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ABSTRACT

Designing a Cheaper and More Effective Unemployment Benefit System*

This paper describes an equilibrium labour market in which an unemployment benefit system cannot raise the average value of being unemployed in the long run. It proposes an alternative benefit system which pays generous benefit rates when unemployment is high, but pays much lower rates in booms. By targeting unemployment compensation to recessions, when being unemployed is particularly costly, this policy provides insurance equivalent to that provided by the current system. By reducing the value of remaining unemployed in booms, the benefit reduction increases wage flexibility over the cycle, which substantially reduces average unemployment.

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NON-TECHNICAL SUMMARY

Unemployment benefit reform has long been an important policy issue in Europe. By comparing countries using different benefit schemes, Layard, Nickell and Jackman (1991) suggest that such schemes can have detrimental effects on unemployment and unemployment duration. Indeed, Great Britain seems to have a relatively severe long-term unemployment problem – in Spring 1995, 43% of the unemployed had been out of work for over a year, while 61% had been unemployed for more than six months. By creating this problem, many have questioned whether the unemployment benefit system is truly benefiting the workforce. This paper analyses an equilibrium turnover model of the labour market which finds that an unemployment benefit system cannot substantially raise the average utility of the unemployed. Rather than raise the average value of being unemployed, it raises average unemployment. Its only redeeming feature is that it provides the unemployed with partial insurance against business cycle risks. This paper shows how to construct a much more effective insurance system. Simulations suggest that this alternative system can provide equivalent insurance against business cycle risk while decreasing average unemployment and the tax cost of the benefit system by as much as 40%.

Although this paper uses a standard labour turnover framework, its approach is quite distinct from the standard matching literature. Typically, the matching literature assumes that all entrepreneurs are fully informed on the latest technologies and know of infinite profit-making opportunities. Should the market wage drop by a penny, there is potentially an infinite inflow of new vacancies, i.e. the entry of vacancies is perfectly elastic. The friction in this framework is that entrepreneurs find it difficult to contact suitable employees. The opposite is the case in this paper. Entrepreneurs are not completely informed on all profit-making opportunities. Having an idea which will make money in the market is, for most of us at least, a rare (and random) event. The creation of new jobs takes time in this model because entrepreneurs have to discover profit-making opportunities. It assumes, however, that filling a vacancy is easy while there is a positive stock of unemployed workers. By posting an advertisement in a newspaper or professional journal, or contacting the local job centre, or using professional contacts, the entrepreneur can locate an unemployed worker arbitrarily quickly. There are no matching frictions.

In essence, the rate at which new jobs are created in the representative occupation depends on the current market wage. The higher the market wage,

the less profit entrepreneurs make when investing in a new vacancy, and so the lower is the rate of new job creation. Wages are, in turn, assumed to be determined competively. If there are many unemployed workers in a particular occupation and one new vacancy enters the market, the wage is bid down until each worker is indifferent to taking the job or remaining unemployed. It is shown that in equilibrium the market wage decreases as the number of unemployed increases. Hence when unemployment is high, the rate of job creation is relatively high (as wages are low), which leads to unemployment falling (on average) over time. Although unemployment levels change randomly over time, they are stable in the long run.

Given this simple market structure, it is clear that in the long run, the average rate of job creation must equal the average rate at which unemployed workers enter the market. By construction of the model, there is a unique wage level which achieves this – denoted w° in the text. If the current market wage exceeds w°, the entry rate of new vacancies is relatively low. The number unemployed gradually builds up over time until the market wage is driven down to w°. Indeed, it is this mechanism which undermines the effectiveness of an unemployment benefit system. If we suppose the government attempts to make the unemployed better off by increasing unemployment compensation, this policy change makes the currently unemployed better off at the original level of unemployment, but in doing so it increases their reservation wage above w°. As this reduces the rate of job creation, unemployment will gradually build up until the reservation wage of the unemployed falls back to w°. In the long run, the main policy effect is to increase total unemployment while leaving the average utility of the unemployed at w°. The increase in cost is obvious.

Nevertheless, this benefit system does provide partial insurance against business cycle risk, where a worker is worse off being unemployed in periods of high unemployment than in periods of low unemployment. It is much harder to get work in a recession. As the expected duration of unemployment is high when unemployment is high, an unemployed worker will receive many more payments in such periods. This targeting effect raises the utility of the unemployed in recessions relative to the average over the business cycle and hence provides partial insurance against such utility risk.

But this insurance mechanism is clearly inefficient. If the government wishes to insure the unemployed against business cycle risk, it should vary payments over the cycle – paying relatively high benefit rates in periods of high unemployment and low (zero?) benefits at other times. There seems little reason why the government should pay high unemployment compensation in periods of low unemployment where it is relatively easy to find work. Furthermore, by reducing these payments in booms, the government reduces the value of each worker's option to remain unemployed. This encourages greater downward wage flexibility, which in turn leads to greater investment rates by entrepreneurs. The added stimulus to job creation results in lower average unemployment. By distorting the market less outside of a recession, this policy promotes greater overall efficiency. Reducing such payments does not lower expected utility in the long run (which remains at w^o). By targeting unemployment compensation to recessions, when being unemployed is particularly costly, this policy continues to provide equivalent insurance.

Introduction.

Unemployment benefit reform has long been an important policy issue in Europe. By comparing countries using different benefit schemes, Layard, Nickell and Jackman (1991) suggest that such schemes can have large detrimental effects on unemployment and unemployment duration. Indeed, Great Britain seems to have a relatively severe long-term unemployment problem -in Spring 1995, 43% of the unemployed had been out of work for over a year, while 61% had been unemployed for more than six months. By creating this problem, many have questioned whether the unemployment benefit system is truly benefiting the workforce. This paper analyses an equilibrium turnover model of the labour market which finds that an unemployment benefit system cannot substantially raise the average utility of the unemployed. Rather than raise the average value of being unemployed, it raises average unemployment instead. Its only redeeming feature is that it provides the unemployed with partial insurance against business cycle risk. But this paper shows how to construct a much more effective insurance system. Simulations suggest that this alternative system can provide equivalent insurance against business cycle risk while decreasing average unemployment and the tax cost of the benefit system by as much as 40%.

