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Risk aversion and rising wage inequality

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Abstract

We propose a model in which, as incomes grow, workers become less risk-averse and move from fixed-wage contracts to variable pay. This can explain the recent increase in wage dispersion between groups, within groups, and over the lifecycle.

Keywords: Inequality; Risk aversion; Wage-setting institutions

JEL classification: J3; O4

1. Introduction

The recent increase in earnings inequality in a number of industrialized countries is by now a well-documented event.[1] Changes in the distribution of earnings have been decomposed into three main elements. First, there has been an increase in between-group inequality, that is, rising educational and age-related wage differentials. Second, the dispersion of the wages of workers with the same observable characteristics, within-group inequality, has augmented. Acemoglu (2000) reports that between 1979 and 1995, the wage ratio of university to high school graduates increased by some 25% in the USA, while he estimates that within-group inequality rose by 17% over the period. Third, the lifetime earnings of each individual have become more volatile. Gottschalk and Moffitt (1994) show that a substantial part of the recent widening in the distribution of earnings in the USA is due to greater volatility of the wages received by each particular individual staying in the same job.

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[1]See, for example, OECD *Employment Outlook* (1996).

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An extensive literature has tried to understand what has driven the increase in between-group and within-group inequality. Changes in distribution are seen as the result of shifts in the marginal value product of different types of workers that alter their relative demands. International trade and skill-biased technical change have been said to have led to an increase in the demand for high-skill workers relative to that for low-skill labor. In contrast, explanations of the increase in within-group inequality rely on shifts in the return to unobserved ability or on different opportunities for learning-by-doing acquired in different jobs by otherwise identical individuals.[2]

These theories have, however, difficulty in explaining the increased volatility of individual lifetime earnings. Our paper presents an explanation that can account for changes in all three components of wage inequality. In doing so, we depart from the supply and demand framework used in previous work. We keep the (relative) marginal value product of workers constant, and seek to explain the evolution of the distribution of earnings through changes in the extent to which wages reflect the productivity of workers. We argue that, as an economy grows, endogenous changes in workers' risk aversion induce changes in the way labor is rewarded. In an economy where output is random, risk-neutral firms will be willing to insure risk-averse workers by offering them a constant wage. As the economy grows and productivity—and hence income—increases, the degree of risk-aversion of workers falls. They are willing to bear more risk, and hence choose different types of contracts. This will impact on the dispersion of earnings between groups, within groups, and over the individual life-cycle.

The crucial assumption in our analysis is that the degree of relative risk aversion of workers decreases with income. Direct survey evidence on relative risk aversion offers no clearcut answers, yet indirect evidence based on investments in risky assets seems to imply that individuals have decreasing absolute and relative risk aversion.[3] Explaining economic behavior through changes in preferences is often criticized within the profession, yet a number of recent papers have shown that endogenising the degree of risk aversion can help explain observed behavior.[4] Our paper is part of this growing literature and suggests that changes in workers' attitudes towards risk following income growth may be a source of rising wage inequality.

2. The model

2.1. Production and wages

Consider an economy with firms and workers. Firms are risk-neutral, while workers are risk-averse. We assume that workers' utility function is of the Stone–Geary form $U(w) = \log(w - z)$, where w is the individual's wage and z is subsistence consumption. This utility function implies that workers have decreasing *absolute* and *relative* risk aversion.

Firms are denoted by $j = 1,2,\ldots$ and are all identical. Production by firm j takes place according to

$$Y_{jt} = \theta_{jt} K_{jt}^{\alpha} (A_t H_{jt})^{1-\alpha}, \tag{1}$$

[2] Aghion et al. (1999) review this literature.
[3] See Guiso et al. (1996) and Arrondel and Masson (1996).
[4] See Bakshi and Chen (1996) and Gordon and St-Amour (2000).

where K_{jt} denotes the firm's stock of capital at time t, A_t measures the labor-augmenting level of technology, and H_{jt} the efficiency units of labor employed. A_t is an economy-wide variable that grows exogenously at rate g. A firm's output also depends on a firm specific productivity shock, θ_{jt}. The distribution of the random shock, $F(\theta)$, is the same for all firms, has mean μ, variance σ^2, and $\theta \geq 0$.

