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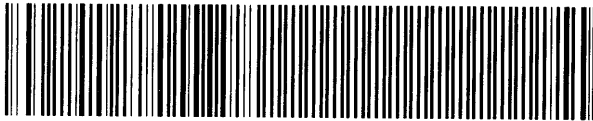
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**YOUTH UNEMPLOYMENT AND
GOVERNMENT POLICY**

J Michael Orszag and Dennis J Snower

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ABSTRACT

Youth Unemployment and Government Policy*

This paper discusses how employment vouchers should depend on age in a simple overlapping generations model in which workers are either young or old. We find that young workers should receive higher vouchers as displacement of the old rises and as the deadweight loss from providing vouchers to the old increases. We provide a simple characterization of the difference between youth and old vouchers in the context of our model.

JEL Classification: J23, J24, J31, J32, J64

Keywords: youth employment, adult unemployment, employment policy, unemployment benefits, long-term unemployment, policy and demographics

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NON-TECHNICAL SUMMARY

This paper examines how government employment support should depend on the age of the unemployed job searchers. We assume, quite plausibly, that the government aims to minimize unemployment subject to a government budget constraint. We focus on one family of policy instruments for reducing unemployment: hiring subsidies for the unemployed. In practice, these instruments can come in many guises, such as tax breaks, vouchers, grants and so on. Since these are broadly equivalent in their impact, we will consider them jointly under the heading 'employment vouchers'. These vouchers are an appropriate way of addressing the market failures highlighted by the insider-outsider, labour-union, and efficiency-wage theories, since these market failures all give rise to excessive wages and an associated deficient labour demand, whereas the vouchers reduce firms' labour costs and thereby stimulate labour demand.

We give special attention to budget-balancing vouchers, i.e. vouchers that cost the government no more than the resulting fall in the government's expenditure on unemployment benefits. Given this policy approach, we examine how employment vouchers to the youth unemployed should differ from those to the adult unemployed.

We show that the optimal employment vouchers to the youth unemployed may differ from those to the adult unemployment due to: a) youth-adult differences in hiring and separation rates in the absence of the vouchers; b) youth-adult differences in the hiring effect of the vouchers ('voucher effectiveness'); and c) displacement of adult unemployed by the subsidized new recruits. Finding these determinants of the optimal voucher differential between the youth and adult unemployed is one of the most fundamental problems of government policy towards youth unemployment. It has received little if any attention in the analytical employment policy literature thus far.

Several of these determinants have been measured in empirical evaluations of employment policies; particular emphasis is commonly given to 'deadweight' (hiring in the absence of the vouchers, representing the waste from giving vouchers to people who would have found jobs anyway) and 'displacement' (firing of existing employees as a result of hiring of subsidized new recruits, representing the waste from subsidizing people who drive others into unemployment). Thus far, however, there have been no attempts to examine the interaction between deadweight, displacement, and voucher effectiveness in a dynamic setting in order to investigate guidelines for government policy

towards youth unemployment. This is the aim of this paper. We also examine how the government's employment policy should depend on the magnitude of unemployment benefits and the death rates of young and old people.

YOUTH UNEMPLOYMENT AND GOVERNMENT POLICY

J. MICHAEL ORSZAG AND DENNIS J. SNOWER

ABSTRACT. This paper discusses how employment vouchers should depend on age in a simple overlapping generations model in which workers are either young or old. We find that young workers should receive higher vouchers as displacement of the old rises and as deadweight loss from providing vouchers to the old increases. We provide a simple characterization of the difference between youth and old vouchers in the context of our model.

1. INTRODUCTION

The rate of youth unemployment in the OECD is about twice as high as that of mature workers with similar levels of education.¹ Policy makers are divided on the appropriate government response. At one extreme are those who observe that relatively high rates of youth unemployment may be the efficient outcome of free market forces. After all, young workers often need time to clarify their job preferences and thus may wish to move in and out of employment until they have found a job that suits them; similarly, they often require time to find where their comparative advantages in skills lie and thus firms may wish to hire and fire them until they have found the appropriate match. In this context, there is no need for government intervention to reduce youth unemployment. At the other extreme of the policy debate are those who argue that, particularly in Europe, young people often get locked into states of long-term unemployment. Those who are not fortunate enough to find jobs reasonably promptly upon entering the workforce, it is claimed, find it progressively more difficult to gain employment later on; their skills are not able to improve through on-the-job training, and they become discouraged and stigmatized in the labor market. Under these circumstances, there may be a role for the government to play in reducing youth unemployment.

