

**BOND Implementation and
Evaluation: Proposal to
Develop Enhancements to the
Benefit Offset Simulation
Model (BOSIM)
Deliverable 26.6**

Final Report

February 24, 2011

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Joel Smith
Denise Whalen
Laura Kosar

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CONTENTS

I	INTRODUCTION	1
A.	Overview of SSDI, BOND, and BOSIM	1
1.	SSDI.....	1
2.	BOND	2
3.	BOSIM.....	3
B.	The BOSIM Development Process	5
1.	Proposed Enhancements	5
2.	The Enhancement Process	7
3.	Timetable	8
C.	Overview of the Rest of Document.....	9
II	CURRENT-LAW VERSION OF BOSIM	13
A.	Introduction	13
B.	Model Structure	13
1.	Inputs to the Model	15
2.	Definition of States	16
3.	Within-State Outcome Variables	18
4.	Outputs	18
C.	Development of the Model.....	20
1.	Development Sample	20
2.	Transition Equations.....	22
3.	Within-State Outcomes.....	25
D.	Testing and Validation.....	27
1.	Replication of National Outcomes over the Sample Period.....	27
2.	Replication of National Outcomes Using Parameters Estimated with BOND Site Data	28
3.	Projections of Future Outcomes	29
III	BOND VERSION OF BOSIM	31
A.	Introduction	31
1.	BOND Features to be Incorporated into BOSIM	31
2.	Estimation and Testing of BOND Parameters	32
3.	Projections for the Introduction of BOND and for the Long Term.....	33
4.	Roadmap	34

- B. Incorporation of BOND Features into BOSIM..... 34
 - 1. BOND Entry Relative to SSDI Entry 34
 - 2. BOND Participation Period..... 36
 - 3. Variables Related to Calculation of BOND Benefits 37
- C. Estimation and Testing of BOND Parameters..... 38
- D. Projections 38
 - 1. National Introduction of BOND (IB) 38
 - 2. Long-Term Projections 39
 - 3. Confidence Intervals 40
- IV** VARIANTS OF THE CURRENT-LAW AND BOND BENEFIT DESIGNS..... 43
 - A. Introduction 43
 - 1. Variants to the Current-Law and BOND Benefit Designs 43
 - 2. Approach to Conditional Projections 46
 - 3. Roadmap 46
 - B. Current-Law Variants 46
 - 1. Elimination of TWP..... 46
 - 2. Extension of the Re-entitlement Period 48
 - 3. Elimination of the TWP and Extension of the Re-entitlement Period..... 49
 - C. BOND Variants..... 50
 - 1. Elimination of the TWP..... 51
 - 2. Duration of the Participation Period 52
 - 3. Starting the Offset at BYA/2..... 52
 - 4. Alternative Offset Rates 54
 - 5. Combination Variants 55
- V** ENHANCEMENTS TO ACCESS 57
 - A. Technical Characteristics 57
 - 1. Data Files 57
 - 2. Program Files 58
 - B. Projections 59
 - C. Output and Output Options 60
 - 1. Output Tables for a Single Projection 60
 - 2. Comparative Tables 61
 - D. Updating the Parameter Estimates 61

VI DOCUMENTATION 63

 A. User Guide 64

 B. Technical Documentation Report 65

REFERENCES 69

EXHIBITS

1.1 Progress of 1996 SSDI Awardees toward Exit for Work as of 20062

1.2 BOSIM Task Timeline 10

1.3 BOSIM Deliverables 11

2.1 Schematic Representation of BOSIM 14

2.2 Categories for the Status Variables that Define a Beneficiary’s State 17

2.3 Within-State Outcome Variables 19

2.4 Table Shell for Key Outputs 19

2.5 Table Shell for Outcomes* by Status Categories 20

2.6 Possible Program Status Transitions 26

3.1 Year on the Rolls by Demonstration Year for BOND Subjects* 36

3.2 SSDI Status Categories under Current Law and BOND* 37

3.3 Table Shell to Display Projected Impacts for a Key Outcome by
Years on the Rolls and Years on the Rolls in the First Projection
Year 40

4.1 Variants to the Current-Law and BOND Benefit Design 44

4.2 Assumptions for TWP Elimination under Current Law 48

4.3 Assumptions for Extension of the Re-entitlement Period under
Current Law 49

4.4 Assumptions for TWP Elimination and Extension of the
Re-entitlement Period under Current Law 50

4.5 Assumptions for TWP Elimination under BOND Design 51

4.6 Assumptions for Changing the Duration of the BOND Participation
Period* 53

6.1 User Guide Draft Table of Contents 65

6.2 Technical Documentation Report Draft Table of Contents 66

I. INTRODUCTION

This document presents a proposal for enhancement of the Benefit Offset Simulation Model (BOSIM). BOSIM was initially developed to support the design of the Benefit Offset National Demonstration (BOND). As described in detail below, the enhanced BOSIM will use information derived from BOND, among other sources, to produce projections of beneficiary outcomes under current law, the benefit offset design being tested in BOND, and a variety of potential changes to the design of SSDI benefits.

The first section of this chapter provides an overview of BOND and BOSIM, including their goals. The second section briefly describes the history and current version of BOSIM and then goes on to describe the process and timeline for development of the enhanced BOSIM. The chapter concludes with a description of the remaining chapters in the report.

A. Overview of SSDI, BOND, and BOSIM

1. SSDI

Social Security Disability Insurance (SSDI) is the disability component of Old Age Survivors and Disability Insurance (OASDI), commonly known as Social Security. Workers contribute to Social Security through payroll taxes, and earn the right to benefits should they experience the onset of a medically determinable impairment that prevents more than a minimal amount of work. Just as with retiree Social Security beneficiaries, disabled SSDI beneficiaries receive a monthly payment based on past earnings, and some receive an auxiliary benefit for eligible dependents. In addition, some adults with disabilities receive benefits based on the earnings of a beneficiary parent—Disabled Adult Children (DAC), or of a deceased spouse—Disabled Widow(er) Beneficiaries (DWB).

For eligibility purposes, the SSDI definition of disability includes the inability of an individual to engage in substantial gainful activity (SGA), defined in essence as the ability to earn a minimum monthly amount in unsubsidized employment, net of allowable impairment-related work expenses (IRWE). In 2010, the SGA amount is \$1,000 for non-blind beneficiaries and \$1,640 for blind beneficiaries. Once having established eligibility, SSDI beneficiaries can use the Trial Work Period (TWP) to test their ability to work without affecting their benefits for nine months. Following completion of the TWP, each beneficiary enters the Extended Period of Eligibility (EPE). In the first 36 months of the EPE, called the “re-entitlement period,” benefits are suspended in any month when the beneficiary engages in SGA, but paid in full in non-SGA months, with the exception of three Grace Period (GP) months in which full benefits are received even though the beneficiary is engaged in SGA. Benefits continue after the 36th month if the beneficiary is not engaged in SGA, but are otherwise terminated as soon as any remaining GP months are used. After termination, the beneficiary must reapply to re-enter SSDI, albeit through an expedited process.

A substantial proportion of SSDI beneficiaries work at some level after SSDI entry, but only a small percentage work sufficiently to leave the SSDI rolls (**Exhibit 1.1**). Following the completion of TWP and use of GP months, the total loss of benefits in any month when the beneficiary’s countable earnings (unsubsidized earnings net of IRWE) exceed the SGA amount, known as the “benefit cliff,” likely discourages some beneficiaries from attaining this level of earnings.

Exhibit 1.1. Progress of 1996 SSDI Awardees toward Exit for Work as of 2006

Source: Stapleton et al. (2010). Each successive group is a subset of the previous group.

2. BOND

BOND will test innovations to SSDI that are designed to address this financial disincentive to SSDI beneficiaries to increase their earnings and reduce their dependence on benefits. The primary innovation to be tested is a change in the way that countable earnings affect SSDI benefits. After the TWP ends and the GP months are used up, the benefit “cliff” will be replaced by a “ramp,” called the benefit offset. This offset will reduce benefits gradually when annual countable earnings rise above the annual equivalent of the SGA amount (12 times SGA), known as the BOND Yearly Amount (BYA). If annual countable earnings are equivalent to BYA, annual benefits will equal 12 times the current monthly benefit amount. For every \$2 of annual countable earnings in excess of BYA, the annual benefit amount the beneficiary receives will be reduced by \$1, until it is zero. Auxiliary benefits (for dependents) remain unchanged unless the individual’s benefit is reduced to zero, in which case they are suspended.

