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A MODEL FOR ANALYZING YOUTH
LABOR MARKET POLICIES

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ABSTRACT

This paper formulates a model of the youth labor market. At the heart of the model is a minimum wage restriction which causes some youths to become unemployed and prevents others from training. Labor is assumed to be heterogeneous in performance on skilled jobs, and is less productive as youths than as adults simply because of immaturity. The model is applied to analyze the effects of three representative policies: a youth subminimum wage, subsidies paid to firms that hire youths, and training subsidies that offset the costs of on-the-job training.

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I. Introduction

This paper formulates a model of the youth labor market and applies that model to analyze the effects of policies which are aimed at improving the labor market status of youths, and in particular their employment rate and the quality of jobs that they hold.¹ At the heart of the model is a minimum wage restriction which has the effect both of causing some youths to become unemployed and of preventing other youths from entering jobs in which they could acquire training which would be useful in their adult years.² There are, in turn, repercussions in the adult labor market, since the mix of youth employment among skilled and unskilled jobs affects the demand for adult skilled and unskilled workers through the usual factor substitutability channels. In order to evaluate fully any policy aimed at conditions in the youth labor market, it is necessary to trace through the effects that the policy will eventually have on the steady state conditions in both the youth and the adult labor markets. This paper considers three representative policies: a youth subminimum wage, subsidies paid to firms that hire youths, and training subsidies that offset the costs of on-the-job training.³ The purpose is to improve our understanding of how employment and training are determined and how they are influenced by policy.

The model developed here incorporates a number of features which are important for any analysis of the youth labor market, yet which have not previously been combined in a single model. First, labor is assumed to be heterogeneous in that different workers are not equally productive in a given skilled job.⁴ Second, in contrast to some wage models where "good jobs" offer the minimum wage and "bad jobs" offer less than the minimum, in this model "good jobs" provide training opportunities and frequently pay

more than the minimum wage to youths, while "bad jobs" pay only the minimum and provide few training opportunities. Finally, individuals are presumed to be less productive as youths than they will ultimately be as adults simply because of their age (immaturity).⁵ A model incorporating these features can be used to analyze how particular employment and training outcomes are affected by labor market policies.

The organization of the paper is as follows. Section II develops a model in which the on-the-job training can be either specific or general, and which includes the features described above. Section III examines the model's properties and derives the effects of alternative policies. Section IV considers some of the welfare implications of the results in terms of ascertaining which groups are better off and which groups are worse off as a result of alternative policy changes. A final section briefly addresses some remaining issues pertaining to the model.

II. A Model of the Youth Labor Market

This section develops a model of youth labor market experience. The model incorporates two broad economic sectors, which may be called the "primary" and "secondary" sectors, and it considers workers at two stages in their working lives, namely youth and adulthood (for a related analysis, see Dickens and Lang, 1983). The two sectors contain what we have called "good jobs" and "bad jobs," respectively. The secondary sector is a sector where skill and training do not have a very great effect on productivity. It may be convenient to visualize this sector as being comprised of fast-food outlets, grocery stores, car washes, and similar establishments. In the primary sector, on the other hand, an individual's productivity does depend on his ability and training. Training must be acquired on the job by going through an initial period of lower productivity, while ability is

considered to be an inherent characteristic of the individual. This implies that some people will be more productive than others in this sector, even if they have the same amount of training.

Youths may work in either sector, but their productivity will be lower than the productivity of comparable adult workers. The lower productivity exposes them to the possibility that not all of them have sufficient productivity to earn the minimum wage, with the result that there may be substantial unemployment among youth. Following Feldstein (1973), in the primary sector this problem of insufficient productivity to justify the minimum wage is aggravated by the fact that any training required for work in this sector reduces productivity even further, and that this training, to the extent it is general training, must be fully financed by the individual at the time of the training. The lower productivity among youths, combined with training requirements for the primary sector, leads to a sorting equilibrium in which individuals follow one of three paths during their working lives, depending on their individual-specific level of innate ability. The most able individuals will find employment in the primary sector even as youths because the productivity resulting from their natural ability justifies a wage above the minimum, despite their relative immaturity and the fact that they must be trained. A second group with intermediate natural ability levels will not be able to find employment in the primary sector as youths, but will be able to find such work as adults. During their youth, these workers as a group will have spotty employment records in the secondary sector, since they have no real advantage over anyone else seeking work in that sector. The third group, with the lowest levels of natural ability, will also find spotty work in the secondary sector as youths, and as adult workers they will find steadier employment

in this sector as they become more mature and their productivity increases.

