GOVERNMENT INTERVENTION IN THE PROVISION OF ON-THE-JOB TRAINING*

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I. Introduction

The Australian Government introduced the Industry Training Levy (ITL) in 1989. This followed the release of a discussion paper on the issue in December 1988 which, on the basis of international comparisons, alleged an underprovision of private sector training in Australia. A case was presented for government intervention, with the major unresolved question of the authors being its form. The levy arrangement, under which firms with a minimum payroll must spend one per cent of payroll on approved training activities or be taxed an equivalent amount, is seen by the government to be an appropriate policy response.

Institution of the policy raises the question of whether or not, and under what circumstances, intervention by government in firms' training arrangements is justified. Important academic responses to the debate (Borland, 1990; Edwards, 1988; and Stromback and Moy, 1989) have pointed out that economic theory sees little or no role for public sector involvement in private on-the-job training. The basic argument of this research is that if there is training underprovision in Australia it is the consequence of misguided rules and policies associated with labour market regulation, and that removal of these impediments is the appropriate government strategy.

In this paper we do not offer a full critique of either the government's position or the challenge offered by conventional theory as the only explanations for Australian training outcomes. Instead we pose the question of whether or not there would be less than optimal training provision in a world in which there were no regulatory impediments to the private provision of training. This is addressed by considering briefly the literature related to the role of training in the determination of technological change, on the one hand, and the processes of innovation diffusion, on the other. The argument is that a fully deregulated labour market would still have the potential to underprovide training, but the reasons offered are not those suggested by the Government to support the ITL.

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It is argued below that an externality — generally not considered in current debate, although touched on by Borland (1990) — arises if training leads to technological advances, the benefits of which cannot be fully protected from the firm's competitors. This is demonstrated in a model employing particular functional forms for the production function. The appropriate government intervention is illustrated under different scenarios of competition and production relations. The general rule is that the establishment of workable arrangements that protect innovation diffusion without reducing aggregate welfare outcomes is the most desirable policy response.

II. Training Underprovision

Background

In the original Government discussion paper (Minister for Employment, Education and Training, Dawkins, 1988), the case for intervention rested on the proposition that there was inadequate training in Australia, due to the nature of award structures, high labour turnover, poaching, poor management attitudes and a reliance on immigration. The analyses of Borland (1990), Borland, Chapman and Rimmer (forthcoming), Edwards (1988) and Stromback and Moy (1989), while placing different emphasises on particular aspects of training theory, all raise a similar and compelling point. This is that barriers to the attainment of optimal training outcomes exist in part because of institutional rigidities in the Australian labour market that arise from minimum wage regulation, narrowly-defined job classifications and the nature of occupationally-based unionism.

An important part of the argument is that many of the characteristics of a poor training environment can be traced to the inhibitions placed on firms by the existing, albeit changing, regulatory framework. Examples typically offered in the Australian context are high labour turnover, relatively flat wage-experience profiles and the poaching of skilled labour. Empirical evidence supports the general thrust of this analysis.[1]

Using this framework only, the appropriate policy response is the changing of Australian labour market institutions. The basic general conclusion is that in the absence of restrictive work practices and regulations participants in the labour market would be free to pursue activities resulting in an optimal training provision.

Whilst accepting the legitimacy of the view that training under-provision will result from the presence of institutional arrangements or policies that limit firms' and/or workers' returns to training, it is possible that training outcomes are importantly influenced also by factors other than labour market regulation. One possibility is that there exists an externality from training in the form of technological change, the benefits of which are unable to be captured fully by the training provider.

[1] Evidence that labour turnover is high in Australia relative to other countries is presented by Minister for Employment, Education and Training, Dawkins (1988). The proposition that there are relatively low levels of informal on-the-job training is supported indirectly in the international comparisons of wage profiles presented in Tan *et al.* (forthcoming).

The Existence of an Externality?

