Stepping Stone Jobs: Theory and Evidence[*]

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December 2001

Abstract

This paper explores the wage and job dynamics of less-skilled workers by estimating a structural model in which agents choose among jobs that differ in initial wage and wage growth. The model also formalizes the intuitive notion that some of these jobs offer "stepping stones" to better jobs. The estimated model assumes that job offers consist of three attributes: an initial wage, an expected wage growth, and an indicator of the distribution from which future offers will come. We derive the conditions under which agents accept these offers and the effect of involuntary terminations on the acceptance decision. This model shows that the probability of leaving an employer depends both on the slope and intercept of the current and offered jobs and the probability of gaining access to the dominant wage offer distribution.

We use the SIPP to estimate this model, which allows us to recover parameters of the wage offer distributions and the probability that a job is a stepping stone job. Our empirical work indicates that wage offer distributions vary systematically with the slope and intercept of wages in the current job and that there is a non-zero probability of being offered a stepping stone job.

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I. Introduction

This paper explores the wage and job dynamics of low-skilled workers. Do workers who start in jobs that have low initial wages and low wage growth continue to get draws from distributions that offer poor prospects for advancement, or do some of these jobs offer "stepping stones" to better jobs? This distinction between "dead end" and "stepping stone" jobs has intuitive appeal but is inherently difficult to explore empirically since the hypothesis is about the unobservable wage offer distributions. This paper attempts to overcome these difficulties by specifying and estimating a structural model in which these wage offer distributions provide the primitives that determine wage growth on each job and wage gains between jobs. This framework provides economic content behind the notion that some jobs, while not highly paid, nevertheless give access to better jobs.

The dynamics of wages is of particular interest in the context of the U.S. welfare system that is being transformed from a transfer system to a work-based system. Proponents of the work-based strategy claim that even low paying entry-level jobs will lead to better jobs. Opponents claim that workers who enter jobs with low wage growth get stuck there or bounce between jobs with equally low prospects for upward mobility. The debate is, therefore, less about the absolute level of wages available to less-skilled workers than about the dynamics that accompany initial employment at low wages.

Our approach is to follow the previous literature in modeling job dynamics as on-the-job search with the wage offer distribution as the primitive that drives job transmissions.[1] We,

[1] See Burdett (1978), Jovanovic (1979a), and Jovanovic (1979b) for seminal articles in this area.

however, introduce two new elements into standard search models in order to incorporate the key element of "stepping stone" jobs.[2] In standard models, agents sample from a wage offer distribution and derive the optimal stopping rule under the assumption that wage growth does not vary across jobs and that future draws come from the same distribution, whether or not the job offer is accepted.[3] In our model we drop both these assumptions. First, each job offer consists of a starting wage and an expected wage growth.[4] Therefore, the decision to take a job depends on the expected duration on the job, since the reward to higher growth will depend on the duration on the job. Second, some jobs give access to draws from "better" distributions.[5] In this sense they are "stepping stone" jobs. Since the future wage offer distribution may depend on the acceptance of a previously offered job, this attribute of the offer will also affect the decision whether or not to accept the job.

This paper consists of three parts. Section II develops the analytical framework in which agents choose between staying in their current jobs or accepting job offers that consist of a starting wage, a wage growth, and an indicator of the distribution from which future offers will come. We derive conditions under which individuals change jobs in order to gain access to the better distribution. Section III presents empirical results of a structural model that allows us to recover parameters of the wage offer distributions as well as the probability of being offered a job that gives access to draws from a better distribution. Our estimates are based on wage and

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[2] Jovanovic (1996) takes a very different approach in which a stepping stone job is one that provides productivity-increasing information about the following job.
[3] See Mortenson (1999) for a review of this vast literature. The empirical literature on returns to job match (see Altonji (1987) and Topel (1992)), likewise assumes that jobs differ in levels but not growth rates.
[4] The relationship between slopes and intercepts can be motivated by heterogeneity in job-specific matters in learning ability, as in Li (1998).
[5] We make these terms precise in the following section.

job dynamics of a sample of less-educated workers in the Survey of Income and Program Participation (SIPP).

II. Analytical Framework

Our analytical model focuses on the relationship between wage growth and turnover by taking account of three key attributes of a job offer: (1) the starting wage, (2) the wage growth on the offered job, and (3) the probability that the offered job will lead to offers of better jobs.

Our model is designed to focus on essentials, while making minimal distributional assumptions. Agents are assumed to act as if they were maximizing expected earnings by solving a simple dynamic programming problem. In our analytical work we use a two-period model since it is tractable and yields results with economic content. Our empirical work is based on a generalization to *T* periods.

All agents, who are assumed to have identical tastes, obtain job offers at the start of both periods 1 and 2. The agent's problem is to decide at the beginning of each period whether to accept the job offer or whether to stay in the current job through that period.

Each job offer is defined by three parameters: the intercept of the wage function on the offered job, α; the slope, β; and an indicator variable, λ, that determines the distribution from which future offers will come. The slope and intercept determines the earnings the agent will receive in the offered job in each period if the job is accepted. Future job offers reflect draws from one of two distributions: $f(\alpha\beta)$ or $f^*(\alpha\beta)$. We assume that $f^*(\alpha\beta)$ statistically dominates $f(\alpha\beta)$ in the sense that the proportion of jobs with earnings below a fixed threshold, conditional on experience, is higher for jobs from $f(\alpha\beta)$ than for jobs from $f^*(\alpha\beta)$ in both periods 1 and 2.[6] Our analytical model focuses specifically on this aspect of changes in the opportunity set.

To be more precise, we use the following notation:

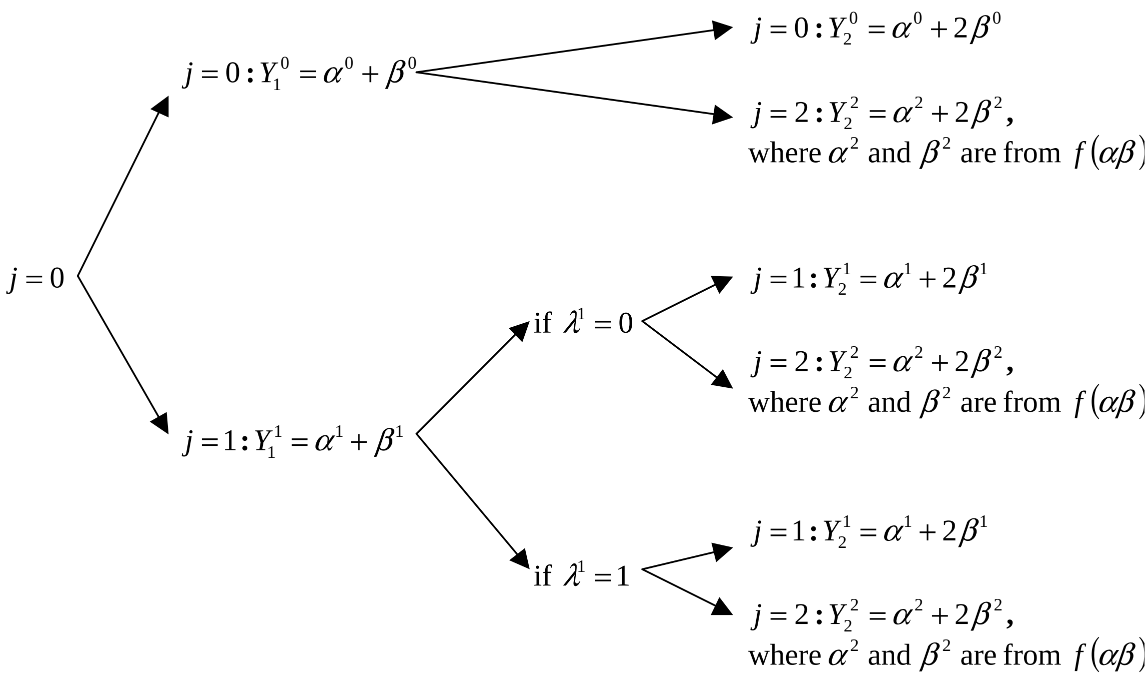
α^0 and β^0	the slope and intercept of the job the agent is holding at the start of period 1.
α^t and β^t	the slope and intercept of the job offered at the start of period t.
$Y_s^t; t = 0,1,2$	the earnings the agent receives in period s if she chooses the job offered in t $(s \geq t)$.
$g(Y_s^t)$	the pdf of Y_s^t.
$G(Y_s^t)$	the cdf of Y_s^t.
λ^t	a binary variable that accompanies period *t* offers indicating that period *t+1* offers will be from $f(\alpha\beta)$ if $\lambda^t = 0$ or from $f^*(\alpha\beta)$ if $\lambda^t = 1$.

The decision tree is shown in Figure 1. Each person starts in job 0 at the beginning of period 1 with earnings of $Y_1^0 = \alpha^0 + \beta^0$.[7] This job has $\lambda^0 = 0$. Therefore, as long as the agent stays in job 0, her future offers will come from $f(\alpha\beta)$. In this sense it is a "dead end" job. A job offer is received at the start of period 1, which consists of the triplet {α^1, β^1, and λ^1}. If $\lambda^1 = 0$, then α^2 and β^2 will be draws from $f(\alpha\beta)$. If $\lambda^1 = 1$, then second period draws will be from $f^*(\alpha\beta)$. If the job offer in period 1 is accepted, the resulting earnings in period 1 are $Y_1^1 = \alpha^1 + \beta^1$. In period 2 the agent will receive an offer from $f(\alpha\beta)$ or $f^*(\alpha\beta)$ depending on the value of λ^1 accompanying the period 1 offer. If the agent accepts the job offered in period 1

[6] In terms of the notation developed below $f(\alpha\beta)$ statistically dominates $f^*(\alpha\beta)$ if $G(Y_s^t) > G^*(Y_s^t)$.
[7] Other normalizations of experience would just change the intercept.

and stays in that job in period 2 her earnings will be $Y_2^1 = \alpha^1 + 2\beta^1$. Alternatively, if she changes jobs in period 2, her earnings will be $Y_2^2 = \alpha^2 + 2\beta^2$.