To begin a more formal description of the model, let T_1 be the number of years that each individual spends as a youth at the beginning of his labor force participation and T_2 be the number of years he spends as an adult in his prime-age working years. The age distribution of individuals in the labor force is presumed to be uniform, so that the number of youths and adults in the labor force can be written as μT_1 and μT_2 , respectively, for some constant of proportionality μ . Labor is assumed to be supplied inelastically, which means that the school-work decisions of youths are not examined in this model.⁶

The technology of the model is described in Table 1. The technology represented in this table is assumed to be linear, meaning constant returns to labor of a given productivity. The underlying physical productivity of adult labor in the two sectors is denoted as $Y_p + \epsilon$ and Y_s , respectively, where Y_p and Y_s are exogenous to the analysis.⁷ ϵ is a time-invariant individual effect associated with each individual's abilities, and it affects productivity in the primary but not the secondary sector (this is to say that all individuals can make hamburgers equally well but that some individuals are better than others at doing electrical work, even after training).⁸ The productivity of youth labor is given by the fractions ν_p and ν_s of the adult productivity, with the fractions reflecting what may be called the immaturity factor. In general, ν_p would be expected to be less than ν_s , reflecting the fact that in the primary sector mistakes can be costlier than in the secondary sector. Finally, anyone working in the primary sector must undergo training for T_1 years, during which period productivity is reduced by C . The assumption of fixed training costs enables the model to focus more sharply on the effects of potential policy changes on the employment and welfare of youths

and adults in the two sectors; for a model focusing more on the determination of the amount of training, see Hashimoto (1982).⁹

The output of the primary sector is taken as the numeraire, and the relative price of the output of the secondary sector is given by P . The value of the minimum wage is measured in terms of the numeraire, that is, the minimum wage is taken as given in terms of primary sector output. The model presumes that workers in each sector are paid the value of their productivity. For youths in the secondary sector, who are assumed to be constrained by the minimum wage, the following relationship must hold:

$$(1) \quad P y_s Y_s + S_w = W_m$$

where W_m is the minimum wage. S_w (which is also measured in terms of primary sector output) is the value of any wage subsidy that the government pays to firms which employ youths; in the case of any subsidies provided by the government in the model, the government is presumed to be able to raise sufficient revenues by means of lump sum taxation. This equation says that the value of the youth's production in the secondary sector plus the amount of the wage subsidy must be equal to the minimum wage.

For youths in the primary sector, it is necessary first to identify the productivity of the marginal youth in this sector. Suppose that the fraction n_{p1} of youths work in the primary sector. Let $F(\epsilon)$ be the cumulative distribution function of the random variable ϵ , and denote its inverse by $G(n)$. Then since the top n_{p1} of the distribution of ϵ will be employed in the primary sector, the value of ϵ associated with the last youth hired in this sector will be $G(1 - n_{p1})$. The total discounted productivity of this youth (including any subsidies), should he

remain with the firm over his lifetime, is given by the quantity

$$v_p [Y_p + G(1 - n_{p1})]k_1 + d[Y_p + G(1 - n_{p1})]k_2 - (C - S_t)k_1 + S_w k_1$$

where $k_1 = \int_0^{T_1} e^{-pt} dt$, $k_2 = \int_0^{T_2} e^{-pt} dt$, $d = e^{-pT_1}$, p is the discount rate, and S_t is the value of any subsidy provided by the government for training in the primary sector, again measured in terms of primary sector output. The four terms in this expression are the productivity of the individual as a youth, the productivity as an adult, the training costs net of any subsidies, and the wage subsidy.

Marginal youths in this sector will need as much of this lifetime productivity as possible to be paid in the early years in order to satisfy the minimum wage requirements. Firms will be willing to do so, even if it means paying youths more than their marginal productivity, as long as the firms can be reasonably assured that the youth will remain with the firm as an adult, and as long as the total lifetime payments to the individual do not exceed the individual's lifetime productivity as calculated above. In particular, the wages the firm pays the individual during his adult years must at least match what the individual could get at another firm. If the individual were to go to another firm at the beginning of his adult years, he would have to undergo some fraction, say α , of his training again. This fraction of the training may be regarded as specific, with the remainder being regarded as general. Thus, the value of his productivity at the second firm, discounted back to the beginning of his working life, is given by¹⁰

$$d\{[Y_p + G(1 - n_{p1})]k_2 - \alpha(C - S_t)k_1\}$$

If the first firm is to pay at least this much to the individual as an adult, and if the individual's total discounted lifetime productivity is

given by the previous expression, then the maximum that the firm will be willing to pay the individual as a youth is given by the difference between the two expressions:

$$v_p [Y_p + G(1 - n_{p1})] \kappa_1 - (1 - d\alpha)(C - S_t) \kappa_1 + S_w \kappa_1$$

The per period wage rate which the firm can pay to a youth is then found by dividing the above expression by κ_1 , and it is this amount which must be just equal to the minimum wage for the marginal individual hired into the primary sector as a youth:

$$(2) \quad v_p [Y_p + G(1 - n_{p1})] - (1 - d\alpha)(C - S_t) + S_w = W_m$$

It can be seen in this expression that the firm is not willing to finance general training, but it will finance up to the fraction d of the costs of specific training, net of whatever subsidy is available to offset the training costs.¹¹ The fraction of specific training costs that the firm will be willing to bear will evidently be higher the lower the real discount rate.¹²

