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I. Introduction

The basic strategy behind our approach to estimating the cost of a paid leave program was to, as much as possible, base estimates of program costs on actual known leave-taking behavior, and where this was not possible, to estimate a range of program costs reflecting a range of reasonable assumptions about unknown aspects of behavior in the presence of a paid leave program. We wanted to be able to estimate the sensitivity of program costs estimates to these assumptions. We also wanted to be able to analyze the distribution of program benefits by demographic characteristics. Furthermore, we wanted to be able to estimate the costs of similarly structured paid leave benefit programs in other states, to be able to have some control over the assumptions about behavior that affect program cost estimates, and to be able to undertake distributional analyses.

We chose a simulation strategy as the best way to accomplish these goals. To obtain the best estimates possible about known leave-taking behavior, we use the Public Use Family and Medical Leave survey data collected by Abt Associates in 2012 for the Department Labor (referred to here as the DOL Survey) (McGarry, Klerman, Daley, and Pozniak, 2013) to estimate behavioral models of leave-taking behavior conditional on the demographic characteristics of individuals, and use the Census Bureau's American Community Survey Public Use Microdata Sample (hereinafter referred to as the ACS or ACS PUMS) to predict leave-taking behavior conditional on the demographic characteristics of individuals.

The DOL Survey is the best available source of information on leave-taking behavior. It is a representative national sample of leave-takers, leave-needers (those persons who said they needed but did not take a leave), and other workers who did not take a leave. The survey, which was conducted between February and June 2012, includes extensive information on the number and types of leaves taken, how long they were, whether and to what extent the employer provided pay while on leave, and whether or not some or additional pay while on leave would result in a decision to take a leave or to have taken a longer leave. The survey includes several demographic characteristics related to leave-taking behavior, including sex, race and ethnicity, martial status, the presence of children, education, family income, and whether or not the respondent was paid on an hourly basis. The survey is used to estimate several aspects of leave taking behavior, conditional on demographic characteristics and leave type. These include the probability of needing a leave, of taking a leave, of getting paid for a leave, of extending a leave if some or more pay were received, etc.

The ACS is a large national representative sample of persons. It is of sufficient size to obtain reliable estimates of paid leave program costs and of the distribution of program benefits at the state and sub-state level. The 5-year ACS PUMS can yield reliably accurate estimates at geographic areas consisting of one or more PUMAs (a PUMA is a geographic area that consists of a population of roughly 100,000 persons). This survey also provides a rich array of demographic characteristics that closely match those on the DOL Survey, which means that the behavioral models estimated on the DOL Survey can be used to predict leave-taking behavior on the ACS.

The simulation model is a software application that "runs" each sample person from the ACS through the estimated behavioral models and sets of assumptions about leave-taking behavior. The flow of the person through the software mimics the sequence of decisions and events that a person makes and experiences in the leave process (depicted in Figures 1-5). This is an appealing aspect of simulation methodology since its structural approach helps identify what assumptions are necessary in developing program cost estimates and at the same time clarifies the impact of these assumptions on the bottom line estimates.

At several points during the simulation, such as when a person decides to take a leave of a particular type or not, a decision is made based on a logit behavorial equation. The logit equation estimates the probability of deciding "yes". This probability, which is a function of the person's demographic characteristics, is compared to a random draw from a standard uniform distribution (any point on the number line between zero and one is equally likely to be chosen), and the random draw is compared to the probability given by the behavioral equation. If the random draw is less than this probability (or less than or equal, it really does not make any difference), the decision is "yes", if not, "no". The model flow then directs the person to the next point in the modeling sequence, depending on the result of this random draw. This is the essence of simulation.

After each person has been passed through the entire flow, the result is a history of leave-taking behavior for a one-year period. The model generates micro-data output files consisting of records for each sample person and leave taken. These files can be analyzed with standard statistical software or database applications.

Aside from errors related to the DOL survey and estimates of the behavioral equation parameters, there are two sources of statistical error related to the simulator that are important to consider. One is sampling error due to the ACS. The ACS is a sample and is subject to sampling error that affects program cost estimates. The magnitude of this error is approximately inversely proportional to the square root of sampling size, and can be reduced by concatenating successive years of the ACS together. The second source of statistical error is due to the simulation methodology itself when the dependent variable is binary (or categorical). Even if the coefficients of a behavioral equation are "correct", individual predictions are not at the individual level. For example, suppose a logit equation predicts that the probability of taking a leave is 30 percent for a person with a certain set of demographic characteristics. For any *single* person, the simulation results in either the person taking the leave – a simulation error of 70 percent-- or the person not taking the leave – a simulation error of 30 percent. The law of large numbers assures that the error approaches zero on average as the number of persons "run" through this equation approaches infinity. The magnitude of this simulation error is inversely proportional to the square root of the number of "runs" through the equation. The incidence of some types of leave is small enough that this source of error is not negligible. This type of error can be reduced by concatenating ACS data files, but there is also another way to reduce simulation error. That way is to "clone" the sample ACS person (i.e., to create several duplicates of the same person) and to run each duplicate person through the simulation. The software allows the user to specify this option. At the state level, the ACS sample is large enough so that cloning is not really necessary; but for estimates at sub-state geographies, cloning may be an excellent way to reduce simulation error.

The next major section of this document describes the simulation strategies. The third major section describes the modeling assumptions used by the simulation model.

The fourth major section of this document describes the flow of the model and the fifth major section describes how leave lengths are dated across the calendar.

II. Simulation Model Strategies

The principal strategy behind the implementation of the model is to use econometric estimates of known leave-taking behavior when possible, and to incorporate reasonable assumptions and user-supplied options about unknown behavior. As new knowledge about behavior becomes available, the user may be able to incorporate that in model options – for example, new knowledge about take-up rates. In addition, new knowledge may be incorporated as it becomes available in future versions of the model.

Modeling Known Behavior

The best source of information on which to model several aspects of known behavior – the incidence of taking or wanting to take a leave of a particular type, the probability of receiving pay while on leave and the amount of pay received, the length of leaves taken, and the probability of meeting the eligibility requirements of a proposed paid leave program – is the Family and Medical Leave in 2012 survey conducted by Abt Associates for the Department of Labor (McGarry, Klerman, Daley, and Pozniak, 2013). The population surveyed consisted of adults 18 and older who had worked for pay in the last 12 months. They were asked about leaves taken or wanted during the prior 18 months for reasons of own health disability (including maternity disability); to care for a new child; for health conditions of children, spouses, parents, other relatives, and non-relatives; and for issues arising from the deployment of a military member. Due to small sample sizes for some categories, we limited our analysis and modeling to the following six leave types:

1. Own health;
2. Maternity disability;
3. Care for a new child;
4. Ill child;
5. Ill spouse; and
6. Ill relative.

The sample of persons surveyed can be classified into four groups depending on whether they took a leave or wanted to take a leave or not:

1. Those who took a leave and who did not not take a leave they wanted to take (leave-takers only, N=1,133);
2. Those who wanted to take a leave but did not take any leaves (leave-needers only, N=219);
3. Those who did not take a leave or want to take a leave (employed only, N=1,301); and
4. Those who both took a leave and also did not take a leave that they wanted to take (dual takers/needers, N=199).