Figure 1
Decision Tree



This model is general in the sense that it makes no functional form assumptions about $f(\alpha\beta)$ or $f^*(\alpha\beta)$, other than statistical dominance. In the following sections we derive the decision rule implied by this structure. We start by considering the choice between staying in the current job with $\lambda^0 = 0$ or accepting an offer of another job which also has $\lambda^1 = 0$. We then turn to the heart of the model, which involves the choice between the current job with $\lambda^1 = 0$ and an offer of a job with $\lambda^1 = 1$ that offers the prospect of draws from $f^*(\alpha\beta)$ in the following period.

A. Choosing among Jobs with λ=0

We start by considering the decision of whether to accept an offer at the start of period 1 of a job with the parameters α^1, β^1, and $\lambda^1 = 0$. The alternative is to stay in job 0, which also leads to future offers from $f(\alpha\beta)$. The value function in period 1 for job 0, V_1^0, is given by the value of the earnings in job 0 in period 1, plus the expected second period earnings, taking into account the probability that the agent will change jobs at the start of period 2:[8]

(1) $$V_1^0 = Y_1^0 + G(Y_2^0)Y_2^0 + [1 - G(Y_2^0)]E[Y_2 \mid Y_2 > Y_2^0],$$

where $G(Y_2^0)$ is the probability that the second period draw is below Y_2^0, so that

$$G(Y_2^0) = \int \int^{Y_2^0 - 2\beta} f(\alpha\beta) d\alpha d\beta .$$

Equation (1) can be rewritten in the familiar form:

(2) $$V_1^0 = Y_1^0 + Y_2^0 + H(Y_2^0),$$

where $H(Y_2^0) = \int_{Y_2^0} (Y - Y_2^0) g(Y) dy$. Equation (2) indicates that the value of staying in job 0 in period 1 is equal to the sum of the earnings in periods 1 and 2 if the person stays in job 0 through both periods, plus the expected gain if the draw in period 2 dominates the second period earnings the person would get if she stayed in job 0.

Likewise, the value function for accepting job 1 is given by:

(3) $$V_1^1 = Y_1^1 + Y_2^1 + H(Y_2^1).$$

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[8] We assume no discounting since this would again complicate notation without adding insight.

To find the values of α^1 and β^1 that make the agent indifferent between accepting job 1 and staying in job 0, we equate (2) and (3). Writing in terms of the underlying parameters yields:

$$(4) \qquad \left(\alpha^1+\beta^1\right)+\left(\alpha^1+2\beta^1\right)+H\left(\alpha^1+2\beta^1\right)=\left(\alpha^0+\beta^0\right)+\left(\alpha^0+2\beta^0\right)+H\left(\alpha^0+2\beta^0\right)$$

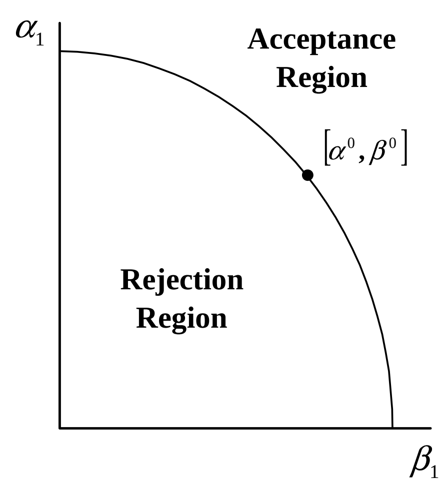
or

$$(4') \qquad 2\alpha^1+3\beta^1+H\left(\alpha^1+2\beta^1\right)=2\alpha^0+3\beta^0+H\left(\alpha^0+2\beta^0\right).$$

Equation (4′) can, therefore, be used to solve for the values of α^1 and β^1 that separate the acceptable offers from the offers that are rejected.

The contour of acceptable offers (for a given values of α^0 and β^0) is shown in Figure 2.[9] The contour must go through the point $\left[\alpha^0, \beta^0\right]$ since the agent would be indifferent between an offered job with the same slope and intercept at the current job.[10] This determines the level of

Figure 2
Acceptance and Rejection Regions for Period 1 Offers



[9] Recall $\lambda^0=\lambda^1=0$

[10] Returns to job-specific tenure, which would lower the profile below $\left[\alpha^0, \beta^0\right]$, could be incorporated into our model by adding a third parameter. This would add notional complexity by increasing the dimensionality of the space of acceptable jobs. For expositional clarity we implicitly assume no return to tenure in this section. However, returns to tenure are incorporated in our empirical work.

the contour.

The slope of this contour can be obtained by totally differentiating equation (4´) with respect to α^1 and β^1, and solving for $d\alpha^1/d\beta^1$:

(5) $$\frac{d\alpha^1}{d\beta^1} = -\frac{1+2G\left(Y_2^1\right)}{1+G\left(Y_2^1\right)} < 0 .$$

Since $0 \le G\left(Y_2^1\right) \le 1$, $\frac{d\alpha^1}{d\beta^1}$ must lie between –1 and $-\frac{3}{2}$. The concavity of the contour is established by recognizing that:

(6) $$\frac{d^2\alpha^1}{\left(d\beta^1\right)^2} = -\frac{g\left(Y_2^1\right)}{\left[1+G\left(Y_2^1\right)\right]^2} < 0 .$$

Since we have made no distributional assumptions, the contour must be concave for any distribution of α^1 and β^1. This is the result of the fact that $\frac{\partial H}{\partial Y_2^1} = -\left[1-G\left(Y_2^1\right)\right]$ for all distributions.[11]

Several conclusions can be drawn from the analysis thus far. First, the probability of switching from job 0 to job 1 decreases with α^0 (holding β^0 constant) and with β^0 (holding α^0 constant) since the contour shifts inward with a decline in either the slope or intercept of the job held at the start of period 1. This is a generalization of search models that implicitly assume no wage growth (i.e., models that assume $\beta = 0$). Our model yields the reasonable prediction that persons are less likely to leave jobs with either high starting wages or high wage growth.

[11] Since $\frac{\partial V_1^1}{\partial \alpha^1} d\alpha^1 + \frac{\partial V_1^1}{\partial \beta^1} d\beta^1 = 0$ along the contour, we have $\left(2+H'\right)d\alpha^1 + \left[3+2H'\right]d\beta^1 = 0$. This can be solved for the expression in equation (5) since $H' = -\left[1-G\right]$.

The second conclusion is that agents accept some offers with lower initial earnings than the current job (i.e., $\alpha^1 + \beta^1 < \alpha^0 + \beta^0$), but higher earnings in the second period (i.e., $\alpha^1 + 2\beta^1 < \alpha^0 + 2\beta^0$). These jobs, that offer initial pay cuts, are jobs in the acceptance region but to the southeast of $[\alpha^0, \beta^0]$. Likewise, some offers with lower wage growth are accepted (i.e., points in the acceptance region but to the northwest of $[\alpha^0, \beta^0]$). A direct implication is that the probability of a job change should be written in terms of the underlying $\alpha^0 s$ and $\beta^0 s$, rather than the resulting Y_1^0.[12]

Thus far we have considered only job exits that result in higher earnings. Agents may, however, have to leave their current jobs because they are involuntarily terminated or have to leave the job for reasons other than income (e.g., relocation or birth of a child). In Appendix A we show that the increases in the probability of such exits leads to flatter profiles. The intuition of this result is that wage growth has smaller benefits if the agent faces a non-zero probability of not being able to stay in the job long enough to reap the benefits of higher growth. Some of these high wage growth jobs, therefore, fall into the rejection region as a result of the prospects of involuntary terminations.

B. Choosing Between Jobs with λ=0 and λ=1

We now return to our distinction between jobs that give access to $f^*(\alpha\beta)$ in period 2 and those that do not. Recall that period 1 offers consist of an intercept and slope for the offered job

[12] The contour of jobs with $Y_1^1 = Y_1^0$ is a straight line through $[\alpha^0, \beta^0]$ and a slope of –1, rather than the concave contour derived in the text.

(α^1 and β^1) as well as an indicator, λ^1, of whether second period offers will come from $f^*(\alpha\beta)$ or $f(\alpha\beta)$.