Specific training thus allows firms to offer an implicit contract which permits some individuals to be hired as youths in the primary sector even though their productivity net of training costs plus wage subsidies falls below the minimum wage. Moreover, this implicit contract arises even in the absence of cyclical fluctuations in demand, which provide the usual explanation for the firm bearing the cost of specific training. Note that the fact that the firm is willing to advance some of the costs of specific but not general training to some individuals in their youth is of importance in this model only because of the existence of the minimum wage, and it is of greatest importance to those whose ability in the primary

sector is marginal and whose wage net of training costs would otherwise fall below the minimum. As would be expected, any turnover for reasons that have not been incorporated in the model, such as differential tastes for job characteristics or specialized talents that require trial and error job search and present a positive probability of quit, will reduce the willingness of the firm to finance such training and will lead to solutions that are closer to those obtained when training is general (Mincer, 1981).

Note also that if inframarginal individuals receive the value of the higher productivity attributed to their greater ability levels, most youths who are employed in the primary sector will be receiving a wage above the legal minimum. Thus if one were to observe only those youth who hold minimum wage jobs, only a small proportion would be found receiving training.¹³ This does not mean, however, that a training or wage subsidy or youth subminimum wage program would have no effect on the number of youths receiving on-the-job training. The effect of such programs would depend on the increase in the hiring of youths for work in the primary sector, a marginal effect the size of which should not be judged to be equal to the fraction of minimum wage workers who receive training.¹⁴

Among adult workers, the necessary requirement is that the marginal worker hired in the primary sector as an adult must be indifferent between working in the primary and secondary sectors.¹⁵ To specify this requirement, let n_{p2} be the fraction of adults who are working in the primary sector. The indifference relationship for this marginal adult hired in the primary sector can be stated as:¹⁶

$$(3) \quad \kappa_2 P Y_s = [Y_p + G(1 - n_{p2})] \kappa_2 - (C - S_t) \kappa_1$$

In this relationship, the left side represents the discounted value of the productivity of this marginal individual in the secondary sector during his

adult working years. The right side represents the discounted value of his productivity in the primary sector, with the second term representing the training costs, net of any training subsidies.¹⁷ The term $G(1 - n_{p2})$ is the value of ϵ associated with this individual.

In this model, all adult workers will be employed in any solution which is characterized by youths working in the secondary sector. This is because a youth working in the secondary sector is producing enough output to earn the minimum wage, and all adult workers can produce at least this much output in that sector. Hence, if there are youths employed in the secondary sector, then it is possible for all adults to earn at least the minimum wage, and all of them should be employed. The appropriate relation to express this requirement is:

$$(4) \quad n_{p2} + n_{s2} = 1$$

where n_{s2} is the fraction of adults working in the secondary sector. Since a solution with no youths working in the secondary sector is not very interesting, we will confine our attention in this paper to the case where they do and where therefore equation (4) holds.

The amounts produced of the two types of output, expressed as functions of the labor inputs are found by multiplying the productivities of youths and adults in the two sectors by the numbers of youths and adults in the sectors, and adding the results. For the primary sector, this yields the following equation for output:

$$(5) \quad q_p = \mu I_1 n_{p1} v_p [Y_p + \phi(n_{p1})] + \mu I_2 n_{p2} [Y + \phi(n_{p2})] - \mu I_1 n_{p2} C$$

where $\phi(x) = (1/x) \int_0^1 \epsilon dF(\epsilon)$ is the average value of ϵ in the top 100x percent of the distribution. The first term represents the

production of youths and the second term the production of adults, both gross of training costs, and the final term subtracts out current training costs. With regard to the last term, note that the fraction n_{p2} of $\mu(T_1+T_2)$ individuals spend the fraction $T_1/(T_1+T_2)$ of their working years in training, so that in a steady state the number of individuals in training at any particular time is simply the product of these three numbers. In the secondary sector, the total output is calculated simply as:

$$(6) \quad q_s = \mu T_1 n_{s1} \nu_s Y_s + \mu T_2 n_{s2} Y_s$$

Here, the first term is the production attributable to youths and the second term the production attributable to adults.

In order to find out how much of the two goods are actually produced, it is necessary to establish the demand for the two goods as a function of their prices. The model uses a relatively simple demand function which specifies the relative demand for the two goods as being dependent on their relative price:

$$(7) \quad q_p/q_s = h(P)$$

with the first derivative of h being positive. This demand function specifies that as the relative price of the output of the secondary sector becomes less expensive, relatively more of it will be demanded. For any given level of income and the price ratio, this function specifies the ratio that is demanded, but not the absolute amounts of the two goods. Since the model is a closed system, the aggregate budget constraint guarantees that there will be just enough income generated in the production of the two goods to buy the output, if the price ratio is correct.

