t-1}^Y$, already on the scene, would previously have been negotiated at $t-1$ when they were young; and the prospect of renegotiation at t is ruled-out. Consequently, we use *bars* over the variables $(\overline{L}_{t-1}^Y, \overline{w}_t^M)$ to denote predetermination. Likewise, the wage $\hat{w}_{t+1}^Y$ of the prospective influx of young workers at time $t+1$, $\hat{L}_{t+1}^Y$, is a matter of anticipation, so that *hats* are used for the future variables $(\hat{L}_{t+1}^Y,\ \hat{w}_{t+1}^Y)$.

The following assumptions relating to the nature of the bargain are made.

Assumption 1: There is bargaining only with new cohort, L_t^Y *, and over wages* $\left(w_t^{CY}, w_{t+1}^{CM}\right)$ *alone.*

Assumption 2: In the event of a disagreement with the new cohort,

(a) *Predetermined variables* $(\overline{L}_{t-1}^Y, \overline{w}_t^M)$ *relating to the previous cohort and anticipated variables* $(\hat{L}_{t+1}^Y,\ \hat{w}_{t+1}^Y)$ *relating to the future cohort are unaffected.*

(b) *Employment of the new cohort is also unaffected.*[17]

(c) *The new cohort is paid the spot wage.*

Assumption 3: Contracts are incentive-compatible, so that $w_{t+1}^S < w_{t+1}^{CM} << \infty$.

There is an obvious incentive-compatibility problem if $w_{t+1}^{CM} < w_{t+1}^{S}$, for middle-aged workers then have an incentive to jump ship by joining another firm paying out the higher spot wage. Likewise, if $w_{t+1}^{CM} >> w_{t+1}^{S}$, it is firms which have an overwhelming incentive to renege on the contract either by sacking middle-aged workers or by refusing to pay them a contract wage that is well in excess of their marginal product.

According to *Assumption 2,* the firm's disagreement payoff is

$$\Pi_t^O = B_t\left(L_t^Y + \overline{L}_{t-1}^Y\right)^{1-\alpha} - w_t^S L_t^Y - w_t^M \overline{L}_{t-1}^Y + \frac{B_{t+1}F\left(\hat{L}_{t+1}^Y + L_t^Y\right)^{1-\alpha} - \hat{w}_{t+1}^Y \hat{L}_{t+1}^Y - w_{t+1}^S L_t^Y}{R_{t+1}^F}$$

Subtraction from (17) gives a simple expression for the firm's bargaining surplus, as the present value difference between the spot wage bill and contract wage bill to be paid to the new cohort:

$$\Pi_t^F - \Pi_t^O = \left(w_t^S + \frac{w_{t+1}^S}{R_{t+1}^F} - w_t^{CY} - \frac{w_{t+1}^{CM}}{R_{t+1}^F} \right) L_t^Y \tag{18}$$

An efficient contract may be determined by setting up the Lagrangean function, H_t,

$$H_t = V_t\left(w_t^{CY}, w_{t+1}^{CM}\right)L_t^Y + \lambda_t \left(w_t^S + \frac{w_{t+1}^S}{R_{t+1}^F} - w_t^{CY} - \frac{w_{t+1}^{CM}}{R_{t+1}^F} \right) L_t^Y \tag{19}$$

where λ_t is marginal utility of profit.

Fixed-employment wage bargaining covers two aspects, *efficiency* and the *division of the surplus* between the two parties. A contract is efficient at the point where the life-time indirect utility of the new cohort, V_t^N, is maximized with respect to the wage pair $\left(w_t^{CY}, w_{t+1}^{CM}\right)$ subject to a given level of the present value wage bill to be paid out by the firm. This generates a solution for the *relative* values of the two contract wages, w_t^{CY}

[17]All firms are symmetric, their number is fixed and there is full employment throughout the economy. This implies that a disagreement has no effect on employment in any firm.

and w_{t+1}^{CM}, which determines the seniority wage structure. The second aspect, the division of the surplus, fixes the *absolute* level of contract wages.