In many European countries, where aggregate unemployment appears to have been trending upwards over nearly 25 years and where

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¹See, for example, the OECD Job Study (1994).

youth unemployment often leads to long-term adult unemployment, high rates of youth unemployment tend to be viewed as a problem. This view has received support in recent unemployment theories, such as insider-outsider, labor union, and efficiency wage theories. In Europe, young people tend to be particularly prone to the inefficiencies analyzed by these theories: they are more likely than their adult counterparts to be "outsiders", disenfranchised in wage negotiations and unprotected by significant labor turnover costs; they often have comparatively little influence on union objectives; and employers' information about their productivity is often comparatively imperfect. These inefficiencies are usually magnified through European unemployment benefit systems. Unemployment benefits are commonly financed through taxes on employers and employees, and thus unemployed people impose uncompensated costs on their employed counterparts. In addition, unemployment benefits tend to discourage job search, for when the unemployed find jobs, these benefits are withdrawn and taxes are imposed. This problem is particularly severe when the unemployed face low-wage jobs. Young people, by being comparatively prone to unemployment and comparatively likely to be associated with low-wage jobs (relative to adults, on average), are particularly susceptible to these benefit-induced inefficiencies.

Accordingly, this paper assumes - quite plausibly - that the government aims to minimize unemployment subject to a government budget constraint. We focus on one family of policy instruments for reducing unemployment: hiring subsidies for the unemployed. In practice, these instruments can come in many guises, such as tax breaks, vouchers, grants, and so on. Since these are broadly equivalent in their impact, we will consider them jointly under the heading "employment vouchers." These vouchers are an appropriate way of addressing the market failures highlighted by the insider-outsider, labor union, and efficiency wage theories, since these market failures all give rise to excessive wages and an associated deficient labor demand, whereas the vouchers reduce firm's labor costs and thereby stimulate labor demand.

We will give special attention to budget-balancing vouchers, i.e. vouchers that cost the government no more than the resulting fall in the government's expenditure on unemployment benefits. Given this policy approach, we will examine how the employment vouchers to the youth unemployed should differ from those to the adult unemployed. This problem will be investigated in the context of a simple, overlapping generations macroeconomic model of the labor market, taking into account the flows between youth unemployment, adult employment, and adult unemployment. The flows will be pictured in terms of Markov

transition probabilities. We will concentrate on steady states of the labour market.²

Within this setting, we will examine the circumstances when the government's employment policy should be age-dependent, i.e. when the youth employment vouchers should differ from the adult employment vouchers. We will show that the optimal employment vouchers to the youth unemployed may differ from those to the adult unemployed due to (a) youth-adult differences in hiring and separation rates in the absence of the vouchers, (b) youth-adult differences in the hiring effect of the vouchers (what we shall term "voucher effectiveness"), and (c) displacement of adult unemployed by the subsidized new recruits. Finding these determinants of the optimal voucher differential between the youth and adult unemployed is one of the most fundamental problems of government policy toward youth unemployment. It has received little if any attention in the analytical employment policy literature thus far.

Several of these determinants have been measured in empirical evaluations of employment policies; particular emphasis is commonly given to "deadweight" (hiring in the absence of the vouchers, representing the waste from giving vouchers to people who would have found jobs anyway) and "displacement" (firing of existing employees as result of hiring of subsidized new recruits, representing the waste from subsidizing people who drive others into unemployment). Thus far, however, there have been no attempts to examine the interaction between deadweight, displacement, and voucher effectiveness in a dynamic setting in order to investigate guidelines for government policy toward youth unemployment. This is the aim of this paper. We will also examine how the government's employment policy should depend on the magnitude of unemployment benefits and the death rates of the young and old people.

The paper is organized as follows. Section 2 presents our simple overlapping generations model of the labor market, describes the government's budget constraint, and provides a general characterization of the optimal employment vouchers. To focus attention on the most important dynamic implications of employment vouchers, we then proceed to consider some simple functional relations between the transition probabilities and the vouchers and we then derive the optimal long-run, self-financing vouchers. Section 3 begins by considering the simple case in which the firing probability for existing employees is constant (independent of the vouchers, so that there is no displacement), and the hiring probabilities of young and old workers are identical, linear

²For practical policy purposes, this limitation is not as serious as it may appear at first sight, since in general it is politically and institutionally infeasible to devise detailed rules whereby employment vouchers vary through time in response to changing labor market conditions.

functions of the vouchers to the young and old (respectively). In this baseline case, the optimal vouchers to the young and old are identical, so that the government has no distinctive youth unemployment policy. We show how these vouchers depend on deadweight, displacement, voucher effectiveness, autonomous job loss, and the death rates. Section 4 then extends this analysis that the young and old workers differ in terms of the hiring probability in the absence of the voucher (deadweight) and the responsiveness of the hiring probability to the voucher (voucher effectiveness), while the hiring functions are still assumed to be linear and there is no displacement. In this context, we derive how the difference in the optimal vouchers to the young and old workers depend on these differences in deadweight and voucher effectiveness. Section 5 examines the effect of displacement on the optimal vouchers. Finally, Section 6 concludes.

2. THE UNDERLYING MODEL

Time is discrete and workers can be in one of three states, *employed and old*, *unemployed and old* or *unemployed and young*. The old are all those over one period old and people are assumed born unemployed. Let h_y and h_o be the probability that an unemployed young worker and unemployed old workers will be hired, and f be the probability that an old employed worker will become unemployed (e.g., be “fired”). (These hiring and firing probabilities will in general depend on the available employment vouchers, but this dependence need not be made explicit at this point.) Furthermore, let d_y and d_o be the death rates of the young and old, respectively; and let b_y and b_o be the birth rates of children to those young and old.