The sample was weighted to the population so population rates and totals could be inferred from the sample. The survey asked about the longest and most recent leaves taken or wanted – and the reason for that leave – in the last 18 months, whether those leaves were taken or wanted in the last 12 months, and how many leaves in all were taken in the last 18 months and in the last 12 months. Leaves were counted by "reason", so intermittent leaves for a single reason were counted as a single leave. Leave-takers were asked about the reasons and lengths of leave for up to two leaves: the longest and the most recent (often they are the same). Leave-needers were asked about the most recent leave needed and the reasons for up to two more leaves needed. For both taker and needer leaves, respondents were asked if they saw a doctor or had a hospital stay. For the most recent leave taken or needed, additional information was asked. For leave-takers, this included questions about pay received while on leave; and if full pay was not received, whether they would have taken a longer leave if they had received additional pay. For leave-needers, this included a question about why they didn't take the leave. Many respondents volunteered that they couldn't afford to take an unpaid leave. These questions about additional pay and affordability were helpful in modeling the response of leave lengths and participation in the presence of a paid leave program. Leave-takers were also asked about whether some of the pay received while on leave was part of a TDI program or a state family leave program.

Respondents were also asked about their work. Particularly useful for modeling behavior and estimating program eligibility were questions about weekly hours, whether they worked full year and were continuously employed by a single employer, how many employees worked at their organization within 75 miles, and whether they were paid on an hourly basis or not. Demographic information on respondents included age, sex, race/ethnicity, marital status, educational attainment, family income, and how many children were in their care.

Earlier theoretical work and statistical analysis of a prior Department of Labor family leave survey (Westat, 2001; Albelda, and Clayton-Matthews, 2010) established that the information in this survey would be useful in estimating statistical models of the probability of taking or needing a leave of a particular type, the probability of receiving partial or full pay, and the probability of meeting the eligibility requirements of the FMLA law or a proposed paid leave program. The estimation strategy involved a specification search that began with a full set of demographic and economic variables and "tested down" to a specification that included independent variables that were at or near statistical significance at the 5% level and that "made sense" in terms of yielding estimated coefficients of the expected sign and reasonable magnitude.

These statistical models are implemented in the model by applying the estimated coefficients to variables on the ACS for each sample individual worker. Most of these models estimate a probability: the probability of taking or needing a leave for a particular reason, the probability of receiving pay while on leave, the conditional probability that that pay was full pay, etc. Using the coefficients of the logit regression model and applying them to the sample individual's independent variables yields a probability of taking or needing a leave, of receiving pay while on leave, of receiving full pay conditional on receiving any pay, etc.[1] These probabilities are compared to a random draw from a standard uniform distribution – using the model's pseudo random number generator – to determine whether an outcome happens or not. Other models – for

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[1] A logit equation estimation is a statistical method similar to linear regression estimations, but with logit analysis, the dependent variable is binary (0 or 1) rather than continuous.

example, for fraction category of pay received, or number of leaves taken – are estimated by an ordered logit model, and the random draw determines the category by the estimated cumulative probability distribution of outcomes. Several models – usually when sample sizes are too small to estimate probabilities conditional on observable characteristics – are simply the weighted distributions from the survey. These models are identical to statistical models that contain only a constant, and are handled by the simulator in the same manner as other models that predict probabilities of binary outcomes or ordered outcomes.

This strategy “works” because both the DOL survey and the ACS are representative samples (after weighting) of the population and both contain closely similar measures of independent variables. The match of variables is not complete, however, so a few variables not available on the ACS have to be imputed. For behavioral models these involve two variables: whether or not the worker is paid on an hourly basis, and whether or not the worker is covered and eligible under the FMLA law. This eligibility criterion is significant in several behavioral relationships, and involves weeks worked, worked full time continuously for a single employer in the past 12 months, and worked for a firm that had at least 50 employees within 75 miles. Other eligibility requirements of proposed paid leave programs might require knowing weeks worked; and benefit rules of proposed programs usually pay benefits proportional to weekly earnings.

The ACS does not ask whether pay is received on an hourly basis; does not ask about employer size; does not ask about the number of employers that the person worked for in the last 12 months; does not ask about weekly pay; and records weeks worked in aggregated categories. These variables are imputed on the ACS using models and distributions estimated from the Current Population Survey (CPS) – which *does* include these variables – conditional on demographic and economic variables common to both the CPS and ACS surveys. Weekly wages on the ACS are estimated as annual earnings divided by the imputed number of weeks worked.

Behavior Estimations

To estimate the cost of paid leave using individual wage and salary workers from the ACS we generate a range of data: the likelihood and actuality of taking a leave, the number of leaves, and the length of leave in the absence of a paid program. We estimate if any particular worker who takes a leave has some form of employer benefits and how much these are worth. We derived probabilities of leave-taking behavior based on findings from several logit regressions based on the following three models:

1. Universe of Leavers

We theorize that whether an employee will take or want to take a leave depends on a variety of factors that include:

a. Whether the employee is eligible for and needs a leave (paid or unpaid), as indicated by the worker's own health status, the health status of family members, a new child in the household, and eligibility requirements (hospital stay, doctor's visit, employer size);

b. The conditions of employment, proxied by whether the employee has a job-protected leave and the employment arrangement (salary or wage worker); and

c. An employee's tastes, preferences, and constraints (work and income) measured by the employer's demographic characteristics (marital status, family income level, age, gender, education level, and race/ethnicity).

We run separate logit regressions for each of the six types of leave (own health, maternity disability, new child, ill health of spouse, ill health of child, ill health of parent).

2. Length of Leave

We theorize that the number of weeks of paid or unpaid leave a person takes depends on:

a. The presence of a family or medical leave condition (this affects the type and severity of leave);

b. Conditions of employment (number of weeks with paid leave, how employer leave is paid, difficulty in taking leave, and whether a leave is job-protected); and

c. The employee's tastes, preferences, and constraints, measured through demographic characteristics (marital status, family income level, age, gender, education level, and race/ethnicity).

Analysis of leaves lengths using the DOL Survey indicates that leave lengths of illness types are related to the severity of illness. However, aside from the gender of the leave-taker (for all but own-health) and severity of illness, there are no other significant predictors of leave length. Importantly, whether or not the leave-taker receives pay from his/her employer does not seem to be associated with the length of the leave. Since the ACS does not have information on individuals' illnesses, the application simulates leave length by randomly drawing from the distribution that corresponds to the type of leave and gender of the leave-taker.

3. Employer benefits

We hypothesize that the amount of employer pay a leave-taker receives (if any) is related to:

a. The length of leave;

b. Conditions of employment (whether the worker is covered by and eligible for FMLA); and

c. The employee's tastes, preferences, and constraints measured through demographic characteristics (marital status, family income level, age, gender, education level, and race/ethnicity).

The 2012 DOL survey asked about how much pay relative to total pay is received over an entire leave did not ask leavers with partial wage replacement about the amount of replacement pay received while on leave for each pay period. However this was asked in the earlier 2000 DOL Survey on family and medical leaves (Westat, 2001). In the 2000 DOL Survey, leavers who indicated that they received partial pay from their employer while on leave were asked if they received at least some pay for each pay period that they were on leave (HA10D), and if not, was the pay for their full salary or only for a part of their salary (HA10E). Leavers were also asked what proportion of usual pay they received in total over the entire length of the leave (HA10F). The relative frequencies of the responses to these questions were tabulated separately for each leave type, and expressed as conditional probabilities (Table 1).