BOND will use an experimental design, in which randomly selected beneficiaries will be assigned to receive the benefit offset (the Stage 1 Treatment Group) and others will continue to receive current-law benefits (the Stage 1 Control Group). A third randomly selected group of beneficiaries will be assigned to a solicitation pool for BOND’s second stage, which is designed to test a counseling intervention in combination with the benefit offset. References to BOND treatment subjects in this document refer those in the Stage 1 Treatment Group. The offset will apply to all BOND treatment subjects for a period of 60 months (the “BOND participation period”), starting with TWP completion or at entry to the demonstration, whichever comes last, and provided that the TWP is completed by September 2017. Treatment subjects will also be entitled to three grace period months before benefits are reduced under the offset, as under current law. Thereafter, benefits are reduced under the offset until the end of the participation period.

All BOND treatment subjects will be offered counseling services. Most treatment subjects will have access to Work Incentives Counseling (WIC), which is designed to be comparable to the benefits counseling services currently available to all SSDI beneficiaries, except that counselors will be trained to provide assistance on how the benefit offset affects SSDI and Supplemental Security Income (SSI) benefits. One treatment group will be offered more intensive counseling services, called Enhanced Work Incentives Counseling (EWIC).

References to “the BOND design” in this document refer specifically to the benefit offset with WIC as implemented during the demonstration; the term distinguishes this version from other benefit offset designs that will also be considered. For a more detailed description of the BOND design, see Chapter 2 of the *BOND Final Design Report*.

3. BOSIM

BOSIM is a microsimulation model initially developed under the BOND design contract to support decisions about the design of BOND. The existing version produces projections for a set of annual outcomes—beneficiary earnings, benefits, taxes, and disposable household income—over a five-year period on the basis of beneficiary characteristics, past beneficiary behavior under current law, and various assumptions about the consequences of changes to the design of SSDI benefits.¹ Enhancements to BOSIM are needed for three important reasons.

First, independently of BOND, SSA is interested in how simplifications to the SSDI work incentives would affect program outcomes. As discussed further in Chapter IV, these current-law variants include:

- Elimination of the TWP,
- Extension of the re-entitlement period until termination occurs for some other reason, and
- The combination of the two.

The existing version of BOSIM is not capable of supporting assessments of these simplifications. The first goal for the enhancements to BOSIM is to systematically combine years of experience under current law and a range of assumptions about how each of these current-law variants affects earnings to produce a range of projections of key outcomes under each variant. The remainder of this document refers to these projections as “conditional” projections, because they are for benefit designs outside of past experience and rely on assumptions about the effects of the variants on earnings.

Second, once BOND is over, SSA will need the capability to project the effects of national implementation of the BOND benefit design on key outcomes over at least a 10-year period—the period that the Congressional Budget Office (CBO) uses to score the effects of legislation on the federal budget. Much longer projections are also of interest. Notably, SSA’s Office of the Actuary (OACT) and the CBO routinely make 75-year projections of OASDI expenditures and revenues to support the annual reports of the OASDI trustees. Policymakers will need the best available projections of effects on program expenditures and beneficiary financial well-being so they can make informed decisions about whether to make such a substantial change to the design of SSDI. Further, SSA administrators will need information about the numbers of beneficiaries that are likely to use the benefit offset and how intensely they are likely to use it, to plan changes to administrative processes and support estimates of administrative resource needs. The second goal for the enhancements to BOSIM is to produce such projections, based on the experience from the demonstration.

BOND will provide data about how beneficiaries actually behave under the BOND benefit design during the demonstration period; these data will be critical to making projections of the effects of a national program. Most importantly, Stage 1 of BOND will provide national-level estimates of the impact of the BOND design during the demonstration period for all beneficiaries

¹ The memorandum, dated March 4, 2010, is BOND Deliverable 26.1.

who were on the rolls during the Stage 1 recruitment period (April through June of 2011). Additional analysis is needed to translate the data into projections for national implementation, for several reasons:

- The BOND impact estimates will be national in nature, because the 10 BOND sites were selected by a random process designed to produce a nationally representative sample of sites. Presumably, however, the sites are not exactly nationally representative with respect to beneficiary or environmental characteristics that might affect national impacts of the BOND design. To the extent feasible, the projections should adjust for differences observed between the BOND site characteristics and national characteristics.
- The size and characteristics of the national beneficiary population will change by the end of the demonstration, and there might also be changes in relevant environmental factors, such as the strength of the economy.
- Beneficiaries who enter SSDI in the BOND sites after the Stage 1 recruitment period will not be eligible for assignment to the Stage 1 treatment group, but their counterparts in a national program would be.
- The national introduction of the BOND design might induce entry into SSDI. The demonstration will not produce estimates of induced entry, but SSA is conducting non-experimental research to assess the likely size of induced entry and the characteristics of those induced to enter.
- In the long run, the BOND design would apply to all beneficiaries as soon as they enter SSDI. When a national program is introduced, most beneficiaries will have been on the rolls for many years and their behavior will have been conditioned on current law. Hence, the long-run effects (for example, 50 years after introduction) of the national program on key outcomes might be different than effects in the shorter term (for example, 10 years after introduction).

The goal is to produce projections of key outcomes for the benefit design to be tested under BOND that take all of the above factors into consideration.

Although this second goal for the enhancements to BOSIM is very important, it must be recognized that this goal alone could be achieved via a simpler approach. Specifically, econometric models developed for the BOND impact analysis could be applied to data on national samples of existing and new beneficiaries. The proposed design for the enhancements to BOSIM is much more complex than it needs to be for the purpose of achieving this goal alone. The complexity of the design reflects the third major goal for BOSIM: to project outcomes under benefit designs that represent modest variants of the BOND design.

Potential variants to the BOND design reflect both interest in simplification of the SSDI work incentives and concerns about benefit costs, as discussed further in Chapter IV. The enhancements to BOSIM are designed to support assessments of the effects of four variants to the BOND design, individually or in combination:

- The TWP could be eliminated as the benefit offset is introduced;
- The benefit offset participation period could be lengthened or shortened from its length under BOND (60 months);
- The level of annual countable earnings at which the offset starts could be changed from its value under BOND (e.g., to one-half of BYA);

- The benefit offset could be varied from the \$1 for \$2 rate under BOND (e.g., \$1 for \$3 or \$1 for \$4)

The third goal for BOSIM is to systematically combine experience under BOND and a range of assumptions about how each of the BOND variants affects earnings to produce a range of conditional projections of key outcomes for each BOND variant.

B. The BOSIM Development Process

This section provides a summary of the proposed enhancements and how they are expected to improve BOSIM’s capabilities. It also outlines the steps in the enhancement process and presents a timetable for the enhancements.

1. Proposed Enhancements

Proposed enhancements to BOSIM include a number of changes:

- Most importantly, two complete sets of model parameters will be developed, one for current law and one for the BOND design, based on the actual behavior of beneficiaries under each of these two designs. In contrast, the existing model is based almost entirely on the behavior of beneficiaries under current law. The current-law version will be developed first. SSA will make decisions about moving forward with the initial BOND version once the current-law version has been developed and tested, and as BOND data become available. If development of the BOND version proceeds as anticipated, by the end of the demonstration, the parameters for the BOND version will be based entirely on the observed behavior of BOND treatment subjects.
- Relative to the existing model, the enhanced BOSIM model will include a substantially expanded number of “states,” defined by the individual’s status with respect to the SSDI work incentives, earnings relative to BYA, SSI, and enrollment for employment services.² For instance, those who have not completed the TWP will be distinguished from those who have, and those in the re-entitlement period will be distinguished from those who have completed the period and remain on the rolls. Further, those within each of these categories with annual earnings above the BYA will be in a different state than those with lower earnings.³
- Although BOSIM will continue to be produce calendar year projections, some enhancements will reflect the fact that benefit status is determined on a monthly basis under current law. Examples of monthly variables to be projected include:
 - Number of months in which the beneficiary is off the rolls for work in each year

² Unless otherwise indicated, the word “state” in this document refers to the status categories such as those described here. References to geographic states include the adjective “geographic.”