We assume that the firm has absolute bargaining power, so that the present value of the contract wage bill is bargained down to equality with the present value of the spot wage bill:

$$w_t^{CY} + \frac{1}{R_{t+1}^F} w_{t+1}^{CM} = w_t^S + \frac{1}{R_{t+1}^F} w_{t+1}^S \qquad (20)$$

This assumption is made to avoid a complication that would arise later should the spot and contract wage regimes be associated with different intertemporal profit levels, for the firm's choice of wage regime would then become trivial. The single no-entry condition for both types of firm is that two-period - rather than single-period - profit is zero.[18]

Before proceeding with the main analysis, we must first make the following point.

Basic Condition: The determination of a long-run wage contract $\left(w_t^{CY}, w_{t+1}^{CM}\right)$ *requires that young households do not engage with the financial sector.*

If young households smooth consumption through the financial sector, either by saving or borrowing, their utility, like firm's profit, is monotonically related to the present value of life-time labour income,

$$V_t^N = \Omega\left(w_t^{CY} + \frac{1}{R_{t+1}^N} w_{t+1}^{CM} \right) \text{ where}$$

$$\Omega \equiv \left(1 + (1+\theta)^{-\sigma} {R_{t+1}^N}^{\sigma-1} + (1+\theta)^{-2\sigma} {R_{t+1}^N}^{\sigma-1} {R_{t+2}^L}^{\sigma-1}\right)^{\frac{1}{\sigma-1}}, \quad R_{t+1}^N = R_{t+1}^L, R_{t+1}^H$$

If young households and the firm face the same interest rate, $R_{t+1}^N = \alpha A$, both parties would be indifferent to the value of the wage in any period, rendering the wage-profile

[18] The implication is that a new entrant firm is able to borrow against an initial period loss in the anticipation of a sufficiently large second period profit.

indeterminate. If $R_{t+1}^{N} = R_{t+1}^{L} < \alpha A$, there would be Pareto-gains in bargaining down the first-period wage to zero[19], causing households to borrow. This invalidates the assumption that households receive the low interest factor $R_{t+1}^{N} = R_{t+1}^{L}$. Likewise, if $R_{t+1}^{N} = R_{t+1}^{H} > \alpha A$, there would be Pareto-gains in bargaining the second-period wage down, making young households savers and invalidating the assumption $R_{t+1}^{N} = R_{t+1}^{H}$.‖

The possibility of a seniority wage contract thus requires that young households do not engage with the financial sector, so that $s_t^Y = 0$ and $c_t^Y = w_t^Y$.[20] The young household's indirect utility function is then

$$V_t^N = \left(w_t^{Y\,\frac{\sigma-1}{\sigma}} + (1+\theta)^{-1}\left(1+(1+\theta)^{-\sigma} R_{t+2}^{L\;\sigma-1}\right)^{\frac{1}{\sigma}} w_{t+1}^{M\,\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{21}$$

See *Appendix 1* for the derivation. Note that the young still expect to save later on, when they become middle-aged, at the interest factor, R_{t+2}^{L}. This is because the firm is assumed not to fulfil any further consumption-smoothing role - in the absence of a similarly negotiated occupational pension.

It is convenient to define the *seniority mark-up factor* as

$$S_{t+1} \equiv w_{t+1}^{CM} \big/ w_{t+1}^{CY} \tag{22}$$

Substituting this definition along with equation (20), where $G_{t+1} = w_{t+1}^{S} \big/ w_t^{S}$, into equation (21) gives

$$V_t^N = \left(1+(1+\theta)^{-1}\left(1+(1+\theta)^{-\sigma} R_{t+2}^{L\;\sigma-1}\right)^{\frac{1}{\sigma}} \left(G_{t+1}S_{t+1}\right)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \left(\frac{1+G_{t+1}\big/R_{t+1}^{F}}{1+G_{t+1}S_{t+1}\big/R_{t+1}^{F}} \right) w_t^S \tag{23}$$

[19] Logically, workers could act as intermediaries themselves by borrowing from finance firms and by lending to their employers by accepting negatively valued first period wages.