III. Modeling Assumptions

Simulating Unknown Behavior

Some information about leave-taking behavior needed for our simulation procedure cannot be estimated from the DOL 2012 survey, although some information collected there is useful in making some reasonable assumptions. The three main pieces of unknown information – whether a worker will use a paid program or employer benefits; program take-up rates; and whether a worker will extend a leave in the presence of a program – are discussed below.

1. How employer benefits affect participation in paid program.

The decision to participate in the paid leave program, given that a person is eligible, will in large part be based on the level of program benefits the worker would receive compared to the next best alternative. These alternatives consist of employer pay (if the person receives it) or nothing (if the leave is unpaid in the absence of the program). In order to compensate for the time and effort of applying to the program, program benefits would have to exceed the next best alternative by some amount. This amount may differ systematically by income and by other factors. It may also vary randomly across different individuals, and even for the same individual, at different times.

In the model, this participation decision is implemented by an arbitrary logit equation with two independent variables: the difference between weekly paid program benefits and weekly pay received while on leave, and family income. The participation probabilities it yields are given in Table 2 for several combinations of benefit/pay differentials and family income.

Optionally, the user can specify that employers who would pay their employees 100 percent of wages while on leave would instead require their employees to participate in the program and would "top-off" the program benefits by paying the difference between program benefits and full pay. Since not all such employers might engage in this behavior, the user can specify the percent of such employers – that is, the percent of employers who pay full wages while on leave – who do so. Also, since this behavior may be less likely for short leaves, the user can specify the minimum leave length for which employers engage in a "top-off" strategy.

2. Take-up Rates

The simulation model estimates the number of all eligible workers that would use a paid leave program in light of current employer benefits. This estimate assumes that everyone taking a leave knows about the program and that the program is virtually costless to use. That is, the output from the simulator assumes a 100 percent take-up rate. However, that may be completely unrealistic, which is why one of the policy parameters that can be adjusted by the user is take-up rates. The degree to which eligible leavers might use a paid leave program depends on a variety of factors beyond the scope of what can be uniformly modeled or assumed. Four important ones are: general knowledge of the program by workers; administrative complexity in obtaining program benefits; workplace norms that either encourages or inhibits use; and leave-taking patterns among some leavers. Recent experiences with care and bonding leaves in California, New Jersey and Rhode Island suggest that take-up rates, at least for several years, will be low. A recent estimate indicated that 25-40 percent of new mothers used the six-week care leave in California, even after 10 years of implementation (Pihl and Basso). Appelbaum and Milkman (2011) found that fewer than 50 percent of California workers knew about paid family leave. The degree to which state administrators and paid family and medical leave advocates work to make the program known will positively affect take-up rates. Use of any program will require time on the part of leave-takers (and employers) to fulfill the administrative requirements of the leave. An easy-to-use program can reduce that time. Still, workers that take relatively short leaves may not bother at all. There may be other real or perceived costs to taking a program leave. If workers fear their position at their job might be threatened if they take a leave, then take-up rates will be low. For example low-wage workers may fear being replaced altogether while high-wage employees may fear an employer might not provide them with better opportunities. Finally, researchers do not know enough about leave-taking patterns and how they interconnect with program requirements. Outside of pregnancy and some own-health leaves, the amount of time needed for a leave or the pattern of time out of work may be unpredictable or intermittent. This, of course, makes it hard to discern if applying for and using a statewide program makes sense. Some leaves may require levels of flexibility in time out of work that are not conducive to applying and using a program largely designed for continuous use over many weeks. Further, for people taking leaves to care for an ill relative there may be care-taker substitutes that affect how leaves are taken and may reduce the likelihood of turning to a program for leave. A considerably smaller percentage of all program paid leaves are for ill relatives in California, New Jersey, and Rhode Island than found among all leavers in the 2012 DOL survey data (which in turn is reflected in the model). This suggests that there may be aspects of these leaves that result in less likelihood of using a program and requires using a very low take-up rate for these leaves on the model.

The simulation model lets the user select a take-up rate based on some reasonable assumptions about the percent of eligible workers that might use a particular program in a particular state. The user can apply different take-up rates for different kinds of leaves. For example, there are reasons to believe that maternity disability leaves might have higher take-up rates than other leaves. Almost all mothers that give birth do leave work for a continuous period of time that is usually known in advance. Employers and employees typically expect new mothers to be away from work for more than a few weeks. Further, obstetricians and others in pregnant mother's networks are likely to inform them of a paid leave program so usage might be higher than other types of leaves.

The user can optionally specify that a particular class of eligible leave takers will participate in the program with certainty. This class is composed of those people who wanted to take a leave in the absence of paid leave program but who did not because they could not afford to. In the presence of a paid leave program, such persons might be more likely to participate than others in the presence of a paid leave program.

3. Extending a leave in the presence of a program

In the presence of a paid leave program, leaves would not be shorter than in the absence of the program, but they may be longer. Lacking empirical evidence about the effect of program benefits on extending leave lengths, we estimate the probability of extending a leave. Because this decision is complex and affected by length of leave before the decision to extend, availability of employer pay, and whether the leave is job-protected, we use different extension rules in the simulation. For workers with short leaves (leaves that end before the waiting period of the program is over), we estimate the probability of taking a longer leave using logit regression estimations relying on the response to the DOL survey question, "Would you take a longer leave if you received some/additional pay?" If the model simulates an extension, we arbitrarily extend the leave for 1 week. We assign a different decision to those employees who reach the end of their original leave length (the length they would take if there was not program) and are receiving either program or employer benefits (but not both). We assume the probability of extending these leaves using program benefits are 25 percent and for those who do extend, that the extension is equal to 25 percent of their original length, not to exceed the maximum length of the program. The last decision applies only to those who have exhausted the paid program and still have some employer benefits available to them (based on the simulation). In this case the simulator assigns them a 50 percent probability of taking an extended leave for as long as they still have employer benefits. In all cases, if the original length of leave is less than the FMLA job-protection length of 12 weeks, an option in the model allows the user to restrict the leave to a maximum of 12 weeks. In the case of own health leaves, there was a significantly longer distribution of leaves for workers who received some part of their pay from state programs; and so the model incorporates longer own health under a paid leave program by using the distribution of leaves experienced by these covered workers.

A note on own-health pregnancy leaves and leaves for a new born

The public use file of the 2012 DOL survey allows for a single leave-type response from women that took a leave to give birth to a child. The respondent could indicate if she took an own-health pregnancy related leave (which may have also included bonding time) or a leave to bond with a new child, but not both. We believe this underestimates both type of leaves for women giving birth. Using very high take-up rates for pregnancy and new child leaves helps adjusts for this, even though it may overestimates the degree to which men take bonding leaves.

IV. What the Model Does: The Flow of the Model

This section describes what the simulation does by following the flow through the model's software. For the most part, this flow corresponds to the timing of decisions and modeling of behavior individuals make and exhibit in the process of taking a leave for personal or family-related medical reasons. Again, the way in which this simulator models the leave process, including the simulated behavior and personal decisions, are highly influenced and constrained by information from and the structure of the DOL survey.

The Main Program Loop

The application reads the ACS input file household by household, and within each household, passes each person through the simulator.

First, it is determined whether or not the person is an adult civilian who worked last year and passed through the rest of the simulator. One user option is to exclude persons that are self employed or government workers in case these workers are not in the universe of possible program leave-takers.