³ The existing version of BOSIM has only two states: in the EPE or not in the EPE. The larger number of states is expected to improve the accuracy of the projections and will also provide the ability to project outcomes not projected by the existing model, such as TWP completions and SSA payments for employment services.

- Month of TWP completion, re-entitlement period completion, and termination (for any reason)
- These outcomes are important for administrative purposes and are closely tied to benefits paid. The existing model either ignores these outcomes or relies on arbitrary assumptions about them.
- The model will explicitly allow for the entry of new beneficiaries in each projection year, based on projections of SSDI awards from SSA actuaries. The existing model projects results for those on the rolls in the base year only, reflecting the model's purpose: to project the behavior of those assigned to the benefit offset at the beginning of the demonstration. New beneficiary projections are needed to make projections for a national program and to assess the effects of possible induced entry.
- The database and SAS code for the model will be delivered to SSA so that SSA analysts can use and update the model on their own. The model will provide SSA analysts with options:
 - To make projections for different populations, different assumptions about new beneficiaries, and benefit designs that differ from either current law or the BOND design, via inputting alternative values for relevant model parameters.
 - To produce an array of output tables, including tables for subpopulations and tables that compare outputs from any pair of projections.

The development process for the BOND parameterization of BOSIM will ensure that the model can reproduce key outcome variables for the 80,000 Stage 1 treatment subjects. If successful, as anticipated, the only remaining substantive sources of differences between the model's projections for the first five years of national implementation and what actually occurs will be factors that are external to the model. These include:

- Differences between the actual and projected number of new SSDI entrants
- Differences between the BOND design and the benefit offset design actually implemented, including differences in how the offset is administered
- Differences between the environment in the demonstration and the national environment that are not captured by the environmental variables in BOND. Such differences might arise because the BOND site environments are not exactly representative of the national environment, or because the national environment during the introduction of BOND is different than the national environment during the demonstration in some important respect.
- Differences between the behavior of beneficiaries under a national program and the behavior of beneficiaries during the demonstration, holding constant characteristics that are captured in BOND. Perhaps beneficiaries, support organizations, and providers might adapt to a national program in different ways than to an experimental program that is available to only a randomly selected minority of beneficiaries.
- Projections will continue beyond five years, for as long as entrant projections are available, but accuracy beyond five years might deteriorate because the model will be developed and tested with data for a five-year period only and because even small

prediction errors in the early years will feed into projections in later years and could be compounded.

The BOND version of BOSIM will not produce projections of induced entry on its own, but can be a useful tool for efforts to estimate the consequences of projections made from external information. Analysts will be able to input external estimates of the impact of the introduction of BOND on SSDI entry into BOSIM. Conditional on the external projections of entrants, BOSIM will be able to project the implications for program costs, tax revenues, and other key outcomes.

The enhancements will also improve BOSIM's capabilities with respect to projections about current law, BOND, and other design variants in other important ways. Notably, the model will be able to project several outcomes not projected by the existing model:

- The number of TWP completers each year, months off the rolls for work (current law), the number of offset users (BOND), employment service enrollment, and SSA payments for employment services
- Terminations for each of four reasons—age, mortality, work, and all other reasons (including medical recovery)—and re-entry by those terminated for reasons other than age or mortality

In addition, the model will project outcomes for as many years as projections of new beneficiaries are provided, compared to just five years for the existing model.

The proposal includes many of the potential enhancements that were described in the earlier memorandum about the existing version of BOSIM and its limitations, but for resource reasons some enhancements described in that memorandum have been omitted. Specifically, the proposed enhancements do not include the introduction of three outcomes that vary by geographic state: state income taxes, state SSI supplements, and enrollment in Medicaid. The introduction of BOND is expected to affect these outcomes, and state governments might be especially interested in these effects. There is little reason to think, however, that the absence of these variables in BOSIM will have a detrimental effect on projections for national variables. Outcomes for geographic states could be included later, should circumstances warrant

2. The Enhancement Process

Subject to SSA approval, the enhancement process will proceed as follows:

- Enhancements for the current-law model will developed by the BOND evaluation team during 2011 and 2012. The following initial enhancements are planned:
 - Develop the current-law parameters for BOSIM based on administrative data available for all beneficiaries from 2005 through 2009.
 - Develop the code for the model and the SAS user interface.
 - Test the current-law model against historical data, and refine as needed.
 - Develop a calendar year 2009 beneficiary sample for use as the base for projections from 2010 on.
 - Obtain projections of new beneficiaries for beyond 2010 from the actuaries (2010 values will be actual).

- Produce initial projections for the current-law model and current-law variants over a horizon of at least 10 years.
- Develop programs and documentation for future updates.
- Deliver the model and documentation to SSA and train SSA staff on use of the model and how to estimate the parameters.
- Once the current-law model has been developed and tested, plans for development of the BOND version will be reviewed and finalized.. Initial development will occur only after sufficient data from the demonstration become available.
- SSA will update the parameter estimates for the enhanced model, with technical assistance from the BOND evaluation team. Once the initial model has been transferred to SSA, the schedule will be at SSA's discretion.
 - As the demonstration proceeds, SSA might wish to update the parameters of both models using new current-law data and data for the 80,000 beneficiaries in the BOND Stage 1 treatment group. At a minimum, two years of BOND data would suffice to fully estimate the BOND parameters.
 - In 2017, as the BOND evaluation is completed, it will be important for SSA to update the model parameters with the BOND data so that the BOSIM projections needed to support the evaluation will fully reflect demonstration experience.

The updated parameter estimates will reflect significant new information about behavior under BOND, but will also reflect the effects of changes in other factors that affect beneficiary behavior, whether internal to SSDI or external. Projections for variants of the current-law and BOND benefit designs will be made by changing model parameters in a fashion that reflects other information or assumptions about how beneficiaries would respond to differences between those designs and either current law or the BOND design. For example, it might be reasonable to assume that, if the TWP were eliminated, outcomes for those who would have been in the TWP under current law will change to be more like outcomes for those who are in the re-entitlement period under current law. Projections for variants are not expected to be as accurate as those for current law or the BOND design, but nonetheless are expected to be very informative.