2.1. Employment and Unemployment. The number of old employed will come from three sources: (a) surviving old employed who are not fired, (b) hired young workers, and (c) hired old unemployed. Thus aggregate employment N_t may be expressed as follows:

$$(1) \quad N_t = (1 - d_o - f)N_{t-1} + h_y U_{t-1}^y + h_o U_{t-1}^o.$$

Similarly, aggregate unemployment of old workers is:

$$(2) \quad U_t^o = (1 - d_o - h_o)U_{t-1}^o + (1 - d_y - h_y)U_{t-1}^y + f_o N_{t-1}.$$

Assuming that all workers are born unemployed, the aggregate unemployment of young workers is equal to the total number of births:

$$(3) \quad U_t^y = b_o N_{t-1} + b_y U_{t-1}^y + b_o U_{t-1}^o$$

Eqs. (1) – (3) may be rewritten as a matrix equation:

$$(4) \quad S_t = TS_{t-1}$$

where S_t is a vector of labor market states:

$$(4.A) \quad S_t = \begin{pmatrix} N_t \\ U_t^y \\ U_t^o \end{pmatrix}$$

and T is a transition matrix:

$$(5) \quad T = \begin{pmatrix} 1 - d_o - f & h_y & h_o \\ b_o & b_y & b_o \\ f & 1 - h_y - d_y & 1 - h_o - d_o \end{pmatrix}.$$

We focus on steady states of the labor market, and thus we assume that birth rates are equated to death rates; as a result of this assumption, the labor force L as well as the number of agents in each cohort will be constant through time.³

Clearly, the aggregate labor force is the sum of aggregate employment (N_t) and aggregate unemployment ($U_t^o + U_t^y$):

$$(6) \quad N_t + U_t^o + U_t^y = L$$

and similarly for the old and young labor forces, respectively:

$$(7) \quad N_t + U_t^o = L^o$$

$$(8) \quad U_t^y = L^y.$$

When birth rates are equal to death rates, the matrix T in our analysis (c.f., Eq. (5)) is a Markov matrix with eigenvalues of $1 - h_o - f - d_o$, 1 and $d_y - d_o$. Convergence rates to steady states are thus increased as hire rates and fire rates for the old increase and depend on the difference of death rates as well as death rates directly.

It is straightforward to show that the steady state of the labor market is given by:

$$(9) \quad N = L \frac{(1 - d_y)h_o + d_o h_y}{(1 + d_o - d_y)(d_o + f + h_o)}$$

$$(10) \quad U^y = L \frac{d_o}{1 + d_o - d_y}$$

³This simplifying assumption is one of substance. If the employment vouchers, in raising employment, also raise the labour supply (by reducing the discouraged worker effect), then the vouchers will have a smaller effect on unemployment than they would in the absence of a labour supply response.

$$(11) \quad U^o = L \frac{f(1 - d_y) + d_o(1 - d_y - h_y)}{(1 + d_o - d_y)(d_o + f + h_o)}$$

The aggregate unemployment rate \bar{u} in the steady state is:

$$(12) \quad \bar{u} = \frac{d_o^2 + f - d_y f + d_o(1 - d_y + f + h_o - h_y)}{(1 + d_o - d_y)(d_o + f + h_o)}$$

To gain understanding of this model of unemployment determination, it is worth mentioning some simple special cases. When $d = d_o = d_y$ and $h = h_o = h_y$ the formula for the steady state unemployment rate is:

$$(13) \quad \bar{u} = \frac{d + f}{d + f + h}$$

When $d_y = 0$ but $h = h_o = h_y$, this unemployment rate becomes:

$$(14) \quad \bar{u} = \frac{d_o + f}{d_o + f + h}$$

When $d = d_o = d_y$ but hire rates differ by age we have:

$$(15) \quad \bar{u} = \frac{f + d(1 + h_o - h_y)}{d + f + h_o}$$

These simple formulae will be usefully in deriving the optimal voucher policies below.

2.2. The Government Budget Constraint. The government's budget constraint, relevant to the determination of the unemployment-minimizing vouchers, may be specified straightforwardly as follows. Let $U^y(v_y, v_o)$ and $U^o(v_y, v_o)$ be the long-run unemployment level of the young and old, as a function of the vouchers v_y paid to young workers and v_o paid to old workers. Then, since the number of old unemployed people hired in each period is $h_o(v_y, v_o)U^o(v_y, v_o)$ and the number of young hired each period is $h_y(v_y, v_o)U^y(v_y, v_o)$, the total cost of vouchers to the government is:

$$(16) \quad v_y h_y(\mathbf{v}) U^y + v_o h_o(\mathbf{v}) U^o(\mathbf{v})$$

where \mathbf{v} is the vector (v_y, v_o) .⁴

This cost must be set against the "voucher revenue", which is the total amount that the government saves on unemployment benefits due to the voucher-induced rise in the employment level. In particular,

⁴We note from Eq. (10) that U^y depends only on death rates which are assumed independent of vouchers.

let $U(\mathbf{v})$ and $U(\mathbf{0})$ be the long-run aggregate unemployment levels in the presence and absence of the voucher policy $\mathbf{v} = (v_y, v_o)$ ($v_y \geq 0$, $v_o \geq 0$), respectively. Let the unemployment benefit β be a positive constant, measured in units of national income. Then the amount that the employment vouchers enable the government to save on unemployment benefit disbursements is $\beta(U(\mathbf{0}) - U(\mathbf{v}))$.

