

Overinvestment in General Capital Provokes Underinvestment in Specific Capital

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1. Introduction

It is the central theme in the recent theory of contract that unavoidable incompleteness of long run contracts allows the party not making specific investment to appropriate the rent from the investment opportunistically. The appropriation reduces incentive for the investment in specific capital. The investing party cannot capture the full marginal return on the specific investment, and so the less than optimum investment in specific capital results. This inefficiency gives rise to vertical integration as its cure. These are the contentions forcefully made by Williamson (1975, 1985) and Klein, Crawford and Alchian (1978). Grout (1984) rigorously formulates the argument.

While appearing convincing, and promising as a foundation of theory of organizations, the above Williamsonian contention of the underinvestment now faces a serious criticism. Obviously, an *ex ante* binding long run contract on the division of the rent, if possible, ensures efficiency in specific investment. However, Crawford (1988), Farrell and Shapiro (1989), Milgrom and Roberts (1990), and Fudenberg, Holmstrom and Milgrom (1990) show that, even without the binding long term contract, a series of short term bargainings brings about efficiency of specific investment given the perfect capital market, symmetric information, observable specific investment, and costless short term bargaining. The reason for this conclusion is that under the conditions, (implicit) monetary transfer from the non-investing party to the investing party simultaneously made with the specific investment entirely compensates the anticipated post-investment appropriation by the non-investing party, and so that the transfer secures to the investing party the full

marginal return on the specific investment. This gives the investing party the right incentive for specific investment.

In consequence, Crawford (1988) deduced underinvestment in specific capital assuming an incomplete capital market, and Tirole (1986) does so assuming unobservable specific investment and asymmetric information. These conditions for underinvestment in specific capital cause inefficiency even without specific investment and incompleteness of long run contract. The contributions of Crawford (1988), and Tirole (1986) are not precisely in line with the Williamsonian view that specific investment together with the impossibility of complete long run contracting is an additional and separate reason for inefficiency in the market economy.

Within the framework of investment in human capital, this paper also deals with the problem of incentive for investment in specific capital. But, in contrast to the literature that has been concerned with specific capital alone, the paper focuses also on general (human) capital involved in specific relationship. This paper throughout maintains the assumptions of the perfect capital market, symmetric information, observable specific investment, and costless short term bargaining. The paper admits the implicit monetary transfer simultaneous with specific investment. In this setting, this paper shows that the Williamsonian opportunism in specific relationship, in the first place, causes overinvestment in *general* (human) capital, which in turn provokes underinvestment in specific capital. Since underinvestment in specific capital obtains here under the set of the above-mentioned stringent conditions, and hence without introducing conditions that alone cause inefficiency, specific investment together with incomplete long run

contracting is demonstrated here as a separate reason for inefficiency. This paper thus revives the Williamsonian view as a foundation of institutional analysis.

More specifically, this paper makes the following points. When an incomplete long run contract on the future wage allows opportunism of a worker, the worker tries to augment his threat point in an effort to appropriate more surplus from specific training (investment) the firm gave to him. For this purpose, the worker increases income he would earn in the event of break-up of the relationship, namely, his income obtainable outside the relationship. General education (investment in general human capital) serves this purpose. It follows that the worker makes investment in general capital not in view of the return from its proper, productive use, but in view of the increased appropriation of the surplus that the augmented threat point makes possible. In other words, investment in general capital has a redistribution effect. This leads to excessive investment in general (human) capital.

The general investment made for the redistribution purpose is a cost to the specific relationship, and hence reduces the surplus from the specific investment in the amount of the cost. Besides, the level of the general investment is higher, the higher the level of the specific investment is. Then, the variable cost of specific investment consists of not only its proper cost, but also the cost of the general investment. It follows that the level of the specific investment gets smaller than its efficient level, namely, less than the level which maximizes the return from the specific investment less its proper cost.

Dow (1985) already conceived the notion of the strategic augmenting of the threat point and the associated inefficiency. I must say, however, that his model as a formalization of the notion has the problem; augmenting a threat point in his model occurs because of the presumed irrational choice of the initial technology, and hence the social waste in the Dow's model is not due to strengthening a threat point, but due to the irrational choice of the initial technology. In consequence, the inefficiency is not identified in the Dow's model. Overinvestment in general capital is not demonstrated in his model. *A fortiori*, the

induced underinvestment in specific capital is not brought out.

This paper is organized as follows. Section 2 presents a model that shows overinvestment in general capital for a stronger threat point provokes underinvestment in specific (human) capital. Section 3 discusses some applications of the principle this paper explores. We especially discuss its application to involuntary unemployment in relation to the insider-outsider model of Lindbeck and Snower (1988). We also remark the relevance of the principle to diversification, the *keiretsu* practice.

2. The Model

The model of this section has two periods. In the first period, a firm employs a worker for a production job, and provides the worker with specific training to get him acquainted with the skills specific to the firm. The worker produces output in the second period. The value of the output in the period is $V(I)$ when the firm invested in the worker's specific skill in the magnitude of I . Symbol I also denotes the cost of the specific investment (training). We assume $V'(I) > 0$ and $V''(I) < 0$.