An efficient labour contract is defined as the value of S_{t+1} that maximises V_t^N:

$$S_{t+1}^* = \arg\max V_t^N = \left(\frac{1+(1+\theta)^{-\sigma} R_{t+2}^{L\ \sigma-1}}{G_{t+1}}\right)\left(\frac{R_{t+1}^F}{1+\theta}\right)^{\sigma}$$

subject to incentive-compatibility [*Assumption 3*]. Using equation (3) we get

$$S_{t+1}^* = \arg\max V_t^N = \left(\frac{1+(1+\theta)^{-\sigma} R_{t+2}^{L\ \sigma-1}}{G_{t+1}}\right)\left(\frac{\alpha A}{1+\theta}\right)^{\sigma} \tag{24}$$

Equations (20) and (22) determine contract wages as a function of the current spot wage, w_t^S, the growth factor, G_{t+1}, where $G_{t+1} = w_{t+1}^S / w_t^S$, and the seniority mark-up, S_{t+1}^*, in equation (24):

$$w_t^{CY} = \left(\frac{\alpha A + G_{t+1}}{\alpha A + S_{t+1}^* G_{t+1}}\right) w_t^S, \qquad w_t^{CM} = S_t^* \left(\frac{\alpha A + G_t}{\alpha A + S_t^* G_t}\right) w_t^S,$$

$$w_{t+1}^{CY} = G_{t+1}\left(\frac{\alpha A + G_{t+2}}{\alpha A + S_{t+2}^* G_{t+2}}\right) w_t^S, \qquad w_{t+1}^{CM} = G_{t+1} S_{t+1}^* \left(\frac{\alpha A + G_{t+1}}{\alpha A + S_{t+1}^* G_{t+1}}\right) w_t^S \tag{25}$$

The existence of a seniority wage equilibrium in the steady-state ($S_{t+1}^* > 1$) implies that $w_t^{CY} < w_t^S < w_t^{CM}$, which is the first part the incentive compatibility condition in *Assumption 2*.

Proposition 2: If there is a seniority wage contract, young households implicitly save at the firm's interest factor, R_{t+1}^F.

According to the *basic condition* for a long-run contract, young households do not save, so that $c_t^Y = w_t^{CY}$. Consider next the consumption choice of the middle-aged. They maximize

[20] If workers are heterogeneous, they might still save and borrow financially to the extent that their individual preferences differ from the measure of preferences that motivates the union or their bargaining representatives.

$$V_{t+1}^{N}=\left(c_{t+1}^{M\,\frac{\sigma-1}{\sigma}}+(1+\theta)^{-1}c_{t+2}^{O\,\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$ with respect to c_{t+1}^{M} subject to $c_{t+1}^{M}+\frac{c_{t+2}^{O}}{R_{t+2}^{L}}=w_{t+1}^{CM}$,

which gives $c_{t+1}^{M}=\frac{w_{t+1}^{CM}}{1+(1+\theta)^{-\sigma}R_{t+2}^{L\,\sigma-1}}$. R_{t+1}^{F} is the solution to $\tilde{R}_{t+1}$ in the implicit Euler

equation, $\tilde{R}_{t+1}=(1+\theta)\left(c_{t+1}^{M}/c_{t}^{Y}\right)^{-\frac{1}{\sigma}}$.‖

Corollary 1: There will be a seniority wage equilibrium, if young households would save were they offered the firm's interest factor, R_{t+1}^{F}, under spot wages provided that growth is not very much higher under seniority wages.

For a common level of growth, this follows trivially from *Proposition 2*. Growth must not be so much higher under seniority wages that the condition, $S_{t+1}^{*}>1$, in equation (24) is invalidated.‖

There are two caveats. First, any contract costs must be sufficiently small. An alternative requirement would be that the interest rate spread and/or the seniority wage mark-up are relatively large, so that the implicit rate of return and/or the amount implicitly saved through the labour contract would outweigh any given cost. Secondly, and more subtly, although a seniority wage equilibrium will be a Pareto-improvement on a spot wage equilibrium with ICF, it still remains Pareto-dominated by a regime with CF - *at least for a given level of growth* - where the middle-aged are also able to receive the competitive interest rate on their savings.