Some necessary information is not directly available on the ACS, and therefore is estimated or simulated. These include weeks worked (imputed from the categorical weeks worked variable), weekly wage (annual earnings divided by weeks worked), paid hourly or not, employer size, and worked for a single employer last year or not.

Based on these imputations, the simulator next determines the work and employer-size eligibility requirements for FMLA and for the paid leave program, using information on the person's work history. To approximate the work requirement under FMLA, the person had to have worked at least 1250 hours last year, and only have had one major employer last year. In addition, for eligibility coverage under FMLA, the size of the establishment must be at least 50 employees. This concept of FMLA eligibility under the work and employer size requirements is used as an independent variable in several of the behavioral equations in the model, because it influences the person's ability and willingness to take a leave, and also is correlated with other personal and job characteristics that are not measured by other independent variables. Worker eligibility and employer coverage under the proposed program is calculated according to user-supplied eligibility requirements.

The person then enters the main software program loop illustrated in Figure 1. Each person is run through two branches illustrated in the figure. The person might be a leave-taker, a leave-needer, or both in a given year. On the left branch, the probability of a person's most recent leave being each of the six possible leave types is estimated conditional on the person's characteristics. These probabilities are compared to a draw from a standard uniform probability distribution. (Think of a "Wheel of Fortune", where the size of each slice on the wheel is proportional to the probability of a particular leave type, with the remaining large slice representing no leave.) Note: except where noted in Figure 1, each arrow represents a positive outcome. A negative outcome results in the person "dropping out" from taking a leave.

If one of the leave types is chosen, the possibility of more than one leave is simulated; and if so, the number of leaves greater than one is simulated as a random draw from the probability distribution of 2 through 6 possible leaves. The types of these additional leaves, if any, is simulated from an estimate of the conditional probability distribution of a second leave (conditional on a first leave). This conditional probability distribution was estimated from those sample persons in the DOL survey who reported on the type of leave for both their longest and most recent leave, when these were different leaves. The survey implied that the probability of taking a second ill child leave or a second ill parent leave was higher than the unconditional probability of each, and the probability of taking a second maternity disability or new child leave in a given year was effectively zero.

The leave length is simulated as a random draw from the estimated distribution of each type of leave length given by the DOL survey. Except for own health leaves, these differed by sex, with women tending to take longer leaves than men. For own health leaves, leave lengths were longer for those who stated that they received some pay from a TDI or state paid leave program, so two leave length distributions were used: in the absence of a program, the distribution of leave lengths for persons who did not report receiving these payments was used; in the presence of program, the distribution of leave lengths for persons who did report receiving these payments was used.

Leave lengths are counted in five-day weeks, so a leave of two weeks, for example, is ten days. At this point in the program flow, the leave lengths represent those in the absence of a paid leave program, except for those persons who would not have taken a leave in the absence of such a program. Later in the flow, in the presence of the paid leave program, the person may choose to extend their leave.

Up to this point, the simulation on the right branch, for leave-needers, is similar, except that simulated leave lengths represent leave lengths *if* they were to take a leave.

For leave-takers, their weekly payments while on leave in the absence of a program is simulated in stages. First, whether or not they receive any pay while on leave. Next, conditional on receiving pay, was it full pay; and if not, what fraction of pay was received.

For those who were partially paid, the 2000 DOL Survey asked if the respondent received some pay for each pay period that they were on leave; and if not, in the pay periods for which they *did* receive pay, was it for their full salary? As described earlier and illustrated in Table 1, the 2000 DOL survey was used to estimate these conditional probability distributions for each leave type and payment group (less than half pay, about half pay, more than half pay). If a person’s leave was partially paid, their payment schedule was randomly selected from the corresponding conditional probability distribution for their leave type.

At this point, the application has determined if a person received some pay each week; and if not, if that person received full pay for some weeks; and if, over the course of their leave, a person received less than half of full pay, about half of full pay, or more than half of full pay (see Figure 2). The weekly pay schedule is then filled out using arbitrary rules subject to these payment schedule and amounts constraints. For example, those persons who received some pay for each week of their leave, but who received less than one quarter pay in total, were assigned 12.5 percent of their weekly pay in each week of their leave, while those persons who received some pay each week, and more than three-quarters but less than full pay, were assigned 87.5 percent of their weekly pay in each week of their leave.

For leave-needers, the model simulates whether they would take a leave if there were a paid leave program based on their reason for not taking a leave being that is was not affordable. If not, they are classified as an ultimate leave-needer. If they do take a leave, they then follow the same remaining path as leave-takers.

At this point, the leave-taker's (or potential leave-taker, if originally a needer), eligibility is determined. The work and employer eligibility conditions have already been determined by this point, so here it is determined whether or not they saw a doctor or went to a hospital (or whether the person they took a leave to care for saw a doctor or went to the hospital). These are computed by comparing the probability of a logit behavioral equation for each condition (i.e., seeing a doctor and going to the hospital) to a corresponding random number. The doctor and hospital requirements vary somewhat depending on the leave type. Essentially, to be eligible for an FMLA-defined leave (except for new child) requires either seeing a doctor or going to the hospital, and it is presumed that if the person or the person they were caring for went to the hospital, they also saw a doctor.

After it has been determined what leaves, if any, the person takes, and their lengths, the leaves are then distributed across a calendar where their leave either finishes in a 12-month period beginning April 16, 2011 and ending April 15, 2012, or they are still on leave on April 15, 2012. The dates for the beginning and ending of the 12-month period are not critical. This period was chosen simply because the survey was conducted between February and June of 2012, so April 15 was approximately in the middle of this period. But, this assumes that leave-taking is not seasonal. Although the model simulates leave-ending dates that are uniformly distributed throughout the year, it does not guarantee that for any simulated person, the dates "make sense" in that it is possible that two simulated leaves overlap in time. However, what it *does* achieve is a reasonable estimate for the extent to which some leaves which take place during a given year "spill" outside the yearly time period, either because they began before the year began or ended after the year ended.

Employer pay, program benefits, and leave length in the presence of a paid leave program

The next step in the model is to simulate employer pay, program benefits, and possible extensions of leave length in the presence of a paid leave program. The application simulates the sequence of events and choices that a leaver would reasonably experience, given their weekly leave history and weekly schedule of employer payments simulated up to this point, in the absence of a paid leave program. Three important, and reasonable, assumptions are embodied in this part of the simulation:

1. Not all eligible recipients participate in the program, due to lack of information, the hassle of applying, or other reasons. The proportion of eligible paid program leave-takers who *do* participate is called the "take-up rate", and is one of the program parameters set by the user. The user can specify a different take-up rate for each leave type. Eligibles who "pass" through this sieve then begin on one of two paths. If they received some employer pay in the absence of a program, they begin an employer-paid leave (Figure 3, state [0]). If they did not receive any employer pay in the absence of a program, they begin an unpaid (without any pay from the employer) leave (Figure 3, state [3]).