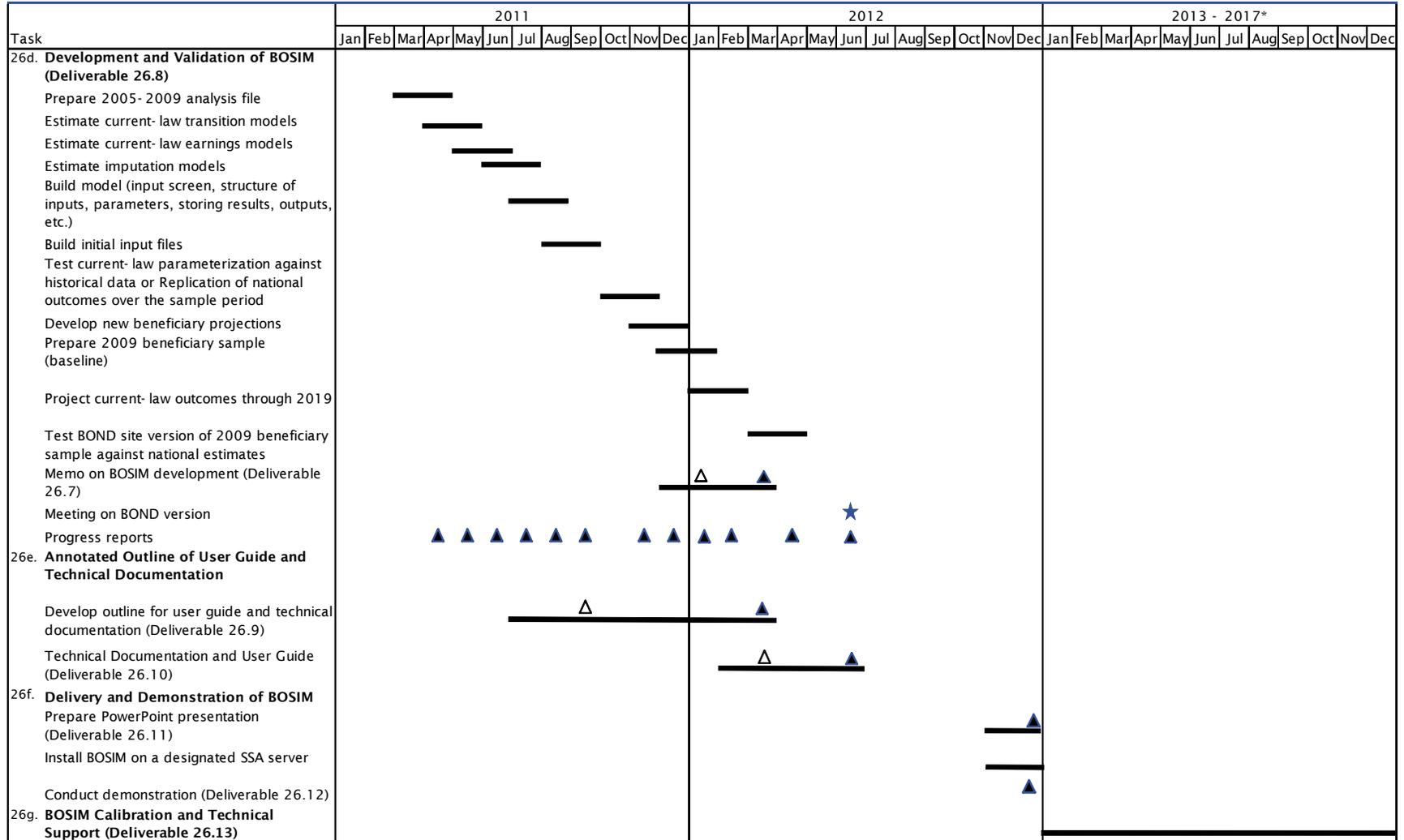
3. Timetable

A timetable (Gantt chart) for the remaining BOSIM work, starting with the current proposal, appears in **Exhibit 1.2** and the schedule of deliverables appears in **Exhibit 1.3**. The timetable calls for completing the work on the initial current-law parameterization of the enhanced BOSIM, including all testing against sample data, by March 2012 (Deliverable 26.7). Progress reports are scheduled at the completion of each development milestone. These will include: a description of the work completed, discussion of issues encountered, and an explanation of how the issues were addressed, or how they will be addressed as development proceeds. If pertinent, the report will be accompanied by drafts of tables or charts. The draft user guide and technical documentation for the current-law version will be delivered to SSA no later than March 2012, with revisions to follow in three months. The current-law version of the model will be delivered to SSA by December 2012. Development of the BOND version will proceed only after BOND data are available, on a schedule that remains to be determined.

C. Overview of the Rest of Document

The rest of this document is organized as follows. Chapter 2 describes the proposed enhancements to the current-law version of BOSIM in detail, its planned capabilities, initial estimation of its parameters, and all inputs and outputs. Chapter 3 provides the initial design for the BOND version and describes design issues to be addressed following delivery of the current-law version. Chapter 4 describes how the enhanced current-law BOSIM can be used to produce projections for specific variants of the current-law benefit design. It also describes how variants of the initial design for the BOND version might be used to produce projections for specific variants of the BOND design. Chapter 5 describes the enhancements to access for SSA analysts, and Chapter 6 describes the process for updating initial versions as more data become available. Finally, Chapter 7 describes the documentation that will accompany the initial update to BOSIM.

Exhibit 1.2. BOSIM Task Timeline



- △ Draft Deliverable
- ★ Meeting
- ▲ Deliverable

*Task 26g will be completed year-round between 2013 and 2017.

Exhibit 1.3. BOSIM Deliverables

Deliverable		Due by:
26.6 Proposal to Enhance BOSIM	Draft	10/05/2010
	Final	03/09/2011
26.7 BOSIM Development Memo	Draft	01/27/2012
	Final	03/30/2012
26.8 Development and Validation of BOSIM		03/30/2012
26.9 Annotated Outline of User Guide and Technical Documentation	Draft	09/16/2011
	Final	03/05/2012
26.10 User Guide and Technical Documentation	Draft	03/30/2012
	Final	06/29/2012
26.11 Enhanced BOSIM Presentation Documents		12/03/2012
26.12 Delivery and Demonstration of Enhanced BOSIM		12/05/2012
26.13 BOSIM Calibration and Technical Support	Annual	2013 - 2017

II. CURRENT-LAW VERSION OF BOSIM

A. Introduction

This chapter presents the proposed current-law version of BOSIM, incorporating the enhancements that were summarized in Chapter I. The current-law version is designed to serve two purposes. The first purpose is to provide accurate projections of outcomes under current law, to serve as a baseline for projections under alternative benefit designs.

The second purpose of the current-law design is to provide a framework that is rich enough to support projections for other benefit designs, including the BOND design and variants of both the current-law and BOND designs (see Chapter I). Some features of the current-law model solely reflect the second purpose. For instance, the model's states identify the beneficiary's status relative to TWP completion. The states also include annual earnings categories that reflect the roll of the annualized SGA amount in both the BOND design and some variants to the BOND design. The challenge will be to develop appropriate alternative parameters, a topic addressed in Chapters III (for the BOND design) and Chapter IV (for variants of both the current-law and BOND designs).

The current-law model can be developed from currently available data. BOND will generate the data needed to develop and estimate alternative parameters that incorporate beneficiary reactions to the benefit offset implemented in BOND (see Chapter III). Development of parameters for other designs will be more challenging, but the current-law and BOND parameters will provide guidance (see Chapter IV).

The first section of this chapter describes the model's structure. This is followed by a description of the many equations for transition probabilities and situational variables that will be built into the model, and how they will be estimated. The chapter concludes with a description of the steps proposed for testing and validating the model. The initial version of the model will be updated as new data become available. The updating process is described in Chapter VI.

B. Model Structure

In general, the proposed current-law model sequentially projects a beneficiary's state and then determines his or her within-state outcomes for each SSDI beneficiary in its baseline database. A state describes the beneficiary's current status according to four categorical variables that reflect current-law policies and how earnings affect benefits under current law: earnings status, SSDI status, SSI status, and employment service status. Thus, each state is defined by values on each of four dimensions, one for each categorical variable.

The model's structure is illustrated in **Exhibit 2.1**. In the base year (that is, the year before the projection starts), all outcomes for each beneficiary in the database are based on actual data. In the first projection year, the model adds a cohort of newly awarded SSDI beneficiaries, based on external projections by age and sex. Their outcomes for the first projection year are based on those for new awardees in the baseline year in the same age-sex group.

Each beneficiary in the baseline database is in a specific state at baseline. Each will be assigned a series of probabilities for transitions from that state to other possible states, based on transition equations to be described in the next section. As described later, the probabilities will be used in a sequential, random process that assigns the beneficiary to a state in the first projection year. The model then simulates each beneficiary's within-state outcomes for the first projection year by