The seven equations numbered above constitute a complete model in seven endogenous quantities: the relative price of output of the secondary sector (P), the two output levels (q_p and q_s), and the four ratios describing the fraction of the youth and adult cohorts working in the two sectors (n_{p1} , n_{p2} , n_{s1} , and n_{s2}). The essence of the model can be described briefly as follows. All adults in the model are presumed to be employed. Adults with high productivity in the primary sector are employed in that sector, with most earning wages substantially in excess of the minimum, while adults whose productivity would be low in the primary sector are instead employed in the secondary sector at a wage only modestly in excess of the minimum. Youths are employed in the primary sector only if their potential productivity in that sector, net of whatever training costs the firms are unwilling to finance, is above the minimum wage. The remaining youths would all like to work in the secondary sector, but were they to do so, their production would depress the price of output in that sector so much that they would be unable to earn the minimum wage there. Therefore, only enough of them can find jobs in that sector so that the price of secondary sector output remains high enough to justify paying the minimum wage to youths who are employed in that sector. The remainder of the youths are unemployed.

III. Policy Analysis with the Model.

This section will be concerned with analyzing how employment in the two sectors, particularly youth employment, behaves under alternative policy changes. The model contains three parameters which are of interest for potential policies to mitigate the effects of the minimum wage on the youth labor market. The first such parameter is S_w , the potential wage subsidy to firms that hire youths, and the second is S_t , the training

subsidy for firms in the primary sector to defray the training expenses of newly hired workers.¹⁸ The third parameter is W_m , the minimum wage variable. Since in this model the minimum wage is not binding on adults, a reduction in W_m may be interpreted either as the introduction of a youth sub-minimum or as a reduction of the minimum for all workers. Further, given the way S_w and W_m enter into equations (1) and (2), which are the only equations in which they appear, either an increase in the wage subsidy or an equal reduction in the minimum wage would have the same employment effects, since either would permit firms to hire youths whose productivity has less value. Hence, in this section we will not consider changes in W_m , with the understanding that the employment and output changes arising from changes in S_w can be interpreted as being the result of changes either in the youth wage subsidy or in the minimum wage.

The first three equations of the model determine youth and adult employment in the primary sector and the relative price of secondary sector output. The impact of either a training or a wage subsidy on these quantities can be calculated as follows:

$$\begin{aligned} dn_{p1}/dS_w &= 1/(\nu_p G'_1) > 0 & dn_{p1}/dS_t &= (1-d\alpha)/(\nu_p G'_1) > 0 \\ dn_{p2}/dS_w &= 1/(\nu_s G'_2) > 0 & dn_{p2}/dS_t &= \kappa_1/(\kappa_2 G'_2) > 0 \\ dP/dS_w &= -1/(\nu_s Y_s) > 0 & dP/dS_t &= 0 \end{aligned}$$

Both types of subsidy are seen to increase not only youth employment in the primary sector, but also adult employment in that sector. With regard to youth employment, both subsidies permit youths with lower ability levels to earn wages above the minimum during their period of training. For adults, the two subsidies encourage employment in the primary sector, but in

different ways. The training subsidy increases the wages that can be offered to adults entering that sector, and for some adults whose ability levels put them at the margin between working in the primary or secondary sector, the increased wages in the primary sector will shift them there. The youth wage subsidy, on the other hand, causes the price of secondary output to fall, and by making it less attractive for the marginal adults to work in the secondary sector, the subsidy encourages a shift of such individuals to the primary sector. Interestingly, since an increase in the minimum wage would have the opposite effect of an increase in the youth wage subsidy, these results indicate that an increase in the minimum wage would cause adult employment in the primary sector to decline. The reason is that an increase in the minimum wage would increase the price of secondary sector output and make it more attractive for the adults on the margin to work in that sector.

The effects on the other variables in the model can also be readily inferred from the remaining equations. Since both types of subsidy cause both youth and adult employment in the primary sector to increase, they also cause primary sector output to increase. The increase in primary sector output, in combination with the fact that the relative price of secondary output is not increased with either type of subsidy, implies through the relative demand equation (7) that secondary sector output also increases. Adult employment in this sector falls, reflecting the fact that there is full employment among adults and that adult employment in the primary sector has increased. Finally, the combination of increased output in the secondary sector with the fact that adult employment in the sector is lower implies that youth employment in that sector must rise as a result of either type of subsidy.

Although the general employment and output effects are the same for

the two types of subsidies, the relative sizes of the effects among youths and adults in the two sectors is not. A convenient way to examine this issue is to consider a change in either type of subsidy of sufficient magnitude to increase youth employment in the primary sector by one individual, and to calculate the magnitude of the accompanying changes in adult employment in that sector and in youth and adult employment in the secondary sector. Since the answers will turn in part on whether the training necessary for the primary sector work is general or specific, let us first look at the case where training is general, that is, where $\alpha = 0$.