Individual i has a constant share h^i in the (constant) aggregate stock of human capital, $\overline{H}$, so that $\Sigma_i h^i = \overline{H}$. In the absence of fixed-wage contracts, factors are paid their marginal product. Firms choose their capital stock each period before the shock is realized. We assume that we are in a small open economy so that the interest rate is given by the world rate, r. Profit maximization by firm j at time t then implies $r = \alpha\mu(A_t H_{jt}/K_j t)^{1-\alpha}$. The optimal physical to human capital ratio depends only on the level of technology, and is the same for all firms. Wages are paid after the shock is realized and observed by all agents. The wage rate paid by firm j at time t is therefore $w_{jt} = (1-\alpha)\theta_{jt}A_t^{1-\alpha}(K_{jt}/H_{jt})^{\alpha}$. Substituting for the physical to human capital ratio, the wage rate received by individual i in firm j can then be expressed as $w_{jt}^i = \beta\theta_{jt}A_t h_j^i$, where β is a constant that lies in (0, 1).[5]

The expected utility to a worker is then

$$EU(w_t^i) = E\big[\log(\beta\theta A_t h^i - z)\big], \tag{2}$$

and the expected profits (and utility) to a firm are

$$EV(w_t) = (1-\beta)\mu A_t H, \tag{3}$$

where the subscript j has been removed as all firms are identical.

Differences in risk aversion between firms and workers give rise to the possibility of insurance in the form of a fixed wage. Paying a fixed wage involves a fixed cost to the firm, C_t. We assume that the cost of a fixed contract to worker i is proportional to her efficiency units of human capital, $A_t h_i$, so that $C_{it} = c\mu A_t h_i$. The constant wage offered by a firm to individual i, $\overline{w}_t^i$, is simply the worker's expected marginal product minus the cost of offering the contract,

$$\overline{w}_t^i = (\beta - c)\mu A_t h^i, \tag{4}$$

where $\beta > c$. A firm's expected profits are therefore the same under both types of contracts.

A worker is willing to accept this wage contract provided that her expected utility under it is greater than or equal to what she would obtain by being paid her random marginal product each period. The cost c is in practice the risk-premium that workers must pay in order to be insured. Define the difference in the expected utilities from the two types of contracts for worker i as ΔU_i, where

$$\begin{aligned}\Delta U_t^i &\equiv EU(\overline{w}_t^i) - EU(w_t^i) \\ &= \log((\beta - c)\mu A_t h^i - z) - \int_0^{\infty} \log[\beta\theta A_t h^i - z]\,\mathrm{d}F(\theta).\end{aligned} \tag{5}$$

The worker will accept a fixed wage if and only if $\Delta U_i > 0$.

[5] We define $\beta \equiv (1-\alpha)(\alpha\mu/r)^{\alpha/1-\alpha}$, and for simplicity of exposition use the normalization $\alpha\mu/r = 1$.

2.2. Insurance versus random wages

In order to illustrate the comparative statics of the model, we specify a particular distribution function for the productivity shock θ. Assume that θ can take the value $\underline{\theta}$ with probability 1/2 and $\overline{\theta}$ with the same probability, where $\underline{\theta} < \overline{\theta}$. The difference between the utility from fixed and random wage contracts can then be expressed as

$$\Delta U_i = \log((\beta - c)\mu A_t h^i - z) - \frac{1}{2}(\log[\beta\overline{\theta}A_t h^i - z] + \log[\beta\underline{\theta}A_t h^i - z]). \tag{6}$$

Define two constants

$$\phi \equiv \frac{cz\mu}{\beta c\mu^2 - \beta^2\sigma^2} \quad \text{and} \quad \psi \equiv \frac{2z\mu c}{c(2\beta - c)\mu^2 - \beta^2\sigma^2} < \phi.$$

It is then possible to show that

- for $A_t h^i < \psi$, $\Delta U_i > 0$ and $\partial\Delta U_i/\partial h^i < 0$, $\partial\Delta U_i/\partial A_t < 0$;
- for $\psi \leq A_t h^i < \phi$, $\Delta U_i \leq 0$ and $\partial\Delta U_i/\partial h^i < 0$, $\partial\Delta U_i/\partial A_t < 0$;
- for $\phi \leq A_t h^i$, $\Delta U_i < 0$ and $\partial\Delta U_i/\partial h^i \geq 0$, $\partial\Delta U_i/\partial A_t \geq 0$.

