A THEORY OF WAGE DETERMINATION

- A Training Model with Heterogeneous Labour Approach -

Yasushi Tanaka
Ph.D, LSE

ABSTRACT

This thesis offers an alternative approach to the theory of wage determination, producing new and interesting interpretations to labour market phenomena. Based on the assumption of heterogeneous labour, a training model based on the concept of adverse selection is introduced. The unique feature of this model is that the heterogeneity is expressed in terms of the cost of OJT as well as the opportunity wage of the potential workers. The model suggests that the existence of unemployment and the downward wage rigidity are conditional upon the market characteristics and that the unemployment can not be eliminated by lowering the wage. It also suggests that policies to control the demand side of the market such as accepting of immigration of able workers, raising the educational standard of the domestic workers, or subsidizing the firm's OJT would be more effective.

Also as a training model, the analysis includes a two-period model, in which the upward-sloping wage profile is derived.

The analysis is extended to the idea of multiple wage equilibrium in one market, which in turn offers a new dimension to the analysis of income distribution. One important result here is that whatever happens in the society will first affect the weakest, to whom therefore the policy makers need to pay greater attention. The derivation of a skewed distribution of wage offers yet one more explanation to the Pigou paradox.

The model attempts also to explain how firms choose workers in the real world job offers usually states a minimum hiring standard as well as the offer wage, and how they react to economic fluctuations — would they, for example, reduce the wage or raise the minimum hiring standard when the demand for the product falls. The analysis suggests that the weaker members of the society are more prone to exogeneous shocks.

CONTENTS

ACKNOWLEDGEMENTS

I am indebted to many people, without whose suggestions, encouragement and patience this thesis would not have been completed.

Firstly the greatest debt is due to Frank A. Cowell, who has provided me in the beginning with the original idea and throughout the process with many suggestions for corrections and improvements, and above all has spared me his great patience.

Secondly, discussions with a following list of people were invaluable not only as contributions to my thesis but also for my better understanding of economics as a whole. Without them I would probably not have appreciated and enjoyed this discipline in such a great depth. This list must include, but in no particular order, Michio Morishima, Oliver Hart, John Moore, Keiichiro Obi, Takamitsu Sawa, Haruo Shimada, Masahiro Okuno, Yusaku Kataoka, Haruo Imai, Jun Iritani, Yoshio Higuchi. It goes without saying, however, that all responsibility for errors lies with the author.

I would also like to thank the Economic Department at London School of Economics and the Faculty of Economics at Kyoto Sangyo University for their kindness in allowing me to use their facilities.

Finally, for her support in forms of constant encouragement and patience I owe an irredeemable debt to my wife, Mari-cruz.

CHAPTER I : INTRODUCTION

Traditional analyses of the labour market, in which the equilibrium is achieved when the supply equals the demand at a certain wage level, invariably have two apparent implications among others: i) there exists no involuntary unemployment and ii) the wage paid for a given grade of labour is uniform. The validity of the first has been a focus of discussion for some time and in great depth, as every economist would know. And among these are a significant number of attempts by Neo-classical economists to explain what should be described as a discrepancy between this Neo-classical implication and the reality that tends to support the existence of involuntary unemployment (See, for example, Clower (1965), and Barro & Grossman (1971)).

However, there have been few discussions as to why a uniform wage should be paid within the competitive market framework, despite the fact that workers are not necessarily identical even within a single market. The idea behind it is that labour service offered to perform the job in question is assumed to be homogeneous, which is a quite separate issue from whether the workers themselves are homogeneous. Hence, on one hand, the workers may be paid differently in an alternative job, due to their heterogeneous productivity — this makes aggregate labour supply upward-sloping. On the other hand, the uniform wage would be paid to all workers, as they perform identically what they are asked to do. And there is nothing new in this argument. Simply, we need to add that homogeneous labour service and heterogeneous labour force are compatible.

But if workers are really identical with respect to the job in question, for which a uniform wage is paid, how can we possibly explain the very common phenomenon of employers having clear preference over potential workers? Given that employers' decisions are rational, it must be that some workers are more beneficial to the employers than other workers. The offer of a uniform wage to a heterogeneous labour force suggests that such an offer is made not because of the homogeneity of their labour service but because of a lack of information to employers due to its high costs, for example, about the heterogeneity of the labour force when offering wages.

(1) The Efficiency Wage Hypothesis

This type of an alternative model of labour market has been developed often under the name of the "Efficiency Wage Hypothesis". The fundamental feature of the hypothesis is that, with every worker endowed with some Efficiency Units (EUs), a level of wage offer affects the EU's of workers in production. This concept could already be found in the early literature of economics. For example, Adam Smith wrote:

> "The wages of labour are the encouragement of industry, which, like every other human quality, improves in proportion to the encouragement it receives. A plentiful subsistence increases the bodily strength

of the labourer, and the comfortable hope of bettering his condition, and of ending his days perhaps in ease and plenty, animates him to exert that strength to the utmost. Where wages are high, accordingly, we shall always find the workmen more active, diligent, and expeditious than where they are low ......", A.Smith 'Wealth of Nations'(1776) (p.184 in reprinted Smith (1977))

In other words, he argued that a higher wage could cause higher productivity through higher morale and better nutrition. In the current literature there are several types of models based on the efficiency wage hypothesis, known as the efficiency wage models. Here we group the main models into four types and introduce them briefly in turn.

(a) The Nutritional Model

This is the original type of the efficiency wage model. The concept may be found as early as in the writing of Adam Smith, as pointed out above. The basic idea is that a higher wage allows a greater level of nutritional intake, which in turn makes a worker more productive. Attention was more recently drawn to the concept by Leibenstein (1957), when he discussed about a case of developing economies and it was further developed into more rigorous analyses by Mirrlees (1975) and Stiglitz (1976). It goes without saying that labour productivity is expressed in terms of efficiency units for this type of model.

(b) The Shirking Model (or The Incentive Model)

With this type of model, a worker is assumed to be able to control the amount of EU to exert in production — the EU input would be small if he shirks or he is not motivated to work and vice versa. His employer, on the other hand, being unable to directly control the workers' EU input i.e. the effort, uses the wage offer as the indirect control device. "Moral hazard" or "Principal-and-Agent problem" is the terminology given to this kind of situation, which is not confined to labour markets. This type of efficiency wage model can be found in Bowles (1981) & (1983), Calvo (1979), or Shapiro & Stiglitz (1982). The labour turnover model, as found in Salop (1979) or Stiglitz (1974), may also be included in this category. In this model a wage offer by a firm is set above the market-clearing wage in order to reduce labour turnover. As turnover is an act of lost incentive to work at the workplace, it is equivalent to full shirking. Consequently, the model can be thought of as having basically the same formal structure as the shirking model.

(c) The Adverse Selection Model

This type of model is found in Stiglitz (1976), Weiss (1980), or Malcomson (1981). Unlike the nutritional model or the shirking model, the efficiency unit endowment of every worker is fixed in the adverse selection model. Given a heterogeneous work force in terms of efficiency unit endowment, the wage level determines the composition of the workers willing to work — a higher wage attracts better workers, i.e. workers with a greater efficiency unit endowment and vice versa. Note that the heterogeneity of workers is a necessary assumption of this model, while in the previous two types of models the work force does not have to be heterogeneous.

(d) Sociological Model

Akerlof (1982) argues that each worker's effort is determined by the work norms of his work group rather than as a result of neo-classical individual utility maximization. The model is a sociological one in that it calls for social conventions to explain phenomena which seem inexplicable in neo-classical terms.

The common result of all the efficiency wage models is that at the equilibrium the market may not clear — in fact the equilibrium wage can be higher than the market-clearing wage, implying an excess supply of labour. This also causes wage rigidity, when the market faces a change in demand for labour. It is crucial to the analysis that the endowment of each worker is not known ex-ante to the employer. If the endowments were known, then the marginal productivity of an efficiency unit (MP_{EU}) would be equated to a wage per efficiency unit (W_{EU}) at the equilibrium and thus the workers would be paid proportionally to their EU endowments, resulting in differentiated wages. The analysis then would not differ much from our usual Neo-classical analysis, except for replacing "labour" by "efficiency unit". And in particular there would be market clearing in terms of supply of and demand for efficiency units. Indeed, the efficiency wage models base their distinctive results on an assumption that the efficiency units actually exerted in production is unobservable. This would mean, for example, that the effort is unobservable in the shirking model or that the workers are indistinguishable in the adverse selection model. This latter assumption clearly needs some justification. (See Chapter IV for extended discussions on this point)

A higher wage offer attracts a group of workers of better quality "on the whole" (i.e. of a larger expected efficiency unit endowments). Firms, then, may choose not to lower the wage when it is faced to an excess supply of labour, since doing so will lower the expected efficiency unit endowment of the workers and may well lower the profit by a reduction in output level. It turns out that the optimal wage, to be called the Efficiency Wage, is the wage level which minimizes the labour cost per efficiency unit (See, for, example, Malcomson (1981)).

The idea of price affecting the quality as well as quantity of the traded good can be found in other markets, too. Stiglitz & Weiss (1981) point out that the interest rate a bank charges may itself affect the riskiness of the pool of loans by either 1) an adverse selection effect, sorting potential borrowers or 2) an incentive effect, affecting the actions of borrowers. And it goes without saying that their two types of effects are analogous to the adverse selection model and the shirking model of labour market respectively.

This concept of quality dependence on price, though not an established one in the modern economic theory as a standard assumption, is well-supported by various observations in the real world not confined only to these two markets. One may purchase a second-hand car from a well-established firm for a higher price rather than from an unknown firm offering a lower price, because he expects that the former sells a second-hand car of a better quality — this would be an example of the adverse selection mechanism, or because he expects that the after-sales services by the former is better — this would be an example of the incentive mechanism. In both cases the consumer's choice does not depend solely on the price but also on other conditions of the purchase, i.e. consumers may not always choose the cheapest good even as a result of rational behaviour. Typically the dependence of quality on price takes place when the goods are heterogeneous and yet the heterogeneity can not be perceived accurately or at a low cost before trading occurs.

Let us now go back to the original question as to why employers have a clear preference amongst workers. To explain this, we require the labour force to be heterogeneous, for if workers were truly homogeneous the choice amongst them would be at random. Of course, what matters here is the perception of the workers by the firms rather than whether the labour force is indeed heterogeneous. However, we appeal to a rational expectations argument that the firms' perceptions are basically correct. Although all of the efficiency wage models illustrated above can incorporate the heterogeneity of the labour force, the adverse selection model is the one that illustrates the issue most clearly for the heterogeneity is the necessary assumption of the model. So we proceed our discussion with this type of the efficiency wage model.

(2) The Adverse Selection Model of the Labour Market

To illustrate the efficiency wage model in a little more rigorous manner, let us consider a model of Weiss (1980).

Each worker is endowed with labour endowment θ, which determines his reservation wage — the reservation wage w is derived from one's marginal productivity in an alternative job. A representative firm, being competitive, can not control the supply of labour but knows a functional relationship $\theta = q(w)$ and a distribution function of the workers in terms of w, F(w). Although it has this information on the workers, the firm may be defined as competitive to the extent that they compete using a wage offer and a volume of labour input (See Stiglitz & Weiss (1981)).

The firm is assumed to maximize its expected profit π

$$\pi = pg(L) - wx \tag{I-1}$$

where p is the product price

w is the wage

x is the labour input in terms of number of workers

$g(\bullet)$ is the production function, whose sole input is EU

L is the total number of EU

L, the total amount of EU, is a function of w and we can write it as,

$$L = \bar{q}(w)x \tag{I-2}$$

$$\text{where } \bar{q}(w) = \frac{\int_0^w q(z)dF(z)}{\int_0^w dF(z)} \tag{I-3}$$

In words, L, the total number of EU, is a product of x, the number of workers employed and $\bar{q}(w)$, the expected EU endowment of those workers willing to work at a wage offer w.

Note that adverse selection implies

$$\bar{q}'(w)>0 \tag{I-4}$$

i.e. the average quality of labour, in terms of EU endowment, rises with the wage rate.

Maximizing (I-1) w.r.t. w and x, we obtain the following set of equations.

$$pg'(L)\bar{q}'(w) = 1 \tag{I-5}$$

$$pg'(L)\bar{q}(w) = w \tag{I-6}$$

from which we obtain the third equation

$$w = \frac{\bar{q}(w)}{\bar{q}'(w)} \qquad \text{(I-7)}$$

which is also the solution to a problem "min $w/\bar{q}(w)$" i.e. "minimize wage per EU" when its interior solution exists. And this is where the name of the hypothesis — the efficiency wage hypothesis — comes from.

Note that w^*, the efficiency wage (EW), is derived solely from (I-7), independent of x^*, the employment level. The solution set (w^*, x^*) of the profit maximizing problem does not give us a conventional demand schedule of the market where, to each employment level, there is a corresponding wage when it is aggregated over all the firms. This also implies that market clearing is not a necessary condition for the market equilibrium — as long as the quantity demanded is no greater than the quantity supplied, the equilibrium wage and employment level of each firm will be established from (I-6) and (I-7) above. In other words, an equilibrium may be derived, that is locally independent of the supply condition.

Thus equilibrium is characterized either by excess supply or by market clearing, the former presenting a persistent job queue. There will be no "excess demand" equilibrium since when the demanders find that their demand is not satisfied, competition will drive up the wage until all the demand is met. Furthermore, no worker will acquire a job by compromising to lower his wage offer, since this would merely single him out as a below-average worker among those willing to work at that wage.

(3) Theoretical Difficulties and Limitations of the Efficiency Wage Models

As we have seen, the efficiency wage models in general have intuitively appealing features. However, there are some theoretical difficulties and limitations related to the models. Some of the extensive arguments on the theoretical difficulties are found in Akerlof & Yellen (1986) and Weiss (1991). Here I illustrate their arguments briefly.

For those efficiency wage models in which the workers' effort levels are the missing information to the employer, a low wage at the initial apprenticeship period (Carmichael (1985)), or either a bond payment (Becker & Stigler (1974)) or an employment fee (Eaton & White (1982)) at the beginning of the contract might act to eliminate the involuntary unemployment. What is common here is the idea that the workers are paid below their marginal productivity in the initial period but there will be an compensation in the next period, which acts to stimulate the incentives of the workers. As a consequence, the offer of an efficiency wag above the market clearing wage to increase the workers' effort becomes redundant. The concept can also be applied to explain the rationale for the use of seniority wage or the reason why the age-earnings profile is upward-sloping.(Lazear (1979) & (1981))

The validity of the adverse selection models depends crucially on the assumption that the firm never finds out about the ability of each worker. If the firm did, it could then pay the workers by piece rate. It has also been suggested that a firm might devise a self-selection scheme or a screening scheme (Guasch & Weiss (1980), (1981), or (1982)) to differentiate the heterogeneous workers.

However, the real world employment contracts are not always characterized by a performance bond, an employment fee, or a piece rate, or some type of self-selection or screening scheme. There are several reasons for this. First, with an imperfect capital market the underpayment in the initial period would not make the labour market efficient --- it is more likely to give a favourable treatment to those with wealth rather than selecting more productive workers. Second, it is not easy to measure the precise level of productivity and thus to derive the corresponding wage that both the employer and the workers accept. When there is a disagreement between the agents, it is said that there is positive "transactions cost", which is the cost of agreeing with each other. And finally, a well-constructed self-selection or screening devise may be too complicated for the workers to comprehend or too costly to operate for the employer. A more formal discussion on this last issue about screening with cost is found in Chapter IV. While most of these arguments are descriptive rather than presented within a theoretical framework, their basic arguments do offer sufficient defence for the efficiency wage models.

The efficiency wage models are based on the concept of efficiency units. But this fundamental concept itself limits a scope of the models. Here we illustrate the limitations within the framework of the Weiss model presented in the previous section. Weiss (1980) states in the introduction that the existences of job queues and wage rigidity can be explained if two critical assumptions are made : (1) The wage received by workers are not proportional to their productivity, i.e. a uniform wage is paid to workers of heterogeneous productivity, and (2) the acceptance wages of workers are an increasing function of their productivity — this also means its inverse exists. While we leave the discussion on (1) to Chapter IV, consider the validity of (2). There are at least three limitations brought about by this fundamental assumption of the efficiency wage model.

Firstly, there is only one efficiency wage for all sorts of labour markets. The efficiency wage is derived from (I-7), which is a composite function of q(w), the functional relationship between the labour endowment and the reservation wage, and F(w), the distribution of workers by the reservation wage but independent of g(L), the production function. This means that there is a unique efficiency wage for all markets, if the idiosyncratic aspect of a particular labour market in this framework is expressed in terms of g(L). On one hand, to be fair to the efficiency unit framework, its original intention probably was not meant to extend the analysis to cover several labour markets. On the other hand, it would be a useful extension to the model if we can somehow relate the level of efficiency wage and the type of labour market. One might attempt to do this by allowing the form of θ=q(w) to vary for each labour market so that, for example, the function for skilled labour market is different from that for unskilled labour market, resulting in different efficiency wages. However, this would be theoretical incorrect, as θ is by definition a parameter attached to each worker rather than to each labour market.

The second limitation has to do with the existence of the efficiency wage. Many of the efficiency wage models seem to assume often implicitly that the efficiency wage always exists. However, it is not necessarily the case. The equilibrium condition (I-7) is also known as the Solow condition, where the elasticity of the average labour endowment with respect to wage is unity, since rearranging (I-7) gives,

$$\frac{d\bar{q}(w)}{dw}\cdot\frac{w}{\bar{q}}=1. \qquad \text{(I-7)}$$

And as the only assumption concerning $\bar{q}(w)$ is the adverse selection condition (I-4), the efficiency wage model does not guarantee the existence of an efficiency wage, let alone the excess supply on the wage rigidity.

Fig.I--1(a) supplements the argument. The minimand $w/\bar{q}(w)$ is an inverse of a slope of a line through the origin to a point w^* on $\bar{q}(w)$. The function $\bar{q}(w)$ is drawn here to have a "convex-concave" shape. Mathematical reason for this is not difficult to see. Firstly, the second order condition for min $\{w/\bar{q}(w)\}$ is

$$d^2/d^2w\{w/\bar{q}(w)\}=d/dw\{(\bar{q}(w))^{-2}[\bar{q}(w)-w\bar{q}'(w)]\}=(\bar{q}(w))^{-2}\{-w(\bar{q}''(w)\}$$

Thus the second order condition dictates that it is concave at w^*. And the concavity for smaller values of w ensures that the solution does not degenerate to zero.

However, for the efficiency wage to be economically meaningful, these conditions have to be justified in economic terms. Noting that $\bar{q}(w)$ is a composite function of q(w) and f(w), it is easier to consider the effects of these two components separately. We may assume that q(w) is a monotonically increasing function, as it is the inverse of $w(\theta)$, the reservation wage function, and thus it is not likely to generate the convex-concave shape alone. As for the frequency distribution f(w), we may assume it "bell-shaped", with both ends of the distribution having low frequency values. Then, for a given form of $q(\bullet)$, as the population is sparse around the both tails, $\bar{q}(w)$ does not increase at the very low and very high values of w as much as around the middle range. This would generate the convexity for the smaller values and the concavity for the larger values of w in $\bar{q}(\bullet)$. Alternatively, there may exist a positive value of w, w_0, say, below which no worker is attracted — such as an initial expense for starting out a new life. This is indicated in Fig.I-1(b) by zero average quality until w_0. The concavity to follow can be explained as the result of the quality of labour eventually approaching some upper bound.

Fig.I-1(c) illustrates a special case where the average quality is invariant across the workers with different acceptance wages. This can be considered as a case of "homogeneous" labour force with respect to the job in the market. Note that the kink at $w_0=0$ of this function helps to maintain the "convexity-concavity" characteristics required of $\bar{q}(\bullet)$. Note that in these realistic cases their characteristics is of a weaker version, i.e. "weak-convexity/weak-concavity". Although the case of Fig.I-1(c) does not accord with the standard first order derivative conditions for minimizing $w/\bar{q}(w)$, the wage may still be defined as an efficiency wage in that it is the solution to the minimization problem.

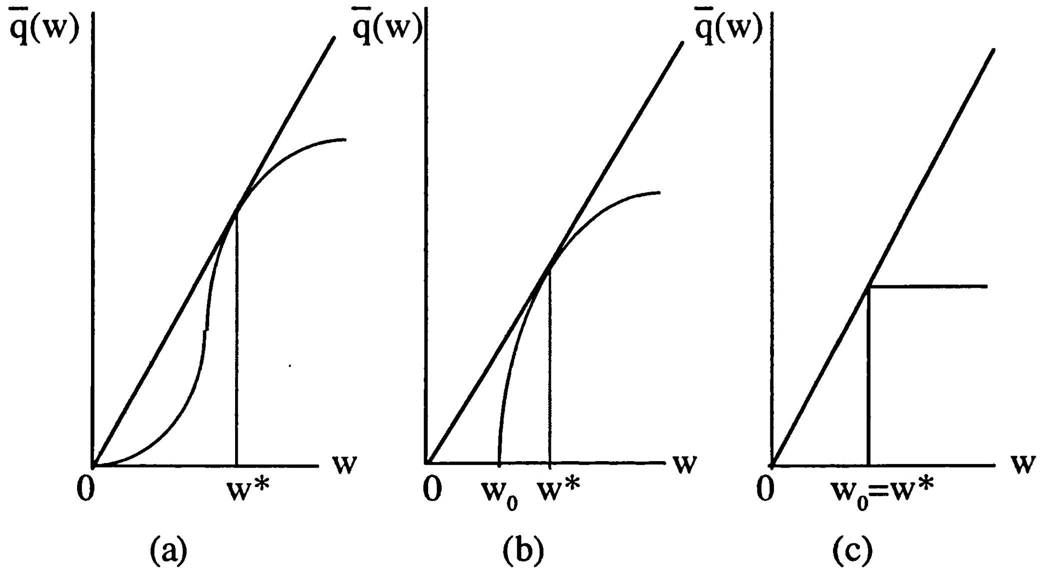


Fig.I-1

Of course, more complex shapes are possible. However, as far as the existence of an efficiency wage is concerned, the "concave-convex" shape is a sufficient condition. While the existence of an efficiency wage may be justified, there is no reason to leave out a possibility that an efficiency wage does not exist. Indeed, in theory if the function were convex (concave) throughout, the objective function would be minimized at w=0 (at the maximum value of w). However, the economic interpretation presented above in on the shape of $\bar{q}(w)$ is too convincing to consider the case that an efficiency wage does not exists. This argument suggests that the adverse selection models usually analyze the special cases where the existence of an efficiency wage is the necessary consequence of the adverse selection mechanism.

Thirdly, the adverse selection does not require a one-to-one functional relationship between w and θ, which is the consequence of the assumption of efficiency units (EUs). This, together with a production function g(•) being cumulative in EU, leads to a situation of "all-round productive ability" among jobs i.e. if a worker has a higher θ than another worker then he is more productive in <u>all</u> jobs. This, however, is not a necessary condition for an adverse selection mechanism nor for excess supply equilibrium to occur. For the adverse selection phenomenon implies,

$$\bar{q}'(w)>0 \text{ and } \underline{\text{not}}\ q'(w)>0 \qquad \text{(I-8)}$$

It is easy to give an example where $\bar{q}(w)$ is an increasing function of w while q(w) is not. Consider, for example, a discrete case with three workers whose opportunity wages are $w_1<w_2<w_3$, and $q(w_1)=1$ $q(w_2)=5$ and $q(w_3)=4$. In this case, $\bar{q}'(w)$ is an increasing function of w as $\bar{q}(w_1)=q(w_1)=1$, $\bar{q}(w_2)=(1/2)\{q(w_1)+q(w_2)\}=3$, and $\bar{q}(w_3)=(1/3)\{q(w_1)+q(w_2)+q(w_3)\}=10/3$, while q(w) is not. In fact the condition that q(w) and $\bar{q}(w)$ are both increasing in w is appropriate for the early efficiency wage models where an increase in w means an increase in the productivity of everyone in the homogeneous labour force since in this case $q(w) \equiv \bar{q}(w)$. Therefore, for the adverse selection model, the assumption that w(θ) is monotionic is not an economic argument but is a technical one in a sense that without this its inverse q(w) may not be defined and this would

deny the whole setting since $\bar{q}(w)$ can not be defined as in (I-3) However, for a heterogeneous labour force it is too restrictive to assume that ability is solely represented as all-round productive skills. Therefore, what the Weiss model illustrates is a special case of the adverse selection mechanism at work.

In total, it appears that Weiss neglected the case in which $q'(w)>0$ does not hold and the case in which the efficiency wage does not exist. By doing so, he simplified the argument and succeeded in showing that an excess supply of labour may exist. However, he left out the more extensive investigation as to when such a outcome is likely to occur. To the extent that the nature of a market depends on the forces determining supply and demand, the nature of the equilibrium depends greatly on the type of the production process and the composition of the labour force within a particular labour market. Yet, this is not explicitly analyzed in a type of efficiency wage model as the Weiss model.

Alternatively, one may introduce an ability endowment a, from which his efficiency unit endowment $\theta=q(a)$ for a particular labour market and the reservation wage $w=w(a)$ are derived. Then the expected profit would be expressed as

$$\pi = pg(\bar{q}(a)x) - w(a)x$$

Then differentiating with respect to x and a, and rearranging the first order conditions, we obtain an equation analogous to (I-7),

$$\frac{w(a)}{\bar{q}(a)} = \frac{w'(a)}{\bar{q}'(a)}$$

and this is also the solution to the analogous problem "min $w(a)/\bar{q}(a)$". Thus the efficiency wage may depend on the characteristics of the function q(a), which takes an idiosyncratic form of a particular labour market. This is a possible extension to the efficiency wage models but is not suggested in the literature — in fact, Weiss (1991) considers different $\bar{q}(w)$'s but they are for different cohorts rather than for different labour markets. This is probably because such an extension would make the model unnecessarily complicated and the model could lose its intuitively appealing features.

Table I-1 summarizes the three limitations : (1) $q'(w)>0$, the all-round productive ability — this is not a critical assumption for the adverse selection mechanism, (2) The adverse selection $\bar{q}'(w)>0$ implies an existence of an efficiency wage — this is not necessarily true, and (3) The efficiency wage is invariant across all jobs — this would treat all the labour markets in the same way so that we can not analyse the nature of the equilibrium in terms of the market characteristics. While the efficiency wage models can claim success in showing that an excess supply is consistent with competitive equilibrium, there is a need to

<u>The Weiss Model</u>

$$\underset{(1)}{q'(w)>0 \rightarrow} \; \underset{(2)}{\bar{q}'(w)>0 \rightarrow} \; \exists \text{ Efficiency } \underset{(3)}{\text{Wage} \rightarrow} \text{ Excess supply or Market Clearing}$$

Table I-1

set up a model that can pick up those aspects of the heterogeneous labour market analysis which the efficiency wage models have not dealt with.

(4) Thurow's Job Competition Model

Discrepancies that exist between what the economic theory predicts and what we observe in the real world were the starting point of the analysis of labour market in Thurow (1975). For him these "deviant observations" in the labour market included the existence of unemployment and the consequent wage rigidity, the Pigou paradox, the phenomenon that the distribution of earnings is skewed despite the allegedly normally distributed ability distribution, and the observation that the wage payments are not always equalized for homogeneous labour.

He introduced a concept of "job competition" to explain these deviant observations in a theoretically acceptable manner. As these concerns of his overlap with our interest, let us briefly introduce his job competition here. The basic premise of the idea is that labour markets are essentially training markets in the sense that firms recruit workers in a labour market to train them to perform the required job. This contrasts with a more orthodox concept of labour market that workers bring with them the required skills.

In the job competition model, therefore, workers are allocated into job slots and wages are paid according to the job characteristics rather than the worker's personal characteristics. Furthermore, Thurow's workers are assumed to be heterogeneous as opposed to the usual assumption of homogeneous labour force in the neo-classical model. Thus after recruiting the heterogeneous workers, the firm offers training to standardize the labour force so that they can all perform the required job. The workers' heterogeneity is reflected in their ability to complete the training — some workers find the training easier than others and thus they may cost less to train to the firm. As a result, the firms have preference about the workers and rank them in order of the preference to form a "labour queue" using educational credentials as a screening device. The preference about workers do exist also for Weiss (1980). However, his preferred workers are endowed with more efficiency units, while Thurow preferred workers have lower training cost than the less preferred ones. Furthermore, unlike in a neo-classical model of a labour market, the wage in the job competition model is determined outside of the market rather than by the supply and demand interaction. And this explains the deviant observations of wage rigidity and unemployment.

The crucial assumption in the Thurow's model is that the training cost is paid by the training firm — otherwise, the firm would be indifferent about the workers even if they are heterogeneous. The incidence of training cost was discussed earlier on in Becker (1964), in which he distinguished "general" and "specific" training. General training is relevant to all jobs and thus acquiring such skill would increase the productivity of the trainee by exactly the same amount in the training firm and in other firms, while specific training has relevance only to the job of the training firm and the productivity of the trainee in other firms does not change. Consequently, the Thurow's training firm would pay for the training since it is specific and not general.

Thurow (1975) contrasts the job competition model with what he calls the wage competition model. In the latter, firms do not have preference about the workers even if they are heterogeneous, since the training are general and thus the cost does not incur to the training firm. These two types of competitions co-exist in the real world according to Thurow. The way Thurow incorporates the human investment aspect into the labour market mechanism is rather intriguing. The firm pays to train the workers, and as the workers are heterogeneous in the training cost the firm has a preference among the workers. This means that the characteristics of a job competition of a particular labour market depend on the training cost heterogeneity — for example, if the training cost is uniform, then the firm will be indifferent about the workers. However, Thurow does not offer a theoretical model of a job competition nor does he explain how the wage is determined. This is our starting point and we use the Thurow's concept of training market to build a more theoretically rigorous model.

(5) Towards a More General Model of Labour Market

The labour service has a very high degree of heterogeneity, while many types of goods and services are supplied in relatively homogeneous forms. Hence, it would be difficult to find two workers with exactly the same level of productivijob of the training firm and the productivity of the trainee in other firms does not change. Consequently, the Thurow's training firm would pay for the training since it is specific and not general.

Thurow (1975) contrasts the job competition model with what he calls the wage competition model. In the latter, firms do not have preference about the workers even if they are heterogeneous, since the training are general and thus the cost does not incur to the training firm. These two types of competitions co-exist in the real world according to Thurow. The way Thurow incorporates the human investment aspect into the labour market mechanism is rather intriguing. The firm pays to train the workers, and as the workers are heterogeneous in the training cost the firm has a preference among the workers. This means that the characteristics of a job competition of a particular labour market depend on the training cost heterogeneity — for example, if the training cost is uniform, then the firm will be indifferent about the workers. However, Thurow does not offer a theoretical model of a job competition nor does he explain how the wage is determined. This is our starting point and we use the Thurow's concept of training market to build a more theoretically rigorous model.

(5) Towards a More General Model of Labour Market

The labour service has a very high degree of heterogeneity, while many types of goods and services are supplied in relatively homogeneous forms. Hence, it would be difficult to find two workers with exactly the same level of productivity, while you can find many pencils, say, of the same quality. The reason is simply that while the quality of labour service depends a lot on the characteristics of each individual worker (Nobody is born identical to anyone else!), many goods and services are produced as homogeneous products (which makes the production easier). However, once labour service is to be used as a factor of production it requires a certain level of homogeneity. In that sense acquiring of knowledge and skills helps to standardize the innately heterogeneous labour force. The simplest example of such is language, without which no collective work is possible. Thus while the human capital theorists argue for the investment aspect of education, where education defined as acquiring of knowledge and skills also acts to standardize the labour force,

Such a standardization of labour force exists even after the employment contract is signed. Training signifies precisely this post-educational standardization process as much as the post-educational investment, although training may be more specific to the job than education. The actual training may take place alongside production i.e. on-the-job training, or at different occasions i.e. off-the-job training. Its cost consists of the opportunity cost due to the lost production during the training and the actual cost of training, as in the human capital model of education. With the introduction of the heterogeneous labour force, it is reasonable to assume that the amount of training required for a particular job and thus its cost differ among the labour force. Furthermore, the training cost differential among the workers may not be the same for all jobs. Take, for example, a university graduate and a high school leaver for a skilled job and an unskilled job. While for the skilled job the graduate may require considerably less amount of training and thus of its cost than the school leaver, for the unskilled job the gap may not be great.

Let us assume, therefore, that a production process consists of production and training. Then the value of net output of a firm may be defined by the value of total output minus the total cost of training and be written as

$$py\left(\sum_{i=1}^{I} x_i\right)-\sum_{i=1}^{I} c_i x_i \tag{I-9}$$

where p is the product price

$y(\bullet)$ is a production function whose sole argument is labour, i.e. the number of workers

i is a group of workers with the same training cost and there are I groups

x_i is the number of workers in group i

c_i is the training cost of each worker in group i

and we have assumed that all workers pursue the same type of job. A similar concept of production and training is employed in Salop (1979), in which the workers must be trained at the outset of employment. Thus the first term may be interpreted as what trained workers produce while the second term refers to what costs the firm to train the newly recruited workers. Particular characteristics of a firm or of a labour market would be expressed by different forms of c_i.

On the supply side of the labour market, the workers are distributed according to an ability endowment α. This must be distinguished from a direct labour input endowment such as EU. Rather, it is a potential or latent ability which can generate productive skills through training. A reservation wage w of a worker with α is derived, based on his productivity in the alternative job. So to each α attached is the training cost, i.e. $c=c(\alpha)$, and the reservation wage $w=w(\alpha)$. In principle, $c(\alpha)$ can take any form, but later on in Chapter III we will assume $c'(\alpha)\leq 0$.

The firms are assumed to know $w=w(\alpha)$, $c=c(\alpha)$ and the distribution function $H(\alpha)$ but not the α of an individual worker. Thus while a single firm knows the quality of labour i.e. the training cost for a given wage offer w, to the extent that it is competitive it does not know the quantity of labour supply it can secure at that wage.

The firm's profit is given by

$$\pi = py\left(\sum_{i=1}^{I} x_i\right) - \sum_{i=1}^{I} c(\alpha_i)x_i - w(\alpha_{max})\sum_{i=1}^{I} x_i \qquad \text{(I-10)}$$

where p is the product price

i is a group of workers with the same α, i.e. α_i — as c is a function of α, this is equivalent to the above definition of i

α_{max} is the α of the group of workers with the highest w among those employed

x_i is the number of workers with α_i employed by the firm

In continuous form

$$\pi=py(x)-\bar{c}(\alpha)x-w(\alpha)x \tag{I-11}$$

where x is now the total labour input

$w(\alpha)$ is the reservation wage of the workers with α — the workers of the highest ability, which is equivalent to α_{max} in (I-10)

$\bar{c}(\alpha)=\dfrac{\int_0^\alpha c(z)dH(z)}{\int_0^\alpha dH(z)}$ i.e. the average training cost of the workers with the endowment range between 0 and α

The firm is, then, to maximize π with respect to α and x. The formal analysis will be given in Chapter III and thus I only point out here that the firm quotes the wage offer and the number of workers it wishes to employ — so it is not a price taker in the perfect competition sense, but whether this demand is met depends on the supply condition — so it acts as a competitive firm.

Thus what we attempt to introduce here is a model of heterogeneous labour market with training. Its basic premises are that a labour market is essentially a training market, to which workers without skills enter to receive training and then work, and that the workers are heterogeneous in some innate ability, which generates the heterogeneity in the training cost as well as in the reservation wage. A competitive firm needs to offer a wage to minimize the labour cost which consists of wage cost and training cost.

This model differs from the Thurow's job competition model and the Weiss's adverse selection model in several ways. As pointed out earlier on, our model follows the concept of a labour market as a training market employed by Thurow (1975). But it is more theoretically rigorous than the Thurow's model. In particular, the wage is endogeneously determined within the theoretical framework rather than exogeneously given.

As with Weiss (1980), its limitations discussed in the earlier part of this chapter are cleared by using an innate ability α rather than the efficiency unit θ. This is brought about by the use of a function $c(\alpha)$ instead of $q(w)$. For example, it was explained that as $w(\theta)$ is assumed to be monotonically increasing if a worker is more productive in the present firm i.e. high θ, he is also more productive in the alternative sector i.e. high w, but this does not always have to hold. For our model, $c(\alpha)$ is not required to be a monotonic function so that we do not have to limit our analysis to the "all-round productive ability" cases. For our model the adverse selection implies an increase in wage to cause a decrease in $\bar{c}(\alpha)$, i.e. $\bar{c}'(\alpha)<0$. But there is no guarantee that the total labour cost will be reduced or equivalently, that the "efficiency wage" always exists. While for the Weiss model the existence of the efficiency wage was not questioned for the reason given in the earlier part of this chapter. Finally, we would like to know how the market characteristics determine the level of efficiency wage. While

Weiss (1980) offers no suggestion on this issue — the efficiency wage is invariant across all jobs, we attempt to relate the training aspect of a labour market to the wage levels as well as to the characteristics of the market equilibrium.

In this chapter we have discussed the following:

Firstly, the efficiency wage hypothesis (EWH) and the four types of labour market models based on this hypothesis, namely, the nutritional model, the shirking model, the adverse selection model and the sociological model, were introduced and their mechanisms were briefly described. With the adverse selection effect or the incentive effect as the key concept, these models help to explain the existence of wage rigidity and involuntary unemployment.

Secondly, the model by Weiss (1980) was examined in detail. Theoretical difficulties and limitations of the efficiency wage models were discussed. One such difficulty is that the involuntary unemployment may be eliminated by an alternative contract characterized by a performance bond, an employment fee or a piece rate payment or a self-selection or screening device, though this could be counterargued. It was also shown that the fundamental assumption of efficiency unit restricts the operation of the efficiency wage models in several ways. First, it restricts the workers to be all-round productive. Second, the adverse selection is treated as if it is the sufficient condition for the existence of an efficiency wage. And thirdly, no analysis is given to explain when the excess supply of labour is likely to occur.

Thirdly, a job competition model by Thurow (1975) was introduced and its mechanism, in which training plays an important role, was described. And finally, a training model based on the concept of Thurow (1975) as well as that of the efficiency wage was introduced.

The remaining chapters are organized as follows:

Chapter II offers a selected survey of the literature on theories of wage determination and a more detailed survey on training models. It is intended to give readers some comparative perspectives of this issue and in particular the reasons why the training model is offered in this work. In Chapter III the model is presented formally and the labour market equilibrium is established Chapter IV gives some space to the explanation of why the uniform wage may be assumed; or, in other words, to examine the conditions in which the equilibrium so established in the previous chapter is robust. Chapter V offers a two-period model of training with heterogeneous labour, in which an upward-sloping wage profile is derived. Chapter VI looks at this competitive equilibrium of the heterogeneous labour market in comparison with monopsony equilibrium, using the Lagrangian multiplier method. Comparative static analysis appears in Chapter VII, in which several policy implications are discussed. Chapters VIII and IX look at slightly different models of labour market by modifying some of the assumptions of the original model — Chapter VIII looks at a case of heterogeneous firms as well as workers, which is then followed in Chapter IX by a case of observationally distinguishable workers. In both cases, the equilibrium is established and the comparative static analysis is offered in an analogous manner to that of the original model. Each chapter ends with a brief summary of the results established in that chapter. And finally the conclusion appears in Chapter X.

CHAPTER II : A SURVEY OF LITERATURE ON THEORIES OF WAGE DETERMINATION

In this chapter we survey the literature on wage determination theories. The theories are presented in a basically chronological manner to illustrate a brief history of the theories of wage determination mechanism. There is a wide variety of approaches offering explanations of wage determination mechanism. And this chapter intends to contrast them and offer comparative perspectives to this issue.

The chapter proceeds as follows. Firstly the overall view is presented to describe how the issue of wage determination has been tackled in the past. Secondly the theories are grouped into 'approaches' in terms of assumptions and basic framework of models. Here the focus of each approach is clarified and its merits and demerits in employing as a model to describe the labour market mechanism are assessed in turn. Then we have a closer look at theoretical and empirical works on economics of training. Finally, these are contrasted with the approach followed in this work.

(1) The Overall View

One way to systematically survey the literature on the theories of wage determination is to categorize them into the following three groups; (a) a determination of wage level, (b) a determination of wage differentials, and (c) a determination of wage distribution. Each group pursues the analysis of the labour market from a slightly different angle from the others. The orthodox neo-classical income distribution approach falls into (a), the first group. The approach presents a labour market within an overall picture of economy in terms of general equilibrium analysis. It shows how the wage level is determined in relation to other prices. However, when one wishes to investigate the reason for the existence of wage differentials i.e. (b) , the second group, one needs a more detailed analysis within one labour market. Thus the human capital approach serves to explain how and why an individual with particular characteristics earns a wage different from others. The institutional approach also shows how persons with different attributes obtain employment in different sectors, thus generating a structure of wage differentials. As for the question of the shape of a wage distribution i.e. (c), the third group, some have been puzzled by its lognormal shape. The statistical/mathematical approach was presented in 1950's, which was then followed by the more economically meaningful job matching approach.

All these approaches assume perfect information. However, with a growing interest in the economics of information since Stigler (1961) through Akerlof (1970), there has been a line of approaches in the field of wage determination parallel to those presented above but with an assumption of imperfect information. Thus the implicit contract approach attempts to explain how a wage is determined — i.e. (a) — when the level of output is not known with certainty in advance. The human capital under uncertainty approach makes explicit the uncertain element at the time the decision making on the educational investment i.e. the future earnings, within the human capital framework.

Uncertainty may affect the participants of a market differently i.e. a case of asymmetric information. As for labour markets, such an informational asymmetry typically occurs when the firms do not know the productivity of each worker. The screening/signalling approach describes possible processes through which wage offers can be differentiated among the workers with different attributes even if the firms do not possess perfect information about the workers' heterogeneity in advance. These are the answers to question of type (b) — i.e. how are wages differentiated?, — taking into consideration the issue of uncertainty. The job matching under uncertainty approach attempts to extend the imperfect information to both sides of the labour market, to describe how wages may be distributed in the world where information is imperfect

	The main issue of the analysis		
	(a)Wage level	(b)Wage differentials	(c)Wage/income distribution
Perfect Information	(i)Income distribution	(ii)Human capital (3)Training models (iii)Institutional	(iv)Statistical/ mathematical (v)Job matching
Imperfect Information	(vi)Implicit contract	(vii)Human capital with uncertainty (viii)Screening/ signalling	(ix)Job matching with uncertainty

Table II-1: The basic features of the approaches i.e. the question of type (c). Table II-1 illustrates the grouping discussed above and each approach is explained in the next section in turn..

(2) The Theories

(A) Perfect Information

(i) The Neo-classical Income Distribution Approach

Within a general equilibrium framework, labour demand exists as a derived demand alongside demand for capital for the production of goods. The wage is a remuneration for labour service, being determined simultaneously with interest as a payment for capital. The firm's profit maximization implies that the marginal productivity of the each factor is equated to the corresponding remuneration. The equilibrium wage is determined by the interaction of supply of and demand for labour as well as that of supply of and demand for capital.