Finally, let G be the maximum lump-sum cost of the employment policy to the government, measured in units of national income per capita, where G could be positive, zero or negative.

Then the government budget constraint (GBC) is:

$$(17) \quad v_y h_y(\mathbf{v})U^y + v_o h_o(\mathbf{v})U^o(\mathbf{v}) \leq GL + \beta(U(\mathbf{0}) - U(\mathbf{v}))$$

i.e. the cost of the employment vouchers must not exceed the maximum cost of the policy to the government (GL) plus voucher revenue ($\beta(U(\mathbf{0}) - U(\mathbf{v}))$) from reduced unemployment. Using Eq. (6), we can rewrite Eq. (17) as:

$$(18) \quad N(\mathbf{v}) \geq \frac{(v_y h_y - v_o h_o)U^y + \beta N(\mathbf{0}) - GL + v_o h_o L}{\beta + v_o h_o}$$

which means that any given voucher must generate a level of employment $N(v_y, v_o)$ to be fundable within the government budget constraint. Clearly, as the maximum government spending G increases, the level of employment need not be as high to sustain funding.

Net government spending on the employment vouchers need not be *not* monotonic in the values of v_y, v_o . At low enough levels of the voucher vector \mathbf{v} (and high enough levels of the unemployment benefit b) a rise in one component of the voucher vector may actually *reduce* government spending, since the rise in the voucher may reduce employment sufficiently and to generate more voucher revenue $\beta(U(\mathbf{0}) - U(\mathbf{v}))$ than voucher cost. But provided that voucher cost rises faster with the level of the voucher than does voucher revenue, then at higher levels of the voucher (and lower levels of the unemployment benefit) an increase in the voucher will of course raise government spending, and at the policy optimum — when unemployment is minimized — the optimal employment voucher $\mathbf{v} = \mathbf{v}^*$ is such that the government budget constraint Eq. (17) holds as an equality:

$$(17') \quad v_y^* h_y(\mathbf{v}^*)U^y + v_o^* h_o(\mathbf{v}^*)U^o(\mathbf{v}^*) = \beta(U(\mathbf{0}) - U(\mathbf{v}^*)) + GL.$$

2.3. The Optimal Employment Voucher. In the context of the labor market described in Section 2.1 and the government's budget constraint described in Section 2.2, the government's aim, as noted, is to provide the employment vouchers to the young and old workers that will minimize the level of aggregate unemployment in the long

run, subject to the government budget constraint. Given that the optimal voucher satisfies Eq. (17') as an equality, the optimal voucher is determined by forming the Lagrangian

$$(19) \quad \mathcal{L} = U^o + \lambda [v_y h_y(\mathbf{v}) U^y + v_o h_o(\mathbf{v}) U^o(\mathbf{v}) - GL - \beta (U(\mathbf{0}) - U(\mathbf{v}))]$$

and combining the first order conditions with respect to v_y , v_o to obtain the optimality condition:

$$(20) \quad \frac{\frac{\partial U^o}{\partial v_y}}{\frac{\partial U^o}{\partial v_o}} = \frac{\frac{\partial GBC}{\partial v_y}}{\frac{\partial GBC}{\partial v_o}}.$$

Eq. (20) and Eq. (17') are a system of two nonlinear equations with two unknowns v_y and v_o . In the next two sections, we derive the optimal policy explicitly for particular parametric forms of the hiring functions $h_o(\mathbf{v})$, $h_y(\mathbf{v})$ and firing function $f(v)$.

3. OPTIMAL EMPLOYMENT VOUCHERS IN THE ABSENCE OF DISPLACEMENT

In this section we derive the optimal vouchers to the young and old workers in the context of a very simple baseline model. We focus our attention on the balanced-budget policies ($G = 0$). We assume the hiring rates to be linear functions of the vouchers:

$$(17.A) \quad h_y(\mathbf{v}) = \eta_{0y} + \eta_{1y} v_y, \quad \eta_{0y} > 0 \quad \eta_{1y} > 0$$

$$(17.B) \quad h_o(\mathbf{v}) = \eta_{0o} + \eta_{1o} v_o, \quad \eta_{0o} > 0 \quad \eta_{1o} > 0$$

The coefficient η_0 stands for *deadweight* (the hiring rate in the absence of the voucher), η_1 is *hiring responsiveness* (the effect of the voucher on the hiring rate); and η_0 is *autonomous job loss* (the rate at which employees become unemployed). Note that, for simplicity, the hiring rate for young workers is assumed to depend only on the youth voucher (and not on the voucher to the old workers). In practice, this is a reasonable approximation because, assuming that the period of "youth" lasts for about 7 years (approximately between the ages of 18 and 25), the effect of the adult voucher will be largely discounted when the young voucher recipients are hired (given reasonable values of the time discount factor).

