A Multinomial Logit Model of Attrition that Distinguishes Between Stopout and Dropout Behavior

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Introduction

College attrition rates are of substantial concern to policy makers and economists interested in educational attainment and earnings opportunities. This is not surprising since nationwide, almost one-third of all first-time college students fail to return for their sophomore year. There exists a substantial body of literature seeking to model this attrition using simple logit specifications to differentiate between those enrolled and those not enrolled in the particular term of interest. Results from such analyses have been used to design policy responses to reduce attrition. While this literature assumes that all attrition is permanent, there is a growing body of evidence indicating that it is not. A substantial fraction of students who leave one institution do return to some institution of higher education within a short time. If this short-term stopout behavior is different from longer-term dropout behavior, the usual analyses will confound the determinants of these two outcomes and the policy responses currently in place will be poorly targeted. Our goal is to determine whether this is indeed a problem, whether the factors associated with stopout behavior are statistically different from the factors associated with dropout behavior.

By providing a more realistic description of attrition, this paper makes a substantial contribution to the college enrollment literature. We explicitly recognize that there are two possible types of withdrawals: short-term stopout and long-term dropout. We use longitudinal data from the 1990 Beginning Postsecondary Survey to differentiate amongst those students who remain continuously enrolled through the first calendar year,

those who stop out for a short period of time, and those who stay out on a long-term basis. Most importantly, we use a multinomial logit specification to model these three outcomes. This specification allows us to test whether the factors associated with stopout behavior are statistically different from the factors associated with dropout behavior. If they are not, then the standard approach to attrition analysis is appropriate. If they are, the approach tested here will provide a more accurate picture of attrition and will better predict enrollment behavior. This analysis can then help to better identify at-risk populations and design intervention programs.

Literature Review

Educational researchers have long recognized that not all students who initially enroll in post-secondary education persist till they receive a degree. There exists a substantial literature both theoretical (Tinto 1975, Bean 1980, Kahn & Nauta 2001) and empirical (including but not limited to Hoenack & Pierro 1990; St. John & Starkey 1995; St. John, Hu, & Weber 2001; DesJardins, Ahlburg and McCall 2002) that seeks to identify the determinants of attrition. More complex analysis has focused on nonlinearities in the return to schooling (Hungerford & Solon 1987) and modeling and estimating the impact of uncertainty and sequential choice on the decision to persist (Manski 1989, Altonji 1993, Cameron & Heckman 1998). Generally speaking, dropout behavior is explained as a rational response to new information that changes the probability with which that individual will receive a degree or the costs and/or benefits associated with that degree. This literature assumes that the attrition decision is a permanent one; that once students stop enrolling, they never return.

Much less attention has been paid to the phenomenon known as stopout behavior, wherein an individual who has begun college temporarily interrupts his/her college career. Many of the data sets used to analyze attrition report enrollment at only two points in time and hence are not able to identify those students who reenter following an interruption. Others have samples with too few observations across individuals and/or time to permit analysis of such behavior (for example, Montmarquette, Mahseredjian, & Houle 2001). Yet stopout behavior is not unusual. O'Toole, Stratton, and Wetzel (2003) report that about 30% of all those actively pursuing an academic degree interrupt their education for at least one term during the five years following initial enrollment. Horn (1998) focuses on students enrolled for the first time in either four-year colleges or two-year public schools and reports that almost 30% interrupt during their first year, but that almost half of these interruptions are relatively short-lived (less than five years). This suggests that 50% of all first year attrition is short-term in nature. She presents simple cross-tabulations to analyze the factors associated with stopout versus stayout, but stops short of conducting multivariate analysis. Light (1996) contributes to this enrollment literature by looking at a sample of students who have stopped enrolling and modeling the duration of their interruption. She finds that local unemployment rates and wage rates are significant deciding factors. However, her analysis assumes that all interruptions are temporary and that, at some point, everyone will reenroll.

Modeling the Enrollment Decision

We model enrollment choice using a random utilities model in which individuals face three choices: continuous enrollment (c), short-term stopout (s), and long-term

dropout (d). The utilities associated with each of these choices are designated U_c, U_s, and U_d respectively. This utility is modeled as a function of individual specific characteristics, X, that effect the utility associated with each choice differently. Hence,

$$U_{ji} = X_i\alpha_j + e_{ji}$$

where subscript j denotes the choice and subscript i denotes the individual. While we never observe utility, we can infer from the choices people make how they rank some of these alternatives. Thus, if an individual chooses to persist, it must be the case that $U_{ci} > U_{si}$ and $U_{ci} > U_{di}$. If the e_{ji} are distributed Weibull, the differences in the ε are distributed logistic and a multinomial logit (MNL) can be used to estimate the differences in the parameters α (ie. $\alpha_c - \alpha_s$ and $\alpha_c - \alpha_d$ in the example).

To proceed we need to identify factors (X) associated with each of the three possible enrollment outcomes. To do so, it is useful to consider the decision process students may employ when considering their future enrollment status. All of our analysis is contingent upon having decided to begin college in the first place. Theoretically, the decision to leave, whether temporarily or permanently, could have been planned prior to initial enrollment or it could be the result of revised expectations.

Since attending college is not free and the benefits attributable to less than a year of college are relatively small, it seems unlikely that individuals would plan ex-ante to attend for only one or two terms and then permanently drop out. Revised expectations constitute a more likely explanation for long-term, first year dropout behavior. Revised expectations follow from new information. One of the most important pieces of 'new'/revised information for college students has to do with their academic performance. While test scores or high school grades may provide some information on

academic ability, first year college grades will be an even better indicator of the likelihood with which an individual will complete a program of study. Other factors, which vary over time and may not be known in advance with perfect foresight, include changes in marital status and parental status. Getting married or having a child is likely to significantly affect one's household and financial responsibilities and hence one's opportunity cost of time. Such major life changes could easily cause students to alter their previous decision to pursue a college degree.