The number of additional adult workers in the primary sector which would accompany each additional youth worker can be calculated as:

$$\frac{dn_{p2}/dS_w}{dn_{p1}/dS_w} = \frac{\nu_p G'_1}{\nu_s G'_2} \qquad \frac{dn_{p2}/dS_t}{dn_{p1}/dS_t} = \frac{\kappa_1 \nu_p G'_1}{\kappa_2 G'_2 (1-d\alpha)}$$

for the youth wage subsidy and the training subsidy. We assume that $T_1 < T_2$, which says that the length of time spent as a youth or in training is shorter than the length of time spent as an adult. This in turn implies $\kappa_1 < \kappa_2$. Then, since $\nu_s < 1$ and, in the case of general training, $\alpha = 0$, the above ratio for the wage subsidy will be larger. That is, for each job that a youth wage subsidy or a training subsidy creates for youths in the primary sector, the wage subsidy will create more jobs for adults in that sector.

With regard to employment in the secondary sector, the wage subsidy will cause a greater decline in adult employment, per additional youth employed in the primary sector, than will the training subsidy. This is because the wage subsidy would cause a larger increase in adult employment in the primary sector, and with full employment among adults, there must be a correspondingly larger reduction in adult employment in the secondary

sector. With regard to youths in the secondary sector, there are several considerations in establishing the relative size of the effects of the two types of subsidy. First, note that per additional youth job in the primary sector, a wage subsidy will increase adult employment more in that sector, and hence it will increase the output of the primary sector more. Second, the relative price of secondary output will fall with a wage subsidy but not with a training subsidy. Through the demand equation, both the higher primary sector output and the lower relative price of secondary sector output will favor an even greater increase in secondary sector output with the wage subsidy. Finally, this greater increase in secondary sector output with a wage subsidy is accompanied by a larger decline in adult employment in this sector, and this tends to make the wage subsidy even more potent, relative to the training subsidy, in creating youth employment in the secondary sector. Thus, if training is general, a wage subsidy will tend to favor employment increases most among youths in the secondary sector and, to a lesser degree, among adults in the primary sector, while a training subsidy will be more successful in concentrating employment increases among youths in the primary sector.

If training in the primary sector is highly specific, so that $\alpha = 1$, the results may be much different. In this case, the magnitude of the ratio $(dn_{p2}/dS_w)/(dn_{p1}/dS_w)$ relative to $(dn_{p2}/dS_t)/(dn_{p1}/dS_t)$ depends on the value of $1/\nu_s$ relative to $\kappa_1/[\kappa_2(1-d\alpha)]$. Substituting for κ_1 and κ_2 , this last expression reduces to $1/(1 - e^{-pT_2})$. If $\nu_s > 1 - e^{-pT_2}$, then it is possible that for every youth job created in the primary sector, the youth wage subsidy may create fewer adult jobs in that sector than would a training subsidy. Further, if the relative demand function h is fairly inelastic with respect to the relative price of output in the

secondary sector, it is in turn possible that for every youth job created in the primary sector, the wage subsidy will create fewer youth jobs in the secondary sector than will a training subsidy. In other words, if training is specific, it is possible that a youth wage subsidy (or, equivalently in this model, a reduction in the minimum wage) will be more successful at focusing increases in employment on youths in the primary sector than will a training subsidy for jobs in the primary sector.

Another way of looking at this result is that if training is specific rather than general, firms may already be willing to finance a substantial portion of the costs, net of any subsidy, of training a youth for work in the primary sector. Under these circumstances, a subsidy to offset the costs of training does not relax the constraints imposed by the minimum wage very much, since the firms are willing to finance most of these costs anyway. Hence, a training subsidy will be relatively less effective in creating additional youth employment in the primary sector. On the other hand, if the training is general, firms will be unwilling to finance it, and it must be financed by the youths themselves. In this case, a training subsidy will provide more relief from the constraints imposed by the minimum wage, and such a subsidy will be relatively more successful in creating jobs for youths in the primary sector. Thus, the relative merits of youth wage subsidies (or reductions in the minimum wage) as against training subsidies for encouraging higher employment of youths in the primary sector may depend on whether training in that sector is predominantly general or specific.

IV. Welfare Considerations

In the previous section, the analysis considered the effects of changes in the minimum wage and of youth wage subsidies and training

subsidies on employment of youths and adults in the primary and secondary sectors. In general, one would expect that a policy which causes an expansion of employment and/or a shift in employment from the secondary sector to the primary sector will have positive welfare effects on the individuals who because of the policy are able to find jobs in the primary sector or who are no longer unemployed. However, in addition to welfare effects generated by employment changes, there are welfare effects associated with any change in relative prices which may occur as a result of the policies. These additional welfare considerations have two consequences. First, it is possible in some instances that an individual who manages to find a job in the primary sector because of a policy will nonetheless find himself worse off as a result. Secondly, the large majority of individuals whose employment status does not change because of a policy may nevertheless find that their level of welfare is affected by the policy.