Externalities arise in market economies when the actions of private agents deliver benefits to others not contributing to the cost. It is argued below that training externalities can arise from industry-specific technological change. As a consequence, if firms are unable to derive fully the rents from such technological change there will be training underprovision.

When training provides benefits throughout the industry and the economy in the form of technological progress, externalities can arise from such training. To the extent that technological change is industry-specific, all producers and consumers of the industry's product may be advantaged, if the firm originally providing the training cannot capture all the rents from the investment. Unable to capture these rents arising from training provision, firms can be expected to provide less training in such an environment than they would have if they had been able to internalise all the benefits.

The evidence suggests that a highly trained workforce appears to be fundamental to the development of an initial idea so that it can be efficiently integrated into the production process.[2] As examples: it is argued that new technologies acquire economic significance only through a period of experimentation and redesign (Nelson, Peck and Kalachek, 1969; Johnson, 1975); Acs and Audretsch (1988) provide evidence that the number of technical innovations appear to be positively influenced by the presence *inter alia* of skilled labour; and Enos (1962) finds that the initial introduction of four new process technologies yielded cost reductions of 1.5 per cent per annum, while subsequent modification and adaptation of these processes yielded cost reductions in excess of 4.5 per cent per annum.

However, no externalities arise if firms are able to protect the information related to the technological change arising from training, since in this case all the technological innovation benefits from training will be completely internalised. But this can only be achieved if the firm is able to control the diffusion of technological information to its competitors.

There are numerous ways in which diffusion of information occurs: through what is revealed in the product, as determined by reverse engineering (a process whereby a firm takes apart a good in order to ascertain how it was produced); through the written word, as in technical journals and papers; by licensing or cross-licensing of technology (to increase returns to investments in innovative activities and training or in exchange for other firms' technology); and by the interaction between users and producers of intermediate goods (new machinery), which results in the incorporation of users' learning in subsequent improved vintages of capital.

Clearly it would be extremely difficult for any firm to stop at least some diffusion of technological information. But, in the absence of this control, provision of training within firms is likely to be lower than that which is desirable from an economy-wide perspective, with one possible solution being some form of government intervention. What follows considers formally the nature of the intervention needed to address the problem.

As implied, the best solution on the basis of economic theory would be the provision of a mechanism that allowed the protection of the firm's innovation, or at least appropriate

[2] This evidence is discussed at greater length in Chapman and Stemp (1991).

recompense from other firms benefiting from the technological development. However, the diffusion literature suggests strongly that the nature of the process is not such as to allow effective patent or licensing arrangements; clearly with training externalities we are in a world a long way from the first-best. Given this, what is a useful framework for considering the issue?

III. The Case for Intervention

This section of the paper develops further the analysis *under the assumptions* that training does lead to technological advance and that it is not possible for innovating firms and workers to internalise the rents from the process. If these conjectures matter empirically, it is useful to highlight the relevant issues for policy through a formal modelling approach.[3]

To motivate the exercise an example is chosen where the externalities from training enter into firms' production technologies in a specific manner. By making very strong assumptions about the production technology and the structure of the market facing the industry the example demonstrates that government intervention can lead to increased profitability for all firms in the industry. This specific example is argued to be a special case of the more general proposition that when there are externalities derived from government intervention in on-the-job training, its provision *may* lead to economy-wide welfare improvements. It is demonstrated that the ultimate benefits from training externalities in a particular industry can be distributed throughout the economy with their incidence being strongly dependent on the market structure facing the industry.

An example where intervention is justified

It is useful to consider the relationship between corporate training and the production decision of the firm in an example of an industry in which firms are price-takers in all markets. Assume further that there are barriers to entry, and training provided by one firm in the industry generates externalities for other firms in the same industry. In this context it can be demonstrated that if firms chose levels of training to maximise their *own* profits then training and output would be less than if the level of training in each firm was chosen so as to maximise *industry-wide* profits. Establishment of this proposition suggests that, for such an industry, collusion or some form of government intervention to encourage collusion-like behaviour will lead to increased training.