In general, a traded commodity in any one market is assumed to be homogeneous within this framework. And it is this homogeneity assumption that limits this type of approach to construct a comprehensive model of a labour market, to describe a process of wage determination for the following reason. The assumption of homogeneity of labour allows only a single wage in the labour market. Thus, if we wish to describe a labour market in the real world, in which there are more than one wage, we would need to assume that there is a complete set of markets for several different types of labour — for example, a skilled labour market and an unskilled labour market. In turn, their wages are determined by the corresponding supply and demand conditions. And while theoretically this does not restrict the range of wage level in any market, we see in reality that a wage in some market is most of the time, if not always, higher than in other market, such as a case of a skilled labour market and an unskilled labour market. One may argue that a wage of skilled labour tends to be higher than that of unskilled labour because there is always a shortage of skilled labour relative to unskilled labour. But then we must answer the next question as to why such a difference in labour supply exists. It would be necessary to say something about the way by which one decides to supply his labour service to one market rather than another. Within the general equilibrium framework, such an extension could make the analysis too complicated to produce some simple and clear results.

Therefore, while this approach ought to be credited for its focus on the analysis of an overall picture of an economy and hence the analysis of a labour market in relation to other markets in the economy, it cannot go very far in explaining the pronounced phenomena in labour markets such as the existence of wage differentials.

(ii) The Human Capital Approach

The labour earnings of a worker may be found to be correlated with his attributes such as years of schooling, sex, race or the amount of working experience. Human capital theorists argue that education is an investment that generates higher earnings as a return in the future, so that the educational decision is analogous to investment decisions of capital. (See, for example, Shultz (1965), Mincer (1974), Becker (1975)) They maintain also that such an investment extends into one's working life in the form of 'On-the-Job Training (OJT)'. This training aspect is dealt with in the nest section in detail.

This approach has three main contributions to the understanding of labour market operations. Firstly, by treating an educational decision as an economic issue, it has questioned the orthodox educational philosophy and the one that many people hold namely that the value of education cannot be rightly measured in monetary terms alone. Secondly, the OJT hypothesis gives an explanation to an upward-sloping shape of a typical age-earning profile. And thirdly it is important to point out that many empirical works have been done based on the human capital theory, using an "earnings equation" of the form : $\ln Y_s = \ln Y_0 + rs$, where s is years of education, Y_i is the earnings of a person with i years of education, and r is a rate of return. I would like to emphasize it here because many theories in this field of labour economics are interesting but difficult to test empirically.

As for our immediate concern, this approach can deal with the issue of how wages are determined and differentiated in terms of the level of investment in education and OJT. By giving some insight into decision making on education and/or OJT, it attempts to rationalize observed wage differentials in terms of an optimization process. It thus solves the problem faced in the neo-classical income distribution approach as a result of having to set up one labour market for each wage to be determined. In fact, the human capital theory is a labour supply analysis, since it describes how a potential supplier of labour determines the amount of investment in himself by examining how much earnings can be generated in the future. However, as an educational investment requires some time to generate its return, the future earnings is likely to bear a considerable degree of uncertainty in two ways — namely, uncertainty about the successful educational achievement and uncertainty about the condition of the demand for the type of labour. The approach could reflect the reality more by taking these uncertainties into the model (See (vii)).

(iii) The Institutional Approach

The models in this group all have quite intuitively appealing features, as their structures are based on historical, institutional or qualitative aspects of labour markets. At the same time, however, their assumptions in some cases do appear to be rather ad hoc to Neo-classical economists. In fact the works we refer to in this category follow the line of what is often called the segmented labour market theories. Their starting point is the questioning of the neo-classical theory of labour markets. For example, they point out that the persistence of poverty and income inequality despite the long-standing policies to eliminate them can not be explained by the neo-classical theory. Cain (1976) offers an extensive survey on the segmented labour market theories.

Two of the more notable works on these theories are the dual labour market theory of Doeringer & Piore (1971) and the job competition theory of Thurow (1975). The dual labour market consists of a primary labour market offering a job with a higher wage, better working conditions, more promotion possibilities and more stable work, and a secondary market offering the opposite of what the primary market is offering. While workers in the primary market have no intention to leave for the secondary market, workers in the secondary market become accustomed to the working patterns of that sector and find it difficult to move out of this inferior sector of the society and thus these two types of labour markets continue to coexist. With the job competition theory, there are two types of market mechanisms called Job Competition and Wage Competition. Under job competition numbers and types of job slots are technologically determined. Wages are not principally determined by market forces. In fact there said to be a persistent job queue, from which firms choose the better workers. Consequently firms use some screening device to select better workers. In contrast, wage competition is what is normally known as a neo-classical market-clearing case. By pointing out that workers of different abilities may receive the same wage under the job competition, Thurow suggests that a wage is paid according to productivity required for the job rather than productivity of the worker. As a consequence, workers are recruited to receive OJT to be able to perform the required jobs.

The main difficulty with these theories is that their presentations are rather descriptive. For example, in the dual labour market analysis it does not explain how one market comes to be considered as a secondary rather than a primary market. Or there is no clear explanation in the job competition theory as to how the wage was determined in the first place. Because of this, as Cain (1976) points out, their criticisms of the neo-classical theory are not substantial.

Bhagwati (1977) and Fields (1974) both attempt to model a theory of education in LDC economy, in which the supply of and demand for the educated workers do not always match. In particular, they describe as 'Job Ladder and Fairness-in-hiring' and 'Bumping' respectively a phenomenon of hiring the better workers first when there is an excess supply of workers. The focus of these works is, however, on the social efficiency/inefficiency of education rather than how the wages are determined and as a result they do not offer a convincing mechanism of wage determination. Similarly the system of labour market, i.e. the job ladder model, the flexible wage model, or the social optimum model for Bhagwati (1977) or the bumping model, the stratification model, or the pooling model for Fields (1974) is a 'choice variable'. Thus, for example, Fields (1974) does recommend one system as the socially most efficient one but can not guarantee that the efficient system prevails as a stable or robust equilibrium.

(iv) The Statistical/Mathematical Approach

At the end of the last century, Pareto (1897) observed that the distribution of income was not symmetric around its mean but rather it is skewed to the right. He derived what is now known as a Pareto distribution to fit this right-skewed income distribution data. It was realized later, however, that this theoretical distribution does not fit well the lower end of the actual income distribution. Gibrat (1931) presented a lognormal distribution as an improved version of the Pareto model, to fit well the lower end of the actual income distribution. Various attempts to explain this skewness of the distribution to this day include Champernowne (1953) and Roy (1950).

Champernowne (1953) employed a theory of stochastic process of the Markov chain type. Given continuous flows of income, he assumed that a probability of falling into a certain income group as a result of an annual change of income follows a certain pattern. He concluded that in a steady state the distribution of income becomes Pareto or lognormal irrespective of the initial state of the distribution. In other words, the Pareto or lognormal shape of the income distribution is the result of continuous income changes that occur following some probabilistic laws. This theory seems to offer a very simple and yet appealing explanation to the observed skewness of the income distribution. His argument relies heavily on his two basic assumptions. Firstly, the presently observed distribution is assumed to be in the steady state. However, as Lydall (1968) pointed out, one's life may not be sufficiently long to generate the steady state and thus his income is more likely to be conditional upon his initial endowment at the beginning of his life. Secondly, the annual income change is assumed to follow a certain pattern of stochastic process. However, no economic interpretation is given in the specification of this process. Although one needs not deny the stochastic factor in the income generating mechanism, it is hard to believe that such a mechanism operates independently of economic factors.

Thus the theory would have been more convincing if its stochastic process had been constructed explicitly on the concept of economic rationality.

Others attributed the cause of income differentials to the ability distribution. To them, however, the crucial issue was to explain what is called the Pigou paradox, that is, a paradox that despite the normally distributed ability the distribution of its derivative i.e. income, is not. (See, for example, Pigou (1932)) Roy (1950) suggested that ability has several dimensions such as intelligence, physical strength, decisiveness and leadership, and showed that when these normally distributed dimensions are multiplicatively combined it produces a lognormal distribution of income. The criticism of this approach is two-fold. Firstly, what we define here as ability are difficult to quantify and consequently it is difficult to actually prove that they are all normally distributed, let alone the determination of its multiplicative distribution. Secondly, it faces the same criticism as that of the Pareto model and the Champernowne model, in that it does not take into consideration the complex interaction of market forces.

(v) The Job Matching Approach

The models of this approach assume heterogeneities of both workers and jobs within a single market. Tinbergen (1951) & (1956) and Lucas (1977) consider continuous heterogeneity in both workers ability and job type. The equilibrium then entails a wage equation, a continuous functional relationship between wage and job/worker attribute. (See Tinbergen (1951) & (1956)) And the wage per unit of attribute is often called a Hedonic Wage. (See Lucas (1977)) The idea of attaching some monetary value to each attribute of a traded commodity is the concept of Hedonic Price and a more general model of this type is found in Rosen (1974). Such a concept is useful for analyzing a market for commodities of a high degree of heterogeneity such as houses or cars as well as labour service. For purchasing a house, for example, one takes into consideration many of its attributes as well as the price itself such as a condition of the house, its size and of its garden, a number of rooms, and its geographical characteristics e.g. its distance to the workplace, or natural and social environment. And the hedonic price of an attribute is the market value attached to a unit of each attribute.

Tinbergen (1956) considered the matching of a demand distribution for labour and a supply distribution of labour. A job in the demand distribution or a worker in the supply distribution is characterized by several attributes by means of its degree. Thus, for example, a worker may possess a high degree of intelligence and yet a low degree of ability to deal with others, or a job may be described by a low degree of precision and a high degree of cooperation among fellow workers. The degrees are measured on a continuous scale of each attribute. His argument is that because these two multivariate distributions on the continuous scale are not necessarily identical, there is a need for what he calls an income scale to match these distributions, through which the income distribution may be determined. Assuming that the supply and demand distributions to be bivariate normal distributions and that the supply is wage elastic and the demand is not, he solves the problem as a workers' utility maximization to obtain the income scale, with the additional condition that supply and demand for each job are equated. He then attempts to generalize the result for the case where the demand distribution is also wage elastic. However, he points out that such a generalization would be possible but extremely complicated and does not present a general solution.

As for the hedonic theories, their contributions to empirical studies have been considerable as the concept of hedonic price/wage is appealing. The human capital model may fall under this category as far as its empirical aspect is concerned. At the theoretical level, attempts have been concentrated on investigating whether the standard results of general equilibrium analysis are valid in the hedonic or implicit market cases. What appears to be missed out in this approach, however, is the issue of imperfect information about the heterogeneities of firms and workers. The equilibrium wage in this model of labour market corresponds to a set of continuous values of wages known as a wage equation. And to each wage level on this wage equation there is a pair of a firm and a worker at the equilibrium. With the full information every agent in the labour market may be able to find his best partner. However, it would be difficult to see that this result holds when the information is less than perfect. And this is the issue we turn to in the next section.

(B) Imperfect Information

(vi) The Implicit Contract Approach

The original idea of the implicit contract was due to Baily (1974), Gordon

(1974) and Azariadis (1975) in the mid 70's. The approach attempted to find an answer to the real world observations that the competitive labour market analysis could not explain the — namely, the wage rigidity and an existence of involuntary unemployment. Consider a risk-neutral firm and homogeneous risk-averse workers in a situation of uncertain demand for products. Acting also as an insurer, the employer is more likely to offer a labour contract with a somewhat lower but fixed wage irrespective of the state of world that would actually occur. However, the models do not always generate involuntary unemployment.

More recently, asymmetric information is introduced into the analysis, while the earlier models assumed symmetric information about the state of world as both firm and workers can observe it. Hence, a firm and workers do not have the same degree of access to information on, for example, the state of world the firms are more informed (See Grossman & Hart (1983)), or the reservation wages — the workers are more informed (See Moore (1985)). For surveys, see Rosen (1985) and Manning (1990).

There is no doubt that the approach has given a further insight into understanding of the wage determination by taking into account the aspect of uncertainty. However, to the extent that most of results here do not depend on the assumption of heterogeneous labour, it is not quite the ideal approach for understanding the reason for the observed wide variety of wage levels in reality.

(vii) The Human Capital under Uncertainty Approach

In its simplest form human capital models do not usually assume that risks are involved in the investment. It goes without saying, however, that the risk element is the important factor in anyone's educational decision making. There are two types of risks in human capital investment. One is the risk involved in how well the investment programme goes. And the other is how well the product i.e. labour after human capital investment, will be valued in the labour market.

Levhari & Weiss (1974) define the two types of risk or uncertainty — input uncertainty and output uncertainty. The former is due to uncertainty about one's own ability to follow the education or about the quality of the education. The latter refers to uncertainty about future supply and demand conditions in the labour market. Their theoretical work concludes among other things that; (i) the optimal level of educational investment is higher for a higher level of inherited wealth, (ii) the increase in the degree of uncertainty reduces the investment, but (iii) the effect of the level of interest rate on the investment level is ambiguous in fact this depends on whether the investor is a net borrower or net lender. One of the empirical works on the human capital investment with uncertainty is given in Olson,White & Shefrin (1979). They examine the degree of income variation in relation to the attributes of workers such as years of schooling. For those potential students, a large income variation in the future given a certain level of education means a high degree of uncertainty for receiving that level of education. They conclude, 'Our empirical results indicate that college should be taken as a package or not at all, due to the large positive effect of the fourth year of college', as income variation for those with less than four full years of college education is found to be larger than those with the full four years.

This approach is much more realistic than the human capital approach described earlier, as the risks in human capital investment are taken into consideration. However, the approach does not go beyond the analysis of labour supply. As for our principal interest lies in the wage determination mechanism and in particular the wage differential mechanism, we need to look more into the interaction of supply and demand.

(viii) The Screening/Signalling Approach

Educational achievement may be used by firms to "screen" the heterogeneous labour force, when the firms do not have information about productivity of each individual worker. With an assumption that a worker with higher productivity does better in education also, a higher educational achievement implies a higher wage. Contrast this with the human capital theory — educational achievement as a screening device merely raises one's earnings relative to others' without raising productivity, while if it is human capital investment it would raise the earnings through an increase in productivity. (Note here that they both imply a positive relationship between educational achievement and earnings.) Stiglitz (1975) shows that there may be multiple equilibria and an equilibrium with screening may be Pareto inferior to others, implying that such an equilibrium may not be socially desirable.

Signalling is another term often used when a market is characterized by informational asymmetry. The distinction between signalling and screening is not exactly an established concept. To some it is the order of move that matters — it is screening if the uninformed player moves first and signalling if the informed player moves first. (See Rasmusen (1989), Stiglitz & Weiss (1994)). To others such as Kreps (1990) the situation is defined as screening if the uninformed side proposes a menu of contracts among which the informed side selects, while it would be signalling if informed side takes the active role. Here we avoid the discussion to be too technical and merely mention that in a labour market the workers i.e. the informed players, obtain education to signal, while the firms i.e. the uninformed players, use the education to screen. Signalling may be also used in a more general sense to describe the informational equilibrium, since the introduction of the term by Spence (1973).

A firm may attempt to acquire information on worker's productive ability using a "self-selection" device upon their application. A self-selection device is a scheme that causes the worker to reveal truthful information about oneself. Such a device may be an application fee (See Guasch & Weiss (1981)), a wage schedule contingent upon a test result (See Guasch & Weiss (1980)), or the both and a test with a cutoff level (See Guasch & Weiss (1982)). One of the earlier discussions on the self-selection mechanism was presented by Rothschild & Stiglitz (1976). They modelled the imperfect information in an insurance market. An insurance firm offers a set of contracts to heterogeneous customers.

The equilibrium may be characterized as a pooling equilibrium in which customers all buy the same contract or as a separating equilibrium in which different customers buy different contracts or there may not be an equilibrium at all. This idea is also used in the field of labour economics when, for example, the firm does not know the productive ability of each worker drawn form a heterogeneous labour force. A pooling equilibrium would be the equilibrium in which all the workers are paid the uniform wage, while a separating equilibrium is characterized by wage differentials based on the heterogeneity of the workers. (See Chapter IV, in which the argument is employed to derive a condition for the uniform wage system of payment.)

This approach explicitly analyses the consequences of imperfect information, while such was not explicitly taken into consideration with the model of a heterogeneous labour market described earlier in this chapter such as those of the job matching approach. It is also worth mentioning that this approach explicitly examines the robustness of an equilibrium. My objection to this approach are two-fold. Firstly, the analysis has become quite technical as more emphasis is placed on the nature of equilibrium. And it is doubtful that the suggested set of contracts is actually implementable in the real world — in reality such detailed and explicitly stated contracts are quite rare. That is probably because such a system of employment contract can be extremely complex and thus costly and time consuming to create and implement in the real world of high degree of worker's heterogeneity. Secondly, firms might be more interested in devoting time for training the workers to perform the job rather than for selecting the optimal workers. This is consistent with the basic concept of OJT, as described in Thurow (1975).

(ix) The Job Matching under Uncertainty Approach

Here heterogeneity is assumed on the both sides of the market. The firms do not possess information on the productivity of each worker as in the models discussed earlier on in this chapter. What makes this approach different is the assumption that the workers' productivity depends on the job, or, to put it differently, there are better matching and worse matching of workers and firms. The main result is that as long as there are no workers who have an absolute advantage in all jobs, accurate information is beneficial. (See MacDonald (1980)) Jovanovic (1979) relates job matching and turnover in such a way that higher productivity generating job matching tends to give a lower turnover rate. With this approach, the emphasis lies on seeking the most efficient matching possible within this framework. Consequently, as the production function takes the simplest form, how wages are determined is not the main issue in this approach.

The main difficulty with job matching models in general lies in the treatment of heterogeneities. The more sophisticated we assume the heterogeneity to be, the more complicated the operation of the model will be. If the uncertainty is further assumed, its analysis would be extremely complicated.

(3) Training Models of a Labour Market

So far we have been assuming the labour market as a market for trained labour so that the newly recruited workers can fully participate in the production right away. However, many dispute this proposition and argue that labour needs further adjustment to perform the required job. They maintain that training of a worker exits as a process of human capital formation which continues throughout one's working life and put much more emphasis on the nature of training than on the supply and demand interaction of the labour market. This section is intended to introduce the basic concepts as well as theoretical models and empirical evidence of training.

Training is an investment in human capital in the same way as education is. Thus, the more training one receives the more productive he will be. The obvious difference between the two is that training is usually given after the labour contract is agreed while education takes place before the employment. More importantly, training is more purpose-specific in a sense that a worker usually receives training with some specific job in mind while education tends to serve for a more general purpose. Training may be categorized into "off-the-job", which is given to workers when they are not engaged in production, and "on-the-job", which is said to take place alongside the production. Much emphasis is given to this latter type of training for at least two reasons. Firstly, many labour economists, for example Becker (1964), believe that the best training is "learning-by-doing," or "learning-through-experience," in a sense that although theories may be taught at school, practice is best acquired at the workplace. Secondly, this idea of learning-by-doing helps to explains the observed upward-sloping wage profile --- one's wage rises by experience because productivity increases through this learning-by-doing.

On of the early works on the economic analysis of training was Becker (1964). He argued that there are two types of OJT; general and specific. General training increases the productivity of the trainee at the training firm and at any other firm to exactly the same extent, while specific training does not raise the trainee's productivity except in the training firm. Becker (1964) illustrated his argument by referring to various types of training given to military officers in the U.S. At one end of the spectrum learning how to fly an aircraft is fully general training since the skill can be used in the civilian sector. The author referred to the fact that "well over 90% of the U.S. commercial airline pilots received much of their training in the armed force." On the other hand, if one is trained to be an astronaut, a fighter pilot or a missile man, there is not much that he can do to increase his productivity in the civilian sector and this would be a fully specific training. In general, however, the most types of training have both aspects. He then argued that the cost of general training is born by the trainee, since it is an investment that the training firm can not secure its return. His argument for the cost of specific training is that it would be shared by both parties as they both try to take a precautionary step to a possible turnover — the firm would fail to capture the return if the worker quits and the worker fails to capture the return if he is fired.

A more explicit argument on the incidence of specific training cost is found in the transactions cost model of Hashimoto (1981). When there exist some values that the both the firm and the worker can not agree costlessly, such as the value of the marginal product of the worker in the training firm or in the alternative firm, a positive transactions cost is said to exist. This in turn could cause the separation of the worker and the firm, even if this means making the both worse off. And in such a case the cost of as well as the return to the specific training are likely to be shared. Katz & Ziderman (1990) questioned the Beckerian preposition on the incidence of general training cost. Their argument is that due to an informational asymmetry between a training firm and a recruiting firm about the extent and the type of the training the latter does not value the worker as high as the former and this discourages the trainee to pay for the general training. The interesting point in their argument is that the distinction between general and specific training lies greatly on the informational asymmetry rather than the actual nature of the training.

Stevens (1994) also reconsidered the Beckerian classification of general vs. specific OJT, of which most types of training are said to be combinations of the two with differing degrees. Her argument is that while specific training is useful to the training firm alone, which corresponds to pure monopsony, and general training is useful to all the firms, which corresponds to perfect competition, other types of training are useful to some firms, which corresponds to the imperfect competition. In this last case, the training is defined as "transferable" and the firm may finance it, as they hold monopsonic power to capture the return to the training. And this explains the observation that firms pay for training even if it does not appear to be specific — it is then transferable rather than general. Stevens(1994c) points out that there could be two types of inefficiency when a firm provides training to workers. As in Stevens(1994b), she defines training as transferable and argues that the imperfect competition among the firms in the labour market causes inefficiency while the information asymmetry concerning the value of the trained worker also causes an allocation inefficiency. With a simple example of two firms and one worker, she suggests that the inefficiency may be reduced if the participants of the market follow a labour contract in which firms set a wage offer after the training is completed as opposed to contracts with a predetermined wage or in which a worker sets the wage.

Specificity of training is also questioned by Acemoglu (1997). He argues that a large portion of the investment in training in Japan and Germany, where the level of training is high, is general rather than firm-specific and yet it is financed by the training firm rather than by the workers. In his model, workers and firms have costly search to find a partner, or the labour market is said to be 'frictional' as opposed to a frictionless competitive market. Then some of the return to training is captured by the future employer firm rather than by the training firm or the worker and this causes underinvestment of the training. As for the reason why the training firm pays for the general training, he explains that this costly search allows the training firm to capture some of the return to the training and thus it does not lose by financing the general training. Put it differently, the general training becomes specific to the extent that the workers can not costly change the employer because of the friction. He further argues that the workers would invest in their skills and accept to receive a low wage today to receive a higher wage tomorrow if the firms are more willing to innovate, since innovations raises their return to training. Turnover also is explained within the framework of general training rather than specific training in his model.

A few training models have also been developed by those who consider that labour markets are essentially markets for training. The job competition model of Thurow (1976) was mentioned in Chapter I as one of these approaches. Ishikawa (1981) constructed a model of dual labour market, in which he offered a generalization of Thurow's job competition. He pointed out that the "educational paradox" of the 60's and 70's U.S., the occurrence that education functioned neither as human capital nor screening — a general increase in the educational level of the nation did not affect the size distribution of income significantly, can be explained by characterizing the U.S. labour market as a job competition model. Here the emphasis of the analysis is on the macroeconomic dynamics of the labour market rather than how a particular training scheme affect the equilibrium of a labour market. Bosworth, Wilson & Assefa (1993) argued that the employment relationship between a worker and a firm is a dynamic relationship through which continuous investment on labour is made in the form of training. Thus we may talk of a "market for training" rather than a market for trained labour, in which the extent and nature of the training activity to be given to workers are determined from the demand for and supply of trained individuals. They offer the general direction in the labour market analysis — a dynamic model of a market for training is necessary to understand training investment behaviour, but fail to offer a specific model.

A more rigorous and theoretical model is found in Felli & Harris(1996), who introduces a dynamic model of training behaviour with specific training generating an upward-sloping wage profile. Every wage along the equilibrium wage profile consists of three components --- the opportunity wage, a premium reflecting what the worker would have accumulated if he was in the alternative job, and a reduction reflecting what the worker would have lost if he was in the alternative job. It is shown that along the time path the wage rises, implying that there are positive returns to tenure i.e. the wage profile is upward-sloping. The intuition behind this result is that the human capital is interpreted as information and thus accumulates over time, causing the value of the specific human capital i.e. wage to rise along the time path.

Salop (1979) offered a unique model of training within the efficiency wage framework. Although it was introduced in Chapter I as a turnover model, I mention it again as it is also one of the well-known training model. His workers are required to be trained at the initial period, while their turnover rate is negatively related to the wage offer. Thus the higher wage implies a group of workers with a generally lower incentive to quit and this means a less number of new workers to train and so a lower training cost to the training firm. As a result there exists a wage that maximizes that profit, as opposed to a usual profit maximizing problem in which the wage is exogeneously given. Salop (1979) assumed the training cost is paid by the training firm and there is no explicit discussion about the incidence as in Becker (1964), Hashimoto (1981), Katz & Ziderman (1990) or Stevens (1994). The incidence of training cost is discussed in Salop & Salop (1976) within a basically same framework as in Salop (1979)'s. But with the cost of training invariant across workers, the detailed analysis on how the training cost could affect the equilibrium of the labour market is not given in either of them.

A list of empirical works on the training issue is far more extensive than that of the theoretical counterpart illustrated above. The type of training varies between on-the-job and off-the-job, formal and informal, privately given and publicly given, or general and specific, but the most of these empirical investigations focus on the two issues, the upward-sloping wage profile or positive return to tenure, and the job mobility or turnover. Recall the Beckerian classification of general and specific training. If training is general, the worker pays for the training to acquire higher productivity after the training to earn a wage increase. As a result, we observe an upward-sloping wage profile. If, on the other hand, the training is specific, the wage profile can still be upward-sloping but not for the productivity increase. In this case, such a wage profile is set by the training firm to keep the trainee after the training, as the trained worker has added productivity for the training firm while the trained worker has no merit to stay on. With the specific training, the turnover is said to decrease for the same reason --- the longer the worker stays in the firm the greater his productivity contribution will be and thus the firm makes more effort to keep him.

Barron, Black & Loewenstein (1989) examined the U.S. survey on the OJT activities in 1982 and observed that "on average a new worker spends over 150 hours in OJT during the first three months of employment." They suggested with the same data that there is a direct relation between the level of training and productivity growth and that at least a half of training is specific because about a half of the returns to training is received by a worker. A word of caution is found in Ashenfelter & Card (1985) for dealing with actual data to estimate the effect of training programme on earnings. Using the U.S. data of the Continuous Longitudinal Manpower Survey, they estimated the wage return to training of the Comprehensive Employment Act training programme. The results were in general supportive of the positive effect of training. However, it was pointed out that those who received the training tended to have a low income in the period immediately before the programme --- in fact, it is not surprising since the progremme was geared towards those in most need, and thus had to be corrected against the overestimation .

Clearly, not everyone in the society receives the training, or to the same extent even if they receive one. The recipients of training are described in Greenhalgh & Stewart (1987), Altonji & Spletzer (1991), and Booth (1991). In Greenhalgh & Stewart (1987), the British data of the National Training Survey was used to show who received training. They found that in general women receive significantly less full-time training than men, and more specifically the higher occupational status means more full-time training for men and single women while for married women the higher status implies more evening training. One more interesting finding is that the acquired skills depreciates within about a decade. Data from the National Longitudinal Survey of the High School Class of 1972 was used in Altonji & Spletzer (1991) to show the link between workers' characteristics and the levels of training. They found, for example, that women receive less training but happen to pay more than men and that blacks receive more training than whites. The gender difference in the provision of training is also pointed out in Booth (1991), who uses the British Social Attitudes Survey of 1987. She finds that the women are less likely to receive formal training than men of the identical characteristics. Her findings also show that the levels of general education and training offered are complementary and that public sector is more likely to offer training than private sector.

Studies in the British apprenticeship were conducted by Booth & Satchell (1994), Chapman (1993), and Stevens (1994d). Their common concern was the decline of the number of apprenticeships particularly in the 1980's. Booth & Satchell (1994) shows that those with higher educational achievement, with higher employment status of the father, and who work in large firms, are more likely to receive apprenticeships. And on the whole the completion of the apprenticeship makes both workers and firms favour continuing employment relation. Chapman (1993) offered the evidence of training schemes in the U.K. For example, in the late 1980's between a quarter to a third of all 16-18years old received some training scheme such as the Youth Training Scheme or apprentices, although an international comparison shows the U.K. has a relatively large number of workers receiving no training or training of very low quality. He also suggested that the problem of employers poaching trained workers is cased by training firms having no property right over the human capital of the trained workers. And this in turn weakens their incentive to pay for the training and thus might have been the cause of the insufficient level of training observed in U.K. Stevens (1994d) searched the reasons for the decline using an investment model. Skilled labour may be acquired either by training workers or by recruiting already skilled workers. She concluded that the hue drop in the apprenticeships in 89's Britain was the result of a high interest rate and relaxed supply condition of skilled labour in the external labour market.

Two main topics of empirical work in the training models are the estimations of upward-sloping wage slope and the negative relationship between the level of training and the turnover, as mentioned earlier. Both Topel (1991) and Mincer (1993) use the U.S. longitudinal data of the Panel Study of Income Dynamics. Topel (1993) attempts to eliminate some sources of bias when estimating the wage and seniority relationship. For example, abler persons may be less mobile and thus the wage rises with seniority not because of the accumulation of the human capital but because they are simply more productive. After adjusting for several sources of bias, he confirms that there is a strong positive relationship between wage and seniority --- 10 years of job seniority raises the wage by over 25%. Mincer (1993) gives the rate of return to training, which is larger than the return to schooling suggesting the relative underinvestment in training, and the total annual costs of job training in the economy, which adds up to a half of the costs of school education for 1976. Bartel (1992) looks at a large manufacturing company and its professional employees. The training programmes are categorized into 'Core Programme' to improve supervising skills, 'Corporate Employee Development' to improve general working skills such as problem solving and oral and written communication, and 'Other Programmes' which are more specific to the skill. Their rate of return are calculated as 25%, 17%, and 13% respectively. She also introduced a 'job performance' as a dependent variable in the estimation and found that it is improved by training. In Lynch (1990) formal training in U.S. is found to be specific and the wage is raised only in the training firm and not in any subsequent firm.

On labour turnover and training, Lynch (1991) examined the socioeconomic factors influencing the turnover among women using the U.S. data of the National Longitudinal Survey Youth and found the probability of leaving job to be low and significant for those who have received the training. This conclusion is supported by Elias (1994), who found that employer-provided formal training has a negative effect on the turnover for both male and female. However, his estimates are significant for women but not for men. Levine (1993) presents a rather controversial result. With the U.S. and Japanese data obtained form surveys of manufacturing establishments, he found no evidence of training generating an upward-sloping wage profile or lowering the turnover. Thus he concludes that the data are not supportive of human capital theory and the specificity of the training in particular in explaining the mechanism of training.

An extensive international comparison on training is found in Shackleton (1995). The comparison is made among the U.S., the U.K., Germany and France. Young people in the U.S. tend to receive job-related vocational training in a typically private full-time institution rather than at the job entry. And employer-provided training tends to be focused on white-collar, better educated, established workers. On the whole, the amount of training appears to be insufficient. In the U.K. educational institutions tend to provide academic rather than vocational education, and the employers are not the major providers of training either. He thus followed Chapman (1993)'s argument that the workers receive insufficient levels of training in the U.K. and suggested that the training system in the U.K. has to be reformed to reflect the need of the labour market, have more direct involvement of employers, and to offer more vocational qualifications and skills. In the continental Europe, the governments play a more active role than the American or British counterparts. Germany offers a "dual system", in which an apprentice is to receive firm-based training to learn general work skills and knowledge as well as college-based education to learn general education and theoretical basis for occupational practice. In France, initial vocational education is the responsibility of the government and is offered at schools, while training is the responsibility of employers. And the government support the both via levies and taxes. On the whole, however, the recent trend is, according to him, that training is receiving much greater attention than before. Shackleton (1995) pointed out that the Japanese economic success is often explain by a high level of educational achievement of the students and a high degree of vocational training provided by employers. Training to that extent is made possible because of Japan's well-developed system of internal labour market, which often leads to the life-time employment. However, he is rather sceptical about introducing the Japanese system of training, as it is largely based on the idiosyncratic nature of the Japanese society and is not easily transferable to other countries.

To Higuchi & Mincer (1988) the observed intensity of human capital formation though training of largely firm-specific skills in Japan is caused by the necessity of the firm as well as workers to cope with her rapid technological changes. Carmichael & MacLeod (1993) argued that a cooperation of rather than a resistance by workers when a firm faces technical changes is a major reason for the success of Japanese firms and they attribute this to the multi-skilling of the Japanese workers. However, they do not see this as the unique feature of Japanese labour market but as some characteristics that may be found in the West at some point in time. Abe (1994) extends an adverse selection model of Greenwald (1986) to explain the observation that labour mobility is higher in the U.S. than in Japan. The main argument is that the relatively low labour turnover in Japan is the result of rather thin external labour market, as this helps to develop the internal labour market and the lifetime employment. Hence, the American and Japanese outcomes are interpreted as outcomes of multiple equilibria of the same system. It might be necessary, however, for the author to show the reason why the external labour market is thinner in Japan than in the U.S. in the first place.

Somewhat more descriptive but extensive analysis on the importance of OJT was discussed in Koike (1991). He pointed out that a quite extended OJT is given to newly recruited workers at large-sized firms in the U.S. as well as in Japan — this was contrary to a general belief by labour economists in Japan that Japan has a well-organized internal labour market while the market is largely external in the U.S. Rather, the difference between the two countries is the extent of on-the-job in that Japanese firms offer a wide range of working experience while it is much narrower for American firms. This wide range of working experience complements with a long-term employment, lifetime employment being the longest, through which what he called a "career formation" takes place. The employees acquire largely firm-specific skills through this process in terms of recruitment, placement, OJT, promotion and transfer. Furthermore, according to Koike (1991) the training is more likely to be on-the-job rather than off-the-job for three reasons — (i) OJT is cheaper than off-the-job, (ii) OJT can adjust more easily to the need of each individual trainee, and (iii) OJT fits better for trainees to acquire what Koike calls "tacit knowledge." The wide range of working skills may be less important for smaller firms. But Koike (1191) pointed that such a career formation does take place in the medium- and small-sized firms in Japan, though it is to a lesser extent.

(4) Towards the Training Model of Heterogeneous Labour

The investigation into a wage determination mechanism in the present work was started by presenting some empirical observations that seem inconsistent with the neo-classical framework such as a uniformity of wage and firm's preference about certain workers. To develop any model to investigate such a mechanism, it seems essential to assume heterogeneity of labour and this will create the informational asymmetry about the heterogeneity. This rules out the approaches such as the income distribution approach, the human capital approach, the statistical/mathematical approach, the job matching approach, the implicit contract approach, and the human capital with uncertainty approach, as the heterogeneity of labour is not a necessary assumption for these approaches. Of course, it is not to deny that they can incorporate an element of heterogeneity but such an attempt will make the model unnecessarily complicated, which in turn could obscure the main argument. The signalling/screening approach and the job matching with uncertainly approach do take these issues into consideration. However, the analyses can get rather technical and less intuitive. The institutional approach offers an interesting attempt to formalize those somewhat "informal" i.e. historical, institutional or qualitative phenomena in labour markets. The main weakness of this approach is, as pointed out earlier, that its rather descriptive presentation makes it difficult to prove right or wrong and in particular it fails to point out theoretically how the system has come into existence in the first place.

The training models, by contrast, give a rather different view of labour market. They see an employment contract as a relatively long-term relationship between a contracting firm and a worker. In particular, it introduces a dynamic element to the operation of labour market. As discussed in Chapter I, the efficiency wage approach does not only assume the heterogeneity of labour and the informational imperfection resulting from it, but also it offers an explanation as to how an offer wage is determined and in particular how it could be affected by the market interaction of demand for and supply of labour. It also maintains an intuitive appeal, for example, in the concept of adverse selection. Indeed the training model of heterogeneous labour as presented in Chapter I was developed along the line of formalizing the job competition theory of Thurow (1975) what this intriguing model by Thurow missed out was to offer an explanation as to how the wage was determined in the first place. Thus what is presented here is a synthesis of the intuitively appealing aspects of the institutional approach and the theoretical rigour of other approaches without losing a simplicity of a model.

In this chapter we have established the following:

Firstly, various approaches to explain the wage determination mechanism were presented in a manner of an overall view of the subject, in which they were categorized in terms of the particular aspect of the wage determination mechanism that each approach is focused on — the wage level, the wage differentials and the wage/income distribution. The approaches range in their style from a socioeconomic type i.e. the institutional approach, which emphasizes the importance of the social structure in determining the wages, through various economic types to quantitative types i.e. the mathematical/statistical approach, which offers highly theoretical models.

Secondly, the approaches were grouped into the "perfect information" group and the "imperfect information" group and the basic features of each approach were briefly analyzed and the limitations discussed in turn. The main limitation of the approaches with an emphasis on the wage level is to leave out the discussions on the cause of wage differentials. And those with an emphasis on the wage differentials tend to leave out the discussions on the market interactions, while the distributional approaches tend to leave out the explanation for the way in which the wages are determined in the first place.

Thirdly, various training models were introduced. They put more emphasis on the way the human capital is formed through training rather than the timeless interaction of supply and demand of labour market. At the same time the empirical works show that training indeed plays a very important role in the employment.

Finally, the reasons for employing the training model of heterogeneous labour were given. Our model as illustrated in Chapter I contains intuitively appealing feature of the institutional approach, such as Thurow's job competition, and at the same time the wage is determined by the supply and demand interaction in the labour market. And furthermore it considers the labour market as a market for training, in which human capital formation takes place over a period of time.

CHAPTER III : THE MODEL

This chapter presents formally the model of a labour market suggested at the end of Chapter I. But before the formal presentation, a brief outline of the model may be useful. The firms are assumed to be homogeneous and maximize profit. They are engaged in a production process consisting of training of workers as well as production. As the workers receive training during the production, it is best described as on-the-job training. The profit of a firm is defined as the revenue minus labour cost consisting of wage cost as well as training cost. The training cost may be actual cost or opportunity cost. An example of the former could be the money value of raw material wasted in the production process due to the incompetence of the trainees, while the money value of the difference between what the trainees have produced and what trained workers could have produced could be an example of the opportunity cost.

The training cost of a worker is a function of α, which means that the heterogeneity of the workers is reflected in the cost of training them, and expressed by $c(\alpha)$. The heterogeneity of the workers also affects their productivity in the alternative sector and this in turn generates the reservation wage as a function of α, i.e.$w(\alpha)$. Contrast this with the Weiss model or any of the efficiency wage models for that matter. For the efficiency wage models, the reservation wage and the productivity in the job are positively related because as Weiss (1980) assumes "the acceptance wages of workers are an increasing function of their productivity" and thus the workers possess all-round productive ability. Our present model, on the other hand, allows other conditions and can show that an adverse selection exists.

With the assumption of homogeneous firms, all firms have the same production process, i.e. production as well as training, within one market. This assumption will be relaxed in the later chapter when the firm becomes heterogeneous within one labour market. Rather, the different training cost functions reflect the characteristics of firms among different labour markets. As a consequence, the equilibrium outcome of a particular labour market is characterized to a large extent by the form of the firm's training cost function. At the end of the training they will all become equally productive and require no more OJT. The heterogeneous workers also have different productivity in the alternative sector, and this is expressed by $w(\alpha)$, the reservation (or opportunity) wage. Initially, we do not impose $c'(\alpha)<0$, while by assumption $w'(\alpha)>0$. And thus we are not restricting the model to a case of all-round productive ability as in the Weiss model.

The use of the concept of OJT in this model is based on the author's belief that wages in reality are related to job characteristics to which workers with certain characteristics are allotted — marginal productivity resides with each job and not with each worker, to use a phrase coined by Thurow (1975). The same type of argument appears in Manning (1994), in which he calls such a payment scheme as a "Company Wage Policy". This also implies the payment of a uniform wage, despite the heterogeneous productive ability among the workers. Equally important is its further implication that the cost of OJT does not incur directly to each worker in the form of wage differentials. And the OJT is assumed to be "general" in Becker (1975)'s terminology. This set of issues i.e. the validity of uniform wage and the nature of OJT and its cost, receive an extended treatment in Chapter IV.

The model implicitly assumes that participating in the production process does increase one's productivity to match the level required by the job, while the workers' own characteristics may help to sort them into different labour markets. That is to say the efficiency wage models are pure screening models, in the sense that the hypothesis mainly deals with the way in which the issue of imperfect information is tackled, while the present model more appropriately, for analyzing the real world, that is, combines aspects of the screening model and the human capital (or the OJT model).

(1) Assumptions

(Workers)

W1 Workers are heterogeneous in ability with a single index α, which is distributed according to a density function $h(\alpha)$, where the range of α is normalized, i.e. $0 \leq \alpha \leq 1$ s.t.

$$H(\alpha)=\int_0^{\alpha} h(z)dz \text{ and } 0\leq H(\alpha)\leq 1$$

W2 An acceptance or reservation wage of a worker, i.e. what he would be paid in an alternative job, with an ability α is $w=w(\alpha)$, where $w'>0$.

(Firms)

F1 There is a large number of firms with an identical production process, i.e. a process of training and production; with no free entry.

F2 The production function $y(x)$ is solely a function of the number of workers, and hence independent of the heterogeneity of the labour force. And $y'>0$ and $y''<0$.

F3 The firms are price takers in a competitive market for their products and are competitive in the labour market, where their competitiveness in the latter means they compete using a wage offer w, and a volume of the input x, in maximizing their profit. (This definition of competitiveness is also employed in Stiglitz & Weiss (1981).)

(Training)

T1 The workers become identically productive, by attaining the skill, irrespective of their α's, after requiring "On-the-Job Training (OJT)".

T2 The cost of the OJT, c, to attain the required job skill differs among the workers of different α's and it is expressed by a "Training Cost Function", $c=c(\alpha)$.

(Information)

I1 Every worker knows his own ability α and opportunity wage $w=w(\alpha)$.

I2 Every firm knows $h(\alpha)$, $c(\alpha)$ and $w(\alpha)$ given α, but is not able to distinguish one worker from another.

(Employment Contract)

E1 Employment contracts are negotiated in advance, last for one period and specify a wage to be paid.

(2) The model

In this competitive labour market, as defined in F3, consider a representative firm which faces a proportion of the aggregate labour supply. Let us construct the supply of and demand for labour of the firm and then analyze the market equilibrium.

(a) The supply of labour

Suppose there are n workers and m firms in the market. Then the supply of labour available to the firm, x^s say, is expressed as,

$$x^s = \int_0^{\alpha(w)} (n/m)h(z)dz \equiv x^s(w) \qquad \text{(III-1)}$$

For the sake of simplicity, let us assume m=n, i.e. each firm faces a "normalized" potential labour supply. Note that since m and n are exogeneous to the model, and in particular m is fixed due to no free entry (cf. F1), there would be no loss of generality with this simplification.