The framework used to analyse this policy is based on Taylor (1995) and Coles (1996). Although it uses a standard labour turnover framework, its approach is quite distinct from the standard matching literature. Typically, the matching literature assumes that all entrepreneurs are fully informed on the latest technologies and know of infinitely many profit making opportunities. Should the market wage drop by a penny, there is potentially an infinite inflow of new vacancies, i.e. there is perfectly elastic entry of vacancies. The friction in that framework is that entrepreneurs find it difficult to contact suitable employees (see Pissarides (1990) for an overview). The opposite is the case in this paper. Entrepreneurs are not completely informed on all profit-making opportunities. Getting an idea which will make money in the market is, for most of us at least, a rare (and random) event. The creation of new jobs takes time in this model because entrepreneurs have to discover profit-making opportunities (similar to Diamond (1982)). Conversely, it assumes that filling a vacancy is easy while there is a positive stock of unemployed workers. By posting an advertisement in a newspaper or professional journal, or contacting the local Job Center, or using professional contacts, the entrepreneur can locate an unemployed worker arbitrarily quickly. There are no matching frictions.

For simplicity, it is assumed that the labour market can be partitioned into distinct occupations and separate geographical regions. For example, it is assumed only accountants are qualified to fill accountancy vacancies and that accountants are either unqualified or are unwilling to accept other forms of employment - such as software design, truck driving, cleaning jobs etc. Here an unemployed accountant simply waits for an accountancy vacancy to be created. With no matching frictions, the number of unemployed accountants varies depending on whether the next labour market entrant is a new vacancy or a new unemployed accountant. Total unemployment and vacancies are found by aggregating over these separate markets.

In essence, the rate at which new jobs are created in the representative occupation depends on the current market wage. The higher the market wage, the less profit entrepreneurs make when investing in a new vacancy, and so the lower is the rate of new job creation. Wages are in turn assumed to be determined competitively. If there are many unemployed workers in a particular occupation and one new vacancy enters this market, the wage is bid down until each worker is indifferent to taking the job or remaining unemployed. It is shown that in equilibrium the market wage decreases as the number unemployed increases. Hence when unemployment is high, the rate of job creation is relatively high (as wages are low) which leads to unemployment falling (on average) over time. Although unemployment levels evolve stochastically over time, they are stable in the long-run.[1]

Given this simple market structure, it is clear that in the long run, the average rate of job creation must equal the average rate at which unemployed workers enter the market. By construction of the model, there is a unique wage level which achieves this - denoted w^c in the text.[2] If the current market wage exceeds w^c, then the entry rate of new vacancies is relatively low. The number unemployed gradually builds up over time until the market wage is driven down to w^c. Indeed, it is this mechanism which undermines the effectiveness of an unemployment benefit system. Suppose the government attempts to make the unemployed better off by increasing unemployment compensation. It is true that at the original level of unemployment, this policy change does make the currently unemployed better off. But by making them better off, their reservation wage rises above w^c. As this reduces the rate of job creation, unemployment will gradually build up until the reservation wage of the unemployed falls back to w^c. In the long run, the main policy effect is to increase total unemployment while leaving the average utility of the unemployed at w^c. The increase in cost is obvious.

[1] Even though there are no matching frictions, aggregating over submarkets implies a negative covariance between total vacancies and total unemployment - the so-called Beveridge curve.

[2] This price depends on the fundamentals of the economy - the rate at which entrepreneurs find profit making opportunities, the distribution of their costs and the entry rate of unemployed workers.

This benefit system does however provide partial insurance against business cycle risk, where a worker is worse off being unemployed in periods of high unemployment than in periods of low unemployment. It is much harder to get work in a recession. As the expected duration of unemployment is high when unemployment is high, an unemployed worker will receive many more payments in such periods. This targeting effect raises the utility of the unemployed in recessions relative to the average over the business cycle and hence provides partial insurance against such utility risk.

But this insurance mechanism is clearly inefficient. If the government wishes to insure the unemployed against business cycle risk, it should vary payments over the cycle - paying relatively high benefit rates in periods of high unemployment and low (zero?) benefit otherwise. There seems little reason why the government should pay high unemployment compensation in periods of low unemployment where it is relatively easy to find work. Furthermore, by reducing these payments in booms, the government reduces the value of each worker's option to remaining unemployed. This encourages greater downward wage flexibility which in turn leads to greater investment rates by entrepreneurs. The added stimulus to job creation results in lower average unemployment. By distorting the market less outside of a recession, this policy promotes greater overall efficiency. Reducing such payments does not lower expected utility in the long-run (which remains at w^c). By targeting unemployment compensation to recessions where being unemployed is particularly costly, this policy continues to provide equivalent insurance.

It is also worth quickly commenting on previous empirical results. Many have estimated the impact of the replacement ratio on the probability that an unemployed worker obtains a job each period. For example, Nickell (1979) estimated this elasticity as -0.6. As the replacement ratio rose from 31.1%

to 37.7% over the period 1963-74, this estimate predicts an increase in the expected duration of unemployment of 12.7% over the same period. Nickell noted that a 12.7% increase in unemployment reflected only one seventh of the actual increase in unemployment. Although there is a wide spread of such estimates (see Layard et al (1991), Devine and Kiefer (1991) for surveys), Atkinson and Mickelwright (1991) argue that the true elasticity is much smaller. At first blush this suggests that unemployment benefit does not explain the large rise in unemployment since the mid 60's.

But these arguments are based on partial models. For example, they do not describe the effect this policy has on prices. By implicitly giving workers greater bargaining power, an increase in unemployment benefit will tend to raise equilibrium wages in a standard matching model. This in turn reduces equilibrium vacancies which increases unemployment still further. Indeed, Millard and Mortensen (1994) calibrate the job creation/job destruction model of Mortensen and Pissarides (1994) by setting the above elasticity to -0.5. Even so, they found that unemployment benefit reform had large equilibrium effects on unemployment. In the simulation presented here, the elasticity is particularly small (approximately -0.05) but the unemployment effect is again large. Not only is there the same equilibrium wage effect, but there is also a simple crowding out story. As total unemployment increases, there are more people chasing each vacancy so that each unemployed worker's re-employment probability falls still further. Such crowding out implies a simple multiplier effect on the above elasticity.[3]

The paper is constructed as follows. Section I introduces the formal model

[3]This crowding out story does not work in a Mortensen/Pissarides style matching model with constant returns. Doubling the number unemployed causes vacancies to double instantaneously so that the matching rate of any particular worker is unchanged.

and section II characterises the central properties of a market equilibrium. As the focus is on policy, many of the technical details are not presented here. Coles (1996) analyses a closely related model and the interested reader is referred to that paper for the technical proofs. For simplicity much of the institutional detail associated with unemployment benefit schemes is also omitted. The results obtained should be interpreted with care - see Atkinson and Mickelwright (1991) for a thorough discussion of such issues. Section III considers the equilibrium effects of varying the level of unemployment benefit. Section IV designs an alternative unemployment benefit scheme which for the same reduction in utility risk, results in much lower unemployment on average with a corresponding reduction in the tax burden.