The decision to stop out could also be the result of new information. New information that increases one's opportunity cost of time temporarily may lead an individual to stop out. This includes new information about labor market conditions for those whose most valuable alternative activity is employment. New information about the time and effort required to study and receive reasonable grades may also lead an individual to reevaluate his/her potential to graduate at the current institution. Thus, students with either low or high grades may decide to transfer and, while pursuing transfer opportunities, they may experience an interruption in their college experience of a term or even a year. Students with low grades may seek an easier institution; students with high grades may seek a better institution or may reapply to better institutions that initially turned then down.

Stopout behavior, however, could also have been anticipated ex-ante. Married individuals and individuals with children know they have a higher opportunity cost of time and may expect to have a more discontinuous enrollment path. Students with fewer economic resources to start with may also be more likely to stop out, in order to gather the resources with which to continue their education. Students with seasonal jobs may

plan to enroll full-time for one term, then interrupt to work full-time for the next term, repeating this pattern in subsequent years.

All told, there are numerous reasons to expect the determinants of dropout behavior to differ from the determinants of stopout behavior. If this is the case, treating all individuals who interrupt their enrollment identically will yield biased estimates of the factors influencing true dropout behavior. Factors that affect stopout (dropout) behavior but not dropout (stopout) behavior may not appear statistically significant when all withdrawals are treated identically. This will be especially true if there are cases where a factor is positively associated with one type of withdrawal and negatively associated with the other. Estimation of a multinomial logit model will enable us both to allow for and to test for differences in the factors associated with each of the three outcomes: continuous, dropout, and stopout behavior.

Data

The data set we use is the 1990/94 Beginning Postsecondary Survey (BPS-90) developed by the National Center for Education Statistics (NCES). This survey follows students who attend a postsecondary institution for the first time in the 1989-90 academic year across time regardless of their later enrollment status. Follow-up surveys were conducted in 1992 and 1994 to provide a data set which spans a five year time period. For the purposes of this study, we use the longitudinal data from the 1992 survey. We confine our analysis to those students who are pursuing an academic degree[1], who enroll at an academically-oriented institution[2], and who initially enroll as full-time students.[3] The original sample of 7253 individuals is thus reduced to a sample of 4251.

We use this final sample to distinguish continuous first year enrollment from short-term stopout behavior from long-term dropout behavior. Ideally the random utilities model requires that we have information on each respondent's ex-ante intentions. In fact, we only observe ex-post revealed behavior and must infer intentions from that behavior. Revealed behavior may not match initial expectations because each period the respondent acquires new information that is used to update his/her enrollment decision. Our ability to distinguish between stopout and dropout behavior is of particular concern. While classification errors of all sorts are possible, we believe that those intending to stop out, because they must decide when to reenter, may be more likely to revise their decision and dropout. If this is true, our reliance on ex-post revealed behavior will lead us to disproportionately misclassify stopouts as dropouts.

Note, however, that there are several significant advantages associated with our approach. First, if our ability to distinguish between stopout and dropout is imperfect, then we will be biased against finding differences between stopout and dropout behavior, and we will fail to reject the naïve model that treats all withdrawals alike. Second, policy makers will be more concerned with actual outcomes than with expectations and so may be more interested in these results than those of an 'ideal' model. And third, standard attrition models rely on only a single point-in-time attendance report to measure attrition and hence fail to make any distinction between stopout and dropout. Our use of longitudinal data gives us a significant advantage by allowing us to examine the assumption, critical to the standard literature, that all attrition is of the same type. This is a significant step forward in the literature and, again, policy makers in particular will benefit from this knowledge.

Using our longitudinal data, we define continuous enrollment as enrollment for three consecutive semesters or four consecutive quarters, depending upon the institution's calendar type. Thus, continuous enrollment gets the student into the first term of their second year of college. Dropout behavior is defined as non-enrollment for a period of at least three semesters (four quarters). This long-term interruption can commence at any time within the three semester/four quarter time frame used to define continuous enrollment. Individuals are classified as stopouts if they leave but then return after no more than a one year absence. Thus, respondents who are enrolled for two semesters, not enrolled for two semesters, then enrolled again the following term would be classified as having stopped out because they interrupted their education, but returned within the three semester time frame.

This classification scheme does a good job capturing the conceptual differences between stopout and dropout behavior. However, the use of any fixed time frame always introduces the possibility of classification error. First, some of those classified as having stopped out may actually enroll for only one term following reentry and then decide to leave permanently. These students might be more accurately classified as long-term dropouts. Of those classified here as stopouts, however, fewer than 2% are observed enrolled for only one term following their return to school. Second, some of those classified as dropouts might reenter in the term or terms following the observation period, and thus be more accurately described as stopouts. In fact, about 25% of those classified here as dropouts are observed reenrolling at a later date. This suggests that our classification scheme may overstate dropout relative to stopout behavior, but our basic results are robust to the reclassification of the 25% who ever reenroll as temporary

stopouts. Finally, there is also some concern that those classified as being continuously enrolled will quit school immediately following the third semester/fourth quarter. In fact, fewer than 8% of those classified here as continuously enrolled are observed enrolled for less than two additional terms. These statistics suggest that our definition does a reasonable job distinguishing among individuals who enroll for the duration, who interrupt their college experience, and who actually drop out.