We explore differences in the acceptance regions in period 1 for persons according to whether they will receive second period draws from $f^*(\alpha\beta)$ or from $f(\alpha\beta)$. Again, consider the period 1 choice of whether to stay in job 0 with a slope of β^0, an intercept of α^0, and λ^0 equal to zero. The alternative is to accept the job offered in period 1 with slope of β^1, intercept of α^1, and λ^1 equal to one. This will form a second concave frontier as in Figure 3. It is straightforward to show that the vertical distance between the contours for jobs offering a future draw from $f^*(\alpha\beta)$ (i.e., $\lambda^1 = 1$) and those offering future draws from $f(\alpha\beta)$ (i.e., $\lambda^1 = 0$) is given by:

(7) $$\Delta = \frac{H^*(Y_2^0) - H(Y_2^0)}{1 + G^*(Y_2^0)} > 0,$$

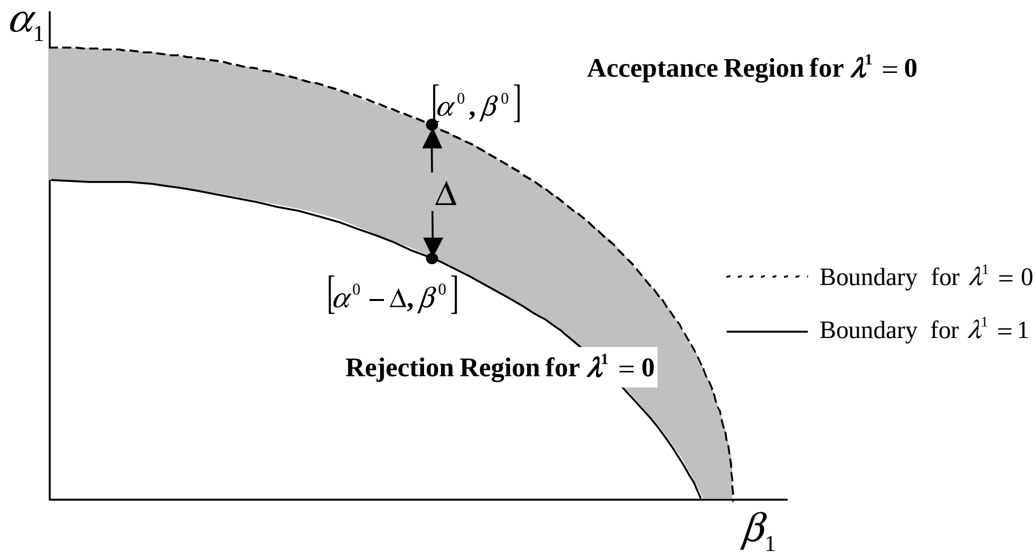
where $G^*(Y_2^0) = \int \int^{Y_2^0 - 2\beta} f^*(\alpha\beta)\, d\alpha\, d\beta$ and $H^*(Y_2^0) = \int_{Y_2^0} (Y - Y_2^0) g^*(Y)\, dY$. Since $\Delta > 0$, the contours for $\lambda^1 = 1$ lie within the contours for $\lambda^1 = 0$.[13] Intuitively, the vertical distance is the premium the agent would be willing to pay for being able to obtain second period draws from $f^*(\alpha\beta)$ rather than $f(\alpha\beta)$.

[13] Statistical dominance of $f^*(\alpha\beta)$ insures that $H^*(Y_0^2) > H(Y_0^2)$. The boundary between the acceptance and rejection region is also flatter since:

$$\frac{d\alpha^1}{d\beta^1} = -\frac{1 + 2G^*(Y_2^0)}{1 + G^*(Y_2^0)} > -\frac{1 + 2G(Y_2^0)}{1 + G(Y_2^0)}.$$

The two boundaries are shown in Figure 3. The dashed and solid lines show the boundaries for persons drawing from $f(\alpha\beta)$ and $f^*(\alpha\beta)$ in the second period, respectively.

Figure 3
Acceptance Regions in Period 2 for Persons Drawing from $f(\alpha\beta)$ and from $f^*(\alpha\beta)$



The shaded region includes jobs that would be accepted in period 1 by persons knowing they will draw from $f^*(\alpha\beta)$ in the second period but not by those who will draw from $f(\alpha\beta)$ in the second period. Conditional on α^0 and β^0, exit probabilities, therefore, increase when λ^1 is equal to one. Intuitively, being able to draw from $f^*(\alpha\beta)$ in period 2 increases the expected value of period 2 offers. Agents are willing to leave job 0 and accept a period 1 offer with a lower slope or intercept, knowing that they are less likely to have to pay the price of future low wages in this job since they are more likely to get a dominating offer in period 2.

III. Empirical Analysis

In this section we use a generalization of the previous model to estimate the parameters of the wage offer distribution and to estimate the probability of being offered a stepping stone job. In our empirical work, agents look forward T periods and may be involuntarily terminated or have to leave a job for other non-economic reasons.

A. **Data**

The data we use come from the 1986 to 1988 and the 1990 to 1993 panels of the Survey of Income and Program Participation (SIPP). This large nationally-representative data set contains monthly information that can be used to determine when a respondent moves to a new employer.[14] The availability of monthly wage data also allows us to estimate starting wages and wage growth on each observed job.[15] From the topical modules we can also determine the respondent's first job, which allows us to estimate the parameters of the model without having to integrate over all possible paths to the current job. Another major advantage of the SIPP is that a direct measure of experience can be constructed.[16] This is particularly important for females since potential experience is a poor measure of actual experience for persons with interrupted careers. The major disadvantage of the SIPP is that the panels are relatively short, ranging from 24 to 40 months.

Our sample includes all males and females with no more than a high school degree who are between the ages of 18 and 55 at some point during the panel and who were observed in their

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[14] Each respondent's employer is assigned a unique identification number. Respondents change employers when these identification numbers change.
[15] We use the terms employer and job synonymously.

first job after leaving school. Individuals must also be observed in the following interview but they may otherwise be right censored. This yields a sample of 3,170 males and 2,767 females.

B. **Likelihood Function**

The parameters of the job offer distribution, and the probability of being offered a stepping stone job (i.e., $\mathbf{Pr}(\lambda = 1)$) are estimated using maximum likelihood assuming that agents obtain job offers from one of J discrete distributions. Each offer consists of a starting wage, the wage growth on the job, and am indicator of whether this is a stepping stone job. The estimation requires that we solve the dynamic programming problem at each iteration of the estimation.

Agents are assumed to stay in their current jobs as long as the value function for the current job is at least as large as the value for the offered job, including the value of having access to a better distribution. Since some sample members move to jobs with lower expected payoffs, we also estimate the probability of having to move for non-economic reasons, which include involuntary terminations or family obligations. The parameters of the model are chosen to maximize the likelihood of the observed job history.

More formally, a job offer j_{t+1}^{o} is a draw from the $f\left(\theta^{k}\right)$ distribution, where $\theta^{0}\,\mathbf{...}\theta^{J}$ index the parameters of the J possible wage offer distributions from which the agent may be drawing (corresponding to the J possible job types). The probability of being in the same job, *k*, in both periods *t* and *t+1*, given that job offers come from $f\left(\theta^{k}\right)$, is given by the probability of

[16] We use information in the topical module asked once each panel. The respondents were asked the year they first started working and the number of times they went 6 months or more without a job. Experience in the months following the interview month is calculated using this base figure.

not receiving an offer that dominates the current job and not having to leave the job for non-economic reasons, such as a geographic relocation of a spouse. The probability of such transitions to jobs with lower economic prospects is given by ϕ_j. For ease of presentation we refer to these as "non-economic" transitions.

The conditional probability of staying in a job between periods *t* and *t+1* while obtaining draws from $f(\theta^k)$ is, therefore, given by:

$$\text{(8)} \qquad \mathbf{Pr}\left(j_{t+1} = j_t \mid f\left(\theta^k\right)\right) = \left(1 - \phi_j\right) \sum_{j_{t+1}^o}^{J} \left(1 - I_{j_{t+1}^o}\right) \mathbf{Pr}\left(j_{t+1}^o \mid f\left(\theta^k\right)\right),$$

where $\mathbf{Pr}\left(j_{t+1}^o = j_t \mid f\left(\theta^k\right)\right)$ is the probability of being offered job j_{t+1}^o when drawing from the distribution $f(\theta^k)$ and $I_{j_{t+1}^o}$ is an indicator variable that takes the value 1 if the value function for the offered job, j_{t+1}^o, is higher than the value function for the current job, j_t. The first term in equation (8), $(1-\phi_j)$, is the probability of not having to leave job *j* for non-economic reasons and the following sum is the probability of being offered a job with a lower value function.

The probability of switching to the offered job in period *t+1* is given by the probability that the individual is offered a job with a higher value function than the current job (i.e., $I_{j_{t+1}^o}$) or the individual leaves the current job for non-economic reasons.[17] The conditional probability of switching to the offered job is, therefore:

$$\text{(9)} \qquad \mathbf{Pr}\left(j_{t+1} = j_{t+1}^o \mid f\left(\theta^k\right)\right) = \left[\left(1 - \phi_{jt}\right) I_{j_{t+1}^o} + \phi_{jt}\right] \mathbf{Pr}\left(j_{t+1}^o \mid f\left(\theta^k\right)\right).$$

[17] An individual is assumed to leave a job for non-economic reasons if the individual is observed in the offered job and the value function for the offered job is lower than the value function for the job held in period *t*.

