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On the Incidence of Employment Subsidies to Vocational Training

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On the incidence of employment subsidies to vocational training

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Abstract

The present paper analyses employment subsidies to vocational training under union wage bargaining. The analysis includes an investigation of the consequences of financing the subsidy by a levy on employment, which is the typical way of financing these types of subsidies in many countries. The paper demonstrates high incidence rates of subsidies to vocational training under standard assumptions about the preference structure of the union. The financing scheme appears to counteract the purpose of the subsidy.

1 Introduction

In most countries employer provided training plays a role in human capital formation. Many countries, if not a majority, have some extent of employment subsidies to further vocational training. National programmes, including work related training of young people as an alternative to pure school based human capital, is a common phenomenon.

A prototypical example of a large scale apprenticeship vocational training programme is the German case. It is analysed in Dustmann and Schönberg (2009) and Acemoglu and Pischke (1998), who emphasize the importance of noncompetitive wage setting in human capital formation. Large scale apprenticeship programmes also exist in Germany's neighbouring countries to the South and the North and in Australia and New Zealand.[1]

Stevens (2001) analyses the ability of training subsidies to overcome failures in the market for training. In the model set-up by Malcomson et al. (2003), the result is an explicit recommendation of a public subsidy to overcome incentive problems inherent in apprenticeship contracts.

The present paper analyses employment subsidies to vocational training under unionised wage bargaining. Unionisation is a characteristic of many countries which have formal vocational training programmes, especially countries with large scale apprenticeship programmes.

Some amount of incidence of employment subsidies is a standard result in union models, see for example the surveys in Cahuc and Zylberberg (2004) and Booth (1995). The present paper demonstrates sharper results in the case of employment subsidies to vocational training.

The analysis is conducted in a union wage-setting model. This is a standard assumption in the analysis of active labour market policy, see for example Calmfors and Lang (1995).

In many countries a typical way to finance employment subsidies to training is a levy on employment. The analysis includes an investigation of the effects of this type of financing.

If large shares of youth cohorts follow the vocational training path, the cost of employment subsidies is substantial. Subsidy schemes for large shares

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[1] A major source to vocational training programmes in various countries is the country surveys of the European Community organisation CEDEFOP.

of youth cohorts of the type analysed in the present paper are a policy issue in for example Germany and they are implemented in Austria and Denmark.

The relevance of the analysis of the paper is not confined to vocational training but can be applied to any groups where attempts are made to further employment by employment subsidies. However, vocational training schemes are the leading case and to fix ideas, participants are termed apprentices in the paper.

The paper is organised as follows. The model is presented in section (2) and it is solved in section (3). The solution is interpreted in section (4), which deals with the consequences of the relative valuation the union attach to its goals, and in section (5), which analyse the effects of financing the subsidy by an employment tax. Eventually the paper contains a discussion of the results.

2　The model

The utility function is assumed to be

$$\Omega = U\left(n, w_n\right) + V\left(a, w_a\right), U_n > 0, U_{w_n} > 0, V_a > 0, V_{w_a} \geq 0. \qquad (1)$$

where n is the number of employed workers or union members, w_n is the wage rate for workers, a the number of employed apprentices and w_a the wage rate for apprentices. The utility function is separable in utility for union members and utility of apprentices.

The policy measure considered in the paper is a subsidy to employ apprentices. The magnitude of the subsidy is denoted s, and the total costs of the subsidy scheme is thus sa. Complete financing of the costs of subsidies by an employment tax entails the budget constraint $tn = sa$, where t is the employment tax. However, it is assumed that the employment tax on workers only finances the subsidy costs with the share θ, while the share $1 - \theta$ comes from other sources. The magnitude of the employment tax is thus $t = \theta sa/n$. The assumption of partial financing is a mean to isolate the effect of the financing. Nothing prevents setting $\theta = 1$ after the derivations.

The costs of employing workers, c, and apprentices, d, are

$$\begin{aligned} c &= w_n + t = w_n + \theta sa/n \\ d &= w_a - s. \end{aligned}$$

3

Noting that $d_{w_a} = 1$ and $d_s = -1$, the derivatives of the costs of employing members become

$$c_{w_a} = \theta s \frac{\partial (a/n)}{\partial d} \tag{2}$$

$$c_s = \theta \frac{a}{n} - \theta s \frac{\partial (a/n)}{\partial d}$$

$$c_{w_a} + c_s = \theta \frac{a}{n} > 0.$$

No employment tax, $\theta = 0$, implies $c_{w_a} = 0$ and $c_s = 0$.