The explanatory variables used in our analysis are defined in Table 1. We include demographic, background, personal, family, institutional, and economic characteristics. Demographic characteristics include gender, race, and ethnicity. Family background is captured with measures of parental education and income in order to capture familial support (both monetary and psychological) for higher education. Personal characteristics, like age and GPA, influence both the expected gain from and cost to education and the likelihood of graduating. Dummy variables identifying individuals who first enroll in the fall term and who enroll immediately following high school graduation are included to proxy for the degree of individual commitment to and interest in higher education. Family characteristics such as marital and parental status may be important, especially for women, as an indication of the household and child rearing opportunity cost of pursuing a degree. We include variables reflecting both initial status for these factors and dummy variables identifying changes[4] separately by gender. Unfortunately there are so few men who were divorced/separated/widowed or whose marital status changed during the course of the first eighteen months, that we are unable to include these men in the study and hence unable to identify the impact such changes have on men's enrollment pattern.[5] Institution-specific factors, such as institution type and distance from home are included.[6]

Finally, the economic environment as measured by student aid receipt and by wages or employment opportunities may also be important, the latter especially for older students with higher economic opportunity costs. Like family characteristics, these factors do change over time. However, no information on potential student aid support is available for those who do not enroll, so the 1989-90 receipt indicators are used as a proxy. Given the level of aggregation of our unemployment rate and expected earnings measures, little change would be observed in these measures between 1989 and 1990. Although changes may be important over a longer time dimension, we utilize the 1990 figures alone here.

Table 2 provides weighted sample means by outcome. Figures at the bottom of the table indicate that approximately 75% of our sample are enrolled continuously, 10% stop out, and 15% drop out. Since we believe these estimates exaggerate dropout behavior at the expense of stopout behavior, stopout behavior may be more common than is demonstrated here. While some differences are apparent in the sample means by outcome, we forego discussion of simple correlations in order to focus on the estimation results that control for all the variables simultaneously.

MNL Results

Table 3 provides the coefficient estimates from the multinomial logit model. All parameter estimates are adjusted for the complex survey design of the BPS-90 (see Thomas and Heck 2001 for a justification). Tests were conducted to determine whether the assumptions underlying this specification are appropriate. Specifically, we conducted a Hausman test of the maintained assumption of Independence of Irrelevant Alternatives (IIA). If two alternatives are more similar to one another than to the third alternative, as

might be supposed if individuals first decide to interrupt and then decide whether the interruption is permanent or temporary, we would expect the test of IIA to reveal such similarities. The fact that we are unable to reject the null hypothesis that the multinomial logit model is appropriate for these data lends further credibility to our specification.[7]

The first two columns in Table 3 report parameter estimates and standard errors comparing short-term stopout with continuous enrollment. Positive coefficients indicate that higher values of the explanatory variable increase the predicted probability of stopout, relative to continuous enrollment. The second two columns report parameter estimates and standard errors comparing dropout with continuous enrollment. Positive values here indicate that higher values of the explanatory variable are associated with increased likelihood of dropout behavior, relative to continuous enrollment. The factors associated with stopout and dropout activity can be compared by differencing the first two columns – as reported in the final two columns of the table. In this case, positive coefficient estimates indicate that higher values of the explanatory variable are associated with increased likelihood of long-term dropout behavior, relative to temporary stopout activity. Asterisks identify the individual variables that have significant effects for each outcome pair.

F-tests are used to test the overall power of these explanatory variables to explain the outcome. The resulting test statistics allow us to reject the hypothesis that all the slope parameters are jointly zero, as well as the hypotheses that all the parameters in the first, second, or third set of columns are jointly zero. The result for the last set implies that there are significant differences between the factors associated with short-term stopout behavior and the factors associated with long-term dropout behavior. This

finding indicates that, contrary to the assumptions maintained in the literature, stopout and dropout are distinctly different choices.

To provide further information regarding the impact various factors have on enrollment behavior, we report the predicted probability of each outcome for select respondent characteristics in Table 4. The base case, reported in the top row of this table, is that of an 18 year old, white male who begins college in the fall term immediately following his high school graduation, whose parents have completed college and have an income between $30,000 and $40,000, who has an average first year GPA, attends a private four-year college that is between 10 and 100 miles from his parent's home, is unmarried and not a parent, lives in an area with a 5.6% unemployment rate and has standard expected earnings and does not receive financial aid. Our model predicts that an individual with these characteristics has a 90.2% probability of being continuously enrolled, a 7.5% probability of stopping out, and a 2.3% probability of dropping out. These figures are notable as this stereotypical college student is not one we would expect to stop out, yet the predicted probability of such an individual stopping out is three times the predicted probability of his dropping out. Even this relatively basic finding supports the thrust of our research that stopout and dropout should be treated as separate patterns of behavior rather than treated equally as "withdrawals."

An analysis of Table 3 indicates that black students are somewhat more likely than whites to stopout relative to enrolling continuously and that nonwhite/nonblacks are somewhat less likely than whites to dropout rather than enroll continuously. Overall, however, demographic characteristics are not jointly significant determinants of enrollment outcome (p-value 0.21).

Parental education is a significant determinant of behavior (p-value 0.0015). Students whose parents have completed college (the base case) are significantly more likely to be continuously enrolled than to stop out or to drop out, as compared to students whose parents have less education. Parental education does not, however, play a distinguishing role between dropout and stopout behavior (p-value 0.61).[8] This can be seen in Table 4 where the probability of dropping out and stopping out is shown to be substantially higher for those whose parents have only a high school education (11.9% and 4.3% respectively) as compared to the base case (7.5% and 2.3%), but the ratio of stopout to dropout probabilities is relatively similar, ranging from 3.2 (7.5/2.3) to 2.8 (11.9/4.3).

Contrary to our expectations, household income has no jointly significant effect on enrollment activity (p-value 0.22) and the only income variable to enter with any significance is the one identifying dependent students from very low income households. These students are more likely to drop out than to continue, even though income was known ex-ante. On the whole, it would appear that whereas income may influence the decision to enroll in college in the first place, it does not play a substantial role in subsequent enrollment decisions.

The timing of college entry is significantly associated with the enrollment outcome overall (the p-value for the test that no timing variables belong in the model at all is 0.0000) and helps distinguish between stopout and dropout behavior (p-value 0.0041). Those first entering in the fall term are marginally more likely to enroll continuously than to stop out as compared with those entering in a non-fall term, but jointly the four timing variables have no significant association with stopout behavior (p-

value 0.3245). By contrast, three of four timing variables significantly influence the likelihood with which an individual is observed dropping out for the long-term versus enrolling continuously. Those first entering in the fall term and those matriculating immediately after high school are substantially less likely to drop out on a permanent basis than to be continuously enrolled, relative to those first enrolling in a non-fall term or delaying entry to college. Matriculation immediately after high school is further associated with a significantly lower probability of dropping out as compared to stopping out. This result is expected since these students are those following the lockstep education pattern of high school to college and are in some sense conforming to traditional educational life cycle behavior patterns. In addition, these students should have fewer distractions relative to those who started later.