From equations (8) and (9), the probability of observing an agent in job j_{t+1}, given a draw from the distribution $f(\theta^k)$, is then:

(10) $$\mathbf{Pr}\left(j_{t+1} \mid f(\theta^k)\right) = (1-\phi_j)\sum\left[\left(1-I_{j^o_{t+1}}\right)\mathbf{Pr}\left(j^o_{t+1} \mid f(\theta^k)\right)\right] + \left[(1-\phi_j)I_{j^o_{t+1}} + \phi_j\right]\mathbf{Pr}\left(j^o_{t+1} \mid f(\theta^k)\right).$$

Thus far, the analysis has been conditional on a generic wage offer distribution, $f(\theta^k)$. Our estimates allow this distribution to differ by starting job and movement to a stepping stone job. The initial wage offer distribution faced by the agent is determined by the initial job, j_0 and is denoted $f(\theta^{j_0})$. For example, an agent who initially starts in a job of type 1 (j_0 with low starting wages and low wage growth) is assumed to obtain draws from the same wage distribution as all other agents who started in the same type of job $f(\theta^1)$). Each offered job is also associated with the probability, π, that it is a stepping stone job. That is, if the offered stepping stone job is accepted, the agent will then begin to draw from the alternative distribution.[18] If the agent has not been offered a stepping stone job in any period, or if all stepping stone jobs have been refused, then the agent continues to obtain offers from $f(\theta^{j_0})$. We further assume that once a person accepts a stepping stone job in period *s* that all future draws come from the distribution $f(\theta^{j_s})$.[19]

[18] In terms of the notation in section II, $\pi = \Pr(\lambda = 1)$, where $\lambda=1$ indicates that the job offer draw is now coming from $f(\theta^{j_1})$ rather than $f(\theta^{j_o})$ and that future offers from $f(\theta^{j_1})$ have a greater value function than future offers from $f(\theta^{j_o})$.

[19] In terms of computation, once a stepping stone job has been accepted, further job offers are not stepping stone jobs. That is $\pi = 0$ for $t = s+1,...,T-1$. In addition, a job offer is not a stepping stone job if the offered job type is equivalent to the type of the current distribution (i.e., $j^O_{t+1} = k$ when an agent is drawing from the distribution $f(\theta^k)$).

In summary, an agent could be drawing from a new wage offer distribution, $f\left(\theta^{j_t}\right)$, in period *t+1* if the job in period *t* is a stepping stone job. Otherwise, the agent continues to draw from the same distribution as in the previous period, which could be $f\left(\theta^{j_0}\right)$ or $f\left(\theta^{j_s}\right)$, depending on whether or not a stepping stone job had been previously accepted in period *s<t*.

Whether or not an agent accepts a stepping stone job is not directly observable. This means that for any observed job path, $j_0 \ldots j_{t+1}$, the agent could have accepted a stepping stone job in any period from 1 to *t*. As a result, the probability of observing a given job path is the probability of the path, given that the individual accepted a stepping stone job in period 1, or in period 2, or in any period up to and including period *t*. The probability of the full job history from period 0 to period *t+1* is, therefore:

$$(11) \qquad L = (1-\pi)^t \prod_{r=0}^{t} \mathbf{Pr}\left[j_{r+1} \mid f\left(\theta^{j_0}\right)\right] + \pi \sum_{s=1}^{t} \left[(1-\pi)^{s-1} \prod_{r=0}^{s-1} \mathbf{Pr}\left(j_{r+1} \mid f\left(\theta^{j_0}\right)\right) \pi \prod_{r=s}^{t} \mathbf{Pr}\left(j_{r+1} \mid f\left(\theta^{j_s}\right)\right) \right].$$

The first term gives the likelihood of the spell when offers are obtained from the original wage offer distribution (i.e., a stepping stone job was never accepted). The probability that a stepping stone job was not accepted in the *t* possible periods is given by $(1-\pi)^t$ and the probability of the job history is, therefore, conditional on obtaining draws from the original wage offer distribution, $f\left(\theta^{j_0}\right)$. The second term gives the likelihood of the job path given that a stepping stone job was accepted in period *s* (with probability π). Since movement to a stepping stone job can occur only once, the *s-1* job offers preceding *s* are not to stepping stone jobs, as reflected in the term $(1-\pi)^{s-1}$. The remaining terms give the probability of observing the individual in job *j* in the first *s-1* periods, given that he is drawing from the original wage offer distribution, while the last term shows that the individual is drawing from the new $f\left(\theta^{j_s}\right)$ distribution after a stepping stone job is accepted in period *s*. The sum over *s* integrates over all possible paths to a stepping stone job.

The likelihood in equation (11) is maximized with respect to the parameters of the model. These include the parameters of the wage offer distributions, $\theta^0 \ldots \theta^J$; the probability of being offered a stepping stone job, π, and the probability of leaving jobs 1 to J for non-economic reasons, $\phi_1 \ldots \phi_J$. In order to keep the problem tractable, we use a discrete approximation to the job offer distributions and limit the number of periods over which the model is estimated.

Job offers are defined in terms of an intercept (i.e., the initial wage in the job) and a slope (the wage growth on the job). Jobs are defined in terms of "low" or "high" intercepts and "low", "medium", or "high" slopes. This yields six possible job offers. The slopes and intercepts of the initial jobs are used to define these categories. The median intercept for the initial job defines the demarcation between jobs with low and high intercepts. The 33rd and 66th percentiles of the observed wage growth distributions define the wage growth categories. Individuals start in one of these six jobs or in unemployment. Each of these seven groups faces a different wage offer distribution. We, therefore, estimate seven separate distributions, each with six points of support. In addition we estimate the probability that the individual does not receive a wage offer.[20]

The second simplification we impose is that we only estimate the parameters over the first 20 months of a person's job history and we aggregate the data over four-month periods,

[20] This can be viewed as a seventh point of support in which the offer is of a job with zero slope and intercept.

which is the frequency of SIPP interviews.[21] Individuals start in one of the six jobs and make transitions if their employer in months 4, 8, 12, 16, or 20 is not the same as four months earlier.

C. Findings

Table 1 provides summary statistics for our samples of males and females with a high school degree or less who are observed in their first job. The top panel shows the characteristics of the individuals and the bottom panel the characteristics of the jobs they hold. Since we require that sample members be observed in their first jobs after completing their education our sample is relatively young, with a mean age of 24. While relatively few are married our sample is not limited to singles with few responsibilities, as reflected by the fact that 24 percent of the males and 37 percent of the females are married. By construction our sample has low education with a mean education of 11 years.

The jobs that these individuals hold pay low wages with an average wage of $7.68 for males and $6.17 for females. They also have low real wage growth with male wages growing by 6.9 percent per year and females by 2.7 percent. These are, however, primarily full-time jobs with 82 percent of the jobs held by males and 61 percent of those held by females requiring at least 35 hours of work.

Figures 4a and 4b shows the Kaplan-Meier estimates of the survivor functions for these jobs for females and males, respectively. The dark solid line shows the survivor function for all jobs. There is substantial turnover in these jobs with slightly more than sixty percent lasting a

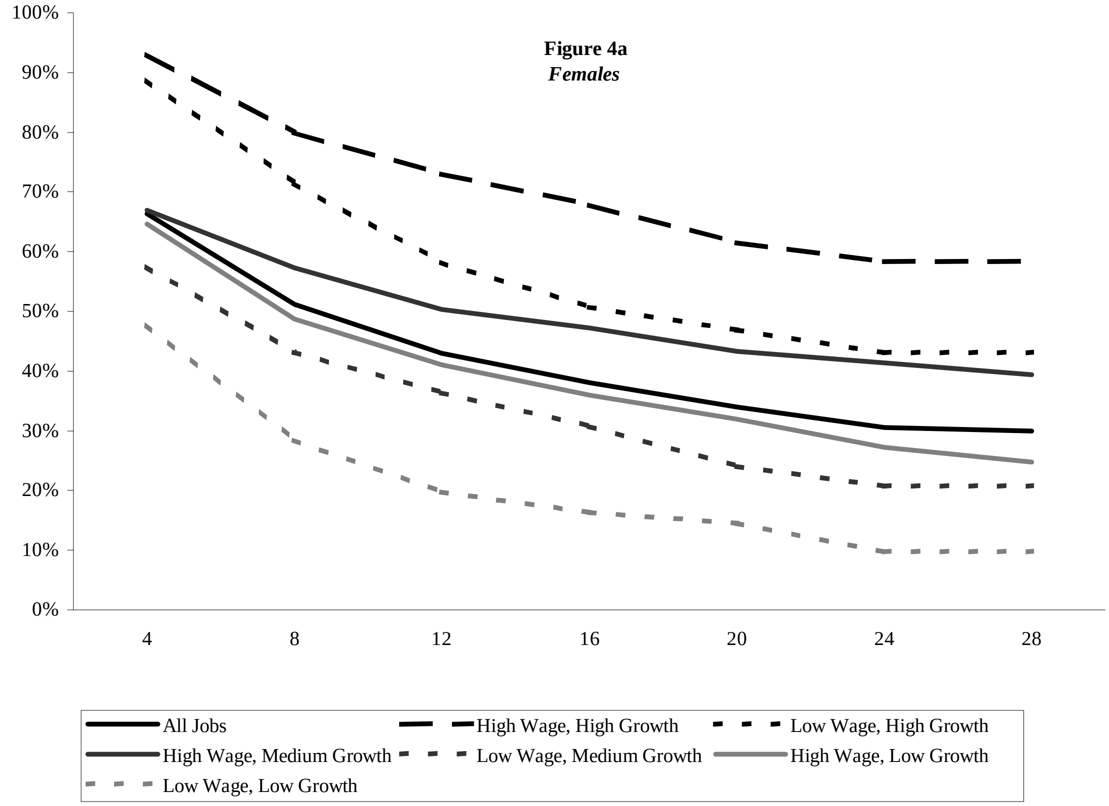
[21] Respondents are interviewed every four months, at which time they are asked about their job and wage history over the previous four months. The well-known "seam-bias" problem occurs because respondents tend to report changes in status as occurring between interviews. Relatively little information is lost since a large proportion of transitions in the SIPP are reported to occur between interviews.