6. Solution with an imperfectly competitive finance sector and seniority wages

Aggregate saving under contract wages

According to the *basic condition*, only middle-aged households save under seniority wages. Their saving and, thus, aggregate saving is then given by

$$s_t^{CM} = \frac{w_t^{CM}}{1+(1+\theta)^{\sigma} R_{t+1}^{L\;1-\sigma}} \tag{26}$$

Proposition 3: Aggregate saving is higher under seniority wages than under spot wages in the non-engagement case (Case 2) of spot wages.

Case 2 of the spot wage regime and the seniority wage regime have the common feature that young households do not engage with the financial sector and that only the middle-aged save. Middle-aged saving and, hence, aggregate saving under the two wage regimes is

$s_t^{SM} = \dfrac{w_t^{S}}{1+(1+\theta)^{\sigma} R_{t+1}^{L\;1-\sigma}}$, and $s_t^{CM} = \dfrac{w_t^{CM}}{1+(1+\theta)^{\sigma} R_{t+1}^{L\;1-\sigma}}$. If $S_t^* > 1$, equation (25) implies $w_t^{CM} > w_t^{S}$ and, so, $s_t^{CM} > s_t^{SM}$ from the above.‖

Case 2 applies where ICF is sufficiently severe, while non-engagement with the finance sector by young households is a zero-probability event under perfect competition in the absence of an interest spread.[21] It should also extend to the neighbouring subset of *Case 1* of spot wages where young households still save but a sufficiently low amount.

Growth under contract wages

It is clear that higher growth reduces the seniority wage mark-up in equation (24). *Proposition 3* also implies that seniority wages may also raise the level of endogenous growth through increasing aggregate saving. To check on the outcome, the seniority wage mark-up and growth factor must be solved simultaneously. Their steady-state values are

$$S^* = \frac{(2+\theta)}{(1+\theta)^2}\left[\frac{-1}{2} + \left(\frac{1}{4} + \frac{2\alpha}{1-\alpha}\left(2+\theta+(1+\theta)^2\right)\right)^{\frac{1}{2}}\right] \tag{27}$$

[21] Assuming the absence of transactions costs.

$$G = \frac{(1-\alpha)A}{2\left(2+\theta+(1+\theta)^2\right)}\left[1+\left(1+\frac{8\alpha}{1-\alpha}\left(2+\theta+(1+\theta)^2\right)\right)^{\frac{1}{2}}\right] \tag{28}$$

Proposition 4: If $\alpha > \left(1+2\left(\frac{2+\theta}{1+\theta}\right)^2\right)^{-1}$*, there is a seniority wage equilibrium (*$S^* > 1$*) with endogenous growth.*

This follows from inspection of equation (27). ‖

Note that a sufficient condition, given a finite rate of time preference ($\theta < \infty$), is that α does not fall below its stylized empirical value of 0.33. Moreover, where $\theta << \infty$, the condition is that α does not fall too far below this value, [22] which echoes the condition for *Proposition 1* . These two propositions are related through *Corollary 1*. If the young would save at the competitive interest rate under CF, there is an incentive to save implicitly at the same rate through a seniority wage contract under ICF. Note that if *Proposition 4* does not hold, the solution to any wage contract is incentive-incompatible.

Corollary 2: Growth is higher under a seniority wages equilibrium ($S > 1$*), if households do not save under the spot wages.*

In this case, in both spot and seniority wage regimes, only middle-aged households save. They save more with higher seniority wages according to *Proposition 3*, so that the level of endogenous growth must be higher.‖

Corollary 3: The gains to seniority wages may are even higher where growth is endogenous, if households do not save under the spot wages.