Between the first and second period, the worker has the opportunity of going to night school to learn book-keeping (a general skill) on his own initiative¹⁾. Let E be the education level obtained in night school, and $h(E)$ be the wage the worker can earn outside of the firm when he undergoes E level of the education. $h'(E) > 0$, $h''(E) < 0$, $h'(E)$ tends to infinity when E tends to zero, and $h'(E)$ tends to zero as E tends to infinity.

One may wonder why the general education in night school does not affect worker's productivity at the firm, mathematically, why V is not a function of E as well as I . The reason why I assume the independence of V from E is not because of mathematical simplicity, but because I believe the assumption of the independence provides a realistic, at the same time, more interesting case to analyze²⁾. Though both the specific and general skills created by I and E could be useful to the firm, a worker with the both skills is unable to use both of them together at the same time in the firm, because these two skills are typically used at different jobs of a

firm, and hence are exercised by two distinct persons. Specifically, we are considering a production worker, say, an operator of a machine of the firm. The specific investment (training) is, for instance, to get him familiar with the machine specific to the firm. The specific training given to a worker increases the firm's output, but his skill of book-keeping does not as far as he is assigned to the machine in the factory of the firm. The worker having the general skill of book-keeping must move to an accounting job in the head office of the firm, or elsewhere to use the skill. This consideration motivates the assumption of the independence of V from E .

Furthermore, we shall deduce the effect of I on worker's decision on E , and then show the firm's anticipation of this effect to influence determination of I in turn. When both I and E are arguments of V , that is, when they are technologically related to each other, one easily expects such interactions between E and I to exist. It should be more interesting to deduce the interactions in the absence of the technological interaction between E and I . We will show technologically unrelated variables, I and E , come to be related to each other economically in specific relationship. I must also note that the assumption of the independence of V from E sharpens the focus of the paper as we want to explore not a usual productive effect, but a distributional effect of general human capital inside a specific relationship. The assumption of the independence allows the distributional effect not to be blended with the productive one.

The life time objective of a worker is to maximize $u(c_1) + \beta u(c_2)$ with $u'(\cdot) > 0$, $u''(\cdot) < 0$, and $0 < \beta < 1$, where $c_1 (\geq 0)$ and $c_2 (\geq 0)$ are the first and second period consumption of the worker. Let S be the first period saving, that is, $S = w_1 - c_1$, where w_1 is the first period wage. S can be negative; the worker can borrow money in the first period. Let i be the interest rate. Then, $c_2 = w_2 + (1 + i)S - E$ holds, because of the budget constraint, and because the tuition for the education of book-keeping is paid out of the worker's pocket. (This does not necessarily mean that the worker is the party who bears the education cost ultimately.) Let $c^0 = h(E) + (1 + i)S - E$. Symbol c^0 represents the level

of the worker's second period consumption when he leaves the machine of the firm in the second period to work as a book-keeper elsewhere³⁾.

The Second Period Ex Post Bargaining

This paper as well as the recent literature of incomplete contract assumes that the firm and worker cannot enforceably agree on the division of the second period rent, in particular, the second period wage in advance, namely, in the first period when specific investment is made. A binding ex ante contract on the second period wage is impossible, because the worker is able to force the firm by the threat of quit to agree to annul the ex ante contract which gives to him a wage less than he would earn through ex post bargaining⁴⁾. Given the difficulty of complete long run contracting that restricts the firm's conduct effectively, the high penalty clause intended to prevent worker's quit is not acceptable to workers. The firm should take advantage of the clause to worsen the work conditions without fear of worker's quit, or even to collect penalties from workers by inducing their quits through harassment⁵⁾.

The absence of a binding contract on the second period wage means that the second period wage, w_2 , is determined by ex post bargaining between the firm and the worker. We assume a Nash bargaining solution for the ex post second period bargaining. The objective of the worker is $u(c_2)$, and that of the firm $V(I) - w_2$ in the second period bargaining. The utility the worker enjoys when he leaves the firm, $u(c^0)$, constitutes the threat point of the worker for the second period bargaining. Accordingly, the bargaining outcome is given by the solution of

$$V(I) = w_2 + \{u(c_2) - u(c^0)\} / u'(c_2). \quad (1)$$

This equation determines the second period wage w_2 given I , E and S which were determined before the second period bargaining.

(1) presumes the worker to stay with the firm in the second period, but the worker is not constrained to do so. He does so when he finds it gives him more income than working elsewhere. He earns $h(E)$ by choosing the latter outside option. Since he can earn only less than $V(I)$ from the firm, $V(I) - h(E) \geq 0$ must hold for the worker to stay with the firm the second period. Conversely, when

$V(I) - h(E) \geq 0$, the wage determined by (1) is no less than $h(E)$. Therefore, the worker stays with the firm, and hence the specific relationship is maintainable if and only if $V(I) - h(E) \geq 0$.

We henceforth assume $u(x) = 1 - e^{-ax}$ to get the second period wage independent of the first period saving. Dependence of the ex post bargaining outcome w_2 on the saving in itself is an interesting point worth a detailed study. But, while its consideration complicates analysis substantially, it does not have an essential bearing on the subject of the paper, that is, the effect of the education of book-keeping (general investment) on the firm's specific investment. The preclusion of the dependence of w_2 on S allows us to focus on the effect of general investment.

