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Rent Sharing, Aggregate Saving, and Growth

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Abstract

The paper investigates the effects on saving and growth of the rent sharing between firm owners and workers documented in recent empirical work. In an overlapping-generations framework, more rent sharing is found to increase growth. This result also holds in a model with a single generation of infinitely lived consumers in which some consumers are patient and save and others are impatient but credit-constrained and simply consume all their current income. This latter result is surprising since rent sharing effectively redistributes income from savers to nonsavers, yet raises aggregate saving.

1. Introduction

Recent evidence suggests that in some industries workers receive wages that exceed the wages for workers doing comparable jobs in other industries. Empirical studies have been unsuccessful at explaining the interindustry wage differentials in terms of differences in abilities of workers or in terms of compensating differentials for job characteristics.[1] The most plausible explanation of these wage differentials appears to be rent sharing. As Krueger and Summers observe: "where rents per workers are greatest, wage rates tend to be highest" (1987, p. 42). Katz and Summers (1989a) and Tyson (1992) suggest that the rent-sharing phenomenon has implications for economic growth. The wage differential is highest in high-tech industries. These are precisely the industries that the "new growth" literature has focused on as the engines of endogenous growth. Romer (1986, 1987, 1990), Lucas (1988), Grossman and Helpman (1991a, 1991b), Young (1991), and others have emphasized the role of innovation in promoting growth. In their view, investment in research and human capital has spillover effects that enhance economy-wide productivity and growth. It appears that the industries which invest in research and development and create new products also generate the greatest rents.

Here we are interested in the effects of rent sharing on economy-wide saving and growth. We investigate models of endogenous growth in which firms generate rents as a return to an intangible asset. We ask how growth is affected as a greater share of those rents are paid to workers instead of being retained by firm owners.

The empirical studies do not reach any firm conclusions on why the firm owners share the rents with workers. While Krueger and Summers (1987) argue that the wage differential reflects some sort of rent sharing, they conclude that "empirical work has been much more successful in ruling out some explanations than in supporting others" (p. 44). Krueger and Summers (1987, 1988) explore several efficiency wage hypotheses to explain the observed rent sharing. Generally these involve using the rents as incentives to induce greater work effort, or at least to minimize shirking. Katz and Summers (1989a) also discuss rent sharing as the outcome of a bargaining agreement between workers and owners. Given the inconclusive nature of the findings on the

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motive for rent sharing, we prefer to concentrate purely on the effects of the sharing *per se*.

We introduce heterogeneity in the population so that when owners share rents with workers they are not merely transferring money from their right hand to their left hand. So, we depart from most of the new growth literature by considering population heterogeneity of two types.[2] We allow an age distribution of the population, and we allow for the possibility of different degrees of patience among consumers.

In our first model, we assume a growing population based on the model of Weil (1989). Consumers are assumed to have identical preferences, but are born at different times. Individuals' levels of wealth differ because they save over their lifetimes. Increasing the share of rents that go to workers has the effect of increasing saving and growth in this model. Essentially this is because the increase in rent sharing has the effect of diminishing current wealth, and hence current consumption. The value of equities declines more than the increase in the discounted value of future wage income for current generations of consumers. Since the sharing has no effect on output, the decline in consumption translates into a greater level of saving and investment.

In the first model, it is assumed that all individuals have identical rates of time preference. In our second model, there are patient consumers whose personal discount rate is low, and impatient consumers with high discount rates. We also impose a credit constraint, which forbids consumers from borrowing against future income. In equilibrium, the impatient consumers simply consume all of their current wage income (including their share of rents) so that their behavior mimics the rule-of-thumb consumers of Campbell and Mankiw (1989). Hence, the patient consumers own all the firms and do all of the saving.

Surprisingly, even in this model increasing the share of rents going to workers increases saving and growth. When firm owners share more rents with workers income is redistributed away from the patient class, since they are the firm owners. Yet, saving rises. The patient segment of the population acts like permanent income consumers. When rent sharing increases, permanent income declines for the patient sector more than their current income declines. So, their saving rises, which means aggregate saving and growth increase.

In the first model, the heterogeneity of agents arises from population growth. In the second model, the heterogeneity in rates of time preference is sufficient to arrive at our results, so that greater rent sharing increases growth even in the version of the model in which there are no overlapping generations.

Before we proceed, we note that while rents in our model are generated as a return to entrepreneurship, an obvious modification could lead to an interpretation as rents arising as a return to a third factor in fixed supply such as land. We could also think of the share of rents that goes to labor as a tax on land rents that is redistributed to labor. Indeed, the role of rents in affecting saving in the first of our endogenous growth models is similar to the role that land rents play in the neoclassical growth model of Drazen and Eckstein (1988).[3]

2. Producers, Consumers, and Financial Markets

We begin by presenting the various building blocks of our model. First we discuss the producers' behavior and the sharing of rents with workers. Then we move on to the consumers' decisions, and finally consider financial markets.

Individuals have infinite horizons and perfect foresight. All agents are endowed with identical human capital when they are born. In the next section we will assume that population grows at a constant rate and we will aggregate the equations describing the behavior of optimizing individuals to obtain the dynamic behavior of the economy. (This contrasts with the older literature on optimal growth with population growth, which studied the path for the economy when a social planner maximized per capita utility.)