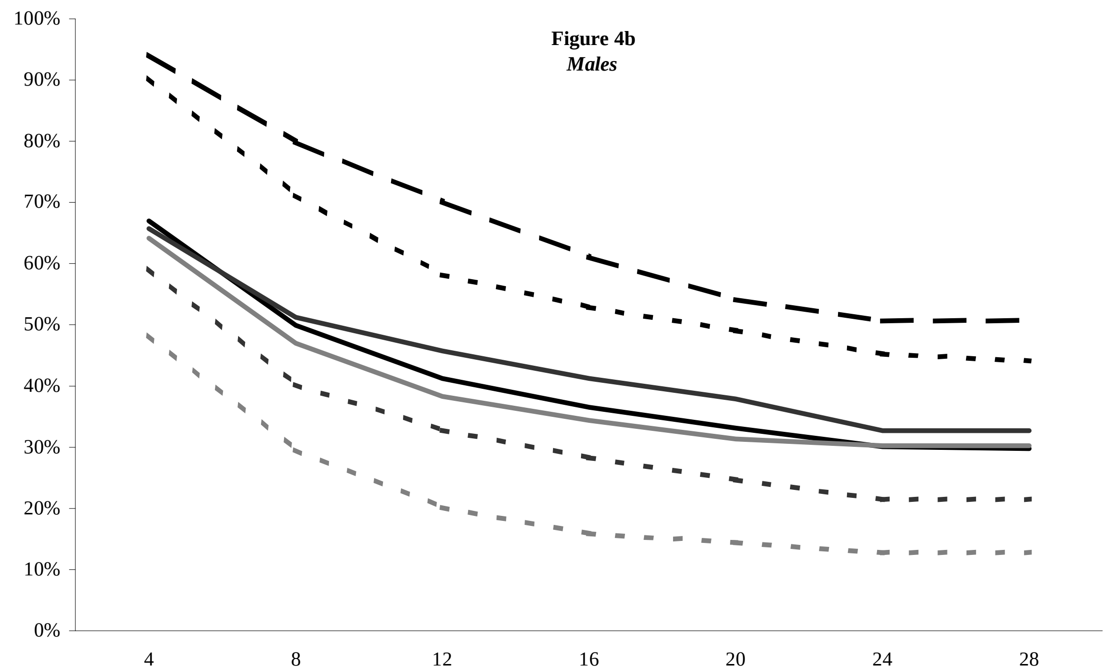
Table 1
Summary Statistics

	Males	***Females***
By Individual	3,170	2,767
Age	23.6	24.4
	(5.5)	(5.9)
White	0.833	0.801
	(0.373)	(0.399)
Hispanic	0.144	0.171
	(0.352)	(0.377)
Married	0.240	0.374
	(0.427)	(0.484)
Education Level	11.1	11.1
	(1.5)	(1.6)
High School Graduate	0.672	0.801
	(0.373)	(0.399)
By Job	5,140	4,220
Full-time Job	0.821	0.614
	(0.383)	(0.487)
Initial Wage	7.61	6.02
	(5.13)	(3.58)
Average Annual Wage Growth	0.527	0.162
	(31.719)	(9.502)

year or less. The exit rates, however, are relatively low after the first year with 30 percent of all jobs lasting more than 28 months. These figures also display the survivor functions for jobs disaggregated by initial wage and wage growth. As expected the jobs with the highest survivor functions are those with high initial wages and high wage growth. The 28-month survival probabilities for these jobs are .51 for males and .58 for females. At the opposite end of the spectrum are jobs with low intercepts and low slopes, which have uniformly low survivor functions. Among males only 13 percent of these jobs last more than 28 months and for females the survivor functions are even lower.

Figures 4a and 4b
Survivor Functions by Job Type





We now turn to the estimates of the key parameters in our empirical model   Table 2 shows the key parameter estimates for males and females, respectively. In order to bound probabilities between zero and one, ϕ_j and π are parameterized as logit transformations (i.e., $\phi_j = \frac{e^{\tilde{\phi}_j}}{1+e^{\tilde{\phi}_j}}$ and $\pi = \frac{e^{\tilde{\pi}}}{1+e^{\tilde{\pi}}}$) and the probability of being in the *j*th cell of the wage offer distribution is parameterized as $\frac{e^{\tilde{\theta}_j}}{\sum_k e^{\tilde{\theta}_k}}$. The resulting coefficients are shown in Table 2. Tests that the coefficients are zero, therefore are equivalent to tests against the null of equal probabilities of each type of offer.

Table 3 converts the estimated coefficients into probabilities. The top panel is for females and the bottom panel is for males.   Each column shows a different set of constraints. Consistent with our model, the constraints faced by each individual are defined by his/her initial job or by job the person entered, if it was a stepping stone job.   The first row shows the estimated probabilities of a separation for non-economic reasons, $\phi_1 ... \phi_J$. Row 2 shows the probability of receiving a positive wage offer.[22] The following six rows show the distribution of these wage offers. These are based on our estimates of $\theta^0 ... \theta^J$. The last row shows the probability that a job offer is for a stepping stone job, π.

Column 2 of the top panel shows the distributions faced by females in jobs with low initial wages and low wage growth. Since these jobs are dominated by all other jobs that have higher intercepts and slopes the probability of leaving this job for "non-economic" reasons

[22] Since non-employment is treated as a job that offers a zero intercept and zero slope, the probability of receiving a non-zero offer is equal to one minus the probability of being offered a wage equal to zero.

Table 2
Job Loss and Job Offer Parameters

		Non-employment	*Low Wage/ Low Growth*	*High Wage/ Low Growth*	*Low Wage/ Medium Growth*	*High Wage/ Medium Growth*	*Low Wage/ High Growth*	*High Wage/ High Growth*
Females								
	Lower Economic Prospects		-0.335 ***	-1.018 ***	-1.050 ***	-1.797 ***	-2.011 ***	-2.465 ***
			(0.061)	(0.066)	(0.066)	(0.104)	(0.080)	(0.108)
	No Job Offer	4.037 ***	3.755 ***	3.304 ***	2.815 ***	3.466 ***	4.077 ***	1.351 ***
		(0.598)	(0.273)	(0.185)	(0.230)	(0.258)	(0.327)	(0.349)
Job Offer	***Low Wage/ Low Growth***	0.741	1.539 ***	1.659 ***	-0.054	-365.847 ***	2.416 ***	-0.699
		(0.711)	(0.288)	(0.233)	(0.350)	(12.725)	(0.362)	(0.517)
	High Wage/ Low Growth	0.747	1.031 ***	1.368 ***	-1.570 ***	1.156 ***	0.313	0.887 **
		(0.690)	(0.307)	(0.211)	(0.480)	(0.310)	(0.388)	(0.382)
	Low Wage/ Medium Growth	1.622 **	0.815 ***	0.037	0.929 ***	1.661 ***	2.222 ***	-1.158 **
		(0.631)	(0.312)	(0.375)	(0.252)	(0.320)	(0.363)	(0.572)
	High Wage/ Medium Growth	0.862	-0.757 *	0.129	-0.194	1.114 ***	-0.146	0.544
		(0.666)	(0.424)	(0.253)	(0.283)	(0.290)	(0.429)	(0.368)
	Low Wage/ High Growth	1.036	0.737 **	0.680 **	-0.763 **	0.039	1.309 ***	-2.172 **
		(0.654)	(0.322)	(0.323)	(0.325)	(0.519)	(0.434)	(0.991)
			95% Confidence					
	Stepping Stone Job	-0.012	-0.462	0.438				
		(0.230)						
	Log Likelihood							-8476.453
	Number of Individuals							2,767
Males								
	Lower Economic Prospects		-0.516 ***	-1.087 ***	-0.940 ***	-0.995 ***	-1.796 ***	-1.912 ***
			(0.066)	(0.062)	(0.063)	(0.062)	(0.072)	(0.111)
	No Job Offer	2.128 ***	4.251 ***	3.179 ***	4.070 ***	3.582 ***	5.483 ***	1.055 ***
		(0.243)	(0.284)	(0.171)	(0.284)	(0.257)	(0.553)	(0.316)
Job Offer	***Low Wage/ Low Growth***	-0.323	2.472 ***	1.558 ***	1.607 ***	-0.037	4.154 ***	-1.320 ***
		(0.462)	(0.293)	(0.209)	(0.342)	(0.541)	(0.570)	(0.547)
	High Wage/ Low Growth	-0.742	1.764 ***	1.525 ***	-0.435	1.802 ***	1.768 ***	0.450 ***
		(0.461)	(0.309)	(0.181)	(0.446)	(0.298)	(0.592)	(0.331)
	Low Wage/ Medium Growth	0.761 ***	1.234 ***	0.363	2.161 ***	1.720 ***	4.125 ***	-1.648 ***
		(0.251)	(0.327)	(0.298)	(0.295)	(0.311)	(0.568)	(0.524)
	High Wage/ Medium Growth	0.335	0.528	0.321	1.510 ***	2.050 ***	1.746 ***	-0.003 ***
		(0.269)	(0.340)	(0.214)	(0.314)	(0.269)	(0.591)	(0.365)
	Low Wage/ High Growth	-0.107	1.720 ***	0.610 **	1.095 ***	0.921 **	3.442 ***	-3.612 ***
		(0.326)	(0.309)	(0.273)	(0.320)	(0.393)	(0.587)	(1.033)
			95% Confidence					
	Stepping Stone Job	-0.136	-0.590	0.318				
		(0.232)						
	Log Likelihood							-10075.846
	Number of Individuals							3,170