1 The Framework.

We consider equilibrium trade in a labour market within the context of an infinite horizon framework. It is assumed that the labour market can be partitioned into separate occupations and distinct geographical regions. There is no switching between such submarkets. In the representative submarket, there are entrepreneurs who hold unfilled vacancies and unemployed workers who are appropriately qualified to fill them. All such vacancies are identical, as are the unemployed workers. There are no matching frictions within a submarket (and implicitly there are infinite switching costs across submarkets). If there is a positive number of vacancies and unemployed workers, it is assumed that in equilibrium, these vacancies and unemployed workers instantaneously match until one side of the market has zero agents. In that case, let $L \in \mathbb{N}$ index the state of the market at any point in time. $L \geq 0$ implies there are zero vacancies and L unemployed workers in this occupation, while $L \leq 0$ signifies there are zero unemployed workers and $-L$ vacancies. Hence if $L > 0$, the market is long in workers and short on vacancies (and conversely for $L < 0$). Assume L is observed by all agents.

Assume all entrepreneurs (who hold vacancies) and workers are risk neutral and have the same discount rate $r > 0$. Unmatched vacancies obtain a zero flow payoff. Unmatched workers receive a flow payoff $b = u + b_g \geq 0$ where $u \geq 0$ is their flow value of leisure and $b_g \geq 0$ is any unemployment compensation received from the government. The expected discounted revenue of a filled vacancy is normalized to unity and so assume $b/r < 1$ so that a gain to trade exists.

Consider $L > 0$ and suppose a new vacancy enters the market. Via some wage bargaining process described below, the entrepreneur holding this vacancy negotiates a wage with one of the workers. If w_L denotes the equilibrium wage agreement in this state, the payoffs to the entrepreneur and the worker who gets the job are $1 - w_L$ and w_L respectively. Once a vacancy is filled by a worker, the vacancy and the worker concerned leave the market for ever. Similarly for $L < 0$ when a new unemployed worker enters the market.

Time is continuous. New unemployed workers enter the market at an exogenous Poisson rate with parameter $g > 0$ [i.e for small time period $\Delta > 0$. $g\Delta$ denotes the probability that a single worker enters this market]. The entry of new vacancies is described by entrepreneurial search, where there is a (large) fixed number of independent entrepreneurs who search for profit making opportunities. On aggregate, these entrepreneurs discover such opportunities at a constant Poisson rate $\alpha > g$. For each discovered opportunity, there is an associated investment cost $c \geq 0$ to exploit it. Furthermore, some opportunities are more costly to exploit than others. Given a discovery, its investment cost c is considered as an independent random draw with distribution F, which is assumed to be continuous and strictly increasing on the support [0,1]. By paying c, the entrepreneur holds a vacancy which he wishes to fill with one worker. If the entrepreneur declines to pay the investment cost, the opportunity is lost forever - there is no recall.

Let V_L denote the expected discounted payoff of an unemployed worker when there are L > 0 unemployed workers. Π_L denotes the expected discounted profit of an unfilled vacancy (for L < 0). Assume that given c and L, an entrepreneur invests if and only if the expected discounted profit by opening a vacancy exceeds its investment cost. Each entrepreneur's investment rule is therefore :

if $L > 0$, invest if and only if $c \leq 1 - w_L$;

if $L \leq 0$, invest if and only if $c \leq \Pi_{L-1}$.

Hence given L, each entrepreneur uses a reservation investment strategy c_L where $c_L = 1 - w_L$ (if $L > 0$) and $c_L = \Pi_{L-1}$ (if $L \leq 0$). This implies that at any point in time, new vacancies enter the market according to a Poisson process with parameter $\alpha F(c_L)$.

The terms of trade between an unfilled vacancy and an unemployed worker are determined depending on the number of unfilled vacancies and unemployed workers which are currently in the market. First consider L ≥ 2 and suppose a new vacancy enters the market (if a new worker enters, the only effect is that L increases by one). In this case, we presume there is Bertrand competition. The negotiated wage ensures each worker is indifferent to taking the job or remaining unemployed, i.e. $w_L = V_{L-1}$, where the vacancy is immediately filled and L decreases by one. Conversely, suppose L ≤ -2 and a new unemployed worker enters the market. Again we presume Bertrand competition where entrepreneurs holding vacancies offer a wage which leaves them indifferent to filling their vacancy at that wage or continuing to wait for another worker to enter the marketplace; i.e $1 - w_L = \Pi_{L+1}$, the worker immediately fills one of the vacancies and L increases by one.

The more complicated case arises when there is exactly one vacancy and one unemployed worker currently in the market - the bilateral bargaining problem. To avoid many of the complications introduced by using a game theoretic framework, we assume that the bilateral bargaining wage w is determined by the axiomatic Nash bargaining approach. Hence :

$$w = \arg\max_x \, [x - T_w]^{1-\theta}[1 - x - T_e]^{\theta} \tag{1}$$

where T_w, T_e are the agents' threatpoints and θ is the entrepreneur's bargaining power. However, rather than choose an arbitrary pair of threatpoints, they are chosen to be consistent with the strategic bargaining game with random alternating offers (see Binmore, Rubinstein and Wolinsky (1986) for a fuller discussion of this issue). In particular, as the time period between price offers goes to zero, Coles and Wright (1995) show that when both agents are risk neutral and have the same discount rate (as is the case here), the solution to the Nash bargaining equation equals that of the limiting strategic bargaining game if and only if the threatpoints equal each agent's expected payoff through perpetual disagreement during the bilateral bargaining game.