Demand functions derived from profit maximisation are assumed to be

$$n(c,d), \ n_c < 0, \ n_d > 0, \tag{3}$$

$$a(c,d), \ a_c > 0, \ a_d < 0.$$

The derivatives of the demand functions with respect to the wage rate of apprentices are

$$n_{w_a} = n_d + n_c c_{w_a}$$

$$a_{w_a} = a_d + a_c c_{w_a}.$$

Applying (2) to the expressions for the impact of the subsidy on the demand for members and apprentices yields

$$n_s = n_d d_s + n_c c_s = -n_{w_a} + n_c \theta \frac{a}{n} \tag{4}$$

$$a_s = a_d d_s + a_c c_s = -a_{w_a} + a_c \theta \frac{a}{n}.$$

Inserting the demand functions (3) into (1), the indirect utility function becomes

$$\Lambda = U(n(c,d), w_n) + V(a(c,d), w_a).$$

3 Solution of the model

Under the assumption that the union sets wage rates, the first order conditions are

$$\Lambda_{w_n} = U_n n_{w_n} + U_{w_n} + V_a a_{w_n} = 0$$

$$\Lambda_{w_a} = U_n n_{w_a} + V_{w_a} + V_a a_{w_a} = 0.$$

In order to keep the derivations tractable, changes in demand are approximated by changes in the levels while changes in the slope of the demand functions are ignored, that is, second order derivatives of the demand functions are set equal to zero.

Second order own derivatives are

$$
\begin{aligned}
\Lambda_{w_n w_n} &= U_{nn} n_{w_n}^2 + 2U_{nw_n} n_{w_n} + U_{w_n w_n} + V_{aa} a_{w_n}^2 < 0 \\
\Lambda_{w_a w_a} &= U_{nn} n_{w_a}^2 + 2V_{aw_a} a_{w_a} + V_{w_a w_a} + V_{aa} a_{w_a}^2 < 0.
\end{aligned}
$$

These inequalities follow per assumption.

The second order cross derivative is

$$
\Lambda_{w_n w_a} = U_{nn} n_{w_n} n_{w_a} + U_{w_n n} n_{w_a} + V_{aw_a} a_{w_n} + V_{aa} a_{w_n} a_{w_a} \lessgtr 0.
$$

It is not possible to sign $\Lambda_{w_n w_a}$ without further assumptions. Assume that wages and employment are complements in the utility of the union in the sense that $U_{w_n n} > 0$ and $V_{aw_a} > 0$. Then it follows that $\Lambda_{w_n w_a} > 0$ (and the two first inequalities also follow). The assumption of complementarity is a sufficient but not necessary condition to obtain the signs. Wages and employment are complements in the standard utilitarian utility function and in for example the CES utility function.

Differentiating the first order conditions with respect to s and applying (4) yields

$$
\begin{aligned}
\Lambda_{w_n s} &= U_{nn} n_{w_n} n_s + U_{w_n n} n_s + V_{aa} a_{w_n} a_s \qquad (5) \\
&= -\Lambda_{w_n w_a} + V_{aw_a} a_{w_n} + \theta \frac{a}{n} E
\end{aligned}
$$

where $E = U_{nn} n_{w_n} n_c + U_{w_n n} n_c + V_{aa} a_{w_n} a_c$, and

$$
\begin{aligned}
\Lambda_{w_a s} &= U_{nn} n_{w_a} n_s + V_{aa} a_{w_a} a_s + V_{w_a a} a_s \qquad (6) \\
&= -\Lambda_{w_a w_a} + V_{w_a a} a_{w_a} + V_{w_a w_a} + \theta \frac{a}{n} F,
\end{aligned}
$$

where $F = U_{nn} n_{w_a} n_c + V_{w_a a} a_c + V_{aa} a_{w_a} a_c$.

The system determining the multipliers with respect to the subsidy rate is

$$
\begin{bmatrix} \Lambda_{w_n w_n} & \Lambda_{w_n w_a} \\ \Lambda_{w_n w_a} & \Lambda_{w_a w_a} \end{bmatrix} \begin{bmatrix} \partial w_n / \partial s \\ \partial w_a / \partial s \end{bmatrix} = \begin{bmatrix} \Lambda_{w_n w_a} - V_{aw_a} a_{w_n} - \theta \frac{a}{n} E \\ \Lambda_{w_a w_a} - V_{w_a a} a_{w_a} - V_{w_a w_a} - \theta \frac{a}{n} F \end{bmatrix}
$$

5

The determinant of the hesse matrix is $D = \Lambda_{w_n w_n} \Lambda_{w_a w_a} - \Lambda_{w_n w_a}^2$, $D > 0$ per assumption.