The specific functional form of the utility function reduces (1) to:

$$V(I) - h(E) = z + (e^{az} - 1)/a \quad (2)$$

where $z = w_2 - h(E)$. Solving (2), one obtains w_2 as a function of I and E when $V(I) - h(E) > 0$. Let $w_2(I, E)$ defined for $V(I) - h(E) \geq 0$ denote this functional relationship. It is easy to see from (2) that w_2 is independent of S . It is also easy to see $\partial w_2 / \partial I > 0$. $\partial^2 w_2 / \partial E^2 < 0$ holds.

General Investment

Between the first and the second period, the worker learns book-keeping at night school on his own initiative. Needless to say, book-keeping is merely an example. It could be typing, carpentry and others. The point is that the worker makes *general* investment (education) in himself between the two periods.

As seen below, the general investment together with specific investment and incomplete long run contract is the cause of the inefficiency in the paper. Hence, one may argue why the firm and worker do not write a contract that bans the general education between the first and second period for their mutual benefit. The reason for excluding such a contract is first that the court is unlikely to uphold a contract that penalizes such an innocuous use of leisure time as education. Second, the role of the general education at night school in the model is to increase income and hence, indirectly, the utility the worker can enjoy in case that he leaves the

firm in the second period. Even music and painting lessons and the chess class at night school which do not increase the worker's earning ability outside the firm, but directly increase his utility from the leisure time serve to play the same role as the general education in the model⁶⁾. It is impossible to write a contract that comprehensively bans every activity that, directly or indirectly, increases the worker's second period utility in the case of the quit of the current firm.

The worker's second period consumption c_2 equals $w_2(I, E) - E + (1+i)S$ if he stays with the firm for a production job in the second period, while it equals $h(E) - E + (1+i)S$ if he leaves the firm, and works elsewhere as a book-keeper. The worker determines the level of the general education in a way to maximize the second period consumption. Let E^o maximize $h(E) - E$, in other words, let E^o be defined by $h'(E^o) = 1$. The following proposition specifies the determination of E .

Proposition 1 There is I_{\min} such that, for $I < I_{\min}$, the worker undergoes E^o level of the general education, and leaves the firm to work as a book-keeper elsewhere in the second period, and such that, for $I \geq I_{\min}$, the worker sets the general education at the level which maximizes $w_2(I, E) - E$, and stays with the firm in the second period.

Proof See Appendix.

By Proposition 1, when $I \geq I_{\min}$,

$$\partial w_2 / \partial E = 1 \quad (3)$$

holds.

Proposition 1 implies that the firm's specific investment less than I_{\min} is useless, because the worker then leaves the firm in the second period. The specific relationship is not maintainable when the investment is less than I_{\min} . The proposition means overinvestment in general capital occurs in specific relationship. That is, the worker remains in the current firm as a production worker, and hence does not need and use the skill of book-keeping, yet he went to night school for the education of book-keeping. The efficient level of the education which is not intended to be utilized is zero, but the worker undergoes the education.

The reason for the overinvestment in the

general human capital is that acquisition of the general human capital improves the worker's threat point (status quo) with the firm in the second period. A stronger threat point yields to the worker a higher second period wage at the firm when the wage cannot be effectively contracted on beforehand. The worker, therefore, undertakes investment in his general skill without intention of actually using the skill, but merely to appropriate more of rent in the relationship. Specific relationship without a binding long run contract gives general investment a redistribution effect. This leads to excessive (useless from the viewpoint of productive efficiency) investment in general human capital.

As in Appendix A, let $E^*(I)$ denote the level of the general education that maximizes $w_2(I, E) - E$ given I . $E^*(I)$ is an interior solution when $I \geq I_{\min}$ as shown in Appendix A. Because of (2) and $h''(E) < 0$, one can show $dE^*/dI = ah' V' / \{a(h')^2 - h''(1 + e^{az})^2\} > 0$ for $I \geq I_{\min}$; that is, an increase in firm's specific training induces a larger worker's investment in general human capital. The same conclusion holds even for the general form of $u(\cdot)$ as far as $u''(\cdot) < 0$.

The intuition behind the property of $dE^*/dI > 0$ is the following. As (1) shows, the bargaining outcome depends on $1/u'(c_2)$, the reciprocal of the marginal utility of the second period consumption. (This is because the reciprocal translates the worker's utility gain from the second period bargaining into the monetary term, so that the gain is comparable to the firm's profit (gain).) Given w_2 , an increase in E results in a lower c_2 , and so a lower $1/u'(c_2)$ because of the decreasing marginal utility. This means that, when E is larger, the utility from the same w_2 gets evaluated lower, and hence the second period wage must be increased to keep the worker's gain in balance with the firm's gain. In other words, the larger the general investment (the stronger the bargaining position), the larger the worker's share in the surplus from the specific investment. Hence, the additional general investment distributes the marginal surplus of the specific investment more favorably to the worker. Thus, a worker is motivated more to make general investment when specific investment is larger.

The First Period Labor Market

Now, let us turn to the first period. We assume that the firm chooses a worker from the competitive labor market to form a specific relationship. (We will also discuss, later in this section, the case where the worker does not belong to the competitive labor market even before formation of a specific relationship.)