This means in particular,

$$x^s(w)=1 \text{ when } \alpha(w)=1 \text{ or equivalently } w=w(1) \tag{III-2}$$

$$x^s(w)=0 \text{ when } \alpha(w)=0 \text{ or equivalently } w=w(0) \tag{III-3}$$

where $\alpha=\alpha(w)$ is the inverse of $w=w(\alpha)$, which exists by $w'>0$ (cf. W2). And note that $x^s(w)>0$ is a cumulative function. (See Fig.III-1 for how the supply curve is constructed from $w=w(\alpha)$ and $h(\alpha)$)

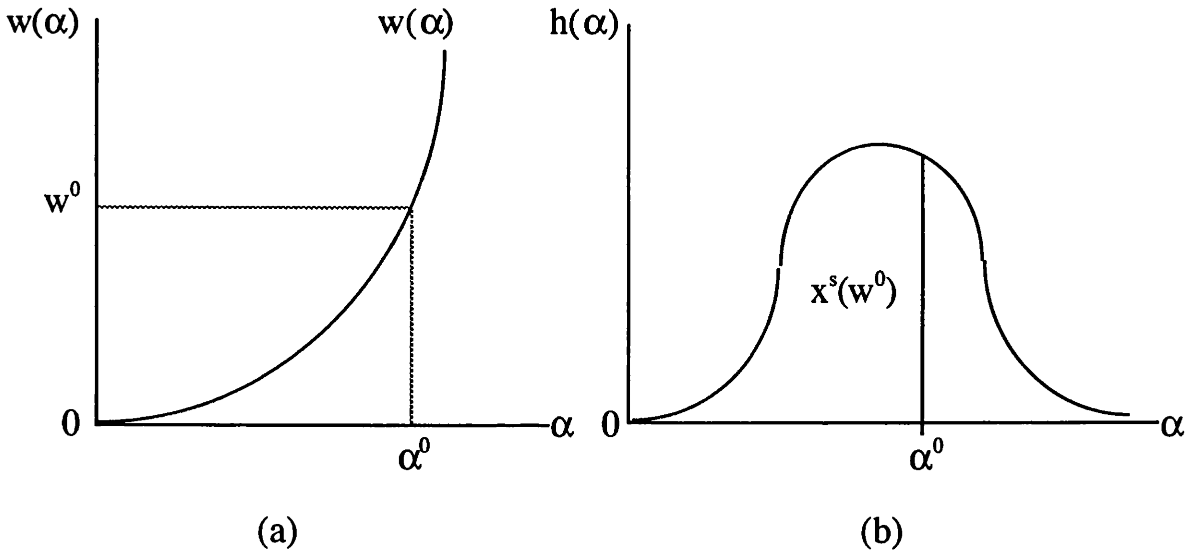


Fig.III-1

(b) The demand for labour

In constructing the demand function, note that a uniform wage is offered to the workers of the heterogeneous ability since they are observationally indistinguishable. (For more extensive arguments on the uniformity of the wage, see Chapter VI)

Being competitive, a firm can not control the supply quality of labour it faces by varying the wage. However, it can control the quality by varying the wage as it knows $w(\alpha)$, $c(\alpha)$, and $h(\alpha)$. Namely, the firm knows that a change in wage affects the expected training cost $\bar{c}(\alpha)$ through a change in the maximum ability available.

$$\text{i.e.}\ \frac{d\bar{c}(\alpha)}{dw(\alpha)}=\frac{d\bar{c}(\alpha)}{d\alpha}\cdot\frac{d\alpha}{dw(\alpha)} \tag{III-4}$$

$$\text{where}\ \bar{c}(\alpha)=\frac{\int_0^\alpha c(z)dz}{\int_0^\alpha h(z)dz}$$

$$=\frac{h(\alpha)\int_0^\alpha [c(\alpha)-c(z)]h(z)dz}{[H(\alpha)]^2w'(\alpha)} \tag{III-5}$$

And we can see that $c'(\alpha)\leq 0$ is a sufficient and not necessary condition for $\frac{d\bar{c}(\alpha)}{dw(\alpha)}\leq 0$. We will assume $c'(\alpha)\leq 0$ from here, emphasizing that it is not a necessary condition for the model, as in the Weiss model. Therefore,

<u>T3</u> $\quad c'(\alpha)\leq 0\ \forall 0\leq\alpha\leq 1$

The firm is to maximize expected profit π with respect to w and x^d, the demand for labour, or equivalently α and x^d, where

$$\pi = py(x^d)-\bar{c}(\alpha)x^d-w(\alpha)x^d \tag{III-6}$$

It should be noted that the difference between choosing (w,x^d) and (α,x^d) as the variables to maximize π is a practical one. In theory, w and c are functions of α so that it would be more appropriate to use α and x^d. In practice, however, workers and firms are more likely to negotiate with w rather than with α. One reason is that even if a worker is endowed with a certain α, a firm may not accept it and in such a case the agreement is difficult to reach about the ability endowment between the two. If they negotiate with w, on the other hand, there is no ambiguity about w.

Here for an analytical purpose, we employ (α,x^d) instead of (w,x^d). Then the first order conditions give us

$$py'(x^d)=\bar{c}(\alpha)+w(\alpha) \tag{III-7}$$

$$\bar{c}'(\alpha)+w'(\alpha)=0 \tag{III-8}$$

It shows that α may be determined independently from (III-8), which then can be substituted into (III-7) to obtain x^d. Note that (III-7) resembles a conventional demand function of a price-taking firm, since by rearranging it will give us,

$$w(\alpha)=py'(x^d)-\bar{c}(\alpha) \tag{III-9}$$

i.e. wage = net marginal productivity

We can call this a 'Conditional Demand Function', being conditional on the value of α, which was determined in (III-8) independently of this function. This implies that in the present model through a wage offer the firm can control the average quality of labour, expressed by $\bar{c}(\alpha)$ through $\alpha(w)$ and then determine the demand for labour. However, there is no guarantee that it can secure x^d by the definition of competitiveness as we have not taken the supply condition into consideration so far.

Similarly, (III-7) may be interpreted as,

$$w(\alpha)+\bar{c}(\alpha)= py'(x^d) \qquad \text{(III-10)}$$

i.e. labour cost per worker= marginal productivity

Determining the optimal value of α independently of (III-7) and thus of x^d, (III-8) states that at the margin a change in the wage rate and a change in the average training cost due to a small change in α offset each other.

Differentiating the profit equation once more, we obtain;

$$\begin{bmatrix} \dfrac{\partial^2\pi}{\partial x^{d2}} & \dfrac{\partial^2\pi}{\partial x^d\partial\alpha} \\[2ex] \dfrac{\partial^2\pi}{\partial\alpha\partial x^d} & \dfrac{\partial^2\pi}{\partial\alpha^2} \end{bmatrix} = \begin{bmatrix} py''(x^d) & -\{w'(\alpha)+\bar{c}'(\alpha)\} \\ -\{w'(\alpha)+\bar{c}'(\alpha)\} & -x^d\{w''(\alpha)+\bar{c}''(\alpha)\} \end{bmatrix} \qquad \text{(III-11)}$$

so the solution is indeed a local minimum if and only if

$$y''(x^d)<0 \tag{III-12}$$

$$y''(x^d)\{w''(\alpha)+\bar{c}''(\alpha)\}x^d-\{w'(\alpha)+\bar{c}'(\alpha)\}^2>0 \tag{III-13}$$

The above conditions are satisfied if $w''(\alpha)+\bar{c}''(\alpha)>0$ and $x^d>0$, since $y''<0$ from F2 and $w'(\alpha)+\bar{c}'(\alpha)>0$ at the optimum . For the moment, let us assume that $w''(\alpha)+\bar{c}''(\alpha)>0$ holds. And define $w(\alpha)+\bar{c}(\alpha)=\Psi(\alpha)$ as 'Average Labour cost Function' and its derivative $\Psi'(\alpha)$ as an 'Optimal Wage Function', since when it is equated to zero this function gives us the profit maximizing wage. $\Psi'(\alpha)$ is the marginal cost per worker of employing a group of workers with a slightly higher α, which is the sum of (i) the extra cost of raising the wage to attract the slightly better workers and (ii) the benefit from the resulting lower expected training cost.

Therefore, at some α,

(i) If $\Psi'(\alpha)>0$, it is cheaper to employ a group of workers whose upper bound ability is less than α.

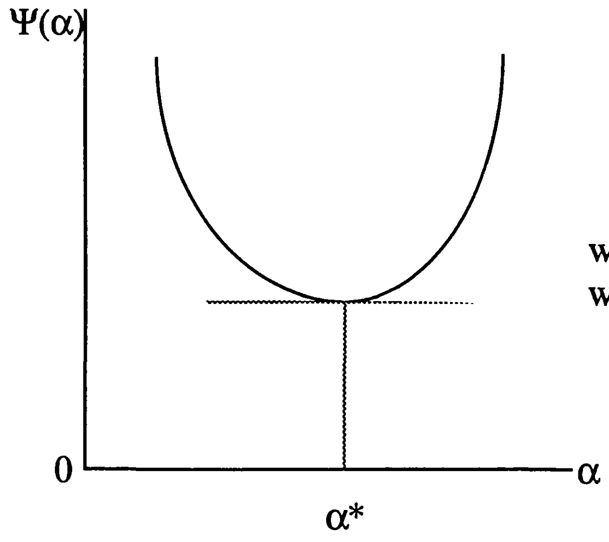
(ii) If $\Psi'(\alpha)<0$, it is cheaper to employ a group of workers whose upper bound ability is more than α.

(iii) If $\Psi'(\alpha)=0$, it is the cheapest to employ the group whose upper bound ability is exactly α.

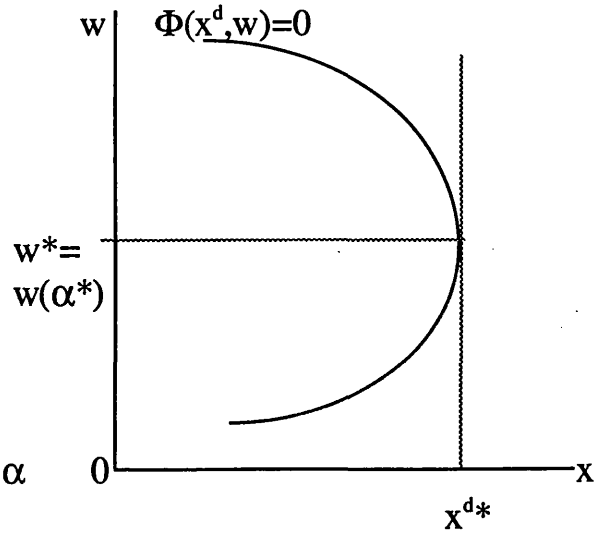
In practice, it is not surprising if the firm through experiences knows this function $\Psi'(\alpha)$ directly instead of $h(\alpha)$ and $c(\alpha)$ in detail to construct it as assumed in I2. Redefine the conditional demand function in a wage-employment space, i.e. $w=py'(x^d)-\bar{c}(\alpha(w))$ and write it as $\Phi(x^d,w)=0$. Differentiating totally, we obtain

$$dw/dx^d=py''/(1+\bar{c}'\alpha')=py''w'/\Psi' \qquad \text{(III-14)}$$

The two first order conditions are illustrated diagrammatically below in Fig.III-2, when $\Psi(\alpha)$ has a unique minimum as an interior solution. Note that at $\Psi'(\alpha)=0$, i.e. when one of the first order conditions is met, the conditional demand function: $\Phi(x^d,w)=0$, becomes vertical. The conditional demand function is also backward-bending when $\Psi(\alpha)$ is convex in α with x^d achieving the maximum at x^{d*} as illustrated in Fig.III-2(a), in which α^* corresponds to x^{d*} through $w^*=w(\alpha^*)$



(a) Average labour cost function



(b) Conditional demand function

Fig.III-2

So far we have assumed $\Psi''(\alpha)>0$ in order to derive these results. The technical reason is that given that the optimal α exists s.t. $\Psi'(\alpha)=0$, $\Psi''(\alpha)>0$ ensures that it is indeed the minimum. But what is the economic argument for $\Psi''(\alpha)= w''(\alpha)+\bar{c}''(\alpha)>0$. Let us examine the two functions separately. As for the reservation wage $w(\alpha)$, it is difficult to determine the sign of the second derivative on a purely theoretical ground. Then, given $w'(\alpha)>0$, a linear function would be the best approximation, i.e. $w''(\alpha)=0$. On an empirical ground, however, we may refer to the Pigou paradox that the normally distributed ability, which is α in our model,, generates a skewedly distributed earnings, which is w in our model. This would mean $w''(\alpha)>0$, since the skewedness often described as lognormal requires that $\alpha=\log w$ and thus $w''(\alpha)>0$. We do not want to be too optimistic about it, since the normally distributed ability is another controversial issue. However, we accept the both arguments and assume $w''(\alpha)\geq 0$. As $\bar{c}(\alpha)$ is a composite function of $c(\alpha)$ and $h(\alpha)$, they have to be treated separately. Given $c'(\alpha)\leq 0$ it is reasonably to assume $c''(\alpha)>0$, since this means an increase of α does not reduce c so much, as α becomes larger. If $h(\alpha)$ is "bell-shaped", $\bar{c}''(\alpha)>0$ will be even more pronounced at higher values of α, while at the low values $\bar{c}''(\alpha)>0$ might be less pronounced. However, on the whole, because of $c''(\alpha)>0$, we assume $\bar{c}''(\alpha)>0$. Consequently, $\Psi''(\alpha)= w''(\alpha)+\bar{c}''(\alpha)>0$. We might point out, however, that "$w''(\alpha)\geq 0$ and $\bar{c}''(\alpha)>0$" is a sufficient but not necessary condition.

Even if $\Psi''(\alpha)= w''(\alpha)+\bar{c}''(\alpha)>0$ does not hold , all is not lost. In such a case, as long as $\Psi(\alpha)$ is a monotonic function, the solution may be found in a following way.

(1) If $\Psi'(\alpha)>0$ $\forall\alpha$, the optimal ability to minimize $\Psi(\alpha)$ is $\alpha=0$

(2) If $\Psi'(\alpha)<0$ $\forall\alpha$, the optimal ability to minimize $\Psi(\alpha)$ is $\alpha=1$

(3) If $\Psi'(\alpha)=0$ $\forall\alpha$, the firm would be indifferent among the workers.

And in these cases the corresponding conditional demand function: $\Phi(x^d,w)=0$ will be (1) downward sloping, (2) upward sloping or (3) vertical respectively.

This analysis shows that the adverse selection does not necessarily imply the existence of an optimal wage. Adverse selection in this model means a negatively sloped $\bar{c}(\alpha)$ for a positively sloped $w(\alpha)$ but this will not guarantee $\Psi''(\alpha)>0$. In fact any of the above cases of the monotonic $\Psi(\alpha)$ could result with the assumption of adverse selection. Hence, the shape of $\Psi(\alpha)$ depends on the relative shapes of $w(\alpha)$ and $\bar{c}(\alpha)$. In particular, note that the assumptions $w'>0$ and $\bar{c}'<0$ do not always guarantee the existence of a local minimum, i.e. the existence of an optimal wage, at which $\Psi'(\alpha)=0$, while it does guarantee an existence of an adverse selection problem — adverse selection means a negative correlation between w and c in this model. Hence, in this model adverse selection does not necessarily imply an existence of a profit maximizing wage solely determined by each firm, as in the case of the efficiency wage models. Note also that the workers are not necessarily assumed to be all-round productive this would mean $c'(\alpha)>0$. But what we assume here is $\bar{c}'(\alpha)>0$, the adverse selection condition and not $c'(\alpha)>0$. Here the same logic as the numerical example of (I-8) should apply. Technically as there is no need to inverse $c(\alpha)$, we do not have to restrict this to a monotonic function.

Therefore, profit is maximized as long as the supply of labour is not binding, by employing x^{d*} workers at w^*, for whom the expected training cost is $\bar{c}(\alpha^*)$ such that $w^*=w(\alpha^*)$. And this is equivalent to choosing a point on $\Phi(x^d,w)=0$ with the largest x^d. Consequently the firm's demand for labour is a "single point". In the conventional neo-classical competition, on the other hand, the demand schedule is a locus because along the demand curve π monotonically increases with x.

(3) The equilibrium

Here we analyze the market equilibrium of the present model in comparison with a market equilibrium usually described in perfect competition with its agents acting as mere price-takers. It can be seen that our equilibrium, though competitive in its nature, does not always coincide with the market-clearing equilibrium of a perfect competition. The reason is that in our model the firm can obtain some information about the nature of the labour supply through an "adverse selection" mechanism.

With our definition of competitiveness, at the equilibrium the aggregate supply S_L and demand D_L would be

$$S_L: N^s(w)=mx^s(w)=nH(\alpha(w)) \qquad \text{(III-15)}$$

$$D_L: N^d(w) \text{ s.t. } w+\bar{c}(\alpha(w))=py'(N^d/m) \qquad \text{(III-16)}$$

where $x^s(w)$ is defined in (III-1).

For each firm the following holds at the market clearing equilibrium, where (w^+, x^+, $\alpha^+=\alpha(w^+)$) is its solution.

$$x^s(w)=H(\alpha(w)) \qquad \text{(III-17)}$$

$$py'(x^d)=w+\bar{c}(\alpha(w)) \qquad \text{(III-18)}$$

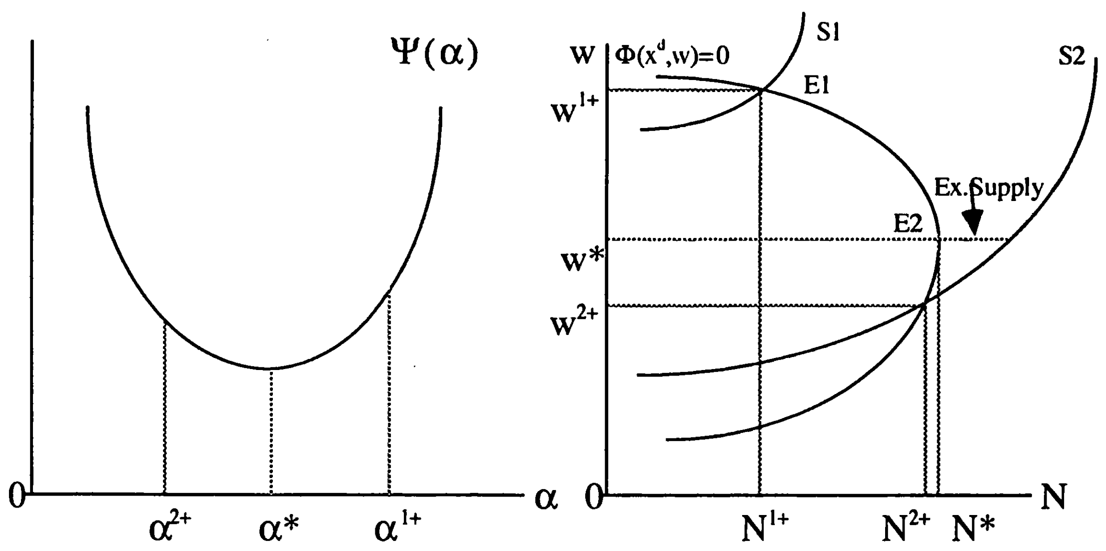
$$x^d=x^s \qquad \text{(III-19)}$$

On the other hand, let (w^*, x^*, α^*) be the solution to the firm's profit maximizing problem, as derived in the previous sections. Then by our definition of competitiveness, the solution of the present competitive model (w^{**}, N^{**}, α^{**}), where $N^{**}=mx^{**}$ and $\alpha^{**}=\alpha(w^{**})$, is given by;

(I) if $\Psi'(\alpha^+)\geq 0$, then $(w^{**}, N^{**}, \alpha^{**}) \equiv (w^+, N^+, \alpha^+)$

(II) if $\Psi'(\alpha^+)<0$, then $(w^{**}, N^{**}, \alpha^{**}) \equiv (w^*, N^*, \alpha^*)$

We can interpret this in the following way : If $\Psi'(\alpha^+)\geq 0$, the market clearing wage $w(\alpha^+)$ is greater than the optimal wage $w(\alpha^*)$ so that at $w(\alpha^*)$ the firm can not secure the desirable number of workers and there will be an excess demand, which will in turn raise the equilibrium wage as far as the market clearing wage. If, on the other hand, $\Psi'(\alpha^+)<0$, the market clearing wage is smaller than the optimal wage, causing an excess supply of labour at $w(\alpha^*)$. The same type of argument as in the efficiency wage models applies here to show that the wage will not fall to the market clearing level — namely, for firms there is no incentive to lower the wage as the profit is maximized at this wage and no worker would offer to work at a lower wage since this will merely single him out as a below-average worker. The situation is illustrated in Fig.III-3, where E1 and E2 indicate the market equilibria of the two cases and the equilibrium values are $(w^{1+}, N^{1+}, \alpha^{1+})$ and (w^*, N^*, α^*) respectively. And S1 and S2 are the supply of labour for the corresponding situations.



(a) Average labour cost function (b) Two types of Equilibrium

Fig.III-3

Thus in (I) a market-clearing equilibrium occurs, while (II) implies an excess supply equilibrium. Which of the two cases the equilibrium turns out to be depends on the relative sizes of the supply and demand, which are in turn conditional upon the behaviours of the functions; y(•), c(•), h(•) and w(•), as well as upon p. These function reflect the aspects of the market from different angles. While h(•) and w(•) reflect the characteristics of the society in which the economic mechanism operates, y(•) and c(•) reflect the idiosyncratic nature of the production technology of the market and p that of a product market from which the labour demand is derived.

Fig.III-4 shows various equilibrium outcomes for different $\Psi(\bullet)$. In each figure the direction of arrows along the conditional demand function: $\Phi(x^d,w)=0$ indicates higher profit and E's the equilibrium points. To see how $\Psi(\bullet)$ affects the behaviour of $\Phi(x^d,w)=0$, one may refer to (III-14): $dw/dx^d= py''w'/\Psi'$ Market clearing occurs in (a) (b) (c) (d) and (f) corresponding to the equilibrium condition (I), while excess supply occurs in (e) and (g), corresponding to the equilibrium condition (II). (a) shows a demand function of homogeneous labour force in the sense that the labour cost of every worker is equivalent from the firm's point of view. The equilibrium wage then becomes supply determined. (b) includes cases of both homogeneous labour force in the sense of perfect competition i.e. c=constant, and heterogeneous labour force i.e. $c=c(\alpha)$. Note that being expressed in this way the homogeneous case does not seem particularly different from other heterogeneous cases.

We might also mention another reason for a constant c(•) — it is possible that the firm does not have enough information to construct c(•) even if the labour force is known to be heterogeneous, if the market is relatively new. In such a case, we might expect that market-clearing is a temporary outcome, since when and if more information on the heterogeneity is made known the equilibrium may be characterized by an excess supply as in (e). In other words, more information acquired by firms about the workers' ability distribution means unemployment. As this is involuntary unemployment, it is not good news for the workers. However, as far as the firms are concerned, this does not imply inefficiency, since they are able to recruit workers with better quality with this information than otherwise.

With no information on supply quantity the aggregate demand price and quantity would be where the quantity is maximum along the conditional demand function: $\Phi(x^d,w)=0$. In cases (a) (b) (c) and (f), this would means an excess demand at the initial value of w. This will have to be revised since the demand cannot be met and consequently each firm will have to raise its wage offer to attract more workers until supply and demand match. (d) also is characterized by a market clearing equilibrium but its path to the equilibrium does not require a tatonnement process since the demanders' initial position already matches with the market clearing position.

On the other hand, in (e) and (g), excess supply would persist — there will be no tatonnement process, since supply is not binding at the aggregate demand price and hence this will be a market equilibrium. In (g), the equilibrium wage will be set at the acceptance wage of the best worker i.e. $w=w(1)$. Furthermore,

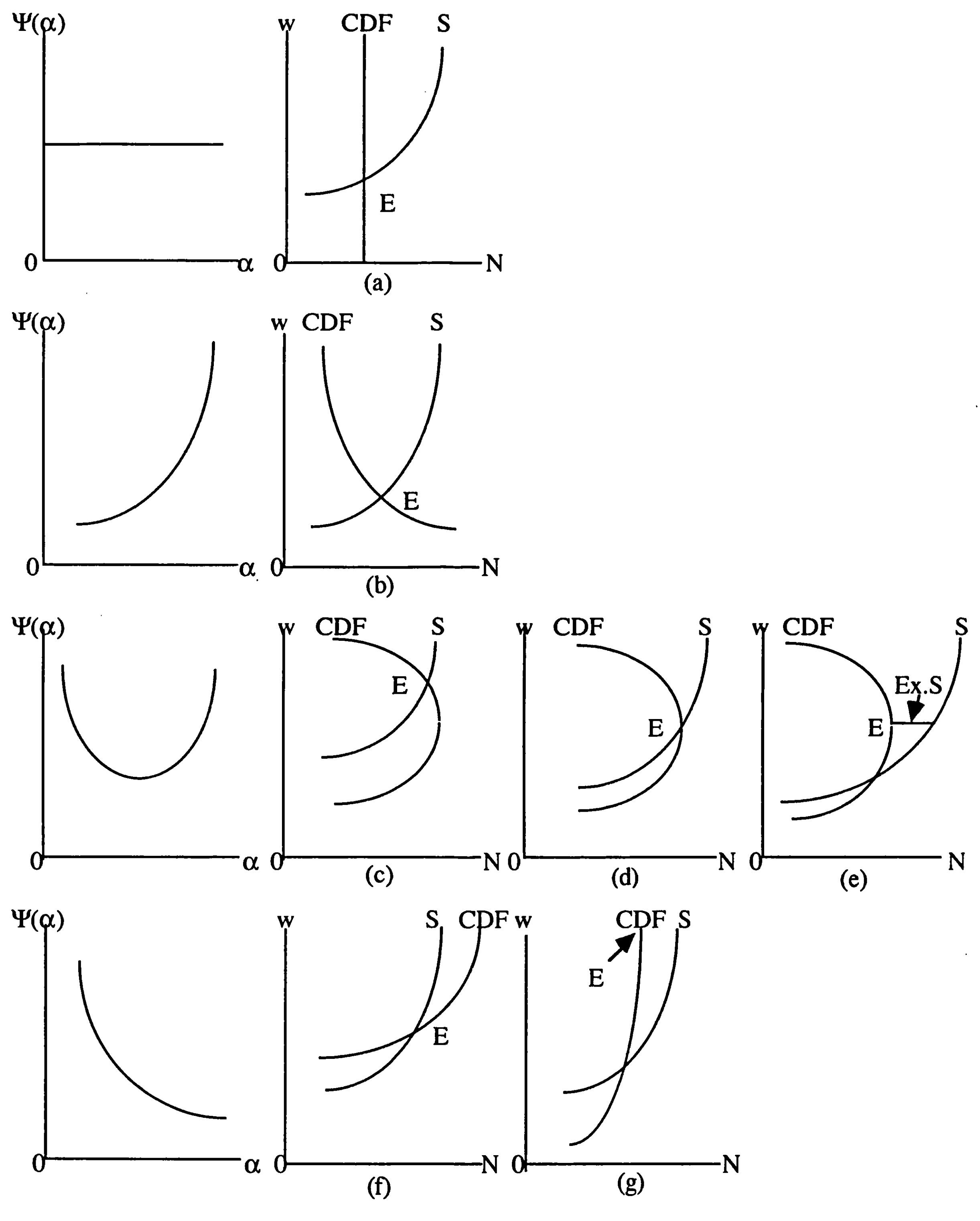


Fig.III-4

where CDF: Conditional demand function S: Supply

E: Equilibrium $\Psi(\alpha)$: Average labour cost function no single unemployed worker can increase his probability of obtaining a job, by reducing his acceptance wage i.e. by agreeing to reduce the economic rent, since this would merely result in indicating to the firms that his value to them is lower than the average worker's.

A level of the product demand expressed as a level of p affects the equilibrium through a shift in the conditional demand function. A rise in p shifts this function to the right, analogous to the case of perfect competition. In particular, when the average labour cost function: $\Psi(\alpha)$ has a local minimum, as in (c) (d) and (e), a change in p could alter the nature of the equilibrium from excess supply to market clearing and vice versa. Thus these two types of equilibrium are compatible outcomes for a single market with firms of given characteristics. So the competitive equilibrium may be characterized as either market-clearing or excess-supply depending on the nature of the conditional demand function. And there are some markets which possess both features: the equilibrium that emerges depends on the level of the product demand.

In this chapter we have established the following :

Firstly, by introducing a heterogeneity in α, of which w and c are functions, the assumption of all-round productive ability — that a good worker is a good worker in all jobs — was relaxed. This helps to clarify that the assumption of all-rounder productive ability, i.e. $w'(\theta)>0$, is not a critical condition as stated in

Weiss (1980), for modelling an adverse selection mechanism. In our model, the equivalent assumption is $c'(\alpha)<0$ and even if we do not assume this the model is not invalidated.

Secondly, the introduction of $c(\bullet)$ to reflect the heterogeneity among the workers for training gives a set of first order conditions consistent with marginal productivity theory (i.e. $\Phi(x^d,w)=0$: $w(\alpha)+\bar{c}(\alpha)=py'(x^s)$) and with individual labour cost minimization (i.e. $\Psi'(\alpha)=w'(\alpha)+\bar{c}'(\alpha)=0$) (See Fig.III-2) Unlike in the efficiency wage models, this latter condition may not be satisfied for some form of $\bar{c}(\alpha)$, in which case the optimal wage does not exists.

Thirdly, excess supply was shown to be consistent with competitive equilibrium. Furthermore, it was pointed out that the nature of production process i.e. the training cost function, c, influences the existence of excess supply in the same way as the product price does. It also showed that our competitive equilibrium sometimes coincides with the orthodox type of competitive equilibrium with market clearing feature.

Finally, recall that we have opted for this type of alternative models including the family of efficiency wage models to explain the existence of firm's preference over workers. It might seem inconsistent that in our equilibrium, the selection of N^d workers out of N^s workers when the supply exceeds the demand at the equilibrium, is made at random, despite the firm's preference. But this is not because the firm's preference does not exist over the N^s workers but because the firm is unable to distinguish the workers once they have "self-selected". Thus, there is naturally a tendency for the firms to improve the recruitment process by some other measure of selection. As to the workers, those left out are likely to be unemployed rather than taking an alternative job, since a non-negative economic rent is attached to the wage in the labour market, which cannot be found in the alternative job.

CHAPTER IV : THE VALIDITY OF THE UNIFORM WAGE

So far in our analysis, we have been assuming that the uniform wage would be paid to the workers of heterogeneous ability at the equilibrium. This is an assumption common to the family of efficiency wage models.

On one hand, in practice it is not rare to observe a payment of a uniform wage for performing an identical job even if the workers have different performance levels. One may counterargue that the payment is uniform since each worker would adjust his performance level so that the performance levels of all the workers are equalized. But if it were the case, then one would not observe the employer's preference among the potential workers, as pointed out at the beginning of Chapter I. Weiss (1980) refers to some empirical finding that "within the same pay group there were very minor pay differences (among the workers) .... On the other hand, the output of the most productive worker was often more than three times as great as the output of the least productive worker among fewer than 20 workers doing the same job with the same supervisor." In other words, common practice seems to support the assumption of a uniform payment to workers of different ability.

On the other hand, within the theoretical framework of a competitive analysis one may argue that there exists a non-uniform wage payment that is preferred by all the agents in the market and thus establishes itself as the equilibrium contracts. To see this, recall the equilibrium we described in Chapter III. At the equilibrium the workers of the ability range $0 \leq \alpha \leq \alpha^*$ were employed at $w^*=w(\alpha^*)$. Now if a new firm enters and offers to the workers of the highest ability among those attracted by w^*, i.e. the workers with ability α^*, a wage marginally above the market wage, $w^*+\varepsilon$, say, then those workers would be attracted by the offer and leave the existing firm. The new firm can do this without reducing the profit by reducing marginally, for example, the wage offer to the workers of the lowest ability, i.e. those with $\alpha=0$. For as long as there is an excess supply at the equilibrium, this can attract those workers with the lowest ability level. Thus this non-uniform contract is capable of disturbing the uniform wage equilibrium. Of course, in the efficiency wage models, such a possibility is usually ruled out with the assumption that the workers are indistinguishable. This suggests that the uniform wage equilibrium may be disturbed if some monitoring device is made available to distinguish the workers.

This chapter examines whether the uniform wage assumption has a theoretically sound underpinning consistent with a competitive market framework. In doing so, we will examine the arguments by Weiss (1980) and the arguments based on the nature of OJT and then employ the concept of a pooling equilibrium to verify the validity of the assumption.

(1) Possible Reasons for the Uniform Wage : the Weiss model

Weiss (1980) argues that there are several reasons why a firm may not offer, instead, wages proportionate to productivity. The most obvious reason according to him is that the cost of precise information on the productivity of individual workers may exceed its benefit. This seems to be a rather intuitively appealing argument. The paper, however, does not describe precise conditions under which acquiring the information is not worthwhile for the firm. In fact the natural extension of this line of argument is found in the literature on the informational equilibrium, where there is a monitoring device with a cost on heterogeneous commodities in the market concerned. A large volume of works on this topic is found in the analysis of an insurance market, of which Stiglitz & Weiss (1976) is one offering a simple and yet clear argument. For the case of a labour market, we find this type of argument in, for example, Guasch & Weiss (1980) (1981) or (1982) or Clemenz (1986). In this chapter we will employ the type of argument employed in Clemenz (1986) to verify the validity of the uniform wage assumption.

Another reason for the uniform wage assumption in Weiss (1980) is that risk aversion on the part of workers induces a wage payment not proportionate to output or expected output at the equilibrium. The idea is that even if the productivity of each worker is known, it does not necessarily imply that the value of actual output can be known with certainty because of the demand uncertainty of the product. However, the issue of adverse selection is essentially concerned with asymmetric information between the firms and the workers, while output uncertainty generates imperfect information to the agents of the both sides of a labour market. Thus this argument does not depend directly on the heterogeneity of the work force as the fundamental assumption of our model and thus on the existence of the adverse selection in turn.

Weiss (1980) also argues that a payment proportionate to productivity or expected productivity may not be realized as this scheme can cause friction among workers, thereby lowering the morale of the workers. It needs to be pointed out, however, that the moral issue is a question of workers' incentives rather than of heterogeneous work force. While such a reasoning may be valid for the incentive models of the efficiency wage hypothesis, this argument is not appropriate here as the present model and the Weiss model alike are the adverse selection models of and not the incentive models of the efficiency wage hypothesis.

(2) Uniform wage and OJT

According to Becker (1975), OJT may be either "firm-specific" or "general", and this determines the incidence of its costs in a following manner. If OJT is general, its cost will be paid by the worker as he collects the return for himself. On the other hand, the cost as well as return of specific OJT are shared by the two parties conditional upon the likelihood of labour turnover. Turning to our model, if the training is general, then the workers would receive non-uniform wages net of the training cost. Thus the training in our model that offers a uniform wage must be specific.

There is some theoretical difficulty with this line of argument — namely, according to this logic the training that each of the homogeneous firms offer s to the workers is specific and yet has the identical training cost function c(•) One can argue that some OJT cost may be paid by a firm even if it is not specific to that firm. As was briefly mentioned in Chapter III, Manning (1994) also argues for the uniform wage, or the company wage policy. He points out that the firms do not use the information about worker characteristics in wage determination and offer an individualistic wage policy, since it would be difficult to derive such a complex policy that satisfies everyone in the labour market. Consequently, the firms end up with providing, i.e. paying for, general training of the workers. Stevens (1993) also shows the empirical support for and justifies theoretically the idea that firms do invest in apparently general training of its workers and are concerned with "poaching" at the same time. But again it is difficult to determine the circumstance for such a wage offer within their approaches.

In the next section, therefore, we develop the first argument for the uniform wage assumption — the validity of the uniform wage payment as the equilibrium contract when there exists a possibility of monitoring the workers.

(3) Pooling Equilibrium and Its Robustness

In order to simplify our argument, we specify our model to the case where workers are characterized by one of only two ability types; each type has corresponding reservation wages and training costs. A similar type of model for the adverse selection model of the efficiency wage hypothesis is found in Clemenz (1986). The basic result in his paper is that two types of equilibria are possible in the labour market — a pooling equilibrium, in which the two types of workers are offered a uniform wage contract, and a separating equilibrium with monitoring, in which the two types of workers are employed with different contracts from each other, making it a non-uniform wage contract. In the latter case, the firms employ a monitoring device to distinguish the two types of workers. And in both cases, the analyses examine the conditions in which either or <u>none</u> of the equilibria exists.

The basic argument of this type of analysis is as follows. Given that firms in the labour market are planning to offer the efficiency wage to all the workers uniformly at the pooling equilibrium, the analysis asks whether there exists some other labour contract preferred by all the agents in the market which offers differentiated wages to the workers of different ability. In the latter type of contract the firms are assumed to employ some monitoring device, which is costly and inaccurate, in order to distinguish the workers. The particular form of the non-uniform wage contract is not given, as it would depend on the specific natures of the supply and demand conditions in the labour market. Rather, it merely asks whether there exists <u>any</u> non-uniform wage contract based on the monitoring mechanism, which is preferred by all the agents in the market and thus invalidates the uniform wage contract as the equilibrium wage contract. Having determined the conditions in which the pooling equilibrium does not exist, the analysis then asks whether a separating equilibrium exists.

Here, to employ a similar type of argument for our model, we need to alter slightly the assumptions made in Chapter III in the following way, where the modified assumptions are indicated by primes.

(Workers)

W1' There are two types of workers, Type I and Type II, whose ability levels are α_1 and α_2, such that $\alpha_1<\alpha_2$, and their proportions in the total work force are β_1 and β_2, such that $\beta_1+\beta_2=1$

W2' Acceptance or reservation wages of each type of workers, are $\underline{w}_1$ and $\underline{w}_2$, such that $\underline{w}_1<\underline{w}_2$.

(Firms)

F1 There is a large number of firms with an identical production process, i.e. a process of training and production; with free entry.

F2 The production function y(x) is solely a function of the number of work ersers, and hence independent of the heterogeneity of the labour force. And $y'>0$ and $y''<0$.

F3 The firms are price takers in a competitive market for their products and are competitive in the labour market, where their competitiveness in the latter means they compete using a wage offer w, and a volume of the input x, in maximizing their profit. (This definition of competitiveness is also employed in Stiglitz & Weiss (1981).)

(Training)

T1 The workers become identically productive, by attaining the skill, irrespective of their α's, after requiring "On-the-Job Training (OJT)".

T2' The cost of the OJT, c, to attain the required job skill differs for the two types of workers are c_1 and c_2, such that $c_1>c_2$.

(Information)

I1' Every worker knows his own ability i.e. α_1 or α_2 and opportunity wage i.e.w_1 or w_2.

I2' Every firm knows β_i, c_i and w_i of Type i workers, for i=1,2, but is not able to distinguish one worker from another.

I3' The firm has a monitoring device which costs μ per worker and is imperfect in such a way that Π_{ij} is the probability that it monitors a Type i worker as a Type j worker i,j=1,2, with $\Pi_{11}+\Pi_{12}=1$, $\Pi_{21}+\Pi_{22}=1$ & Π_{11}, $\Pi_{22}>1/2$.

(Employment Contract)

E1 Employment contracts are negotiated in advance, last for one period and specify a wage, or a set of wages to be paid according to the workers' types.

(Treatment of risk)

R1' Workers are risk averse and have an identical utility function of the von

Neumann-Morgenstern type, whose only factor is wage, i.e. $u(w)$, such that $u'>0$ and $u''<0$.

R2' The firms are risk neutral and maximize expected profits.

(a) Pooling equilibrium with a uniform wage contract

At $\underline{w}_1$, the firm attracts only Type I workers so that its expected profit is,

$$E(\pi)=py(x)-(\underline{w}_1+c_1)x \tag{IV-1}$$

while at $\underline{w}_2$, it attracts the both types of workers so that its expected profit is,

$$E(\pi)=py(x)-(\underline{w}_2+\beta_1c_1+\beta_2c_2)x \tag{IV-2}$$

And $\underline{w}_2$ will be the equilibrium wage, if

$$\underline{w}_1+c_1>\underline{w}_2+\beta_1c_1+\beta_2c_2 \tag{IV-3}$$

$$\text{i.e. } \underline{w}_2-\underline{w}_1<\beta_2(c_1-c_2) \tag{IV-3)'}$$

provided that there exists an excess supply of labour. We define this as a pooling equilibrium as with this wage offer the firm is able to attract the both types of workers with the same condition. In terms of our continuous model of Chapter III, this would be equivalent to saying that at $\underline{w}_2=w(\alpha_2)$, $w(\alpha)+\bar{c}(\alpha)$ is minimized or equally $w'(\alpha)+\bar{c}'(\alpha)=0$

(b) A non-uniform wage contract as an alternative

Now introduce a two-wage contract $W_M=(w_1,w_2)$, with an imperfect and costly monitoring device, where a worker monitored as Type I receives w_1 and a worker monitored as Type II receives w_2. Then the uniform wage contract may be upset if;

(i) one or the both types of workers prefer this contract to the uniform wage contract.

& (ii) the firm can generate profits with this contract that are at least as large as with the uniform wage contract.

The first condition implies that at least one of the following conditions is met.

$$u(\underline{w}_2)<\Pi_{11}u(w_1)+\Pi_{12}u(w_2) \quad \text{for Type I workers} \tag{IV-4}$$

$$u(\underline{w}_2)<\Pi_{21}u(w_1)+\Pi_{22}u(w_2) \quad \text{for Type II workers} \tag{IV-5}$$

Fig.IV-1 illustrates this set of constraints with the assumptions that workers are risk averse and Π_{11}, $\Pi_{22}>1/2$. The curves I and II are the indifference curves of the two types of workers i.e. (IV-4) and (IV-5) with equality, so that (IV-4) and (IV-5) hold to the right of the indifference curves I and II respectively. Our interest lies in the area below the 45° line since $\underline{w}_1<\underline{w}_2$. Any contract in the area A is preferred by the both types of workers to the uniform wage contract indicated as W_p, while any contract in the area B attracts Type II workers only away from the uniform wage contract W_p. And no contract in the area C can attract any worker away from the uniform wage contract. The both curves are

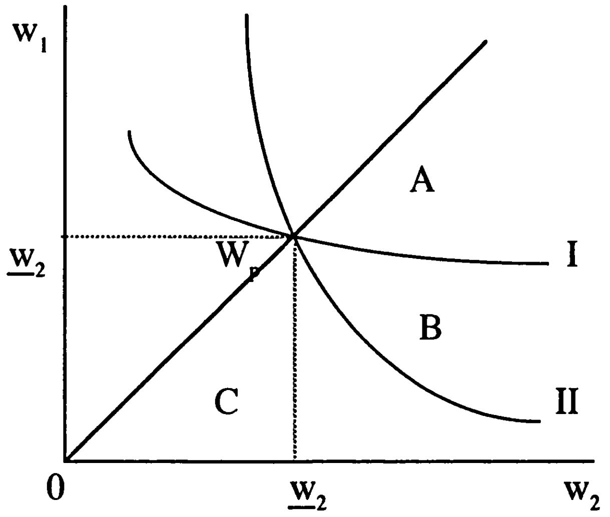


Fig.IV-1

convex to the origin due to the assumption of the risk-averse workers, while the indifference curve I is drawn above the indifference curve II to the right of the 45° line because at W_p the absolute slope of the indifference curve I, Π_{12}/Π_{11} is smaller than the absolute slope of II, Π_{22}/Π_{21} because of Π_{11}, $\Pi_{22}>1/2$. As for the second condition, the firm's expected profit depends on the type or types of workers it can attract by the wage contract. First, if the firm can attract the both types of workers, which implies that the contract must lie in the area A, its expected profit would be

$$\pi_M=py(x)-\{(\beta_1\Pi_{11}+\beta_2\Pi_{21})w_1+(\beta_1\Pi_{12}+\beta_2\Pi_{22})w_2+\beta_1c_1+\beta_2c_2\}x-\mu x \qquad \text{(IV-6)}$$

where $\beta_i\Pi_{ij}$ is the proportion of the workers of Type i monitored as Type j over the whole labour force, with i,j=1,2. It is assumed here that the required labour demand x is satisfied by the labour supply. Here the second condition may be expressed as,

$$(\beta_1\Pi_{11}+\beta_2\Pi_{21})w_1+(\beta_1\Pi_{12}+\beta_2\Pi_{22})w_2+\beta_1c_1+\beta_2c_2-\mu\leq\underline{w}_2+\beta_1c_1+\beta_2c_2 \qquad \text{(IV-7)}$$

$$\text{i.e. } (\beta_1\Pi_{11}+\beta_2\Pi_{21})w_1+(\beta_1\Pi_{12}+\beta_2\Pi_{22})w_2\leq\underline{w}_2-\mu \qquad \text{(IV-7')}$$

However, we can show that such a contract does not exists.