The solution is

$$
\left[\begin{array}{c} \partial w_n / \partial s \\ \partial w_a / \partial s \end{array} \right] = \left[\begin{array}{c} 0 \\ 1 \end{array} \right] - \frac{1}{D} \left[\begin{array}{c} V_{aw_a} \left(\Lambda_{w_a w_a} a_{w_n} - \Lambda_{w_n w_a} a_{w_a} \right) - \Lambda_{w_n w_a} V_{w_a w_a} \\ \Lambda_{w_n w_n} V_{w_a w_a} + V_{aw_a} \left(\Lambda_{w_n w_n} a_{w_a} - \Lambda_{w_n w_a} a_{w_n} \right) \end{array} \right]
$$
$$
+ \theta \frac{a}{n} \frac{F}{D} \left[\begin{array}{c} \Lambda_{w_n w_a} - \frac{E}{F} \Lambda_{w_a w_a} \\ \frac{E}{F} \Lambda_{w_n w_a} - \Lambda_{w_n w_n} \end{array} \right] . \tag{7}
$$

The solution consists of three items on the right hand side, which are to be interpreted.

4 The role of union preferences

The procedure is to specialise the solution into the simplest case and then proceed to the characterisation of more complex cases. Simpler cases than the full solution are denoted by superscripts attached to the multiplies.

This section contains an interpretation of the first two terms on the right hand side of (7). The point of departure is thus the case $\theta = 0$, such that the subsidy is not financed by an employment tax but in some other way, which does not enter into the wage formation process. This assumption implies that the third expression on the right hand side of (7) goes away.

The benchmark case is $V_{w_a} = 0$, implying $V_{w_a w_a} = V_{aw_a} = 0$, which arises in the case where the union places zero value on further increases in the wage of apprentices. This assumption implies that the second expression on the right hand side of (7) vanishes.

Denoting the multiplies with superscript a in this case, the solution becomes $(\partial w_n / \partial s)^a = 0$ and $(\partial w_a / \partial s)^a = 1$. The impact of a subsidy to employ apprentices is an increase in the wages of apprentices by the same amount as the subsidy, while all other variables are unaffected.

Before the subsidy, the union decided an optimal combination of wage rates for the members, employment of members and employment of apprentices, given the trade-off between the variables determined by the demand functions for members and apprentices. The introduction of the subsidy implies an increase in employment of apprentices and a decrease in employment

of members. From the point of view of the union this is not optimal, and equilibrium is restored by increasing the wages of apprentices by the same amount as the subsidy. This leaves employment of apprentices and members at the same level as before the subsidy, and the same is the case with the wage level for members. It is worth emphasizing that the basic assumption is that the union cares about employment of apprentices; if this was not the case, the union would render employment of apprentices diminutive by increasing the wage rate of apprentices without bounds.

Next assume that $V_{w_a} > 0$ and $V_{w_a w_a} < 0$, such that the union places a positive but diminishing value of a marginal increase in the wages of the apprentices. Assume furthermore that $V_{a w_a} = 0$, such that the utility of the union is separable in apprentice employment and the wage of the apprentices. The assumption $\theta = 0$ is maintained. Denoting the solution in this case with superscript b, the multiplier for the wages of apprentices becomes $(\partial w_a / \partial s)^b = 1 - \Lambda_{w_n w_n} V_{w_a w_a} / D$. As utility maximization implies $\Lambda_{w_n w_n} < 0$ and $D > 0$, the result is $(\partial w_a / \partial s)^b < 1$.

When the union cares about the wages of the apprentices, the value of increases at the margin is diminishing, and the union will thus not allow the wage rate of apprentices to increase by the full amount of the subsidy. Further increases in the wage rate are not valued to the same extend as previous increases, and this makes a check on the amount that wages for apprentices go up as a consequence of the subsidy. Instead the union applies a part of the subsidy to the other purposes which the union cares about, in particular employment of apprentices.

Under the previous assumption, the union did not care about the wage rate of the apprentices, and wage rates for apprentices were thus set in order to obtain desired levels of the entities that enter into the utility function of the union. The outcome in the present case is thus the intuitive but perhaps paradoxical result that when the union actually cares about the wages of the apprentices, the increase in the wage as a consequence of a wage subsidy is smaller compared to the situation when the union does not care about the wage of apprentices. This is a result which is valid on the margin, and nothing is said about the levels of the wage rates for apprentices in the two cases.