Our notation convention in this paper is that variables pertaining to individual consumers or firms are in small letters, aggregate variables are in capital letters with a tilde over them, and aggregate per capita variables are in capital letters.

Production

The firm produces output by two processes—a high-tech and a low-tech process. Following much of the new growth literature, we assume that the high-tech process uses some sort of knowledge capital. The production function takes the form $\theta k(j, t)^{\gamma} \tilde{K}(t)^{1-\gamma}$, $0 \leq \gamma \leq 1$. The capital input by firm j at time t is $k(j, t)$. $\tilde{K}(t)$ is the aggregate capital stock.

Capital in this type of model can be viewed as knowledge, or it can be viewed as physical capital, or it can be viewed as knowledge and physical capital which must be combined in fixed proportions. Our production function shares a feature common in much of the new growth theory, that there are investment externalities (see Romer, 1986). So, we assume that investment embodies some sort of innovation which is useful to other firms. Furthermore, this knowledge is nonrival and nonexcludable. Other firms can benefit from the investment by firm j without fully compensating firm j, and without diminishing the usefulness of the investment for firm j. Likewise, firm j benefits from the investment of other firms. Hence, firm j's output is increased by increases in the aggregate capital stock, $\tilde{K}$.

At the firm level, the high-tech production process exhibits diminishing returns. We assume there is an intangible asset that is necessary in the production process. This asset can be interpreted as entrepreneurship. It is assumed to be nonreproducible. Essentially, we view high-tech firms as being centers where entrepreneurs exploit a production opportunity. The firm cannot split in order to produce at a more efficient scale because the intangible asset cannot be split.

We also assume that there are a fixed number of firms—a fixed number of investment opportunities. There are a large number of firms, so each firm is a price taker in goods and factor markets. Grossman and Helpman (1991a, 1991b) model the entry and exit of firms as higher-quality products are developed. We keep the model simple by ignoring this aspect of market dynamics.

The low-tech method of production simply uses labor to produce the good, with a fixed marginal product. So, the low-tech production function is simply $\omega \ell(j, t)$, where $\ell(j, t)$ represents the labor input. Then, output of firm j is given by

$$y(j, t) = \theta k(j, t)^{\gamma} \tilde{K}(t)^{1-\gamma} + \omega \ell(j, t).$$

Rents are the return to entrepreneurship. They are equal to $(1 - \gamma)\theta k(j, t)^{\gamma-1}\tilde{K}(t)^{1-\gamma}$ for firm j. The marginal product of labor is ω. But, we do not assume that workers get paid their marginal product. Instead, we assume that firms share a fraction η of the rents with workers.

There is substantial evidence that in some industries workers are paid a wage greater than their marginal product. The evidence suggests that the wage gap does not represent a compensating differential for job characteristics. Dickens and Katz (1987) note that in the high-wage industries workers in all types of jobs are compensated more than in low-wage industries. This is true even when very similar jobs are compared, such as secretaries or salesmen, so that the wage difference is not likely to be due to working conditions. Murphy and Topel (1987) and Krueger and Summers (1988) find little success in relating the wage differential to specific measures of working conditions. Krueger and Summers, and Dickens and Katz also adduce evidence to suggest that the strength of unions across industries does not account for the differential.

There has been a great deal of work devoted to investigating whether the wage differentials represents a difference in worker ability. Krueger and Summers (1988) use two types of data to argue that ability does not explain industry wage differences. First, they attempt to measure labor quality explicitly, and find that observable characteristics do not account for wage differences. They also examine longitudinal data on displaced workers, and find that workers moving from low-wage to high-wage industries experience an increase in wages, and vice versa. Gibbons and Katz (1992) argue that there is a potential bias against the worker-ability hypothesis in the approach of looking at changes in wages for displaced workers. However, when they attempt to account for this bias, they still find that ability does not explain industry wage differentials. This is confirmed by Blackburn and Neumark (1992), who also attempt to control for the bias.

Krueger and Summers (1987) conclude that traditional neoclassical explanations for the industry wage differential fail to explain the difference fully, and instead conclude there is rent sharing by firms. They point out the fact that the negative relationship between turnover rates and industry wage differentials argues in favor of the claim that workers receive rents. Such a relationship would not hold if the differential could be explained by working conditions or unobserved quality differences. Raff and Summers (1987) and Katz and Summers (1989b) buttress these arguments with anecdotal evidence. However, both Krueger and Summers, and Katz and Summers concede that the reason for the rent sharing is not clear. The leading candidate is that the workers are paid an efficiency wage that might increase productivity or reduce turnover (thereby reducing hiring and training costs). Alternatively, the rent sharing might be the result of a bargaining game with workers. Or it might reflect a gift relationship with workers as in Akerlof (1984).

We take η to be exogenous and ask how saving and investment change as η changes. One way to motivate the division of rents between labor and owners of firms is to assume that a union and management bargain on behalf of workers and owners, respectively. For example, assume that the bargaining game is the alternating offers one of Rubinstein (1982) with discounting and both parties risk-neutral, and let the union make the first offer. The division of the rents generated by the externality is then given by

$$\eta = \frac{1 - \beta_{\mathrm{m}}}{1 - \beta_{\mathrm{u}}\beta_{\mathrm{m}}},$$

where β_{u} is the union's discount factor and β_{m} is the management's discount factor. In this case, an increase in η can be caused by the owner's representative becoming more impatient (a fall in β_{m}) or by the union becoming more patient (a rise in β_{u}). Both changes increase the bargaining power of labor.[4] However, we do not formally incorporate this type of bargaining arrangement into our model.