Finally, older men are more likely than younger men to drop out rather than to continue, while age is not a significant factor in the dropout/continue decision for women.[9] This gender differential becomes significant by about age 25. Table 4 presents some predictions for those delaying entry and for those not enrolling first in a fall term, to demonstrate the substantial impact these variables have. Age effects are more difficult to portray as age is not observed independent of other timing factors. Predicted probabilities for a man and woman who are age 21, independent, and have delayed entry following high school are presented and show that such individuals have a substantially lower probability of enrolling continuously, mostly because they are much more likely to drop out, than those having base case characteristics.

As expected, the influence of grades is substantial. Those missing all grade reports (perhaps because all courses were taken pass/fail) and those with low grades are

substantially more likely to stop out or to drop out than to remain continuously enrolled, as compared to those with institution-reported mid-level grades. Those self-reporting mid-level grades are no more likely to stop out versus remain enrolled continuously than those with institutionally-reported mid-level grades. They do appear, however, to have a higher probability of dropping out relative to continuing and furthermore of dropping out relative to stopping out. We observe no evidence that those with high grades are more likely to stop out in order to transfer between institutions. Such transfers may be more likely to occur between academic years, such that no enrollment gap is observed. Tests interacting income with GPA provided no evidence that independent students or those from less privileged households were more sensitive to grade reports.

Family characteristics, such as being married or having a child, play a pivotal role in first year enrollment behavior, though one qualified somewhat by the small number of individuals who are not childless and single throughout the duration. Current marital status is more significantly correlated with stopout (p-value 0.0053) than with dropout (0.0382) behavior, but is significant in each comparison. Married men are significantly and substantially more likely to stop out, rather than to enroll continuously. They are also significantly and substantially more likely to stop out than to drop out. Indeed marriage lowers men's probability of dropping out. Married women are also more likely to stop out than otherwise similar single women, but their probability of dropping out also rises a bit. Divorced women are more likely to drop out than to continue their education, but this differential is only marginally significant.

Changes in marital status for women have a significant impact on enrollment outcome. Women who marry are more likely to drop out but less likely to stop out,

relative to remaining continuously enrolled. Women whose marriages end are more likely to stop out and less likely to drop out, relative to remaining continuously enrolled. It is notable that of the eighteen men who married within this time frame, none stepped out, but a larger sample would be necessary to draw any clear inferences about the role of marital changes for men.[10]

Parental status variables are also important, though the impact of children under age six differs for men and women. The presence of a young child makes married 21 year old women more likely to drop out than to stop out. The presence of a young child makes married 21 year old men more likely to enroll continuously and even less likely to drop out. Having a newborn substantially increases the probability with which men will drop out rather than either stop out or remain enrolled. Women who have a newborn are somewhat more likely to both drop out and stop out, though the association with dropout behavior is stronger.

Institutional characteristics have a strong impact on overall interruption, but one that differs little by type of interruption. The public/private nature of the institution has no significant or substantial effect. Those individuals attending a two-year institution are, however, more likely to both stop out and drop out than those individuals attending a four-year institution, approximately doubling both probabilities.

The impact of financial aid receipt will be of particular interest to policy makers. Our results indicate that aid information does not help differentiate between short-term stopout and continuous enrollment (p-value 0.45). However, the probability of dropping out, relative to stopping out or to remaining continuously enrolled, is higher for those receiving loans and lower for those receiving work-study aid. Loans must be paid back

and may be seen as a drain on future income. Work-study aid, by contrast, may both integrate the student more closely to the college and provide a convenient income source. Work-study schedules are also more likely to mesh with rather than to interfere with class schedules. Results in Table 4 show an increased probability of continuous enrollment with grant aid and substantial shifts between stopout and dropout behavior for recipients of loan and work-study financial aid packages. The probability of dropping out, for example, falls by half (from 2.3% to 1.1%) relative to the base case for those receiving work-study aid.

Finally, while a higher unemployment rate has the predicted positive impact on continuous enrollment, suggesting that higher unemployment rates keep students from leaving school, the unemployment rate is only statistically significant in distinguishing between dropout and continuous enrollment. Overall, the set of economic variables is not statistically significantly related to enrollment outcome (joint p-value across all equations is 0.25).

A Comparison with Simple Attrition Models

The results of our MNL indicate that there are differences between those who stop out and those who drop out. This suggests that parameter estimates from a logit model of attrition that fails to distinguish between stopout and dropout behavior will be biased. We examine the nature and magnitude of this bias by estimating a simple logit model in which dropout and stopout are treated as a single behavior (interrupted enrollment) and contrasted with continuous enrollment. In table 5, we present parameter estimates from the MNL model of dropout side-by-side with parameter estimates from the simpler logit

analysis. These results confirm the importance of distinguishing between short-term and long-term withdrawal.

Focusing primarily upon the coefficients that are statistically significant, there are several key differences between these specifications. Grant receipt and 'lives further than 100 miles' are statistically significant in the simple logit model but not the MNL model. This result can probably be attributed to the fact that each of these variables is associated with an increased probability of continuous as opposed to either dropout or stopout activity in the MNL model, and this increased probability is almost statistically significant. The association between immediate matriculation and dropout behavior is, by contrast, lost in the simple model because those who immediately matriculate are no more likely to stop out than to remain continuously enrolled. The effect of gender and age is similar between the two models if one takes into account the substantially larger probability with which women of any age will drop out in the simple model. Married women, who appear more likely to drop out using the simple definition of attrition, actually appear so inclined because they are significantly more likely to stop out only for a short time, not because they drop out for the long term. However, when stopout and dropout are treated as the same behavior, the association with stopout behavior dominates and gives the impression that being a married woman increases the probability of becoming a dropout. In the multinomial analysis, we "see them" as temporary stopouts rather than as permanent dropouts. Although the traditional literature treats them as dropouts, many married women actually return quickly to higher education. Conversely, women who marry do not appear significantly more likely to drop out in the simple model, because they are no more likely to stop out. Men who become fathers do not

appear at risk for dropping out using the simple model, because they are so much less likely to stop out than men who do not become fathers. Loans and work-study aid do not appear to have a significant influence in the simple model, because such aid does not change the probability of continuous enrollment, only the dropout/stopout mix.