(Proposition IV-1) There is no $W_M=(w_1,w_2)$ that satisfies (IV-4) (IV-5) and (IV-7') simultaneously.

(Proof)

The risk-averse workers means

$$u(\underline{w}_2)<\Pi_{11}u(w_1)+\Pi_{12}u(w_2)<u(\Pi_{11}w_1+\Pi_{12}w_2) \quad \text{for Type I workers}$$

$$u(\underline{w}_2)<\Pi_{21}u(w_1)+\Pi_{22}u(w_2)<u(\Pi_{21}w_1+\Pi_{22}w_2) \quad \text{for Type II workers}$$

and they mean in turn

$$\underline{w}_2<\Pi_{11}w_1+\Pi_{12}w_2 \quad \text{for Type I workers} \qquad \text{(IV-4')}$$

$$\underline{w}_2<\Pi_{21}w_1+\Pi_{22}w_2 \quad \text{for Type II workers} \qquad \text{(IV-5')}$$

Now with (IV-4') and (IV-5'), the right hand side of (IV-7') will be such that

$$(\beta_1\Pi_{11}+\beta_2\Pi_{21})w_1+(\beta_1\Pi_{12}+\beta_2\Pi_{22})w_2>\underline{w}_2>\underline{w}_2-\mu$$

which contradicts (IV-7')

<u>Q.E.D.</u>

Next, if the firm attracts Type II workers only, which implies that the contract must lie in the area B, the expected profit would be

$$\pi_M=py(x)-(\Pi_{21}w_1+\Pi_{22}w_2+\beta_2c_2)x-\mu x \qquad \text{(IV-8)}$$

assuming that the required demand x is satisfied by the supply of Type II workers alone. And this means that the second condition is expressed as,

$$\Pi_{21}w_1+\Pi_{22}w_2+\beta_2c_2-\mu\leq\underline{w}_2+\beta_1c_1+\beta_2c_2 \qquad \text{(IV-9)}$$

$$\text{i.e.}\,\Pi_{21}w_1+\Pi_{22}w_2\leq\underline{w}_2+\beta_1(c_1-c_2)-\mu \qquad \text{(IV-9')}$$

Here we can show that such a contract does not exist if $\beta_1(c_1-c_2)<\mu$

(Proposition IV-2) There is no $W_M=(w_1,w_2)$ that satisfies (IV-5') and (IV-9') if $\beta_1(c_1-c_2)<\mu$.

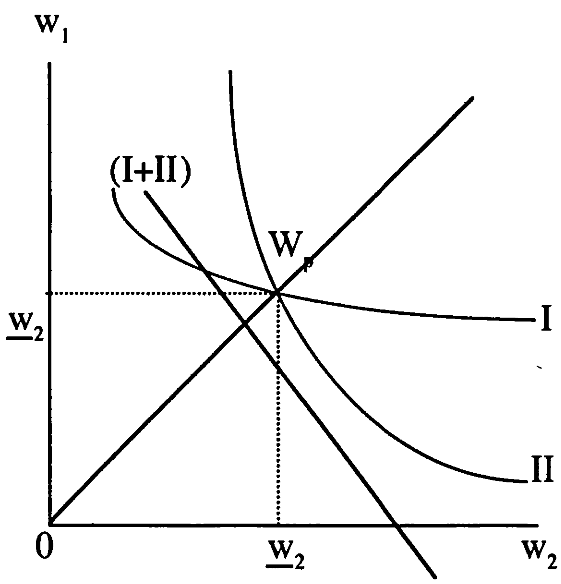
(Proof)

Given $\beta_1(c_1-c_2)<\mu$, (IV-9') implies $\Pi_{21}w_1+\Pi_{22}w_2<\underline{w}_2$. However, this contradicts (IV-5'), the condition derived from the risk-averse Type II workers.

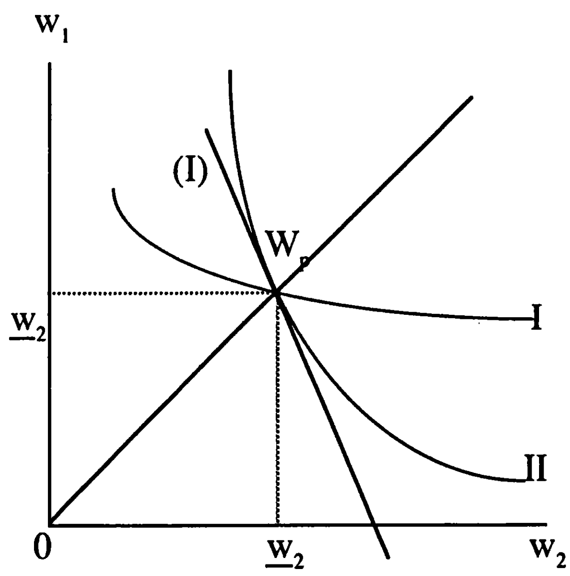
<u>Q.E.D.</u>

As for the area C, there could be no production as no worker can ever be attracted away from the uniform wage contract $W_p=(\underline{w}_2,\underline{w}_2)$.

The two cases are illustrated in Fig.IV-2(a) & (b) together with the indifference curves of Fig.IV-1, where the line in the each figure i.e.(I+II) and (I) indicates the iso-profit lines of the firm. Fig.IV-2(a) shows, however, that there is no monitoring contract $W=(w_1,w_2)$ that can attract the both types of workers away from the uniform wage contract and makes at least as large profit as the uniform wage contract at the same time. This is because the iso-profit line (I+II) cuts the 45° line at $W=(\underline{w}_2-\mu,\underline{w}_2-\mu)$ to the south-west of $W_p=(\underline{w}_2,\underline{w}_2)$ as long as $\mu>0$ and at the slope $(\beta_1\Pi_{12}+\beta_2\Pi_{22})/(\beta_1\Pi_{11}+\beta_2\Pi_{21})$ steeper than the slope of the indifference curve I, Π_{21}/Π_{11}. And when $\mu=0$ the iso-profit condition implies that the only plausible monitoring contract is $W=(\underline{w}_2,\underline{w}_2)\equiv W_p$, i.e. the pooling equilibrium itself.



(a) with Type I & II workers



(b) with Type I workers

Fig.IV-2

The iso-profit line (I) in Fig.IV-2(b) is drawn with the condition that $\beta_1(c_1-c_2)$

$=\mu$. Note here that the iso-profit line (I) is tangential to the indifference curve II at W_p. (I) would shift to the left if $\beta_1(c_1-c_2)<\mu$ and to the right if $\beta_1(c_1-c_2)>\mu$. As in the above case, therefore, no alternative monitoring contract exists if $\beta_1(c_1-c_2) \leq\mu$.

Thus together with (IV-3'), the condition for $\underline{w}_2$ as the pooling equilibrium, the uniform wage contract exists as the equilibrium contract if,

$$\underline{w}_2-\underline{w}_1<\beta_2(c_1-c_2) \ \& \ \beta_1(c_1-c_2)\leq\mu \qquad \text{(IV-10)}$$

In (IV-10), $\beta_2(c_1-c_2)$ is the difference in the average training cost per worker between the two uniform wage contracts, i.e. $\underline{w}_1$ and $\underline{w}_2$, while $\beta_1(c_1-c_2)$ is the difference in the average training cost per worker between the uniform wage contract $W_p=(\underline{w}_2,\underline{w}_2)$ and an monitoring contract $W_M=(w_1,w_2)$ which attracts only Type II workers. Thus these inequalities simply state that in order for the uniform wage offer $\underline{w}_2$ to be an equilibrium,

(i) for the two uniform wage offers, $\underline{w}_1$ and $\underline{w}_2$, the difference in average training cost per worker must be greater than the difference in the wage cost per worker.

(ii) for the uniform wage offer $\underline{w}_2$, or $W_p=(\underline{w}_2,\underline{w}_2)$ equivalently and a monitoring contract $W=(w_1,w_2)$, the reduction in average training cost per worker when the latter is considered must not exceed the cost of monitoring.

In terms of the values of μ, β_1, c_1, c_2, $\underline{w}_1$, and $\underline{w}_2$, this means that the uniform wage assumption is valid when,

(i) μ is sufficiently large, i.e. monitoring cost is large

(ii) β_1 is sufficiently small, i.e. Type II is a large group

(iii) c_1-c_2 cannot be too large or too small, i.e. it needs to be large enough to make $\underline{w}_2$ as the pooling equilibrium rather than $\underline{w}_1$, but at the same time it needs to be not too large to make an alternative contract with monitoring upset $\underline{w}_2$ as the equilibrium wage.

This result helps to clarify the first argument by Weiss (1980) for the assumption of uniform wage that the cost of precise information on the productivity of individual workers may exceed its benefit. While (i) states that acquiring the information may not be worthwhile when its cost is high, (ii) states that a gain in monitoring is small because Type II workers already constitute a large part of the labour force without monitoring. (iii) states that a gain in monitoring is small because the training costs of the two groups of workers are not large enough to offset the cost of monitoring. But at the same time if it is too small this could make the wage offer $\underline{w}_1$ more profitable than $\underline{w}_2$ to the firm.

At this point, it needs to be mentioned that the next step in a standard informational equilibrium literature is to see if any other type of equilibrium exists when the pooling equilibrium fails to exists. A separating equilibrium is the alternative equilibrium, at which there is a set of contracts, $W_1=(w_{11},w_{12})$ and $W_2=(w_{21},w_{22})$, say. And each contract is preferred by one type of workers. We do not go further into the discussion on the separating equilibrium here, since our aim of this chapter is to verify whether the assumption of uniform wage is a valid one by examining the conditions in which the pooling equilibrium with the wage offer $\underline{w}_2$ is likely to occur.

(4) An Application To The Case Where Ability Is Continuous

The argument for the continuous ability case is far more complex and the intuitive reasoning with a help of figures such as Fig.IV-1 & 2 for the two-ability case discussed above is no longer applicable. In this section I merely intend to show that the fundamental approach would remain unchanged when the two-ability case is generalized to the continuous case.

When the heterogeneity of the workers is assumed as in Chapter III, the alternative monitoring contract would take a form $W_M=\{\omega(\alpha)\}$ with $0\leq\alpha\leq 1$. Assuming that the labour demand were fulfilled by Type α^* workers alone, (IV-9), i.e. the condition that it is worthwhile for a firm to offer this monitoring contract, may be expressed as,

$$\int_0^{\alpha^*} \Pi(\alpha^*,\alpha)\omega(\alpha)d\alpha+c(\alpha^*)+\mu\leq w(\alpha^*)+\bar{c}(\alpha^*) \qquad \text{(IV-11)}$$

where $\Pi(\alpha^*,\alpha)$ is the probability of a Type α^* worker being monitored as Type α, such that $\int_0^1 \Pi(\alpha^*,\alpha)d\alpha=1$ and $\omega(\alpha)$ is the wage offer to Type α workers. However, the assumption that all the labour demand would be satisfied by Type

α workers clearly is not plausible as the supply of labour of Type α workers alone is zero in the continuous case. Rather, the left hand side of (IV-11) should be taken as the lower bound of the average training cost, for employing the workers with $\alpha<\alpha^*$ would result in an increase in the average labour cost. Of course, $W_M=\{\omega(\alpha)\}$ also has to meet the condition that this will only attract Type α^* workers only away form the pooling contract with the uniform wage $w^*=w(\alpha^*)$. Let us assume that this is also met.

Then no monitoring contract can attract away the workers from the pooling contract if the lower bound of its average labour cost, i.e. wage cost and training cost per worker, is greater than the corresponding cost for the pooling contract.

$$\text{i.e.} \int_0^{\alpha^*} \Pi(\alpha^*,\alpha)\omega(\alpha)d\alpha+c(\alpha^*)+\mu>w(\alpha^*)+\bar{c}(\alpha^*) \qquad \text{(IV-12)}$$

By rearranging (IV-12), we can obtain the analogous condition to (IV-9') as,

$$\int_0^{\alpha^*} \Pi(\alpha^*,\alpha)\omega(\alpha)d\alpha>w(\alpha^*)+\bar{c}(\alpha^*)-c(\alpha^*)-\mu \qquad \text{(IV-13)}$$

Here the same argument as Proposition IV-2 may be applied to state that the pooling equilibrium exists if $\bar{c}(\alpha^*)-c(\alpha^*)<\mu$. And this holds if,

(i) μ is sufficiently large

(ii) $\bar{c}(\alpha^*)-c(\alpha^*)$ is sufficiently small

Here the first condition is identical to the case of the two-type ability case. The second condition says that the difference between the average training cost among the workers with $0 \leq \alpha \leq \alpha^*$ and the training cost of the workers with α^* is very small. It is easy to deduce here that this difference is small when $c(\alpha)$ is relatively flat since this would imply that $\bar{c}(\alpha)$ does not differ much from $c(\alpha)$ for all values of α and for α^* in particular, and when the workers are concentrated at the higher values of α since this would imply a generally low level of $\bar{c}(\alpha)$. And again these conditions are the same as the conditions derived for the two-ability case.

In this chapter we have established the following;

First, we examined the reasons put forward by Weiss (1980) for the validity of the uniform wage assumption in the adverse selection model of the efficiency wage hypothesis. Of the three reasons we examined, it was concluded that the only valid reason was the first argument that the cost of precise information on the productivity of individual workers may exceed its benefit. However, it was pointed out that there is a need to offer a more theoretically rigorous argument. The other two reasons were ruled out as they are not necessarily based on the adverse selection mechanism.

Secondly, the model in Chapter III was slightly modified to apply the argument in the informational equilibrium literature to offer the more theoretical approach of the Weiss's first argument. Using a two-type ability worker model, our equilibrium was established and defined as the pooling equilibrium.

Thirdly, the robustness of the pooling equilibrium was discussed against other alternative wage contracts with imperfect and costly monitoring. And it was concluded that the pooling equilibrium exists and thus the uniform wage equilibrium derived in Chapter III is valid when the monitoring cost is high, the proportion of the workers with high ability is high, and/or the training cost difference among the workers of different ability level is neither too small or too large.

And finally, an attempt was made to generalize these results to the case of the continuous ability, in which it was found that the same line of argument may be applied and that the conditions for the pooling equilibrium to be robust were the same as in the case of the two-ability worker case.

CHAPTER V : TWO-PERIOD MODELS OF TRAINING

In this chapter, we add one more period to our analysis of the training model This would be a reasonable extension, as training is essentially a dynamic issue. However, the main purpose of this extension here is to contrast our training model of heterogeneous labour with the adverse selection models based on the efficiency unit assumption such as Weiss (1980), so that the model is kept as simple as possible. The discussions proceed in three steps. First, the general framework of the model is briefly explained in relation to the Weiss model as well as other training models. Then a two-period model is introduced, in which the firm maximizes its profit for each period. And finally, we consider the two-period model with the firm maximizing the present value of the profit stream.

(1) The Basic Framework

The basic framework of the model remains unchanged in this two period case. Thus in the period I the workers receive the training alongside production. In the period II the workers are assumed to become equally productive and need no more OJT. Thus in the period II the firm does not have preference among its work force, while the Weiss' firm was never indifferent about its work force. In fact the assumption in the adverse selection model that the firm never learns about the heterogeneous productivity of its workers is often called into question.

This becomes even more questionable when the model has to operate several periods. Besides, it would be difficult to model the upward-sloping wage profile within the Weiss' framework.

Indeed, one of the main features of the labour models with specific training See, for example, Donaldson & Eaton (1976), Nickell (1976), Ohashi (1983), or Felli & Harris (1996), is the derivation of an upward-sloping wage profile. The firm invests in workers by training them in the first period to receive the return in the second period. However, if the worker quits it can not procure the return. As a result the firm sets the wage lower in the first and higher in the second periods, to prevent the premature quitting by the trained workers. Note that this OJT has to be specific for this result to hold, since the standard view is that the firm is not going to pay for general training. The incidence of training cost was discussed with the survey on training models in Chapter II. As pointed out, the distinction between general training and specific training is not the core assumption in some of the recent models such as Stevens (1994c) and Acemoglu (1997).

Most of the training models assume homogeneous labour and consequently there is no adverse selection, let alone the existence of unemployment. The exception is Salop & Salop (1976), who assume that the quit rate is a negative function of wage offer. When new workers are recruited in place of the quitters, there is a fixed cost of training them. There is an adverse selection in the sense that the higher the wage offer is the more reliable the type of labour will be reducing the average quit rate and hence the lower the total training cost will be. Hence the firm has to weigh the wage cost and the training cost, to determine the wage offer. Salop & Salop (1976)'s modelling of a labour market with training and heterogeneous aspects is very similar to ours. However, the heterogeneity is not as explicit as ours with c(•) and thus can not relate easily the degree of heterogeneity and the nature of equilibrium.

We assume that the firm always "pays" for the training whether it is general or specific. This is because with heterogeneous labour it is costly for the firm to determine the training cost of each worker to charge them individually. Instead, the firm prefers to pay the total training cost. This assumption is supported by the descriptive arguments by Weiss (1980) and Manning (1994) as well as the pooling equilibrium analysis in Chapter IV that monitoring of the individual training cost itself is costly because of the heterogeneity of the work force. Acemoglu (1997) argues that the training is general and yet the training firms do pay for it in some countries where the level of training is high such as in Germany and Japan and thus sets up his model accordingly. However, it goes without saying that the real incidence of the training cost is likely to be shared between the two, as in a typical tax incidence argument. In the multi-period, the nature of training plays an important role in determining the opportunity wage of the post-training periods. This is because the more general the training is the higher the productivity in an alternative job will be. Thus his opportunity wage i.e. the wage he can demand in the alternative job will rise with the degree of generality of the training In the present model we will assume that the training has both general and specific elements in such a way that the opportunity wage of the trained worker in the post-training period is $w(\alpha_1{}^*)+k\bar{c}(\alpha_1{}^*)$, where $0\leq k\leq 1$ is a parameter of general applicability of the training. Thus if $k=0$ it is completely specific, while $k=1$ implies a fully general type of training.

(2) Case I : Optimizing At Each Period

First, assume that every firm maximizes the profit in the each period. Then for the period I, the firm maximizes the profit π with respect to the employment level x_1 and the ability index α_1, with the subscript signifying the period I,

$$\pi_1=py(x_1)-[w(\alpha_1)+\bar{c}(\alpha_1)]x_1 \tag{V-1}$$

This is equivalent to the optimization problem in Chapter III of the single period case and the corresponding first order conditions are

$$\partial\pi_1/\partial x_1=py'(x_1)-[w(\alpha_1)+\bar{c}(\alpha_1)]=0 \tag{V-2}$$

$$\partial\pi_1/\partial\alpha_1=-[w'(\alpha_1)+\bar{c}'(\alpha_1)]x_1=0 \tag{V-3}$$

Then the solution $\{\alpha_1{}^*, w_1{}^*, x_1{}^*\}$ could cause either excess supply or market clearing in the labour market, depending on the supply availability. As for the incidence of the training cost, (V-1) simply repeats our assumption that the firm pays for the training i.e. $\bar{c}(\alpha_1)x_1$ irrespective of the type of training. Also note that from (V-2) the wage is equated to the net marginal productivity, i.e. net of training cost, and consequently there is no discrepancy between the wage and the marginal productivity. This point is worth mentioning since the discrepancy is a much-discussed issue in the training literature in relation to the labour turnover.

In the period II, with x_1* workers already needing no more training the firm maximizes the profit π_2 by choosing the levels of wage offer w_2, through determination of α_2, and of employment x_2, given α_1* and x_1*, where

$$\pi_2=py(x_2)-[w(\alpha_2)+\bar{c}(\alpha_2)](x_2-x_1^*)-[w(\alpha_1^*)+k\bar{c}(\alpha_1^*)]x_1^* \tag{V-4}$$

The second term refers to the labour cost i.e. wage and training, of new workers and the third to the wage cost i.e. the opportunity wage, of the existing workers. And the first order conditions are,

$$\partial\pi_2/\partial x_2=py'(x_2)-[w(\alpha_2)+\bar{c}(\alpha_2)]=0 \tag{V-5}$$

$$\partial\pi_2/\partial\alpha_2=-[w'(\alpha_2)+\bar{c}'(\alpha_2)]x_2=0 \tag{V-6}$$

which are in fact identical to the first order conditions for the period I.

Thus, $\alpha_2^*=\alpha_1^*$, $w_2^*=w_1^*$, and $x_2^*=x_1^*$ and the firm repeats his action in the period II. This rather trivial result is due to the fact that the reduction in the total cost of training x_1* workers in the period II i.e. $\bar{c}(\alpha_1^*)x_1^*$, is a fixed sum by the time x_1* is decided and thus does not affect the firm's decision in the period

II. (V-6) implies that the optimal wage is unaffected and neither is the best group of workers for the firm. And this in turn means that with (V-5) the demand for labour remains as before. This generates an upward-sloping wage profile over the periods with $w_1^*=w(\alpha_1^*)$ and $w_2^*=w(\alpha_1^*)+k\bar{c}(\alpha_1^*)$. And the profile becomes steeper as the degree of generality i.e. k rises. This is true as long as the excess supply condition holds. Note also that there will be no more recruitment as long as $0\leq k<1$, since for the period II the existing worker costs $w_2^*=w(\alpha_1^*)+k\bar{c}(\alpha_1^*)$, while the new worker would cost $w_2^*=w(\alpha_1^*)+\bar{c}(\alpha_1^*)$, and $w(\alpha_1^*)+k\bar{c}(\alpha_1^*)<w(\alpha_1^*)+\bar{c}(\alpha_1^*)$. When k=1, on the other hand, the firm becomes indifferent between the two groups of workers in the period II. For example, the firm could lay off all the existing workers and employ totally new labour force. This can be interpreted as not following a seniority rule, with the seniority rule being defined as giving a priority of employment to the longer serving workers. It goes without saying that when $0\leq k<1$ the rule holds as no new worker is employed. If more workers are needed in the period II due to an exogeneous increase in the product demand, the firm will still seek for the same type of workers by offering the same optimal wage as long as the excess supply exists. The new workers would then receive $w(\alpha_1^*)$ in the period II, i.e. what the existing workers received in the period I, while the latter will have a wage increased to $w(\alpha_1^*)+k\bar{c}(\alpha_1^*)$.

We may contrast this result with how the Weiss model would perform in the two period case. If the profit maximization is done at each period as in our model, the Weiss model would produce the identical equilibria in the two periods. As a consequence, the wage profile will always be flat and there will be no seniority rule concerning who is to employ first. Considering the fact that the formation of human capital over time may play an important role in the operation of a labour market, these results require some justifications. Furthermore, the Weiss' firm would remain ignorant about the productivity of each worker over two periods i.e. even after the production is completed. It is difficult to imagine that the firm continues to turn the blind eye to the information on the true productivity of the heterogeneous workers.

(3) Case II : Optimizing Over Two Periods

So far the firm was assumed to act as a profit maximizer in each period. However, it is probably more realistic to assume that it maximizes the profit stream over time, as it takes time to generate the return on the training. Therefore, the firm would maximize, by setting the wage offer $\{w_1, w_2\}$ and the employment levels x_1 and x_2, the present value of the profit stream $PV(\pi)$,

$$PV(\pi)=py(x_1)-[w_1+\bar{c}(\alpha)]x_1+(1+r)^{-1}[py(x_2)-w_2x_2] \qquad \text{(V-7)}$$

where r is the discount rate. Before we move on to the firm's optimization, note that it has to offer an attractive wage profile to the workers as well as maximizing its own present value. We tackle this by two steps. First list up all the wage profiles $\{w_1,w_2\}$ that gives the same labour cost to the firm. Then the worker's utility maximizing wage profile is derived given some constraints on the profile. As $\bar{c}(\alpha)$ appears in (V-7), w_1 & w_2 must attract those workers with the ability below α, one of the wage profiles being $w_1=w(\alpha)$ & $w_2=w(\alpha)+k\bar{c}(\alpha)$. Then the firm could give any other wage profile as long as labour cost remains unchanged. Therefore, for the given values of α, x_1, and x_2, w_1 & w_2 will satisfy the following condition,

$$[w_1+\bar{c}(\alpha)]x_1+(1+r)^{-1}w_2x_2=[w(\alpha)+\bar{c}(\alpha)]x_1+(1+r)^{-1}[w(\alpha)+k\bar{c}(\alpha)]x_2 \quad \text{(V-8)}$$

$$\text{i.e. } w_1x_1+(1+r)^{-1}w_2x_2=w(\alpha)x_1+(1+r)^{-1}[w(\alpha)+k\bar{c}(\alpha)]x_2 \quad \text{(V-8)'}$$

Assume further that there is no turnover, i.e. no worker quits or is laid off, and thus $x_1=x_2=x$. A typical specific training model — see, for example, Hashimoto (1981), Nickell (1976), Donaldson & Eaton (1976), or Ohashi (1983), would assume the turnover rate to be determined within the model. And in particular, a quit rate is generally assumed to be a positive function of the period II wage, with the rationale that the partly deferred payment reduces their incentive to quit, and this is the reason for the upward-sloping wage profile in general. In the present model, we do not have to worry about the deferment since the productivity rises over time at the firm as well as outside in our model as long as $k>1$. On the whole, it is not intuitively appealing to assume that the firm sets the quit rate above zero by setting the wage profile, unless this is done to screen the workers.

This assumption sets ranges to the values of w_1 & w_2. First, observe that $x_1=x_2=x$ changes (V-8)' to,

$$w_1+(1+r)^{-1}w_2=w(\alpha)+(1+r)^{-1}[w(\alpha)+k\bar{c}(\alpha)] \qquad \text{(V-8)''}$$

Suppose now that $w_1>w(\alpha)$. Then by (V-8)", $w_2<w(\alpha)+k\bar{c}(\alpha)$. The workers would find it to their benefit to quit the firm at the end of the period I, since they can earn $w(\alpha)+k\bar{c}(\alpha)$ elsewhere by definition. Thus, in order to keep the trained workers for the period II, the firm needs to set the wages to the ranges of

$$w_1\leq w(\alpha) \;\;\&\;\; w_2\geq w(\alpha)+k\bar{c}(\alpha) \qquad \text{(V-9)}$$

If, on the other hand, the wage in the period I is too low, the workers might find it difficult to believe the firm's no-layoff policy. Thus the firm has to offer a wage profile which shows that laying off the trained workers to replace them with the new workers is more costly than keeping the existing labour force and thus it has no intension to do so.

$$\text{i.e. } w_1+\bar{c}(\alpha)+(1+r)^{-1}[w(\alpha)+\bar{c}(\alpha)]\geq w_1+\bar{c}(\alpha)+(1+r)^{-1}w_2 \qquad \text{(V-10)}$$

$$\text{i.e. } w(\alpha)+\bar{c}(\alpha)\geq w_2$$

And with (V-8)'', the workers believe that there is no lay off, if

$$w_1\geq w(\alpha)-[(1-k)/(1+r)]\bar{c}(\alpha) \;\&\; w_2\leq w(\alpha)+\bar{c}(\alpha) \qquad \text{(V-11)}$$

(V-9) and (V-11) together set the ranges of w_1 & w_2 as,

$$w(\alpha)-[(1-k)/(1+r)]\bar{c}(\alpha)\leq w_1\leq w(\alpha) \quad \& \quad w(\alpha)+k\bar{c}(\alpha)\leq w_2\leq w(\alpha)+\bar{c}(\alpha)$$

(V-12)

a quick glance at which tells us $w_1\leq w(\alpha)\leq w(\alpha)+k\bar{c}(\alpha)\leq w_2$, i.e. $w_1\leq w_2$, with the equality holding when k=0. So the wage profile is either flat or upward-sloping.

Given (V-12), the firm would set the wages to attract the workers. If the workers are assumed to be risk-averse following the analysis of Chapter V, the firm needs to offer a wage profile that maximizes the present value of the worker's utility, PV(U)

$$PV(U)=u(w_1)+(1+r)^{-1}u(w_2)$$

$$\text{s.t. } w_1\geq w(\alpha)-[(1-k)/(1+r)]\bar{c}(\alpha) : \lambda_1 \qquad \text{(V-13)}$$

$$w_1\leq w(\alpha) : \lambda_2 \qquad \text{(V-14)}$$

$$w_1+(1+r)^{-1}w_2=w(\alpha)+(1+r)^{-1}[w(\alpha)+k\bar{c}(\alpha)] : \mu \qquad \text{(V-15)}$$

where the λ_1 and λ_2 are the multipliers for the w_1 constraints on the lower bound and the upper bound respectively, while μ is for the iso-labour cost condition of the firm so that this with (V13) & (V-14) will set the lower and the upper bounds of w_2. Then the Lagrangian *L* is;

$$L=u(w_1)+(1+r)^{-1}u(w_2)+\lambda_1[w_1-w(\alpha)-[(1-k)/(1+r)]\bar{c}(\alpha)]+\lambda_2[w_1-w(\alpha)]$$
$$+\mu[w(\alpha)+(1+r)^{-1}[w(\alpha)+k\bar{c}(\alpha)]-w_1-(1+r)^{-1}w_2] \qquad \text{(V-16)}$$

Note that the multipliers are set so that they become either zero if the constraint is not binding or positive if binding. In particular, λ_1 and λ_2 will have to satisfy one of the three conditions ; (1) $\lambda_1>0$ & $\lambda_2=0$, i.e. $w_1=w(\alpha)-[(1-k)/(1+r)]\bar{c}(\alpha)$, which means from (V-8)'', $w_2=w(\alpha)+\bar{c}(\alpha)$, (2) $\lambda_1=0$ & $\lambda_2=0$, i.e. $w(\alpha)-[(1-k)/(1+r)]\bar{c}(\alpha)<w_1<w(\alpha)$, which means from (V-8)'', $w(\alpha)+k\bar{c}(\alpha)<w_2< w(\alpha)+\bar{c}(\alpha)$, or (3) $\lambda_1=0$ & $\lambda_2>0$, i.e. $w_1=w(\alpha)$, which means from (V-8)'', $w_2=w(\alpha)+k\bar{c}(\alpha)$ Then the first order conditions imply the following,

$$u'(w_1)+\lambda_1-\lambda_2-\mu=0 \tag{V-17}$$

$$u'(w_2)-\mu=0 \tag{V-18}$$

as well as the constraints. Eliminating μ from (V-17) and (V-18), we obtain,

$$u'(w_1)-u'(w_2)+\lambda_1-\lambda_2=0$$

If (1) $\lambda_1>0$ & $\lambda_2=0$, then $u'(w_1)-u'(w_2)<0$ and thus $w_1>w_2$. This is not consistent with (V-12). If (2) $\lambda_1=0$ & $\lambda_2=0$, then $u'(w_1)-u'(w_2)=0$ and thus $w_1=w_2$. But it only holds when $k=0$. It turns out (3) $\lambda_1=0$ & $\lambda_2>0$ is the solution, when $w_1=w(\alpha)$ and $w_2=w(\alpha)+k\bar{c}(\alpha)$ from (V-8)".

Fig.V-1 illustrates the optimization on the w_1-w_2 wage space. The negatively-sloped line AD indicates the firm's iso-wage cost line (V-8)", while the segment BC on the line AD is derived from the no-turnover condition (V-12). Note that any $\{w_1,w_2\}$ on the segment CD gives the firm incentive to lay off the workers while any on AB gives the workers incentive to quit. Among the indifference curves U_1, U_2 and U_3, U_2 satisfies the optimization and the optimal point is B which is a corner solution with $w_1=w(\alpha)$ & $w_2=w(\alpha)+k\bar{c}(\alpha)$.. Note that at B the marginal rate of substitution of PV(U) between the wages of the two periods is greater than the relative values of the cost in the two periods for the firm, given $w_1 \leq w_2$,

i.e. $[u'(w_1)/u'(w_2)](1+r) \geq 1+r$ (V-19)

And B is indeed the corner solution.

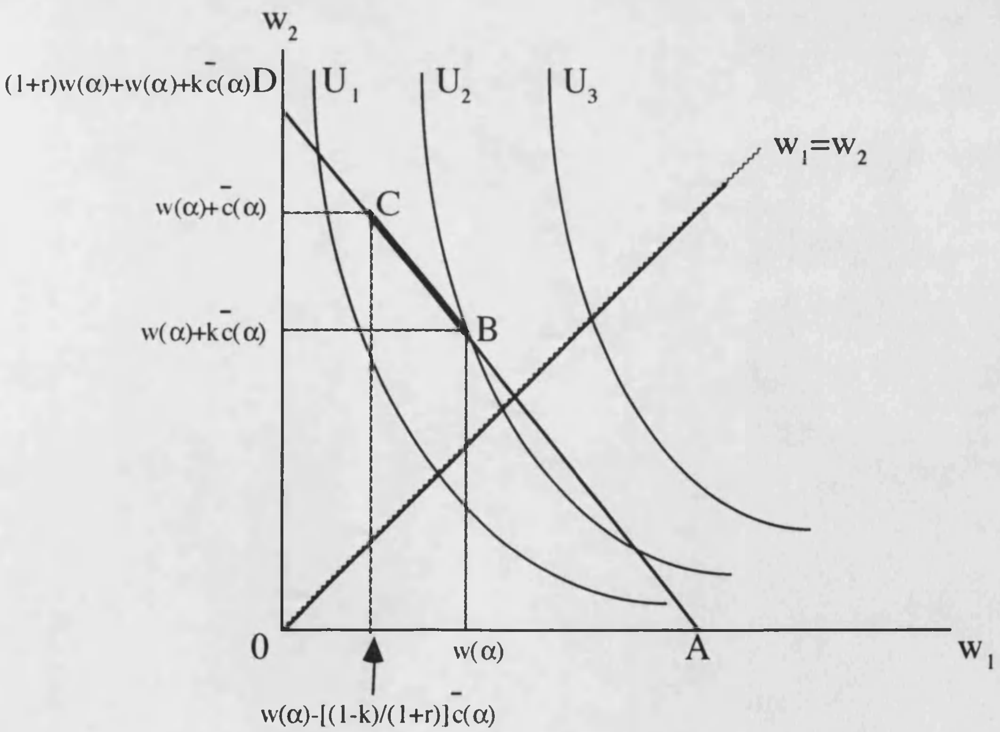


Fig.V-1

The solution at B means among various wage profiles $\{w_1,w_2\}$ satisfying the iso-wage cost line (V-8)'', the workers favour the flattest profile acceptable to the firm --- any profile flatter than this would make workers quit after the period I and thus not acceptable to the firm, following the earlier argument of the chapter.

Therefore substituting $w_1=w(\alpha)$ & $w_2=w(\alpha)+k\bar{c}(\alpha)$ into (V-7), the firm's optimization is reduced to,

$$\max PV(\pi)=py(x)-[w(\alpha)+\bar{c}(\alpha)]x+(1+r)^{-1}\{py(x)-[w(\alpha)+k\bar{c}(\alpha)]x\} \quad \text{(V-20)}$$

The first order conditions are;

$$\partial PV(\pi)/\partial x=py'(x)-[w(\alpha)+\rho\bar{c}(\alpha)]=0 \quad \text{(V-21)}$$

$$\partial PV(\pi)/\partial \alpha=-[1+(1+r)^{-1}][w'(\alpha)+\rho\bar{c}'(\alpha)]x=0 \quad \text{(V-22)}$$

where $\rho=(1+r+k)/(2+r)$

They resemble the first order conditions derived in Chapter III as well as those of the two period model of this chapter, with the main difference being the introduction of ρ. The function $\rho(k,r)$ can be easily verified to be an increasing function of both k and r and to range from 1/2 to 1, as k ranges from 0 to 1 and r from 0 to infinity. Fig.V-2 shows how ρ changes with k for a given value of r.

ρ

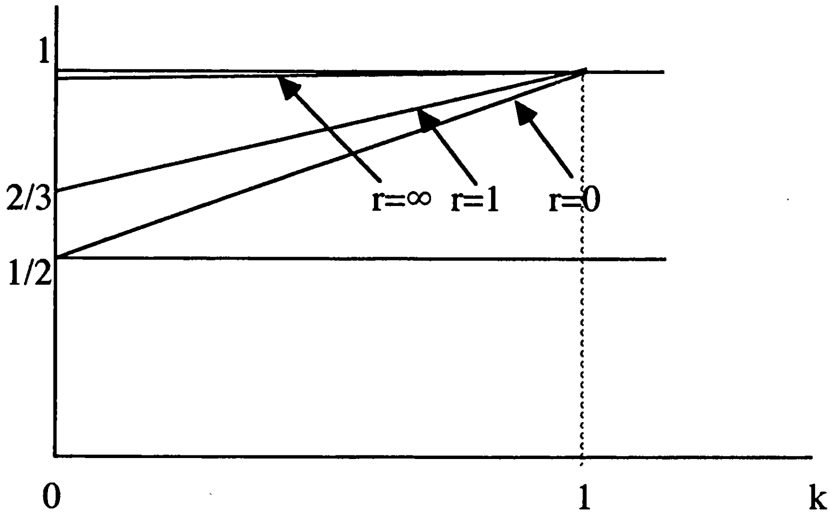


Fig.V-2

We differentiate (V-21) and (V-22) with respect to ρ and obtain the following comparative static results.

$$d\alpha/d\rho=-\bar{c}(\alpha)/[w''(\alpha)+\rho\bar{c}''(\alpha)]>0 \qquad \text{(V-23)}$$

$$dx/d\rho=\bar{c}(\alpha)/py''(x)<0 \qquad \text{(V-24)}$$

Thus a high value of ρ would mean a high level of α and a high level of w in turn by $w=w(\alpha)$ but a low level of x, and vice versa. Recall the average labour cost function of Chapter III : $\Psi(\alpha)=w(\alpha)+\rho\bar{c}(\alpha)$ and redefine as $\Psi(\alpha|\rho)=w(\alpha)+\rho\bar{c}(\alpha)$. The economic interpretation of this result is that as ρ falls, the weight on $\bar{c}(\alpha)$ in the average labour cost function : $\Psi(\alpha|\rho)=w(\alpha)+\rho\bar{c}(\alpha)$, making low ability workers less costly, as well as reducing the labour cost itself. As a result, the firm reduces the general ability of the workers by offering a lower wage and raises the employment level.

Fig.V-3 illustrates visually what is happening. On the right hand side of the diagramme, the average labour cost functions for high and low values of ρ, i.e. $\Psi(\alpha|\rho_H)=w(\alpha)+\rho_H\bar{c}(\alpha)$ and $\Psi(\alpha|\rho_L)=w(\alpha)+\rho_L\bar{c}(\alpha)$, as well as $w(\alpha)$ are drawn. Note that as $\rho_H>\rho_L$ $\Psi(\alpha|\rho_H)$ is drawn above $\Psi(\alpha|\rho_L)$ and by (V-24) $\alpha_H*>\alpha_L*$, where they are the solutions to $\Psi'(\alpha|\rho_H)=0$ and $\Psi'(\alpha|\rho_L)=0$ respectively i.e. (V-22). They in turn generate $w_H*=w(\alpha_H*)>w_L*=w(\alpha_L*)$. On the left hand side of the diagramme, the marginal productivity is drawn against the employment level i.e. $py'(x)$, which is equated to $w(\alpha)+\rho_H\bar{c}(\alpha)$ or $w(\alpha)+\rho_L\bar{c}(\alpha)$ i.e. (V-21), which in turn gives x_H* or x_L*. The diagramme indicates $x_H*<x_L*$, as $py'(x)$ is a decreasing function of x and $w(\alpha_H*)+\rho_H\bar{c}(\alpha_H*)>w(\alpha_L*)+\rho_L\bar{c}(\alpha_L*)$. Note that $w(\alpha_H*)$ is w_1, the wage for the period I, and w_2 is $w(\alpha_H*)+k\bar{c}(\alpha_H*)$. And if there is an excess supply with ρ_H, then ρ_L would generates the lower supply level and the higher demand level, reducing the excess supply.

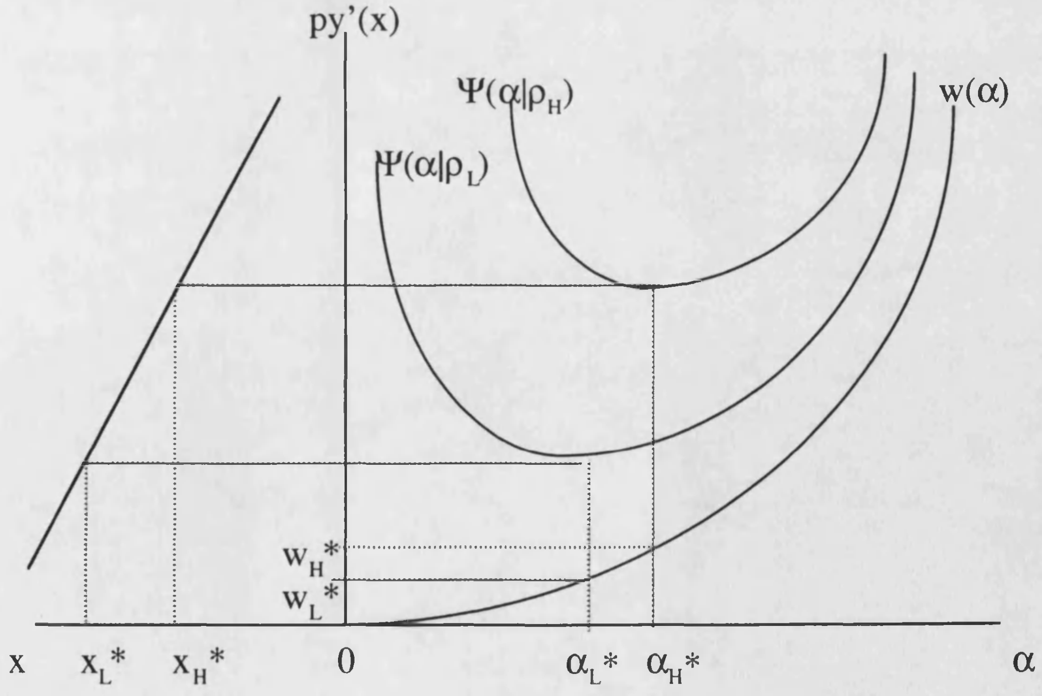


Fig.V-3

Let us verify this result in terms of r, the discount rate and k, the parameter of general applicability of the training. Firstly, the higher the discount rate is the closer ρ becomes to one and the more it resembles to the one-period case. This is not surprising since a high discount rate means less importance attached to the future activities. Because the training cost incurs in the period I and the benefit of training is generated in the period II, the firm would put more on reducing the cost than when the discount rate is high i.e. r is large. To see this consider (V-20) when r=0 and $r \to \infty$ i.e. $2\{py(x)-[w(\alpha)+(1/2)(1+k)\bar{c}(\alpha)]x\}$ and $py(x)-[w(\alpha)+\bar{c}(\alpha)]x$ respectively. The coefficient $\bar{c}(\alpha)$ is larger relative to the coefficients of $w(\alpha)$ in the latter case. As a result the firm would quote a higher wage to attract workers with lower training cost i.e. abler workers, and the employment level will be lower because of the higher labour cost. As for the market equilibrium, an increase in the supply of labour as a result of the wage increase and a decrease in the demand for labour as a result of the labour cost increase will make the excess supply more likely, as long as the supply conditions remains unchanged.