Furthermore, we make the simplifying assumption that the fire rate is independent of vouchers, i.e., there is no displacement:

$$(17.C) \quad f(v) = \lambda_0, \quad \lambda_0 > 0$$

where " η " stands for "employment" and " λ " stands for "job loss".

Finally, we assume that the hire rates are independent of age: $\eta_0^y = \eta_0^o = \eta_0$ and $\eta_1^y = \eta_1^o = \eta_1$, and death rates are independent of age as well: $d_y = d_o = d$. In this case, the old unemployment rate is:

$$(22) \quad U^o(\mathbf{v}) = \frac{-d^2 + \lambda_0 + d(1 - \eta_0 - \lambda_0 - \eta_1 v_y)}{d + \eta_0 + \lambda_0 + \eta_1 v_o}.$$

As we shall see, under these conditions, the optimal voucher is age-independent: $v = v_y = v_o$. To show this, we begin by constraining the voucher to be age-independent, and observe that, by Eq.(13), voucher costs are:

$$(23) \quad v(\eta_0 + \eta_1 v) \frac{d + \lambda_0}{d + \lambda_0 + \eta_0 + \eta_1 v} L$$

and the voucher revenues are:

$$(24) \quad \beta \cdot [U(0) - U(v)] = \beta \cdot \left[\frac{\lambda_0}{\lambda_0 + \eta_0} - \frac{\lambda_0}{\lambda_0 + \eta_0 + \eta_1 v} \right].$$

Setting the voucher costs equal to the voucher revenues in the government budget constraint, we obtain the optimal balanced-budget voucher:

$$(25) \quad v = \frac{\beta}{d + \lambda_0 + \eta_0} - \frac{\eta_0}{\eta_1}$$

as an interior solution (i.e. the hiring rate lies between zero and unity at the optimal voucher).

Appendix A verifies that this voucher, which sets $v_y = v_o$ satisfies Eq. (20), and thus the age-independent voucher is optimal, at least locally. Note that Eq. (25) is specific to the case of zero government spending but that the age-independent voucher result holds for any level of government spending.

The implication of this result is worth spelling out: even if the youth unemployment rate is far above the adult unemployment rate, the government should not offer young workers a larger voucher than old workers, provided that there is no displacement and the hiring functions of the young and old workers are identical functions of the youth and adult vouchers (respectively). It can be shown that this result continues to hold when the model is extended to allow for age-dependent death rates, since the optimal voucher depends only on the death rate of the old (and not on that of the young).⁵

Eq. (25) implies that the optimal voucher depends:

- negatively on deadweight,

⁵This can be verified explicitly. In addition, a program which verifies this numerically is available: <ftp://www.econ.bbk.ac.uk/lmig/vouchers/olgage.f90>.

- positively on the unemployment benefit.
- positively on hiring responsiveness, and
- negatively on autonomous job loss.
- negatively on the death rate of the old.

4. OPTIMAL EMPLOYMENT VOUCHERS UNDER AGE-DEPENDENT HIRING RATES

We now assume death rates are constant but hiring rates depend on age. In this case it can be shown that the difference between young vouchers and old vouchers is

$$(26) \quad v_y - v_o = 0.5 \left[\frac{\eta_{0o}}{\eta_{1o}} - \frac{\eta_{0y}}{\eta_{1y}} \right]$$

independent of the level of government spending.

This is a striking result: in the absence of displacement, the difference between the youth voucher and the adult voucher is equal to half the difference between ratio of deadweight and voucher effectiveness of old and young workers. In other words, the youth voucher rises relative to the adult voucher (a) the greater is the adult deadweight and the smaller is the youth deadweight and (b) the smaller is the adult voucher effectiveness and the greater is the youth voucher effectiveness.

This result is also robust to allowing death rates to depend on age. Details of the proof are provided in Appendix B.

5. OPTIMAL EMPLOYMENT VOUCHERS WITH DISPLACEMENT

We now consider the influence of displacement on the optimal employment voucher policy. Having assumed thus far that the voucher affects the hiring but not the firing rate, the analysis above has excluded the possibility of displacement. We now relax this assumption and suppose, instead, that both the hiring and firing rate depend positively and linearly on the size of the voucher: With displacement, we assume that:

$$(27) \quad f(v_o) = \lambda_0 + \lambda_1 v_o$$

where λ_0 and λ_1 are positive parameters. We find⁶ that increasing displacement tends to increase the youth voucher relative to the old voucher even if death and hire rates are constant across age. In particular, the mere existence of displacement is enough to justify paying a higher voucher to the young.

⁶The figure uses the following parameter values $d = 0.01$, $\lambda_0 = 0.03$, $\eta_0 = 0.20$, $\eta_1 = 0.85$, $\beta = 0.15$, $G = 0.0$. The reader is welcome to experiment with other parameter values using the program available at <ftp://www.econ.bbk.ac.uk/lmig/vouchers/olgdopt.f90>.