Whether or not an individual accepts a fixed wage then depends on her level of income, which is determined by $A_t h^i$, relative to the cost of providing insurance. For low values of $A_t h^i$, the individual is sufficiently risk-averse to be willing to pay the cost of insurance ($\Delta U_i > 0$). For low values of $A_t h^i$, ΔU_i is also strictly decreasing, implying that as A_t or h^i increases a fixed wage becomes less attractive. Eventually ΔU_i becomes negative. The increase in income makes agents less averse to risk, the benefit from a constant wage falls relative to the cost of being insured, and workers prefer to receive a random wage. That is, for higher levels of h^i or, alternatively, at all levels of h^i as A_t increases, workers are less willing to pay a given risk premium.

2.3. Wage inequality

We can now examine the evolution of relative wages as the level of technology, A_t, increases. Let us consider two types of workers which we call high-skill and low-skill. Their stocks of human capital are, respectively, h_H and h_L, with $h_H > h_L$. Let ω_t be their *expected* relative wage. As the economy grows, ω_t will go through three phases, characterized by whether or not each type of worker chooses to be insured.

Phase 1: Suppose A_t is low so that $A_t h_L < A_t h_H < \psi$. Both types of workers choose to be insured, and the relative wage is given by

$$\omega_t^{(1)} = \frac{\overline{w}_{H,t}}{\overline{w}_{L,t}} = \frac{(\beta - c)\mu A_t h_H}{(\beta - c)\mu A_t h_L} = \frac{h_H}{h_L}.$$

Phase 2: As A_t grows, the economy moves into a situation in which $A_t h_L < \psi < A_t h_H$. High-skill workers choose to receive a random wage, and the (expected) relative wage is

$$\omega_t^{(2)} = \frac{E(w_{H,t})}{\bar{w}_{L,t}} = \frac{\beta\mu A_t h_H}{(\beta - c)\mu A_t h_L} = \frac{h_H}{h_L}\frac{\beta}{\beta - c}.$$

Phase 3: Eventually, further increases in A_t raise the productivity of unskilled workers to a point where $\psi < A_t h_L < A_t h_H$. Low-skill workers will also prefer not to be insured, hence

$$\omega_t^{(3)} = \frac{E(w_{H,t})}{E(w_{L,t})} = \frac{\beta\mu A_t h_H}{\beta\mu A_t h_L} = \frac{h_H}{h_L}.$$

The mechanism behind this wage pattern is simple. For low levels of income, both categories of workers are insured. Both receive a wage less than their marginal product, as they are paying firms a risk premium. Since the risk-premium is proportional to each agent's efficiency units, the skill premium is simply equal to the relative skill endowment. As A_t grows, the degree of risk aversion decreases. When their level of income is sufficiently high, high-skill workers prefer a random but higher wage. By not being insured, high-skill workers stop paying the risk premium to firms and thus have a higher expected income than in Phase 1. The economy-wide relative wage thus jumps to a level above the relative skill endowment. For even higher levels of technology (Phase 3), the degree of risk-aversion of low-skill workers becomes sufficiently small for them to also prefer not to be insured. At this point, the skill premium drops back to the relative skill endowment.

This very stylized model allows us to account for the three types of inequality discussed in the introduction. First, the transition from Phase 1 to Phase 2 results in an increase in wage inequality between groups with different levels of skills, that is, between educational or age groups. Second, as the economy moves from Phase 1 to Phase 2, workers with a higher stock of human capital start being paid random wages. If the realization of the productivity shock θ differs across firms, then at any point in time, workers with the same (high) level of human capital but employed in different firms will receive different wages. Therefore, within-group wage dispersion increases. Lastly, for those endowed with a high level of human capital, the volatility of earnings of one specific worker over her lifetime also increases.

As the economy moves to Phase 3, workers with low human capital start receiving a random wage. Between-group inequality would decline. This episodic nature of the increase in the skill premium seems to fit the latest evidence on the distribution of wages which shows a recent deceleration of the rate of increase of the skill premium.[6] Within group inequality and individual earnings volatility, however, remain higher than they were in Phase 1. Within all groups of workers, wage dispersion as well as the volatility of lifetime earnings are now positive.

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[6] Katz and Autor (1999) show that the rate of increase of the US skill premium between 1979 and 1987 was more than twice as fast as that observed during the 1987–1995 period. Welch (1999) even finds a small decrease in the skill premium after 1995.

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