Now suppose there is exactly one worker and one vacancy in the market who are negotiating in the bilateral bargaining game. Over small time period $\Delta > 0$, a new vacancy enters the market with probability $\alpha F(\Pi_{-1})\Delta$ and a new worker enters the market with probability $g\Delta$. In either event, the bilateral bargaining game ceases and the payoffs are determined by the corresponding Bertrand game. In the limit as $\Delta \to 0$, the expected payoff to the worker if they never reach agreement equals $[b + \alpha F(\Pi_{-1})(1 - \Pi_{-1}) + gV_1]/(r + \alpha F(\Pi_{-1}) + g)$, which defines T_w. Similarly, $T_e = (\alpha F(\Pi_{-1})\Pi_{-1} +$

$g(1-V_1))/(r+\alpha F(\Pi_{-1})+g)$. Inserting these threatpoints into (1) and solving implies

$$w = \frac{r[(1-\theta)+\theta b/r] + \alpha F(\Pi_{-1})[1-\Pi_{-1}] + gV_1}{r+\alpha F(\Pi_{-1})+g} \tag{2}$$

The bilateral bargaining wage is a weighted average of $(1\text{-}\theta+\theta b/r)$, $[1-\Pi_{-1}]$ and V_1. $[1-\theta+\theta b/r]$ would be the negotiated wage if there were no breakdown of the bilateral bargaining game. If $\theta = 1$ (the firm has all the bargaining power) this term equals b/r, while if $\theta = 0$ this term equals one. Throughout we shall only consider $\theta \in [0,1]$. [1-Π_{-1}] is the worker's payoff should a new vacancy enter, and V_1 is his payoff should a new worker enter. The weights depend on the relative rates at which each breakdown occurs.

A Market Equilibrium (ME) is defined as a solution to conditions (A)-(C) defined as follows :

(A) the wage bargaining equations are satisfied for all L $\neq 0$, i.e. that

(i) $w_L = V_{L-1}$ for $L \geq 2$, (ii) $w_L = 1 - \Pi_{L+1}$ for $L \leq -2$ and (iii) $w_1 = w_{-1} = w$ satisfies (2), where

(B) V_L, Π_L are the agent's expected payoffs given wage agreements $< w_L >_{L=-\infty}^{+\infty}$ and entry rates $g, \alpha F(c_L)$ of new workers and new vacancies respectively.

As the value of being unemployed must be no smaller than b/r, an unemployed worker should refuse a job offer if $w_L < b/r$ while entrepreneurs should refuse to hire workers if $w_L > 1$. Hence voluntary trade imposes the additional restriction

(C)$w_L \in [b/r, 1]$ for all $L \neq 0$.

The next section will characterise the ME but will not provide a formal existence and uniqueness proof.[4] Given that characterisation, the subsequent

[4] See Coles (1996) which formally establishes existence and uniqueness of ME for the case b = 0. Generalising those arguments for b > 0 is straightforward.

section considers the equilibrium effects of an unemployment compensation system. The reader who is not interested in the formal details might skip straight to section 3.

2 Characterisation of a Market Equilibrium.

The first step characterises V_L, the value of being unemployed in a ME when there are $L > 0$ unemployed workers. Clearly V_L depends on how the market is expected to evolve in the entire future. Lemma 1 derives the appropriate recursive conditions.

Lemma 1 (Characterization of the Value of Being Unemployed)

Given the bilateral bargaining wage $w \in [b/r, 1]$, then in a ME, V_L satisfies

$$rV_L = b + \alpha F(1 - V_{L-1})[V_{L-1} - V_L] + g[V_{L+1} - V_L] \tag{3}$$

for $L = 1, 2, 3.....$subject to the boundary conditions

$$V_0 = w \tag{4}$$

$$V_L \in [b/r, 1] \text{ for all } L > 0. \tag{5}$$

Proof in Appendix

(3) is a standard recursive equation which has a simple interpretation. The flow value of being unemployed when there are L unemployed workers equals b plus the expected capital gain should a new vacancy arrive and the expected capital loss should another unemployed worker arrive. If L = 1 and a new vacancy enters, the agent negotiates the bilateral bargaining wage w ($\equiv V_0$).

Note, b/r is the value of being unemployed forever. If w = b/r, so that the worker gets no surplus in the bilateral bargaining game, (3)-(5) imply $V_L = b/r$ for all L > 0. The worker is no better off than remaining unemployed forever. However, if $w \in (b/r, 1)$, so that the worker obtains positive surplus in the bilateral bargaining game, lemma 2 below shows that $V_L > b/r$ for all L > 0. V_L can be interpreted as the value of the worker's option to wait for unemployment to fall to zero, whereupon the worker obtains positive surplus in the bilateral bargaining game. Of course, it is the discount rate r and the entry rate of new vacancies and workers which determine the value of this option. (3)-(5) essentially computes this price for all L > 0. The next lemma describes its solution.[5]

Lemma 2 (Existence and Uniqueness of V_L)

Given $w \in [b/r, 1]$, there exists a unique solution V_L to (4)-(6). Furthermore if $w \in (b/r, 1)$;

(i) $V_L \in (b/r, w)$ for all $L \geq 1$,

(ii) V_L is strictly decreasing in L for all L ≥ 0, where $lim_{L \to \infty} V_L = b/r$.

Recall that $w_L = V_{L-1}$ for L > 0. Lemma 2 implies that wages fall as the number unemployed increases. As unemployment becomes arbitrarily large, the wage falls to the value of worker's leisure. The formal reason why this occurs is that as unemployment increases, the value of each worker's option to wait for L to fall to zero in this market also falls - it will take longer for this to occur. Competition between workers causes the market wage to fall as the number unemployed increases. The same arguments characterise Π_L

[5]Essentially (3) has the saddle path property as $L \to \infty$. (5) implies V_L must lie on that saddle path which has the properties described in Lemma 2. See Coles (1996) for details.

Lemma 3

Given $w \in [b/r, 1]$, then in a ME, Π_L is defined by

$$r\Pi_L = g[\Pi_{L+1} - \Pi_L] + \alpha F(\Pi_{L-1})[\Pi_{L-1} - \Pi_L] \tag{6}$$

for $L = -1, -2, -3....$ subject to the boundary conditions

$$\Pi_0 = 1 - w \tag{7}$$

$$\Pi_L \in [0, 1]. \tag{8}$$

These recursive equations have the same interpretation as before and its solution has the same qualitative properties.

Lemma 4 (Existence and Uniqueness of Π_L)

For any $w \in [0, 1]$, there exists a unique solution Π_L to (7)-(9). Furthermore if $w \in [0, 1)$;

(i) $\Pi_L \in (0, 1 - w)$ for all $L \leq -1$,

(ii) Π_L is strictly increasing in L where $lim_{L \to -\infty} \Pi_L = 0$.

Formally identifying a market equilibrium requires solving for w defined by (2) where $V_1 = V_1(w), \Pi_{-1} = \Pi_{-1}(w)$ are given by Lemmas 1 and 3. Although existence and uniqueness of a ME can be formally established, we do not go into details here (see Coles (1996) for a formal proof). It can be shown that in equilibrium w $\in (b/r, 1)$[6] and so wages are strictly decreasing for all L.