Table 3

Job Loss and Job Offer Probabilities

		Non-employment	Low Wage/ Low Growth	High Wage/ Low Growth	Low Wage/ Medium Growth	High Wage/ Medium Growth	Low Wage/ High Growth	High Wage/ High Growth
Females								
	Pr(Lower Economic Prospects)		41.7%	26.5%	25.9%	14.2%	11.8%	7.8%
	Pr(No Job Offer)	78.6%	76.3%	65.5%	73.6%	70.3%	68.3%	38.8%
Pr(Job Offer)	**Low Wage/ Low Growth**	13.6%	35.1%	36.7%	15.8%	0.0%	40.9%	8.2%
Pr(Job Offer)	**High Wage/ Low Growth**	13.7%	21.1%	27.4%	3.5%	23.5%	5.0%	40.0%
Pr(Job Offer)	**Low Wage/ Medium Growth**	32.8%	17.0%	7.2%	42.4%	38.9%	33.7%	5.2%
Pr(Job Offer)	**High Wage/ Medium Growth**	15.3%	3.5%	7.9%	13.8%	22.5%	3.2%	28.4%
Pr(Job Offer)	**Low Wage/ High Growth**	18.2%	15.7%	13.8%	7.8%	7.7%	13.5%	1.9%
Pr(Job Offer)	**High Wage/ High Growth**	6.5%	7.5%	7.0%	16.7%	7.4%	3.7%	16.5%
		100%	100%	100%	100%	100%	100%	100%
			95% Confidence					
	Stepping Stone Job	49.7%	(38.6% -	60.8%)				
Males								
	Pr(Lower Economic Prospects)		37.4%	25.2%	28.1%	27.0%	14.2%	12.9%
	Pr(No Job Offer)	55.8%	70.5%	61.6%	71.9%	60.1%	58.7%	41.5%
Pr(Job Offer)	**Low Wage/ Low Growth**	10.9%	40.3%	31.7%	21.9%	4.0%	37.6%	6.6%
Pr(Job Offer)	**High Wage/ Low Growth**	7.2%	19.9%	30.6%	2.8%	25.4%	3.5%	38.7%
Pr(Job Offer)	**Low Wage/ Medium Growth**	32.3%	11.7%	9.6%	38.0%	23.4%	36.5%	4.8%
Pr(Job Offer)	**High Wage/ Medium Growth**	21.1%	5.8%	9.2%	19.8%	32.5%	3.4%	24.6%
Pr(Job Offer)	**Low Wage/ High Growth**	13.5%	19.0%	12.3%	13.1%	10.5%	18.4%	0.7%
Pr(Job Offer)	**High Wage/ High Growth**	15.1%	3.4%	6.7%	4.4%	4.2%	0.6%	24.7%
		100%	100%	100%	100%	100%	100%	100%
			95% Confidence					
	Stepping Stone Job	46.6%	(35.7%	57.9%)				

reflects only moves to non-employment. The probability of such transitions is .417. For females in other columns transitions for "non-economic reasons" include moves to other jobs with lower value functions. Looking across the column indicates that the better jobs have lower probabilities of separations for non-economic reasons. For females in jobs with high intercepts and high slopes, all other jobs have lower value functions. The probability of a transition for non-economic reasons is only .078 for this group.

The second row shows the probability of not receiving an offer. For persons who are currently not employed (column 1) this is identified from the probability of remaining unemployed. For job holders, the probability of not receiving an offer is identified by the probability of staying in the same job. However, this probability now reflects the probability of receiving offers with lower expected payoffs as well the probability of not receiving an offer. The likelihood function takes both of these into account.

The first column of Table 3 shows that 78.6 percent of females who are not employed do not receive an offer and thus remain in the non-employment state. The estimated probability of not receiving an offer is marginally lower for the other columns. For example, the probability that a female in a job with a low initial wage but high wage growth does not receive an offer is .683. It is only females in jobs with high initial wages and high wage growth that have higher arrival rates of wage offers.

The following six rows show the distribution of non-zero wage offers. These are plotted in Figures 5a and 5b. These estimates show that females tend to receive offers of jobs that have similar initial wages to the jobs in which they started. For example, females in jobs with low initial wages and low wage growth (column 2) who receive offers, have a high probability that

Figure 5a
Wage Offer Distributions (Females)

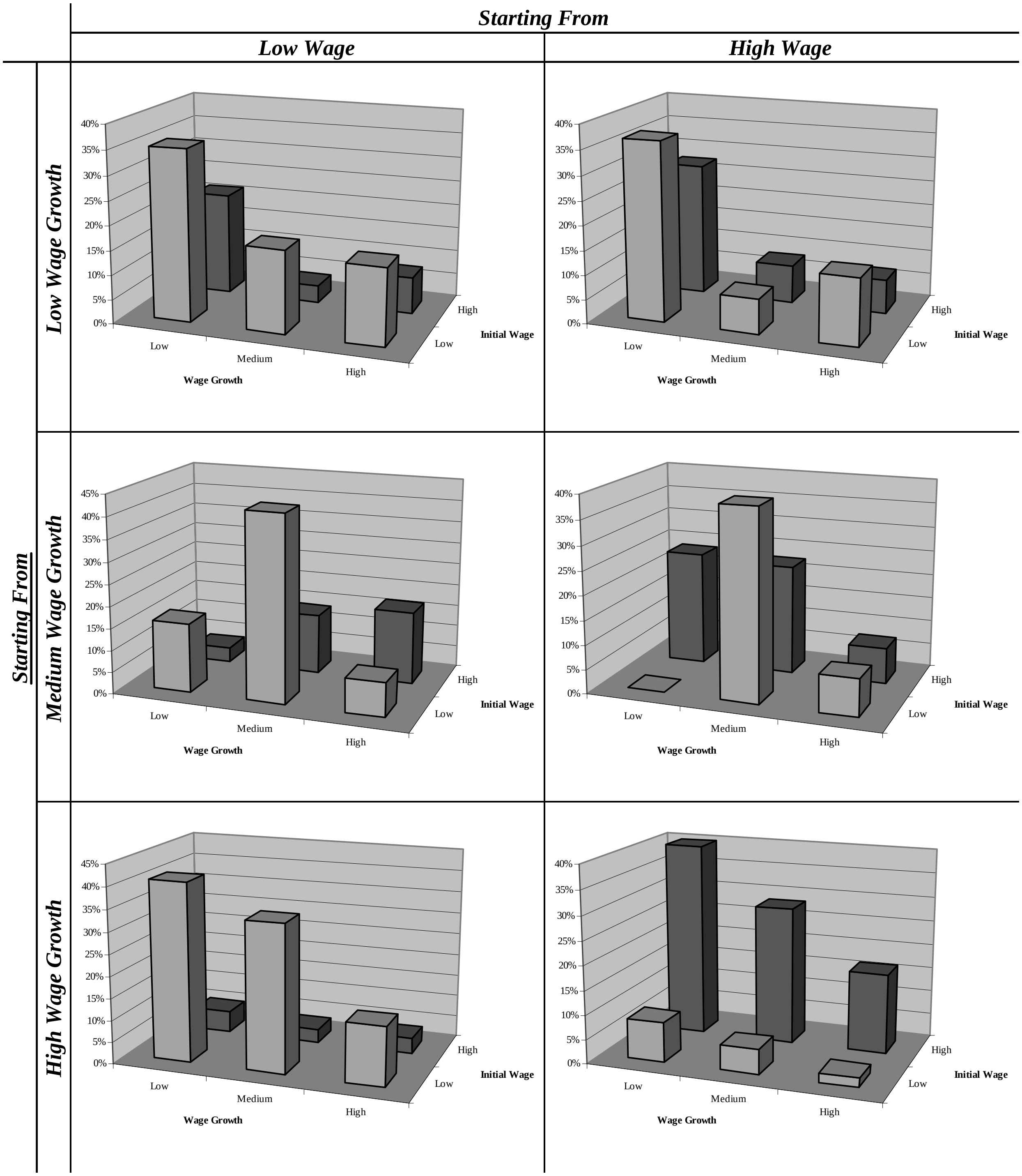


Figure 5b
Wage Offer Distributions (Males)