In the labor market, we assume that each individual supplies one unit of labor inelastically.

We assume all firms are identical, and for notational simplicity we normalize the number of firms to equal one. So, $k(j, t) = \tilde{K}(t)$ in equilibrium. Note that this implies that the per capita aggregate production function is linear:

$$Y(t) = \omega + \theta K(t),$$

where $Y(t)$ is aggregate per capita output and $K(t)$ is the aggregate per capita capital stock. The equilibrium wage is then given by

$$w(t) = \eta\theta(1-\gamma)K(t) + \omega.$$

Firms rent capital at interest rate r. Equating the marginal product of capital to the interest rate, we have

$$r = \theta\gamma k(j, t)^{\gamma-1}\tilde{K}(t)^{1-\gamma},$$

or, in equilibrium, $r = \theta\gamma$.

The interest rate is constant over time. The social marginal product of capital is θ, but owners of capital earn a lower return, $\theta\gamma$. This reflects the investment externality.

Owners of the firm are entitled to the rents that are not shared with workers. Letting the price of the good be unity, we find in equilibrium that dividend payments are given by $\theta(1 - \gamma)(1 - \eta)\tilde{K}(t)$.

Consumption

Individuals are assumed to have logarithmic utility and maximize utility over an infinite horizon. The dynamic budget constraint faced by an individual at time t who was born at time v is

$$\dot{a}(v, t) = r \cdot a(v, t) + w(t) - c(v, t).$$

The individual also faces the lifetime constraint

$$\lim_{t\to\infty} a(v, t)e^{-rt} = 0.$$

Finally, we assume that $a(v, v) = 0$.

In the above equations, $a(v, t)$ is the assets held by the individual at time t, and $c(v, t)$ is her consumption. $w(t)$ is the wage paid at time t. Note that it is independent of the individual's age.

It is easy to show that the optimal consumption choice is given by

$$c(v, t) = \delta[a(v, t) + h(t)],$$

where $h(t)$, human capital, is given by

$$h(t) = \int_t^\infty w(s)e^{-r(s-t)}ds,$$

and δ is the rate of time preference.

A crucial assumption in this framework is that agents cannot trade claims to human capital. We will make a distinction between assets which can be traded (equity and capital) and those that cannot (human capital).

Financial Markets

Before examining the aggregate system, we consider the financial market. Because all individuals have perfect foresight, all assets must pay the same rate of return in equilibrium. This means that the return to holding equities must equal r. The rate of return for equities is given by

$$r = \dot{q}(t)/q(t) + \theta(1-\eta)(1-\gamma)\tilde{K}(t)/q(t).$$

In this expression, q represents the price per share. We assume there is one share per firm. Along with the assumption of the representative firm, q can be seen to also equal the aggregate value of shares. So, we have that the capital gains rate plus the flow of dividends per share equals the interest rate.

3. Rent Distribution in a Model with New Generations

We assume overlapping generations of the Weil (1989) type. There is constant proportional population growth at the rate n. We assume no bequest motive. Aggregation proceeds as in Weil.

We examine in this section only the case of $r = \theta\gamma > \delta$. In the case, consumers save some of their income. In the other case, consumers do not save and there is no capital accumulation. In section 3 we allow for there to be two types of consumers, some for whom the discount rate exceeds the interest rate and some for whom the opposite relation holds.

In this model, because labor is supplied inelastically and the number of firms is fixed, the share of rents accruing to each recipient does not affect any factor supply or factor demand decision; it affects only the wealth of each generation. The larger the share of rents that go to labor, the smaller the wealth of generations currently alive. When rents accrue to labor, future generations will capture some of those rents, but when rents accrue to firms they are captured by the current owners of the firm.

Aggregate accumulation per capita of tradeable assets is given by

$$\dot{A}(t) = (\theta\gamma - n)A(t) + w(t) - C(t),$$

where $A(t) = K(t) + q(t)$, $C(t)$ represents aggregate per capita consumption, and $q(t)$ is the per capita value of shares.

Consumption evolves according to

$$\dot{C}(t) = (\theta\gamma - \delta)C(t) - \delta n K(t) - \delta n q(t).$$

The evolution of equity prices is given by

$$\dot{q}(t) = (\theta\gamma - n)q(t) - \theta(1-\gamma)(1-\eta)K(t).$$

Taking the equation for $\dot{q}(t)$, subtracting it from the equation for $\dot{A}(t)$ (and using the fact that $w(t) = \theta\eta(1-\gamma)K(t) + \omega$), we have

$$\dot{K}(t) = (\theta - n)K(t) - C(t) + \omega.$$

The dynamic system can be written:

$$\begin{bmatrix} \dot{C}(t) \\ \dot{K}(t) \\ \dot{q}(t) \end{bmatrix} = \begin{bmatrix} \theta\gamma - \delta & -\delta\eta & -\delta n \\ -1 & \theta - n & 0 \\ 0 & -\theta(1-\gamma)(1-\eta) & \theta\gamma - n \end{bmatrix} \begin{bmatrix} C(t) \\ K(t) \\ q(t) \end{bmatrix} + \begin{bmatrix} 0 \\ \omega \\ 0 \end{bmatrix}. \tag{1}$$

We will assume that $\theta\gamma > n$. This amounts to assuming that the interest rate is greater than the population growth rate. This rules out dynamically inefficient paths.