Secondly, a large value of k has essentially the same effect on the firm's behaviour as well as on the labour market equilibrium as that of r through ρ. Consider two types of training with one being more specific than the other and call them specific training and general training with parameters $k_s<k_g$ respectively. By the analogous argument to those of $\rho_H>\rho_L$, the optimal wages will be such that $w_s^*=w(\alpha_s^*)<w_g^*=w(\alpha_g^*)$ since $\alpha_s^*<\alpha_g^*$. Thus the period I wage is higher for the job offering general training than specific training. In order to see the way the generality of training affects the period I wage, rewrite (V-20) as

$$PV(\pi)=\{1+(1+r)^{-1}\}\{py(x)-[w(\alpha)+(1+r+k)(2+k)^{-1}\bar{c}(\alpha)]x\} \qquad \text{(V-20)'}$$

The more general the training is, the higher k and thus the opportunity wage will be. This makes the coefficient on $\bar{c}(\alpha)$ larger and the optimal wage will be larger, as an increase in α reduces the training cost term $(1+r+k)(2+k)^{-1}\bar{c}(\alpha)$ more than it raises the wage cost term $w(\alpha)$ with higher k. Note that the demand for labour i.e. x, will be lower for the general training as high k means generally high labour cost $w(\alpha)+(1+r+k)(2+k)^{-1}\bar{c}(\alpha)$. This together with larger labour supply due to a higher wage offer means that the excess supply is more likely for general training at the equilibrium. (See Fig.V-3)

The wage profiles will be $\{w(\alpha_s^*), w(\alpha_s^*)+k_s\bar{c}(\alpha_s^*)\}$ for the specific training and $\{w(\alpha_g^*), w(\alpha_g^*)+ k_g\bar{c}(\alpha_g^*)\}$ for the general training, where $w(\alpha_s^*)+k_s\bar{c}(\alpha_s^*)< w(\alpha_g^*)+k_g\bar{c}(\alpha_g^*)$ can be shown with some extra calculations. We need to determine the sign of

$$(d/dk)[w(\alpha)+k\bar{c}(\alpha)] \text{ given } w'(\alpha)+(1+r+k)/(2+r)\bar{c}'(\alpha)=0$$

Now $(d/dk)[w(\alpha)+k\bar{c}(\alpha)]=[w'(\alpha)+k\bar{c}'(\alpha)](d\alpha/dk)+\bar{c}(\alpha)$

But $w'(\alpha)+\rho\bar{c}'(\alpha)=0$ implies $w'(\alpha)+(k-k+\rho)\bar{c}'(\alpha)=0$. Thus,

$$w'(\alpha)+k\bar{c}'(\alpha)=(k-\rho)\bar{c}'(\alpha)=[(1+r)(k-1)/(2+r)]\bar{c}'(\alpha)>0$$

since $k<1$ & $\bar{c}'(\alpha)<0$. And differentiating $w'(\alpha)+(1+r+k)/(2+r)\bar{c}'(\alpha)=0$ with respect to k, we obtain,

$$w''(\alpha)(d\alpha/dk)+(2+r)^{-1}\bar{c}'(\alpha)+[(1+r+k)/(2+r)]\bar{c}''(\alpha)(d\alpha/dk)=0$$

$$\therefore d\alpha/dk=-\bar{c}'(\alpha)/(2+r)\{w''(\alpha)+[(1+r+k)/(2+r)]\bar{c}''(\alpha)\}>0$$

since $\bar{c}'(\alpha)<0$ & $w''(\alpha)+[(1+r+k)/(2+r)]\bar{c}''(\alpha)>0$. Thus

$$(d/dk)[w(\alpha)+k\bar{c}(\alpha)]=[w'(\alpha)+k\bar{c}'(\alpha)](d\alpha/dk)+\bar{c}(\alpha)>0$$

Therefore if $k_s<k_g$, $w(\alpha_s^*)+k_s\bar{c}(\alpha_s^*)< w(\alpha_g^*)+k_g\bar{c}(\alpha_g^*)$ i.e. the more general the training is, the higher the wage profile will be. Furthermore, as k increases from 0 to 1, the difference between the wages of the two periods i.e. $k\bar{c}(\alpha)$ increases from 0 to $\bar{c}(\alpha)$. Thus the wage profile becomes steeper with the generality of training between the two polar cases. (The rate of wage increase from the period I to the period II can be defined by $k\bar{c}(\alpha)/w(\alpha)$. And widening of the difference by the generality of training would mean $d/dk\{k\bar{c}(\alpha)/w(\alpha)\}>0$. However, without specifying the functional forms of $\bar{c}(\alpha)$ and $w(\alpha)$, this sign is indeterminate for $0<k<1$.) On the other hand, the demand for labour is higher for the specific training i.e. $x_s^*>x_g^*$, while each firm receives less workers for the specific training case as $w_s^*<w_g^*$. Then the excess supply in the labour market will be reduced and the possibility of market clearing will emerge.

These results are summarized in Table V-1 and Fig.V-4

The last result does not seem convincing at the first glance. One may expect that relatively general training creates a fairly competitive atmosphere, as the acquired skill itself is applicable in all the firms. However, what really happens here is that a higher opportunity wage in the period II raises the average labour cost over the two periods and as a result the labour demand is reduced. At the same time the increased weight on the training cost i.e. $k\bar{c}(\alpha)$ raises the optimal wage and that attracts more workers. Together, they are more likely to generate an excess supply equilibrium than with relatively specific training in the labour market.

Type of training	More specific		More general
k	k_s	$<$	k_g
Optimal wage	$w_s^* = w(\alpha_s^*)$	$<$	$w_g^* = w(\alpha_g^*)$
Wage profile : w_1	$w(\alpha_s^*)$	$<$	$w(\alpha_g^*)$
: w_2	$w(\alpha_s^*) + k_s\bar{c}(\alpha_s^*)$	$<$	$w(\alpha_g^*) + k_g\bar{c}(\alpha_g^*)$
Labour demand	x_s^*	$>$	x_g^*
Market equilibrium is more likely to be;	Market clearing		Excess supply

Table V-1

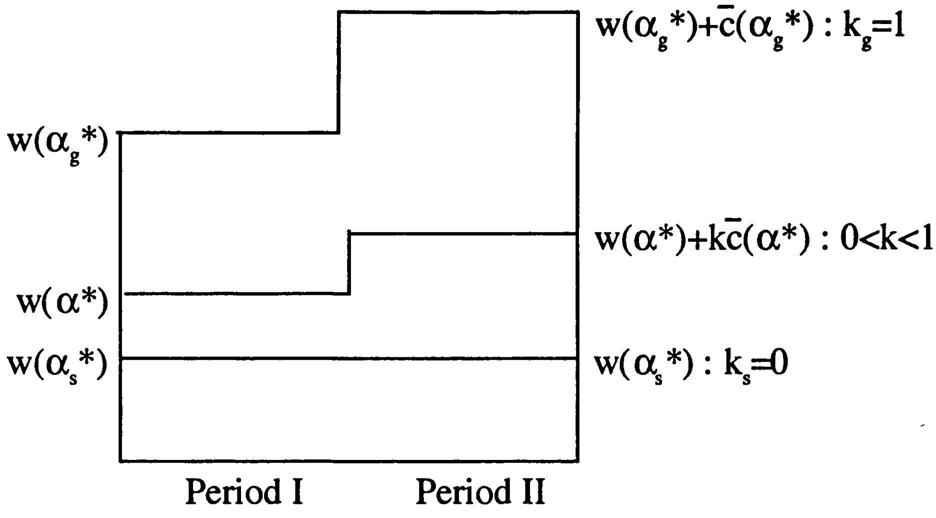


Fig.V-4 : The wage profile

In this chapter we have established the following;

Firstly, a two-period training model of heterogeneous labour was introduced and contrasted with the adverse selection model of Weiss (1980) as well as the training models such as Donaldson & Eaton (1976), Nickell (1976), and Ohashi (1983). The model presented in this Chapter has several unique features compared with these models. For example, it can be more easily extended to a multi-period case than the Weiss model, in which an upward-sloping wage profile can be derived. But unlike most of the training models the introduction of heterogeneity of labour in terms of training cost means that the firm initially pays for the training whether it is general or specific, although, as in the standard theory of tax incidence, the actual incidence would depend on the elasticities of supply of and demand for labour. The training type instead affects the alternative wage of the period II.

Secondly, the firm maximized the profit for each period. It turned out that the firm's first order conditions were identical in the two periods. They were also equivalent to those of Chapter III except that the period II wage was higher due to the higher alternative wage.

Finally, we assumed that the firm maximized the present value of the profit stream. With no turnover an upward-sloping wage profile was derived. The firm's decision and the consequent market equilibrium depended in particular on the generality of training. On the whole, the more general the training is, the higher the wage profile will be, the lower the employment level will be, and the more likely that the equilibrium entails the excess supply.

CHAPTER VI : MONOPSONY AND COMPETITION IN HETEROGENEOUS LABOUR MARKETS

We have established earlier on in Chapter III that in a heterogeneous labour market, where workers differ in the training costs, a competitive equilibrium does not always imply market clearing unlike in the case of a homogeneous labour market. One might, then, wonder whether there are similar irregularities when the heterogeneous labour market is not competitive.

Consider monopsony, as a typical form of non-competitiveness in labour markets. It will be shown that the set of profit maximizing conditions of a monopsony firm is identical to that of a competitive firm in certain cases. The rationale behind this result is that if the supply of labour is not binding in the competitive equilibrium, i.e. if there is an excess supply, then this information about the supply , which a monopsony firm has an access to, becomes redundant.

Consider a heterogeneous labour market of the type described in the earlier chapter, where the workers are heterogeneous in α and consequently in $w(\alpha)$, the acceptance wage and in $c(\alpha)$, the cost of OJT. As the difference between competitive equilibrium and monopsony in a labour market lies in the availability of information on the supply of labour to the firm/firms, we may illustrate this formally by using the Lagrangian method, for which the supply information acts as a constraint. We also extend the Lagrangian method to analyse within the same framework the homogeneous case, in which there is a well-established result that monopsony always produces lower levels of wage and employment than competitive equilibrium.

(1) The Lagrangian and the Constraint

Define the profit equation in the following form.

$$\pi = py(x^d) - wx^d - Cx^d \qquad \text{(VI-1)}$$

This is identical to (III-6) of Chapter III except that w and C are not the functions of α. And we introduce constraints, with λ's being the multipliers, as

(i) $\lambda_1 : w = w(\alpha)$

(ii) $\lambda_2 : C = \bar{c}(\alpha)$

(iii) $\lambda_3 : w \geq W^s(x^d)$

so that the Lagrangian is given by

$$L = py(x^d) - (w+C)x^d + \lambda_1((w - w(\alpha)) + \lambda_2(C - \bar{c}(\alpha)) + \lambda_3(w - W^s(x^d)) \qquad \text{(VI-2)}$$

(i) and (ii) express the heterogeneity of the labour force through the reservation wage and the average cost of OJT, both of which vary with α. Note that (VI-1) with these constraints is (III-6), i.e. $\pi = py(x^d) - \bar{c}(\alpha)x^d - w(\alpha)x^d$, or it is identical to optimize (VI-2) with λ_3 being restricted to zero. In the following discussion we do not consider the zero restrictions of λ_1 and $\lambda_2$separately, i.e. it is either "$\lambda_1>0$ and $\lambda_2>0$" or "$\lambda_1=0$ and $\lambda_2=0$", since either one of them only would not generate the situation of adverse selection. $\lambda_1>0$ and $\lambda_2>0$ implies that the firm holds information about the heterogeneity, while $\lambda_1=0$ and $\lambda_2=0$ means no information to the firm while optimizing.

(iii) is the "monopsony" constraint. This is derived from the facts that; (i) a monopsonist knows the labour supply: $w=W^s(x^s)$ and (ii) he ensures that his demand is always met, i.e. $x^s \geq x^d$, where x^s and x^d are the quantity demanded and supplied respectively. Thus, $w=W^s(x^s) \geq W^s(x^d)$ since $W^{s\prime}>0$. This is illustrated in Fig.VI-1. Consequently, optimizing the Lagrangian (VI-2) with restricting λ_3 to non-negative is the optimization of a monopsony firm, while with $\lambda_3=0$ it is of a competitive firm. Note that the former does not rule out $\lambda_3=0$, since, unlike (i) and (ii), (iii) is an inequality — $\lambda_3>0$ when the constraint is binding and $\lambda_3=0$ when it is not.

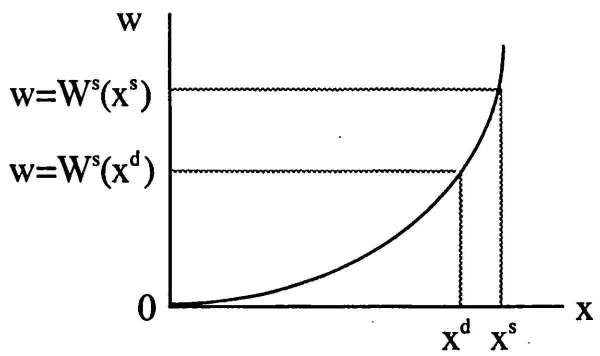


Fig.VI-1

Table VI-1 below relates the characteristics of a labour market to the restrictions on the λ's.

		Workers	
		Heterogeneous	Homogeneous
Firms	Monopsonist	$\lambda_1,\lambda_2>0$ & $\lambda_3\geq 0$	$\lambda_1,\lambda_2=0$ & $\lambda_3\geq 0$
	Competitive	$\lambda_1,\lambda_2>0$ & $\lambda_3=0$	$\lambda_1,\lambda_2=0$ & $\lambda_3=0$

Table VI-1

(2) The Cases

Let us now derive the firm's optimization conditions for different labour markets in turn.

(A) Monopsony with Heterogeneous labour: $\lambda_1,\lambda_2>0$ & $\lambda_3\geq 0$

Because the firm knows the quality response of the labour, λ_1 and λ_2 are positive. And with the knowledge of the supply behaviour, the firm's optimization translated into the Lagrangian is (VI-2).

$$L_A=py(x^d)-(w+c)x^d+\lambda_1((w-w(\alpha))+\lambda_2(C-\bar{c}(\alpha))+\lambda_3(w-W^s(x^d)) \qquad \text{(VI-2')}$$

Optimizing L_A with respect to w, C, α, x^d and λ's gives us a set of conditions as below

$$\partial L_A/\partial w=-x^d+\lambda_1+\lambda_3=0 \qquad \text{(VI-3)}$$

$$\partial L_A/\partial C=-x^d+\lambda_2=0 \qquad \text{(VI-4)}$$

$$\partial L_A/\partial\alpha=-\lambda_1 w'(\alpha)-\lambda_2\bar{c}'(\alpha)=0 \qquad \text{(VI-5)}$$

$$\partial L_A/\partial x^d=py'(x^d)-(w+c)-\lambda_3 W^{s\prime}(x^d)=0 \qquad \text{(VI-6)}$$

$$\partial L_A/\partial\lambda_1=w-w(\alpha)=0 \qquad \text{(VI-7)}$$

$$\partial L_A/\partial\lambda_2=C-\bar{c}(\alpha)=0 \qquad \text{(VI-8)}$$

$$\partial L_A/\partial\lambda_3=w-W^s(x^d)=0 \qquad \text{(VI-9)}$$

From (VI-3) (VI-4) and (VI-5), from (VI-6) (VI-7) and (VI-8) and from (VI-7) and (VI-9) respectively,

$$(x^d-\lambda_3)w'(\alpha)+x^d\bar{c}'(\alpha)=0 \qquad \text{(VI-10)}$$

$$py'(x^d)=w(\alpha)+\bar{c}(\alpha)+\lambda_3 W^{s\prime}(x^d) \qquad \text{(VI-11)}$$

$$w(\alpha)=W^s(x^d) \qquad \text{(VI-12)}$$

From (VI-10) and (VI-11), by eliminating λ_3, we obtain,

$$py'(x^d)=w(\alpha)+\bar{c}(\alpha)+(x^d/w'(\alpha))(w'(\alpha)+\bar{c}'(\alpha))W^{s\prime}(x^d) \qquad \text{(VI-13)}$$

This is consistent with the usual monopsony condition in a labour market that at the equilibrium marginal productivity of labour (i.e. LHS of (VI-13)) is equated to marginal cost of labour (i.e. RHS of (VI-13)), since the marginal cost of labour is,

$$d/dx^d(\text{total cost})=d/dx^d\{(w(\alpha)+\bar{c}(\alpha))x^d\}$$

$$=w(\alpha)+\bar{c}(\alpha)+x^d\{w'(\alpha)+\bar{c}'(\alpha)\}(d\alpha/dx^d)$$

$$=w(\alpha)+\bar{c}(\alpha)+x^d\{w'(\alpha)+\bar{c}'(\alpha)\}(W^{s\prime}(x^d)/w'(\alpha))$$

where, from totally differentiating (VI-12), $w'(\alpha)d\alpha=W^{s\prime}(x^d)dx^d$

(B) Competitive market with Heterogeneous labour: $\lambda_1,\lambda_2>0$ & $\lambda_3=0$

As the firm does not know the supply response of the workers, it maximizes profit in the absence of constraint (iii). Thus the Lagrangian is,

$$L_B=py(x^d)-(w+C)x^d+\lambda_1((w-w(\alpha))+\lambda_2(C-\bar{c}(\alpha)) \qquad \text{(VI-14)}$$

and this is optimized with respect to w, C, α, x^d, λ_1 and λ_2, so that we obtain

$$\partial L_B/\partial w=-x^d+\lambda_1=0 \qquad \text{(VI-15)}$$

$$\partial L_B/\partial C=-x^d+\lambda_2=0 \qquad \text{(VI-16)}$$

$$\partial L_B/\partial \alpha=-\lambda_1 w'(\alpha)-\lambda_2\bar{c}'(\alpha)=0 \qquad \text{(VI-17)}$$

$$\partial L_B/\partial x^d=py'(x^d)-(w+C)=0 \qquad \text{(VI-18)}$$

$$\partial L_B/\partial \lambda_1=w-w(\alpha)=0 \qquad \text{(VI-19)}$$

$$\partial L_B/\partial \lambda_2=C-\bar{c}(\alpha)=0 \qquad \text{(VI-20)}$$

From (VI-15) (VI-16) and (VI-17), and from (VI-18) (VI-19) and (VI-20) respectively,

$$w'(\alpha)+\bar{c}'(\alpha)=0 \qquad \text{(VI-21)}$$

$$py'(x^d)=w(\alpha)+\bar{c}(\alpha) \qquad \text{(VI-22)}$$

which are the optimization conditions derived in Chapter III for a competitive firm, i.e. (III-8) and (III-7) respectively. In order to make comparable the market demand in monopsony and competitive equilibrium, we let x^d be the market demand by letting n=1, where n is the number of firms. Note that we do not lose generality by doing so, as we assume the lack of information to mean the competitiveness.

The optimization conditions (VI-10) (VI-11) and (VI-12) of monopsony would be equivalent to those of a competitive firm i.e. (VI-21) and (VI-22) if $\lambda_3=0$, since, with $\lambda_3=0$, (VI-12) disappears. Furthermore, when $\lambda_3=0$ holds for monopsony, competitive equilibrium exhibits an excess supply of labour since the equilibrium conditions for monopsony are those of competitive equilibrium i.e.

$$w'(\alpha)+\bar{c}'(\alpha)=0$$

$$py'(x^d)=w(\alpha)+\bar{c}(\alpha)$$

$$w(\alpha)>W^s(x^d)$$

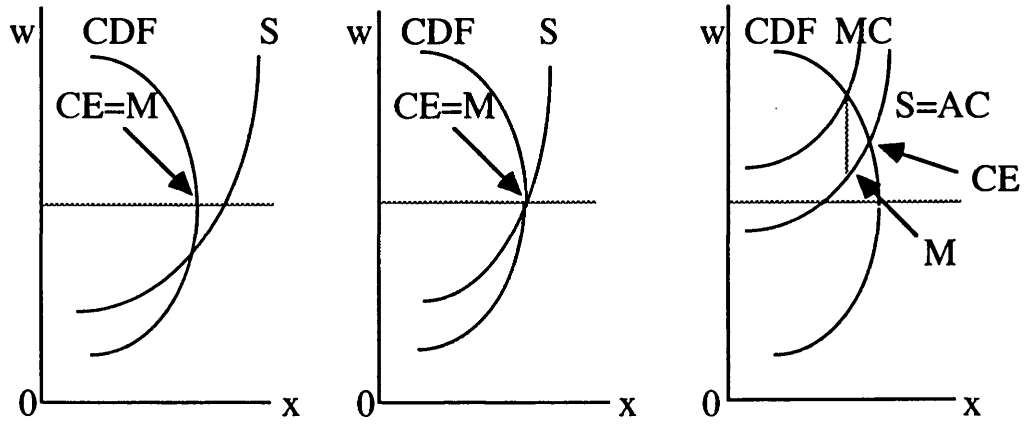
It needs to be pointed out that in the case A, i.e. the case of monopsony with heterogeneous labour, the possibility of $\lambda_3=0$ can not be ruled out a priori — it will be shown later that in the case of monopsony with homogeneous labour $\lambda_3=0$ holds only at zero production. For, from (VI-3), $\lambda_3=x^d-\lambda_1$, and $\lambda_1>0$ by assumption so that λ_3 is non-negative rather than strictly positive. Therefore, when a competitive equilibrium is characterized by an excess supply or equally non-binding labour supply, it is indistinguishable from monopsony. Whether $\lambda_3=0$ holds or not depends on the exogeneously given functions y(•), w(•), c(•) and h(•) and product price p in a similar manner to the one described earlier in determining whether an excess supply exists with competitive equilibrium.

When $\lambda_3>0$, on the other hand, the supply condition is binding and from (VI-10),

$$w'(\alpha)+\bar{c}'(\alpha)=(\lambda_3/x^d)w'(\alpha)>0 \qquad \text{(VI-10')}$$

which means that the equilibrium wage is above the optimum wage. In this case, competitive equilibrium exhibits market clearing i.e. the labour supply is binding, since $\lambda_3>0$ means that the profit a competitive firm would be increased if the supply information was available. Therefore, when $\lambda_3>0$, monopsony and competitive equilibrium are distinct and both are characterized by the binding labour supply.

Fig.VI-2 shows the comparison of the two equilibria for different values of λ_3. Note in particular that $\lambda_3=0$ holds as long as competitive equilibrium (CE) is characterized by an excess supply of labour, where the two equilibria are identical (See Fig.VI-2(a) and (b)). But once competitive equilibrium exhibits market clearing, the two equilibria become distinct with monopsony (M) offering lower levels of wage and employment than competitive equilibrium (See Fig.VI-2(c)).



(a) λ_3=0 (b) λ_3=0 (c) λ_3>0

Fig.VI-2

(C) Monopsony with Homogeneous labour: $\lambda_1=0$ and $\lambda_2=0$ & $\lambda_3\geq 0$

In maximizing the profit, the firm knows the supply of labour i.e. $\lambda_3>0$. However, for the moment we allow λ_3 to be non-negative. Then the Lagrangian is

$$L_C= py(x^d)-(w+C)x^d+\lambda_3(w-W^s(x^d)) \tag{VI-23}$$

Optimizing with respect to w, x^d and λ_3, we obtain

$$\partial L_C/\partial w=-x^d+\lambda_3=0 \tag{VI-24}$$

$$\partial L_C/\partial x^d=py'(x^d)-(w+C)-\lambda_3 W^{s\prime}(x^d)=0 \tag{VI-25}$$

$$\partial L_C/\partial \lambda_3=w-W^s(x^d)=0 \tag{VI-26}$$

It can be seen from (VI-24) that λ_3 is zero only when x^d is zero — in other words, when production takes place the firm always makes use of the supply information, unlike in the heterogeneous case we have just discussed. Eliminating λ_3 from (VI-25) and (VI-26), we obtain the usual monopsonist's equilibrium condition

$$py'(x^d)=(w+C)+x^d W^{s\prime}(x^d) \tag{VI-27}$$

This is the optimization condition in monopsony that marginal productivity of labour is equated to marginal cost of labour.

(D) Competitive market: $\lambda_1=0$ and $\lambda_2=0$ & $\lambda_3=0$

The firm has to maximize the profit with w as given so $\lambda_3=0$. Thus the Lagrangian is

$$L_D=py(x^d)-(w+C)x^d \tag{VI-28}$$

Optimizing with respect to x^d will give us a condition

$$py'(x^d)=w+C \tag{VI-29}$$

Note that the optimization condition of monopsony (VI-25) would be equivalent to that of a competitive firm (VI-28) if $\lambda_3=0$, analogous to the heterogeneous cases described earlier. However, in the homogeneous case $\lambda_3=0$ implies no production by (VI-24). Hence competitive equilibrium and monopsony are always distinct as long as there is production.

In this chapter we have established that in a heterogeneous labour market an equilibrium in monopsony and competitive equilibrium are not necessarily distinct states as is the case in a homogeneous labour market. Using the Lagrangian approach, they are shown to be indistinguishable when the competitive equilibrium is characterized by an excess supply of labour. This is the case where $w=W^s(x)$ is not binding. And they are distinct as in the homogeneous case when competitive equilibrium is characterized by market clearing. Whether this occurs, of course, depends on the relative natures of the functions $y(\bullet)$, $w(\bullet)$, $c(\bullet)$ and $h(\bullet)$ and the level of product price.

CHAPTER VII : COMPARATIVE STATICS

We have so far argued that the nature of a competitive equilibrium of a heterogeneous labour market depends on the behaviour of the following functions; production function :y(•), opportunity wage function :w(•), training cost function :c(•) and distribution function of ability :h(•), as well as on the level of product price, p. Together they determine whether the equilibrium is characterized by market clearing or an excess supply of labour through the supply of and demand for labour. This can be seen by recalling how they were defined in Chapter III. The supply was defined by;

$$S_L: N^s(w)=mx^s(w)=nH(\alpha(w)) \qquad \text{(III-15)}$$

where N^s is the aggregate labour supply

m is the number of firms

x^s is the labour supply that each firm faces

$H(\alpha) = \int_0^{\alpha} h(z)dz$

$\alpha(w)$ is an inverse function of $w(\alpha)$.

On the other hand, the demand of each firm was derived in Chapter III from a set of conditions; the conditional demand function (CDF) and the optimal wage function (OWF);

$$\text{CDF}:\Phi(x^d,w)=\phi \quad \text{i.e. } w=py'(x^d)-\bar{c}(\alpha(w)) \tag{VII-1}$$

$$\text{OWF}:\Psi'(\alpha)=w'(\alpha)+\bar{c}'(\alpha)=0 \tag{VII-2}$$

And for the market as a whole, (VII-1) may be written in terms of N^d, so that

$$\text{CDF}:\Phi(N^d,w)=\phi \quad \text{i.e. } w=py'(N^d/m)-\bar{c}(\alpha(w)) \tag{VII-1'}$$

$$\text{OWF}:\Psi'(\alpha)=w'(\alpha)+\bar{c}'(\alpha)=0 \tag{VII-2}$$

Thus from (III-15) (VII-1') and (VII-2), we see that;

(i) a shift in $y(\bullet)$ affects CDF only.

(ii) a shift in $w(\bullet)$ affects the supply, CDF and OWF.

(iii) a shift in $c(\bullet)$ affects CDF and OWF.

(iv) a shift in $h(\bullet)$ affects the supply, CDF and OWF.

(v) a change in p affects CDF only.

In this chapter before considering the precise effects of these functions and the price levels on the equilibrium levels of wage and employment, let us describe the effects of these on the demand and the supply sides of the market separately.

(1) The functions

(a) Production function : $y(\bullet)$

We assume $y(\bullet)$ to be identical to all firms since for each production process its particular characteristics is assumed to be expressed by $c(\bullet)$.

(b) Price level : p

The price level only appears in CDF and its increase as a result of an increase in the demand for product (D_p) would raise the demand for labour without causing the optimal wage to change. This is shown in Fig.VII-1 as a parallel outward shift of CDF.

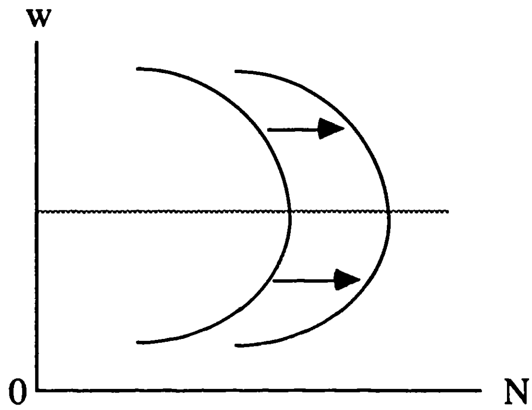


Fig.VII-1 : $D_p \uparrow$ (i.e. p $\uparrow$)

(c) Training cost function : c(•)

This function appears in both of the demand conditions through $\bar{c}(\bullet)$, since

$\bar{c}(\alpha) = \dfrac{\int_0^\alpha c(z)h(z)dz}{\int_0^\alpha h(z)dz}$; in such a way that for CDF it is the absolute level of the average cost that affects the level of employment , while for OWF it is the steepness of the average cost that affects the level of optimal wage. To see how the training cost function affects the labour supply and demand, consider adding a positive constant term k to the average cost function. Then (VII-1') will be,

$$w=py'(N^d/m)-\bar{c}(\alpha(w))-k \tag{VII-1''}$$

This means a general increase in labour cost, which results in the reduction of the labour demand. Note that this does not affect the optimal wage since the optimal wage is solely determined by OWF. (See Fig.VII-2(a)) Now suppose $\bar{c}(\alpha)$ is replaced by $k\bar{c}(\alpha)$ where $k>1$. The new OWF will be,

$$w'(\alpha)+k\bar{c}'(\alpha)=0 \tag{VII-2'}$$

or $\quad w'(\alpha)+\bar{c}'(\alpha)=(1-k)\,\bar{c}'(\alpha)>0$

Thus at the ability level that satisfies (VII-2') the original OWF is positive. Because both $w(\bullet)+\bar{c}(\bullet)$ and $w(\bullet)+k\bar{c}(\bullet)$ have a single local minimum, a steeper $\bar{c}(\bullet)$ implies an increased optimum value of α and thus of w. On the other hand, how this affects the optimal quantity is indeterminate since the change of the slope can not be separately analysed from the change of the absolute level of $\bar{c}(\bullet)$. This is illustrated as an upward shift of the original OWF in Fig.VII-2(b).

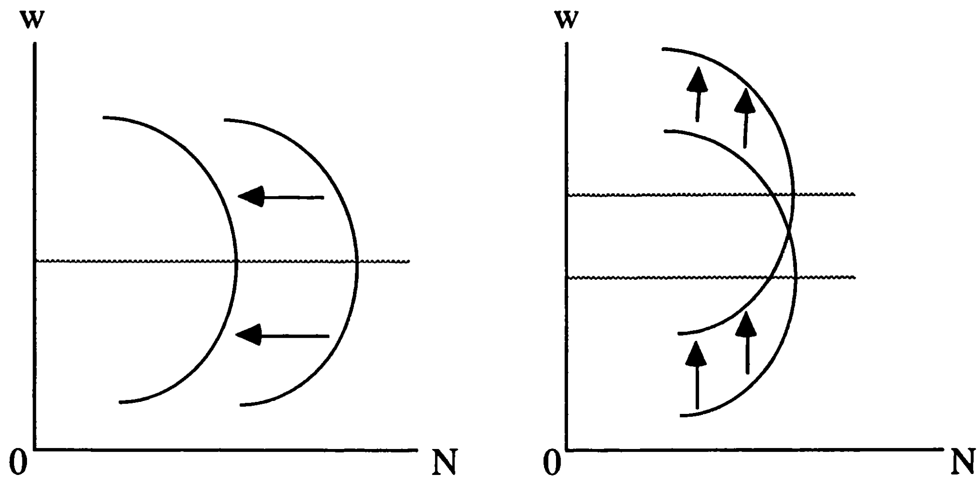
We still need to see how $c(\bullet)$ and $\bar{c}(\bullet)$ are related. Suppose $c(\bullet)$ is increased by k, then

$$\frac{\int_0^\alpha (c(z)+k)h(z)dz}{\int_0^\alpha h(z)dz}=\bar{c}(\alpha)+k \tag{VII-3}$$

implying that $\bar{c}(\alpha)$ will equally be increased by k. Now suppose c(•) is increased to kc(•) s.t. k>1, i.e. c(•) is steeper for all values of α, then

$$\frac{\int_0^\alpha kc(z)h(z)dz}{\int_0^\alpha h(z)dz} = k\bar{c}(\alpha) \qquad \text{(VII-4)}$$

implying that $\bar{c}(\alpha)$ will also be steeper by k. Thus (i) a generally high valued c(•) generates lower labour demand and thus the demand function i.e. CDF nearer to the vertical axis and (ii) a steeper c(•) implies a higher optimal wage, which means the demand function away from the horizontal axis.



(a) a high valued $\bar{c}(\alpha)$ (b) a steeper $\bar{c}(\alpha)$

Fig.VII-2

(d) Distribution of ability : $h(\alpha)$

If α is the sole and innate ability of each individual worker, then this distribution is exogeneous to the model. There are at least three cases in which a change of $h(\alpha)$ may be taken into consideration. Firstly, α may be an observable part of the innate ability, in which case a different type of observation or screening could generate a different distribution, $d(\beta)$ say. Secondly, α may be achieved through educational investment, in which case more education would mean that the distribution is more concentrated at higher values of α. The government may be interested in such a policy to raise the general standard of education. Thirdly, a demographic change could cause the distribution to change its shape. For example, immigration of workers with relatively high α into the country or emigration of workers with relatively low α from the country would again generate $h(\alpha)$ with relatively high density at higher values of α.

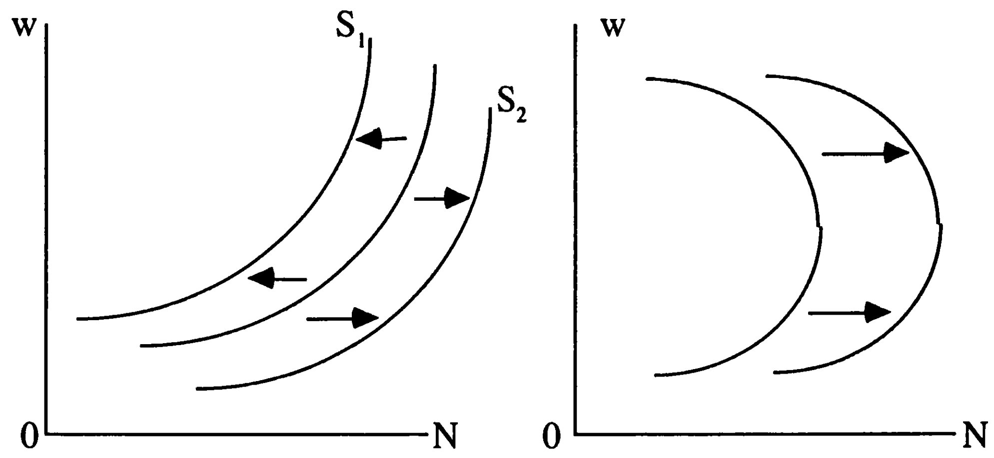
Here, consider what will happen to the supply and demand conditions when the distribution $h(\alpha)$ becomes high density at higher values of α, as a result of the government policy to raise the educational level of the population or to allow in the immigration of workers with relatively high level of ability. Note that a difficulty arises when the effect of a change in $h(\alpha)$ is discussed, since this function appears in all of the three conditions of the supply and demand.

The supply response to a change in the distribution $h(\bullet)$ differs between (i) when the quality of the existing population improves and (ii) when extra supply of the high quality workers is added. In (i) as the total quantity is unchanged, there will be equal or less number of workers willing to work than before at all wage and this causes the supply to shift to left. In (ii) the high quality workers from outside are added to the domestic supply at the corresponding wage levels and this causes the supply to shift to right. This is shown in Fig.VII-3(a).

To see the effect on the demand conditions, we need to see how $h(\alpha)$ affects $\bar{c}(\alpha)$ and $\bar{c}'(\alpha)$. We might expect that as the population becomes wiser by more education or by accepting new and more able labour force from abroad, the average training cost will fall. But the way $\bar{c}'(\alpha)$ changes with $h(\alpha)$ is indeterminate, unless $h(\bullet)$ and $c(\bullet)$ are given in a more specific manner.

Just to illustrate the situation, assume a discrete model with three ability levels : $\alpha_1, \alpha_2, \alpha_3$ s.t $\alpha_3-\alpha_2=\alpha_2-\alpha_1$ and $c_1=c(\alpha_1)>c_2=c(\alpha_2)>c_3=c(\alpha_3)$ to be consistent with $c'(\bullet)<0$. And assume that $h(\alpha)$ changes form a uniform distribution $h_1(\alpha)$ i.e. $h_1(\alpha_1)=h_1(\alpha_2)=h_1(\alpha_3)=1/3$ to a new distribution $h_2(\alpha)$ s.t. $h_2(\alpha_1)=1/6$, $h_2(\alpha_2)=2/6$, and $h_2(\alpha_3)=3/6$. (See fig.VIII-4(a)) Then the average training cost with the uniform distribution, defined as $c(\alpha|h_1(\alpha))$, is larger than that with the new distribution, defined as $c(\alpha|h_2(\alpha))$, for $\alpha=\alpha_1$, α_2, and α_3, and the former is flatter than the latter. This is because with $h_1(\alpha)$, $\bar{c}(\alpha_1|h_1(\alpha))=c_1$, $\bar{c}(\alpha_2|h_1(\alpha))=1/2(c_1+c_2)$, $\bar{c}(\alpha_3|h_1(\alpha))=1/3(c_1+c_2+c_3)$, with $h_2(\alpha)$, $\bar{c}(\alpha_1|h_2(\alpha))=c_1$, $\bar{c}(\alpha_2|h_2(\alpha))= 1/3(c_1+2c2)$, $\bar{c}(\alpha_3|h_2(\alpha))=1/6(c_1+2c_2+3c_3)$, and $\bar{c}'(\bullet)$ being defined between the α's.

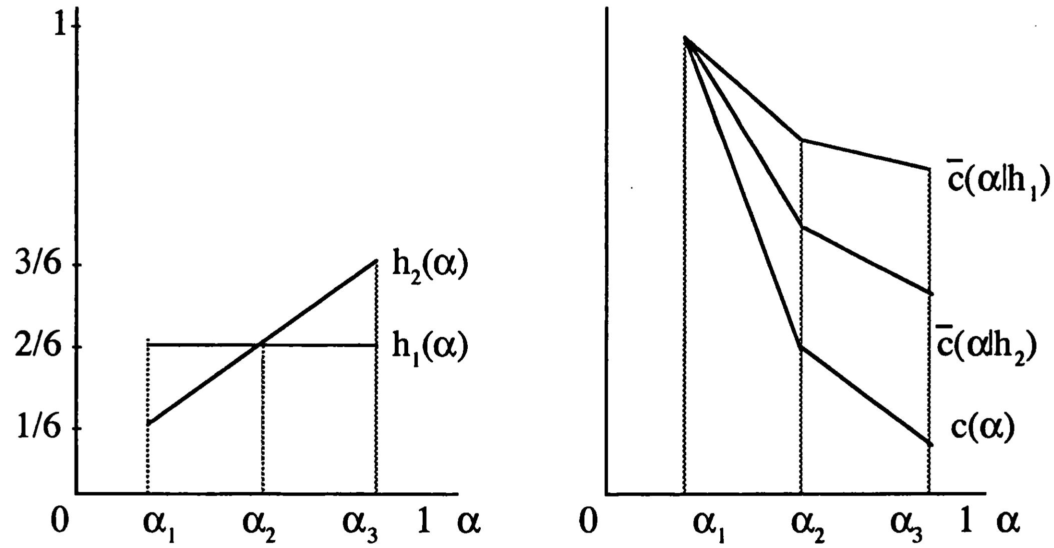
The result is illustrated in Fig.VII-4(b), in which the training cost function, $c(\alpha)$, and the average cost functions for the two distributions, $\bar{c}(\alpha|h_1(\alpha))$ and $\bar{c}(\alpha_1|h_2(\alpha))$ are shown. Thus this example shows a case where a rise in the general level of ability of the workers reduces $\bar{c}(\alpha)$ as well as raises the steepness of $\bar{c}(\alpha)$ for all values of α. However, in general it is difficult to prove that



(a) Supply : S_1 Improved workers
S_2 Added workers

(b) Demand

Fig.VII-3 : When there is high density for high ability in $h(\alpha)$



(a) $h_1(\alpha)$: the original population and $h_2(\alpha)$: the abler population

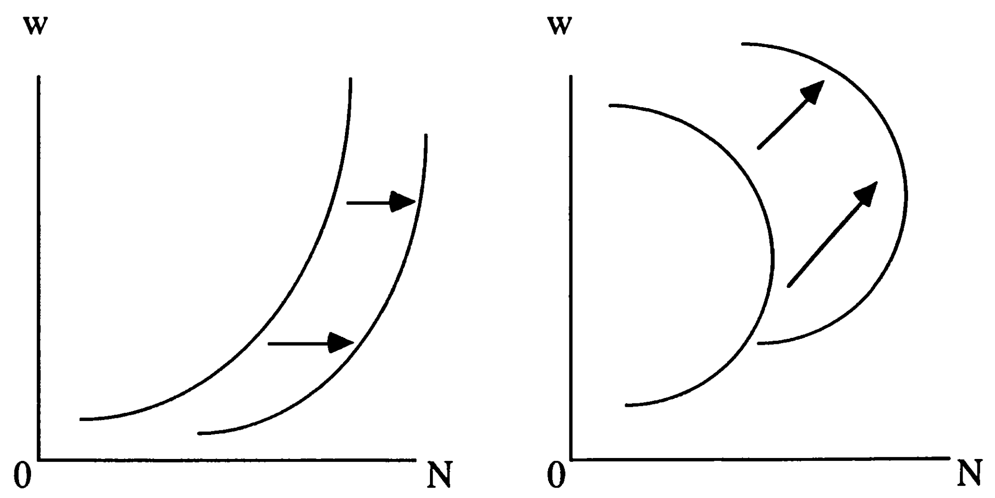
(b) Training cost functions

Fig.VII-4

$\bar{c}(\alpha|h_2(\alpha))$ is always steeper than $\bar{c}(\alpha|h_1(\alpha))$, as the slope of $\bar{c}(\alpha)$ is derived as a rather complicated composite function of $c(\alpha)$ and $h(\alpha)$ — $h(\bullet)$'s in the example were quite simple ones. As a steeper $\bar{c}(\bullet)$ is not the robust result, here we only consider a smaller $\bar{c}(\bullet)$. In other words, we assume the optimal wage is not affected by the change of h(•). This is illustrated in Fig.VII-3(b) by a parallel outward shift.