In the model, the firm is assumed to have one input, raw labour, L, and the output per unit of labour can be increased by the provision of training courses, T, within the firm. In addition to its influence on the output per unit of labour within the firm, some training financed by the firm[4] is assumed to provide an externality to the industry by increasing the output per unit of input of other firms in the same industry. Benefits to the rest of the industry resulting

[3] An abridged version of Sections III, IV and V is contained in Chapman and Stemp (1991).

[4] There may be important reasons for the financing of risky training to be mainly underwritten by firms, not workers. As well, training leading to innovation is initially firm-specific and theory suggests that firms must finance part of this training. The essence of the analysis is not compromised if workers contribute to the financing.

from training provision by one firm occurs, for example, if that training results in modifications of new equipment or adaptations which eventually become the industry standard.

To explain the model further assume that there are a total of $m(>1)$ firms in the industry, each of which is assumed to have the same technology (identical production functions). Firms finance the training provided to their own staff so that training can be funded without calling on resources from elsewhere in the economy. As noted the industry is assumed small in the national economy so that it is a price-taker in the market for labour and training resources. In addition, it is assumed that the national output by the industry is small in a world market, so that the domestic industry is a price-taker on the product market. These last assumptions allow prices, wages and the cost of training to be treated as exogenous to the decision of the firm. The model is long-run and abstracts from the dynamics associated with the time-stream of costs and benefits associated with training.

Using subscripts to denote each of the m different firms, a model of the ith firm is given by:

$$\Pi_i = pY_i - wL_i - cT_i \qquad c > w \tag{1a}$$

$$Y_i = F(L_i, T_i, X_i) = [a + bX_i^{\alpha}](L_i + T_i)^{\beta} \qquad a>0,\ b>0,\ \alpha>0,\ \beta>0,\ \alpha + \beta < 1 \tag{1b}$$

$$X_i = \sum_{j \neq i} T_j \tag{1c}$$

where

Π_i = nominal profits of ith firm
Y_i = units of output by ith firm
L_i = raw labour units demanded by ith firm
T_i = units of training provided within ith firm[5]
X_i = units of training provided by all firms within the industry other than the ith firm
p = price of unit of output (assumed exogenous)
w = nominal wage per unit of raw labour (assumed exogenous)
c = nominal cost per unit of training (assumed exogenous)

Equation (1a) defines nominal profits as equal to income derived from sales of output less wage costs and the cost of training within the firm. Equation (1b) defines the technology facing the producer, represented by a production function defining output of the firm. Provision of training increases the output of the industry in two ways. The first is that the provision of training within the firm increases output within the firm, so that even if no firms in the industry other than the ith firm provide training ($X_i = 0$), aggregate production can be represented in the form:

$$Y_i = a(L_i + T_i)^{\beta} \tag{2a}$$

[5] A unit of training is implicitly defined here as that amount of training that, in the absence of externalities, will increase output by the same amount as will one unit of raw labour.

Thus, it is assumed that increases in training will increase aggregate output even in the absence of any externalities.

The second way training provision increases output in this model is that when other firms in the industry also provide training (represented by $X_i > 0$, so that the externalities are positive) then the externality generated by such training will result in increased output even if inputs within the firm remain the same. With the addition of benefits generated from training provided elsewhere in the industry, output is given by:

$$Y_i = [a + bX_i^{\alpha}](L_i + T_i)^{\beta} > a(L_i + T_i)^{\beta} \tag{2b}$$

Clearly, output is greater as a consequence of benefits generated from the externalities.

Similar specifications of the manner in which externalities from some social input (such as training) in one firm can have an impact on the output of other firms has been adopted in the economic growth literature. For example, such a specification has been adopted: by Arrow (1962), who models the externalities generated by a scale related learning by doing effect; by Romer (1986), who models a knowledge related technology effect; and by Azariadis and Drazen (1990) who model the externalities generated by a training regime in which private rates of return on human investment depend positively on the existing average quality of human resources.