[6] w = b/r cannot be an equilibrium price as Lemma 1 implies $V_1 = b/r$ while lemma 4 implies $\Pi_{-1} < 1 - b/r$. (2) then implies w > b/r. Similarly for w = 1.

The simulations in the next section effectively solve for the saddle paths described in lemmas 2 and 4 for a given value of w, and then finds w which satisfies the fixed point condition (2) [which always exists].

3 The Equilibrium Effects of Unemployment Benefit.

The previous section has shown that in a Market Equilibrium, wages strictly decrease as L increases. Figure 1 graphs a particular example.

Insert Figure 1 here.

Given particular values of b (and a choice of parameter values which will be described in detail below), Figure 1 plots V_L for L > 0 and 1-Π_L for L < 0. If L = 10 for example, this graph plots w_{11}, the equilibrium (Bertrand) wage when there are 11 unemployed workers in the market (recall that $w_L = V_{L-1}$). Similarly for $L \leq -1$. The bilateral bargaining wage is given by the y-intercept.

Given any value of b, equilibrium implies that the entry rate of vacancies is strictly increasing in L (lower wages stimulate greater job creation rates). Define w^c where $\alpha F(1 - w^c) = g$.[7] At this wage level, the entry rate of vacancies equals the entry rate of unemployed workers. For large levels of unemployment where $w_L < w^c$, the entry rate of vacancies exceeds the entry rate of unemployed workers. This implies that unemployment is expected to fall over time. The converse holds for low L where $w_L > w^c$. Although unemployment levels will vary stochastically over time, in the long-run, the market is stable. The dynamics of L revert in expected value to L = L* where

[7] which is unique and well-defined for $\alpha \geq g$.

$w_{L^*} = w^c$. Most interestingly, these reduced form dynamics imply that in the long-run, negotiated wages will center around w^c.

By definition of w^c, it is an increasing function of α/g (which we refer to as entrepreneurial activity) and is independent of θ and b. The above suggests that unemployment compensation b_g will have little effect on the long-run distribution of negotiated wages. As wages reflect the value of being unemployed, it also suggests that unemployment benefit cannot make the unemployed better off in the long-run. The rest of this section will establish the following two statements :

(i) for low levels of unemployment benefit, an increase in unemployment benefit has little effect on the average value of being unemployed (which is largely determined by entrepreneurial activity), while

(ii) for high levels of unemployment benefit, the market is unstable ; unemployment becomes arbitrarily large over time.

Proposition 1 : If $b \geq rw^c$ the market is unstable. The number unemployed becomes arbitrarily large over time and $w_L \to b/r$ as $L \to \infty$.

Proof in Appendix

For $b \geq rw^c$, the workers' reservation wages are so high that the rate of job creation cannot keep pace with the entry rate of unemployed workers. The wage level is bid down to the value of remaining unemployed forever and both the number unemployed and the expected duration of unemployment become arbitrarily high. Hence a benefit scheme which offers $b_g \geq rw^c - v$ has disastrous consequences. (ii) above corresponds to this case.

The remainder of this section assumes $b < rw^c$. The next proposition implicitly describes the effect of unemployment benefit in high turnover markets.

Proposition 2 In a ME as $g, \alpha \to \infty$, where g/α is fixed and $b < rw^c$, (i)$w_L \rightarrow w^c$ for all L finite

(ii) the dynamics of L (conditional on a new entrant) tend to a random walk. Its ergodic variance becomes unboundedly large.

Proof - see Coles (1996)

Proposition 2 shows that in an (almost) frictionless economy, unemployment compensation has no effect on the limiting equilibrium wages (which is also true for bargaining power and the value of leisure). The expected duration of a completed unemployment spell is arbitrarily small in this case and so each unemployed worker expects to receive (almost) no unemployment benefit. Unemployment benefit therefore has no effect on the value of being unemployed (as long as $b < rw^c$). The terms of trade adjust so that the equilibrium flow of new vacancies equals the entry rate of unemployed workers. An interesting consequence is that this market has large quantity variation (L follows a random walk) and small price variation (w_L limits to w^c for all L). In apparent contradiction to the "sticky wage" literature, this outcome is efficient in that it replicates the utilitarian Social Planner's solution (see Coles (1996) for further details).

Proposition 2 has shown that (i) above is true for very high turnover levels. Simulations now show that this is also true for reasonably low turnover levels. Assume c is uniformly distributed and a discount rate of 5% per annum. We consider a representative occupation - say the market for accountants in region A - and choose a relatively low turnover rate, say one new unemployed accountant enters this market (on average) every 10 days. [In a market equilibrium, this will also be the average entry rate of new accountancy vacancies.] The chosen parameter values are therefore $r = 0.05$ and $g = 36.5$, where one unit of time corresponds to a year. Set $\alpha = 1.5g$ (which implies $w^c = 1/3$) and $\theta = 0.5$ (equal bargaining powers).[8] Although the turnover rates α and g are quite low, α/r and g/r are both large numbers. Proposition 2 therefore provides a reasonable description of the equilibrium outcome - equilibrium wages are closely distributed about w^c and (i) above holds. In comparison g/r small, say less than one, requires turnover rates lower than one new agent entering the market every 20 years.

We shall consider four different levels of b. For expositional purposes assume $u = 0$ so that b is equivalent to unemployment benefit. As unemployment benefit is typically set proportional to earned income, we shall consider benefit levels which are proportional to w^c. We set b/r equal to 0, $w^c/3$, $2w^c/3$ and $0.9w^c$ which implies replacement ratios of (approximately) 0, 1/3, 2/3 and 0.9 respectively. Changing the values of α and g do not change the qualitative nature of the following discussion, though the magnitude of the effects are different. Figure 1 above plots the equilibrium negotiated wages in a ME for given values of b.

Not surprisingly, the greater the level of unemployment benefit, the greater the wage that is negotiated for any given value of L. This wage effect becomes more pronounced the larger the value of L. The benefit system is clearly playing a positive insurance role when unemployment is high.

Given the equilibrium wages depicted in figure 1, it is straightforward to calculate the entry rates of new vacancies and unemployed workers. As L varies stochastically over time, it has a non-degenerate ergodic distribution. Table 1 describes its mode, mean $(\overline{L})$, variance and the symmetric 95%

[8] Other simulations have been run and qualitatively similar results obtained. Raising turnover to $g = 365$, so that one new entrant arrives on average every day, while keeping $\alpha = 1.5g$ results in equilibria similar to the one described in Proposition 2. Reducing turnover still further results in unemployment spells with expected durations of a year or more. Changing α mainly results in a change in the terms of trade where $w^c = 1 - g/\alpha$.

confidence interval (L_L, L_H) where $P(L < L_L) = P(L > L_H) = 0.025$.