There need not be convergence to the steady state. Two cases arise, depending on the values of the parameters. In one case the economy is saddle-path stable, and consumption and the capital stock converge to the steady state. This is the case in which there is one negative and two positive roots to the dynamic system given in equation (1).

When all roots are positive, the system is unstable. This case is analogous to the models of sustained growth of Romer and others. In our model, in the unstable case, the steady-state values for capital and consumption will be seen to be negative, but capital and consumption proceed along paths that diverge from the steady state.

In both the divergent and convergent cases, the interest rate $\theta\gamma$ exceeds the discount rate δ. Grossman and Helpman (1991) have demonstrated that a common characteristic of models with sustained growth is that the interest rate exceeds the discount rate, while in convergent models the reverse is true. However, the possibility of a convergent growth path even with the marginal product of capital exceeding the discount rate arises out of the overlapping-generations framework. This can occur because, while in the steady state all individuals will be accumulating wealth when $r > \delta$, the population growth can be rapid enough that wealth per capita remains constant.

The steady-state values of $K(t)$, $C(t)$ and $q(t)$ are denoted $\overline{K}$, $\overline{C}$ and $\overline{q}$. Their values are

$$\overline{K} = \frac{(\theta\gamma - \delta)(\theta\gamma - n)\omega}{\theta(\delta + n\gamma - \theta\gamma)(\theta\gamma - n) + \delta n\theta(1-\gamma)(1-\eta)}.$$

$$\overline{C} = \frac{[\delta n(\theta\gamma - n) + \delta n\theta(1-\gamma)(1-\eta)]\omega}{\theta(\delta + n\gamma - \theta\gamma)(\theta\gamma - n) + \delta n\theta(1-\gamma)(1-\eta)}.$$

$$\overline{q} = \frac{\theta(\theta\gamma - \delta)(1-\gamma)(1-\eta)\omega}{\theta(\delta + n\gamma - \theta\gamma)(\theta\gamma - n) + \delta n\theta(1-\gamma)(1-\eta)}.$$

The product of the characteristic roots of the dynamic system in equation (1) is equal to the negative of the denominator of each of the expressions for the steady-state values. Thus, when the system is saddle-path stable, all of the variables are positive in the steady state. When all roots are positive (the sustained growth case) then all the variables are negative in the steady state. There is no particular problem with the variables being negative in the steady state in this case. The initial capital stock is non-negative, and the economy will diverge from the steady state, so that K, C and q are always positive.

There are an infinite number of dynamic paths that solve equation (1). Only one path (in the stable and unstable cases) satisfies the feasibility conditions for the economy that $K(t)$ and $C(t)$ remain positive in all time periods. Along this path, the variables converge to the steady state at a rate given by λ_1, the negative eigenvalue, if the system is stable. If it is unstable they diverge from the steady state at the rate λ_1, the smallest of the positive roots.[5] We have, then, that

$$\dot{K}(t) = \lambda_1\left(K(t) - \overline{K}\right). \tag{2}$$

We are interested in how $\dot{K}(t)$ changes with a change in η. As $\dot{K}(t)$ rises, then the growth rate of output will rise. Since a change in η has no effect on output, an increase in investment in this economy can only be accomplished with a decline in current consumption. Our first result is that increasing the share of rents that workers receive will increase the growth rate:

$$\text{Result 1: } \frac{d\dot{K}(t)}{d\eta} \geq 0 \text{ for all } K(t) \geq 0.$$

This result is proved formally in the Appendix. Here we discuss the intuition.

When more rents accrue to workers, future generations are able to capture more of the rents. The wealth of current generations falls. The value of equities falls as rents for firm owners are decreased. But this is not completely offset by the increase in human wealth for current workers, since some of those rents will go to workers who have not yet entered the labor force. So, the aggregate wealth of the current generation falls. This leads to a decline in consumption, and an increase in saving. We have

$$\frac{d\overline{K}}{d\eta} = -\overline{K}\frac{\delta n\theta(1-\gamma)}{\lambda_1\lambda_2\lambda_3},$$

where λ_2 and λ_3 are the other two (positive) roots to the dynamic system given in equation (1). $d\overline{K}/d\eta > 0$ because $-\overline{K}/\lambda_1 > 0$. In the stable economy, capital accumulation will be higher, and the long-run levels of the capital stock and consumption will be higher. The initial consumption is lower, but eventually the path of consumption rises above its original position.

The same basic intuition applies in the economy with sustained growth. Recall that in this economy, $\overline{K} < 0$. But this economy is never near its steady state, as consumption and the capital stock grow steadily. When η is increased, consumption falls and saving increases. This leads to a permanently higher growth rate. Initial consumption is lower, but again, the path of consumption will eventually rise above its original position.

So, when rent sharing is increased, the growth rate is higher. In this economy, this occurs because the change in rent sharing leads to an intergenerational transfer away from agents who currently consume, thus lowering their wealth and consumption. Since this change has no effect on output (because the model assumes that changing the share of rents has no incentive effects on work effort), a drop in consumption translates into increased saving.