Consider the case with $I \geq I_{\min}$ where and only where a specific relationship is possible by Proposition 1. Given the budget constraint of $c_2 = w_2(I, E^*(I)) - E^*(I) + (1+i)(w_1 - c_1)$, the worker maximizes $u(c_1) + \beta u(c_2)$ to determine c_1 . Then, the usual condition of the intertemporal optimization, that is,

$$u'(c_1) - \beta(1+i)u'(c_2) = 0 \quad (4)$$

must hold. On the other hand, competition in the labor market does not allow the worker to enjoy more than the competitive level utility, U_0 . That is,

$$u(c_1) + \beta u(c_2) = U_0 \quad (5)$$

holds. Let c_1^* and c_2^* be the solution of (4) and (5), and let W denote $c_1^* + \delta c_2^*$ where $\delta = 1/(1+i)$. Conditions (4) and (5) mean that W is the minimized cost of attaining the competitive utility level of U_0 . Therefore, W represents the market value of the worker. It must be noticed that the value of W is independent of the specific investment. Using symbol W , one can express the budget constraint of the worker as:

$$\begin{aligned} w_1 + \delta w_2 &= c_1^* + \delta c_2^* + \delta E^*(I) \\ &= W + \delta E^*(I). \end{aligned} \quad (6)$$

The first period wage changes to establish (5). Hence, one can interpret (6) as the determination of the first period wage given the functions, $w_2(I, E)$ and $E = E^*(I)$. First period wages lower than determined by (6) are unable to attract workers to the firm. They give a worker lower utilities than U_0 . Those higher than that lead the firm to replace the worker by another who is willing to work for a lower first period wage, since the wages give him more than U_0 utility. Bargaining between the firm and worker determines the second period wage. The worker can increase the bargained wage even further by going to night school. But, competition in the labor market works to deprive the worker of the anticipated gain from the second period bargaining and the general

investment (the augmentation of the threat point) in advance. The competition forces the worker to be satisfied with a lower first period wage in return for the anticipated gain in the second period. Monetary transfer is, in effect, made from the worker to the firm simultaneously with the specific investment to cancel the gain. Thus, the worker earns only *net* income of W just enough to achieve U_0 , the competitive utility level over the two periods. This means that the firm can take the entire net surplus of the specific relationship given the competitive labor market despite the worker's opportunism and augmentation of his threat point.

Specific Investment

Since the far left side of (6) is the present value of the firm's wage cost, the present value of the firm's profit is $\delta V(I) - I - (W + \delta E^*)$. The firm maximizes this formula subject to $I \geq I_{\min}$. Accordingly, the level of the firm's investment in specific capital is given by

$$\delta V'(I) = 1 + \delta dE^*/dI \quad (7)$$

if it is an interior solution, and the level is I_{\min} otherwise.

Because of $dE^*/dI > 0$, (7) implies $\delta V'(I) > 1$, namely, underinvestment in specific capital. Accordingly, unless the socially optimum level of the specific investment, which is given by $\delta V'(I) = 1$, is less than the level of the investment that can maintain the specific relationship, underinvestment in specific capital results.

Crawford (1988), Farrell and Shapiro (1989), and Milgrom and Roberts (1990) show that the worker's opportunism permitted by the absence of a binding long run contract on the wage does not imply firm's underinvestment in specific capital given the perfect capital market, symmetric information, observable investment, and costless short term bargaining. The remark made after (6) is the intuition behind this conclusion; given the conditions, the monetary transfer simultaneously made with specific investment keeps the worker's well-being invariant to the post investment wage bargaining; and hence, under the conditions, the firm can capture all the surplus from the specific investment. That is, without the augmenting of the threat point as in Crawford (1988) and others, the wage

cost is W , and the surplus is $\delta V(I) - I - W$, which implies that the firm makes specific investment efficiently.

By contrast to Crawford (1988) and others, we have demonstrated specific relationship to entail underinvestment in specific capital given the same stringent conditions and admitting the *de fact* monetary transfer simultaneous with specific investment. General capital involved in specific relationship causes underinvestment in specific capital even under the same conditions. Thus, we have provided a new reason for the Williamsonian underinvestment contention. Crawford (1988) and Tirole (1986) have already deduced the Williamsonian underinvestment contention, but from the conditions that alone imply inefficiency without the pair of specific investment and incomplete long run contract. Since we have done the same without such conditions, our result seems to warrant the contention better, because Williamson appears to regard specific investment together with incomplete contract as an additional, separate cause of inefficiency in the market economy.

Intuitively, the reason for our underinvestment conclusion is the following. The literature assumes the worker's threat point constant throughout. By contrast, the paper takes the view that the absence of a binding contract on the second period wage induces the worker to augment his threat point (to invest in general capital). It follows that the surplus to be created by the relationship gets smaller in the amount of the cost of the augmenting, that is, it decreases from $\delta V - I - W$ to $\delta V - I - W - \delta E$. Part of the return on specific investment is wasted on the general investment which is made to affect only the distribution. Then, the firm earns $\delta V(I) - I - W - \delta E$ since the market force allows the firm to capture the entire surplus despite the post-specific investment opportunism of the worker. Maximization of the above formula yields (7), as the level of the general education which the worker determines depends upon that of the specific investment for the reason already mentioned.