Insert Table 1 here

By supporting higher wages, the benefit system reduces the rate of vacancy creation for each value of L. Table 1 reveals the extent to which the distribution of L shifts to the right. The resulting increase in unemployment potentially makes each unemployed worker worse off.

Table 1 also shows that as unemployment benefit increases, the equilibrium distribution of L becomes more skewed (towards greater unemployment) and has greater variance. The explanation is that unemployment benefit reduces downward wage flexibility. Consider the **recovery rate** of the economy defined as $|\alpha F(1 - w_L) - g|$. For high L where $w_L < w^c$, this term gives the rate at which L is expected to decrease. For the uniform distribution, the recovery rate equals $\alpha|w^c - w_L|$. Figure 1 clearly shows that the recovery rate in periods of high unemployment falls substantially when unemployment benefit is high. Periods of high unemployment therefore last longer on average - explaining the right skewness of the distribution - and L has a greater variance.

Using the ergodic distribution probabilities, Table 2 documents the expected value of becoming unemployed $(\overline{V})$, the expected duration of unemployment measured in years $(\overline{d})$,wage dispersion calculated as (w_{L_H}, w_{L_L}) which also reflects the risk attached to becoming unemployed, and the tax burden associated with financing this scheme for this particular occupation.[9]

Insert Table 2 here.

Ignoring the associated tax implications, the second column shows that the

[9] Given L, the expected cost of the unemployment benefit scheme C_L can be calculated recursively. By using the ergodic distribution probabilities, we calculate the (long run) expected tax burden as $E_L C_L$.

unemployment benefit scheme makes the unemployed slightly better off on average, but the effect is marginal. Providing a large amount of unemployment benefit (corresponding to a replacement ratio of 0.9) raises average unemployed worker utility by only 2.5%. This result is typical. In any non-degenerate market equilibrium, the entry rate of vacancies has to average (in the long run) the entry rate of unemployed workers. As a consequence, the value of being unemployed has to average around w^c (which equals 1/3 in this case). Raising unemployment benefit raises the value of being unemployed for any given level of unemployment, but in equilibrium, average unemployment has to increase to force the workers' reservation wages back down to w^c. No compensation scheme can change this basic fact - the expected value of being unemployed is fundamentally determined by entrepreneurial activity.

Table 2 shows that raising unemployment benefits has a marked effect on the expected duration of unemployment spells. For a replacement ratio of 0.9, the expected duration of unemployment becomes almost a year in length. Such durations increase to keep the value of being unemployed close to w^c. Also note how quickly the tax burden increases with an increase in unemployment benefit. Doubling the replacement ratio from 1/3 to 2/3 almost quadruples the tax burden. Not only is the government paying twice as much to each unemployed worker, the policy results in many more claimants.

There is one social benefit of the above unemployment benefit scheme - it reduces the utility risk associated with being unemployed. Wage variation (and correspondingly, the risk of being unemployed) is substantially reduced. If the Social Planner's preferences are strictly concave, the Planner may wish to reduce such risk. However, the above payment system does not necessarily do this at least cost. Indeed, we now construct an alternative system which does this more efficiently.

4 The Case for a Variable Unemployment Compensation System

Given that no unemployment benefit scheme can effectively raise the average value of being unemployed, the focus of attention ought to be whether such schemes can reduce the utility risk attached to being unemployed, where such risk arises because the number unemployed varies over the business cycle.

Flat payments which are independent of L are not an effective way of reducing such utility risk. The scheme considered here allows payments b_L to be conditioned on L. The most natural insurance scheme is $b_L = \gamma[w^c - V_L]$, where $\gamma \geq 0$. As w^c is (approximately) the long run expected value of being unemployed, then for L high these payments (partially) compensate each unemployed worker the loss in expected utility due to a currently high level of unemployment.[10] The following Proposition describes the equilibrium properties of such a scheme.

Proposition 3

Assuming $u < rw^c$ and a compensation scheme $b_L = \gamma[w^c - V_L]$ where $\gamma \geq 0$, then in a ME :

(i) V_L is decreasing in L and so payments b_L rise with unemployment.

(ii) $V_L \rightarrow \overline{V} = (u + \gamma w^c)/(r + \gamma)$ as $L \rightarrow \infty$.

(iii) $b_L < rw^c - u$ for all $L,\gamma > 0$.

Proof in Appendix

In equilibrium, this scheme results in benefit payments which are in-

[10] Although the practical implementation of such a scheme is not considered here, notice that w^c is (approximately) the average wage of those currently employed, whereas V_L is the current market wage for a new hire. Unemployment compensation is set proportional to this difference.

creased as unemployment increases, though the unemployed continue to be worse off as unemployment increases. The insurance provided remains incomplete. (ii) shows that the value of being unemployed cannot fall below a floor level $\overline{V}$. This floor is strictly increasing in γ and tends to w^c (full insurance) as $\gamma \to \infty$. (iii) shows that in equilibrium, individual unemployment benefit payments are bounded above. This occurs because a generous compensation scheme raises V_L so that $\gamma[w^c - V_L]$ is bounded, even for γ arbitrarily large. It also shows that the greater the value of leisure (u), the lower the payments made by the government.

To evaluate the performance of this scheme relative to the flat payments scheme we repeat the experiments considered in Tables 1 and 2. Table 3 below reports those values of γ where the equilibrium unemployment risk is comparable to those described in Table 2.

Insert Table 3 here

The fourth column shows that increasing γ reduces equilibrium utility risk, but the table shows it also increases average unemployment and the tax burden. However, comparing these results with those in Tables 1 and 2, this scheme is clearly much more efficient at risk reduction - for comparable reductions in risk, the rise in average unemployment and the tax burden is much smaller. To understand why this occurs, consider figure 2 which compares the variable unemployment compensation scheme (with $\gamma = 0.2075$) against the flat scheme with $b = 2rw^c/3$.