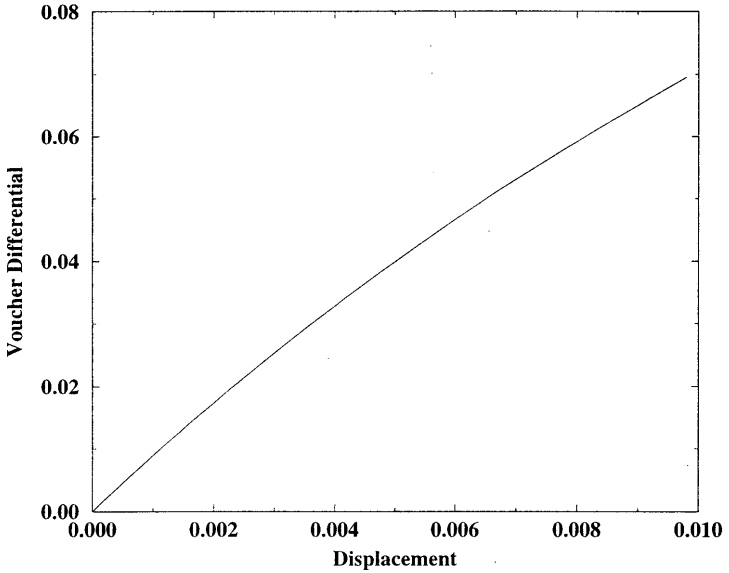


FIGURE 1. Difference between youth and old voucher as a function of the displacement coefficient λ_1 .

It is helpful to compare the effects of the optimal voucher with that of the optimal uniform voucher. This helps to assess how much a more complicated policy adds in terms of employment effects.

The optimal flat vouchers with $G = 0$ are (using formulae in Orszag and Snower (March 1996) but substituting $\lambda_0 + d_o$ for λ_0):

$$(28) \quad v^* = \min \left[\max \left[\left(\frac{1}{2\eta_1 \lambda_1} \left[-(\eta_1 (\lambda_0 + d_o) + \lambda_1 \eta_0) + \sqrt{Z} \right] \right), 0 \right], \frac{1 - \eta_0}{\eta_1} \right]$$

where:

$$(28.A) \quad Z = (\eta_1 (\lambda_0 + d_o) + \lambda_1 \eta_0)^2 - 4\eta_1 \lambda_1 \left[\eta_0 (\lambda_0 + d_o) - \beta \frac{(\lambda_0 + d_o) \eta_1 - \eta_0 \lambda_1}{\lambda_0 + d_o + \eta_0} \right].$$

One interesting property of this optimal v^* is that the voucher rises with the square root of benefits rather than benefits. In Orszag and

Snower (March 1996)), we show that the optimal voucher is lowered by:

- An increase in deadweight (η_0).
- A decrease in unemployment benefits (β).
- An increase in displacement (λ_1).

There are corresponding results in Orszag and Snower (March 1996) for positive government spending.⁷ For the non-uniform voucher case, we find similar qualitative effects.

With constant hiring rates, the quantitative differences between flat vouchers and age-dependent vouchers tend in most cases to be small. In Fig. (2) we plot the relative difference in vouchers⁸ and the difference is less than 20% which corresponds to a small effect on total unemployment.⁹

One problem with this analysis is that we have assumed that the labour market is effectively segmented in that the fire rate of old workers does not depend on the vouchers of the young and only on that of old workers. Thus, we replace Eq. (27) with:

$$(29) \quad f(v_o) = \lambda_0 + \lambda_1 v_o + \lambda_2 v_y$$

A positive value of λ_2 reduces the optimal voucher premium to the young, as illustrated in the calibration exercise below.¹⁰ One result of interest is that even if the coefficients λ_1 and λ_2 are equal, there is still a voucher differential.¹¹

It is useful to consider a simple calibration exercise to give some rough indications of the practical implications of our model. To do so, we move to a discretization in terms of quarters; this poses some issues of interpretation and a better model would involve a continuum of durations where discretization issues do not arise; however, such a model is considerably more complicated and certainly beyond the scope of this paper. The average unemployment spell in the absence of vouchers is $\frac{1}{\eta_0}$. We consider $\eta_0 = 0.25$ corresponding to an average spell

⁷Optimal vouchers can also be computed on-line for this case with a JAVA applet <http://www.econ.bbk.ac.uk/lmig/java/Vouchers.html> (choosing a separation rate of $\lambda_0 + d_o$).

⁸Defined as youth vouchers with age-dependent vouchers divided by constant vouchers minus one. We note that we from Sec. 3 above, the difference when $\lambda_1 = 0.0$ is zero. A program is provided at <ftp://www.econ.bbk.ac.uk/pub/lmig/vouchers/olgdsopt.f90> for those who want to experiment with different parameter values. The particular parameter values used in Fig. (2) are $G = 0.00$, $d = 0.01$, $\lambda_0 = 0.03$, $\eta_0 = 0.20$, $\eta_1 = 0.85$, $\beta = 0.15$.

⁹The relative effect is under 1 %.

¹⁰A program is provided at <ftp://www.econ.bbk.ac.uk/lmig/vouchers/olgdsopt.f90> if the reader wishes to experiment with different parameter values.