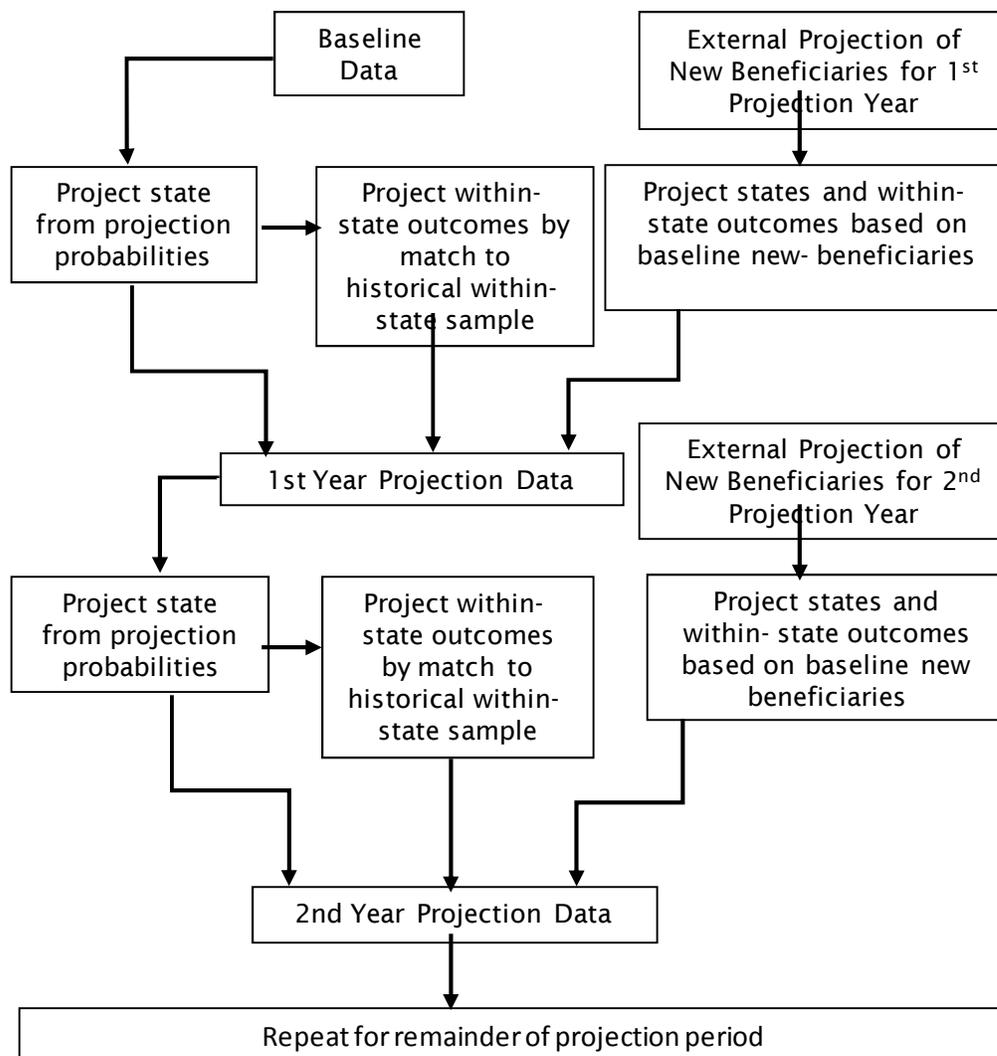
drawing from a sample of matched beneficiaries within the same state, developed from historical data.

This completes the first-year projection database. The model then repeats this process each successive projection year, starting with the prior year’s projection database and external projections of new beneficiaries, under the assumption that SSDI will continue under current law for the duration of the projection period.

As indicated in Exhibit 2.1, all outcome projections are for annual periods. As described below, some states are determined by an event that occurs in some month during the year, not necessarily at the end of the year. This is because SSDI benefits are determined on a monthly, rather than annual basis. The choice to use annual periods reflects the fact that one key outcome variable, earnings, can only be observed on an annual basis. The proposed enhancements accommodate the monthly nature of current-law benefits by including some within-state outcomes that are monthly in nature (such as months with no benefits because of work).

The remainder of this section describes the model’s inputs, how the various states are defined, and the within-state outcome variables.

Exhibit 2.1. Schematic Representation of BOSIM



1. Inputs to the Model

The model will require the following inputs: baseline data representing the SSDI beneficiary population prior to the first projection year, projections of new SSDI beneficiaries, and a set of parameters for the transition and earnings equations embedded in the model.

Initially the baseline data will consist of a sample of beneficiaries who were on the rolls in 2009 (that is, in current pay status or suspended in at least one month). The data will primarily come from the 2009 Ticket Research File (TRF), but values for some variables will come from linked files or will be imputed based on equations estimated with National Beneficiary Survey (NBS) data linked to administrative data. Section C provides details on the data. The size of the database will be determined during the development process. The database needs to be large enough so that there will be a substantial number of beneficiaries in each of the model's states in each year. Earlier BOSIM versions were developed using a 10 percent sample, but the development of the enhanced version might need a somewhat larger sample for the sake of accuracy and repeated use during testing and validation. The model could potentially be based on all records meeting the criteria described above, or about eight million beneficiaries in 2009.

The second input is a set of projections of new awardees. Projections from OACT will be used to generate this input. Each year, OACT projects counts of new SSDI beneficiaries by age and sex for the next 75 years. The data from the new beneficiaries in the baseline sample will be used to impute the first-year states and outcomes for the projected new beneficiaries. Specifically, each new beneficiary in the baseline sample will be added as a new beneficiary in the projection year, but using a weight that is equal to the number of projected beneficiaries in the beneficiary's age-sex group divided by the number in the same group in the baseline sample.

The new beneficiary weight will be applied in all calculations of projected means and sums for a projection year. For instance, consider the second projection year: suppose that the number of projected new beneficiaries in the first year is 1.02 as large as the number in the baseline year, and suppose that the number in the second year is 1.03 as large. Projected beneficiaries in the second year will include: 1) all baseline beneficiaries whose benefits have not been terminated, each with a weight of 1.0; 2) new beneficiaries from the first year except those whose benefits have already been terminated, each with a weight of 1.02; and 3) new beneficiaries from the second year, each with a weight of 1.03. The projected number of beneficiaries in the second projection year will be the sum of the weights, and the projected mean of any outcome variable (e.g., earnings) will be the weighted mean of the individual projections for that variable.

One issue about the OACT projections that needs further investigation is whether they include reinstated beneficiaries—those whose benefits were previously terminated, but have successfully re-entered SSDI. BOSIM will model reinstatement as a transition from a terminated SSDI state to a non-terminated state. Hence, projected new beneficiaries should include first-time SSDI entrants only. If the OACT projections include former beneficiaries, it will be necessary to scale down OACT's projections by the historical ratio of first-time SSDI entrants to all SSDI entrants.

The model's parameters are the final input. As described in the next section of this chapter, a set of current-law parameters for the transitional and situational equations will be estimated using historical data. Analysts will be able to input alternative parameter values for various purposes.

2. Definition of States

In each year, each individual's annual state will be defined by the values of four categorical variables: (1) annual earnings status, (2) employment service status, (3) SSDI status, and (4) Supplemental Security Income (SSI) status. The proposed categories for each of these status variables are listed in **Exhibit 2.2**. The categories could potentially be modified for practical reasons as the model is developed.

The annual earnings status categories were designed to support BOND projections and an offset variant that starts at one-half BYA. The two top categories (BYA to twice BYA and twice BYA or more) could potentially be combined. The highest earnings category is of interest for purposes of comparisons to projections for the BOND design because of the theoretical prediction that some beneficiaries who would earn substantially more than BYA under current law will reduce their earnings under the BOND benefit offset design (Bell et al. 2011, Chapter Two). In contrast, theory predicts that those who would earn less than BYA under current law will increase their earnings under BOND. The boundary between the two categories could be adjusted, based on examination of the actual earnings distributions, or the two categories could be combined.

The SSDI status categories for TWP completed and re-entitlement period completed indicate the year in which the respective periods are completed. TWP completion and completion of the re-entitlement period 36 months later can occur during any month of the year. Typically, some months in each of these years will be in the re-entitlement period. Re-entitlement period status includes the two years after the TWP completion year, during which all 12 months of each year are in the re-entitlement period. Transitions from the TWP completion year category through the post-re-entitlement period category will be automatic, following program rules, unless termination occurs.

Termination can occur during any month of the year, so the model will project how many months in the year occur after termination. Termination for age and mortality are absorbing states. Those terminated for other reasons might re-enter SSDI in a later year.

The termination categories are not mutually exclusive with the other SSDI status categories during a year. For example, an individual who completes the re-entitlement period in a year might transition to a terminated status later in the year. In such cases, program status for the year will be defined by the termination status.