Table 2 summarizes the general welfare implications of changes in the minimum wage and of youth wage subsidies and training subsidies for various groups according to their employment status in the presence of and in the absence of the particular policy. The first two columns indicate the sectors in which the individuals in the group would be employed as youths and as adults without the policy, and the next two columns indicate the sectors in which they would be employed with the policy. The final three columns indicate whether the welfare of the group would improve, deteriorate, stay the same, or would be indeterminate with the policy.

In the table, the groups denoted by A, C, E, H, and J include all the individuals whose employment patterns are not affected by the policies. For these groups, any welfare change must be mediated either by a change in relative prices or by a change in wages directly induced by a subsidy.

Since the training subsidy does not entail any change in the relative price of secondary sector output, such a subsidy affects the welfare of these groups only to the extent that it pays for some of the training of primary workers. Hence, groups A, C, and H, whose members are trained at one time or another for employment in the primary sector, gain, while groups E and J, whose only employment is in the secondary sector, neither gain nor lose under a training subsidy. A reduction in the minimum wage, on the other hand, will lower the relative price of secondary sector output. This will improve the welfare status of individuals in groups A and H, who work only in the primary sector during their lifetimes. For group C, whose members work in the secondary sector as youths and in the primary sector as adults, the welfare effect of a reduction in the minimum wage will be ambiguous. On balance, though, if their employment in the secondary sector is relatively short as compared with the length of time they spend in the primary sector, one would presume that these individuals would probably show welfare gains. For individuals in groups E and J, whose only employment is in the secondary sector, the decline in the relative price of the output of that sector will mean that these groups are worse off with a reduction in the minimum wage. A youth wage subsidy creates much the same pattern of gainers and losers among these five groups as does a reduction in the minimum wage, except for groups C and E. For the individuals in group C, the extra value of the subsidy is enough to make them definite welfare gainers with a wage subsidy. The individuals in group E will also gain as youths because of the subsidy, but since youth is short relative to adulthood, one would presume is that on balance they lose because the value of the secondary output they produce as adults declines. With regard to either a reduction in the minimum wage or a youth wage subsidy, note in

particular that individuals in groups E and J, who are definite or probable losers under either policy, are at the bottom of the ability scale and also at the bottom of the wage scale as adults, so that the relative disparity between high wage groups and low wage groups is likely to be accentuated under either policy.

The remaining groups include individuals whose employment patterns are changed by the policies, so that either they would find a job in the primary sector where otherwise they would not, or they would not be unemployed whereas otherwise they would. With a training subsidy, all such groups would be better off, since the gains due to the employment change would never be offset by a deterioration in the relative price of secondary sector output. A reduction in the minimum wage or a youth wage subsidy will also make many of these groups better off, but again in these cases the deterioration of the relative price of secondary sector output will cause ambiguities in the welfare effect of the subsidy among groups which spend part of their time in the secondary sector. For instance, consider the individuals in group L, who are unemployed as youths at a high minimum wage but who would be employed with a reduced minimum wage. These individuals may find that the decline in the value of the wages that they earn in the secondary sector as adults more than offsets the gains that they realize as youths by being employed. All of the remaining ambiguous cases among these groups arise in a similar fashion, with individuals who are initially employed in the secondary sector as adults suffering losses because the value of the goods they produce falls.

V. Summary and Conclusions

This paper has explored the effects of changes in the minimum wage, in the level of youth wage subsidies, and in the level of training subsidies

in a model characterized by a sorting equilibrium based on the ability levels of individuals in the labor force. Three results in particular are worth noting in a summary. First, an increase in the minimum wage may reduce adult employment in the primary sector, even though such an increase would reduce youth employment in this sector and even though the model assumes perfect substitutability between youths and adults within industries (although not at a one-to-one rate) and full employment of adults. Secondly, whether or not a youth wage subsidy or a reduction in the minimum wage is more successful than a training subsidy at creating primary sector jobs for youths depends on whether or not training in the primary sector is specific or general. If the training is specific, it is possible that a wage subsidy or a reduction in the minimum wage can create a relatively larger fraction of new youth jobs in this sector. This result may occur because firms are already willing to finance a large fraction of the costs of specific training, so that a training subsidy does little additional to relieve the constraint imposed by a minimum wage. Finally, it should be kept in mind that these subsidies may have large welfare effects on groups other than the groups immediately affected by the subsidy. Most importantly, it appears that a youth wage subsidy or a reduction in the minimum wage will in general have an unfavorable impact on most adult secondary workers and a positive impact on most adult primary sector workers.