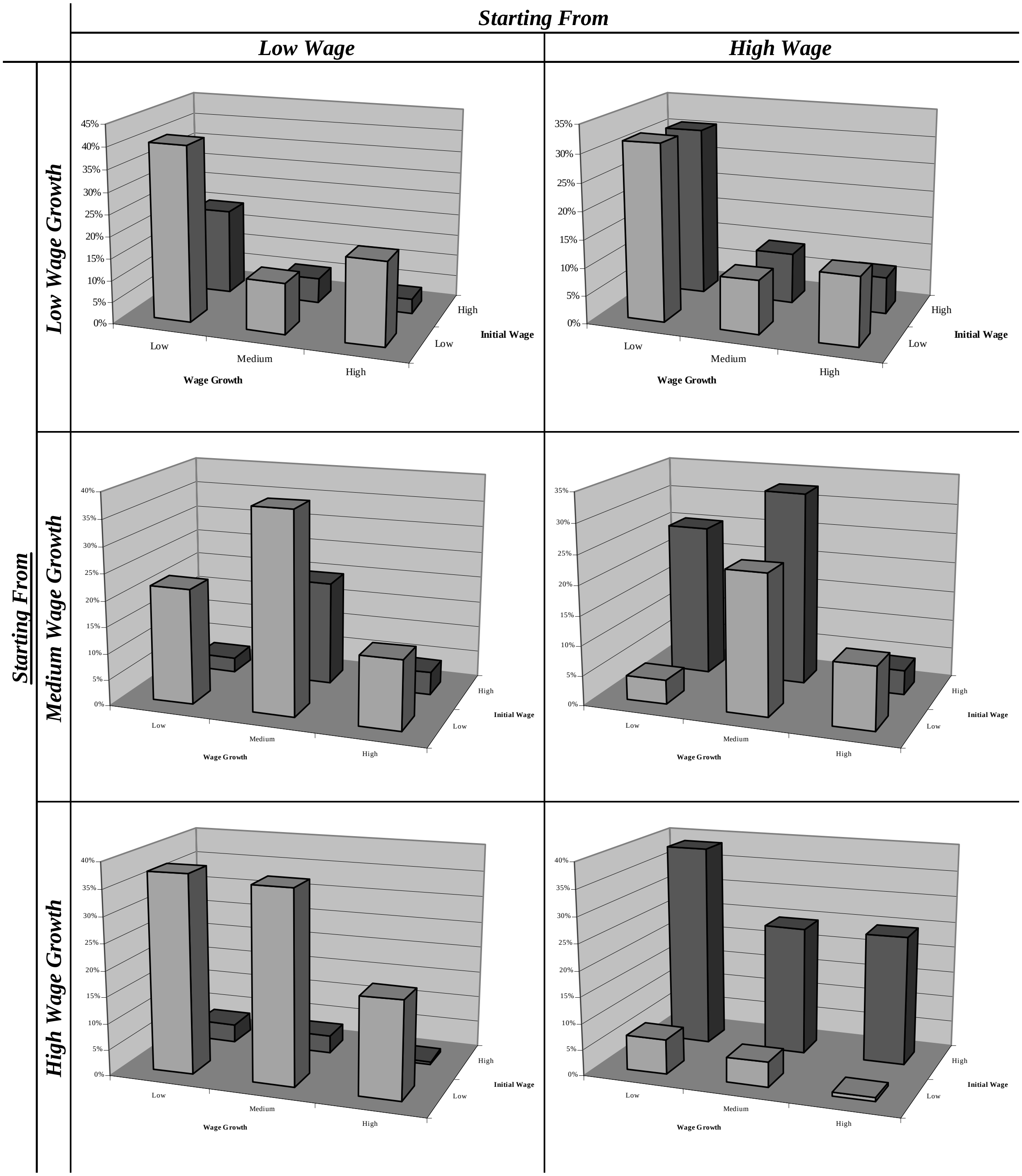
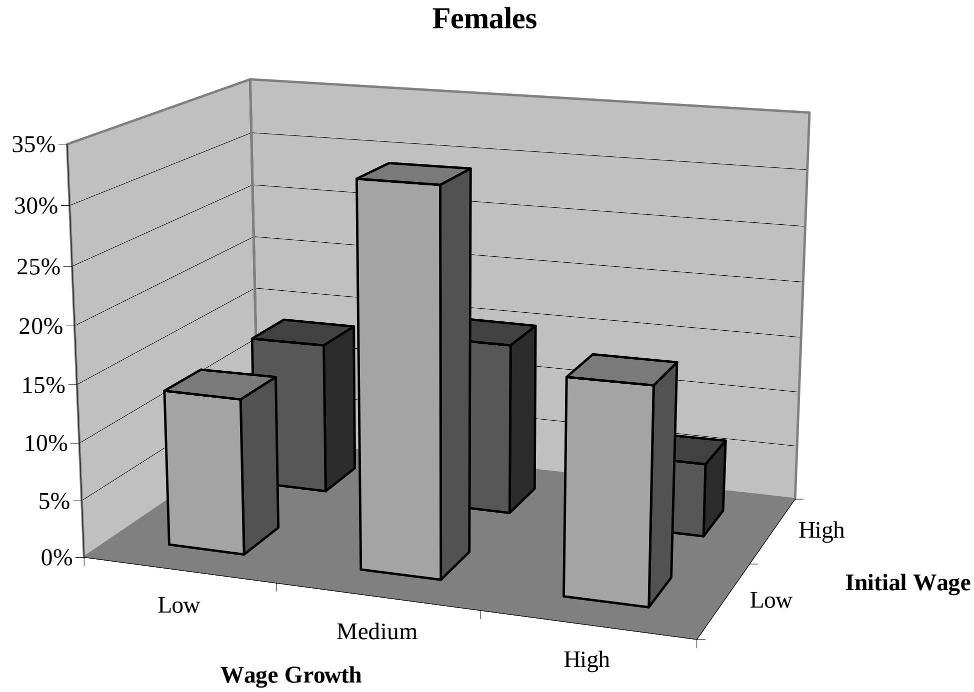
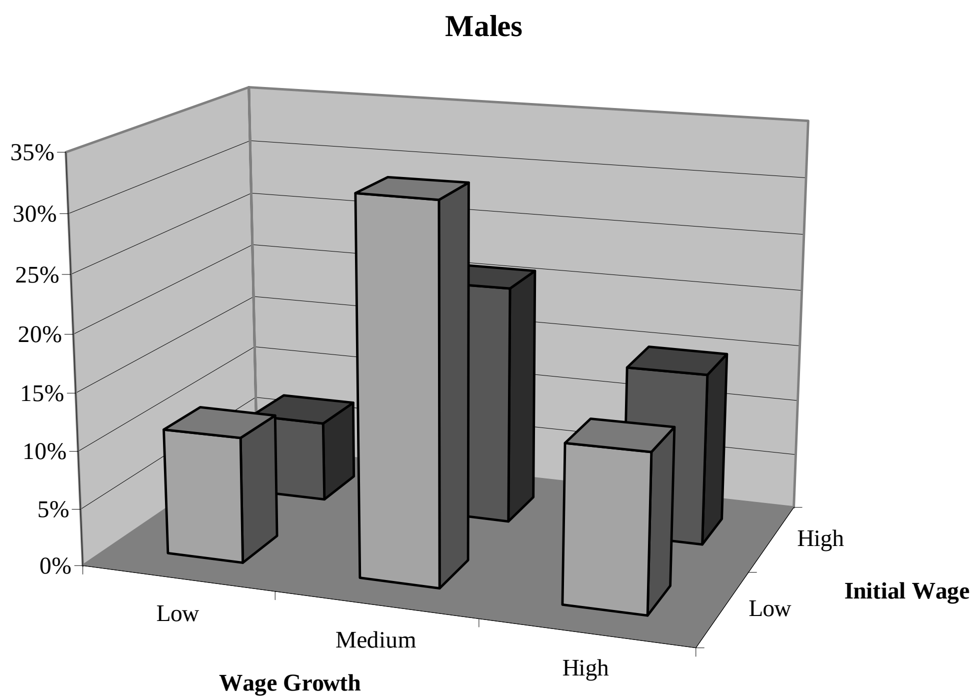


Table 6
Wage Offer Distributions Starting From Nonemployment





the offer will be for a similar job (.351) but very low probabilities of receiving offers of jobs with high wage growth (.075 for jobs with high initial and high wage growth). Those females starting in jobs with low initial wages (left hand column of graphs) tend to have a higher marginal probability of jobs with similar starting wages. A similar pattern emerges for those starting with high initial wages. The wage growth on the initial job is, however, a poorer predictor of the wage growth on the offered job.

Finally, the top panel of Figure 6 shows the wage offer distribution faced by females who are not employed.[23] Comparing these distributions with those in Figures 5a indicates that they are closer to the distributions faced by persons in jobs with medium rather than low wage growth. This is consistent with full-time search being more productive than on-the-job search. Females in jobs with low initial wages and low wage growth may, therefore, have higher value functions if they quit their jobs and search full-time. For them, the forgone income may be sufficiently offset by the higher expected income from drawing from better offers, a possibility that is taken into account in our estimation.

While females in jobs with low initial wages and /or low wage growth may face poor wage offer distributions these may simply reflect stepping stones to better distributions. The last row in Table 3 indicates that the probability of a stepping stone job is imprecisely estimated. The coefficient itself in Table 2 is not significantly different from zero and the standard error is sufficiently large to yield a 95 percent confidence interval lying between .386 and .608. Without

[23] Individuals move to unemployment because of non-economic separation or because unemployment is a stepping stone to a better wage offer distribution.

more precise estimates we cannot draw strong conclusions about the existence of stepping stone jobs.

The picture for our sample of less-educated males is in many ways similar. The probability of leaving a job for non-economic reasons varies from .374 for males in jobs with low initial wages and low wage growth to .129 for males in jobs with high initial wages and high wage growth. Those in the middle columns of Table 3 have probabilities around 25 percent. Thus, persons in "good jobs" tend not to leave those jobs for jobs with lower value functions. The second row of the bottom panel indicates that the probability of a male not receiving an offer is also similar to that for females.

Finally, comparing the wage offer distributions for males in Figure 5b with those of females in Figure 5a shows remarkably similar patterns. While wage offer distributions differ systematically according to the initial job held, the distributions are similar for males and females. The starting wage on the initial job held by males is a strong predictor of the starting wage on the offered job but wage growth is not.

The similarity of the results for males and females is reassuring. The large number of parameters that must be estimated jointly severely limits our ability to add covariates. For this reason we have restricted the sample to a narrow group of less-educated workers on their first jobs. Nevertheless, other characteristics could be driving the patterns we find in wage offer distributions. The fact that the distributions are similar for males and females at least indicates that conditioning on this important characteristic does not alter our conclusions.