Medicare status could potentially be incorporated as an additional SSDI status category. Medicare entry at 24 months after SSDI entry is automatic, so the model could incorporate Medicare entry in a very mechanical way, based on SSDI entry month. Of more interest is Medicare exit. Under current law this occurs automatically if benefits are terminated for death, medical recovery, or reasons other than attainment of the FRA (starting at age 65 Medicare entitlement is based on age) or SGA. Since 2000, those whose benefits are terminated for work are entitled to keep Medicare for at least 93 months after they complete the TWP, depending on when SGA first occurs after TWP completion. After that, the former SSDI beneficiary may continue Medicare enrollment by paying the Part A premium.⁴ If the number of beneficiaries that exhaust their Medicare enrollment after SSDI termination for work turns out to be substantial, further consideration will be given to dividing

⁴ The former beneficiary can also continue enrollment in Part B, but must continue to pay the Part B premium.

the Terminated for Work category into subcategories, one with automatic Medicare enrollment and the second with enrollment contingent on payment of the Part A premium.

Employment Service Enrollment refers to services that SSA will pay for if certain criteria are met. It includes enrollment for services at a state vocational rehabilitation agency (SVRA) or at any other public or private provider that has contracted with SSA to offer services as an Employment Network (EN) under the Ticket to Work (TTW) program. Any provider (including an SVRA) can be paid under its choice of two TTW payment systems, Milestone-Outcome and Outcome Only. In addition, the SVRA can choose to be paid under a cost reimbursement system that was in place prior to TTW, on a case-by-case basis. The “enrolled” status for this variable includes past as well as current employment, because any relationship between enrollment and earnings may persist beyond the year of service enrollment. Further, SSA payment for services often occurs after the enrollment year. Under cost reimbursement, payment is generally made once, after the beneficiary has earnings above SGA for nine out of twelve consecutive months—something that seldom occurs by the end

Exhibit 2.2. Categories for the Status Variables that Define a Beneficiary’s State

Annual Earnings Status—$E(i,t)$	SSDI Status—$DIS(i,t)$
<ul style="list-style-type: none"> • Zero • Greater than zero and less than one-half BYA (i.e., 6 times monthly SGA) • Greater than or equal to one-half BYA and less than BYA • Greater than or equal to BYA and less than twice BYA • Greater than or equal to twice BYA 	<ul style="list-style-type: none"> • TWP not completed • TWP completed (during year) • Re-entitlement period • Re-entitlement period completed (during year) • Post re-entitlement period • Terminated for age • Terminated due to mortality • Terminated for work • Terminated for medical recovery or any other reason
Employment Service Status—$ES(i,t)$	SSI Status—$SSI(i,t)$
<ul style="list-style-type: none"> • Never enrolled • Enrolled in the current year or a previous year 	<ul style="list-style-type: none"> • Never SSI • Current SSI • Former SSI

of the year of enrollment for services. Under the TTW payment systems, payments are made in up to 36 monthly installments, and are dependent on earnings and benefit status during the month.⁵

⁵ Before July 2008, up to 60 payments were made under TTW, the monthly payment amounts were lower, and some other aspects of the TTW rules were different than they are today. As these changes occurred in the next to last year of the sample that will be used to develop the model, for estimation purposes it will be necessary to incorporate them in the specification of the model’s initial equations. The estimated equations will be slightly simplified for purposes of projections after 2009 so that they no longer include elements needed to project payment outcomes under the earlier TTW rules.

The SSI status variable has three categories, for “never”, “current” and “past” SSI recipients. The individual is classified as a current SSI recipient if: (1) an SSI payment is due, (2) SSI payments are suspended because of work (that is, the recipient is in 1619b status), or (3) SSI payments are suspended for some other reason but for less than 12 months. The SSI status definition allows for the fact that concurrent beneficiaries in 1619(b) status may start to receive a monthly SSI benefit again if their earnings drop by a sufficient amount, without reapplication, while those whose SSI benefits are suspended for other reasons may only return without reapplication if their benefits have been suspended for less than 12 months, provided that the reason for suspension has been addressed. Former SSI recipients include all those who received SSI in at least one month after they entered SSDI, but who are not current SSI recipients. Both the current and past SSI categories will exclude those who received SSI during the SSDI waiting period only, but lost SSI eligibility as soon as the waiting period ended.

The expectation is that former SSI recipients will have a higher probability of entering SSI each year than those who have never received SSI.

Taken together, the four categorical variables define $5 \times 9 \times 3 \times 2 = 270$ mutually exclusive states. The 50 categories involving termination for age or mortality can be collapsed into two, one for each cause of termination. It might also make sense to reduce the 25 cells involving termination for medical recovery and other into one cell. Under this scenario, the number of cells would be reduced to 198.

At baseline, the cells for terminated due to age or mortality will be empty. In each projection year, each beneficiary will transition from their previous year’s cell to another cell, or remain in the same cell, via a process described in Section C.

3. Within-State Outcome Variables

Given the individual’s state, the model will assign values for the within-state outcome variables (e.g., annual earnings, annual benefits) in **Exhibit 2.3** for each individual.⁶

4. Outputs

Each projection will produce a file that contains values for all state and within-state outcomes for each individual for each calendar year in the projection period. From this file, BOSIM will produce tables containing summary statistics for each year of the projection period. The analyst will be able to produce these tables for the entire BOSIM sample or for various subgroups within the sample, defined by either baseline characteristics (for example, age, sex, or baseline state variables) or by their state variables in each projection year.

⁶ Section C.3 provides a description of the equation used to project the annual earnings level. See Section C.1 for a description of the disposable household income equation.

Exhibit 2.3. Within-State Outcome Variables

<ul style="list-style-type: none"> • Annual earnings amount (within the earnings status category) • Months off the SSDI rolls for: <ul style="list-style-type: none"> - Work - Age - Mortality - Medical recovery or any other reason • Annual benefits <ul style="list-style-type: none"> - Primary SSDI benefit due - Auxiliary SSDI benefit due - SSI benefit due (if concurrent) • Other household income 	<ul style="list-style-type: none"> • Payments for employment services <ul style="list-style-type: none"> - Percent with a cost-reimbursement payment - Mean cost-reimbursement payment amount - Percent with milestone or outcome payment(s) - Mean amount of milestone or outcome payments • Tax payments <ul style="list-style-type: none"> - Federal Income Tax (FIT) payments - Payroll taxes (FICA) payments • Disposable household income
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Exhibits 2.4 and **2.5** are table shells for BOSIM outputs. The width of these tables (number of columns) will depend on the length of the projection period, T , which is controlled by the analyst. Projections of monetary variables will be in constant dollars as of the baseline year, and the discount rate used to compute present values will be the real rate used by OACT.⁷

Exhibit 2.4. Table Shell for Key Outputs

Variable	Present Value	Year 1	Year 2	...	Year T
DI beneficiaries (thousands)	--				
Total benefits (millions)					
DI benefits					
SSI benefits					
Earnings (millions)					
Taxes paid (millions)					
Payroll taxes					
Federal income tax					
Payments for employment services (millions)					
Cost reimbursement payments					
Ticket payments					
Household disposable income per beneficiary	--				

⁷ Currently 2.9 percent.

C. Development of the Model

This section describes the sample that will be used to develop the model and presents initial specifications for each of the model's many equations. It also discusses how those specifications will initially be tested, equation by equation, and modified as needed to yield a fit that is satisfactory with respect to the equation's predictions relative to observed values. Testing and validation of the equations after assembly in BOSIM is discussed in the next section.

1. Development Sample

The analysis sample will come from the following data sources: the 2009 TRF, the Master Earnings File (MEF), the RSA-911 data, the Vocational Rehabilitation Reimbursement Management System (VRRMS), and the National Beneficiary Survey (NBS). The 2009 TRF contains administrative information concerning a beneficiary's benefit status as well as many other characteristics relevant to the program. Because TTW was not available nationwide prior to 2005, only the data for 2005 and later will be used.

Exhibit 2.5. Table Shell for Outcomes* by Status Categories

Variable	Year 1	Year 2	Year 3	...	Year T
Annual Earnings Category					
Less than SGA					
SGA up to 0.5 BYA					
0.5 BYA to BYA					
BYA to 2 BYA					
2 BYA+					
SSDI Status					
TWP					
Not completed					
Completed					
Re-entitlement year					
Re-entitlement completed					
Post-re-entitlement					
Benefits Terminated					
Age					
Mortality					
Work					
Medical Recovery or Other					
Employment Service Status					
Never enrolled					
Enrolled in current or past year					
SSI Status					
Never					
Current					
Past					

*Statistics to be displayed in this format include the percentage of beneficiaries in each category and means for each situational variable: annual earnings, the number of months off the SSDI rolls for work, months off the rolls due to age, months off the rolls due to death, months off the rolls due to medical recovery or other reasons, annual SSDI and SSI (if concurrent) benefits, cost-reimbursement and TTW payment variables (percent with payment(s) and mean payments for those with payment), household disposable income, FIT, and FICA.