It should be kept in mind that in the interests of making relatively clear the mechanisms generating the results, the model has been kept fairly simple. There are a number of directions in which the model could be extended, many of which are suggested by the existing literature. These include: (a) the elimination of the sharp dichotomy between youth and adulthood by introducing additional periods representing the transition between these two phases in the life cycle, (b) the introduction of a skill

factor, varying from individual to individual, in the secondary sector, (c) the introduction of heterogeneity in the productivity losses due to the immaturity of youths, (d) a role for general labor market experience, which would require the specification of some mechanism for allocating unemployment among youth, (e) a corresponding role for specific job experience and its relation to internal labor markets via job ladders (See Hall, 1981, and Carmichael, 1983b), (f) a consideration of imperfect information about the individual's productivity, his propensity to quit, the characteristics or requirements of the job, and/or the course of future demand, which may vary for cyclical or other reasons, all of which provide alternative reasons for unemployment and turnover and which hence affect the firm's willingness to finance specific training (See Oi, 1983 and Carmichael, 1983a), (g) a consideration of potential variation in the quantity of on-the-job training, and (h) the introduction of an elastic supply of untrained vs. generally trained labor perhaps resulting from the availability of vocational training in the schools. Although many of these extensions should be addressed before any empirical implementation of the model, it does not appear that they should change substantially the principal conclusions mentioned above.

Footnotes

1. For a thorough analysis of the course of employment and wages in the youth labor market in recent years, see Freeman and Wise (1983) and Freeman and Medoff (1983).
2. A number of reasons other than the minimum wage have been given for the unsatisfactory performance of the youth labor market. These include the following: (a) the casual labor market attachment of full-time students (Feldstein and Ellwood, 1983), (b) imperfect or asymmetric information about individual abilities, efforts expended, preferences, and the characteristics and requirements of jobs (e.g., see Leighton and Mincer, 1983), and (c) high relative reservation wages due to income maintenance programs (Venti, 1983).
3. The policies we examine are general forms of the three major "policies to reduce youth unemployment" cited in the 1983 Economic Report of the President, pp. 44-45. The policies described there are the Job Training and Partnership Act of 1982, the Minimum Wage Reform, and the Targeted Jobs Tax Credit. There is, however, a major difference between the policies we examine and those cited in the Economic Report. The policies examined in this paper are, for the most part, not narrowly targeted on special groups within the youth or adult populations. (For a discussion of the implications of narrow targeting, see Johnson, 1982).
4. For a discussion of the importance of assuming a heterogeneous population when analyzing labor market policy, see Nichols (1982). For studies of the impact of minimum wages which assume the population is heterogeneous in their abilities, see Heckman and Sadlacek (1981) and Meyer and Wise (1983).
5. For a sample of employer testimony to the effect that youths are less reliable and less productive than older workers for reasons other than inexperience, see Barton (1976).
6. The relationship between minimum wages and the decision to continue in school is discussed by Mincer and Leighton (1981). For an empirical analysis of the impact of wage offers and youth unemployment on the jointly determined school choice and labor supply decisions, see Gustman and Steinmeier (1981). The effects of minimum wages on the employment, compensation, and schooling of youth depend on whether, in addition to basic schooling, there is general vocational training available in the schools. For a discussion, see Gustman and Steinmeier (1982).
7. Note that this assumes that adult productivity is unaffected by the unemployment experience of the individual as a youth. Meyer and Wise (1982) find that holding individual specific characteristics constant, there is no lasting effect of nonemployment after leaving school on employment in subsequent years. They do find, however, that early nonemployment is associated with lower wage rates later in one's youth. Ellwood (1983) also finds that there are persistent negative effects of lost wages. Findings that wages are lower for those

unemployed as youths all the way into adulthood would have greatest impact on our results if these findings do not in fact represent the effects of unmeasured characteristics. To incorporate any effects of early unemployment on subsequent wages into our analysis, equations representing a mechanism for determining who among the young population experiences unemployment and how the duration of unemployment is distributed among youth would have to be added to the model. There is no general agreement on how to distribute unemployment in a minimum wage model. See, for example, Mincer (1976) and Gramlich (1976). Were the other reasons for unemployment and high job turnover experienced by youth in footnote 2 incorporated into the model, it might be more important than it is in the current framework to assume that general labor market experience affects later productivity (Hall, 1982, also emphasizes turnover). We further simplify our task by assuming that minimum wage coverage is universal.