(d) Opportunity wage function : $w(\alpha)$

This function also appears in all of the supply and demand conditions. If productivity in the alternative job changes, there will be a shift in $w(\alpha)$. For example, as in Weiss (1980) if the alternative job exhibits diminishing returns to scale then a reduction in the employment level in the market in question will in turn induce a fall in the productivity in the alternative sector and hence $w(\alpha)$ will shift down. This will shift the supply to the right. At the same time this change in $w(\alpha)$, i.e. lower and flatter $w(\alpha)$ causes a shift in the demand condition in a way similar to that of $\bar{c}(\alpha)$. (See Fig.VII-5) Under constant returns to scale, on the other hand, $w(\alpha)$ will be unaltered by the employment level in the alternative sector. In this model we assume constant returns to scale so that neither supply nor demand would shifts by a change in the opportunity wage.



(a) Supply (b) Demand

Fig.VII-5 : When $w(\alpha)$ shifts downwards

Using the analyses given for each function and the product price on their effects on the supply of and demand for labour, let us analyse the following three aspects of comparative statics : (a) an effect of a change in the product price (b) an effect of different technological processes, and (c) an effect of improving the general ability of the labour force, on the equilibrium, with the assumption of the constant returns to scale in the alternative job.

(2) Comparative statics

(a) Product demand : D_p

Under constant returns to scale, where $w(\alpha)$ is unaffected by a change in the employment level in the alternative sector, a change in the level of product demand, with the firms being price takers in the product market, will have following consequences.

(i) If, at the equilibrium, there is an excess supply, then

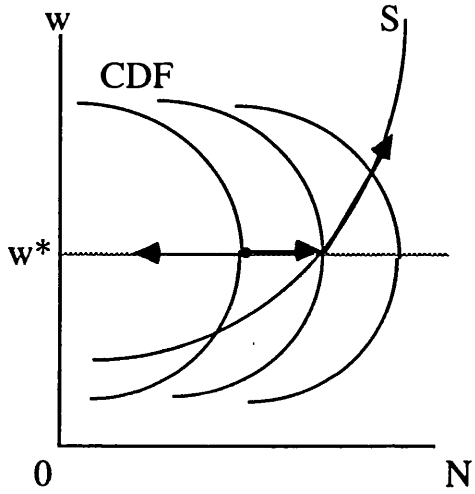
- a fall in D_p results in downward rigidity of the wage.
- a rise in D_p results in either upward rigidity <u>or</u> a rise in the wage.

(ii) If, at the equilibrium, there exists no excess supply, then

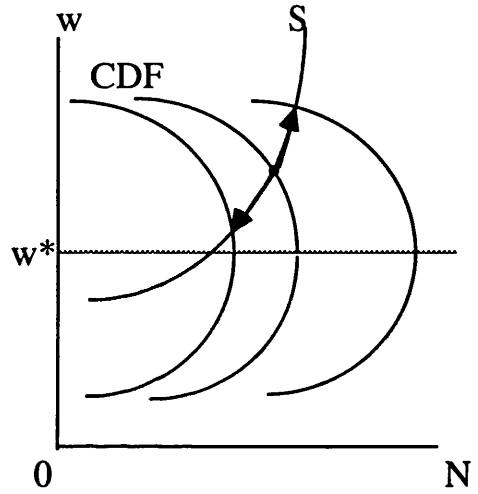
- a fall in D_p results in a fall in the wage.
- a rise in D_p results in a rise in the wage.

(See Fig.VII-6)

Note that of the four consequences, the upward rigidity is the only non-robust result. Under the excess supply equilibrium, a rise in D_p results in an upward rigidity if the rise is small or if there is a large volume of excess supply. Analytically, this asymmetry is due to the facts that (i) the optimal wage acts as a lower bound of a wage offer range and (ii) "flexibility dominates rigidity" i.e. if an outcome contains both flexibility and rigidity then we observe it as the flexibility of the wage.



(a) Initially in excess supply



(b) Initially in market clearing

Fig.VII-6

(b) Different technological processes : c(•)

A technological process is meant here a combination of training the workers and production. Keeping the production function unchanged, let us consider these different training processes: $c_1(\alpha)$, $c_2(\alpha)$ and $c_3(\alpha)$ such that

$$|c_1'(\alpha)|>|c_2'(\alpha)|>|c_3'(\alpha)| \quad \forall\alpha \qquad \text{(VII-5)}$$

and for which there exist α^{i*} s.t.

$$w'(\alpha)+\bar{c}_i'(\alpha)=0 \quad i= 1,2,3 \tag{VII-6}$$

where h(•) is the same for the three cases. This implies

$$\alpha^{1*}>\alpha^{2*}>\alpha^{3*} \tag{VII-7}$$

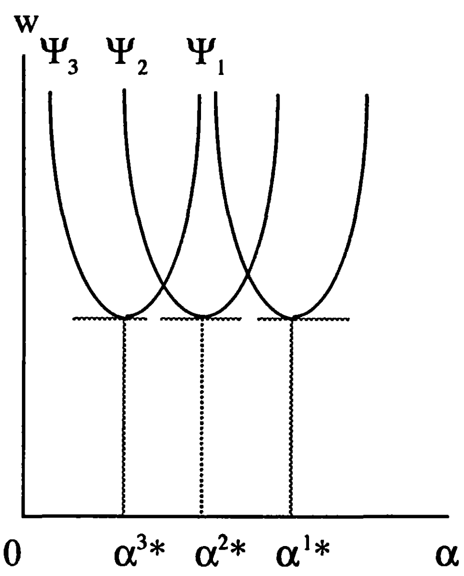
and $$w^{1*}>w^{2*}>w^{3*} \quad \text{where } w^{i*}=w(\alpha^{i*}) \tag{VII-8}$$

Fig.VII-7 illustrates the three cases ;

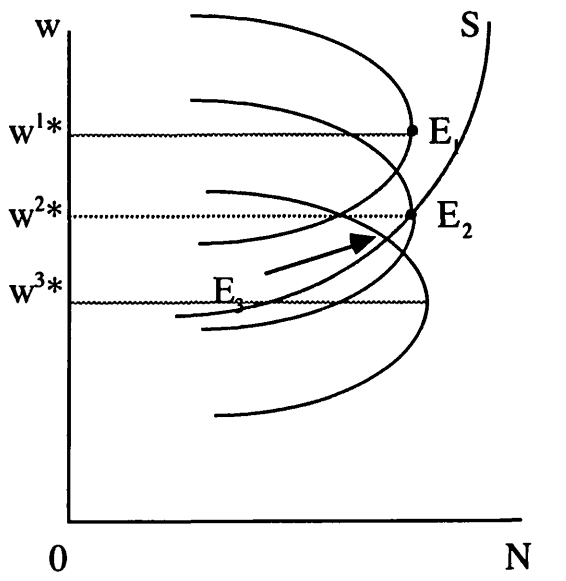
(i) $c_1(\bullet)$: E1 — an excess supply equilibrium

(ii) $c_2(\bullet)$: E2 — the supply is just binding

(iii) $c_3(\bullet)$: E3 — the supply is binding i.e. market clearing



(a) OWF's with different c(•)



(b) Equilibria with different c(•)

Fig.VII-7

The equilibrium is more likely to be of an excess supply when c(•) is steeper, since a steeper c(•) means a vertically more high-positioned CDF. But a steep c(•) is a training process in which more able workers are valued considerably highly relative to less able workers. Hence, for example, a labour market where individual difference in ability matters more in determining OJT cost is more likely to exhibit an excess supply equilibrium.

(c) Effects of an exogeneous change in the ability distribution

Following the analysis in (1) (c) of this chapter, we can deduce that an improvement in the labour force quality would always raise the labour demand but the effect on the labour supply depends on how the improvement is achieved. Market clearing is more likely with educational investment on the existing labour force than with adding labour supply of higher quality, since the former reduces labour supply while the latter increases it.

Fig.VII-8 illustrates the argument when the equilibrium is initially characterized by an excess supply of labour at E_0. With the improvement in labour force, CDF shifts to the right. The labour supply shifts from S to S' when the domestic labour force is improved through educational investment and this moves the equilibrium from E_0 to E', i.e. to market clearing situation. The shift from S to S" occurs with the imported labour and the equilibrium moves from E to E", i.e. the excess supply is more likely to be maintained.

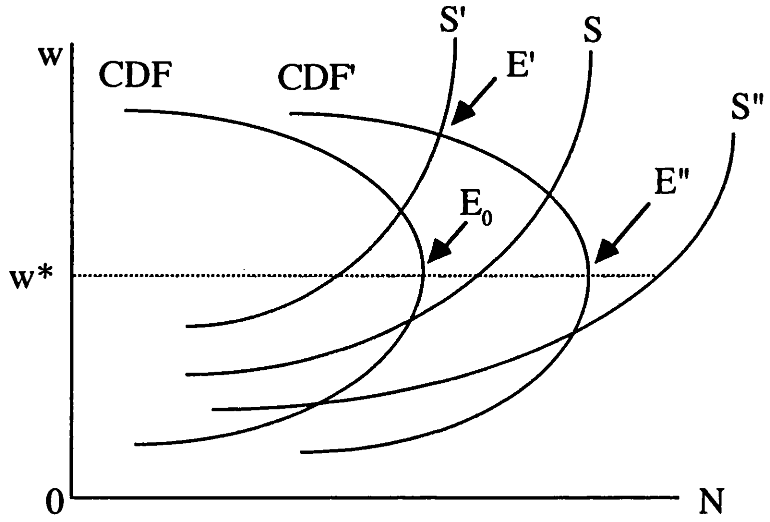


Fig.VII-8

(d) Effects of a change in product demand in different industries

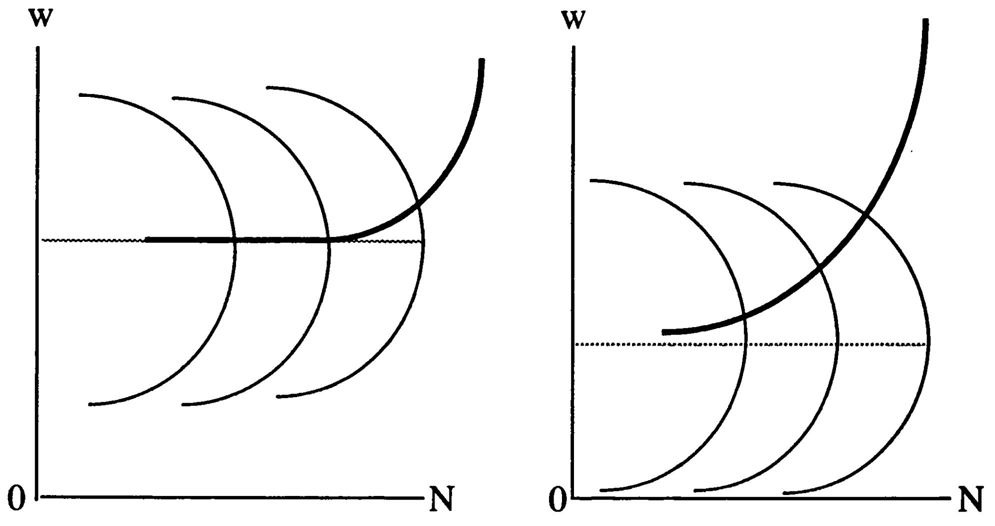
Consider two types of jobs I and II with $c_H(\bullet)$ and $c_L(\bullet)$ s.t.

$$|c_H'(\alpha)|>|c_L'(\alpha)| \quad \forall\alpha \tag{VII-9}$$

With (2)(b), more able workers with low training cost are valued considerably highly relative to less able workers, i.e. the workers with high training cost in the job I than in the job II. The same comparison can be made between a skilled job and an unskilled job. This is because the former requires more training in terms of time spent or the level of intensity than the latter --- remember that they are assumed to receive no training before the employment, so that the training cost differential among the workers of different ability is generally greater for the skilled job. It follows that the skilled job market (i.e. job I) is more likely to be characterized by a stable wage while the unskilled job market (i.e. job II) tends to exhibit a fluctuating wage, when the product demand changes. Also note the optimal wage i.e. the wage s.t. $\Psi'=0$ for the skilled job is higher than for the unskilled job. (See Fig.VII-9) As for the employment level, this model suggests that the skilled job market tends to have excess supply, while the unskilled job market tends to be in market clearing.

It should be noted here that this result, though it may appear to be contrary, is compatible with an empirical finding that a skilled labour sector is generally characterized by a lower level of unemployment. There are two reasons for this. Firstly, a longer job queue in the skilled sector would imply a higher level of unemployment in that sector <u>only if</u> the skilled workers are confined to the skilled labour market. But as various models attempt to show, the skilled workers are accessible to the unskilled market as well. (See, for example, Fields (1974) and Bhagwati & Srinivasan (1977)). Under such an assumption the excess supply figure does not appear as an unemployment figure. Rather the excess supply becomes an issue of underemployment. This issue is analysed in the next chapter in the form of heterogeneous firms within one market.

Secondly, a job queue does not necessarily imply unemployment because what we consider here are "potentially" skilled and unskilled workers. If they had already been skilled or unskilled by the time they enter the market, they would have been distinguishable, which does not accord with our assumption. Our workers are unskilled before the OJT so that if not selected they will still be unskilled whichever market they apply to.



(a) high $|\bar{c}'|$ (b) low $|\bar{c}'|$

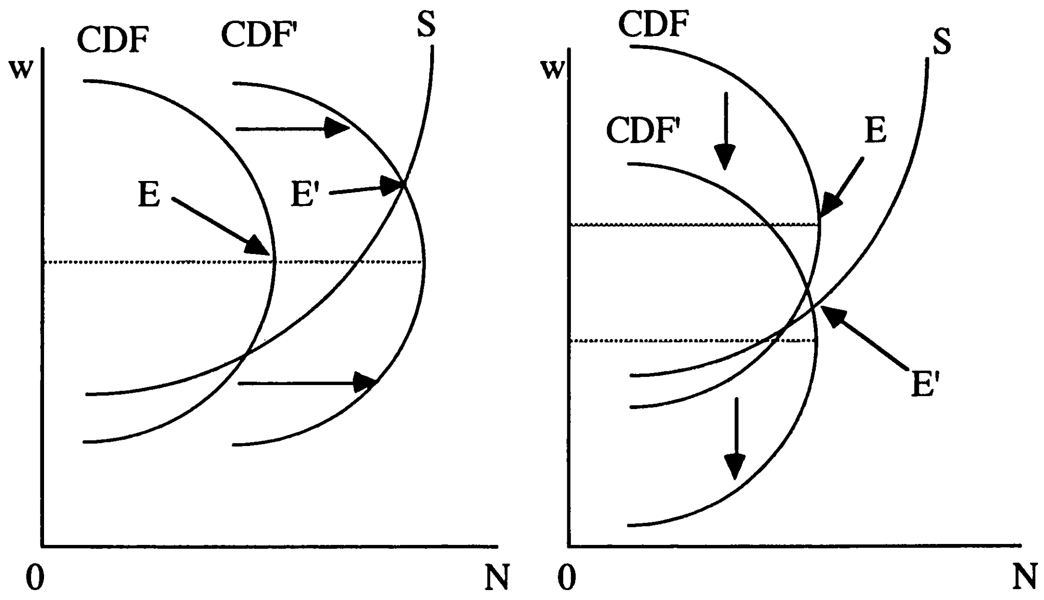
Fig.VII-9 : Equilibrium path

(3) Policy implications

Three policy implications can be drawn from this. First, an attempt to eliminate the excess supply in a skilled job sector by lowering the wage will not succeed since this will push the firms away from the optimal point, where the wage is equated to the marginal productivity. This denies the suggestion that the unemployment exists because the wage is set too high by political pressure or social convention such as a minimum wage law and therefore the wage should be allowed to vary to eliminate the unemployment. Rather, a policy to control supply or demand should be implemented to eliminate the excess supply as it is an equilibrium phenomenon.

Secondly, improving the quality of labour force can reduce the excess supply through generating more demand for labour. There are at least three ways to do this. Firstly, an immigration of high grade labour will improve the distribution of ability at home. This was shown in (1)(d) of this chapter. The intuition behind this result is that the generally improved labour force stimulates the production through the reduction of $\bar{c}(\alpha)$ and thus encourages the firms to employ more workers. However, this also expands the labour supply and thus the excess supply may not be reduced so much. (See Fig.VII-3) Second, you may educate the domestic labour force. Compared with the immigration policy, this requires more time and cost. However, as this gives a reverse effect on the labour supply from the immigration policy as in Fig.VIII, it is more effective in eliminating the excess supply. The third way to improve the quality of labour force is through the reduction of training cost itself. It can be done by improving the training method of by receiving subsidies. Again, the firms find the workers less costly and thus employ more to expand production.

This could be pursued in either of two ways: (a) by reducing the cost evenly or (b) by concentrating on reducing the cost of relatively lower ability. (See the argument in (1)(c) of this chapter) Analytically, they amount to shift CDF to the right by lowering $c(\bullet)$ and down by flattening $c(\bullet)$ respectively, and both reducing the excess supply. (See Fig.VII-10) The choice of or the emphasis on either of the two ways over the other should be based on both the direct cost of the training and its indirect social and economic implications as well as its effectiveness in reducing the excess supply in a following sense. Firstly, it may well be more economical to simply raise everyone's ability than concentrate

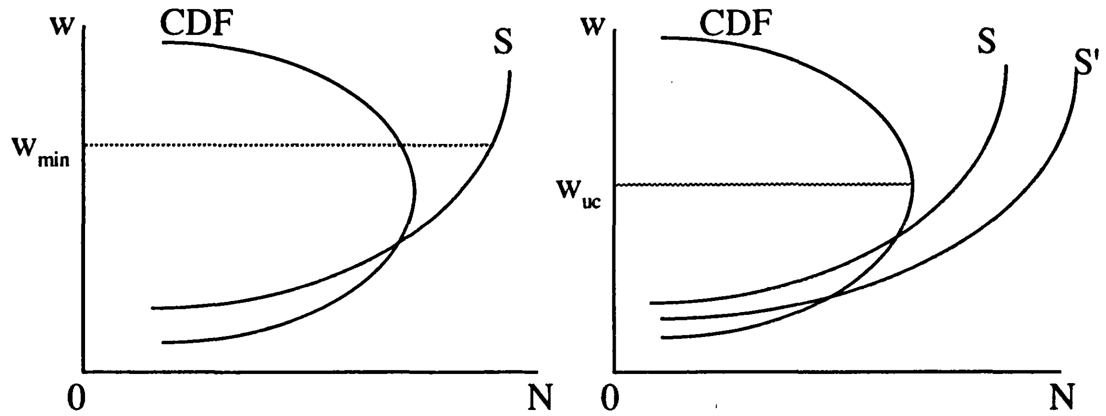


(a) Lower c(•) (b) Flatter c(•)

Fig.VII-10

on raising the ability of a particular group of workers. Secondly, 'a uniformalization' of the workers' ability through raising more the ability of the relatively lower ability workers may act to give equal opportunity to everyone in the society, but at the expense of the more able group. Thirdly, in a long run it might contribute more to the economic growth if an effort is made to raise even further the ability of the more able group. Although these are highly important issues in educational planning, within the present model they are much outside of the scope of the present paper.

Thirdly, under the excess supply equilibrium an introduction of a minimum wage gives a different result from what one usually expects. The standard result of an effect on a minimum wage based on a two-market analysis ---



(a) Covered sector
Market wage : w_{min}

(b) Uncovered sector
Market wage : w_{uc}

Fig.VII-11

see, for example, Elliot (1990), is that an introduction of a minimum wage would raise the market wage of a 'covered sector', a sector that follows the minimum wage legislation, while the wage of the 'uncovered sector' would fall. This is because there is a "spill-over" of labour supply from the covered sector to the uncovered sector and this causes the uncovered sector's wage to fall. The implication is the legislation is ineffective since securing a better wage is made at the expense of a fall in a wage of the uncovered sector. It is further suggested that generating extra demand for labour is a better policy since it should raise the wages of the both sectors.

The same story gives different interpretation in our model. Fig.VII-11 illustrates the argument. Assume that there is an excess supply equilibrium --- note that a <u>fully</u> unskilled job market has to be left out of this analysis since an excess supply equilibrium does not exist in such a labour market, having a constant $c(\alpha)$. An introduction of a minimum wage, w_{min} above the optimal wage in the covered sector would initially drive those unemployed to the uncovered sector --- a shift from S to S'. However, their search of job would be unsuccessful since the optimal wage in the uncovered sector w_{uc} stays unchanged i.e. the group of workers attracted by the optimal wage still remains the best choice for the firm. Thus the effect of the legislation is simply to increase the total excess supply of labour over the two sectors. Hence, while the uncovered sector clears with the wage below the minimum wage for the standard analysis, our model predicts that the wage in the uncovered sector will not be affected. Also in our model, an increase in the demand for labour may not result in an immediate increase in the wage as long as an excess supply exists in that sector. It might be more effective to raise the optimal wage itself. This can be done by reducing the training cost of relatively able workers, as the firm would find the able workers less expensive and decide to raise the optimal wage. Following the argument in (1)(c), one could do so by subsidizing the training cost of relatively abler workers and thereby reducing their training cost. (See Fig.VII-10(b))

In this chapter we have established the following ;

Firstly, we looked at the effects on the market supply and demand of changes in the forms of exogeneously given functions and the product price. The main results are that : (1) an increase in p shifts the CDF to the right without affecting the optimum wage, (2) an uniform increase in c(•) shifts CDF to the right without affecting the optimum wage, (3) an increase in the steepness of c(•) shifts up

CDF, raising the optimum wage.

Secondly, a downward rigidity of wage is more likely to be observed than an upward rigidity of wage. This is because the optimum wage acts as a lower bound of the wage offer range.

Thirdly, a labour market with a steeper c(•), which may represent a relatively skilled labour market, is more likely to exhibit an excess supply equilibrium and thus a downward wage rigidity and vice versa.

Fourthly, the theoretical finding of the present model that an excess supply phenomenon is attributed to skilled labour markets is compatible with an empirical finding that the problem of unemployment is more serious in unskilled labour markets. This is due to two reasons : (1) the excess supply being derived in the present model ought to be considered as underemployment rather than unemployment — in reality, the unemployed skilled workers are also accessible to unskilled labour market but not vice versa, (2) in the view of the fact that there is OJT, the workers are all "unskilled" without joining the production process.

Finally, the policy implications to be drawn from this are:

(1) lowering the wage will not solve the problem of excess supply.

(2) three ways to eliminate the excess supply are;

(i) an immigration of the high ability labour force

(ii) educational investment on the existing labour force

(iii) a reduction of training cost

(3) an introduction of a minimum wage will not cause the wage of the uncovered sector to fall as long as there is excess supply.

CHAPTER VIII : HETEROGENEOUS FIRMS

In the previous chapters we have characterized labour markets in terms of the nature of OJT, i.e. training cost function, c(•). It was shown that a labour market in which relatively unskilled labour is demanded tends to be characterized by market clearing equilibrium and thus by a flexible wage when faced to a change in the product demand, while that of skilled labour tends to be characterized by excess supply equilibrium and thus by a downwardly rigid wage.

In this chapter we assume that within a single market firms as well as the labour force are heterogeneous by allowing the firms to have different c(•)'s. After the equilibrium is established for this heterogeneous firm case, comparative static analyses are given and the chapter is concluded with some policy implications.

(1) Equilibrium

Assume that there are two groups of identical firms, A and B, within one market with their types differing merely in the form of c(•); c_A and c_B, in such a way that their optimal wages are $w_A^*>w_B^*$. Or formally,

$\exists$ optimal wages, w_A^* and w_B^*

s.t. $\Psi_A'(\alpha_A^*) \equiv w'(\alpha_A^*)+\bar{c}_A'(\alpha_A^*)=0$ & $w_A^*=w(\alpha_A^*)$

$$\Psi_B'(\alpha_B^*) \equiv w'(\alpha_B^*)+\bar{c}_B'(\alpha_B^*)=0 \ \ \& \ \ w_B^*=w(\alpha_B^*)$$

$$\text{and } w_A^*=w(\alpha_A^*)>w_B^*=w(\alpha_B^*) \qquad \text{(VIII-1)}$$

These are the same functions as those appeared in Chapter III and thus have the characteristics described in the assumptions. Note, however, that $\bar{c}_A$ and $\bar{c}_B$ differ in $c_A(\bullet)$ and $c_B(\bullet)$ but <u>share the same h(•)</u>. As for the difference of $c_A(\bullet)$ and $c_B(\bullet)$, we assume the single-crossing property, i.e. that $c_A(\bullet)$ is always steeper than $c_B(\bullet)$. Or formally,

$$|c_A'(\bullet)|>|c_B'(\bullet)| \quad \forall 0<\alpha<1 \qquad \text{(VIII-2)}$$

Following the argument in Chapter VI about the relationship between c(•) and $\bar{c}(\bullet)$, this in turn implies

$$|\bar{c}_A'(\bullet)|>|\bar{c}_B'(\bullet)| \quad \forall 0<\alpha<1 \qquad \text{(VIII-3)}$$

and consequently (VIII-1) holds. Fig.VIII-1 illustrates this. Notice that because of (VIII-3) Ψ_A lies to the right of Ψ_B generating α_A^* greater than α_B^* and thus w_A^* greater than w_B^*. We will see later on in this chapter that two distinct wage offers can exist within a single market as long as the sum of the labour demand of the two groups of the firms does not exhaust the available labour supply. The multiplicity of the equilibrium wage can be best understood as these wages being on what is called as an "offer curve" in Rosen (1974) in his ambitious attempt to analyse an equilibrium of a heterogeneous labour market. The present model with the heterogeneity of firms can be thought of as a member of this type of job matching models with Tinbergen (1951) being one of the pioneer works.

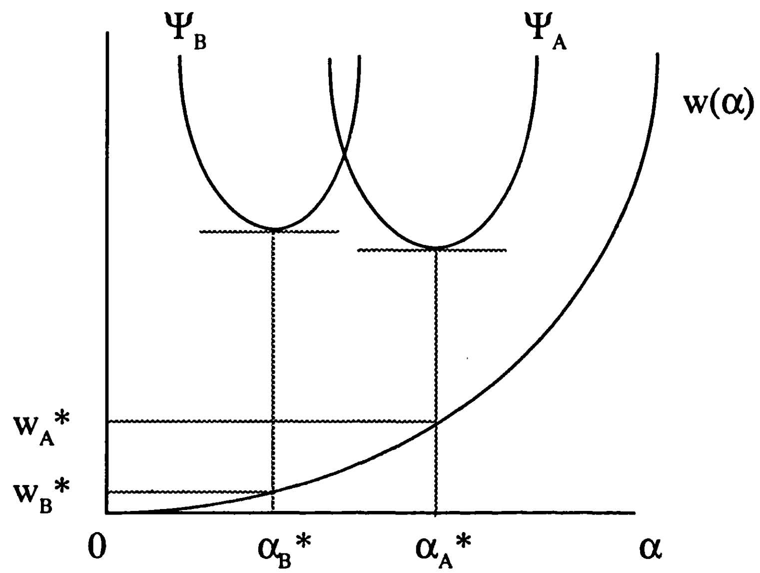


Fig.VIII-1

The basic framework of the equilibrium in the present model remains the same as that of the homogeneous firm case of the earlier part of this paper and Chapter III in particular — the equilibrium can still be characterized either by market clearing or by excess supply. The difference, however, is that such an analysis has to be made within each group of firms forming what could be called a "sub-market" within the labour market. Furthermore, as might be expected, whether each sub-market exhibits market clearing or excess supply is conditional upon the behaviour of the other group. Market equilibrium must fall into one of the following categories; (i) excess supply in A & B (ii) excess supply in A and market clearing in B (iii) market clearing in A and excess supply in B (iv) market clearing in A and B. (See Table VIII-1 below, where the entries correspond to the supply and demand situations of the whole market.)

		Sub-market B in	
		S>D	S=D
Sub-market A in	S>D	(i) S>D	(ii) S=D
	S=D	(iii) Not defined	(iv) S=D

Table VIII-1 : The characteristics of the market equilibrium

Let us consider these market equilibria in turn. In the following analysis we define;

w_i** : the equilibrium level of wage for the group i firms

α_i** : the ability level at the equilibrium wage, w_i** i.e. $w_i^{**}=w(\alpha_i^{**})$

x_i** : the equilibrium level of employment of an individual firm in the group i

n_i : a number of firms in the group i

N_i** : the total level of employment for the group i at the equilibrium s.t. $N_i^{**}=n_i x_i^{**}$ with i=A and B

(i) Excess supply in A & B

As the both sub-markets exhibit an excess supply, their optimal wages are the equilibrium wages. And the equilibrium levels of ability wage and employment for the two groups, $(w_A^{**},N_A^{**},\alpha_A^{**},)$ and $(w_B^{**},N_B^{**},\alpha_B^{**})$, must satisfy the following;

$$py'(x_A^{**})=w(\alpha_A^{**})+\bar{c}_A(\alpha_A^{**}) \qquad \text{(VIII-4)}$$

$$w'(\alpha_A^{**})+\bar{c}_A'(\alpha_A^{**})=0 \qquad \text{(VIII-5)}$$

$$py'(x_B^{**})=w(\alpha_B^{**})+\bar{c}_B(\alpha_B^{**}) \qquad \text{(VIII-6)}$$

$$w'(\alpha_B^{**})+\bar{c}_A'(\alpha_B^{**})=0 \qquad \text{(VIII-7)}$$

where $x_A^{**}=N_A^{**}/n_A$ and $n_A$and $x_B^{**}=N_B^{**}/n_B$. This is illustrated in Fig.VIII-2. In order to facilitate the diagrammatic representation, h(•) is assumed to be uniform over $0\leq\alpha\leq1$ and there is only one firm in each group i.e. $n_A=n_B=1$ and thus $x_A^{**}=N_A^{**}$ and $x_B^{**}=N_B^{**}$ — we continue to assume that the firms are competitive rather than duopolistic. The equilibrium values are determined as follows; First, α_B^{**} and α_A^{**} are derived from (VIII-5) and (VIII-7).(in Fig.VIII-2, they are the minimands of Ψ_A and Ψ_B respectively in the first quadrant) Given the CDF's (VIII-4) and (VIII-6), the demand for labour is derived for a single firm in the each group i.e. x_A^{**} and x_B^{**}. (In Fig.VIII-2, this is shown in the second quadrant.) And from this we can derive the demand for labour of the each sub-market, i.e. $N_A^{**}=x_A^{**}$ and $N_B^{**}=x_B^{**}$ since $n_A=n_B=1$. (See the fourth quadrant) If there is excess supply for the both sub-markets, the following conditions have to hold;

$$H(\alpha_A^{**})>N_A^{**}$$

$$H(\alpha_B^{**})>N_B^{**}+N_A^{**}(H(\alpha_B^{**})/H(\alpha_A^{**}))$$

(In Fig.VIII-2, this means the empty space below the shaded and dotted areas in h(•) in the fourth quadrant.) It should be noted that the diagrammatical illustration is valid for any n_A and n_B. Changing these values merely change the sizes of the shaded areas — for example, when they are large the sub-markets and thus the whole market is more likely to be in market clearing. On the other hand, they do not affect the optimal wages at all.

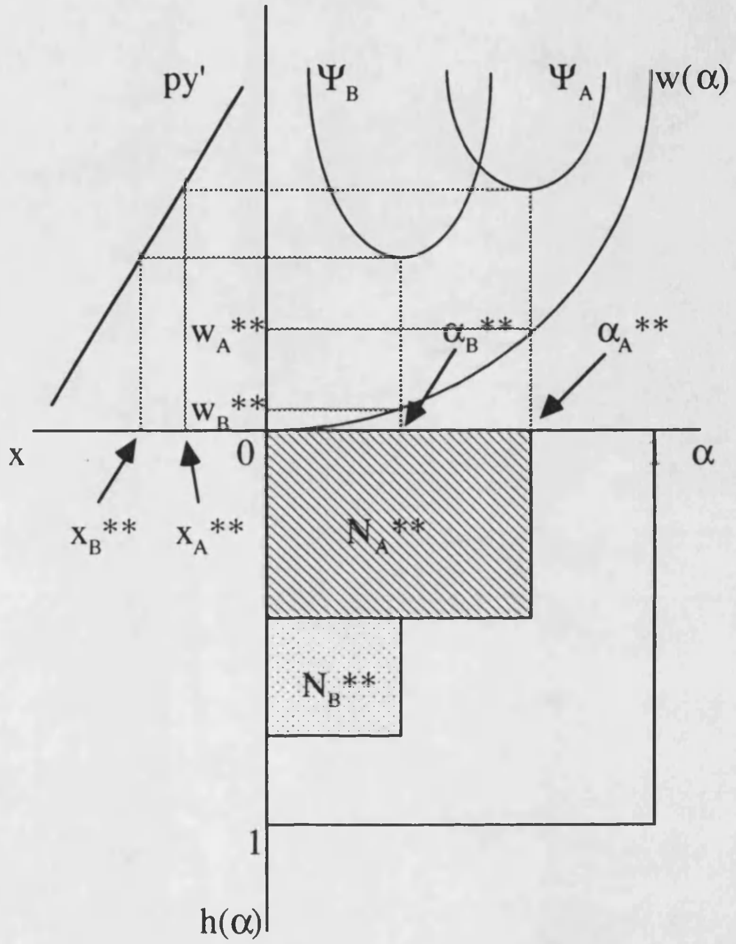


Fig.VIII-2

(ii) Excess supply in A and market clearing in B

The equilibrium conditions for the group A firms are the same as in (i), while the conditions for the group B firms do not include OWF. Instead, there is an equation expressing the market clearing of the whole market. Namely,

$$py'(x_A^{**})=w(\alpha_A^{**})+\bar{c}_A(\alpha_A^{**}) \quad \text{(VIII-4)}$$

$$w'(\alpha_A^{**})+\bar{c}_A'(\alpha_A^{**})=0 \quad \text{(VIII-5)}$$

$$py'(x_B^{**})=w(\alpha_B^{**})+\bar{c}_B(\alpha_B^{**}) \quad \text{(VIII-6)}$$

$$H(\alpha_B^{**})=N_B^{**}+N_A^{**}(H(\alpha_B^{**})/H(\alpha_A^{**})) \quad \text{(VIII-8)}$$

where $x_A^{**}=N_A^{**}/n_A$ and $n_A$and $x_B^{**}=N_B^{**}/n_B$ Fig.VIII-3 shows how the equilibrium is reached. Suppose first that the two groups of firms offer their optimal wages i.e. the group A firms offering w_A^{**} and the group B firms offering w_B^*, the optimal wage (cf. the first quadrant). This will generate the labour demand of x_A^{**} and x_B^0 for a single firm in each group. (cf. the second quadrant). This means in turn for the each sub-market the labour demand of N_A^{**} and N_B^0. However, this gives excess demand for labour for the whole market for the wage below w_B^* — this is indicated by the "double shaded" area in the fourth quadrant. The excess demand causes the group B firms' wage offer to rise above their optimal wage w_B^* as far as w_B^{**}, at which the supply equals the demand through an increase in the supply (cf. the fourth quadrant) and a decrease in the demand (cf. the second quadrant). Note here that the equilibrium in the sub-market A is not affected at all, since its higher wage offer means no worker chooses a group B firm when he faces the two different wage offers.

(iii) Market clearing in A and excess supply in B

This is not plausible since if the group A firms can clear the market with the wage w_A^{**}, which is above their optimal wage by definition, then no group B firm can attract any worker with their optimal wage, which is their offer wage with excess supply. This is indicated by "Not defined" in Table VIII-1.

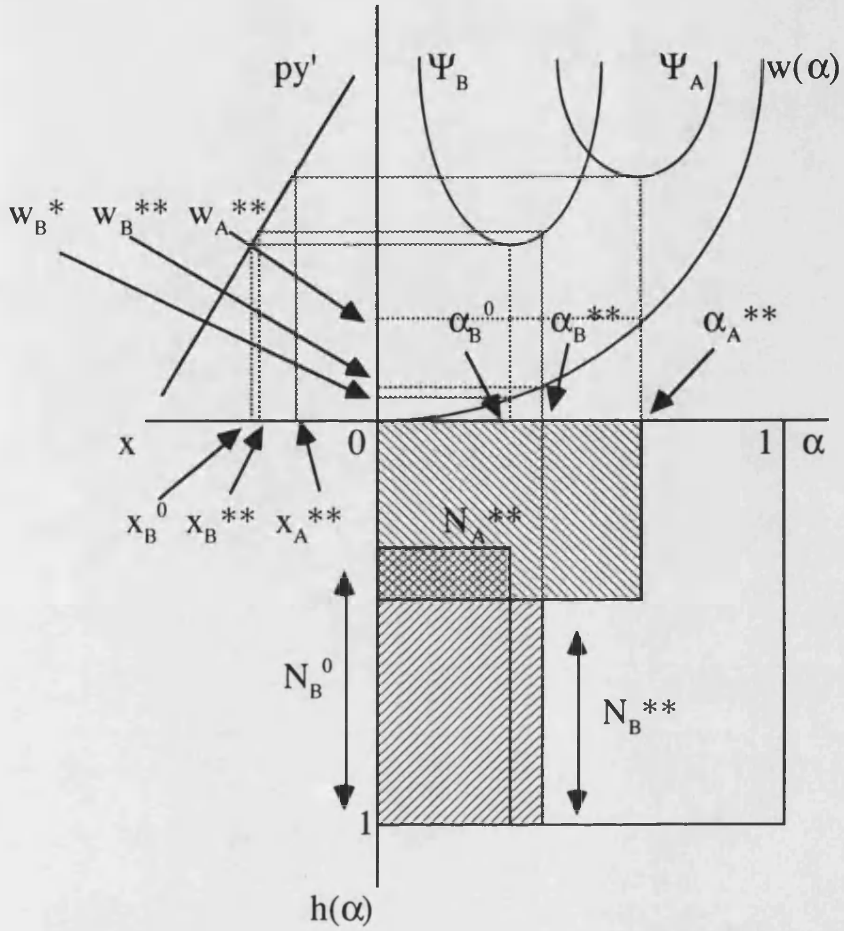


Fig.VIII-3

(iv) Market clearing in A and B

Suppose first that the sub-market A is in market clearing at wage w_A^+, which is higher than the optimal wage w_A^* by definition. Then no group B firm can attract any worker at its optimal wage w_B^*, since $w_A^+ \geq w_A^* > w_B^*$ and whoever willing to work at w_B^* is already employed by a group A firm as there is no

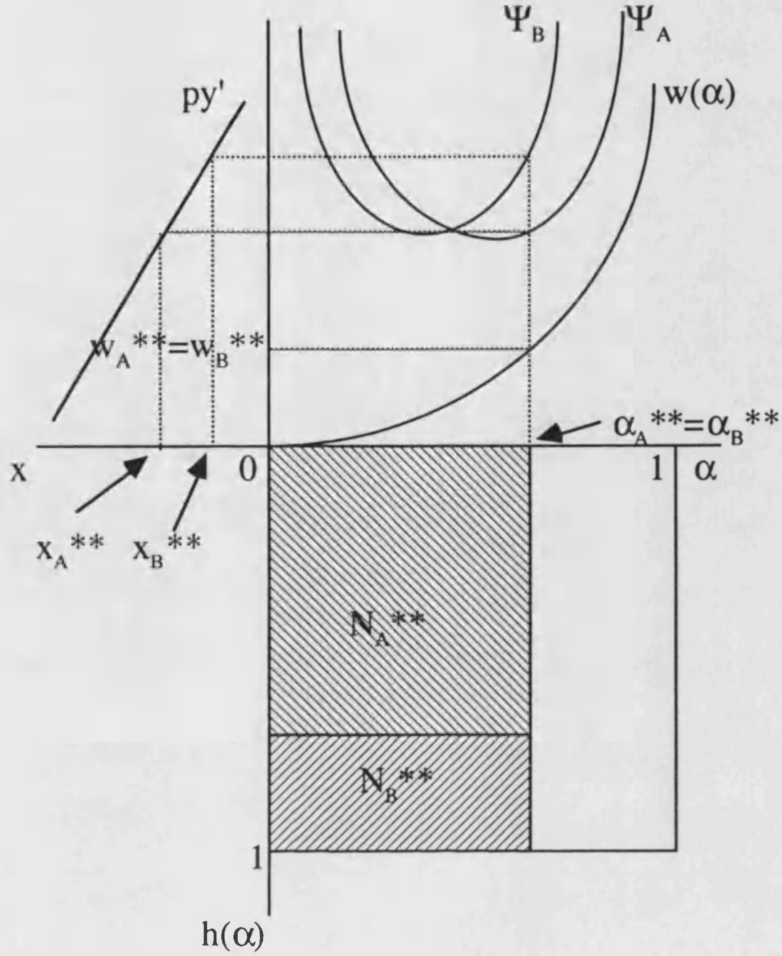


Fig.VIII-4

excess supply. A group B firm will have to raise the offer wage as high as w_A^+ to compete with the group A firms. With the group B firms joining the demand for labour, there will be an excess demand, which will cause the wage to fall until the supply equals demand. In this case there will be a unique equilibrium wage.

At the equilibrium the solutions (w_A^{**},N_A^{**},α_A^{**},) and (w_B^{**},N_B^{**},α_B^{**}) must satisfy the following ;

$$py'(x_A^{**})=w(\alpha_A^{**})+\bar{c}_A(\alpha_A^{**}) \quad \text{(VIII-4)}$$

$$py'(x_B^{**})=w(\alpha_B^{**})+\bar{c}_B(\alpha_B^{**}) \quad \text{(VIII-6)}$$

$$N_A^{**}+N_B^{**}=H(\alpha_A^{**}) \quad \text{(VIII-9)}$$

$$\alpha_A^{**}=\alpha_B^{**} \text{ i.e. } w_A^{**}=w_B^{**} \quad \text{(VIII-10)}$$

where $x_A^{**}=N_A^{**}/n_A$ and $n_A$and $x_B^{**}=N_B^{**}/n_B$ and (VIII-10) indicates a single equilibrium wage. This is illustrated in Fig.VIII-4. Note that at α_A^{**} Ψ_A and Ψ_B are positively sloped (cf. the first quadrant), implying that no excess supply exists. This also means $N_A^{**}+N_B^{**}=H(\alpha_A^{**})$ (cf. the fourth quadrant)

(2) The Training Cost Function and Multiple Wage Equilibrium

In Chapter VII, we have shown that a steeper $c(\cdot)$ and thus a steeper $\bar{c}(\cdot)$ tends to cause the market equilibrium to be characterized with the excess supply of labour under the assumption of homogeneous firms i.e. uniform $c(\bullet)$. What effects could generally steeper $c(\bullet)$'s and thus $\bar{c}(\bullet)$'s have on the market equilibrium when firms are heterogeneous within a market, i.e. when $\bar{c}(\bullet)$ differs among the firms ?

We can answer this question in two ways, both of which would simply be derived as corollaries to what we have just found. Firstly, there is a question concerning each group of firms within a market. It was shown that the steeper $\bar{c}(\bullet)$ is relative to others the higher the optimal wage would be and thus the more likely it is to have a job queue i.e. excess supply.