In summary, using a model of attrition that fails to distinguish between short-term and long-term withdrawal will only accurately identify those factors that have a similar impact on stopout and dropout behavior. Those factors that have a differential impact on stopout and dropout behavior cannot be accurately assessed with a naïve model. One of these effects may dominate, or they may balance or cancel each other out, causing the simple logit on interruptions to yield substantially different results than the more complex MNL model. The MNL model provides a significantly more flexible specification.

Conclusion

Attrition studies are often unable to distinguish between short-term and long-term interruptions and hence typically assume either that all attrition is permanent or that all attrition is temporary. We discuss the attrition decision and suggest that in truth there is probably attrition of each sort. Using longitudinal data from the BPS-90, we define long-term dropouts as individuals who interrupt their studies for more than a calendar year and short-term stopouts as individuals who interrupt their studies for a calendar year or less. This classification is likely to overstate dropout behavior both because those initially choosing to stop out may withdraw for more than a calendar year and because those initially choosing to stop out may be more likely to revise their decision and drop out than those initially choosing to drop out. Further work using data with ex-ante

expectations or specifications that permit imperfectly observed regimes would aid in the identification of stopout and dropout behavior. Despite a bias against observing stopout behavior, however, we find that 40% of all first year attrition is temporary.

We then use a multinomial logit model to estimate the relation between personal, household, institutional, and economic factors and three first year enrollment outcomes: continuous enrollment, stopout, and dropout. We find significant differences between the factors associated with stopout and dropout behavior. Delayed matriculation, first year financial aid type, and marital and parental status, in particular, generate significantly and substantially different predicted interruption types. We show that these differences are not apparent in a naïve attrition model that fails to distinguish between dropout and stopout behavior. Researchers examining college attrition rates should take care to consider the nature of the withdrawal before making firm statements about the factors associated with "dropout rates". Policy makers should reevaluate the ability of naïve models to identify at-risk students. Our results suggest that a more complex model will do a better job.

Also of interest to policy makers are our results regarding the impact of aid policy on enrollment behavior. A naïve model understates the impact of financial aid receipt on enrollment outcomes. Our analysis shows that grant, work-study, and loan recipients have different enrollment behaviors from one another and from those not receiving aid. Those receiving work-study aid have the lowest probability of dropping out and those receiving grants having the highest probability of enrolling continuously. Further analysis of stopout behavior is warranted, as our study does not indicate whether those who stop out eventually complete the degree. While, there is evidence from O'Toole,

Stratton, and Wetzel (2003) that a surprisingly large fraction of those who interrupt their education are still enrolled five years after initial matriculation, data covering a longer period are needed to truly address this question. Initial evidence clearly shows strong support for work-study and grant aid if the goal is persistence towards a degree.

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Footnotes

[1] Most of those excluded are enrolled in trade school programs that typically last no more than one year. If included in our analysis, such students would be classified as having dropped out, even though they have completed their program of study.

[2] Attendance at all two-year for-profit institutions as well as bible colleges, culinary institutes, and the like is excluded from the analysis.

[3] Excluded were a total of 1222 individuals who either enrolled part-time or did not report their enrollment status. A handful of observations were also excluded due to missing family composition data or zero weights.

[4] Changes are identified by comparing status just prior to enrollment with status one year and three months later for marriage and with status one year and six months later for parenthood – thus permitting some foreknowledge.

[5] There are literally four men who were separated/divorced/widowed, eighteen men who married, and no men whose marriage ends.

[6] Information on the institutional fit is often critical in single institution studies of retention, but less relevant to studies such as this one where respondents may transfer between institutions without being classified as having dropped out. We have tested various measures of academic and social integration, but found they were universally statistically insignificant and so have excluded these variables from the models reported here.

[7] Two Hausman tests were conducted. In one, the MNL results were compared with those from a simple logit between the dropout and continuous samples. In the other one, the MNL results were compared with those from a simple logit between the stopout and continuous samples. In both cases, it was necessary to use a generalized variance-covariance matrix. The p-values associated with the resulting test statistics were 0.93 and 0.96 respectively, allowing us to handily fail to reject the assumption of IIA.

[8] Parental education appears to have a stronger effect on dropout for students under the age of twenty. As older students are more likely to receive their financial and social support from persons other than their parents, this finding is reasonable, but the difference is not statistically significant.

[9] Specifications with quadratic and nonlinear age effects were tested, but a linear effect appears to be sufficient.

[10] Recall that these men as well as those who were separated/divorced/widowed at the start of the first term were excluded from the analysis.