¹¹This is due to the difference in employment rates and durations in the different states.

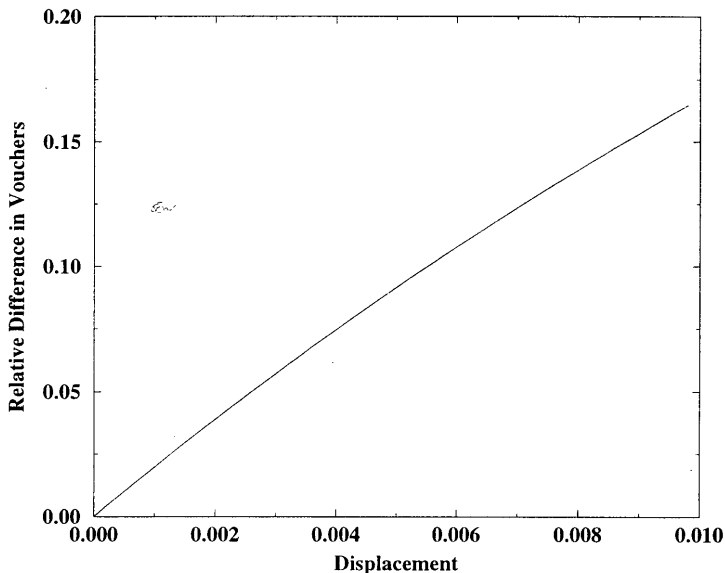


FIGURE 2. Relative difference between youth voucher with and without age-dependent policies as a function of displacement λ_1 .

of 4 quarters. We set $b = 0.15$ (one quarter the replacement ratio) and consider balanced-budget policies (where $G = 0$). The average tenure in a job in the absence of vouchers is $\frac{1}{\lambda_0}$; we set $\lambda_0 = 0.03$ corresponding to an average tenure of slightly under 10 years in Britain (c.f., Burgess and Rees (December 1994)). We set the death rate equal to 0.0075 corresponding to an average working life of about 33 years.

There are some estimates of separation and hiring elasticities with respect to wages in the literature (c.f., Holzer, Katz, and Krueger (1991) and Krueger (1988) for hiring; Campbell (1993) and Shaw (1985) for separations) which led Card and Krueger (Card and Krueger (1995)) to conclude hiring elasticities range from 0.5 to 4.0 and that the separation elasticity was about 1.0. Since these elasticities are defined with respect to permanent changes in real wages whereas the employment vouchers are short-lived, the associated voucher elasticities will be substantially smaller. Snower (forthcoming, 1996) provides arguments

that the wage elasticities are typically 8-10 times the corresponding voucher elasticities.

η_1	λ_1	λ_2	h_o elasticity	f elasticity	v_y^*	v_o^*	$\frac{\Delta u^o}{u^e}$
1.0	0.00	0.0	0.5208	0.000	0.27174	0.2717	-51.55 %
1.0	0.00	0.0025	0.5186	0.000	0.14701	0.26929	-49.48 %
1.0	0.01	0.0	0.4525	0.0644	0.2556	0.20662	-41.84 %
1.0	0.01	0.01	0.4542	0.0649	0.0000	0.20807	-38.85 %
1.0	0.01	0.001	0.4515	0.0642	0.20726	0.2058	-40.85 %
1.0	0.02	0.0	0.3894	0.0961	0.2412	0.1594	-33.67 %
0.75	0.00	0.0	0.3611	0.000	0.1884	0.1884	-34.96 %
0.75	0.00	0.001	0.3591	0.000	0.1295	0.1868	-33.92 %
0.75	0.005	0.00	0.3151	0.0249	0.1772	0.15335	-29.18 %
0.75	0.01	0.00	0.2708	0.0396	0.1666	0.12379	-24.03 %
0.75	0.015	0.00	0.2275	0.0468	0.1564	0.0982	-19.41 %
0.75	0.01	0.001	0.2680	0.0391	0.1111	0.12207	-22.93 %
0.6	0.00	0.0	0.2014	0.000	0.1051	0.1051	-19.08 %

TABLE 1. Optimal Voucher Calculations

Table (1) presents a variety of calculations using our model for different values of the voucher effectiveness coefficient η_1 and the displacement coefficients λ_1 and λ_2 . The baseline unemployment rate, given our choice of parameters η_0 and λ_0 , is 10.7%.¹² The results indicate that for realistic elasticity values, a balanced-budget voucher can have an a significant effect in reducing unemployment. The size of the youth voucher is particularly sensitive to the value of λ_2 because most of the population is old and as a result small displacement coefficients will displace more workers than are hired as a result of the voucher.

6. CONCLUSION

This paper has provided a simple analytical groundwork for the formulation of government policy towards youth unemployment. We have focused attention on one specific, useful policy problem: the derivation of employment vouchers (subsidies) for unemployed youth and adults that minimize aggregate unemployment, given the government's budget constraint. In this context, our analysis shows how the optimal youth and adult vouchers should depend on certain key features of labor market activity: deadweight (the hiring rates of the young and old workers in the absence of the vouchers), displacement (the effect of the vouchers on the separation rate), voucher effectiveness (the response of the hiring rates of the young and old workers to the vouchers), the death rates, and the level of unemployment benefits.