The basic assumption of this paper is non-contractibility of the general investment. The assumption is natural and realistic as I contended earlier. But, it must be remarked that there are ways to overcome the non-

contractibility. First, regular overtime prevents the worker from going to night school. If a worker rejects overtime, the firm should, as the referee suggests, reduce his career prospective, which is equivalent to increasing the marginal cost of the general education. Second, the shift system also prevents the worker from going to night school.

We, in deriving (7), assumed that the firm chose a worker from the competitive pool. This assumption is not essential for the underinvestment contention. If the worker does not belong to the competitive labor market even before a formation of a specific relationship, the determination of the first period wage, w_1 , is not constrained by (5). In that case, the first period short run bargaining between the firm and worker on w_1 and I maximizes the product of $\delta\{V(I) - w_2(I, E)\} - I - w_1$ and $\beta u(c_2) + u(c_1)$ subject to $E = E^*(I)$ and $c_2 = w_2(I, E) - E + (1+i)(w_1 - c_1)$. This maximization of a Nash product can be interpreted to first maximize $\delta\{V(I) - w_2(I, E)\} - I - w_1$ given the value of $\delta\{w_2(I, E) - E\} + w_1$ and subject to $E = E^*(I)$, and next to determine the value of $\delta\{w_2(I, E) - E\} + w_1$. In other words, the first period short run bargaining in the first place maximizes $\delta V(I) - I - \delta E^*(I)$, namely, the anticipated surplus of the specific relationship. It is then easy to see the maximization of the Nash product as well yields equation (7); In other words, underinvestment in specific capital occurs. We obtain the same result as before since the level of specific investment is determined here again so as to maximize the net surplus from the specific relationship.

Related Literature

Becker (1964) contends that the cost of general training is to be entirely borne by the worker in the competitive market. By contrast, in the model of this section which also assumes the competitive labor market, the firm in effect bears the entire cost of the general training, though the worker is the direct payer of the cost. In the case of Becker (1964), the competitive market for the general skill allows the worker himself to capture all the return from the general training. Then, no one but the worker bears the cost of the general training. In the present paper, the

worker does not gain from the training after all, so that a worker in a specific relationship is as well off as others outside specific relationships. This means that the worker does not, but the firm does bear the cost of the training.

This paper appears to bear some resemblance to Grossman and Hart (1986)⁸⁾ and Hart and Moore (1990) in the sense that they take the threat point (status quo) for the ex post bargaining as an endogenous variable⁹⁾. However, Grossman and Hart (1986) and Hart and Moore (1990) focus on the allocation of asset ownership as a determinant of the endogenous threat point (bargaining position), while this paper does so on general investment. The difference in the focuses reflects different economic intuitions this paper, Grossman and Hart (1986) and Hart and Moore (1990) intend to bring out. Grossman and Hart (1986) and Hart and Moore (1990) study the assignment of asset ownership which creates appropriate incentive for agents' specific investments in a way to maximize the overall social surplus. Identifying a firm with assets it owns, they then examine when it is desirable for transactions to be made within an integrated firm. This paper intends to show that general investment, representing the outside earning capacity, is made in specific relationship merely to augment the threat point, and hence becomes an unproductive, costly activity which, reducing the return on specific investment, brings about underinvestment in specific capital.

Hart and Moore (1990, Proposition 1) also demonstrate underinvestment in specific capital. Similarly to Grout (1984), this is nothing but the conclusion which Crawford (1988), Farrell and Shapiro (1989) and Milgrom and Roberts (1990) have shown to follow from the absence of (implicit) monetary transfer made simultaneously with specific investment. This paper demonstrates underinvestment in specific capital, admitting the implicit monetary transfer.

Hart and Moore (1988), MacLeod and Malcomson (1993), and Aghion, Dewatripont and Rey (1994) explore long run contractual arrangements that ensure efficient specific investments even when renegotiation takes place after the investments. Hart and Moore (1988, Proposition 3) show that, when only

one party to a long run contract makes specific investment, the long run contract that implies full bargaining power to the party in the event of renegotiation ensures efficiency of the specific investment. Their Proposition 4 shows that when the both parties to a contract make specific investments, the investments cannot be efficient. MacLeod and Malcomson(1993, Proposition 7) extend the result of Hart and Moore, showing that the same conclusion holds even if the specific investment is not a self one, and even if, simultaneously with the specific investment, the other party makes general investment that affects the value of that party's outside option. Aghion, Dewatripont and Rey(1994) also extend the result of Hart and Moore. They show that even if the both parties make specific investments, the investments can be efficient when the long run contract gives one party full bargaining power in the renegotiation, and the other the default option the value of which is designed to be maximized when the second party makes its specific investment efficiently.

These contributions appear to dispel the problem of underinvestment in specific capital due to incomplete contracts and the associated opportunism. After all, however, the problem is to which extent particular long run contracts are enforceable in particular situations. When Hart and Moore(1988) and MacLeod and Malcomson(1993) are interpreted in the context of this paper, a high penalty (a negative non-trade price) that the original contract stipulates the worker to pay in the event of the non-cooperation gives full bargaining power to the firm. Similarly, the default option of Aghion, Dewatripont and Rey(1994) means, in the context of the present paper, that workers are prohibited to quit the firm¹⁰. As already noted, a high penalty for worker's quit and ban on a quit cannot be accepted by the worker as part of the labor contract. Besides, they should not be enforceable as a slavery clause even if included in contracts.