Equation (1c) defines training provided by all firms other than the ith firm. In the model benefits accrue to individual firms as a result of training provided by other firms in the same industry; accordingly, it is possible for an individual firm to 'free-ride' on its competitors by not providing an appropriate share of training to its own employees. Such free-riding behaviour can lead to less than desirable provision of training throughout the industry, a point demonstrated below by considering alternative profit maximising scenarios.

If each firm in the industry made its production decision so as to maximise profits throughout the industry then, since each firm faces the same production technology and the same cost structure, each firm will choose the same level of production, labour and training. As prices, wages and the cost of training are assumed exogenous to the industry, these will be unaffected by the decisions of the firm and the decision to maximise profits over the whole industry will be accompanied by increased profits for firms within the industry.

In the case when each firm decides to maximise profits over the whole industry, if each firm has perfect knowledge about the production technology and cost structure of its competitors, then it will know that the level of training provided by its competitors will be the same as its own level of training provision. The solution resulting when each firm makes its training and production decisions so as to maximise overall profits within the industry is henceforth referred to as the solution under industry-wide collusion. In this case, the aggregate level of training provided by all firms other than the ith firm is given by:

$$X_i = (m-1)T_i \tag{3}$$

It is demonstrated in the Appendix that the level of training, T_i, under this scenario will be positive.

The case of the free-riding firm occurs when an individual firm knows nothing about the optimisation decision of other firms in the industry, but simply assumes that aggregate training provision by such firms is fixed. In the model presented here the free-riding firm will provide no training. If each firm in the industry adopts the same approach of maximising its own profits taking training by the rest of the industry as given, then no firms in the industry will provide training.

Levels of training, output and profits over the industry will always be greater under industry-wide collusion than when some (or all) firms choose to free-ride. Hence, under collusion, all firms have higher profits and are better off. All firms would also be better off if the incentive for any firm to attempt to free-ride on its competitors was removed.

Given complete information, one way in which the incentive for firms to free-ride could be eliminated would be by a mandatory requirement that all firms provide a minimum level of training to their staff, or a minimum training expenditure to an industry training board. If each firm could be required to provide and fund the level of training that would be forthcoming from industry-wide collusion this would generate similar improvements in industry-wide training, employment and profit scenarios as would have been achieved under a profit-maximising solution based on industry-wide collusion. By removing the incentive to free-ride, the profit position of the industry can be improved.

The general case for intervention

The example presented above shows that there are situations in which the profits of an industry will be higher under industry-wide collusion, voluntarily reached or government induced. Essentially, such improvement in profitability can be achieved because it is possible to spend resources on additional industry-wide training to achieve an increase in output throughout the industry which is greater than the additional resources needed to provide this additional training.

Of course, there is no reason why the government should intervene just because profits in a particular industry will be higher. The economic outcomes under different criteria need to be ranked by more appropriate means according to some welfare criteria. Two types are:

- equity criteria, which attempt to assess whether resources are distributed fairly throughout the economy;
- aggregate welfare criteria, which assess whether resources can be used more effectively so as to increase economy-wide benefits. This approach does not take account of how resources are distributed.

It is useful to keep in mind that, by making use of lump-sum transfers, any policy which satisfies a particular aggregate welfare criterion can also be made to satisfy given equity criteria. One aggregate welfare criterion uses a money metric approach to measuring welfare (Boadway and Bruce, 1984), identifying aggregate welfare improvements in the economy as follows:

$$\textit{change in aggregate welfare} = \textit{change in consumer surplus} + \textit{change in producer surplus} \quad (4)$$

Under this criterion any process which increases profits of firms within an industry, thus increasing producer surplus, while at the same time not reducing consumer surplus, will lead

to an aggregate welfare improvement. Similarly, a process which reduces the price of output, thus increasing consumer surplus, while at the same time not reducing producer surplus, will result in a welfare improvement.