The path of aggregate consumption is related to the path of the capital stock according to

$$C(t) - \overline{C} = (\theta - n - \lambda_1)\left(K(t) - \overline{K}\right). \tag{3}$$

We show in the Appendix that $\lambda_1 < \gamma\theta - n$, so $\theta - n - \lambda_1 > 0$. Therefore, in the stable case as capital converges to $\overline{K}$, consumption converges to $\overline{C}$. In the unstable case, $C(t)$ grows along with the capital stock.

4. Impatient, Credit-Constrained Consumers

At least since Kaldor (1956), economists have accepted the notion that workers and firm owners might have different consumption preferences. (See Mankiw and Zeldes (1991) for a modern treatment.) In this section we model this by allowing two classes of consumers. One class is patient: their discount rate, δ, is less than $\theta\gamma$ (which will be the interest rate in equilibrium). The other is impatient, so that their discount rate, ρ, is greater than $\theta\gamma$.

We also follow some of the current work in the empirical consumption literature (e.g., Flavin, 1985; Lam, 1991), and assume that there is a credit constraint for consumers. We assume that they cannot borrow against future wages, so that the value of equities plus capital owned by an individual of generation v at time t, $a(v, t)$, must be greater than or equal to zero. This constraint might be particularly important in less-developed countries (see Rosenzweig and Wolpin, 1993).

Our assumptions essentially divide the population into two groups, savers and nonsavers. The savers are the only ones that own nonhuman wealth. So, the firm owners have positive saving, while the group that does not own firms consume all their current income and has a zero saving rate. As a result our population is divided exactly as in Campbell and Mankiw (1989). A fraction are permanent-income consumers and a fraction consume current income. Campbell and Mankiw find that the two groups are roughly equal in size.

We find that increasing the share of rents going to workers raises saving and growth in this model. This is particularly surprising since it is true even when there is no population growth, so there are no overlapping generations. It would seem especially in this case that increased rent sharing should lower saving, since it is purely a redistribution of income from savers to nonsavers. But we find that aggregate saving does indeed increase as rent sharing rises.

So, we assume that a fraction $1 - x$ of the population has a discount rate of δ, and a fraction x has a discount rate of ρ, where $\delta < \theta\gamma < \rho$. The production side of the model is unchanged, so we still have $r = \theta\gamma$. It follows, for the group whose discount rate is ρ, that

$$c_2(t) = \omega + \eta\theta(1-\gamma)K(t),$$

where c_2 represents the consumption of an individual of this group. Since this group represents a fraction x of the population, the per capita consumption of this group is xc_2 (where per capita consumption means aggregate consumption of this group divided by the total population). Note that all members of this group have the same level of consumption, irrespective of their date of birth.

The behavior of the other group is the same as in section 1. Let $C(t)$ represent aggregate consumption of this group divided by the total population. Aggregating as in Weil (1989), we have as before

$$\dot{C}(t) = (\theta\gamma - \delta)C(t) - \delta n K(t) - \delta n q(t).$$

Per capita capital accumulation is given by

$$\dot{K}(t) = (\theta - n)K(t) - C(t) - xc_2(t) + \omega$$
$$= (\theta - x\theta(1-\gamma)\eta - n)K(t) - C(t) + \omega(1-x).$$

The equation for the evolution of the share price is the same as in section 2. This is because we have not directly changed any assumption about the share of rents that go to stockholders. So, the economy is described by the dynamic system:

$$\begin{bmatrix} \dot{C}(t) \\ \dot{K}(t) \\ \dot{q}(t) \end{bmatrix} = \begin{bmatrix} \theta\gamma - \delta & -\delta n & -\delta n \\ -1 & \theta - x\theta(1-\gamma)\eta - n & 0 \\ 0 & -\theta(1-\gamma)(1-\eta) & \theta\gamma - n \end{bmatrix} \begin{bmatrix} C(t) \\ K(t) \\ q(t) \end{bmatrix} + \begin{bmatrix} 0 \\ \omega(1-x) \\ 0 \end{bmatrix}. \tag{4}$$

Formally, this dynamic system behaves much like the one in section 2. There are again two possibilities: that the economy is saddle-path stable (one negative and two positive eigenvalues) or it is unstable (all roots are positive). In the stable case, the steady-state values of C, K, and q are positive, and in the unstable (sustained growth) case they are negative. Equation (2) still describes the dynamics of the economy.

Our second result is the same as our first, but it holds for the more general model in which $x \neq 0$:

$$\text{Result 2: } \frac{d\dot{K}(t)}{d\eta} \geq 0 \text{ for all } K(t) \geq 0.$$

The Appendix proves this result in general for $n \geq 0$, but it is helpful to discuss the intuition in terms of the Ricardian model in which $n = 0$. The general case would include the effects discussed here and the effects discussed in the previous section.

For $n = 0$, we have that $\lambda_1 = \theta\gamma - \delta > 0$. In this case, only sustained growth is possible. In the general model, for positive n, both convergent and divergent cases are possible. Recall that in the divergent case the steady-state capital stock is negative:

$$\overline{K} = \frac{-\omega(1-x)}{\theta(1 - x(1-\gamma)\eta)} < 0.$$

We consider the consumption and saving by the group of consumers who are patient. In the model with no population growth, when workers receive more rents, income is essentially redistributed from the patient fraction of the population to the impatient. The firm owners are all patient, so they lose from rent sharing. They get part of those rents back in their role as workers, but some of the rents go to the impatient nonsavers.