We must also note that the contractual arrangements in MacLeod and Malcomson (1993) and Aghion *et al* (1994) do not correct the problem of worker's overinvestment in general capital which this paper points out to occur in specific relationship. One party in

their models always receives the outside option or default option. After specific investment are made possibly by both parties, the party expected to receive the value equivalent to the outside or default option invests in general capital to increase the values of the options, and then to extract more of the surplus from the other party's specific investment in a way this paper has described. The same inefficiency in general investment as in this paper occurs. This suggests that overinvestment in general capital should be more fundamental than underinvestment in specific capital in a specific relationship.

3. Diversification, Keiretsu, and Involuntary Unemployment

This paper has discussed the problem of specific investment in relation to general investment. The party not undertaking specific investment augments its threat points (improves its status quo) to appropriate more of rents from the specific investment. For this purpose, that party invests in general capital, since the investment increases the party's income in the event of break-up, namely, income obtainable outside the relationship. Investment in general capital is made not in view of its productive effect, namely, the return from its proper use, but in view of its redistributive effect, namely, the return from an augmented threat point. This means investment in general capital is excessively made. Furthermore, it is not the party augmenting its threat point, but the party undertaking the specific investment who in effect bears the cost of the augmenting. Then, the return from the specific investment for the party undertaking it is partly used up to bear the cost, and hence the investment in the threat point causes underinvestment in specific capital.

Diversification

The above principle brought about in the context of training of workers should be applicable to many specific relationships. Diversification of firms, which is usually explained in terms of risk pooling, may be an example. A firm diversifies into a new market in pursuit for a stronger threat point *vis à vis* its particular buyer with which the firm is in a specific relationship.

Keiretsu

Another example should be the *keiretsu* (exclusive purchase) practice of Japanese firms. The most puzzling aspect of *keiretsu* that attracts criticisms (anger?) of outside observers and, especially, American companies should be that an apparent large price differential does not convert assembling firms from suppliers within their *keiretsu* to outside suppliers, and hence that the firms seem not to be governed by economic calculation, but by some favoritism. The interplay of specific and general investment analyzed in the preceding sections not sociologically, but economically explains why assembling firms do not purchase cheap parts from the outside of *keiretsu*.

An assembling firm purchases parts specific to it from firms that have undertaken specific investment necessary to produce the parts. Then, the assembling firm would invest in design and production lines to use standard parts. This investment is a general investment (a sort of "going to night school") that allows the assembling firm to make a profit without the part supplier investing in specific capital, and hence to have a stronger threat point against the suppliers. If it were made, investment in design and production line necessary for using standard parts would be an inefficient overinvestment in general capital, and would entail underinvestment by the suppliers in the equipment to produce specific parts in a way analyzed in the preceding sections. To avoid these inefficiencies, the assembling firm commits itself to the *keiretsu* practice. In order words, despite the apparent lure for deviation, the assembling firm commits itself *not* to invest in production lines and designs that enable the firm to use standard parts, and commits itself to purchase parts exclusively from suppliers that have made the specific investment. In the terminology of this paper, the assembling firm does not "go to night school for book-keeping" that does not affect the productivity of suppliers of specific part. There must be many ways to facilitate suppliers' specific investments¹¹. The exclusive purchase practice is among them.

Involuntary Unemployment

The model of this paper implies involuntary unemployment. In the model, workers face the perfect capital market, and the competitive labor market does not allow them to enjoy more than U_0 utility. It then appears that a firm can employ a worker for wages as much as W in the present value. W equals the market value of workers, since it is defined as the minimized value of $c_1 + \delta c_2$ subject to $u(c_1) + \beta u(c_2) = U_0$. Therefore, the cooperative production of the firm and worker seems to yield the net surplus of $\delta V(I) - I - W$. If $\delta V(I) - I > W$ holds for some I , workers seem employed by firms in the model. However, this is not necessarily true.

The literature on internal labor market such as Donaldson and Eaton (1976) and Oswald (1984) generally presumes that the cost of employing workers is their market value such as W in the above argument. But, the result in the previous sections shows it is not. Once a specific relationship develops, the worker tries to strengthen its bargaining position with the firm by going to night school for the knowledge of book-keeping. Since the knowledge is meant not to increase rent in the firm, but to divide it favorably to the worker, activities for a stronger bargaining position constitute inefficiency. The firm must bear the cost of the inefficiency entirely given the constant worker's well-being that competition in the labor market forces. Therefore, the cost of employing a worker is $W + \delta E^*(I)$ as seen in the previous section.

It is possible $\delta V(I) - I - W - \delta E^*(I) < 0$ for any I while $\delta V(I) - I - W > 0$ for some I 's. In this case, workers are not employed by firms, although the value of their product ($\delta V(I) - I$) can exceed their market values (W). The extreme form of the underinvestment in specific capital occurs. Looking at this situation, one can say involuntary unemployment exists; workers belonging to the competitive labor market cannot be employed for a job that yields output whose value is above the market value of the workers¹².