Table 1
Variable Definitions

Demographic Characteristics	
Female	1 if Female
Black	1 if Black
Nonwhite/Nonblack	1 if neither White nor Black
Hispanic	1 if Hispanic. Note that ethnicity and race are identified separately.
Parental Education	Dummy variables identifying the highest level of education completed by a parent. Use parental reply where available, else respondent's.
Less than High School	1 if most educated parent did not complete high school.
High School	1 if most educated parent completed high school, no more.
Some College	1 if most educated parent took some college courses.
College +	1 if most educated parent completed college or more. **Base Case.**
Missing	1 if have no information on parental education from either parent or respondent.
Household Income	
Independent	1 if student declares him/herself to be financially independent.
Parental Income < $20K	1 if student is dependent and annual parental income is < $20,000
Parental Income $20-30K	1 if student is dependent and annual parental income is $20-30,000
Parental Income $30-50K	1 if student is dependent and annual parental income is $30-50,000. **Base Case.**
Parental Income > $50K	1 if student is dependent and annual parental income is > $50,000
Timing	
First Attended in the Fall Term	1 if first attend during the fall term.
Immediate Matriculation	1 if individual matriculated immediately after completing high school.
Male Age - 16	Age - 16 for Men
Female Age - 16	Age - 16 for Women
Grades	First year GPA with preference given to institution-reported grades.
Low GPA	Institution reports GPA < 2.0 or individual reports "Mostly C's" or worse.
Self-Reported Average GPA	Individual reports "Mostly B's" or "B's and C's". No institution report available.
Institution-Reported Average GPA	Institution reports GPA between 2.0 and 3.25. **Base Case.**
High GPA	Institution reports GPA > 3.25 or individual reports "A's and B's" or better.
Missing GPA	Neither institution nor individual reported first year grades.

Family Characteristics	
Current Marital Status	Measured at the start of the first term enrolled.
Married Man	1 if respondent is a married man.
Married Woman	1 if respondent is a married woman.
Sep/Div/Wid Woman	1 if respondent is a separated, divorced, or widowed woman.
Change in Marital Status	Measured at the end of the term that begins one calendar year after first enrolled.
Woman who Marries	1 if respondent is a woman who marries.
Woman whose Marriage Ends	1 if respondent is a woman whose marriage ends.
Current Parental Status	Measured before initial enrollment.
Male Parent, Child < Age 6	1 if the respondent is a man with a child born after 1981.
Female Parent, Child < Age 6	1 if the respondent is a woman with a child born after 1981.
Change in Parental Status	Measured 18 months after first enrolled.
Child Born to Man	1 if the respondent is a man and a child enters his household.
Child Born to Woman	1 if the respondent is a woman and a child enters her household.
Institutional Characteristics	For first school attended.
Public School	1 if institution is Public, 0 if Private.
Two Year School	1 if institution is a 2 year school, 0 if a 4 year school.
Lives within 10 miles	1 if respondent lives within 10 miles of institution.
Lives further than 100 miles	1 if respondent lives more than 100 miles away from institution.
Financial Aid Variables	Dummy variables identifying the type of financial aid the individual received in his/her first year.
Received a Grant	1 if respondent received a grant.
Received a Loan	1 if respondent received a loan.
Received Work-Study	1 if respondent received work-study aid.
Received Employer Provided Aid	1 if respondent received employer provided aid.
Received Other Aid	1 if respondent received other aid.
Economic Conditions	
1990 Unemployment Rate	1990 Unemployment Rate in respondent's home state.
Expected Earnings (in 000s)	1990 Census data reporting earnings of a high school graduate working full-time, matched to the respondent's gender, race/ethnicity, and age.

Table 2
Sample Means by Enrollment Outcome

Variable	Continuously Enrolled Mean	Continuously Enrolled Std Err	Stopout Mean	Stopout Std Err	Dropout Mean	Dropout Std Err
Demographic Characteristics						
Female	0.5418	0.0126	0.5005	0.0445	0.5352	0.0345
Black	0.0702	0.0076	0.1349	0.0310	0.1150	0.0226
Nonwhite/Nonblack	0.0668	0.0077	0.0410	0.0212	0.0293	0.0107
Hispanic	0.0566	0.0067	0.0428	0.0147	0.0741	0.0235
Parental Education						
Less than High School	0.0443	0.0059	0.0370	0.0134	0.1042	0.0250
High School	0.2577	0.0120	0.3105	0.0367	0.3463	0.0314
Some College	0.2235	0.0104	0.2646	0.0340	0.2632	0.0316
College +	0.4649	0.0137	0.3494	0.0371	0.2604	0.0320
Missing	0.0096	0.0030	0.0385	0.0175	0.0259	0.0098
Household Income						
Independent	0.0730	0.0081	0.1328	0.0281	0.2053	0.0292
Parental Income < $20K	0.1610	0.0089	0.1847	0.0342	0.2084	0.0279
Parental Income $20-30K	0.2801	0.0114	0.2283	0.0326	0.2593	0.0298
Parental Income > $50K	0.2486	0.0103	0.2325	0.0351	0.2137	0.0267
Timing						
First Attended in the Fall Term	0.9519	0.0095	0.8923	0.0314	0.8213	0.0345
Immediate Matriculation	0.9027	0.0082	0.8358	0.0282	0.6631	0.0342
Male Age – 16	1.2240	0.0602	1.4282	0.1420	1.8828	0.3794
Female Age – 16	1.5890	0.0911	1.8732	0.4252	2.4180	0.3191
Grades						
Low GPA	0.1634	0.0109	0.3941	0.0427	0.3848	0.0355
Self-Reported Average GPA	0.0867	0.0104	0.0585	0.0165	0.1218	0.0233
High GPA	0.3113	0.0119	0.2170	0.0365	0.1632	0.0287
Missing GPA	0.0049	0.0017	0.0189	0.0142	0.0647	0.0235
Family Characteristics						
Married Man	0.0081	0.0022	0.0188	0.0080	0.0174	0.0092
Married Woman	0.0181	0.0039	0.0462	0.0193	0.0591	0.0200
Sep/Div/Wid Woman	0.0046	0.0017	0.0075	0.0067	0.0439	0.0140
Woman who Marries	0.0071	0.0019	0.0062	0.0040	0.0296	0.0076
Woman whose Marriage Ends	0.0032	0.0019	0.0098	0.0098	0.0009	0.0009
Male Parent	0.0104	0.0029	0.0097	0.0060	0.0172	0.0096
Female Parent	0.0257	0.0047	0.0490	0.0201	0.1237	0.0261
Male Parent, Child < Age 6	0.0074	0.0027	0.0088	0.0059	0.0035	0.0025
Female Parent, Child < Age 6	0.0133	0.0033	0.0057	0.0035	0.1078	0.0290
Child Born to Man	0.0032	0.0010	0.0012	0.0012	0.0179	0.0095
Child Born to Woman	0.0069	0.0029	0.0129	0.0051	0.0588	0.0171