The effect on the wage rate for members becomes $(\partial w_n / \partial s)^b = \Lambda_{w_n w_a} V_{w_a w_a} / D$. In the case where $\Lambda_{w_n w_a} > 0$, the effect on the wage rate for members becomes $(\partial w_n / \partial s)^b < 0$. A sufficient condition for $\Lambda_{w_n w_a} > 0$ is $U_{w_n n} > 0$. Increased employment of apprentices and consequently decreased employment of mem-

bers leads a decreased marginal valuation of wages for members. If wages and employment for members are not complements, it cannot be precluded that $\Lambda_{w_n w_a} < 0$ with the consequence $(\partial w_n / \partial s)^b > 0$.

Next consider the more general case with $V_{w_a} > 0$ and $V_{w_a w_a} < 0$, but $V_{a w_a} \neq 0$, such that the utility of the union is no longer separable in employment and wages for apprentices. The assumption $\theta = 0$ is maintained. Denote the multipliers with superscript c. We have $(\partial w_a / \partial s)^b > (\partial w_a / \partial s)^c$ if the second part in the second bracket in (7) in the expression for $\partial w_a / \partial s$ is positive. Under the assumption of complementarity the condition is $\Lambda_{w_n w_n} a_{w_a} > \Lambda_{w_n w_a} a_{w_n}$. Expressions for the derivatives of the demand function for apprentices can be obtained under further assumptions. Under the assumptions of constant elasticity of substitution between employment of union members and employment of apprentices, constant returns to scale in production and no scale effect in production arising from changes in aggregate labour costs, the Marshall-Hicks equations can be invoked, see for example Hamermesh (1993). The condition becomes $\Lambda_{w_n w_n} < -\frac{w_a}{w_n} \Lambda_{w_n w_a}$. This inequality is likely to be fulfilled for two reasons. The wages of apprentices typically constitute less than one half of wages for members. Furthermore, second order cross derivatives of the indirect utility function are on average dominated in numerical value by the second order own derivatives, see the expression for D.

The corresponding part in the expression for the multiplier for the wage rate of members becomes positive such that $(\partial w_n / \partial s)^b > (\partial w_n / \partial s)^c$ if $\Lambda_{w_a w_a} a_{w_n} > \Lambda_{w_n w_a} a_{w_a}$. After invoking the Marshall-Hicks equations, the condition becomes $\Lambda_{w_a w_a} > -\frac{w_n}{w_a} \Lambda_{w_n w_a}$, which is less helpful with respect to signing the multiplier. In the case when wages and employment are not complements, the magnitude of the multipliers relative to the case $V_{a w_a} \neq 0$ is undetermined.

5 The effect of financing the subsidy

Finally consider the effect of financing stemming from the third term on the right hand side of (7). The following discussion is valid irrespective of the value of θ, which could be set to full financing or partial financing.

Under the assumption of complementarity between wage rates and employment it is possible to sign the values to $E < 0$ in (5) and $F > 0$ in (6) such that $E/F < 0$. The first and the last utility terms in both the nu-

merator and denominator of E/F are identical and they dominate the cross derivative utility terms in the middle term numerically, see the expression for D. Furthermore, identical terms of the derivatives of the demand functions with respect to membership costs enter in both the first and the last term of both the numerator and the denominator. The E/F ratio deviates from one to the extent that the slopes of the demand functions for members and apprentices differ. It is assumed in the following that the numerical value of the E/F ratio is not so far away from one that it renders an analysis based on the relative magnitude of the Λ-terms irrelevant.

From $D = \Lambda_{w_n w_n} \Lambda_{w_a w_a} - \Lambda^2_{w_n w_a} > 0$ it must be such that either $|\Lambda_{w_n w_n}| > |\Lambda_{w_n w_a}|$ or $|\Lambda_{w_a w_a}| > |\Lambda_{w_n w_a}|$, or both. That is, the last Λ-terms with second order own derivatives in the last squared parenthesis in (7) tend to dominate in numerical value over the first Λ-terms with second order cross derivatives. If both inequalities hold, the expression in the second line in the last squared parenthesis in (7) is expected to be positive while the expression in the first line is expected to be negative. This implies larger increases in apprenticeship wages and a decrease in member wages, that is, $\partial w_a/\partial s > (\partial w_a/\partial s)^c$ and $\partial w_n/\partial s < (\partial w_n/\partial s)^c$, where the derivatives without superscripts are the expressions in (7) while the derivatives with superscript c is the solution without financing under the assumption of complementarity.