We compare this involuntary unemployment with that of the insider-outsider model of Lindbeck and Snower (1988). Involuntary unemployment in the insider-outsider model occurs because of the rent-related turnover

cost such as the legal severance pay and litigation cost involved in firing. The rent-related turnover cost is unrelated to productivity of the incumbent, but merely allows wages of the incumbent to exceed the competitive wage more than productivity differential without inviting replacement of incumbent workers with unemployed workers. In both the insider-outsider model and the present model, latent extra costs of employing unemployed workers account for involuntary unemployment. But there are differences in the characters of the latent costs. First, in this paper, the latent cost arises from very much innocuous and, in appearance, productive activities such as going to night school. In the insider-outsider model, the rent-related cost, which constitutes the latent extra cost in the model, arises from practices obviously hazardous to the market mechanism. Further, in the insider-outsider model, incumbent workers (or the government) introduce the latent cost with the intention of preventing replacement of the incumbent with the unemployed. By contrast, in this paper, nobody intends to prevent it.

As Lindbeck and Snower (1988, p. 8, p. 176) recognize well, the insider-outsider model must assume an imperfect capital market. In the presence of the perfect capital market, outsiders anticipating to earn high insider wages in future would agree to be employed at lower wages (or, even to pay to the firm to be employed) in the introductory period. They thus compensate high insider wages. This arrangement allows the firm to employ outsiders at the competitive cost over time, and hence gets involuntary unemployment of the insider-outsider model to disappear. However, this paper assumes the perfect capital market, allowing lower wages in the first period to compensate high wages in the second period. Yet, involuntary unemployment can arise. Given the perfect capital market and the competitive labor market, the firm, in effect, bears the cost from the inefficiency involved in worker's pursuit for a stronger bargaining position. The firm's anticipation of this cost gives rise to involuntary unemployment.

4. A Final Comment

At the end of this paper, I make a comment on the case where the production technology depends on both specific and general skills of a worker.

If one generalizes the irrelevance of the general skill to a specific relationship to assume that the general skill is valuable, but less important in a specific relationship than at outside jobs, one can still conclude that underinvestment in specific capital occurs in association with overinvestment in general capital as we have demonstrated under the assumption of the irrelevance in this paper.

When the general skill is more important in a specific relationship than at outside jobs, we cannot conclude similarly in the otherwise same model. However, in that case, one cannot maintain the Stackelberg structure with the firm as a leader deciding on the specific investment and the worker as a follower deciding on the general investment. One can show that it becomes to the interest of the firm to directly determine the general investment as well as the specific one, and that it is to the interest of the worker to accept the firm's decision on the general investment. The opportunism problem disappears, and the firm sets the specific and general investment at their optimum levels.

Thus, even if the general skill is relevant to the firm's production as well as the specific one, the opportunism of the worker, if possible, always causes the firm's underinvestment in specific capital along with the worker's overinvestment in general capital. A detailed exposition of the above needs an extensive space, and cannot be included here. It is available from the another upon request.

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APPENDIX

This appendix proves Proposition 1 after some lemmas. Define I_0 by $h'(h^{-1}(V(I_0))) = 2$.

Lemma 1 When $I > I_0$, maximization of $w_2(I, E) - E$ given I and subject to $V(I) \geq$

$h(E)$ has a unique interior solution. When $I \leq I_0$, $w_2(I, E) - E$ attains its maximum at $E = h^{-1}(V(I))$, and $w_2(I, E) - E = V(I) - h^{-1}(V(I))$.

Proof In (2), z tends to zero when E tends to $h^{-1}(V(I))$. Hence, when $I > I_0$, $\partial w_2 / \partial E = h'(E) e^{az} / (1 + e^{az}) < 1$ for $E = h^{-1}(V(I))$. Since $h'(E)$ tends to infinity as E tends to zero, $\partial w_2 / \partial E > 1$ when E is close to 0. Accordingly $w_2(I, E) - E$ has an interior maximum given I in the domain of $0 \leq E \leq h^{-1}(V(I))$. This maximum is unique, since $\partial^2 w_2 / \partial E^2 < 0$ holds.

On the other hand, when $I \leq I_0$, $\partial w_2 / \partial E \geq 1$ for $E = h^{-1}(V(I))$. Then, because of $\partial^2 w_2 / \partial E^2 < 0$, $w_2(I, E) - E$ attains the maximum at $E = h^{-1}(V(I))$, and hence $w_2(I, E) - E = V(I) - h^{-1}(V(I))$ by (2) when $I \leq I_0$. (Q. E. D.)

In the following, let $E^*(I)$ denote the unique solution of maximizing $w_2(I, E) - E$ given I and subject to $V(I) \geq h(E)$.

Lemma 2 When $h^{-1}(V(I)) > E^o$, $w_2(I, E^*(I)) - E^*(I) > h(E^o) - E^o$.

Proof When $h(E^o) < V(I)$, $w_2(I, E^o) > h(E^o)$ by (2), and so $w_2(I, E^o) - E^o > h(E^o) - E^o$. Then, by the definition of $E^*(I)$, $w_2(I, E^*(I)) - E^*(I) > h(E^o) - E^o$. (Q. E. D.)