Apart from the private Pareto-gains from seniority wage contracts, for a given level of growth, *Corollary 2* indicates the possibility of an additional benefit effect

[22] If $\theta = 2$, for example, the condition requires $\alpha > 0.22$.

through the externality of increased growth, which raises the net present value of lifetime labour income according to equations (4) and (20).‖

The comparative levels of growth under competitive finance with spot wages and non-competitive finance with seniority wages

Corollary 2 is a robust result pertaining to the case where (i) there is a seniority wage equilibrium and (ii) young households would not engage with the financial sector under spot wages. There is also an even more interesting but less robust result that aggregate saving and growth may even be higher under ICF with seniority wages than under CF with spot wages. This possibility is difficult to prove analytically, but may be shown by computing the values for growth in equations (10) and (28). We tabulate the growth values as a ratio of αA for various values of the rate of time-preference, θ, where $\sigma = 1$, $\alpha = 1/3$ and where $N = 1$ for the ICF case. The seniority mark-ups have been included in parentheses. For example, for $\theta = 3$ and if one period constitutes 24 years, the tabulated value of 1.286 implies that 1% of annual wage growth is due to tenure.

Table: The growth factor as a proportion of αA (where $\sigma = 1$ and $\alpha = 1/3$)

θ		**ICF $(N = 1)$ with seniority wages**	**CF $(N \to \infty)$ with spot wages**
0		0.768 (2.604)	**0.890**
1		0.456 (1.645)	**0.462**
2		**0.318** (1.398)	0.302
3		**0.243** (1.286)	0.223

Proposition 5: If $\sigma = 1$ and $\alpha = 1/3$ **and *the rate of time preference is not too low, growth is higher under imperfect competition with seniority wages than under perfect competition in the finance sector.***

Shown by inspecting the values in the *Table*.‖

Intuitively, although ICF reduces the deposit rate of interest, this only has a small effect on aggregate saving if the interest elasticity is sufficiently low (where $\sigma = 1$). On the other hand, the redistributive effect of seniority wages in favour of inelastically-saving middle-aged households may be quite strong. The simulated values show this latter effect may dominate if the rate of time preference is sufficiently high. Intuitively, if the rate of time preference is very low, young households would save substantial amounts under CF, so the fact that the young no longer save financially under seniority wages would be a dominating factor.

Growth may be higher under ICF, if young households respond by negotiating seniority wage contracts as an alternative and implicit form of saving. The resulting income distribution effect may raise aggregate saving and growth. Even if growth is not higher, the shortfall caused by ICF will not be so low, because of these growth-enhancing effects of seniority wages, which remain a fairly robust feature of the model.

7. Further discussion

ICF and growth

It has been shown that growth may be higher under ICF - because of the labour market response of forming seniority wages - than under CF for certain parameterisations of the model. Consider the alternative scenario where young households would borrow under CF, implying no desire to negotiate seniority wages under ICF. Growth would again be higher under ICF, because higher interest rates on borrowing would reduce the crowding-out of the investment funds that fire economic growth, since households are assumed to borrow to finance current consumption, and because lower rates on deposits would not affect inelastically saving middle-aged households. The result would no longer apply if either young households borrowed to invest in human capital or saving by the middle-aged were sufficiently elastic.

Contract costs

There has been no consideration of contract costs. These may be interpreted literally as the administrative costs of negotiating, writing and enforcing contracts or as the implicit costs incurred when workers forswear their rights to mobility. Consequently, workers might require a wage premium in the presence of unanticipated idiosyncratic shocks to firms, which would cause the seniority wage mark-up factor to be sufficiently in excess of unity in order to ensure that contract wage profiles would substantially differ from the spot wage profile. Another implication of contract costs is that the existence of seniority wages would become more sensitive to disturbances in the values of other parameters.

Strategic complementarity

We have concentrated on symmetric equilibria where all firms pay seniority wages or where no firm does. With heterogeneous rates of time preference, θ, a situation arises where only a proportion, λ, $1 < \lambda < 1$ of firms and worker groups may negotiate seniority wages. The logic of the central result that they raise the growth rate, G, is that $\partial G/\partial\lambda > 0$. Higher growth would also raise the scale of utility for each wage regime and, so, the gross utility gain from switching from spot to seniority wages,

$$g = \left[U^C\left(\alpha A; R_{t+2}^L\right) - U^S\left(R_{t+1}^L; R_{t+2}^L\right)\right]\left(1 + \frac{G(\lambda)}{\alpha A}\right)w_t^S > 0 \quad \text{as } R_{t+1}^L < \alpha A \text{ for } N < \infty$$

As $\partial g/\partial G > 0$ and $\partial G/\partial\lambda > 0$, there is strategic complemetarity, $\partial g/\partial\lambda > 0$. The higher the proportion of firms with seniority wage contracts, the greater the incentive for any single firm to follow suit.