2. The decision to participate in the paid leave program, given that the person is eligible, is also based on the level of program benefits he/she would receive compared to the next best alternative, which is employer pay if the person received it, or nothing, if the leave was unpaid in the absence of the program. In order to compensate for the time and effort of applying to the program, program benefits would have to exceed the next best alternative by some amount, and furthermore, this amount may differ systematically by income and by other factors. It may also vary randomly across different individuals, and even for the same individual, at different times. This participation decision is implemented by an arbitrary logit equation that has the difference between weekly paid program benefits and weekly pay received while on leave, and family income as independent variables. The participation

probabilities it yields are given in Table 2 for several combinations of benefit/pay differentials and family income. The larger the difference and the lower the person's family income, the higher the probability of participating in a program. This decision occurs in several places in the possible paths through the model. The user can turn off this participation module if they wish, and rely solely on the take-up rate parameter instead.

3. The part of the simulation flow that establishes employer pay, program benefits, and possible extensions of leave length in the presence of a paid leave program is illustrated in Figures 3 through 5. The software models the process as a sequence of states (i.e. section of source code with at least one path of entry or exit), represented as circles in the diagrams. Some of these states are "decision" states, in which the leaver must make a decision to participate in the program, or to extend their leave beyond its "original" length, the length simulated prior to this point. The transition from state to state, represented by arrows, is the result of events or decisions, such as the end of receipt of employer pay, the original length of leave being reached, the decision to participate or extend a leave, etc. Diamonds represent predetermined conditions or conditions over which the person has no control, such as whether the person is eligible or receives employer pay. Numbers in brackets correspond to the state number. The flow from state to state traces a "path".

In order to illustrate how this part of the simulator works, let's follow one of the many possible paths that a leaver might experience. Suppose that the person originally took a partially paid leave of 3 weeks from her employer, got paid 30 percent of her full time pay for the first two weeks of leave, and is eligible for the paid leave program. This person might take the following path.

The person beings in state number 0, "Begin employer leave, eligible for paid leave program". After the waiting period of a week, the person decides whether or not to participate in the program, and is in state number 8, "Participate in paid leave program?". The weekly benefit from the paid leave program substantially exceeds the person's partial pay from her employer, so that the probability of participation in the program is high. In fact, suppose that the probability is greater than the random number drawn, so that the person participates. The person is then in state number 2, "Begin paid leave program".

After being on the program for two weeks, the original leave length is reached, and the person then decides whether or not to extend her leave. The person is in state number 12, "Extend?". The simulation sets the probability of extending the leave to 25 percent. Suppose the random number drawn is less than .25, so the person extends her leave. The leave is then extended by 3 days, or 25 percent of the original leave length of 15 days.

The person is then in state number 7, "Begin/continue paid leave program". The person remains in this state for three days, and then ends her leave, entering state number 20, "End leave".

The "End leave" state in the simulator performs some accounting and cleanup tasks. Among other tasks, a number is assigned to a variable called "path" that uniquely identifies this path that the person traversed. The "path" variable is calculated as the sum of a number of terms, where each term is the number two raised to the power given by the state number. The "End leave" state is omitted from this calculation since every leave ends in the "End leave" state. The value of "path" calculated for this particular path is 4485.

The processing for each person ends with outputting nearly all the information from the simulation to several files. Information from each leave is output to the "leaves" file, which contains the path traversed for each leave, along with summary information on program benefits received, employer pay received, the type of leave, its length in days, and other information. A record of the traverse through each state is also output to the "state" file, and the weekly record of program benefits and employer payments are written to three "weekly" files. The "main" file outputs information at the person level, including a summary of the leaves the person took, if any, and demographic information from the ACS so that the distribution of program benefits can be analyzed.

V. Distributing Leaves Across the Calendar

There are several aspects of timing of leave-taking that need to be modeled to estimate length of leaves with a program and program costs. Length of leaves that are extended because of the program as well as those that were in process during the DOL survey (making their truncated because of the survey) must be accounted for by assigning beginning and end dates of leaves across the calendar. Further we need to account for the fact that program costs take place over a calendar or fiscal year (12 month period we refer to as the program year), but some leaves start before the program year, while others will end later.

Beginning and Ending Dates of Leaves

The simulator distributes leaves in time consistent with certain observed distributions from the DOL survey. The leaves are assigned beginning and ending dates in the absence of a paid leave program. Below we will simply use the term “program” for “paid leave program”; and will refer to the beginning and ending dates of leaves as “pre-program” dates in the absence of a program, and “post-program” dates in the presence of a program. In the presence of a program, program participants may choose to extend the length of their leave. These extensions affect the ending date – but not the beginning date – of the simulated leaves. That is, the post-program ending date of a leave may be later than the pre-program ending date, but the post-program and pre-program beginning dates of a leave are always the same.

The DOL survey reports leaves in days, as five-day weeks. We record the length of a leave as the number of weekdays between the beginning and ending dates, including the beginning and ending date. For example, a week that begins on a Wednesday and ends on the following Tuesday is 5 days long; Saturdays and Sundays are not counted. The number of weeks in a leave is the length of the leave divided by 5. Beginning and ending dates of leaves always fall during a weekday – Monday through Friday – and holidays that fall on a weekday are counted as leave days.

The Procedure for Assigning Pre-Program Beginning and Ending Dates

Two aspects of the survey are reflected in the procedure for how the model distributes these leaves in time:

1. The survey asks about leaves taken in the last 18 months and in the last year. The tabulations of how many months ago the leave began (variables A13_1_CAT and A13_2_CAT from the DOL survey) suggest that respondents considered leaves that were ongoing during these time periods, which means that they included leaves that began before 18/12 months prior as long as they were still on leave during the target period. The simulator is based on the 12-month target period, and so distributes leaves so that their pre-program ending dates fall in a 12-month calendar, called the "program year".
2. Respondents were asked (variable A3 from the DOL survey) if they were currently on their most recent leave. These truncated leaves account for approximately 15% of leaves that took place in the last 12 months. Like the survey, the lengths of these leaves given by the simulator reflect the lengths as reported at the time of the survey. They are not "completed" or "full" lengths, but are "truncated" lengths. The simulator assigns the pre-program ending dates of these truncated leaves to end on the last weekday of the program year.

The types and lengths of leaves for each worker, if any, are determined in the simulation model prior to assigning the pre-program beginning and ending dates. The leaves for each worker are then assigned pre-program beginning and ending dates. First, it is determined if any of the person's leave is truncated, based on a logit model giving the probability of a leave being truncated conditional on its observed length. If one of the person's leaves is truncated, it is assigned a pre-program ending date of the last weekday of the program year.

For leaves that are not truncated, the pre-program ending date for each of the person's remaining leaves, if any, are assigned with uniform probability over the weekdays of the program year. This feature of the simulation model is important because it yields a theoretically correct distribution of leaves that begin prior to the program year. This in turn is important for correctly estimating annual benefit costs and other program year measures, which should not include costs that occur either prior to or after the program year.

In the case of multiple leaves, the procedure tries to assign the leaves so they do not overlap in time, so as to make the person's simulated record look realistic, but this feature is not important for the estimation objectives of the simulator. In contrast, the uniform distribution of pre-program ending dates across all persons *is* important, and so the uniform objective was given priority over the non-overlap objective in the design of the simulator. Even if a person's pre-program leaves do not overlap, their post-program leaves might if any leaves are extended.

Program Year Concepts

The simulator provides two sets of variables for pre-program and post-program dates, leave lengths, benefit payments, employer wage payments, lost product, days receiving benefits, days receiving employer pay, and days without any benefits or compensation. One set consists of variables that measure the entire leave, and the other restricts the measures to the activities that occur within the program year. These two sets may differ for leaves that "spill" out of the program year, either because they began before the program year began or ended after the program year ended. For leaves that began and ended during the program year, the two sets of variables are the same.