Lemma 3 When $I \leq I_0$, $h(E^o) - E^o > w_2(I, E^*(I)) - E^*(I)$.

Proof When $I \leq I_0$, $h'[h^{-1}(V(I))] \geq 2$, and hence $h(E^o) - E^o > h[h^{-1}(V(I))] - h^{-1}(V(I)) = V(I) - h^{-1}(V(I))$. This inequality together with Lemma 1 means Lemma 3. (Q. E. D.)

Proof of Proposition 1 Because of Lemma 2, $w_2(I, E^*(I)) - E^*(I) > h(E^o) - E^o$ for $I > V^{-1}(h(E^o))$. Besides, $w_2(I, E^*(I)) - E^*(I)$ is increasing in I for $I > I_0$ on account of Lemma 1. Then, in view of Lemma 3, there is I_{\min} belonging to $[I_0, V^{-1}(h(E^o))]$ such that $w_2(I, E^*(I)) - E^*(I) \geq h(E^o) - E^o$ if $I_{\min} \leq I$, and such that $w_2(I, E^*(I)) - E^*(I) < h(E^o) - E^o$ if $I < I_{\min}$.

Notes

* Comments from Professor Y. Seoka of Osaka City University and two referees of *Economic Review* were very helpful in improving earlier versions of this paper. Of course, any remaining errors are mine.

1) The worker can go to the school before. But, it is to the interest of the worker to postpone going there as late as he utilizes the result of the education.

2) It must be noted that the dependence of V on E as well as I does not change the conclusion of the paper essentially. We will discuss this point at the end of this paper.

3) In case that c^0 becomes negative at the solution of the model on account of negative S , simply modify the model to allow a sufficiently large initial asset (for instance, bequest) for the worker. It allows c^0 to be non-negative without changing the subsequent analysis.

4) Hashimoto and Yu (1980) show that a wage formula agreed upon before specific investment reduces the loss from nonpotimal separation, though such a wage formula cannot suppress the incentive for the ex post bargaining completely, and hence cannot prevent it entirely.

5) It must be also noted that, though this paper does not include uncertainty after completion of specific investment, such a rigid contract as created by the penalty clause forces inefficient trading in some contingencies. This also makes the clause unattractive, since it is impossible to list in advance every contingency that must annul the clause.

6) Since someone argues that education increasing the value of leisure, such as piano lesson, does not strengthen the worker's bargaining power, let me discuss in some detail the value of leisure time as a threat point. Suppose, for simplicity, that worker's choice is not on working hours, but whether to work for a given length of time. When a worker works, he earns w_2 , but does not have enough time to enjoy, say, playing piano. Then, his utility is $1 - e^{-aw_2}$. When he does not work, he earns nothing, but has enough time to play piano. The utility he then has is equivalent to $h(E)$ money income, namely, the utility is $1 - e^{-ah(E)}$. When E is the amount of lessons he underwent. With the above formulation, the model becomes the same whether general education is on book-keeping or on playing piano. The length of leisure time differs whether one works or not. The ability of playing piano is used at leisure. The value of piano lessons then depends on whether one works or not. This means piano lessons change the threat point when the alternative to working is leisure.

7) From (1), one obtains $\partial^2 w_2 / \partial E \partial I = -V'(I)$

$u''(c_2)/u'(c_2)\{-2+(V(I)-w_2)u''(c_2)/u'(c_2)\}^2$
which means $dE^*/dI > 0$ when $u''(\cdot) < 0$.

8) The Grossman and Hart model is the following. After investing in specific capital (a_i variables in the model), managers of firms make ex post contractible decisions (q_i variables in their symbol) on how to use the firm's assets. Since the decisions on q_i 's are ex post contractible, they are to be made cooperatively among the managers because cooperative decision benefits all parties. But, the residual rights of control over the firm's assets confer to its manager freedom to determine the use of the assets, q_i . This means the non-cooperatively determined way of using the assets constitutes the manager's threat point. The dependence of the non-cooperative way of the use on the manager's initial specific investment leads managers to decide on the specific investment in view of its effect on the threat point.

9) The endogenous threat point in the Nash bargaining solution has been conceived before Grossman and Hart (1986). For instance, See Owen (1982, p. 137).

10) Cast in the context of this paper, the quantity variable in Aghion *et al* (1994) takes the value of one or zero (to cooperate, or not to), and it is one for the default option. This means ban on a quit, in other words, that the original contract requires the worker to always cooperate with the firm.

11) Someone points out that assemblers in Japan facilitate specific investments of their suppliers by the two vender policies and having their own parts division. These practices facilitate the investment, but do not explain why the assemblers do not buy cheap parts from the outside of *keiretsu*.

12) It would be better to cite the usual answer to the criticism frequently made to theories of involuntary unemployment. Workers claimed as involuntarily unemployed may take up simple jobs that pay the competitive wage. Otherwise, they rest at home; they choose to be unemployed. This is merely a semantic criticism. Involuntary unemployment must not be understood literally, but be defined as an apparent inefficiency in which workers, whether literally out of job or not, cannot be employed for jobs which produce output with the value exceeding the workers' present wages after the disutility involved in the jobs is considered.

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