The MEF contains annual earnings data for all beneficiaries. SSA maintains a file of MEF records for all beneficiaries in the TRF. Because the MEF contains confidential information and is not publically available, an SSA employee will need to merge this source onto the TRF sample and estimate equations that require annual earnings data. The RSA-911 data contain information needed to determine if an individual has enrolled for services with an SVRA (possibly without assigning a Ticket), and have been previously merged to the TRF. The VRRMS contains a record for each payment made by SSA to an SVRA under the cost-reimbursement system and has not been previously matched to the TRF.

NBS data, which have already been matched to the TRF, will be used to impute values for the few variables in BOSIM that cannot be obtained from other sources. The specific variables required are income tax filing status (married, single head of household, or single), number of dependents, and other household income. The NBS data, pooled across the first three rounds, will be used to develop an imputation methodology.⁸ Following the approach used for the earlier version of BOSIM, the methodology will consist of:

- A trivariate probit equation to predict filing status. Explanatory variables, all from the administrative data, will include Indexed Monthly Earnings, an indicator for auxiliary benefits, age and its square, sex, duration since SSDI entitlement and its square, primary impairment, and SSI status.
- For each filing status:
 - A logit equation for non-zero other household income
 - A lognormal equation for other household income, conditional on positive household income

Tentatively, six equations will be estimated, two for each filing status. Tentatively, these equations will use the same explanatory variables as in the trivariate probit for filing status. Alternatively, two or more of the filing status categories could be pooled, and filing status indicators could be added to the explanatory variables.

For the married and single head of household categories, a count model (e.g., Poisson) will be used to determine the number of dependent children. Tentatively, there will be separate equations for the two filing status categories, but consideration will also be given to pooling the samples and including filing status as an explanatory variable. The explanatory variables will be the same as for the other equations.

Once these models have been estimated, they will be used to impute values for filing status, other household income, and number of dependents for each record in the model's baseline data.

Three additional variables will be derived from the actual or imputed values of other variables. Following the current version of BOSIM, federal income taxes (FIT) will be calculated on the basis of federal tax rules, assuming that the standard deduction is applied. The beneficiary's payroll tax contributions will be calculated as the total FICA percentage. The expectation is that almost no

⁸ It is possible that fourth-round NBS data will be available in time for estimation of these models.

beneficiaries will earn more than the Social Security maximum. Disposable income will be calculated as benefits plus earnings plus other household income minus taxes.

The development of the current-law model provides an opportunity to formally test whether parameters estimated from BOND site observations will produce different national projections than those estimated from a nationwide sample. This is an important issue, because the BOND parameters for BOSIM must be estimated from BOND site data alone (see Chapter III), but will be used to produce national projections. For this reason, all beneficiaries with addresses in the BOND demonstration sites will be included in the development sample (approximately 800,000 in each year) along with a random sample of approximately equal size from the rest of the country.⁹ As described later in this chapter, discrepancies between estimates based on BOND site data and national data, and differences between national projections based on these two versions of current-law parameters, will be used to guide revisions to the model, with the objective of reducing such discrepancies.

Once constructed, the analysis file will contain values for each of the state variables and within-state outcome variables in each year. The data will support estimation of a series of equations that (1) describe the transitions between states, given demographic characteristics and previous states, and (2) predict the value of earnings, given demographic characteristics and previous states. The plan for developing both sets of equations is described below.

2. Transition Equations

The number of potential transitions from one of the 270 states defined above to another state is $270^2 = 72,900$ (which includes “transitions” to the same state). Many transitions are not possible, however. For instance, a beneficiary cannot complete the TWP in one year and then enter a pre-TWP completion state in the next year. In these cases, the probability of transition will be defined to be zero. Even when taking into account the number of infeasible transitions, the number of possible transitions is very large, implying that the number of parameters in the transition equations will also be very large.

A very simple approach would be to estimate a single probability for each possible transition, regardless of individual characteristics or characteristics of the individual’s environment, such as the nature of the labor market and the nature of the support system for workers with disabilities. This would ignore the likely considerable covariation between transition probabilities and both individual and environmental characteristics. Such a model would perform poorly when used to project outcomes for beneficiaries with a different mix of characteristics or in different environments. A somewhat less simple approach would be to group beneficiaries into smaller cells by age, duration on the rolls, and perhaps one or two other characteristics, and estimate probabilities for each cell. This approach would still be quite limiting, because in a specification rich enough to capture the many characteristics of interest, many cell sizes would be small. Although millions of records are available for estimation purposes, a very large share of the individuals in each year will be in the

⁹ For purposes of defining the BOND site sample, the address observed in 2005 or the address observed at entry in a later year will be used. Those who migrate to other areas later will still be counted as part of the BOND site sample, reflecting the design of the demonstration. A substantial number of addresses will be for representative payees; in these cases the beneficiary’s address might not be in the demonstration site. This seems inconsequential for purposes of developing BOSIM, however.

lowest earnings category, whereas the most important behavior that BOSIM needs to reflect is the behavior of those with relatively high earnings. Hence, a more structured approach seems warranted.

To describe the proposed approach, it is helpful to begin by describing an approach that is conceptually appealing, but computationally challenging—a many-dimensional first-order Markov process. Let $p(m,n,i,t)$ represent the probability that an individual in state n (one of the 270 possible states) in year $t-1$ transitions to state m in year t . Except in the case when the transition probability is 0, the equation for each transitions probability could be written as follows:

$$p(m,n,i,t) = f[X(i,t)b(m,n)],$$

where:

$X(i,t)$ is a row vector of K characteristics for individual i (or the characteristics of the environment in the area in which individual i resides);

$b(m,n)$ is a column vector of K parameters, or coefficients; and

$f[.]$ is a function that maps the full range of $X(i,t)b(m,n)$ into the $(0, 1)$ interval.

One element of $X(i,t)$ is unity for all individuals and years, so one element of $b(m,n)$ is the equation's intercept. The other variables in $X(i,t)$ are age (categorical), duration since SSDI entry (also categorical), primary impairment category, baseline primary SSDI benefit amount, population density in the beneficiary's county, mean household income in the beneficiary's county, the state unemployment rate in the base year, and the state unemployment rate in the current year. Other environmental variables will also be considered.

The logit equation could potentially be used for $f[.]$. A multinomial logit specification could be used, in principle, to ensure that probabilities for transitions out of any state, n , to all other possible states sum to one. This approach would be computationally intensive, because the dimensionality of each multinomial logit would likely exceed 100. A more practical, but also more restrictive, approach is to model transitions in a sequential manner that recognizes the joint nature of the four state variables (that is, that the transition from one status to another for any one state variable is typically not independent of transitions for the other three).

The proposed sequence described below appears practical and not exceptionally restrictive. It is important to recognize that this sequence is not intended to represent a sequential transition process on the part of the individual, but is instead a mathematical device for addressing the problem of modeling the 72,900 transitions in the model in a manner that approximates what would be obtained from the multinomial logit model described above.

This sequence, and the exact specification of each equation, should be considered to be a starting point in the development of the transition probabilities. As each equation is developed, its in-sample predictions will be compared to actual sample outcomes. Specifically, the number of transitions of each type will be compared to the number observed, and the characteristics of beneficiaries making each type of transition will be compared to the corresponding characteristics for those that actually make the transition. If an estimated equation leads to predictions that differ from those observed in a specific manner, the specification will be modified to address the problem. It should also be noted that all of the specified equations are first-order Markov processes; transition probabilities depend on the individual's current state, but not past states. This is an assumption that could potentially be relaxed on an equation-by-equation basis to improve the equation's ability to replicate transitions observed in the sample period.