VI. Conclusion

The application provides a sophisticated estimation of family and medical leaves. The program includes considerable flexibility for the user in terms of possible paid leave program specifications and behavioral responses to a paid program. The application is a powerful estimation tool that can be used at the national, state, or even the metro area or city level. It not only estimates the amount that a paid leave program might cost, it also estimates the amount of employer benefits paid (in the absence and presence of a paid leave program) as well as employee uncompensated wages due to any portion of earnings that are unpaid during a leave. Further, because the simulator outputs add the simulated variables onto the ACS, it is possible to look at the beneficiaries of paid leave programs by gender, race and ethnicity, marital status, and income level.

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Table 1

For those who receive partial pay, how much and when was it received for those with own-health leaves

		Did you receive some pay for each pay period that you were on leave?	If not, when you did receive pay, was it for your full salary?
About how much of your usual pay did you receive in total?	Less than half	0.6329781	0.3273122
	About half	0.8209731	0.3963387
	More than half	0.9358463	0.3633615

Notes: Cells are proportions of respondents.
From variables HA10D, HA10E, HA10F of the DOL 2000 Survey

Table 2

Probability of Participating for Selected Values of Benefit/Wage Differential and Family Income

		Difference Between Weekly Program Benefit Amount and Next Best Alternative		
		$ 25	$ 50	$ 125
Family Income	$ 10,000	0.12	0.59	1.00
	$ 20,000	0.08	0.48	1.00
	$ 30,000	0.05	0.38	1.00
	$ 40,000	0.04	0.28	1.00
	$ 50,000	0.02	0.21	1.00
	$ 60,000	0.02	0.15	1.00
	$ 70,000	0.01	0.10	0.99
	$ 80,000	0.01	0.07	0.99
	$ 90,000	0.00	0.05	0.98
	$100,000	0.00	0.03	0.98

These probabilities are based on a logit equation where the independent variables are the difference between the weekly program benefit and the next best alternative, and family income. The "next best alternative" is either the weekly pay received from the employer while on leave, or zero if the leaver receives no pay while on leave.