Insert Figure 2 here

For $\gamma = 0.2075$, the mode of the distribution of L occurs at $L = 4$. For such low values of L, the variable payments scheme pays substantially less than the fixed benefit scheme. For L small, the reduction in expected payments implies V_L does not rise so much. Average unemployment therefore does not have to rise so far to force the average reservation wage back down to w^c [with $\overline{L} = 6$ with no compensation, the average number unemployed rises to 11 (approximately doubles) rather than to 17 (approximately triples)]. Furthermore, this unemployment effect helps to reduce total payments. This scheme therefore succeeds on two fronts. By reducing individual payments on average, it reduces average unemployment, while the fall in average unemployment helps to reduce the total tax burden.

Despite this, the variable payments scheme is equally effective at reducing the utility risk of being unemployed. It targets payments to periods when unemployment is unusually high and finding work is difficult (for example when $L \geq L_H = 47$). For low values of L, this scheme effectively decides that it is not difficult for the unemployed to obtain work and so decides not to compensate them much.

Before concluding, we now show this scheme has a second major advantage over the fixed payment scheme. Suppose $u > 0$, a convenient case being $u/r = 1/9$ (which implies $u = rw^c/3$). We again compare the fixed benefit scheme $b_g = \rho r w^c$ (where ρ is the replacement ratio) with the variable scheme $b_{gL} = \gamma[w^c - V_L]$

Insert Table 4 here

Table 4 reveals how sensitive the market outcome can be under a fixed payments system. Proposition 1 shows the market degenerates if $b_g \geq rw^c - u$. In the above example with $u = rw^e/3$, this occurs for replacement ratios greater than 2/3. A positive value of leisure can totally undermine the desirability of the fixed payment system. The number unemployed becomes arbitrarily large, the probability of obtaining work becomes arbitrarily small while the corresponding tax burden becomes arbitrarily large.

This cannot happen under the variable compensation scheme - it is a much more robust system. Proposition 3 shows that for any $\gamma > 0$, as long as u $< rw^c$ the entry rate of vacancies will exceed the entry rate of unemployed workers for large enough L. The market remains stable over time.

5 Conclusion

This paper has considered an equilibrium model of unemployment with entrepreneurial search and wage bargaining. In contrast to the standard matching literature, there are no matching frictions but entrepreneurs have to search for profit-making opportunities. In the long-run, an unemployment benefit system does not substantially raise the expected value of being unemployed. It can also be highly destabilising if the value of leisure is sufficiently positive. The paper has also proposed a more effective insurance system. There are many interesting extensions for future research.

The most difficult extension is to allow recall of investment opportunities. This makes the model relatively intractable as with recall, the market wage is a function of the distribution of currently known investment opportunities (which in the above case would be of infinite dimension) and of the current number unemployed. Furthermore, this distribution changes endogenously over time. One way to investigate this effect is to restrict investment costs to two types, high or low. Preliminary work suggests that recall reduces the variance of unemployment and of market wages, but market wages still have to hover around w^c. For the same reasons explained above, this suggests that an unemployment benefit scheme will not raise the average utility of the unemployed by much.

A more interesting extension would be to allow unemployed workers to switch occupations subject to some retraining cost $c > 0$.[11] A simple case would be to have two types of professions - say accountants and doctors. Suppose there are many unemployed accountants while there is a shortage of doctors. Clearly if there are enough unemployed accountants, so that the value of being an accoutant is low, then some accountants might retrain if c is low enough. However, the unemployment benefit scheme analysed here raises the value of being an unemployed accountant and hence reduces the incentive to retrain. The unemployment benefit scheme therefore increases expected mismatch in the economy. One policy response might be to subsidise retraining of unemployed workers - such as the current Restart Scheme. However a cheaper approach for the government might be to cut unemployment benefit once a worker has been unemployed for a certain period. By doing this, the government encourages retraining in occupations where unemployment is high (which is sustaining long unemployment spells). Millard and Mortensen (1994) predict that cutting benefits off after 6 months unemployment would result in U.K. unemployment falling by 2.5 percentage points. Presumably, their policy works by reducing equilibrium wages. In our context, it will also reduce mismatch.

This paper has analysed unemployment benefit reform independently of other possible reforms. In particular, the simulations have shown that increasing unemployment benefit not only increases average unemployment, it also extends the expected duration of recessions (by reducing the recovery rate of the economy). Perhaps the government ought to offer investment subsidies in recessions to raise the recovery rate of the economy back to its original level. This would not only make the economy more efficient, but by reducing expected unemployment more quickly, it would also reduce the

[11] Alternatively, c could describe a migration cost to move to a low unemployment region.

expected cost of the unemployment benefit system. Analysing how to mix optimally an unemployment benefit system with an investment subsidy program is an important extension.

6 APPENDIX

Proof of Lemma 1:First consider $L \geq 2$. For $\Delta > 0$ but arbitrarily small, the Bellman equation for V_L in a ME implies,

$$\begin{aligned}(1 + r\Delta)V_L &= b\Delta + \alpha F(1 - V_{L-1})\Delta V_{L-1} + g\Delta V_{L+1} \\ &\quad +[1 - \alpha F(1 - V_{L-1})\Delta - g\Delta]V_L + o(\Delta).\end{aligned}$$

Over time period $\Delta > 0$ (but arbitrarily small), an unemployed worker obtains flow payoff bΔ. With probability $\alpha\Delta$, one entrepreneur finds a profit making opportunity and, anticipating a negotiated wage of $w_L = V_{L-1}$, invests with probability $F(1 - V_{L-1})$. Given that outcome, the Bertrand equilibrium implies the unemployed worker receives an expected payoff of V_{L-1}. With probability $g\Delta$, one unemployed worker enters the market and L increases to $L + 1$. Otherwise the state remains unchanged. The o(Δ) term captures effects whose order of magnitude are smaller than Δ. Rearranging and letting $\Delta \to 0$ implies (4) for $L > 1$.

Now consider $L = 1$. This time if a new vacancy enters the market, the negotiated wage equals w, and so the corresponding Bellman equation is

$$(1+r\Delta)V_1 = b\Delta + \alpha F(1-w)\Delta w + g\Delta V_2 + [1 - \alpha F(1-w)\Delta - g\Delta]V_1 + o(\Delta).$$

Rearranging and letting $\Delta \to 0$ implies (4) with (5) as the appropriate boundary condition. (6) must hold because of A(i) and (C).

Proof of Proposition 1 : As w_L is strictly decreasing in L in a Market Equilibrium, lemma 2 implies $w_L > b/r \geq w^c$ for all finite L . This implies that the entry rate of vacancies is strictly less than g everywhere and so L must become arbitrarily large with probability one. Lemma 2 implies the limiting value of w_L.