Both of these wage changes draw in the direction of a reduction in employment of apprentices relative to employment of members. As the a/n ratio is reduced, subsidies are also reduced and consequently is the magnitude of the employment tax also reduced. If one of the inequalities is not fulfilled, then the other inequality is so much more fulfilled. That is, if wages for apprentices do not increase, then wages for members decrease strongly.

In the case where the union does not value marginal increases in the wage of apprentices, implying that the middle term in (7) vanishes, and both of the above inequalities are fulfilled, we get $\partial w_n/\partial s < 0 = (\partial w_n/\partial s)^a$ and $\partial w_a/\partial s > 1 = (\partial w_a/\partial s)^a$. This implies a reduced a/n ratio compared to the level before the introduction of the subsidy.

The expected effect of the financing scheme is thus a reduction of employment of apprentices relative to employment of members. The financing scheme consequently counteracts the purpose of the employment subsidy to vocational training.

6   Discussion

Employment subsidies to further vocational training are not to be expected to have full effect as wage rates to apprentices are likely to increase. The paper has shown that there are due reasons to expect higher incidence rates than in the general case of subsidies to employment of union members. In the general case of employment subsidies to unionised workers, the incidence rate is less than one if employment is a normal good. In the case of employment subsidies to vocational training, incidence rates can be one or larger than one, depending on the preference structure of the union.

Financing subsidies by levies on employment is expected to counteract the purpose of employment subsidies to vocational training. The combined effects of subsidies and financing can actually result in diminished employment of apprentices and a reduction in the amount of vocational training.

If the goal of an empirical analysis is to obtain inference about the preference structure of the union, one should follow the line of the classical papers of Farber (1978) and MaCurdy and Pencavel (1986). A more modest research agenda is to investigate if there actually are indications of incidence of employment subsidy schemes to vocational training. As inferred from the results of the present paper, knowledge of the preference structure of the union is not enough to conclude about the amount of incidence; the impact of the financing scheme has to be taken into consideration.

The impetus to the present paper is the observation that apprentice wage rose considerable after the introduction of employment subsides to vocational training in Denmark, see Albæk (2009). However, the ability of aggregate time series data to form the basis of inference about the present issue appear to be limited. It is a difficult task to disentangle the amount of incidence of subsidies from the effect of other factors of relevance for wage formation for apprentices. Microdata appear more suited for empirical analysis of the issue of incidence of employment subsidies to vocational training.

References

Albæk, Karsten (2009). The Danish Apprenticeship System, 1931-2002: The Role of Subsidies and Institutions. Applied Economics Quarterly, Vol. 55, No. 1, pp. 39-60.

Acemoglu, Daron and Jorn-Steffen Pischke (1998). Why Do Firms Train? Theory and Evidence. *The Quarterly Journal of Economics*, Vol. 113, No. 1, pp. 79-119.

Calmfors, Lars and Harald Lang (1995). Macroeconomic effects of active labour market programmes in a union wage-setting model. *Economic Journal*, Vol. 105, pp. 601-619.

Dustmann, Christian and Uta Schönberg (2009). Training and Union Wages. *Review of Economics and Statistics*, Vol. 91, No. 2: 363–376.

Booth, Alison L. (1995). *The Economics of the Trade Union*. Cambridge: Cambridge University Press.

Cahuc, Pierre and André Zylberberg (2004). *Labor Economics*. Cambridge: MIT Press.

Farber, Henry S. (1978). Individual Preferences and Union Wage Determination: The Case of the United Mine Workers. *The Journal of Political Economy*, Vol. 86, No. 5 , pp. 923-942.

Hamermesh, Daniel (1993). Labor Demand. Princeton: Princeton University Press.

MaCurdy, Thomas E. and John H. Pencavel (1986). Testing between Competing Models of Wage and Employment Determination in Unionized Markets. *The Journal of Political Economy*, Vol. 94, No. 3, Part 2: pp. S3-S39.

Malcomson, James M., James W. Maw, Barry McCormick (2003). General training by firms, apprentice contracts, and public policy. *European Economic Review*, Vol. 47, pp. 197-227.

Stevens, Margaret (2001). Should firms be required to pay for vocational training. *Economic Journal*, Vol. 111, pp. 485-505.