Figure 1
Paid Leave Simulation Flow

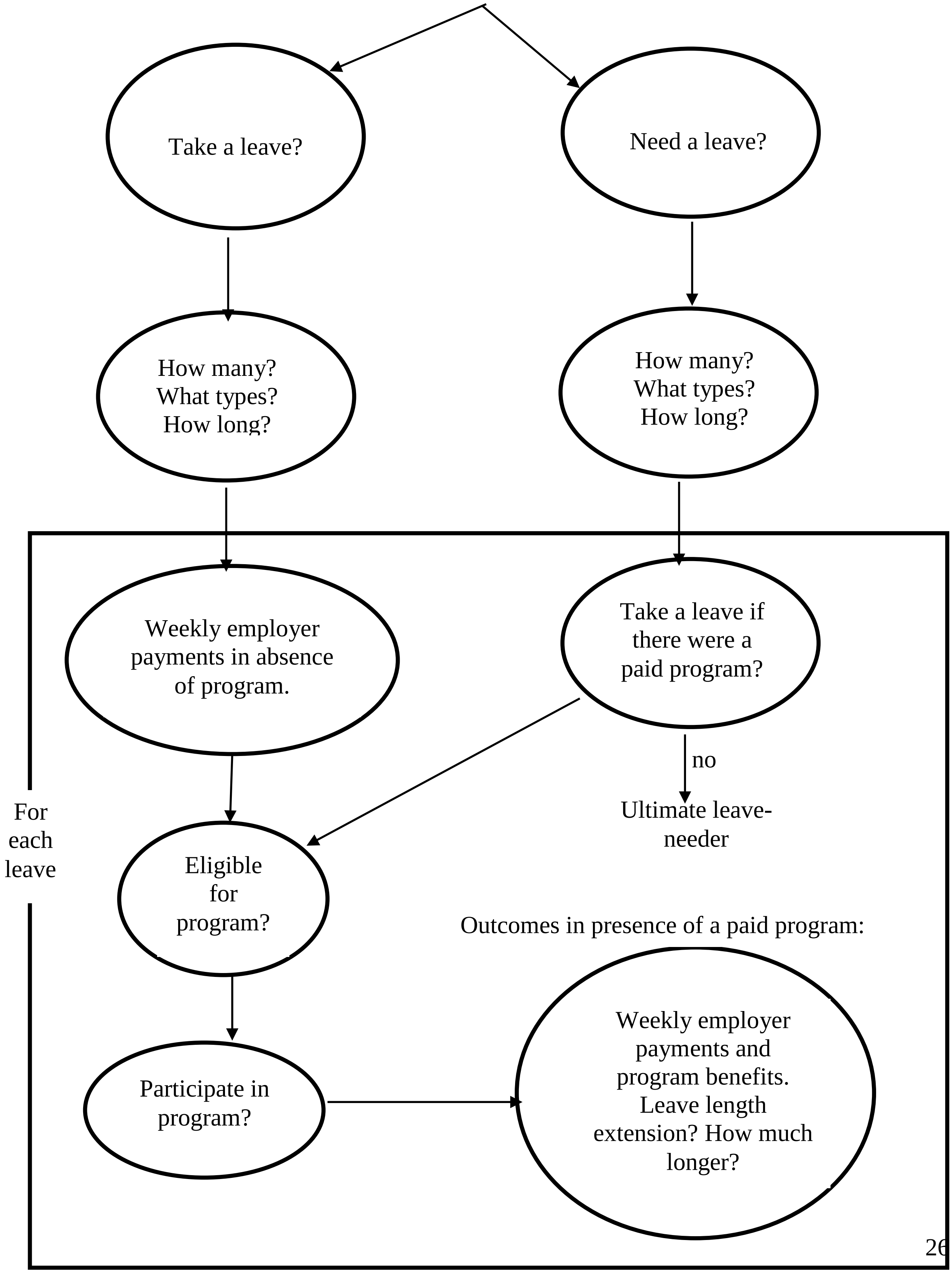


Figure 2

Weekly employer payments for leave in absence of a paid leave program

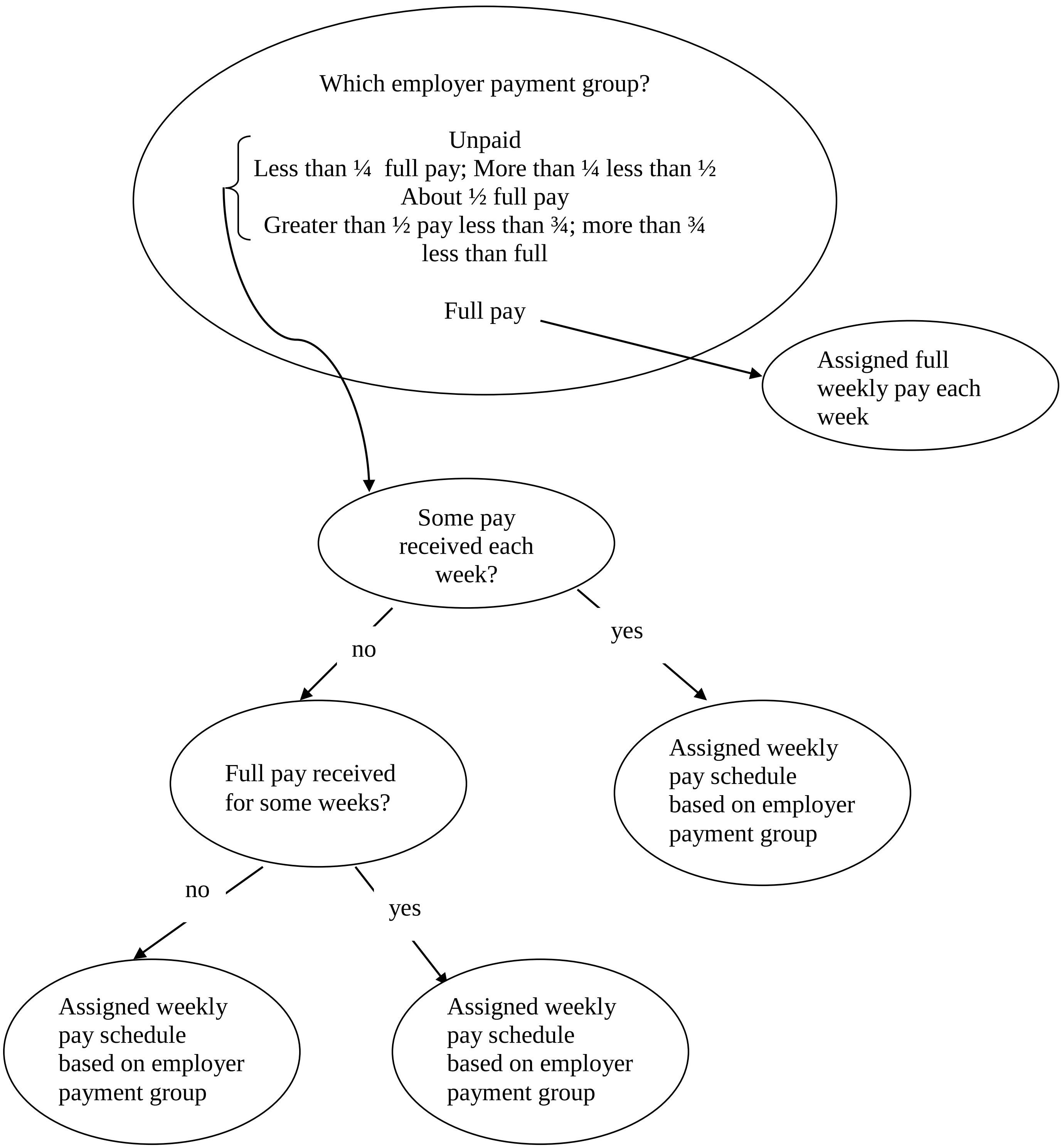
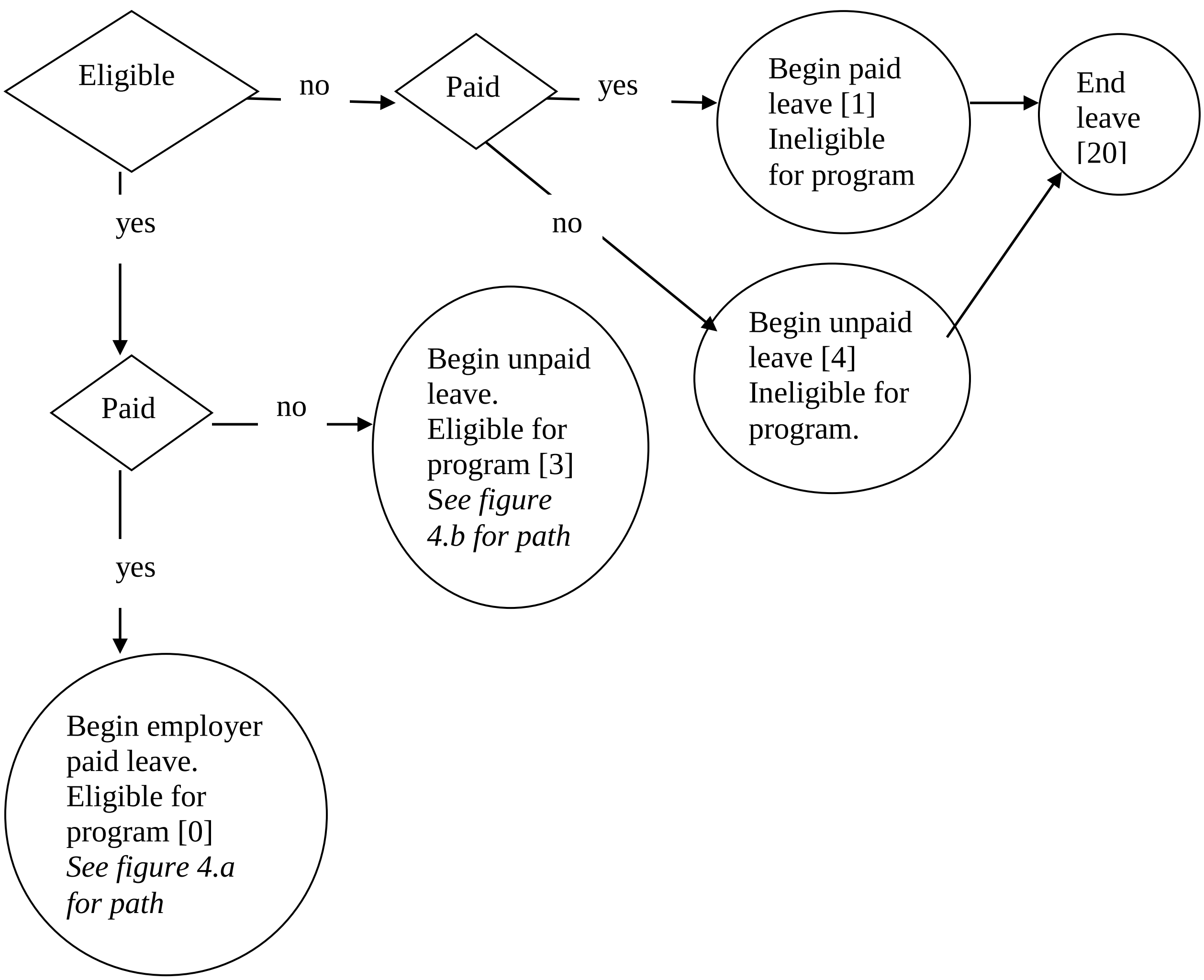


Figure 3
Simulating Weekly employer pay and leave program benefits in presence of paid leave program



Note: Numbers in brackets in figures 3-5 correspond the state number.