Secondly, let us consider two different markets each of which consists of heterogeneous firms in the present sense. A market whose firms are generally characterized by steep $\bar{c}(\bullet)$ is more likely to be in excess supply equilibrium and hence to be characterized by a multiple wage equilibrium, the wage being the optimal wages of each firm. On the other hand, a market whose firms are generally characterized by flatter $\bar{c}(\bullet)$ is more likely to be in a market clearing and single wage equilibrium.

(3) Comparative statics

We shall examine the effect of a change in product demand on the levels of equilibrium wage and employment by looking at two types of price change. Firstly, we look at the effect of the product price change on equilibrium in a market with two groups of firms, who are competitors in the same product market, i.e. there is a unique product price p, that changes. Secondly, we allow the two groups to be suppliers of different products, whose prices are p_A and p_B. In this latter case, our aim is to examine the comparative statics of a change in only one of the two product prices.

(a) The effect of a product price change in a single industry case

It was shown that the market equilibrium for the two-group case is characterized by one of the following.

(i) Excess supply equilibrium with both firms facing an excess supply.

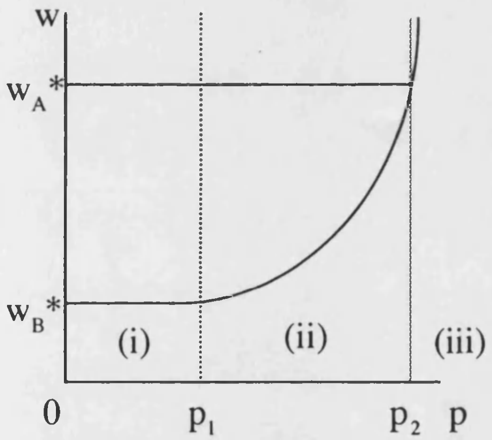
(ii) Market clearing equilibrium with the group A firm facing excess supply and the group B firm facing market clearing.

(iii) Market clearing equilibrium with both firms facing market clearing.

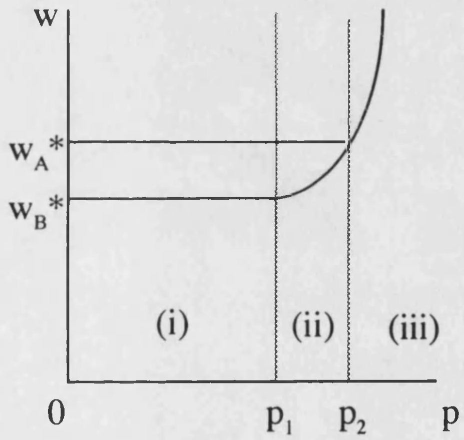
In terms of the product price, (i) is likely to occur with relatively low p, (iii) with relatively high p, while (ii) is the intermediate case. An equilibrium wage locus in terms of the product price p is illustrated in Fig.VIII-5(a), with the areas with numbers corresponding to the above three types of the equilibrium, and p_1 and p_2 signifying the product prices above which the group B firms and the group A firms face market clearing levels of labour supply respectively. It is worthwhile mentioning that as the product demand increases the wage differential, $w_A{}^{**}-w_B{}^{**}$ narrows down, with its upper and lower bounds being $w_A{}^{*}-w_B{}^{*}$ and zero respectively and with the wage offer of the steeper $\bar{c}(\bullet)$ group being more rigid. Furthermore, the closer the slopes of $\bar{c}_A(\bullet)$ and $\bar{c}_B(\bullet)$ are, the closer $w_A{}^{*}$ and $w_B{}^{*}$ are, and the more rigid $w_B{}^{*}$ is. (i.e. (ii) is less likely to occur) (See Fig.VIII-5(b) in comparison with (a)).

The argument may be extended to a case of multiple optimal wage equilibrium. (Fig.VIII-6(a) illustrates a case of five groups of firms with each having distinct optimal wage $w_i{}^{*}$ with i=A,B,C,D,& E s.t. $w_A{}^{*}> w_B{}^{*}>w_C{}^{*}>w_D{}^{*}>w_E{}^{*}$) Again they are assumed to be competitive. The loci are derived in a following manner. Suppose first that at $0<p<p_1$ the level of labour demand is low enough for all of the five groups of the firms to be in excess supply in their sub-markets.

When p rises all the firms will raise their demand and the group E with the lowest optimal wage is the one who faces the market clearing first. As a result they will have to raise their wage offer until it reaches w_D*, the optimal wage of the group D firms. During this time other groups can secure their demand at their optimal wages and thus they will not have to change the wage offers. And this process will continue until all the offer wages are equalized, after which point there will be a uniform wage. Notice that the highest optimal wage group i.e. group A offer the most rigid wage, while the lowest optimal wage group i.e. group E offers the most flexible wage as the product price varies.



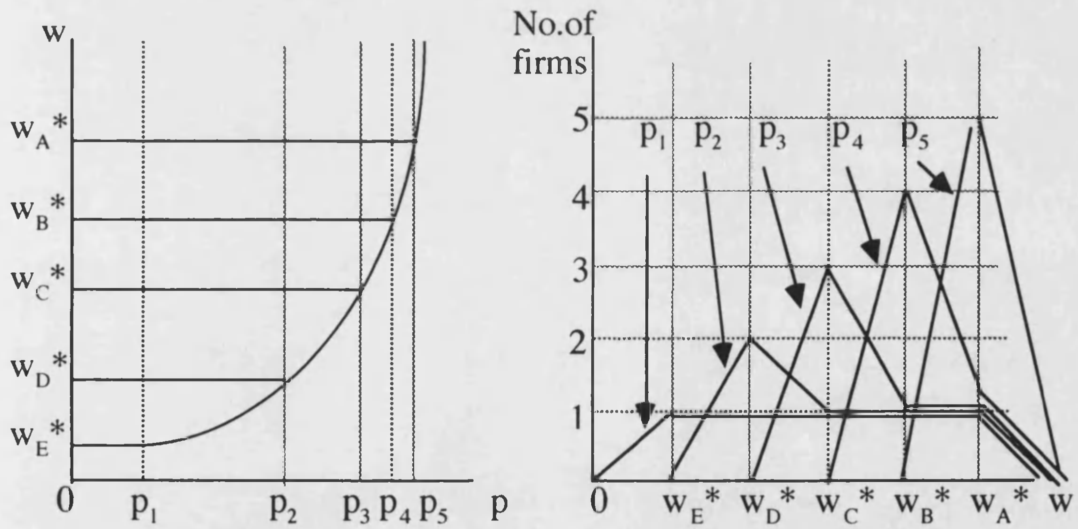
(a) when w*'s are not close



(b) when w*'s are close

Fig.VIII-5

An interesting implication of this result is that the distribution of the wages is more equal when the product demand is high i.e. in a boom. A family of the distributions of wages for different product price levels is given in the Fig.VIII-6(b), when there is only one firm in each group. Note here that the distributions apart from the extreme cases i.e. all at w_A* and all are distinct, are skewed to the right. Although one has to be careful when deriving a hypothesis to explain the real world phenomenon from a simplified model, it is worthwhile noting that a similar skewness is observed with the distribution of personal income in the real world. The skewness is often explained in relation to a normally distributed ability — what is known as "Pigou paradox" that a normally distributed ability does not generate a normally distributed income but a Pareto or lognormal distribution of income. In the present model the skewness came from a uniformly distributed optimal wages as opposed to Roy(1950) but with more elements of economics than Champernowne(1953). (See Chapter II(2)(iv)) Indeed it is important because this derivation takes into consideration the demand side of the market.



(a) Equilibrium wage loci (b) Equilibrium wage distribution

Fig.VIII-6

So far we have not specified which equilibrium among the three (i.e. (i) (ii) and (iii)) a market is actually in. This can only be determined ex post by observing the behaviour of the wage when the product price change actually occurs.

However, it is plausible to state that in the market where c(•) is generally steep the market is more likely to be in the excess supply equilibrium and vice versa.

Within the same industry, the different steepness of c(•)'s among the firms is best interpreted as the difference of the system of training workers of the firms. Firms with steep c(•)'s think that the opportunity wage of a worker (defined as his productivity in an alternative job such as in a self-employment sector) is a quite reliable proxy to his training cost and vice versa. The following example might help the reader to verify this point. Assume that the opportunity wage reflects one's productivity in a self-employed sector, in which strong individuality rather than conformity counts. Then a firm in which workers are trained individually may be categorized as having a steep c(•) since it means to value workers with high opportunity wages highly, while a firm with a mass training scheme may be categorized as having a flatter c(•). We might label the former a "specialist firm" and the latter a "generalist firm" — here we do not employ the terms skilled and unskilled labour as in the previous chapter, to illustrate that the difference of c(•) is due to difference in OJT process rather than that in skill level.

With these labelling, the results in the section can be rephrased as;

(1) Generalist firms offer lower wages than specialist firms.

(2) A wage offer of generalist firms is more flexible.

It should be noted that whether these two types of firms co-exist depends on two things. At a theoretical level, their profit levels must be such that it does not pay a firm to change its OJT method because of a certain fixed cost of starting a new OJT scheme, as different OJT method could mean different profit level. At a more practical level, they often co-exist as the values that workers put on the work, be it monetary or non-monetary, differ among them. We do not analyse in detail this latter aspect in the present paper, since here the utility functions of workers are assumed to be identical and are functions of the present wage only.

(b) The effects of a product price change in a multi-industry case

So far we have limited our analysis to a labour market for one industry or firms competing in the same product market. In this section we consider a labour market where the demand comes from more than one industry. Consequently, the different c(•) may be the result of different types of skills required in different industries. It also needs to be pointed out that there are more than one product price that could change when considering comparative statics. We examine the effect of a change in product prices p_A and p_B on equilibrium in turn.

(i) A change in p_A

Assume that the both groups are facing excess supply. An increased labour demand for the group A firms will be met initially by using up the excess supply at the beginning without a wage increase. Once the excess supply is exhausted, w_A** starts attracting the workers who would otherwise work for a group B firm. This will cause the group B firms to raise their wage offer above their optimal wage w_B*.

(ii) A change in p_B

Suppose that both the group A firms and the group B firms are facing excess supply with their optimal wages as the equilibrium wages, i.e. $w_A^*=w_A^{**}$ and $w_B^*=w_B^{**}$. The increase of labour demand is initially met without raising the wage offer w_B^{**}, because of the excess supply situation. The wage will have to be raised when there is no excess supply left for the group B firms. And w_B^{**} will continue to rise until it reaches w_A^*, after which the two wage offers rise together.

The equilibrium wage loci of the above two cases resemble that of (a), where $p_A=p_B$. The main point here is that irrespective of which price changes, the wage offer to be influenced initially is that of the firms offering a lower wage i.e. the group B firms' w_B^{**} in our case. In particular, an increase in the labour demand of the higher wage offer firms raises the wage offer of the lower wage offer firm. If we define these two groups of firms A and B as demanders of skilled and unskilled labour respectively — we do not call them specialist and generalist firms as in (a) since we defined these terms to mean different processes of producing the same product while the two groups here are suppliers of distinct products, the above result may be rephrased as "an increased demand for skilled labour raises the wage offer of the unskilled labour." (See Fig.VIII-6)

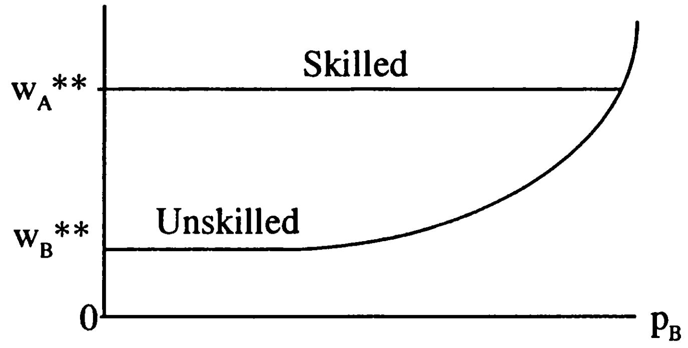


Fig.VIII-7

(5) Statistical Discrimination

The concept of heterogeneous firms employed in this chapter can also be used to explain how statistical discrimination occur in labour markets. To see this recall two groups of firms, A and B, of Chapter VIII (1). And replace the groups by groups of workers, A and B, while all the firms are assumed to be identical. Each group consists of heterogeneous in terms of c(•) but indistinguishable workers, while the groups are distinguishable from each other.

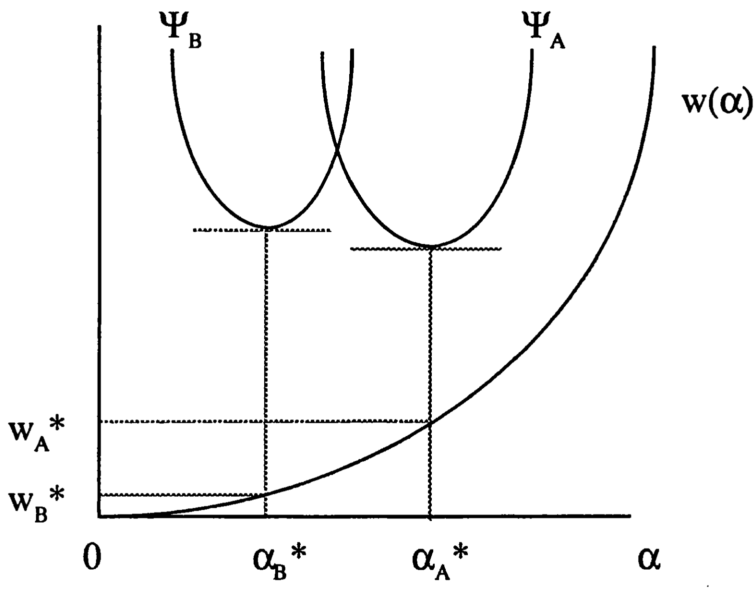


Fig.VIII-8

Fig.VIII-8 illustrates how the discrimination would take place. The firm faces two groups of workers whose average labour cost are given by

$$\Psi_A(\alpha)=w(\alpha)+\bar{c}_A(\alpha) \text{ and } \Psi_B(\alpha)=w(\alpha)+\bar{c}_B(\alpha)$$

The firm would offer the wage that minimizes the labour cost i.e. w_A*. However, in order to secure the minimum labour cost it needs to refuse all the group B applicants, since a typical group B worker attracted by w_A* has a much higher expected labour cost. This is the case of statistical discrimination, since not all workers in the group B are less productive than those in the group A and yet they are refused. Such discrimination may be dealt with by an anti-discrimination legislation appealing for an equal opportunity to all. However, this will force the firms away from the optimal point. The better remedy lies in the change of ability distribution of the group B through education so that the firms do not find it profitable to discriminate against the group B.

(6) Policy Implications

There are three main policy implications that can be drawn from the results obtained in this section. The first is concerned with non-uniformity of the equilibrium wage. In a simple neo-classical framework, the existence of multiple wage may be explained as a result of a luck of information on the wage variation or a lack of competition among the firms to eliminate the variation. In the present approach, instead, it was shown that multiple wage is possible at the equilibrium, when the firms are heterogeneous, with the heterogeneity being expressed here in terms of different OJT cost among the firms. It was also noted that the multiplicity would be more likely in a market where labour traded is mostly skilled. Hence the resulting unequal distribution of labour earnings can not be eliminated by making available the information on the wage variation or by encouraging the competition among the firms. As the multiplicity comes from the heterogeneities in both workers and the firms, the most effective policy to eliminate the inequality would be to eliminate the heterogeneities themselves. As for the firms, this means for all the firms to have an identical training cost function so that the optimal wage is unique to all the firms. Or the government may be able to tax or subsidize the firms on their training cost to uniformalize the optimal wage. As for the firms, this would mean to, for example, recommend to all the firms to pursue the same OJT. As for the workers, the opportunity wage has to be uniformalized among the potential workers by means of educational planning. This would supplement the training as post-educational investment. .

The second is concerned with the distribution of labour earnings and business cycle. The labour earnings are distributed more equally during booms with high labour demand and more unequally during slumps with low labour demand — the second part of Kuznet's Reversed U shape hypothesis i.e. after some spell of income unequalization, economic growth will eventually bring about the equality. (See Kuznets (1963)) Thus the redistribution of income through taxation is most needed when it would hurt the economy most, rather than when the economy can afford to be generous to the less fortunate members of the society.

Thirdly, the wages are not determined by equating supply and demand unless the market is in market clearing equilibrium and hence the wage differential is the direct result of the production process and in particular of the OJT. Therefore those wage differentials can not be eliminated or eased by controlling the supply of or demand for various types of labour, as is the case for neo-classical models of labour markets. So, for example, a rise in demand for skilled labour raises the wage of unskilled labour first and thus reduces the wage differential, while in a neo-classical model this would widen the wage differential.

In this chapter, we have established the following ;

Firstly, we have shown that when firms are heterogeneous within a market in terms of c(•) a multiple wage equilibrium is possible. The necessary condition for the multiple wage equilibrium to occur is that the firm with the highest wage offer faces an excess supply of labour. Conversely for the highest wage offer firm to be in market clearing means that the whole market is in market clearing equilibrium and with its wage being the single equilibrium wage.

Secondly, with comparative static analysis it was shown that in a multiple equilibrium situation, the lower the wage is relative to other offers the more flexible it is as the product demand fluctuates. Also the theoretical model suggests that the distribution of wages is skewed to left just as the real world income distribution shows, with it becoming more equal in booms and less equal in slumps.

Thirdly, with different types of industries acting as demanders of labour in the same labour market, wage offers for skilled labour tends to be more rigid than those for unskilled labour. Whichever product it may be, a change in its demand affects most the wage offer of the most unskilled labour. In particular, a rise in demand for products for which a skilled labour is required will first raise the offer wage of unskilled labour. The rational behind this result is that the demanders of the unskilled labour have to raise the wage to make up for the labour supply taken away by the skilled labour demanders.

Fourthly, the model was used to explain how statistical discrimination could occur. It was pointed out that an anti-discrimination legislation to give equal opportunity to all would force the firms away from the optimal point and thus some other policy to change the ability distribution of the discriminated group would be more advisable.

Finally, some policy implications were drawn. The multiple wage is not a market failure and thus the policy to eliminate it would require basic revisions of supply of and /or demand for labour. The equity measure is more important in slump than in booms. And lastly the wage of unskilled labour is affected and is so first by a change in demand for any type of labour.

CHAPTER IX OBSERVATIONALLY DISTINGUISHABLE WORKERS

(1) Introduction

So far we have been assuming that ability of each worker is not observable to the firm at the time of contract. Indeed, this was the crucial assumption in explaining as to why the workers are paid uniformly despite their heterogeneity in the earlier model. In reality, however, it is more likely that the ability of each applicant is known to the recruiting firm at least partially. Recall the excess supply equilibrium we have described earlier on. If a firm can select workers from those willing to work at the optimal wage rather than picking them at random, it will rank and recruit workers according to the ability level, because the total training cost would be reduced. This in turn raises the employment level.. Thus it is the interest of the recruiting firm to know the ability levels of the applicants.

Typically, a job opening specifies an offer wage and a minimum hiring standard as well as other aspects of working conditions. This also prompts the potential workers to reveal their ability --- otherwise, they may be considered as not satisfying the standard and fail to get the job. Hence the distinguishability becomes an important element for both sides of the labour market. In this chapter, we examine the mechanism of a labour market, in which observationally distinguishable workers form a job queue by their known ability levels for jobs specifying the wage offer and the minimum hiring standard. The basic framework of this model is unchanged from the indistinguishable workers case of the earlier chapter. In particular, the recruiting firms offer OJT and the uniform wage is offered to several openings of an identical job despite the heterogeneity of the applicants.

There are several theoretical issues to be clarified before we move on to the analysis. To illustrate them, let us first present an example of a type of a labour market we have in mind in this chapter. In Japan, where there are more than 500,000 university students graduating in March every year, early summer months are the busiest time for the final year students with their job search. Although most of them are lucky enough to secure a job before graduation, this activity is rather tiresome for the job searching students as well as for the recruiting firms, with so many future workers trying to find the ideal post within few months. To fit in all those, many large firms offer tens or even hundreds of the same job openings and give them OJT. Typically, the job applicants experience a three-stage recruiting procedure by a firm. At the first stage, screening by educational credentials singles out the applicants with good academic achievements as well as from universities of relatively high reputation. The successful applicants are then invited to take a short test, in which general rather than specific knowledge is asked. This may be repeated and by the end of this stage the number of applicants is greatly reduced. An interview or several interviews are held in the last stage of the recruitment for the group of applicants already small enough to make more detailed and personal evaluations. The applicants are asked to express their commitment to the firm, the fellow employees and to the job itself. If the interviews are repeated, the interviewers are upgraded in the firm's hierarchy each time.

The newly recruited workers, who are relatively homogeneous by age will receive OJT, a training necessary to adapt them to the new working environment. This will then be followed by a promotion race. In Japan, the path to the promotion is known to be quite long compared to those in other developed countries. Koike (1991) argues, for example, that the major promotion for university graduates could take place as late as 15 years after the recruitment.

Several remarks may be made about this example. Firstly, the competitions for jobs is hard and tiresome not because of large excess supply of labour but because each graduate applies to many firms. In a way such a search strategy is not meaningless, as the firms see the educational achievement as an indicator of trainability rather than immediate productive quality in its own right --- in general it is more so for students of non-pure science courses than to those of science courses but the former group is much larger. Furthermore, the ranking table of universities makes university entrance extremely competitive. And this makes many families start investing in education of their children at a much earlier stage. Many educationalists hold the opinion that such an interest in education is rather overheated, and these selected graduates are not always so much more productive than others since academic achievement is not the only quality needed for job performance. In fact some firms, notably Sony already for some years, do not ask the applicants which university they graduated from. But it has not yet become the standard procedure. (See Takeuchi (1995) for more extended analysis. He provides extremely useful information on this issue. I do not deal with it here mainly because it is more of a sociological approach and thus would not be directly relevant to the present analysis.)

Secondly, despite a decade or more that the workers have to wait to receive what they deserve, the quit rate is not known to be particularly high in Japan compared with other developed countries. (See Koike (1991)) This is puzzling, at least theoretically, since one might expect the workers to quit to move to other job or where he can be paid what he thinks is worth right away. Contrast this type of turnover with the relationship between training and job tenure discussed earlier in Chapter II and Chapter V. It was about evaluating productivity of workers over time in the world of homogeneous labour, while here we are concerned with evaluating workers of homogeneous ability. There are several reasons for not paying the wage according to one's productivity even if the individual difference is known by the educational credentials. Firstly, it would be too tedious and costly to derive an individual wage scheme for everyone recruited to the same job --- the productivity difference among the recruits may be too insignificant especially in our example. To the extent that OJT is a group activity, it might be difficult to determine the individual OJT cost --- the firm may know the total OJT cost instead. Put it differently, firms are not likely to adjust the wage to individual recruits who are expected to perform the same task. There are cases where the wage may be set according to one's productivity. For example, an already highly skilled worker may negotiate his wage to fully reflect his productivity. But it is a different type of labour market all together from our case of recruiting inexperienced workers to train them to be skilled. And even for our highly skilled worker the wage will be associated to the job characteristics or grade --- the firm would claim that the employee receives £ x per month say, because he performs a job of the grade y say, which generates the productivity worth £ x, rather than because his productivity is worth £ x. The best way to imagine it is that workers are allocated to already existing job slots and there is not always a slot for everyone. Extended discussions on such an issue are found in the job evaluation literature in the management science --- see, for example, Patten (1977) for an introductory reference, but often their arguments are not based on economic theories.

There is also a question of an accuracy of the screening --- the educational credentials need to be complemented by short tests and interviews, because it is not considered to be the perfect screening device. After all, the best way to screen is monitoring on the job. It may not be a good idea to determine one's wage fully based on the pre-employment information, which is not perfect. That this inaccurately measured wage can affect one's incentive to work is another reason for the uniform wage. (See Patten (1977)) Think of the recruitment as the starting point of a promotion race. It would be the interest of the firm to organize a fair race starting with the same wage and rewarding later on properly reflecting the achievement of each participant.

One might also wonder what happens to those unsuccessful applicants i.e. those with the credentials below the minimum hiring standard. Can they, for example, improve the chance of recruitment by offering to work at a lower wage? Recall that in the indistinguishable workers case, the further attempt of unsuccessful applicants by offering to work at a lower wage is not effective as this merely acts to reveal their low level of ability. When the ability is observable, the wage offer of those unsuccessful applicants will be bid down to their own opportunity wages as the firms are assumed to know $w(\alpha)$. As this is the wage they can earn in the alternative sector, they do not find worthwhile to seek an employment in this firm. Notice that this argument is valid provided that the successful applicants are paid the uniform wage, the assumption supported by the earlier remarks of this chapter. Thus as long as the uniform wage is maintained by the reasons explained earlier, no once-unsuccessful applicant can make it with the second attempt by undercutting his offer wage.

The model of this chapter is a simplified version of such a process of recruitment, OJT and promotion as described by the Japanese example. Thus the model is particularly relevant to the labour market for new recruits who require training , and not for already skilled workers. In this model 'qualification', the educational credential, is the only screening device and there is no short test or interview. The underlining assumption is that the qualification is not perfect but superior at least to the other two. Secondly, it is a one-period model with recruitment and OJT but without promotion. A multi-period model with promotion races would be more complete and appropriate particularly for dealing with the incentive aspect. However, we stay with the one-period model in order to concentrate on the adverse selection aspect of the labour market model in relation to the heterogeneity of labour. The equilibrium will be described by a market clearing situation for the workers with the qualification range covered between the wage offer, i.e. the qualification of the workers whose opportunity wage is the optimal wage, and the minimum hiring standard. And those below the minimum hiring standard forming the excess supply.

(2) The Model

Recall the set of profit maximization conditions for the model with indistinguishable workers,

$$py'(x^d)=\bar{c}(\alpha)+w(\alpha) \tag{III-7}$$

$$\bar{c}'(\alpha)+w'(\alpha)=0 \tag{III-8}$$

from which α^* and x^* are derived for the excess supply equilibrium. And the profit is,

$$\pi_I=py(x^*)-[w^*(\alpha^*)+\bar{c}(\alpha^*)]x^* \tag{IX-1}$$

It follows from this that if the firm can choose a particular group of x^* workers out of the pool of workers at w^* by setting a minimum hiring standard $\underline{\alpha}$, its profit would be increased. This is because selecting the better x^* workers in such a way from the pool of workers would imply,

$$\pi_{II}=py(x^*)-[w^*(\alpha^*)+\bar{c}(\underline{\alpha},\alpha^*)]x^* \tag{IX-2}$$

where $\bar{c}(\underline{\alpha},\bar{\alpha})=\dfrac{\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)h(z)dz}{\int_{\underline{\alpha}}^{\bar{\alpha}} h(z)dz}$ and $\bar{\alpha}=\alpha^*$

And as $\partial\bar{c}(\underline{\alpha},\bar{\alpha})/\partial\underline{\alpha} < 0$ and $\bar{c}(\alpha^*) \equiv \bar{c}(0,\alpha^*) \equiv \bar{c}(0,\bar{\alpha})$

$$\bar{c}(\alpha^*) \geq \bar{c}(\underline{\alpha},\bar{\alpha}) \quad \text{for } 0\leq\underline{\alpha}\leq\bar{\alpha} \tag{IX-3}$$

Consequently, $\pi_I \leq \pi_{II}$

Formally, the firm's optimization problem for the present model is,

$$\max_{x,\underline{\alpha},\bar{\alpha}} [\pi_{II}=py(x)-\{w(\bar{\alpha})+\bar{c}(\underline{\alpha},\bar{\alpha})\}x] \tag{IX-4}$$

The first order conditions are,

$$\partial\pi_{II} / \partial x=py'(x)-\{w(\bar{\alpha})+\bar{c}(\underline{\alpha},\bar{\alpha})\}=0 \tag{IX-5}$$

$$\partial\pi_{II} / \partial\underline{\alpha}=-\{\bar{c}_1(\underline{\alpha},\bar{\alpha})\}x\geq 0 \tag{IX-6}$$

$$\partial\pi_{II} / \partial\bar{\alpha}=-\{w'(\bar{\alpha})+\bar{c}_2(\underline{\alpha},\bar{\alpha})\}x=0 \tag{IX-7}$$

where $\bar{c}_1=\partial\bar{c}/\partial\underline{\alpha}$ and $\bar{c}_2=\partial\bar{c}/\partial\bar{\alpha}$

Note that the second condition holds with equality, when $x^*=0$ or , $\underline{\alpha}=\bar{\alpha}$, both implying 'no production'. In other words, the optimum value for $\underline{\alpha}$ is indeterminate within this set of the first order conditions. In order to determine x^*, $\underline{\alpha}^*$ and $\bar{\alpha}^*$ (or w^* equivalently), the firm requires a condition for labour supply availability unlike in the case of observationally indistinguishable workers, where it comes to the market with their desired levels of wage and the employment. The first and the third together would be equivalent to the conditions for the case of observationally indistinguishable workers if $\underline{\alpha}$=0. Consequently the third condition does not necessarily hold with equality either just as for a market clearing case of the previous model.

The optimum values x*, $\underline{\alpha}$* and $\overline{\alpha}$* are determined as the market equilibrium values such that,

$$py'(x)=\{w(\overline{\alpha})+\bar{c}(\underline{\alpha},\overline{\alpha})\} \qquad \text{(IX-8)}$$

$$w'(\overline{\alpha})+\bar{c}_2(\underline{\alpha},\overline{\alpha})\leq 0 \qquad \text{(IX-9)}$$

$$H(\overline{\alpha})-H(\underline{\alpha})=x \qquad \text{(IX-10)}$$

where, as in the indistinguishable workers' case, H(·) is the portion of the labour supply that is available to one firm.

These three conditions imply in turn;

(i) the marginal productivity is equal to the marginal labour cost

(ii) the marginal labour cost with respect to $\overline{\alpha}$ is non-positive.

(iii) supply equals demand

And unlike the indistinguishable workers' case, they will have to be determined simultaneously. Recall that (IX-9) depends on $\underline{\alpha}$ as well as $\overline{\alpha}$. Although there is no excess supply equilibrium in the sense described earlier, the equilibria should be categorized into two types in terms of the value of $\underline{\alpha} - \underline{\alpha}>0$ means it succeeded in securing the labour force with $w'(\bar{\alpha})+\bar{c}_2(\underline{\alpha},\bar{\alpha})=0$, while $\underline{\alpha}=0$ means that the firm could not secure the quality and quantity of workers it had wished with $w'(\bar{\alpha})+\bar{c}_2(\underline{\alpha},\bar{\alpha})<0$. Therefore they are analogous to excess supply and market clearing respectively.

Fig.IX-1 shows how the equilibrium is reached in this model with distinguishable workers. We assume the uniformly distributed h(•) as in the similar diagrammatical illustrations of earlier chapters. Firstly, let the firm set the minimum hiring standard at 0. Since $\underline{\alpha}$ is now fixed, $\bar{c}(\bullet,\bullet)$ depends on $\bar{\alpha}$ alone. Assume first that (IX-9) holds with inequality. This is identical to the market clearing equilibrium of the indistinguishable worker case. If (IX-9) holds with equality, this in turn determines $\bar{\alpha}$, $\bar{\alpha}_0$ say, in the equation and together they, i.e. 0 and $\bar{\alpha}_0$, determine the supply of labour i.e. $H(\bar{\alpha}_0)-H(0)=\bar{\alpha}_0$ and the demand for labour, i.e. x_0 through (IX-8) at the same time. In this particular example, $x_0>\bar{\alpha}_0$, i.e. there is excess demand. And the wage would be raised to ate the supply and demand. This would mean in turn that a new set of offers, i.e. $\{\underline{\alpha}, w(\bar{\alpha})\}$ has to be made to attract more workers. In this diagram, it is expressed by a higher wage $w^*=w(\bar{\alpha}^*)$ and a positive minimum hiring standard $\underline{\alpha}^*$. Note that with $\underline{\alpha}^*>0$, $\bar{c}(\underline{\alpha}^*,\bar{\alpha})>\bar{c}(\underline{\alpha}_0,\bar{\alpha})\ \ \forall\alpha\leq\bar{\alpha}\leq 1$. This also implies that RHS of (IX-8) becomes smaller, resulting in a new and higher level of x, as py'(x) is lower. The process will continue until (IX-10) is met. In Fig.IX-1, $x^*=\bar{\alpha}^*-\underline{\alpha}^*$. Note that for every $\underline{\alpha}$, there exists some $\bar{\alpha}$ to satisfy (IX-9). In Fig.IX-1 the optimal wage is indicated to be greater for (IX-9) with a greater value of $\underline{\alpha}$. However whether this holds depends on the functional form of c(•,•). This is discussed later.

What is established here is that involuntary unemployment can exist at the equilibrium just as for the models of the earlier chapter with indistinguishable workers. But here the unemployed are not randomly chosen from those willing to work at the offer wage but they are the workers with their ability lower than the minimum hiring standard. In fact the indistinguishable workers' case may be thought of as a constrained case of the present model, with the constraint being $\underline{\alpha}=0$. The type of a labour market that is likely to exhibit the excess supply equilibrium is the same as the earlier model. Hence, the minimum qualification is more likely to exist in a skilled job market, in which excess supply is more likely, than in an unskilled job market.

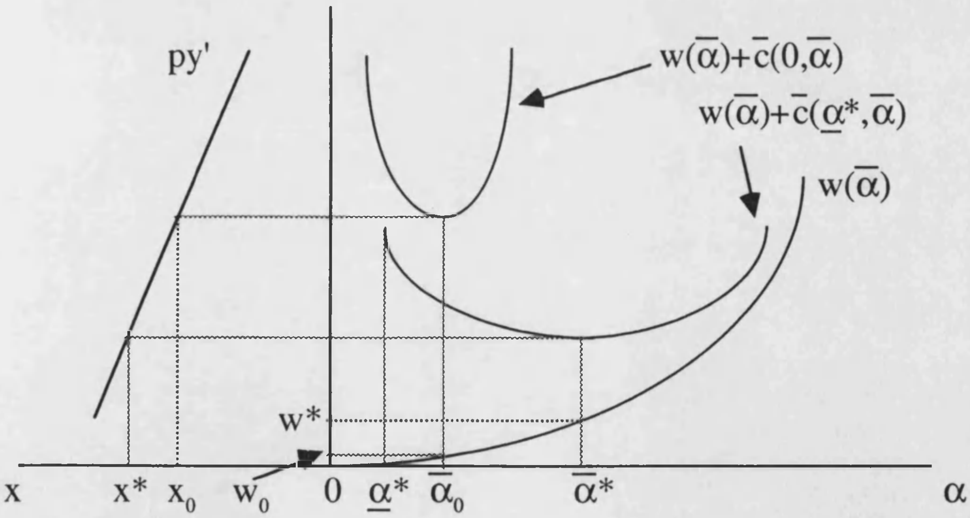


Fig.IX-1

(3) Comparative statics

Having determined the equilibrium mechanism of this model with distinguishable workers, we can now turn to its comparative static analysis. We shall examine the effect of a change in the product demand on employment schedules i.e. on the wage level and the minimum hiring standard. One of the quite interesting and practical questions here is how changes in economic state affects the heterogeneous workers. Take a case of reduced product demand. If, for example, such a reduction is met by raising the minimum hiring standard without affecting the wage, then this would hurt less able workers more as they are going to be involuntarily unemployed. If, on the other hand, the reduction in demand is met by lowering the equilibrium wage, then this would hurt everyone equally in the sense that everyone still in employment will face the reduction in wage and those who left the job did so voluntarily. Thus the comparative statics in this model can tell us about the distributional effects of a change in economic state. Or "Would a bad time affect everyone equally by reducing the wage or the less able workers more by raising the minimum hiring standard?"

In pursuing the analysis, we need to consider the case of $\underline{\alpha}>0$ only, for if $\underline{\alpha}=0$, then the equilibrium exhibits a market clearing situation in the sense described in the earlier chapters with indistinguishable workers and thus an exogeneous change at the margin would not affect $\underline{\alpha}$. Differentiate, therefore, (IX-8), (IX-9) with equality, and (IX-10) with respect to p and we obtain,

$$py''(x)(dx/dp)+y'(x)=w'(\overline{\alpha})(d\overline{\alpha}/dp)+\bar{c}_1(\underline{\alpha},\overline{\alpha})(d\underline{\alpha}/dp)+\bar{c}_2(\underline{\alpha},\overline{\alpha})(d\overline{\alpha}/dp) \qquad \text{(IX-11)}$$

$$w''(\bar{\alpha})(d\bar{\alpha}/dp)+\bar{c}_{21}(\underline{\alpha},\bar{\alpha})(d\underline{\alpha}/dp)+\bar{c}_{22}(\underline{\alpha},\bar{\alpha})(d\bar{\alpha}/dp)=0 \tag{IX-12}$$

$$h(\bar{\alpha})(d\bar{\alpha}/dp)-h(\underline{\alpha})(d\underline{\alpha}/dp)=dx/dp \tag{IX-13}$$

where $\bar{c}_{21}(\underline{\alpha},\bar{\alpha})=\partial^2\bar{c}/\partial\underline{\alpha}\partial\bar{\alpha}$ and $\bar{c}_{22}(\underline{\alpha},\bar{\alpha})=\partial^2\bar{c}/\partial\bar{\alpha}^2$

With $w'(\bar{\alpha})+\bar{c}_2(\underline{\alpha},\bar{\alpha})=0$ at the equilibrium, (IX-11) (IX-12) and (IX-13) may be written in a matrix form as;

$$\begin{bmatrix} py'' & 0 & -\bar{c}_1 \\ 0 & w''+\bar{c}_{22} & \bar{c}_{21} \\ 1 & -h(\bar{\alpha}) & h(\underline{\alpha}) \end{bmatrix} \begin{bmatrix} dx/dp \\ d\bar{\alpha}/dp \\ d\underline{\alpha}/dp \end{bmatrix} = \begin{bmatrix} -y'(x) \\ 0 \\ 0 \end{bmatrix} \tag{IX-14}$$

And therefore

$$dx/dp=|A|^{-1}\{-y'((w''+\bar{c}_{22})h(\underline{\alpha})+\bar{c}_{21}\bullet h(\bar{\alpha}))\} \tag{IX-15}$$

$$d\bar{\alpha}/dp=|A|^{-1}\{-y'\bullet\bar{c}_{21}\} \tag{IX-16}$$

$$d\underline{\alpha}/dp=|A|^{-1}\{y'(w''+\bar{c}_{22})\} \tag{IX-17}$$

where $|A|=py''\{(w''+\bar{c}_{22})h(\underline{\alpha})+\bar{c}_{21}\bullet h(\bar{\alpha})\}+(w''+\bar{c}_{22})\bar{c}_1$, i.e. the determinant of the matrix of (IX-14)

Among the terms in (IX-15) (IX-16) (IX-17) and $|A|$, we know;

$y'>0$, $y''<0$, $w''+\bar{c}_{22}>0$, $h(\bullet)\geq 0$, $\bar{c}_1<0$, $\bar{c}_{22}>0$, $p>0$,

while we do not know the sign of $\bar{c}_{21}$. However,

$$\bar{c}_{21} = \bar{c}_{21}(\underline{\alpha},\bar{\alpha}) = \partial^2\bar{c}/\partial\underline{\alpha}\partial\bar{\alpha} = (\partial/\partial\underline{\alpha}\partial\bar{\alpha}) \frac{\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)h(z)dz}{\int_{\underline{\alpha}}^{\bar{\alpha}} h(z)dz}$$

$$= (\partial/\partial\underline{\alpha})\ [h(\bar{\alpha})\{c(\bar{\alpha}) - \bar{c}(\underline{\alpha},\bar{\alpha})\}/\{H(\bar{\alpha})-H(\underline{\alpha})\}]$$

$$= [h(\bar{\alpha})/\{H(\bar{\alpha})-H(\underline{\alpha})\}^2\ ][-\bar{c}_1(\underline{\alpha},\bar{\alpha})\{H(\bar{\alpha})-H(\underline{\alpha})\}+\{c(\bar{\alpha})-\bar{c}(\underline{\alpha},\bar{\alpha})\}h(\underline{\alpha})]$$

$$= [h(\underline{\alpha})h(\bar{\alpha})/\{H(\bar{\alpha})-H(\underline{\alpha})\}^2][c(\underline{\alpha})+c(\bar{\alpha})-2\bar{c}(\underline{\alpha},\bar{\alpha})] \qquad \text{(IX-18)}$$

since $\bar{c}_1 = -h(\underline{\alpha})\{c(\underline{\alpha})-\bar{c}(\underline{\alpha},\bar{\alpha})\}/\{H(\bar{\alpha})-H(\underline{\alpha})\}$ (IX-19)

Thus $\bar{c}_{21} \geq (<) 0$ if $(1/2)\{c(\underline{\alpha})+c(\bar{\alpha})\} \geq (<) \bar{c}(\underline{\alpha},\bar{\alpha})$ (IX-20)

It is difficult to say anything precise about the direction of the inequality without specifying at least functional forms of $c(\bullet)$ and $h(\bullet)$. All that can be said at this point is that $\bar{c}(\bullet,\bullet)$ has $c(\underline{\alpha})$ and $c(\bar{\alpha})$ as its upper and lower bounds respectively, with these polar cases representing the limiting cases of $h(\bullet)$ being concentrated at $\underline{\alpha}$ and $\bar{\alpha}$ respectively. Therefore a very high concentration of the distribution at $\underline{\alpha}$ would imply $\bar{c}_{21}<0$ and at $\bar{\alpha}$ $\bar{c}_{21} \geq 0$. However, as $\underline{\alpha}$ and $\bar{\alpha}$ are not exogeneously given variables but rather they are endogeneously determined in the market equilibrium, we can not state whether $\bar{c}_{21} \geq (<) 0$ by simply examining the shape of $h(\bullet)$ in this manner. However, given the sign and the size of $\bar{c}_{21}$, the signs of (IX-15) (IX-16) and (IX-17) can be easily determined. To see this group the terms which appear in (IX-15) (IX-16) and (IX-17) into the following four terms — $|A|$, $\{-y'((w''+\bar{c}_{22})h(\underline{\alpha})+\bar{c}_{21}\bullet h(\bar{\alpha}))\}$, $-y'\bullet\bar{c}_{21}$, and $y'(w''+\bar{c}_{22})$. Their signs will depend on the sign and the size of $\bar{c}_{21}$ in such a way that,

$$|A| = py''\{(w''+\bar{c}_{22})h(\underline{\alpha})+\bar{c}_{21}\bullet h(\bar{\alpha})\}+(w''+\bar{c}_{22})\bar{c}_{1}>0,$$

$$\text{if } \bar{c}_{21} < -\{h(\underline{\alpha})/h(\bar{\alpha})\}(w''+\bar{c}_{22})[1+\{\bar{c}_{1}/h(\underline{\alpha})py''\}]$$

$$\{-y'((w''+\bar{c}_{22})h(\underline{\alpha})+\bar{c}_{21}\bullet h(\bar{\alpha}))\} >0, \quad \text{if } \bar{c}_{21}>-\{h(\underline{\alpha})/h(\bar{\alpha})\}(w''+\bar{c}_{22})$$

$$-y'\bullet\bar{c}_{21}>0, \quad \text{if } \bar{c}_{21}>0$$

$$y'(w''+\bar{c}_{22})>0 \quad \text{for all values of } \bar{c}_{21}$$

And for these ranges of $\bar{c}_{21}$, the signs of (IX-15) (IX-16) and (IX-17) are determined as in Table IX-1 below.