Proof of Proposition 3 : Given γ, it is straightforward to show (3) becomes

$$r^*V_L = (u + \gamma w^e) + g[V_{L+1} - V_L] + \alpha F(1 - V_{L-1})[V_{L-1} - V_L] \qquad (9)$$

where $r^*=r+\gamma$. Hence (9) is equivalent to (3) with r replaced by r^* and b replaced by $(u+\gamma w^c)$. Statements (i) and (ii) follow from lemma 2. V_L decreasing implies $b_L < \gamma[w^c - \overline{V}]$ for all L>0. Hence $b_L < \gamma(rw^e - u)/(r+\gamma)$ $< rw^e - u$ for all $\gamma > 0$.

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Figure 1 : Equilibrium Wages (given b)

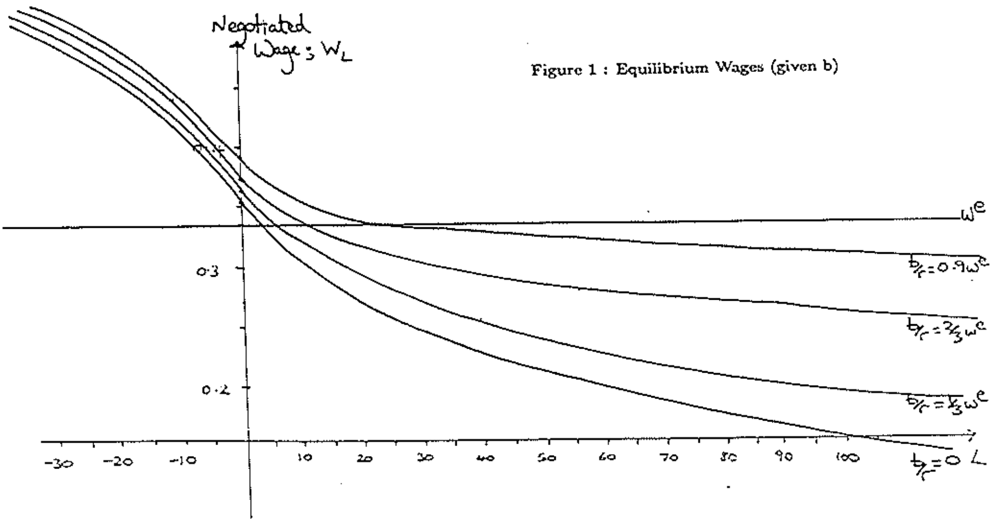

Figure 2 : Comparing Unemployment Benefit Schemes :
Variable Payment Scheme : $\gamma = 0.2075$
Fixed Payment Scheme : $b = 2rw^e/3$.

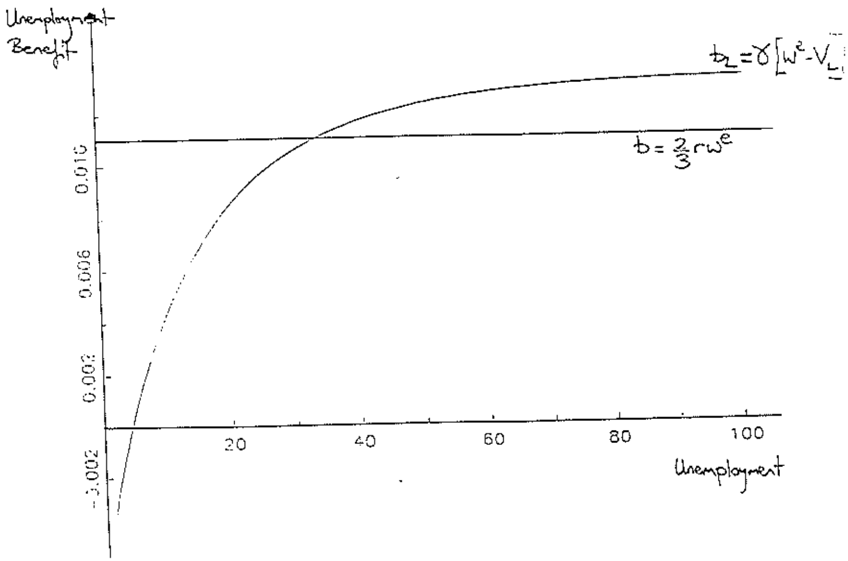

Table 1 : Descriptive Statistics of the Ergodic Distribution of L

Replacement Ratio	Mode	$\overline{L}$	Variance	(L_L, L_H)
0	3	6	144	(-16 , 31)
1/3	6	10	181	(-14 , 39)
2/3	11	17	291	(-11 , 56)
0.9	24	38	805	(-4 , 105)

Table 2 - Statistics Describing Market Equilibrium

Replacement Ratio	$\overline{V}$	$\overline{d}$	(w_{L_H}, w_{L_L})	Tax Burden
0	0.3237	0.22	(0.2384 , 0.4405)	0
1/3	0.3254	0.30	(0.2523 , 0.4383)	1.2
2/3	0.3282	0.50	(0.2743 , 0.4345)	4.1
0.9	0.3317	0.95	(0.3051 , 0.4131)	11.7

Table 3 Variable Unemployment Compensation Scheme

γ	$\overline{L}$	(L_L, L_H)	(w_{L_H}, w_{L_L})	$\overline{V}$	Tax Burden
0	6	(-16,31)	(.2384,.4405)	.3237	0
0.0775	7	(-16,36)	(.2527,.4421)	.3248	0.8
0.2075	11	(-15,47)	(.2744,.4397)	.3266	2.2
0.5425	20	(-13,83)	(.3052,.4325)	.3294	5.9

Table 4 - The Effect of a Positive Value of Leisure (u/r=1/9).

	$\overline{L}$	(L_L, L_H)	(w_{L_H}, w_{L_L})	$\overline{V}$	Tax Burden
Fixed Payments ρ					
0	10	(-14,39)	(0.2523, 0.4383)	0.3254	0
1/3	17	(-11,56)	(0.2743, 0.4345)	0.3282	2.0
2/3	∞	∞	no risk	0.3333	∞
0.9	∞	∞	no risk	0.4111	∞
Variable Payments γ					
0	10	(-14,39)	(0.2523, 0.4383)	0.3254	0
0.0775	12	(-13,47)	(0.2687, 0.4353)	0.3267	0.9
0.2075	17	(-12,65)	(0.2914, 0.4318)	0.3284	2.4
0.5425	28	(-11,101)	(0.3146, 0.4268)	0.3313	5.6