Figure 4.a
Simulating Use of Paid Leave Program and Employer Benefits for Employees with Some Employer Paid Leave

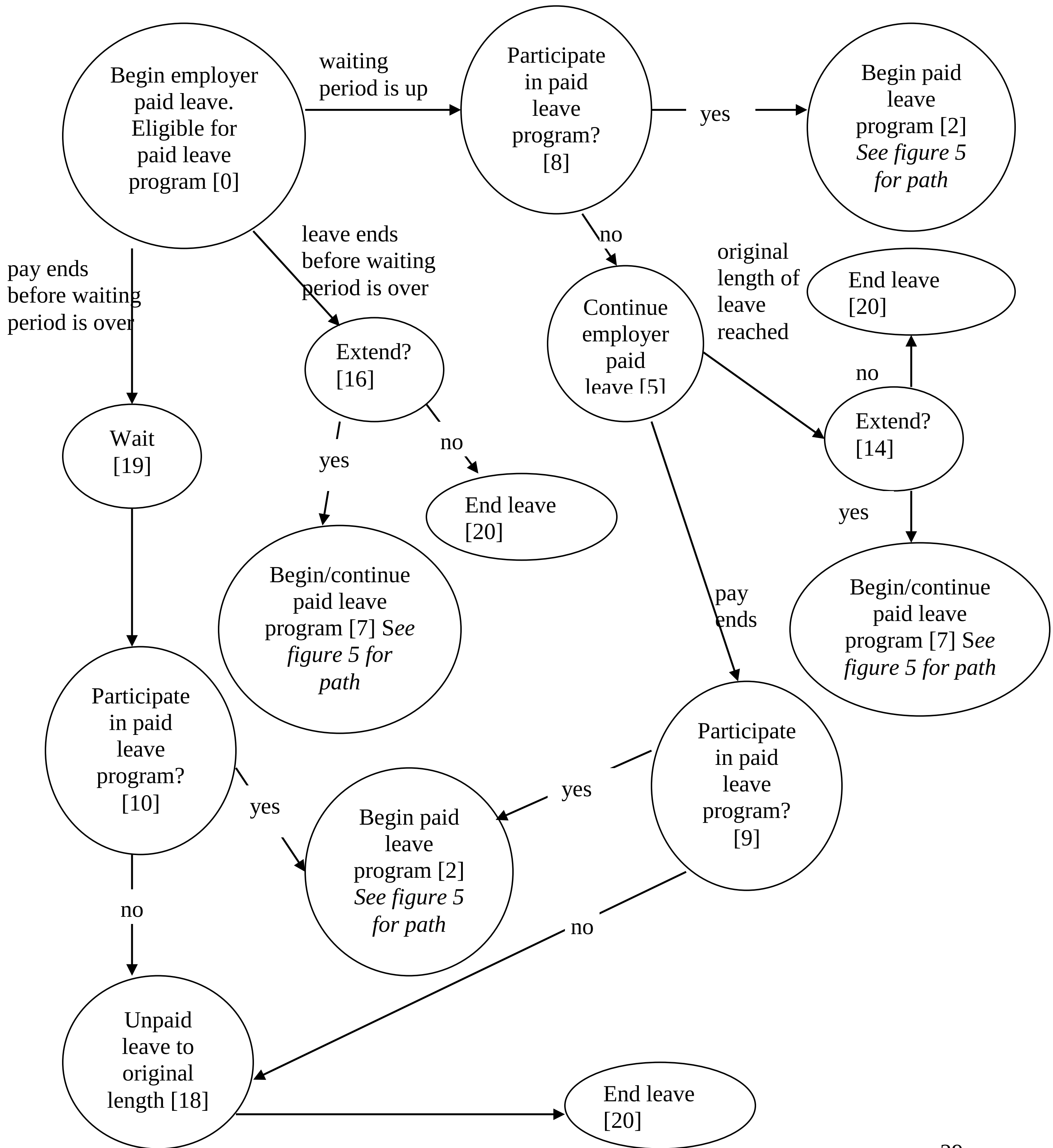


Figure 4.b
Simulating Use of Paid Leave Program for Employees with no employer paid leave

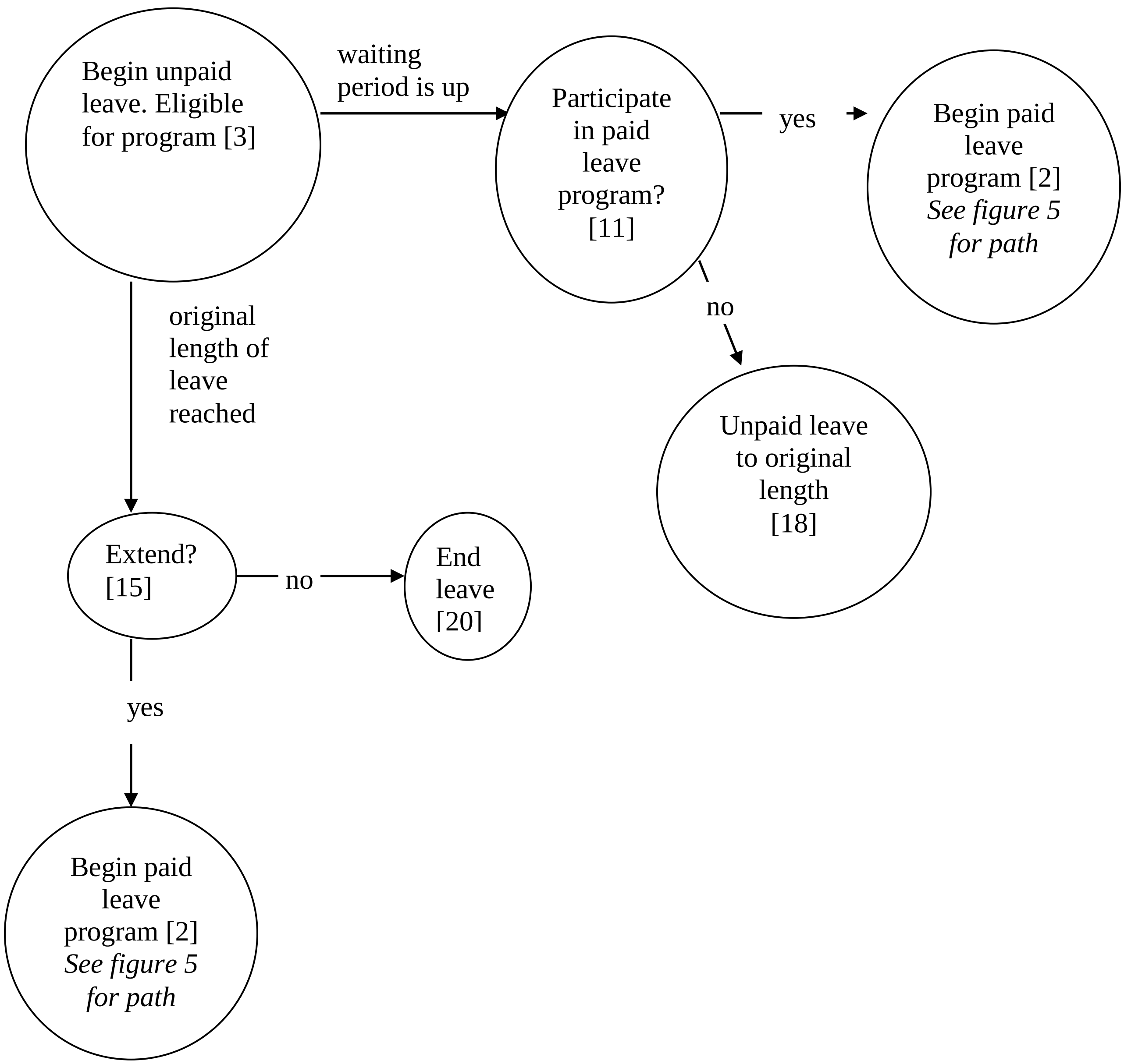


Figure 5
Simulating Use of Paid Leave Program Once it Begins