Section 1 shows that the patient consumers consume a fraction δ of their wealth. Their wealth is the sum of their holdings of K, q, and human wealth. We can write their aggregate consumption per capita as

$$C(t) = \delta\left[K(t) + q(t) + H(t)\right], \tag{5}$$

where $H(t)$ is their per capita human capital.

There is a more instructive way to rewrite this consumption function. Human capital can be broken up into two parts, the discounted value of rents that workers receive, and the discounted value of nonrent wages. The latter is simply equal to $\omega/\theta\gamma$, recalling that the interest rate equals $\theta\gamma$.

Let us call $R(t)$ the present discounted value of rents produced in this economy. $R(t)$ equals $q(t)/(1-\eta)$. The patient workers receive these rents in two ways: as firm owners and as workers. The share of total rents received by the patient is $1 - x\eta$. The impatient workers receive a share $x\eta : \eta$ of the rents go to workers, and the impatient workers are a fraction x of all workers.

So, we can rewrite equation (5) as

$$C(t) = \delta\left[K(t) + (1 - x\eta)R(t) + \omega/\theta\gamma\right]. \tag{6}$$

A change in η at time t has no effect on $K(t)$ or $\omega/\theta\gamma$, but affects consumption of this group directly by changing their share of rents, and indirectly by changing the value of rents.

We can define the right-hand side of equation (6) to be the permanent income of the patient workers. The permanent income that comes from rents is $\delta(1 - x\eta)R(t)$. Using the fact that since $\dot{q}(t) = (\theta\gamma - \delta)(q(t) - \bar{q})$, we have that $(\theta\gamma - \delta)(q(t) - \bar{q}) = -\theta(1-\gamma)(1-\eta)(K(t) - \bar{K}) + \theta\gamma(q(t) - \bar{q})$. A little bit of algebra (along with the relation $q(t) = (1-\eta)R(t)$) gives us

$$\delta(1 - x\eta)R(t) = (1 - \eta x)\left[\theta(1-\gamma)K(t) + \frac{(1-\gamma)(\delta - \gamma\theta)}{\gamma}\bar{K}\right]. \tag{7}$$

The left-hand side of this equation is the permanent income of the patient. The bracket on the right-hand side consists of two terms. The first term is current flows from rents. The second term is a positive number. This tells us that permanent income from rents for the patient exceeds current income from rents.

Holding $R(t)$ constant, an increase in η causes permanent income to drop more than the fall in the current flow of rents to the patient. Thus, a one dollar drop in their flow of rents causes their consumption to fall by more than a dollar, increasing their saving. The saving of the impatient group remains at zero, so aggregate saving rises as rent sharing increases.

Why does permanent income from rents exceed the current flow? It is because income from rents is growing rapidly. If income from rents grew at a constant rate equal to the difference between the interest rate and the discount rate, then permanent income would equal the current flow of income. But, the growth rate is faster than that. From equation (2), and using the fact that $\lambda_1 = r - \delta$, we have

$$\dot{K}(t)/K(t) = (r - \delta)\left[1 - \left(\bar{K}/K(t)\right)\right] > r - \delta.$$

So, permanent income from rents is greater than the current flow of rents. An increase in rent sharing lowers permanent income more than it lowers the current flow of rents to the patient savers.

Actually, we held $R(t)$ constant in the above analysis. But $R(t)$ rises when η rises. That is because the increase in η raises growth and causes the present value of rents to be greater. This effect tends to mitigate the drop in consumption of the patient consumers. However, logically the effect cannot be so large that aggregate saving actually falls when η rises. If it did, then growth would be lower and $R(t)$ would be lower, which is a contradiction.

When we allow n to be greater than zero, we essentially have that saving increases as rent sharing increases for the reasons just discussed, and for the reasons discussed in section 2.

5. Conclusions

We find that increasing rent sharing makes saving and growth increase. As noted earlier, we have examined an exogenous change in rent sharing. We would recommend against an empirical test of the simple proposition that countries with greater rent sharing have higher growth. The amount of rent sharing in different economies might differ because the structure of the economies is different. Workers might have more bargaining power, allowing them to capture a larger share of the rents. Or, effort may be more difficult to monitor, which may affect the optimal efficiency wage. Or, there may be different traditions of the gift relationship between workers and firm owners. So, the amount of rent sharing will be different across countries for endogenous reasons. These in turn may have an effect on growth through channels other than the ones we discuss here.

Indeed, as a next step in this line of research, it would be helpful to model the rent sharing, and to relate it to the nature of the rents. We believe the evidence shows that the greatest rent sharing occurs in those high-tech industries that are the engines for growth. The rent sharing could affect the incentives for innovation. If, for example, agents were discouraged from investing in research and development because some of the potential rents will be shared with workers, then growth could be lower because of rent sharing in spite of the saving effects we consider here.

An issue considered by Katz and Summers (1989a, 1989b), Dickens (1992) and Tyson (1992) is whether the interindustry wage differential has implications for international trade policy. That is another area in which there are possible synergies between rent sharing and growth, but ones we do not consider here. Our model has only one production sector, so it is not a useful vehicle to consider the possible benefits of subsidizing industries with high degrees of rent sharing.