Strategic complementarity in conjunction with contract costs at an intermediate level, c, points to the existence of dual stable Nash equilibria at $\lambda^* = 0{,}1$ where $g\big|_{\lambda^*=0} < c$ and $g\big|_{\lambda^*=1} > c$ plus an upwardly-unstable intermediate equilibrium, $\lambda^* = \hat{\lambda}$ such that $g\big|_{\lambda^*=\hat{\lambda}} = c$. This suggests that both the existence and the non-existence of a seniority wage equilibrium may be the result of self-fulfilling beliefs, so that any particular outcome could be quite fragile if beliefs are volatile.[23]

In order to explain the existence of a stable mixed equilibrium it is necessary that there is a distribution of contract costs such $\partial c/\partial\lambda > \partial G/\partial\lambda$, which requires either that

[23] Balan (2003) presents evidence that seniority wage payments may have broken down over the last decade.

$\partial G/\partial\lambda < 0$ or that c is sufficiently steep where $\partial g/\partial\lambda > 0$. This latter case holds where young households would formally save a large amount under spot wages. There may also be a mixed-equilibrium even with strategic complementarity, if rates of time preference were sufficiently heterogeneous, because some proportion of young workers who would never want to wait for seniority payments.

The return of profits

We have abstracted from the issue of returning financial sector profits to the economy, because this effect merits a separate analysis. There are two issues: one is how profits are returned to the household sector, which will generally affect the equilibrium outcomes without altering the underlying behavioural assumptions, and the other is how the ownership of profit-making institutions by households may undermine a core, behavioural assumption, namely, profit maximization.

Roberts (2005) shows that the return of profits to young households may actually cause a higher level of capital and, by implication in this present context, higher growth under ICF. Furthermore, the necessary condition for this to occur, a very low interest elasticity of saving, is the same one underpinning this present analysis. On the other hand, returning profits to the old, either through a tax-transfer policy or through endogenous dividend payments on holdings of financial sector equity, as in Roberts (2003), unambiguously reduces the capital stock. Therefore, there is some combination of these two options for profit redistribution that is neutral, which is equivalent to making the assumption that profits are wasted.

As regards the central case of this paper, seniority wages will raise financial profits through increasing aggregate savings, the raw input for financial activity. According to the analysis in Roberts (2003), if profits are returned as dividend payments on holding of financial sector equity, increased profits will inflate equity prices and reduce growth by crowding out some of the "productive saving" that gets channelled into investment. There are some interesting interactions. First, the effect of seniority wages on growth will be dampened by the inflation of financial equity values. Secondly, the dampening will imply a greater incentive to form seniority wages and a higher associated mark-up according to (22).

The main alternative to profits being returned as dividends is that they are taxed and distributed as fiscal transfers to the three generations of households in various combinations. These predictions are quite straightforward, following from the implications of consumption smoothing. Returning profits to the old will reduce the incentive for the middle-aged to save for retirement, so that the young, in anticipation, have less inclination to agree to upwardly-sloping wage-profiles. There is, also, a countervailing effect, since lower saving will reduce the growth rate, which increases the incentive for the young to negotiate seniority wage contracts.

Consumption-smoothing also implies a reduced desire of the young for seniority wage contracts if financial profits are returned as fiscal transfers to the middle-aged, but a greater desire if they themselves receive the profit transfers. In conclusion, there is some broad means of returning and distributing financial profits, which will be neutral and tantamount to assuming that profits are wasted. Generally, returning profits to a particular generation will affect the saving motive of the young and, hence, the parameter conditions supporting an equilibrium with seniority wages.