Institutional Characteristics						
Public School	0.7416	0.0147	0.8215	0.0235	0.8462	0.0189
Two Year School	0.3177	0.0195	0.5259	0.0428	0.6585	0.0349
Lives within 10 miles	0.2561	0.0152	0.3057	0.0392	0.4595	0.0343
Lives further than 100 miles	0.3090	0.0151	0.1927	0.0266	0.1187	0.0171
Financial Aid						
Received a Grant	0.4424	0.0138	0.3231	0.0331	0.3473	0.0331
Received a Loan	0.2189	0.0097	0.1566	0.0209	0.2015	0.0235
Received Work-Study	0.1016	0.0075	0.0729	0.0135	0.0508	0.0120
Received Employer Provided Aid	0.0043	0.0012	0.0099	0.0092	0.0031	0.0022
Received Other Aid	0.1507	0.0095	0.0968	0.0250	0.0729	0.0144
Economic Factors						
1990 Unemployment Rate	5.5729	0.0419	5.5192	0.0796	5.5134	0.0610
Expected Earnings (in 000s)	14.9277	0.0568	15.0888	0.1592	15.2690	0.1754
# of Observations	3491		343		454	
Weighted Fraction of Sample	75.2%		10.1%		14.7%	

Table 3
Multinomial Logit Model of Continuous, Stopout, and Dropout Behavior

	Stopout versus Continuous			Dropout versus Continuous			Dropout versus Stopout		
Variable	Coefficient	Std Error		Coefficient	Std Error		Coefficient	Std Error	
Demographic Characteristics									
Female	-0.5046	0.4392		-0.2885	0.3701		0.2161	0.4541	
Black	0.5782	0.3253	*	0.0884	0.2893		-0.4898	0.4036	
Nonwhite/Nonblack	-0.5813	0.6058		-1.0318	0.5442	*	-0.4505	0.6793	
Hispanic	-0.2146	0.3540		-0.2684	0.4703		-0.0538	0.5430	
Parental Education									
Less than High School	-0.1889	0.5468		0.5087	0.3942		0.6976	0.5973	
High School	0.5338	0.2324	**	0.6971	0.2158	***	0.1633	0.2764	
Some College	0.4656	0.2203	**	0.5498	0.2351	**	0.0842	0.2891	
Missing	1.7789	0.6117	***	1.4852	0.5355	***	-0.2937	0.6656	
Household Income									
Independent	0.2383	0.4709		0.1068	0.4033		-0.1315	0.5091	
Parental Income < $20K	0.0674	0.3509		0.5779	0.3156	*	0.5105	0.4513	
Parental Income $20-30K	-0.3838	0.2555		0.1596	0.2973		0.5434	0.3598	
Parental Income > $50K	-0.1290	0.2431		0.3806	0.2549		0.5096	0.3337	
Timing									
First Attended in the Fall Term	-0.6879	0.3846	*	-1.0905	0.3457	***	-0.4026	0.3675	
Immediate Matriculation	-0.3211	0.3166		-1.0834	0.2732	***	-0.7623	0.3603	**
Male Age – 16	-0.0410	0.0941		0.1186	0.0544	**	0.1595	0.1029	
Female Age - 16	-0.0456	0.0635		-0.0150	0.0387		0.0306	0.0581	
Grades									
Low GPA	1.2143	0.1987	***	1.4813	0.2124	***	0.2670	0.2338	
Self-Reported Average GPA	-0.3153	0.3412		0.6813	0.3215	**	0.9966	0.4047	**
High GPA	-0.1205	0.2413		-0.1944	0.2612		-0.0739	0.3469	
Missing GPA	1.3507	0.7864	*	2.6986	0.4877	***	1.3479	0.8395	
Family Characteristics									
Married Man	2.4542	0.7989	***	-0.5855	0.9230		-3.0396	1.0674	***
Married Woman	1.4023	0.6384	**	0.6534	0.6264		-0.7488	0.6995	
Sep/Div/Wid Woman	1.1865	1.2180		1.6593	0.9280	*	0.4728	1.1379	
Woman who Marries	-0.0148	0.7963		1.2389	0.6003	**	1.2537	0.8242	
Woman whose Marriage Ends	0.6672	1.2360		-1.6431	1.0938		-2.3103	1.4974	
Male Parent, Child < Age 6	-0.7533	0.5382		-1.5307	0.7855	*	-0.7775	0.7910	
Female Parent, Child < Age 6	-1.9003	0.8997	**	0.7166	0.5355		2.6170	0.9948	***
Child Born to Man	-2.7286	1.2133	**	1.6306	0.7409	**	4.3593	1.3038	***
Child Born to Woman	0.4336	0.6360		1.9742	0.4820	***	1.5406	0.6666	**

Institutional Characteristics											
Public School	-0.0891	0.1782		0.0408	0.1874		0.1299	0.2515			
Two Year School	0.7107	0.1851	***	0.9508	0.1677	***	0.2401	0.2134			
Lives within 10 miles	-0.1249	0.2209		0.3020	0.1894		0.4269	0.2628			
Lives further than 100 miles	-0.2699	0.1860		-0.2375	0.1982		0.0323	0.2504			
Financial Aid											
Received a Grant	-0.3339	0.2263		-0.2692	0.2153		0.0647	0.2759			
Received a Loan	-0.1520	0.1959		0.3582	0.2072	*	0.5102	0.2658	*		
Received Work-Study	0.0680	0.2596		-0.7463	0.3611	**	-0.8143	0.4187	*		
Received Employer Provided Aid	1.0681	1.0926		-0.0864	0.7845		-1.1546	1.2895			
Received Other Aid	-0.0471	0.3042		-0.1155	0.2564		-0.0684	0.3731			
Economic Factors											
1990 Unemployment Rate	-0.1153	0.1012		-0.1674	0.1012	*	-0.0521	0.1275			
Expected Earnings (in 000s)	-0.1141	0.1361		-0.1478	0.1083		-0.0337	0.1522			
Constant	1.1152	2.1147		1.6280	1.8509		0.5129	2.3634			
F-Test All	6.79										
F-Test Column	3.83			10.03			2.67				

Asterisks indicate statistical significance using a 2-tailed test. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.
All statistics take into account the complex sample design of the BPS.