In summary, we think there are at least four ways that rent sharing could affect growth. To the extent that rent sharing increases labor's productivity, it can enhance the attractiveness of investment opportunities. It may, however, reduce the incentive to research and develop new products since it diminishes the expected flow of rents to firm owners. Rent sharing may have effects on the intersectoral distribution of factor supplies, which in turn could influence growth. Finally, by changing income flows among different segments of the population it can influence aggregate saving. We have isolated the fourth channel in this study, but a comprehensive picture would take into account all of these elements.

We believe the channel we have isolated—the aggregate saving effects of rent sharing—could be significant. In our first model, we note that rent sharing can affect saving and growth through the same mechanism that has been considered important in studies of taxation and growth. Like certain forms of taxation, rent sharing can redistribute income from currently living generations to generations yet to be born, thus increasing saving by lowering the wealth and aggregate consumption of current generations. Our second model emphasizes a different mechanism. Rent-sharing redistributes income from high savers to credit-constrained individuals who do no saving. The important point we make is that such a redistribution can increase aggregate saving in a world of permanent-income consumers. The permanent income of the savers might decline more than their current income—so saving rises.

Appendix

We show that $d\dot{K}(t)/d\eta \geq 0$ for all $K(t) \geq 0$, for the model of section 3. This also proves the claim for the model of section 2, which is the special case of section 3 with $x = 0$. Let

$$A = \begin{bmatrix} \theta\gamma - \delta & -\delta n & -\delta n \\ -1 & \theta - x\theta(1-\gamma)\eta - n & 0 \\ 0 & -\theta(1-\gamma)(1-\eta) & \theta\gamma - n \end{bmatrix}.$$

The three eigenvalues for this system are λ_1, λ_2, and λ_3, where $\lambda_1 < \lambda_2 < \lambda_3$. Using the well-known facts that $\lambda_1\lambda_2\lambda_3 = \det(A)$, $\lambda_1 + \lambda_2 + \lambda_3 = \mathrm{tr}(A)$, and $\lambda_1\lambda_2 + \lambda_2\lambda_3 + \lambda_1\lambda_3 = a_{11}a_{22} + a_{11}a_{33} + a_{22}a_{33} - a_{12}a_{21} - a_{13}a_{31} - a_{23}a_{32}$, we have:

$$\lambda_1 + \lambda_2 + \lambda_3 = \theta - n + \gamma\theta - \delta + \gamma\theta - n - \theta(1-\gamma)x\eta,$$

$$\lambda_1\lambda_2\lambda_3 = [\theta - \theta(1-\gamma)\eta x - n](\gamma\theta - \delta)(\gamma\theta - n) - n\delta(1-\eta)(1-\gamma)\theta,$$

$$\lambda_1\lambda_2 + \lambda_2\lambda_3 + \lambda_1\lambda_3 = [\theta - \theta(1-\gamma)\eta x - n](\gamma\theta - \delta + \gamma\theta - n) + (\gamma\theta - \delta - n)\gamma\theta.$$

These facts will come in handy later. Now, define

$$P(\lambda) = [\theta - \theta(1-\gamma)\eta x - n - \lambda](\gamma\theta - \delta - n - \lambda)(\gamma\theta - \lambda) + n\delta(1-x)(1-\gamma)\theta\eta.$$

The eigenvalues are found by setting $P(\lambda) = 0$.

Let $0 \leq x \leq 1$, and $0 \leq \eta \leq 1$. Then $P(\gamma\theta - \delta - n) \geq 0$, which implies $\lambda_1 > \gamma\theta - \delta - n$.

Since $P(\lambda) > 0$ for $\lambda < \lambda_1$, then $P(\lambda) < 0$ for $\lambda > \lambda_3$. But $P(\gamma\theta) > 0$, so $\lambda_3 > \gamma\theta$.

It must also be the case that $P(\lambda) < 0$ for $\lambda_1 < \lambda < \lambda_2$, so there are two regions for which $P(\lambda) < 0$. Now, $P(\gamma\theta - n) < 0$. But since $\lambda_3 > \gamma\theta - n$, then $\gamma\theta - n$ must lie in the other region for which $P(\lambda) < 0$; i.e., $\lambda_1 < \gamma\theta - n < \lambda_2$.

Note that these results show that λ_2 and λ_3 are greater than zero, while λ_1 can be positive or negative.

We can write

$$\overline{K} = \frac{-\omega(1-x)(\gamma\theta - \delta)(\gamma\theta - n)}{\lambda_1\lambda_2\lambda_3}.$$

Note that $\overline{K} > 0$ when $\lambda_1 < 0$ and vice versa. Taking the derivative:

$$\frac{d\overline{K}}{d\eta} = -\overline{K} \cdot \frac{n\delta(1-\gamma)\theta - x\theta(1-\gamma)(\gamma\theta - n)(\gamma\theta - \delta)}{\lambda_1\lambda_2\lambda_3}.$$

Setting $P(\lambda_1) = 0$, differentiating, and making use of the relations derived at the beginning of the Appendix, we find

$$\frac{d\lambda_1}{d\eta} = \frac{n\delta(1-\gamma)\theta(1-x) - x\theta(1-\gamma)(\gamma\theta - \lambda_1)(\gamma\theta - n - \delta - \lambda_1)}{(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)}.$$

We have $d\lambda_1/d\eta \geq 0$, since $\gamma\theta - \delta - n \leq \lambda_1 \leq \gamma\theta$. From equation (2):

$$\frac{d\dot{K}(t)}{d\eta} = \left(K(t) - \overline{K}\right)\frac{d\lambda_1}{d\eta} - \lambda_1 \frac{d\overline{K}}{d\eta}.$$