8. Allowing these individual effects to be positively correlated over time rather than constant would probably not greatly affect the results, but it would complicate the model considerably because allowance would have to be made for some individuals who undertook training as youth to revert to the secondary sector as adults.
9. The model is not much affected, though the algebra becomes more tedious, if the period of training is taken to be shorter than T_1 or if the cost of training is presumed to be different for youth and adult workers.
10. This expression presumes that the individual will be eligible again for the training subsidy at the second firm. If an individual is eligible to receive this subsidy only once during his working life, then S_t must be deleted from this expression.
11. Note that S_w in equations (1) and (2) is a subsidy on the wage rate and not on earnings, and it is available to all youths no matter what their wage. An alternative formulation would target the subsidy on low wage workers, e.g., as a proportion of the difference between a target wage and a market wage (Barth, 1974). For an early analysis of the role of wage subsidies in a somewhat different context, see Rosen (1972).
12. Another consideration which may influence the sharing of the costs and benefits of specific training is the business cycle (See Hashimoto, 1979). Our model does not consider the impact of cyclical variation on the cost sharing.
13. To generate behavior where no training takes place in jobs offering the legal minimum wage, there must be wage interdependence or some other institutional arrangement such a union which raises all offered salaries in the primary sector above the minimum wage.
14. Some of the funds earmarked for a training or wage subsidy will have the effect of bidding up the wage of inframarginal workers. The marginal impact of employment and training programs for youth may be increased by targeting these programs on those who would not otherwise be hired as youths in the primary sector. The importance of targeting

has been appreciated by Congress and is reflected in legislation, e.g., the targeted jobs tax credit program. However, there are also dangers in targeting since if the targeting is too narrow, the targeted group may simply replace others who are equally deserving but who are ineligible for the subsidy. See Johnson (1982). For an earlier analysis in the context of government training programs, see Hamermesh (1971).

15. If the distribution of ϵ is such that all adults find it advantageous to work in the primary sector, then equation (2) below should be replaced by the equation $n_{p2} = 1$. Such a change would not greatly affect the general conclusions drawn from the model, however, with the obvious exception that none of the policies considered would affect adult employment in either sector.
16. According to this equation, a training subsidy is available to adults as well as youths, If the training subsidy were available only to youths, S_t would not appear in the equation.
17. This relationship assumes $n_{p1} < n_{p2}$, meaning that all the individuals hired into the primary sector as youths remain as adults, and in addition some individuals are newly hired into the primary sector as adults. It can be shown that a necessary and sufficient condition for this result is:

$$(\nu_s / \nu_p) PY_s + (1 - d\alpha)(C - S_t) / \nu_p > PY_s + (C - S_t)(\kappa_1 / \kappa_2)$$

The condition is satisfied, for instance, if $\nu_s > \nu_p$ (i.e., immaturity has a greater detrimental effect in the primary sector) and $PY_{\kappa_2} \gg (C - S_t)\kappa_1$ (i.e., training costs are fairly small compared to total adult productivity). In the analysis of this paper, it will always be assumed that the condition is satisfied. On the other hand, for sufficiently small values of ν_s , all individuals in the primary sector will be hired as youths and will continue working there as adults, in which case the equation $n_{p1} = n_{p2}$ should replace equation (3) in the model. For still smaller values of ν_s , it is even possible that some individuals hired and trained in the primary sector as youths will switch to the secondary sector as adults. This would require that equation (3) in the model be replaced by

$$PY_s = Y_p + G(1 - n_{p2})$$

and that equation (2) be modified to reflect the fact that the marginal youth in the primary sector will switch sectors as an adult.

18. One might expect that the firms in the secondary sector would try to claim that some of their activity is training in order to claim the subsidy. Similar incentives would exist for firms in the primary sector to claim that they do more training than they in fact do. The model abstracts from the potential difficulties in monitoring the claims of training.

Table 1
Production Technology

	Productivity as Youth	Productivity as Adult
Primary Sector		
During Training	$\nu_p (Y_p + \epsilon) - C$	$Y_p + \epsilon - C$
After Training		$Y_p + \epsilon$
Secondary Sector	$\nu_s Y_s$	Y_s

Table 2
Welfare Gainers and Losers

Group	Without Policy		With Policy		Gain(+)/Loss(-) As Result of Policy		
	Sector of Employment as Youth	Sector of Employment as Adult	Sector of Employment as Youth	Sector of Employment as Adult	Reduced Training Subsidy	Minimum Wage	Youth Wage Subsidy
A	Primary	Primary	Primary	Primary	+	+	+
B	Secondary	Primary	Primary	Primary	+	+	+
C	Secondary	Primary	Secondary	Primary	+	?	+
D	Secondary	Secondary	Secondary	Primary	+	?	?
E	Secondary	Secondary	Secondary	Secondary	0	-	?
F	Unemployed	Primary	Primary	Primary	+	+	+
G	Unemployed	Primary	Secondary	Primary	+	+	+
H	Unemployed	Primary	Unemployed	Primary	+	+	+
I	Unemployed	Secondary	Unemployed	Primary	+	?	?
J	Unemployed	Secondary	Unemployed	Secondary	0	-	-
K	Unemployed	Secondary	Secondary	Primary	+	?	?
L	Unemployed	Secondary	Secondary	Secondary	+	?	?

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