Table 4
Selected Predicted Outcome Probabilities

Individual Characteristics	Continuous Enrollment	Stopout Behavior	Dropout Behavior
Base Case (a)	90.2%	7.5%	2.3%
Woman	91.4%	6.5%	2.1%
Parents have only a High School Education	83.8%	11.9%	4.3%
Delayed Entry	84.0%	9.6%	6.4%
First Attending a Non Fall Term	80.6%	13.3%	6.1%
Low GPA	71.8%	20.1%	8.1%
Age 21, Independent, Delayed Entry	80.1%	10.3%	9.6%
+ Married	39.1%	58.3%	2.6%
+ Married + Child < Age 6	58.2%	40.9%	0.8%
Woman, Age 21, Independent, Delayed Entry	84.7%	9.1%	6.2%
+ Married	63.3%	27.8%	8.9%
+ Married + Child < Age 6	73.9%	4.8%	21.2%
Public School	90.7%	6.9%	2.4%
Two-Year School	81.0%	13.7%	5.4%
Received a Grant	92.7%	5.5%	1.8%
Received a Loan	90.3%	6.4%	3.3%
Received Work-Study	90.8%	8.1%	1.1%

(a) 18 year old white male who enrolls in the fall term immediately following high school graduation, whose parents have completed college and earn between $30,000 and $40,000 annually, who has an average GPA, attends a private 4-year college that is 10-100 miles from his parent's home, is unmarried and not a parent, lives in an area with a 5.6% unemployment rate and has standard expected earnings for a white male 18 year old.

Table 5
Comparing MNL and Logit Models of Dropout Behavior

	Dropout vs. Continuous MNL Model			Interrupt vs. Continuous Simple Logit Model		
Variable	Coefficient	Std Error		Coefficient	Std Error	
Demographic Characteristics						
Female	-0.2885	0.3701		1.0786	0.8156	
Black	0.0884	0.2893		0.2834	0.2314	
Nonwhite/Nonblack	-1.0318	0.5442	*	-0.8069	0.4775	*
Hispanic	-0.2684	0.4703		-0.2060	0.3257	
Parental Education						
Less than High School	0.5087	0.3942		0.2834	0.3573	
High School	0.6971	0.2158	***	0.6238	0.1749	***
Some College	0.5498	0.2351	**	0.5103	0.1773	***
Missing	1.4852	0.5355	***	1.5933	0.4578	***
Household Income						
Independent	0.1068	0.4033		0.1253	0.3570	
Parental Income < $20K	0.5779	0.3156	*	0.3056	0.2403	
Parental Income $20-30K	0.1596	0.2973		-0.1324	0.2089	
Parental Income > $50K	0.3806	0.2549		0.0961	0.1859	
Timing						
First Attended in the Fall Term	-1.0905	0.3457	***	-0.8925	0.3079	***
Immediate Matriculation	-1.0834	0.2732	***	-0.0216	0.0413	
Male Age – 16	0.1186	0.0544	**	0.0707	0.0483	
Female Age – 16	-0.0150	0.0387		-0.7745	0.2288	***
Grades						
Low GPA	1.4813	0.2124	***	1.3467	0.1681	***
Self-Reported Average GPA	0.6813	0.3215	**	0.3101	0.2536	
High GPA	-0.1944	0.2612		-0.1515	0.1827	
Missing GPA	2.6986	0.4877	***	2.1919	0.4373	***
Family Characteristics						
Married Man	-0.5855	0.9230		0.8296	0.7066	
Married Woman	0.6534	0.6264		0.8669	0.5105	*
Sep/Div/Wid Woman	1.6593	0.9280	*	1.5703	0.8283	*
Woman who Marries	1.2389	0.6003	**	0.8534	0.5235	
Woman whose Marriage Ends	-1.6431	1.0938		-0.1708	1.0572	
Male Parent, Child < Age 6	-1.5307	0.7855	*	-1.1581	0.6011	*
Female Parent, Child < Age 6	0.7166	0.5355		0.2350	0.4120	
Child Born to Man	1.6306	0.7409	**	0.5060	0.6105	
Child Born to Woman	1.9742	0.4820	***	1.5179	0.4101	***

Institutional Characteristics						
Public School	0.0408	0.1874		-0.0290	0.1311	
Two Year School	0.9508	0.1677	***	0.8256	0.1386	***
Lives within 10 miles	0.3020	0.1894		0.1208	0.1543	
Lives further than 100 miles	-0.2375	0.1982		-0.2431	0.1462	*
Financial Aid						
Received a Grant	-0.2692	0.2153		-0.3065	0.1703	*
Received a Loan	0.3582	0.2072	*	0.1365	0.1510	
Received Work-Study	-0.7463	0.3611	**	-0.3590	0.2256	
Received Employer Provided Aid	-0.0864	0.7845		0.5349	0.8091	
Received Other Aid	-0.1155	0.2564		-0.0877	0.2152	
Economic Factors						
1990 Unemployment Rate	-0.1674	0.1012	*	-0.1443	0.0784	*
Expected Earnings (in 000s)	-0.1478	0.1083		-0.1475	0.0970	
Constant	1.6280	1.8509		2.0447	2.1493	
F-Test Column	10.03			9.64		

Asterisks indicate statistical significance using a 2-tailed test. *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level.
All statistics take into account the complex sample design of the BPS.