In summary, we find that there is substantial heterogeneity in the types of offers received by persons with a high school degree or less. Persons starting in jobs with bleak prospects are more likely not to get offers or to get offers of similar jobs. In this sense, many workers are stuck in "dead end" jobs.

IV. *Conclusion*

We have provided a model that puts economic structure behind the popular notion that some individuals enter jobs that provide "stepping stones" to better jobs while others are "stuck in dead end" jobs. We interpret the former as meaning that accepting some jobs changes the wage offer distribution from which future draws are obtained.

The analytical model we develop assumes that job offers consist of three attributes: an initial wage, an expected wage growth, and an indicator of the distribution from which future offers will come. We have shown the conditions under which agents will accept offers when they are forward-looking. This model shows that the probability of leaving an employer depends both on the attributes of the current job, the attributes of the offered job, and the probability of gaining access to the dominant wage offer distribution.

Our empirical work shows that wage offer distributions vary systematically with the characteristics of the current job. Persons in jobs with low starting wages or low wage growth are most likely to obtain offers of similar jobs. Thus, even forward-looking agents are likely to remain in jobs with poor prospects. Since the probability of gaining access to a better distribution via a stepping stone job is measured imprecisely we cannot at this time draw strong conclusions about the quantitative importance of this potential source of mobility.

Appendix A

Separation for Non-economic Reasons

In this appendix we relax the assumption that agents always have the option of staying either in their current job or in the offered job. Involuntary terminations, relocation for family reasons, and other such separations can lead to unanticipated job exits, which we call non-economic separations.

Since the analysis is similar whether $\lambda^1 = 1$ or $\lambda^1 = 0$, we focus on persons drawing from $f(\alpha\beta)$. If either the current job or the offered job ends for non-economic reasons at the end of period 1, the agent must accept whatever job is offered in period 2. Let the probability of a non-economic separation be given by ϕ_0 if the person stays in the job held in period 0. The probability of such a separation if the person accepts the job offered in period 1 is given by ϕ_1.

The value function for job *j*th must now take account of the fact that it is only with probability ($1-\phi_j$) that the agent will be able to choose between period 2 offers and Y_j^2. With probability ϕ_j the agent will have to accept the second period offer from the untruncated distribution with mean $\mu = E[Y_2]$. The value function for job *j* (i.e., *j*=0,1) is, therefore, given by:

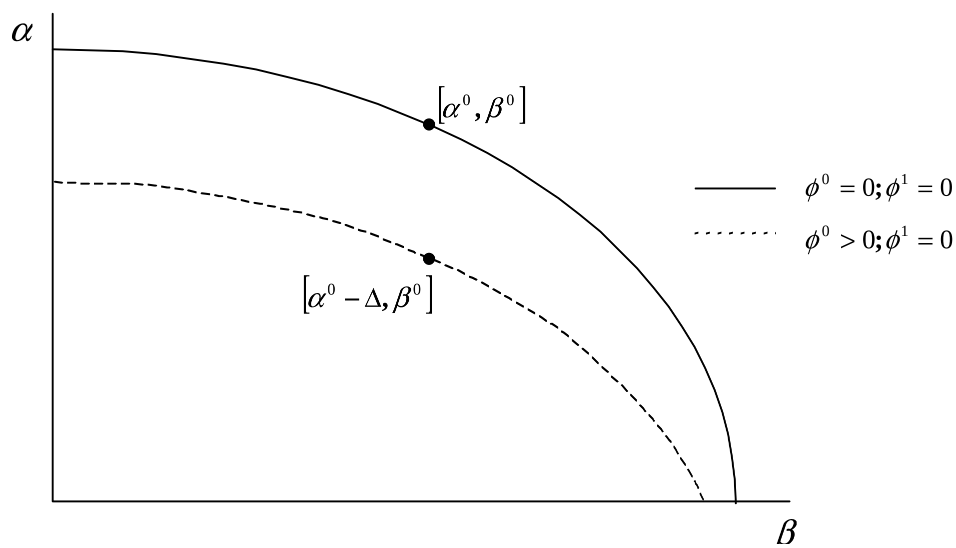
(A-1) $V_1^j = Y_1^j + (1-\phi^j)[Y_2^j + H(Y_2^j)] + \phi^j \mu$.

To see the effect of such separations, totally differentiate equation (A-1):

(A-2) $dV_1^j = [1 + (1-\phi_j)G(Y_2^j)]d\alpha^j + [1 + 2(1-\phi_j)G(Y_2^j)]d\beta^j + (\mu - \tilde{\mu})d\phi_j$, where $\tilde{\mu} = E\left[Y_2 \mid Y_2 > \alpha^j + 2\beta^j\right]$. The last term indicates that an increase in the probability of non-economic separation from job *j*th decreases the value of job *j*th by the difference between the mean of the conditional and unconditional distributions.

The effect of such separations on the decision of whether to accept the job offered in period 1 or to stay in job 0 can be seen in Figure A-1. This figure shows the impact of raising the probability of a non-economic separation in the job held at the start of period 1 (i.e., $d\phi_0 > 0$). As a point of reference, we include the contour previously derived for the case where there are no

Figure A-1
Impact of Involuntary Termination in Job 0



such separations (i.e., $\phi_0 = \phi_1 = 0$).

The reasoning is similar to that used earlier. Consider the case where jobs may end for non-economic reasons. If the probability of a non-economic separation in the offered job is zero but is non-zero in the current job (i.e., $\phi_0 > 0; \phi_1 = 0$), then the agent will be indifferent between the current job and an offered job with the same slope but a lower intercept than in the current job. The size of the premium the agent is willing to pay not to face non-economic separation can be obtained from equation (A-2) by finding the value of $d\alpha^0$ necessary to offset ϕ_0, holding $dV^0 = 0$:

$$\text{(A-3)} \quad d\alpha^0 = \frac{\tilde{\mu} - \mu}{1 + (1 - \phi_0)G(Y_2^0)} d\phi_0 > 0 .$$

The new contour must, therefore, go through $[\alpha^0 - d\alpha^0, \beta^0]$. Its slope does not change since equation (5) still holds as long as $\phi_1 = 0$. The result is a downward shift in the contour. This reflects the fact that offers of job 1 that were previously unacceptable now become acceptable because job 0 has a non-negative probability of ending involuntarily. As a result, the probability that job 1 is accepted increases. Not surprisingly, this result tells us that agents are less likely to stay in the current job if it has a higher probability of ending in a non-economic separation.

More informative is the impact of a non-zero probability that an offered job will end for non-economic reasons (i.e., $\phi_1 > 0$). Consider the case where both the current job and the offered job have the same termination probabilities (i.e., $\phi_0 = \phi_1 = \phi$). The contour must again go through $[\alpha^0, \beta^0]$ since the agent would be indifferent between two jobs offering the same intercepts, slopes, and termination probabilities.[24] The slope of the contour, however, depends

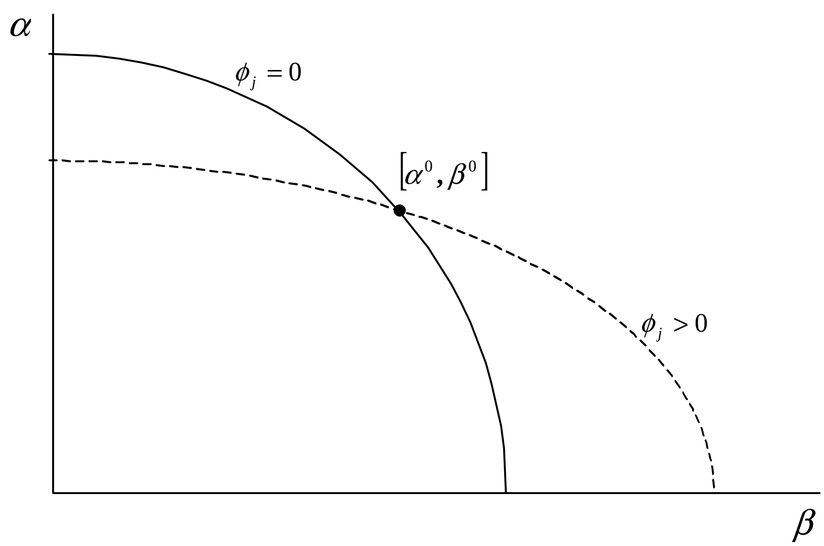
[24] Formally $\alpha^1 = \alpha^0$ and $\beta^1 = \beta^0$ will satisfy $V_1^0 = V_1^1$ as given in equation (A-2) as long as $\phi_0 = \phi_1$.

on ϕ_1. Solving equation (A-2) for those values of $d\alpha^1$ and $d\beta^1$ that maintain $dV_1^1 = 0$ yields the slope of the contour:

(A-4) $$\frac{d\alpha^1}{d\beta^1} = -\frac{1+2(1-\phi_1)G}{1+(1-\phi_1)G}.$$

Equation (A-4) shows that ϕ_1 flattens the profile, as illustrated in Figure A-2. The effect of flattening the profile is to include more jobs with higher starting wages (high α^1) and lower wage growth (low β^1) in the acceptance region.

Figure A-2
Impact of Involuntary Termination in Either Job



In the extreme case where $\phi_1 = 1$ the slope is –1 so $d\alpha^1 = d\beta_0^1$. This implies that period 1 earnings are constant along the contour. Knowing that both the current job and the offered job will end with certainty, the agent does not value growth, which comes from a higher β^1.

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