The example above presented a scenario under which government intervention will lead to an increase in profits for a particular industry without any reduction of benefits to other sectors of the economy. In the money-metric approach to welfare discussed above, an increase in industry profits is equivalent to an increase in producer surplus and hence, under the criterion summarised in equation (4), such intervention leads to a welfare improvement.

In the model it is assumed that prices, wages and the cost of training are exogenous. In this case, an equivalent outcome to that achieved under the government intervention scenario could also be achieved by a change in market structure. For example, if all firms in the domestic industry combined to form a monopoly then, under the assumptions outlined above, such intervention would achieve the solution derived from industry-wide collusion or equivalent market intervention under complete intervention.

In many circumstances the industry will not be a price-taker in all markets and barriers to entry will not exist. In such cases, if training externalities exist, government intervention may still lead to a welfare improvement, but the extent to which it is distributed between increases in producer surplus and increases in consumer surplus will depend on the particular structure of the market. This point is pertinent to the determination of the most desirable form of intervention.

Under market structures which differ from that presented in the model, a welfare improving outcome may not be able to be achieved without an interventionist solution. For example, where an industry is not a price taker in the market for output and there are no barriers to entry, if perfect competition prevails then market intervention designed to lead to an appropriate level of training results in a decline in output prices with no long-run change in profits. The benefits will then be realised through an increase in consumer surplus leading to corresponding welfare improvements. But if the firms combined to form an industry-wide monopoly this would lead to a pricing distortion, implying that increases in output and corresponding welfare improvements would be less than could be achieved by government intervention requiring specified levels of training in the perfectly competitive industry.

Other scenarios where increased levels of training lead to changes in the level or structure of wages or the cost of training can also be considered. Complex and relevant situations where changes to profits, prices and the returns to other factors of production all occur simultaneously can also be considered. Clearly, different scenarios can result in different distributions of welfare improvements between increases in consumer surplus and increases in producer surplus. In particular, benefits from market intervention may not accrue within the specific industry but may be distributed throughout the economy. From this discussion it is clear that if there are externalities from on-the job training then government intervention can lead to welfare improvements, with the ultimate incidence of benefits differing depending on the market structure facing the industry.

IV. Methods of Government Intervention

The government may believe that there are benefits to be gained from training externalities and that these benefits are not being delivered by the market. If the benefits are assessed to be large enough a case can be made for government intervention in the industry. One way the government can intervene is by choosing a mandatory requirement that all firms in the industry provide a minimum level of expenditure on training. If this happens then there are two important questions to be addressed: how should the mandatory training requirement be distributed between firms?; and, how should the required levels of training be financed? The answer to both questions will depend to some extent on the production technologies of different firms within the industry and on the market structure faced by the industry.

The most desirable distribution of training requirements between firms depends crucially on the way in which the externalities associated with training interact with production technologies. It is useful to assume that different firms within the industry possess different technologies so that, in the absence of intervention, profit-maximising firms vary in levels of employment, output, training and profits. In the model, such an outcome can be illustrated by assuming that different firms within the industry have unequal values for the parameters α and β in their respective production functions. Modified to allow for different values of α and β across firms the production function is given by:

$$Y_i = F_i(L_i, T_i, X_i) = [a + bX_i^{\alpha i}](L_i + T_i)^{\beta i} \tag{5a}$$

where

$$X_i = \sum_{j \neq i} T_j \tag{5b}$$

Under this specification, the externalities from training for the ith firm enter through the variable, X_i, which takes no account of training provided within the ith firm. Accordingly, if the α_is and β_is are allowed to vary so that different firms possess different technologies, then industry-wide externalities generated by additional training will differ according to which firm provides the training. The best level of government intervention in training provision would then differ across firms with the mandatory training requirement for each firm depending on the α_is and β_is for all firms in the industry.