Since $K(t) \geq 0$ for all t, and $d\lambda_1/d\eta \geq 0$, we have

$$\frac{d\dot{K}(t)}{d\eta} \geq 0 \quad \text{if} \quad \overline{K}\frac{d\lambda_1}{d\eta} - \lambda_1 \frac{d\overline{K}}{d\eta} \geq 0.$$

But, using the results from above, we have

$$\overline{K}\frac{d\lambda_1}{d\eta} - \lambda_1 \frac{d\overline{K}}{d\eta} = D_1 + D_2,$$

where

$$D_1 \equiv \overline{K}\delta n\theta(1-\gamma)\left[\frac{1}{\lambda_2\lambda_3} - \frac{1}{(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)}\right],$$

$$D_2 \equiv \overline{K}\theta(1-\gamma)x\left[\frac{(\gamma\theta - n - \lambda_1)(\gamma\theta - \delta - \lambda_1)}{(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)} - \frac{(\gamma\theta - n)(\gamma\theta - \delta)}{\lambda_2\lambda_3}\right].$$

Here, we have used the fact that we can rewrite

$$\frac{d\lambda_1}{d\eta} = \frac{n\delta(1-\gamma)\theta - x\theta(1-\gamma)(\gamma\theta - n - \lambda_1)(\gamma\theta - \delta - \lambda_1)}{(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)}.$$

Since $1/(\lambda_2\lambda_3) - 1/[(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)] > (<)\ 0$ as $\lambda_1 < (>)\ 0$, and $\overline{K} > (<)\ 0$ as $\lambda_1 < (>)\ 0$, we have that $D_1 > 0$ in both cases. When $\lambda_1 < 0$, we have

$$\frac{(\gamma\theta - n - \lambda_1)}{(\lambda_2 - \lambda_1)} > \frac{\gamma\theta - n}{\lambda_2} > 0 \ \left(\text{because } \lambda_2 > \gamma\theta - n\right), \text{ and}$$

$$\frac{(\gamma\theta - \delta - \lambda_1)}{(\lambda_3 - \lambda_1)} > \frac{\gamma\theta - \delta}{\lambda_3} > 0 \ \left(\text{because } \lambda_3 > \gamma\theta - \delta\right).$$

So, in this case:

$$\frac{(\gamma\theta - n - \lambda_1)(\gamma\theta - \delta - \lambda_1)}{(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)} - \frac{(\gamma\theta - n)(\gamma\theta - \delta)}{\lambda_2\lambda_3} > 0 \quad \text{and} \quad \mathrm{D}_2 > 0.$$

When $\lambda_1 > 0$:

$$\frac{\gamma\theta - n}{\lambda_2} > \frac{(\gamma\theta - n - \lambda_1)}{(\lambda_2 - \lambda_1)} > 0, \text{ and}$$

$$\frac{(\gamma\theta - \delta - \lambda_1)}{(\lambda_3 - \lambda_1)} < \frac{\gamma\theta - \delta}{\lambda_3}.$$

So in this case also:

$$\frac{(\gamma\theta - n - \lambda_1)(\gamma\theta - \delta - \lambda_1)}{(\lambda_2 - \lambda_1)(\lambda_3 - \lambda_1)} - \frac{(\gamma\theta - n)(\gamma\theta - \delta)}{\lambda_2\lambda_3} < 0 \quad \text{and} \quad D_2 > 0.$$

(Note that we do not need to know the sign of $\gamma\theta - \delta - \lambda_1$.) So, since D_1 and D_2 are both positive, we have $d\dot{K}(t)/d\eta \geq 0$.

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Notes

1. Krueger and Summers (1987, 1988), Dickens and Katz (1987), Murphy and Topel (1987), Katz and Summers (1989a, 1989b), Gibbons and Katz (1992), Blackburn and Neumark (1992) and Dickens (1992) all find significant interindustry wage differentials.
2. Among the growth papers that do allow for population heterogeneity are the overlapping generations models of Jones and Manuelli (1992), Saint-Paul (1992), and Alogoskoufis and van der Ploeg (1991), and the models of income distribution and growth of Alesina and Rodrik (1991), Bertola (1993), and Perotti (1993).
3. Superficially our paper is related to Bertola (1993), who looks at a question of distribution and growth. The rent sharing that we examine is a purely nondistortionary redistribution among households. Bertola, in contrast, considers Pigouvian subsidies to investment financed by taxes on wages or consumption. An increase in the subsidy rate starting at zero reduces the wedge between private returns to capital and the social marginal product of capital. This policy is a Pigouvian subsidy to capital since labor is supplied perfectly inelastically in his model. While Bertola addresses an important issue, it is completely distinct from our concern about the effects of rent sharing.
4. These conclusions hold as well if management makes the first offer instead. Note that the discount factors we refer to are those of the representatives, and not those of workers and owners.
5. This is the path that satisfies the conditions: $K(t) \geq 0$ for all $K(t)$, and $\lim_{t\to\infty} K(t)e^{-(\theta-n)t} \geq 0$ (which comes from integrating the equation of motion for the aggregate capital stock and imposing a boundary condition). These are necessary for a feasible infinite-horizon consumption stream.