	$\bar{c}_{21}<B$	$\bar{c}_{21}=B$	$B<\bar{c}_{21}<C$	$\bar{c}_{21}=C$	$C<\bar{c}_{21}<0$	$\bar{c}_{21}=0$	$0<\bar{c}_{21}$
dx/dp	+	?	-	0	+	+	+
$d\bar{\alpha}/dp$	+	?	-	-	-	0	+
$d\underline{\alpha}/dp$	+	?	-	-	-	-	-

where $B= -\{h(\underline{\alpha})/h(\bar{\alpha})\}(w''+\bar{c}_{22})[1+\{\bar{c}_{1}/h(\underline{\alpha})py''\}]$ and $C= -\{h(\underline{\alpha})/h(\bar{\alpha})\}(w''+\bar{c}_{22})$

Table IX-1

The case of $0<\bar{c}_{21}$ is what one would normally expects from an increased demand for product, where it generates an increase in the employment level by raising the wage offer (since an increase in $\bar{\alpha}$ means an increase in w) as well as relaxing the minimum hiring standard. The case of $\bar{c}_{21}=0$ is an interesting one as it claims that the increase in employment is achieved by lowering the minimum hiring standard only without changing the wage offer. When $C<\bar{c}_{21}<0$, the wage offer is reduced while the employment level is increased, implying that the firm decides to employ less able but cheaper workers. The cases of $B<\bar{c}_{21}<C$ and $\bar{c}_{21}=C$ show rather unexpected results that the increased demand for the product causes the reduction and no change in the labour demand respectively. The entries for the case of $\bar{c}_{21}=B$ mean that they are undefined since this condition implies $|A|=0$ and in such a case we can not solve the simultaneous equations (IX-14). And finally if $\bar{c}_{21}<B$, the employment is increased by raising both the wage offer and the minimum hiring standard, implying that the firm decides to employ more expensive but more able workers.

In total, the comparative statics results can be almost anything if we do not restrict the value of $\bar{c}_{21}$. On the other hand, it is true that $\bar{c}_{21}$ is derived from $c(\bullet)$ and $h(\bullet)$ which do follow certain behaviour. Let us attempt to illustrate more explicitly the issue here, by specifying $c(\bullet)$ and $h(\bullet)$ as linear functions such that;

$$c(\alpha)=1-\alpha \tag{IX-21}$$

$$h(\alpha)=(1-\frac{a}{2})+a\alpha \quad \text{where } -2\leq a\leq 2 \tag{IX-22}$$

The second function secures that $H(1)=1$ for all values of a and at the same time represents linearly increasing/constant/decreasing density functions for negative/zero/positive value of a respectively.

With these specifications,

$$\bar{c}(\underline{\alpha},\bar{\alpha})=\frac{\int_{\underline{\alpha}}^{\bar{\alpha}}c(z)h(z)dz}{\int_{\underline{\alpha}}^{\bar{\alpha}}h(z)dz}=\frac{\int_{\underline{\alpha}}^{\bar{\alpha}}(1-z)\{(1-\frac{a}{2})+az\}dz}{\int_{\underline{\alpha}}^{\bar{\alpha}}\{(1-\frac{a}{2})+az\}dz}$$

$$=\frac{1-\frac{a}{2}+(\frac{3a}{4}-\frac{1}{2})(\bar{\alpha}+\underline{\alpha})-\frac{a}{3}((\bar{\alpha}^2+\bar{\alpha}\underline{\alpha}+\underline{\alpha}^2)}{1-\frac{a}{2}+\frac{a}{2}(\bar{\alpha}+\underline{\alpha})} \qquad \text{(IX-23)}$$

so that, for example, for the following three values of a, $\bar{c}(\underline{\alpha},\bar{\alpha})$ is

(i) If a=0; $\bar{c}(\underline{\alpha},\bar{\alpha})=1-\frac{1}{2}(\bar{\alpha}-\underline{\alpha})$ (IX-24)

(ii) If a=2; $\bar{c}(\underline{\alpha},\bar{\alpha})=1-\frac{2(\bar{\alpha}^2+\bar{\alpha}\underline{\alpha}+\underline{\alpha}^2)}{3(\bar{\alpha}+\underline{\alpha})}$ (IX-25)

(iii) If a=-2; $\bar{c}(\underline{\alpha},\bar{\alpha})=1-\frac{(\bar{\alpha}+\underline{\alpha})-\frac{2}{3}((\bar{\alpha}^2+\bar{\alpha}\underline{\alpha}+\underline{\alpha}^2)}{2-(\bar{\alpha}+\underline{\alpha})}$ (IX-26)

And so from (IX-20) (IX-21) and (IX-23), $\bar{c}_{21}\geq(<)0$ if

$$(1/2)\{2-(\bar{\alpha}+\underline{\alpha})\}\geq(<)\frac{1-\frac{a}{2}+(\frac{3a}{4}-\frac{1}{2})(\bar{\alpha}+\underline{\alpha})-\frac{a}{3}((\bar{\alpha}^2+\bar{\alpha}\underline{\alpha}+\underline{\alpha}^2)}{1-\frac{a}{2}+\frac{a}{2}(\bar{\alpha}+\underline{\alpha})}$$

i.e. $\frac{1}{2}\{2-(\bar{\alpha}+\underline{\alpha})\}\{1-\frac{a}{2}(\bar{\alpha}+\underline{\alpha})\}\frac{1}{2}\{2-(\bar{\alpha}+\underline{\alpha})\}\geq(<)$

$$1-\frac{a}{2}+(\frac{3a}{4}-\frac{1}{2})(\bar{\alpha}+\underline{\alpha})-\frac{a}{3}(\bar{\alpha}^2+\bar{\alpha}\underline{\alpha}+\underline{\alpha}^2)$$

i.e. $(1/12)a(\bar{\alpha}+\underline{\alpha})^2\geq(<)0$

i.e. $\bar{c}_{21}\geq(<)0$, if $a\geq(<)0$ (IX-27)

Referring to Table IX-1, we can conclude that with a linear training cost function if the population is concentrated among the more able workers i.e. a>0, then an increase in the product demand is likely to bring about an increase in the wage offer and a lowering of the minimum hiring standard. If the population is concentrated among the less able workers i.e. a<0, then the increase in the product demand is likely to bring about a lowering of the minimum hiring standard as before but the wage offer will fall. Finally, if the population has a uniform distribution of ability i.e. a=0, then the wage offer will be rigid.

How about the convexity of c(•)? Can we say anything about the sign of $\bar{c}_{21}$ from the convex shape of c(•) by assumption i.e. T2 in (1) Assumptions of Chapter III)? In order to examine this, continue to assume the linear h(•) as in (IX-22) but a strictly convex c(•) as we have already dealt with a linear c(•) i.e. $c(\alpha)=1-\alpha$. We would like to verify the sign of $\bar{c}_{21}$ or equally from (IX-20) $\frac{1}{2}\{c(\underline{\alpha})+c(\bar{\alpha})\}\geq(<)\bar{c}(\underline{\alpha},\bar{\alpha})$. The convexity implies,

$$\frac{1}{2}\{c(\underline{\alpha})+c(\bar{\alpha})\}=\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}}(B\text{-}Az)dz>\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}}c(z)dz \qquad \text{(IX-28)}$$

where $B-A\alpha$ is a linear function of α, which goes through $(\underline{\alpha}, c(\underline{\alpha}))$ and $(\bar{\alpha}, c(\bar{\alpha}))$, (See Fig.IX-2)

Now compare the RHS of (IX-28) and $\bar{c}(\underline{\alpha},\bar{\alpha})$,

$$\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}}c(z)dz\geq\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}}c(z)dz-\frac{1}{H(\bar{\alpha})-H(\underline{\alpha})}\int_{\underline{\alpha}}^{\bar{\alpha}}c(z)h(z)dz$$

$$=\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)dz-\frac{1}{(\bar{\alpha}+\underline{\alpha})\{1-\frac{a}{2}+\frac{a}{2}(\bar{\alpha}+\underline{\alpha})\}}\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)(1-\frac{a}{2}+az)dz$$

$$=\frac{a\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)\{\frac{1}{2}(\bar{\alpha}+\underline{\alpha})-z\}dz}{(\bar{\alpha}+\underline{\alpha})\{1-\frac{a}{2}+\frac{a}{2}(\bar{\alpha}+\underline{\alpha})\}} \qquad \text{(IX-29)}$$

As $-2\leq a\leq 2$, the denominator is positive unless $\underline{\alpha}=\bar{\alpha}$ or $\underline{\alpha}+\bar{\alpha}=0$. And

$$\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)\{\frac{1}{2}(\bar{\alpha}+\underline{\alpha})-z\}dz\geq 0$$

since (i) $c(\bullet)$ is a decreasing function

(ii) $\frac{1}{2}(\underline{\alpha}+\bar{\alpha})-\alpha$ is linear in α, and 0 at $\alpha=\frac{1}{2}(\underline{\alpha}+\bar{\alpha})$ (See Fig.IX-3(a)and(b))

Therefore if $a\geq 0$,

$$\frac{1}{2}\{c(\underline{\alpha})+c(\bar{\alpha})\}=\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}} (B-Az)dz>\frac{1}{\bar{\alpha}-\underline{\alpha}}\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)dz\geq$$

$$\frac{1}{H(\bar{\alpha})-H(\underline{\alpha})}\int_{\underline{\alpha}}^{\bar{\alpha}} c(z)h(z)dz=\bar{c}(\underline{\alpha},\bar{\alpha}) \qquad \text{(IX-30)}$$

and hence if $a\geq 0$, $\bar{c}_{21}\geq 0$. Note that, on the other hand, $a<0$ does not necessarily guarantee $\bar{c}_{21}<0$. This rather asymmetric result is due to the convexity of $c(\bullet)$ in α. So these examples show that a positive slope of the population density and a convexity of the training cost function makes as a more likely outcome an increase of wage in response to an increase of product demand. (See Table IX-2)

These results can be summarized in more descriptive terms as follows. An increase in product demand may or may not raise the employment level. When it does, it always lowers the minimum hiring standard but the effect on the wage

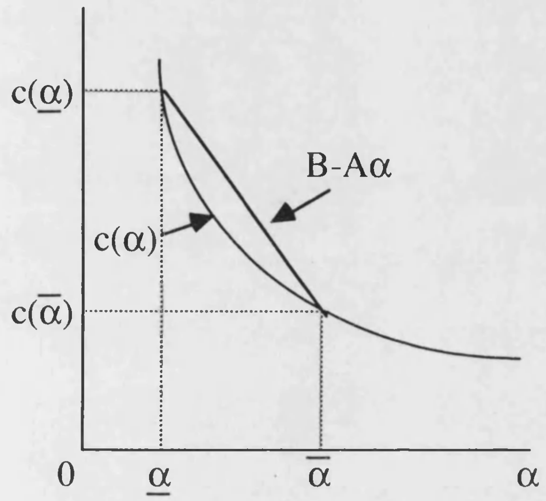
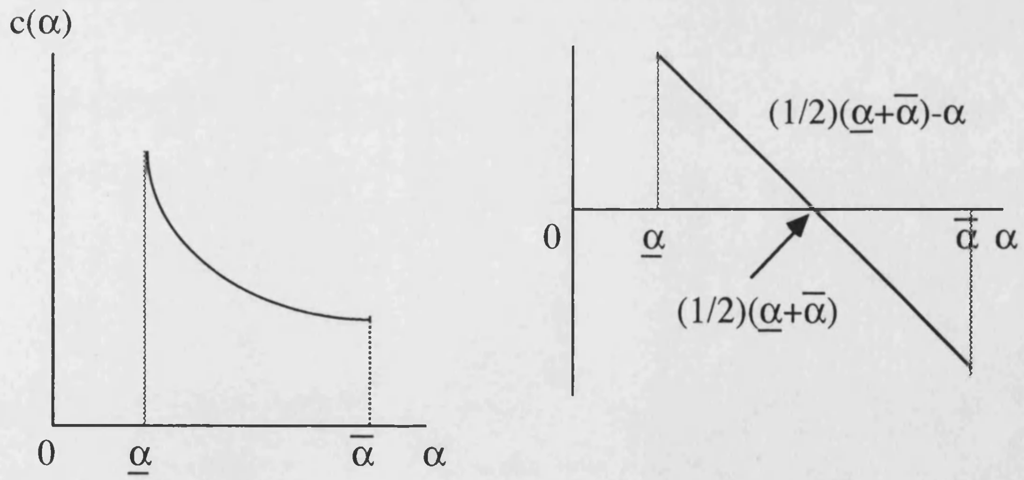


Fig.IX-2

c(•) \ h(•)	a<0	a=0	a>0
Linear	-	0	+
Convex	-/+	+	+

Table IX-2 : dw/dp



(a) (b)

Fig.IX-3

offer could work in either way. (See Table IX-1) For example, if highly qualified workers i.e. those with high α are scarce i.e. $a<0$, then the increased demand for product may be met by lowering of the wage together with a greater decrease in the minimum hiring standard such that the average qualification of the workers the firm wishes to hire unambiguously falls. Or if a large proportion of the population have a high level of ability i.e. $a>0$, then the increased demand for product generates an increase in wage offer and an decrease in the minimum hiring standard at the same time. And an increase rather than an decrease in the wage offer becomes more likely as the return on training cost of qualification is relatively higher at the lower level of qualification i.e. $c''(\alpha)$ is large.

While the increase of employment is generally achieved by widening the hiring standard range both upwardly and downwardly, the relative magnitudes of these adjustments depend largely on the forms of $w(\bullet)$, $c(\bullet)$ and $h(\bullet)$ — as an extreme case, it was shown that when $c(\bullet)$ is linear in α and $h(\bullet)$ is a uniform distribution of α (i.e. $a=0$ in (IX-22)), the wage is rigid.

Fig.IX-4 illustrates these comparative statics results with a uniformly distributed $h(\bullet)$. Assume that the market is in equilibrium at $\{w^*=w(\overline{\alpha}^*), \underline{\alpha}^*, x^*\}$ for every firm. When p rises, this will shift $py'(x)$ outward. At the present wage offer and minimum hiring standard, there is an excess demand of x_1-x^*. This will then have to be offset by attracting more workers. When the minimum hiring standard is relaxed to $\underline{\alpha}_1$ — this change of $\underline{\alpha}$ is indicated in Fig.IX-4 by drawing a new OWF i.e. $w(\overline{\alpha})+\bar{c}(\underline{\alpha}_1,\overline{\alpha})$, the wage offer will change to $w_1=w(\overline{\alpha}_1)$ and the demand for labour will drop to x_2. In this particular case if $x_2=\overline{\alpha}_1-\underline{\alpha}_1$, then the new equilibrium is reached. Note, however, that whether $\overline{\alpha}^*\geq(<)0$ depends on $\overline{c}_{21}\geq(<)0$.

The main difference between these results and those obtained in the earlier model is the existence of the wage rigidity when the product demand changes. In the present model, the wage rigidity occurs when $\overline{c}(\bullet,\bullet)$ takes a certain form, e.g. linear. Then there are two ways to explain the wage rigidity within this framework. One is to say that the wage rigidity occurs as an equilibrium phenomenon as in the earlier model. But for this, the characteristics of $\overline{c}(\bullet,\bullet)$ has to be specified. Namely, we need to assume a constant marginal return to qualification, with the return being defined by reducing the cost of OJT. Another way is to assume that the wage rigidity is a constraint imposed on the labour market operation. With this approach it is easier to explain why the wage is rigid

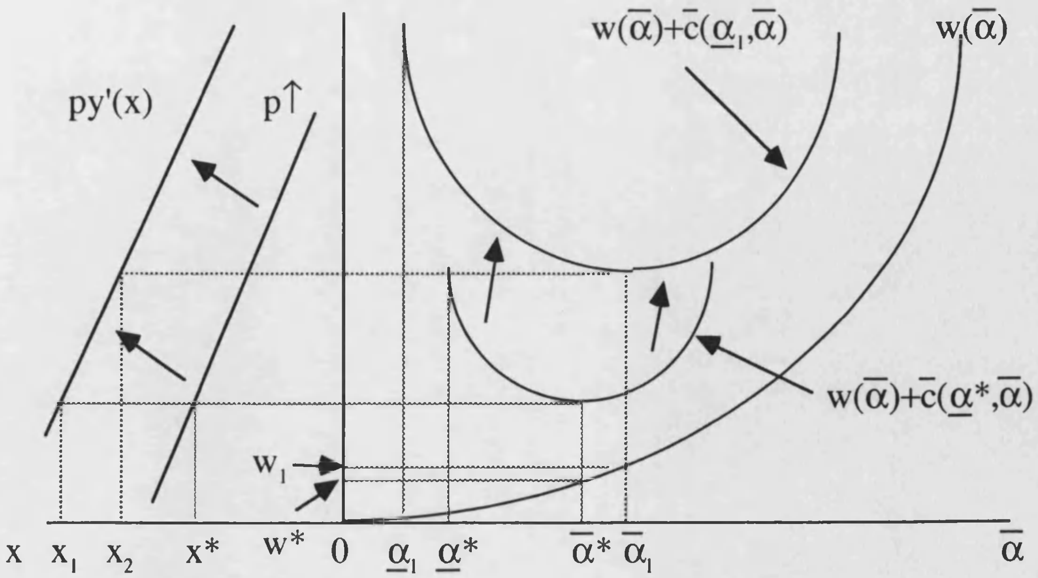


Fig.IX-4

downwards only — namely, the pressure to keep the wage rigid only exists downwardly. The result is a greater rise in the minimum hiring standard than otherwise, which hits the low ability group harder.

(4) Policy implications

Firstly, when a uniform wage is offered to heterogeneous workers there is always an incentive coming from workers as well as from firms to make the workers distinguishable, even if the uniform wage system is to continue. Then the government will do well by helping to reveal everyone's ability. Not to make the information available to firms is to miss out a Pareto improvement i.e. this will not help the workers either, although on the equity criterion this might not appear to be desirable. The equal opportunity, however, should be given to every worker in acquiring education before they come to the labour market.

Secondly, the excess supply in the labour market can not be eliminated by advising the firms to reduce the wage offer — the firms simply would not do it. One of the effective ways to eliminate this involuntary unemployment is to offer some employment subsidy to the firms who are willing to lower their minimum hiring standard.

Thirdly, as for the downward wage rigidity, it may not be desirable but this inability of the wage to respond to the fall in demand for product can be complemented by a greater rise in the minimum hiring standard, with the result that the low qualification workers are hit harder than when the wage is flexible. In other words, the downward wage rigidity simply protects the more able workers by sacrificing the less able workers. Hence allowing the downward wage rigidity is not only inefficient but also unequalizing, or socially undesirable. Therefore the government should discourage any move towards the wage rigidity.

In this chapter we have established the following;

Firstly, it was pointed out that in the real world observationally distinguishable workers may be paid uniformly, despite the neo-classical claim that they ought to receive different wages. Rather the distinguishability determines not the wage of each worker but the ability range of workers to be employed at that unique wage. This was supported by a Japanese example of a university graduate recruitment process. Thus the model is particularly relevant to the labour market for new recruits who require training , and not for already skilled workers.

Secondly, the main difference between the model of this chapter and the model of the earlier chapter is the treatment of the minimum hiring standard — the earlier model can be thought of as a special case of the present model with the minimum hiring standard constrained at zero. Also it is worthwhile noting that at the equilibrium demand is always equal to supply, the latter being defined as the number of workers bounded between the wage offer and the minimum hiring standard.

Thirdly, an increase in product demand will always be met by lowering of minimum hiring standard, while the response of the wage offer is not determinate. With a certain specification of functions, it was claimed that the wage would react positively to the change in demand unless the population is concentrated at low qualification, in which case a negative response by the wage to the change of product demand is possible. Also if the marginal return of education in reducing the cost of OJT is much greater at a low level of qualification, then this tends to cause the positive response of the wage to the change in product demand.

Finally, the policy implications are: (1) the government should encourage the information on the individual ability to be available to firms. (2) to eliminate the excess supply of labour the government should encourage the firms to employ the workers with low qualification by offering, for example, some employment subsidy to firms willing to employ them. (3) the government should bear in mind the distributional effect of allowing the downward rigidity of wage and should discourage any move towards it.

CHAPTER X : CONCLUSION

This work has offered an alternative approach to the theory of wage determination, producing new and interesting interpretations to labour market phenomena. The following are the summary of the work and some suggestions for the future research.

There have always been cynical criticisms against attempts by neo-classical economists to explain theoretically the real world phenomena. And the labour issues are probably one of the most "sacred" areas, to which the economists with scientific rationality have found it difficult to enter, as some feel that such an approach applied to labour market analysis is too simplistic to describe complicated human mind and the institutions created by it. It makes it is difficult to find 'the standard economic theory' for labour economics. In fact there are many theories and ideas, be it neo-classical or otherwise, but none could be considered as outstanding or prominent in this field of economics.

The theories, however, could be categorized into either an institutional type or a neo-classical type. Consider the various approaches presented in the survey of Chapter II. There is a trade-off between theoretical rigour and intuitive appeal at one end of the spectrum there is the institutional approach, which offers intuitively appealing and realistic explanations of the labour market phenomena but seems to miss out theoretical rigour and at the other end there are various types of the neo-classical approach, which seem to maintain the theoretical rigour but have lost intuitive appeal. And these two types of approaches seem to interact very little. Among those, however, the efficiency wage models and the training models stand out closest as syntheses of the institutional approach and the neo-classical approach, to bridge the gap between the theory and the real world of labour market phenomena.

The present model shares the basic concept of adverse selection and invariably contains the positive and negative features of the adverse selection models. For example, the assumption of heterogeneous labour, which is the key assumption of the adverse selection model, makes the model quite realistic, closing the gap between the theory and the real world. This is a valuable attempt since one of the most popular criticisms towards the neo-classical analysis of labour markets, particularly from other social scientists, is that it is too simplistic to assume that workers are homogeneous since the very formation of our society is based on the diversity of the individual members of the society. However, when the heterogeneity of labour is assumed together with the uniform wage, although in the real world it is not unusual, it was necessary to justify theoretically that they can co-exist, as in Chapter IV.

In Chapter IV, a theoretically rigorous argument for the validity of uniform wage was given, using the concept of informational equilibrium. It was shown that the uniform wage assumption is a theoretically valid one within this model when the monitoring cost is sufficiently high or when the ability distribution of workers has relatively high density among the workers with high ability.

What the present model differs from the rest of the efficiency models and the adverse selection models is the introduction of On-the-Job Training aspect of labour. This concept of OJT as a part of labour market mechanism was also suggested in Thurow(1975)'s institutional approach and thus the present model is even more synthesizing than most of the efficiency wage models. Such a modelling helps to correspond a type of labour market to an equilibrium type and to its response to economic fluctuations. Throughout the chapters, c(•) acts as a parameter for such a modelling. It is important to note that this approach gives new insight and direction to the market analysis of heterogeneous labour. While the efficiency wage models can suggest the existences of job queues and rigid wages, our model can go further to determine the market characteristics of such phenomena.

Chapter V extended the concept of training to include one more period in the model. Based on the heterogeneous labour and multi-period the model explains the existence of a job queue as well as the way the wage profile is upward-sloping.

That the model has maintained the theoretical rigour can also be seen in Chapter VI. Using the Lagrangian multiplier method, it was pointed out that in the world of heterogeneous labour, monopsony and competition are not always distinct. One of the implications of this result is that to restrict monopsony in the labour market does not always reduce the firms advantage relative to the workers. It is hoped that the method be employed to investigate a more general case of imperfect competition in comparison with perfect competition.

Chapter III and VII together form the main body of the present work. The model offered explanations for the existence of unemployment and the downward rigidity as most of other adverse selection models do. The present model, however, goes more than that to correspond the market characteristics to these phenomena. Thus, for example, unemployment and thus downward wage rigidity are more likely to occur in a skilled labour market. Based on these analyses, it was suggested that the unemployment can not be eliminated by lowering the wage — thus, for example, unemployment is not caused by an unreasonably high minimum wage. It also suggested that policies to control the demand side of the market such as accepting of immigration of able workers, raising the educational standard of the domestic workers, or subsidizing the firm's OJT would be more effective.

Chapter VIII and Chapter IX have offered some new insights into the market mechanism in general and of the labour market in particular. In Chapter VIII the idea of multiple wage equilibrium in one market can offer a new dimension to the analysis of income distribution. One important result here is that whatever happens in the society will first affect the weakest, to whom therefore the policy makers need to pay greater attention. This is a rather cynical but perhaps quite realistic view of the world. The derivation of a skewed distribution of wage offers yet one more explanation to the Pigou paradox and further insight into the trade-off between efficiency and equity. The further investigation into this issue requires more time and space and thus it should also be left for other occasion.

The model of Chapter IX is probably the closest to the real world mechanism of labour market among the models presented in this work. But this means at the same time that it is least theoretically rigorous. The minimum hiring standard as one of the conditions for an employment offer is a realistic assumption but to model this together with a uniform wage offer, although there is nothing unusual in reality, requires some theoretical justification. As for the results obtained here, the minimum hiring standard adjustment to the demand fluctuation when the wage is not flexible gives a new explanation to the wage rigidity. It is worthwhile pointing out that this explanation allows both economic (in that it assumes equilibrium) and non-economic (in that it allows downward wage rigidity as a result of social agreement) aspects of labour market.

Its implication that involuntary unemployment exists among less qualified workers says again that the weaker members of the society are more prone to exogeneous shocks. However, this result slightly differs from the result in Chapter IX — while in Chapter VIII the selection of the weaker is made at random under excess supply as the workers are indistinguishable, in Chapter IX the weaker are the low ability workers always. This sounds quite gloomy but perhaps seems more realistic, and gives the true picture of what is going on about who is actually hit the hardest.

Finally it needs to be mentioned that the real world of labour is much more complex than what any of these models suggests. However, it has shown at least that modelling of training and heterogeneous labour improves intuitive appeal of the analysis greatly. And it is hoped that more investigations are going to be made along this line of research.

BIBLIOGRAPHY

Abe, Y.(1994). "Specific Capital, Adverse Selection, and Turnover: A Comparison of the United States and Japan", Journal of the Japanese and International Economies; 8(3), pp.272-292.

Acemoglu, D.(1997). "Training and Innovation in an Imperfect Labour Mar ket," Review of Economic Studies, 64, pp.445-464.

Addison, J. & Siebert, S.(1979). The Market for Labor, Los Angeles: Good-year.

Akerlof, G.(1970)."The Market for 'Lemons' : Quality Uncertainty and the Market Mechanism," Quarterly Journal of Economics, 84(3), pp.488-500.

_____(1976)."The Economics of Caste and of the Rat Race and Other Woeful Tales," Quarterly Journal of Economics, 90(4), pp.599-617.

_____(1982)."Labour Contracts as Partial Gift Exchange," Quarterly Journal of Economics, 97(4), pp.543-569.

_____(1984)."Gift Exchange and Efficiency-wage Theory: Four Views," American Economic Review, 74(2), pp-79-83.

_____ & Yellen, J.(1986). "Introduction" in Akerlof, G.A. & Yellen, J. (ed.): Efficiency Wage Models of the Labour Market, Cambridge University Press.

Altonji, J. & Spletzer, J.(1991). "Worker Characteristics, Job Characteristics, and the Receipt of On-the-Job Training", Industrial and Labor Relations Review; 45(1), pp.58-79.

Arrow, K.(1973). "Higher Education as a Filter," Journal of Public Economics, 2, pp.193-216

Ashenfelter, O. & Card, D. (1985). "Using the Longitudinal Structure of Earnings to Estimate the Effect of Training Program," Review of Economics and Statistics, November, pp.648-660.

Azariadis, C.(1975)."Implicit contract and underemployment equilibria," Journal of Political Economy, 83(6), pp.1183-1202.

Bhagwati, J. & Srinivasan, T.(1977)."Education in a 'Job Ladder' Model and the Fairness-in-hiring Rule," Journal of Public Economics, 7, pp.1-22.

Baily, M.N.(1974)."Wages and Employment under Uncertain Demand," Review of Economic Studies, 41(1), pp.37-50.

Barro, R. & Grossman, S.(1971)."A General Disequilibrium Model of Income and Employment," American Economic Review, 60(1), pp.82-93.

Barron, J., Black, D. & Loewenstein, M.(1989). "Job Matching and On-the-Job Training", Journal of Labor Economics; 7(1), pp.1-19.

Bartel, A.(1992). "Training, Wage Growth and Job Performance: Evidence from a Company Database," NBER Working Paper No.4027, March.

Becker, G.(1964). Human Capital; A Theoretical and Empirical Analysis with Special Reference to Education, National Bureau of Economic Research.

_____& Stigler, G.(1974). "Law Enforcement, Malfeasance and the Compensation of Enforcers", Journal of Legal Studies, 3, pp.1-18.

Booth, A.(1991). "Job-related Formal Training: Who Receives It and What Is It Worth?" Oxford Bulletin of Economics and Statistics, 53(3), pp.281-294.

_____& Satchell, S.(1994). "Apprenticeships and Job Tenure," Oxford Economic Papers, 46, pp.676-695.

Bosworth, D., Wilson, R. & Assefa, A.(1993). "The Market for Training: A Human Capital Approach", International Journal of Manpower; 14(2-3), pp.33-46.

Bowles, S.(1981)."Competitive Wage Determination and Involuntary Unemployment : A Conflict Model," mimeo., University of Massachusetts.

_____(1983)."The Production Process in a Competitive Economy: Walrasian, Neo-Hobbesian and Marxian Models," mimeo., University of Massachusetts.

Cain, G.(1976)."The Challenge of Segmented Labour Market Theories to Orthodox Theories: A Survey," Journal of Economic Literature, 14, pp.1215-1258

Calvo, G.(1979)."Quasi-Walrasian Theories of Unemployment," American Economic Review, Proceedings, 69, pp.102-107.

Carmichael, L. & MacLeod, B.(1993). "Multiskilling, Technical Change and the Japanese Firm", Economic Journal; 103(416), pp.142-160.

Chapman, P.(1993). The Economics of Training, LSE Handbooks in Economics Series, Harvester Wheatsheaf.

Clemenz, G.(1986)."The Impact of Imperfect Monitoring on the Efficiency Wage Hypothesis," Empirica, 13(2), pp.203-219.

Clower, R.(1965)."The Keynesian Counter-Revolution: A Theoretical Appraisal," in Hahn, F. & Brechling, F.(ed.): The Theory of Interest Rates, London.

Dixit, A.(1990)."Optimization in Economic Theory," Oxford University Press.

Donaldson, D. & Eaton, C.(1976). "Firm-specific human capital : a shared investment or optimal entrapment?", Canadian Journal of Economics, Vol.9, no.3, pp462-472.

Doeringer, P. & Piore, M.(1971). Internal Labour Markets and Manpower Analysis, Heath Lexington Books.

Eaton, C. & White, W.(1982). "Agent Compensation and the Limits of Bonding", Economic Inquiry; 20(3), pp.330-343.

Elias, P.(1994). "Job-related Training, Trade Union Membership, and Labour Mobility: A Longitudinal Study," Oxford Economic Papers, 46, pp.563-578.

Elliot, R.(1990). Labour Economics : A Comparative Text, Macgraw-Hill.

Fallon, P. & Verry, D.(1988). The Economics of Labour Market, Philip Allan.

Fields, G.(1974)."The Private Demand for Education in Relation to Labour Market conditions in Less-developed Countries," Economic Journal, 84, pp.906-925.

Folli, L. & Harris, C.(1996). "Learning, Wage Dynamics, and Firm-Specific Human Capital," Journal of Political Economy, 104(4), pp.838-868.

Gibrat, R.(1931). Les inegalites'economiques, Paris, Sirey.

Champernowne, D.(1953)."A Model of Income Distribution," Economic Journal, 63, pp.318-351.

Greenhalgh, C. & Stewart, M. (1987). "The Effects and Determinants of Training," Oxford Bulletin of Economics and Statistics, 49(2), pp.171-190.

Greenwald, B.(1986). "Adverse Selection in the Labour Market", Review of Economic Studies; 53(3), pp.325-3pp.47.

Grossman, S. & Hart, O. (1983)."Implicit Contracts under Asymmetric Information," Quaterly Journal of Economics, Supplement, pp.123-156.

Guasch, J. & Weiss, A.(1980)."Wages as Sorting Mechanisms in Competitive Markets with Asymmetric Information: A Theory of Testing," Review of Economic Studies, 47, pp.653-664.

_____& _____(1981)."Self-selection in the Labour Market, American Economic Review, 71(3), pp.275-284.

_____& _____(1982)."An equilibrium analysis of wage-productivity gaps," Review of Economic Studies, 49, pp.485-497.

Hashimoto, M.(1979)."Bonus Payments, On-the-job Training and Lifetime Employment in Japan," Journal of Political Economy, 87(5), pp.1086-1104.

_____(1981)."Firm-Specific Human Capital as a Shared Investment," American Economic Review, vol.71,no.3, pp.475-482.

Ishikawa, T.(1981)."Dual Labour Market Hypothesis and Long-run Income Distribution," Journal of Development Economics, 9, pp.1-30.

Jovanovic, B.(1979)."Job Matching and the Theory of Turnover," Journal of Political Economy, 87(5), pp.972-990.

Katz, L.(1986)."Efficiency Wage Theories: A Partial Evaluation" in Fisher, S.: Macroeconomic Annual 1986, National Bureau of Economic Research, pp.235-276.

_____& Ziderman, A.(1990). "Investment in General Training: The Role of

Information and Labour Mobility", Economic Journal; 100(403), pp.1147-1158.

Kreps, D.(1990)."A Course in Microeconomic Theory," Harvester Wheatsheaf.

Koike, K.(1991). *Shigoto no Keizaigaku*(Economics of Work) in Japanese, Toyo Keizai Shinposha.

_____(1995). The Economics of Work in Japan, (The English Version of Koike, K.(1991)), LTCB International Library Selection No.3, LTCB International Library Foundation."

Kuznets, S.(1955)."Economic Growth and Income Inequality," American Economic Review, 45(1), pp.1-28.

_____(1963)."Quantitative Aspects of the Economic Growth of Nations," Economic Development and Cultural Change, 11(2), pp.1-80.

Lazear, E.(1979). "Why Is There Mandatory Retirement?", Journal of Political Economy; 87(6), pp.1261-1284.

_____& Rosen, S.(1981)."Rank-tournaments as Optimum labour contracts," Journal of Political Economy, 89(5), pp.841-864.

Leibenstein, H.(1957). Economic Backwardness and Economic Development, NY: Wiley.

Levhari, D & Weiss, Y.(1974)."The effect of Risk on the Investment in Human Capital," American Economic Review, 64(6), pp.950-963.

Levine, D.(1993). "Worth Waiting for? Delayed Compensation, Training, and Turnover in the United States and Japan," Journal of Labour Economics, 11(4), pp. 724-752.

Lucas, R.(1977). "Hedonic Wage Equations and Psychic Wages in the

Returns to Schooling," American Economic Review, 67(4), pp.549-558.

Lynch, L.(1990). "Private Sector Training and the Earnings of Young Workers," NBER Working Paper No.2060-88.

_____(1991). "The Role of Off-the-job vs. On-the-job Training for the Mobility of Women Workers," American Economic Review, 81(2), pp.151-156.

Lydall, H.(1968). The Structure of Earnings, Oxford University Press

MacDonald, G.(1980)."Person-specific Information in the Labor Market," Journal of Political Economy, 88(3), pp.578-597.

_____(1982)."A Market Equilibrium Theory of Job Assignment and Sequential Accumulation of Information," American Economic Review, 72(5), pp.1038-1055.

Malcomson, J.(1981)."Unemployment and the efficiency wage hypothesis," Economic Journal, 91(364), pp.848-866.

Manning, A.(1990)."Implicit-Contract Theory" in Sapsford, D & Tzannatos,Z.(ed.) : Current Issues in Labour Economics, MacMillan.

_____(1994)."Labour Markets with Company Wage Policies," mimeo., London School of Economics.

Mincer, J.(1970)."The Distribution of Labour Incomes: A Survey with Special Reference to the Human Capital Approach," Journal of Economic Literature, 8, pp.1-26.

_____(1974). Schooling, Experience, and Earnings, National Bureau of Economic Research.

_____(1976)."Progress in Human Capital Analyses of the Distribution of

Earnings" in Atkinson,A.B.(ed.): The personal distribution of incomes, George Allen & Unwin.

_____(1993)."JobTraining: Costs, Returns, and Wage Profiles," in Studies in Human Capital: Collected Essays of Jacob Mincer, vol.1, pp.263-281.

_____& Higuchi, Y.(1988). "Wage Structures and Labor Turnover in the United States and Japan", Journal of the Japanese and International Economy; 2(2), pp.97-133.

Mirrlees, J.(1975)."A Pure Theory of Underdeveloped Economies," in Reynolds, L.(ed.): Agriculture in Development Theory, New Haven: Yale University Press.

Mookherjee, D.(1988)."Involuntary Unemployment and Worker Self-selection," Journal of Economic Theory, 45, pp.171-188.

Moore, J.(1985)."Optimal Labour Contracts when Workers have a Variety of Privately Observed Reservation Wages," Review of Economic Studies, LII, pp.37-67.

Mortensen, D.(1978)."Specific Capital and Labor Turnover," Bell Journal of Economics. 9(2), Autumn, pp.572-586.

Nickell, S.(1976). "Wage Structures And Quit Rates", International Economic Review, Vol.17, no.1, pp.191-203.

Ohashi, I.(1983). "Wage Profiles, Layoffs, and Specific Training", International Economic Review, Vol.24, no.1, pp.169-181.

Olson, L., White, H. & Shefrin, H.(1979)."Optimal Investment in Schooling when Incomes are Risky," Journal of Political Economy, 87(3), pp.522-539.

Pareto, V.(1897). Cours d'economie politique, Lausanne: Rouge.

Patten, T.(1997). Pay : Employee Compensation and Incentive Plans, The Free Press.

Pigou, A.(1932). The Economics of Welfare, Macmillan.

Polachek, S & Siebert, W.(1993). The Economics of Earnings, Cambridge University Press.

Rasmusen, E.(1989). Games and Information-An Introduction to Game Theory, Basil Blackwell.

Riley, J.(1979)."Testing the Educational Screening Hypothesis," Journal of Political Economy, 87(5), S227-S252.

Rosen, S.(1974)."Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," Journal of Political Economy, 82(1), pp.34-55.

_____(1985)."Implicit Contracts: A Survey," Journal of Economic Literature, 23, pp.1144-11175.

Rothschild, M. & Stiglitz, J.(1976)."Equilibrium in Competitive Insurance Markets: An Essay on Economics of Imperfect Information," Quarterly Journal of Economics, 90(4), pp.630-649.

Roy, A.(1950)."The Distribution of Earnings and of Individual Output," Economic Journal, 60, pp.489-505.

Salop, J. & S.(1976)."Self-selection and Turnover in the Labour Market," Quarterly Journal of Economics, 90(4), pp.1-48.

Salop, S.(1979)."A Model of the Natural Rate of Unemployment," American Economic Review, vol.69 no.1, pp.117-125.

Sapsford, D & Tzannatos, Z.(1993). The Economics of the Labour Market, Macmillan.

Sattinger, M.(1980). Capital and the Distribution of Labour Earnings, North-Holland Publishing Company.

Shackleton, J.(1995). Training for employment in Western Europe and the United States, Aldershot, U.K.

Shapiro, C. & Stiglitz, J.(1982)."Equilibrium Unemployment as a Worker Discipline Device," mimeo., Princeton University.

Shultz, T.(1965)."Personal Income Distribution Statistics of The United States," prepared for the Joint Economic Committee of Congress.

Smith, A.(1776) The Wealth on Nations (reprinted in 1977 by Penguin Books)

Spence, M.(1973)."Job Market Signalling," Quarterly Journal of Economics, 87(3), pp.355-374.

_____(1976)."Competition in Salaries, Credentials and Signaling Prerequisites for Jobs," Quarterly Journal of Economics, 90(1), pp.51-74.

_____(1981)."Signalling Screening and Information," in Rosen, S.: Studies in Labour Markets, National Bureau of Economic Research.

Starrett, D.(1976)."Social Institutions Imperfect Information and the Distribution of Income," Quarterly Journal of Economics, 90(2), pp.261-284.

Stevens, M.(1994a). "A Theoretical Model of On-the-Job Training with Imperfect Competition", Oxford Economic Papers; 46(4), pp.537-562.

_____(1994b)."Transferable Training and Poaching Externalities," mimeo, Trinity College, Oxford University.

_____(1994c)."Labour Contracts and Efficiency in On-the-job Training," Economic Journal, 104(March), pp.408-419.

_____(1994d)."An Investment Model for the Supply of Training by Employers," Economic Journal, 104(May), pp.556-570.

Stigler, G.(1961)."The Economics of Information," Journal of Political Economy, 69(3), pp.213-225.

Stiglitz, J.(1974)."Wage Determination and Unemployment in L.D.C.'s: The Labour Turnover Model," Quarterly Journal of Economics, 88(2), pp.194-227.

_____(1975)."Incentives, Risk and Information: Notes towards a Theory of Hierarchy, Bell Journal of Economics, 6(2) Autumn, pp552-579.

_____(1975)."The Theory of 'Screening' Education and the Distribution of Income, American Economic Review, 65(3), pp.283-300.

_____(1976)."The Efficiency Wage Hypothesis, Surplus Labour and the Distribution of Income in L.D.C.s, Oxford Economic Paper, 28(2), pp.185-207.

_____(1986)."Theories of Wage Rigidity" in Butkiewicz,J., Koford,K. & Miller, J.(ed.): Keynes' Economic Legacy. N.Y.Praeger.

_____(1987)."The Causes and Consequences of the Dependence of Quality on Price, Journal of Economic Literature, 25, pp.1-48.

_____& Weiss, A.(1981)."Credit Rationing in Markets with Imperfect Information, American Economic Review, 71(3), pp.393-410.

_____& _____(1994)."Sorting Out the Differences Between Screening & Signaling Models," in Bachrach, B.(ed.): Oxford Essays in Mathematical Economics, Oxford University Press.

Takeuchi, Y.(1995). *Nihon no meritokurasii* (in Japanese) or Japan's Meritocra cy, Tokyo University Press.

Topel, R.(1991). "Specific Capital, Mobility, and Wages: Wage Rise with Job Seniority," Journal of Political Economy, 99(1), pp.145-176.

Thurow, L.(1975). Generating Inequality, New York: Basic Books.

Tinbergen, J.(1951)."Some Remarks on the Distribution of Labour Incomes," International Economic Paper, 1, pp.195-207.

_____(1956)."On the Theory of Income Distribution," Weltwirt schaftliches Archiev, 77, pp.155-173.

Weiss, A.(1980)."Job Queues and Layoffs in Labour Market with Flexible Wage," Journal of Political Economy, 88(3). pp.526-538

_____(1991). Efficiency Wages : Models of Unemployment, Layoffs & Wage Dispersion, Oxford University Press.

Yellen, J.(1984)."Efficiency Wage Models of Unemployment," American Economic Review, Proceedings, 74, pp.200-205.