An alternative production technology can be represented by:

$$Y_i = F_i(L_i, T_i, Z) = [a + bZ^{\alpha i}](L_i + T_i)^{\beta i} \tag{6a}$$

where

$$Z = \sum_j T_j \tag{6b}$$

For this specification, the externalities from training enter through the variable, Z. This variable does take account of training within the ith firm and additional training generates the same externalities throughout the industry, no matter which firm provides the training. Under this specification, a given training requirement funded at a given lump-sum cost to

the industry will have the same impact on output and profit levels for the industry overall irrespective of how that mandatory training requirement is distributed across firms within the industry.[6]

Even if the government can determine that training externalities exist within an industry, it is unlikely to be aware of the precise functional form of the production function of each firm in each industry; in practice, production functions are likely to be significantly different for each firm. The functional form of the production functions will be crucial in the determination of the allocation of mandatory training requirements across firms, with the manner in which training generates externalities for each firm across the industry being best understood by industry members. Even then, this process may be only imperfectly understood by members of the industry. Accordingly, if a mandatory training requirement were to be introduced then the distribution of mandatory training requirements would probably be best determined by an industry board with appropriate representation by all firms within the industry; however, even an industry board may not have access to sufficient information to allow its intervention to achieve desirable outcomes.

If appropriate mandatory levels of training across firms within the industry can be determined, it will still be necessary to decide how such training requirements should be financed. This decision will depend on a combination of aggregate welfare and equity considerations.

For a given level of training intervention in each firm there will be a corresponding level of benefits from training externalities across the whole industry. When evaluating the aggregate welfare gains from such intervention these benefits must be offset against the welfare losses associated with the distortions introduced by alternative financing proposals.[7]

As noted in Section III, the principal benefits of any externalities arising from mandatory training requirements may not be realised as additional profits within the industry at all. For example, if the externalities lead to a change in product prices then the externalities may be realised as an increase in consumer surplus only. The benefits from externalities may also accrue to factors of production such as wages and the costs of training. This would be represented as an increase in producer surplus. In general, benefits may be realised as an increase in consumer surplus, as an increase in producer surplus or as a combination of both. Equity considerations lead to the conclusion that it would be desirable for the costs of mandatory training to be borne by those sectors of the economy that are the ultimate beneficiaries of training intervention. To identify those beneficiaries would require, for each industry, a detailed

[6] Since the demand for raw labour must always be positive, this assertion assumes that no firm provides 'too much' training.

[7] Fred Gruen has raised the interesting possibility that Australian government financing of formal training — such as in the case of TAFE or higher education — already corrects some of the distortions arising from industry training under-provision. The point has some relevance where training externalities deliver economy-wide benefits but cannot be used to justify the *status quo* if specific industry producers are the beneficiaries. In such a situation a levy imposed on particular industries to finance the specific formal training would be desirable. In the case where the externalities are generated from on-the-job training the financing of formal skills enhancement programs is not obviously relevant to the intervention issue.

study of market structure and distributions of consumer surplus and producer surplus. Such an analysis is beyond the scope of this paper. Suffice it to say that larger benefits could accrue to those sectors that possessed some degree of monopoly power.

It is also important to note that different methods of financing will result in varying levels of market distortion and in corresponding welfare losses. The example presented in Section III assumed that each firm financed its own training requirements; this is equivalent to financing by a lump-sum tax and introduces no distortion to the profit-maximising decision of the firm. Other financing options will typically involve the introduction of distortions somewhere in the economy thus to some extent reducing aggregate welfare. For example, any method of financing that involves some form of marginal taxation will introduce distortions which will tend to offset the benefits derived from the training externalities. The cost of additional training could be financed by slightly raising marginal tax rates across the economy or by a levy on firms within the industry. If such a levy were to be based on some form of marginal taxation then it would introduce greater distortions than would be the case with funding through economy-wide taxation.

To further develop the methods by which the distribution of a levy across firms within the industry could be determined it is useful to distinguish the following three possibilities:[8]

(a) each firm finances the training provided to its own staff;

(b) training is financed by a sales-tax levied on firms within the industry;

(c) training is financed by a payroll tax levied on firms within the industry.