Concerning the behaviourial effect, Roberts (2003) and (2005) argues that if financial equity and financial deposits, as alternative ways of saving, are perfect substitutes, the existence of a transactions friction will induce households to hold only one of these two assets. Households will be then be divided into two groups, the *owners* of the financial sector as equity holders and its *customers* as deposit holders. It is then possible to sustain the assumption of profit or value maximization, as this will be in the interest of the owners, who do not hold deposits, while the customers, who would prefer a better deal on interest rates, will have no share-holder voting rights.

7. Conclusions

We have shown that forming seniority wage contracts may be an optimal labour market response to interest rate spreads in the same way that implicit labour contracts were earlier regarded as a possible solution for the absence or inadequacy of formal insurance markets. The microeconomic effect of a seniority wage contract, that young workers implicitly save at the higher interest rate charged to the firm, is unambiguously Pareto-improving for a given level of growth. Furthermore, there is the macroeconomic effect of a rise in aggregate financial savings through an intergenerational income distribution that favours middle-aged households with higher (non-zero) savings ratios. If this Kaldorian effect is dominant, which requires that saving is relatively interest-inelastic, then seniority wages may raise the level of endogenous growth.

Seniority wages may lessen the adverse effects of IFC on capital accumulation and, for some parameter values, may even cause growth to be higher under IFC than under FC. Consequently, if the young households are loathe to save at the low rates of return offered by the financial sector, the gains to financial liberalization may be over-stated if the labour market is able to respond by negotiating seniority wage contracts that not only facilitate implicit saving by young workers but also raise aggregate saving and growth.

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Appendix 1: Derivation of the indirect utility function under contract wag*es*

The *Basic Condition* for a long-run contract, $s_t^Y = 0$, implies

$$c_t^Y = w_t^{CY} \tag{A1}$$

Consider next the consumption choice made by the middle-aged in maximizing

$$V_{t+1}^N = \left(c_{t+1}^{M\,\frac{\sigma-1}{\sigma}} + (1+\theta)^{-1} c_{t+2}^{O\,\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \tag{A2}$$

with respect to c_{t+1}^M subject to

$$c_{t+1}^M + \frac{c_{t+2}^O}{R_{t+2}^L} = w_{t+1}^{CM} \tag{A3}$$

The solution is

$$c_{t+1}^M = \frac{w_{t+1}^{CM}}{1+(1+\theta)^{-\sigma} R_{t+2}^{L\;\sigma-1}}, \tag{A4}$$

$$c_{t+2}^O = \frac{(1+\theta)^{-\sigma} R_{t+2}^{L\;\sigma} w_{t+1}^{CM}}{1+(1+\theta)^{-\sigma} R_{t+2}^{L\;\sigma-1}} \tag{A5}$$

Substitution of (A1), (A4) and (A5) back into equation (6) gives equation (21).

Appendix 2: *Parameter condition for saving by young households under spot wages where* $N = 1$, $\sigma = 1$ *and* $\alpha = 1/3$

In equation (14.1), these first two parameter restrictions ensure that the relationship between the deposit interest factor and the growth factor - in the steady-state - satisfies the cubic equation,

$$\left(\frac{R^L}{G}\right)^3 + (3+\theta)\left(\frac{R^L}{G}\right)^2 - (1+\theta)^2\left(\frac{\alpha A}{G}\right) = 0\,. \tag{B1}$$

The borderline case where $s^Y = 0$ implies that

$$\left(\frac{R^L}{G}\right) = \frac{(1+\theta)^2}{2+\theta} \tag{B2}$$

according to equation (8). Growth is then solved from equations (3)-(5) and (9) as

$$G = \frac{(1-\alpha)A}{2(2+\theta)} \tag{B3}$$

Substituting (B2) and (B3) into (B1), using the third parameter restriction, $\alpha = 1/3$, and rearranging gives the quartic equation

$$(1+\theta)^4 + (2+\theta)(3+\theta)(1+\theta)^2 - (2+\theta)^4 = 0 \qquad \text{(B4)}$$

This equation is satisfied by $\theta = 1.9$, so that a steady-state of saving by young households would require $\theta < 1.9$.