¹²The baseline unemployment rate (Eq. (10.B) with $v = 0$) is independent of η_1, λ_1 .

Our analysis suggests that these policy issues are of great potential significance. For a wide range of plausible parameter values, as shown in Table 1, our model indicates that the implementation of optimal employment vouchers can lead to significant reductions in unemployment at no extra cost to the government.

APPENDIX A: THE OPTIMAL VOUCHER IN THE BASELINE CASE

The derivatives of the unemployment rate are:

$$(30) \quad \frac{\partial U}{\partial v_y} = -\frac{d\eta_1}{d + \eta_0 + \lambda_0 + \eta_1 v_o}$$

$$(31) \quad \frac{\partial U}{\partial v_o} = -\frac{\eta_1(\lambda_0 - d^2 + d(1 - \eta_0 - \lambda_0 - \eta_1 v_y))}{(d + \eta_0 + \lambda_0 + \eta_1 v_o)^2}$$

The derivatives of the government budget constraint are:

$$(32) \quad \frac{\partial GBC}{\partial v_y} = -d\eta_1 \frac{(\beta + v_o(\eta_0 + \eta_1 v_o))}{d + \eta_0 + \lambda_0 + \eta_1 v_o} + d\eta_1 v_y + d(\eta_0 + \eta_1 v_y)$$

$$(33) \quad \frac{\partial GBC}{\partial v_o} = \frac{((d + \eta_0 + \lambda_0 + \eta_1 v_o)(\eta_0 + 2\eta_1 v_o) - \eta_1(\beta + v_o(\eta_0 + \eta_1 v_o)))z_1}{(d + \eta_0 + \lambda_0 + \eta_1 v_o)^2}$$

where:

$$(34) \quad z_1 = -d^2 + \lambda_0 + d(1 - \eta_0 - \lambda_0 - \eta_1 v_y)$$

Although complex, any solution with $v_y = v_o$ satisfies the Lagrangian conditions.¹³ The maximal v clearly leads to the lowest unemployment. In addition, setting $v_y = kv_o$ and solving for zeroes of k leads to a unique solution of $k = 1$. Therefore, the optimal voucher is flat. Note also that the derivatives do not depend on the level of government spending so that the optimal voucher is also flat with policies where the government runs a surplus or a deficit.

APPENDIX B: AGE-DEPENDENT HIRE RATES

This appendix derives the difference between the youth and old vouchers:

$$(35) \quad v_y - v_o = 0.5 \left[\frac{\eta_{0o}}{\eta_{1o}} - \frac{\eta_{0y}}{\eta_{1y}} \right]$$

¹³We verified this using symbolic algebra and numerical optimization; a program to solve the problem numerically is available at: <http://www.econ.bbk.ac.uk/lmg/vouchers/olgopt.f90>

This relation comes from applying Eq. (20) in the manner discussed below. The gradient vector of unemployment is:

$$(36) \quad \frac{\partial U}{\partial v_y} = -\frac{d\eta_{1y}}{d_o + \eta_{0o} + \lambda_0 + \eta_{1o}v_o}$$

$$(37) \quad \frac{\partial U}{\partial v_o} = -\frac{\eta_{1o}(-d^2 + \lambda_0 + d(1 - \eta_{0y} - \lambda_0 - \eta_{1y}v_y))}{(d_o + \eta_{0o} + \lambda_0 + \eta_{1o}v_o)^2}$$

For the government budget constraints:

$$(38) \quad \frac{\partial GBC}{\partial v_y} = -d\eta_{1y} \frac{(\beta + v_o(\eta_{0o} + \eta_{1o}v_o))}{\eta_{0o} + d_o + \lambda_0 + \eta_{1o}v_o} + d\eta_{1y}v_y + d(\eta_{0y} + \eta_{1y}v_y)$$

$$(39) \quad \frac{\partial GBC}{\partial v_o} = \frac{(G_3 - d^2 + \lambda_0)(G_1 + G_2)}{G_4^2}$$

$$(40) \quad G_1 = G_4(\eta_{0o} + 2\eta_{1o}v_o)$$

$$(41) \quad G_2 = -\eta_{1o}(\beta + v_o(\eta_{0o} + \eta_{1o}v_o))$$

$$(42) \quad G_3 = d(1 - \lambda_0 - \eta_{0y} - \eta_{1y}v_y)$$

$$(43) \quad G_4 = \eta_{0o} + d_o + \lambda_0 + \eta_{1o}v_o$$

Combining these derivatives and solving the equation $\frac{U_{v_y}}{U_{v_o}} - \frac{G_{v_y}}{G_{v_o}} = 0$ yields the result.¹⁴ The result (Eq. (26)) also holds when death rates depend on age.¹⁵

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¹⁴See <ftp://www.econ.bbk.ac.uk/lmig/vouchers/oldhire.f90> for a program which verifies this numerically.

¹⁵See <ftp://www.econ.bbk.ac.uk/lmig/vouchers/oldgdopt.f90> for a program which verifies this.

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