If a mandatory training requirement is imposed then the self-financing proposal (method (a)) is equivalent to a form of lump-sum taxation and, consequently, imposes no distortion on the profit maximising decisions of firms within the industry. The other methods ((b) and (c)) impose distortions and tend also to disadvantage different types of firms. For example, high productivity firms[9] would be taxed more under a sales tax than under a payroll tax, while the opposite is true for low productivity firms. As well, sales and payroll taxes in specific industries would introduce larger distortions into the economy than would an economy-wide tax yielding equivalent revenues.

In summary, on aggregate welfare criteria the methods of financing can be ranked as follows. First, financing by lump-sum taxation is equivalent to each firm in the industry financing its own training (method (a)) and is preferred to financing by economy-wide taxation. Second, economy-wide taxation is preferred to financing by a sales tax or by a payroll tax within the industry (methods (b) and (c)).

[8] A fourth option would be a profits tax. There is a problem with how profits should be defined, and for certain technologies, such as when the production function is homogeneous of degree one, firm profits will be driven to zero (which is also the case in a perfectly competitive industry).

[9] In the notation of the model, productivity of the ith firm is given by Y_i/L_i.

If the ultimate incidence of benefits from additional training is spread broadly through the economy (for example, through increased consumer surplus only) or if the distribution of benefits cannot be reliably determined, then an equity argument would support the spread of training costs throughout the economy. However, in some situations firms within the industry may possess a degree of monopoly power so that a large share of the welfare gains will be realised as additional producer surplus in the form of increased profits. In such a situation, an equity argument would support the financing of a mandatory training requirement on the basis of a levy applied to firms within the relevant industry.

An overall assessment of aggregate welfare and equity arguments suggests that if an appropriate level of mandatory training can be determined then additional training should be funded by economy-wide taxation or by requiring that each firm fund its own additional training provision at market rates. Funding by economy-wide taxation should be viewed more favourably if benefits from training externalities are expected to be distributed throughout the economy. On the other hand self-financing of training by firms should be viewed more favourably if the ultimate benefits from training externalities are expected to accrue within the industry only.

V. The Consequences of Misguided Intervention

So far it has been shown that, under certain circumstances, welfare improvements may be achieved from government intervention in the provision of training. But, as illustrated above, it may be extremely difficult for the government to determine the best distribution of training requirements across firms within an industry. Indeed, the government's estimate of training requirements for the aggregate industry may be very inaccurate; and even industry representatives may not have sufficient information to determine an appropriate level of intervention. Also, distortions may be introduced by the method of financing government intervention. In this section, the possibility that the government may intervene incorrectly is canvassed.

If the benefits of mandatory training requirements are small and the method of financing the additional training requirement introduces a further distortion to economic decisions, then the welfare gains arising from enforced training may well be more than offset by losses associated with distortions introduced by the method of financing. Intervention under such a scenario will lead to an aggregate welfare loss.

Even assuming complete information, government intervention in training provision can only be effective if welfare gains from training externalities are large enough to offset both the losses from the associated distortions and the costs of monitoring the effectiveness of such intervention. Thus government intervention will only be welfare improving up to some threshold training level. As mandatory training increases beyond the threshold level aggregate welfare gains will diminish and may eventually become negative.

The important point is that there is a danger that intervention can do more harm than good for the economy. Effective intervention requires that the government make an accurate assessment of whether or not there are sufficient benefits to be gained from such intervention and care must then be taken to ensure that firms in the industry are not forced to maintain

excessive training requirements. Ultimately training intervention is only warranted if the perceived benefits are large and the government or its representatives have access to sufficient information to ensure that no firm is required to provide 'too much' training; in practice, such stringent requirements justifying intervention are unlikely to be met.

VI. Conclusion

The Australian Government's introduction of an ITL has been justified by a perceived underprovision of industry training. This paper has argued that training provided by one firm in an industry is a social input which generates externalities for other firms in the same industry and, possibly, also for other industries. If firms are unable to internalise all the benefits of training, then this would go some way toward explaining inadequate training levels.

Of course, the first-best response would involve the adoption of effective patent or licensing arrangements; but, in practice, the manner in which the externalities from training are diffused throughout the workforce, means that such arrangements cannot be instituted. The Government's adoption of the ITL is an attempt at a second-best approach which provides incentives for firms to spend a percentage of their payroll on approved training activities. The analysis of this paper has used a formal modelling approach to examine under what circumstances such intervention would be justified, to examine appropriate and inappropriate ways in which intervention could be implemented, and to consider the information necessary to ensure that intervention would be effective.

Using a formal model of an industry in which individual firms benefit from training externalities, we have provided an example of how such externalities could lead to underprovision of training. In this simple model government intervention requiring higher training levels would lead to higher profits for all firms in the industry. It has then been shown, in a more general framework, that the benefits from government intervention may not even accrue to firms within the industry but instead may be passed on to other players in the market such as workers within the industry or consumers of the firms' product. In practice, the manner in which training externalities interact with the production technology to increase output levels is difficult to determine and will inevitably differ across industries; also it would be very difficult to establish the ultimate beneficiary of government intervention with the possibility that even industry participants would not be able to determine the ultimate incidence of benefits.

The process of financing government intervention by taxing some sector of the community introduces additional distortions to the economy thus reducing the aggregate welfare benefits of government intervention. For intervention to be warranted, it is essential that the benefits from providing additional training should not be offset by the additional distortions resulting from financing arrangements. An overall assessment of welfare and equity arguments has argued that it is desirable that additional training requirements should be funded by economy-wide taxation if the benefits are spread broadly throughout the community; only if it can be established that the ultimate benefits of training accrue within the industry would self-financing of additional training requirements by firms within the industry be warranted.

In a world where the magnitude and ultimate incidence of benefits are uncertain there is a real danger that legislated training requirements can do more harm than good. While this

paper demonstrates that an omniscient government may well be able to improve economic outcomes by appropriate intervention, in practice there is no evidence that government has sufficient information to intervene appropriately.

Appendix

The profit maximising solution under industry-wide collusion presented in Section III of this paper is derived from an optimisation problem of the form:

Choose L, T so as to maximise

$$\Pi = p[a + b(m-1)^{\alpha}T^{\alpha}](L+T)^{\beta} - wL - cT \tag{A1}$$

The first-order conditions for a maximum satisfy

$$\frac{\partial \Pi}{\partial L} = \beta p[a + b(m-1)^{\alpha}T^{\alpha}](L+T)^{\beta-1} - w = 0 \tag{A2a}$$

$$\frac{\partial \Pi}{\partial T} = \alpha pb(m-1)^{\alpha}T^{\alpha-1}(L+T)^{\beta} + \beta p[a + b(m-1)^{\alpha}T^{\alpha}](L+T)^{\beta-1} - c = 0 \tag{A2b}$$

The appropriate second-order conditions for a maximum are also satisfied.

Equations (A2a, A2b) reduce to:

$$\beta p[a + b(m-1)^{\alpha}T^{\alpha}](L+T)^{\beta-1} = w \tag{A3a}$$

$$\alpha pb(m-1)^{\alpha}T^{\alpha-1}(L+T)^{\beta} = c - w > 0 \tag{A3b}$$

Clearly, the optimal solutions for L and T satisfy

$$L + T > 0 \tag{A4a}$$

$$T > 0 \tag{A4b}$$

The profit maximising solution of a free-riding firm is derived from an optimisation problem of the form:

Choose L, $T(\geq 0)$ so as to maximise:

$$\Pi = p[a + bK^{\alpha}](L+T)^{\beta} - wL - cT \tag{A5}$$

where K is exogenous and fixed.

The profit maximising solutions for L and T satisfy:

$$L > 0 \tag{A6a}$$

$$T = 0 \tag{A6b}$$

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