The initial specification for the sequential model is as follows:

- Program status transitions, for $DIS(i,t)$ categories, will be modeled first. The reason for this is that the program status categories play an important role in the current-law variants of interest to SSA (TWP elimination and extension of the re-entitlement period), and will be modified for purposes of producing conditional projections under these variants (see Chapter IV). Although there are nine program status categories, the number of transitions possible from any one category to all others is no more than five (**Exhibit 2.6**), and after elimination of termination for age, which is deterministic, there are no more than four. In each case the specification could be a multinomial logit or a sequence of bivariate logits.¹⁰
- Enrollment for employment services, $ES(i,t)$, will be modeled next. This variable has only two status categories, and transitions can only occur in one direction. Hence, the second model could be a logit equation for the transition from never enrolled to enrolled. The relevant sample consists of those never enrolled in $t-1$, not terminated for age or mortality, and not attaining the FRA in the following year. Explanatory variables would include the $X(i,t)$ as well, the other status variables for $t-1$, and program status for t .
- SSI transitions would be estimated next. There are three possible transitions, from never to current, from current to past, and from past to current. Three binary logits could be modeled with the same explanatory variables as for the employment services equation, except that employment service enrollment status in t would be added.
- Transitions for earnings status would be estimated last. An individual in any one state can transition into any one of the other five states, so there are $5 \times 5 = 25$ possible transitions. Each set of five transitions (from one state to any one of the others) could potentially be modeled as an ordered logit with five outcome categories. The model would have the same explanatory variables as for the SSI transition models, except that SSI status in t would be added.

In addition to estimating each equation with the national sample, each equation will be estimated two additional times, once using data from the BOND sites only, and the second using the rest-of-country sample. A chi-square test will be used to test for the equality of the BOND area and rest-of-country parameter estimates. Significant differences will lead to specification changes designed to address the specific nature of the differences. For instance, introduction of geographic area or year effects might capture important environmental factors that are not captured in the $X(i,t)$. It would be preferable, however, to capture such variation through the introduction of observed environmental factors, because out-of-sample projections are likely to be more accurate if they are conditioned on explicit, measurable factors rather than assumptions about the applicability of area or year effects.

¹⁰ It should be noted that the estimation sample for each equation in the model may include multiple observations for the same individual (i.e., observed in multiple years). Hence, the disturbance terms across such observations will not be independent. A random effects estimator will be used to address this issue.

BOSIM's current-law transition process will use the developed equations in the following manner. At baseline, each beneficiary is in a specific state, defined by program status, employment service status, SSI status, and earnings status. The process will assign the beneficiary to a state in the first projection period through a sequential process that reflects the structure of the transition equations:

- The program status transition equations will be used to determine program status in the first projection period. The equations used will depend on baseline program status. To illustrate, consider a beneficiary in the TWP not completed category at baseline whose age is at least two years below the FRA. The model will predict probabilities for each of the four possible program categories in the first projection year: TWP not completed, TWP completed, benefits terminated for medical recovery, and benefits terminated for mortality or other. The predicted probabilities will sum to one. The program will then divide the unit interval into four segments, with each segment's length equal to the corresponding probability. It will then randomly draw a value between zero and one from a uniform distribution. The beneficiary will be assigned to the first projection period status whose segment corresponds with the uniform random number.
- The employment service transition equation will then be used to determine employment service status. If the beneficiary was enrolled at baseline, the beneficiary will remain in that status throughout the projection period. If not, the logit model will be used to determine the probability of transition from not enrolled status to enrolled status. The program will draw a value between zero and one from a uniform distribution and will assign the beneficiary to enrolled status in the first projection period if the value drawn is less than the probability; otherwise the beneficiary remains in not enrolled status.
- The appropriate SSI status transition equation—all binary logit equations—will then be applied in an analogous fashion to determine whether the beneficiary remains in the same SSI status in the first projection year, or transitions to the other possible status.
- The appropriate earnings transition equations will be applied last, to determine earnings status. The equations will predict probabilities for each of the five earnings categories. A random process analogous to the process for assigning program status will be used to determine earnings status in the first projection year.

The model will repeat this process for each subsequent projection year, conditional on the beneficiary's status in the previous year.

3. Within-State Outcomes

To determine within-state outcomes for a projection period, BOSIM will match each beneficiary record in the projection period to a beneficiary record in the same state from the baseline period and with approximately the same value for predicted annual earnings. The within-state outcomes for the latter beneficiary (including actual earnings) will serve as the projected within-state outcomes for the former.

Exhibit 2.6. Possible Program Status Transitions

Current Program Status	Possible Next Program Status
Not completed TWP	Not completed TWP, completed TWP, terminated for reason other than work
Completed TWP	Re-entitlement, terminated for reason other than work
Re-entitlement	Re-entitlement (if in 1st re-entitlement year), completed re-entitlement (if in 2nd re-entitlement year), or terminated for any reason
Completed Re-entitlement	Post-re-entitlement or terminated for any reason
Post-re-entitlement	Post-re-entitlement or terminated for any reason
Terminated for age	Absorbing state
Terminated for mortality	Absorbing state
Terminated for work	Remains terminated or returns to not completed TWP or re-entitlement
Terminated for medical recovery or other	Remains terminated or returns to not completed TWP or re-entitlement

If the individual is in a state in which earnings status is zero, a random draw will be made from all baseline records in the same state, with replacement. If the individual is in a state with positive earnings, an econometric equation will be used to predict earnings and the individual will be matched to a baseline record in the same state with the closest value of predicted earnings, again with replacement.

The initial specification of the earnings equation appears below. The specification for the dependent variable ensures that the predicted earnings level will fall within the range for the relevant earnings status category. Specifically, the dependent variable will be:

$$Y(g,i,t) = \ln[P(g,i,t)/(1 - P(g,i,t))],$$

where:

- g is an index for the earnings status category,
- $P(g,i,t) = (Earn(i,t) - LB(g)) / (UB(g) - LB(g))$,
- $Earn(i,t)$ is the individual's earnings,
- $LB(g)$ is the lower-bound of earnings for state g , and
- $UB(g)$ is the upper-bound of earnings for state g .

The earnings model is:

$$Y(g,i,t) = X(i,t)b(g) + DIS(i,t)d(g) + ES(i,t)f(g) + SSI(i,t)b(g) + DIS(i,t)TWP(i,t)q(g) + e(i,t),$$

where:

- $TWP(i)$ is the number of months after TWP completion in the individual's TWP completion year;

- $b(g)$, $c(g)$, $d(g)$, $f(g)$ and $h(g)$ represent coefficients, and $e(i,t)$ is an independent, identically distributed normal disturbance; and
- The first element of $q(g)$, corresponding to the pre-TWP completion state, will be constrained to be zero.

This initial model will be modified as needed to ensure that mean predicted earnings for subgroups of beneficiaries, defined by combinations of the explanatory variables, are close to actual mean earnings. Once a satisfactory model has been developed, a predicted earnings level will be assigned to each record in the baseline database. In each projection year, the same model will be used to calculate predicted earnings for each individual in earnings status category g . The model will then match the latter individual to a baseline record in the same state (defined by all four status variables) on the basis of predicted earnings, and assign the values of the record's within-state outcomes variables to the projection-year record for the individual.

The proposed matching method will use deciles of the predicted earnings distribution for the baseline records within each state. Each individual in a projection year sample will be randomly matched to a baseline record for the corresponding state with predicted earnings in the same decile, with replacement. If the number of baseline records in some states is too sparse, a smaller number of earnings categories will be used.

D. Testing and Validation

Initial model testing will be conducted on an equation-by-equation basis as outlined in the previous section. That will not guarantee, however, that the equations together will produce satisfactory projections over multiple years. This section outlines a series of three tests designed to progressively validate the model's projection capabilities: (1) replication of national outcomes over the sample values, (2) projection of national outcomes over the sample period based on parameters estimated using BOND site data only, and (3) projections for 2010 through 2019. Problems that might be diagnosed at each stage will be addressed as warranted, and the test repeated. Once the iterative process at each of the first two stages produces acceptable simulations, the process will proceed to the next stage.

Our expectation is that the current-law model, based on estimated transition models and the within-state outcome sampling model, will, when assembled into BOSIM, replicate sample outcomes over a five-year period in a satisfactory manner. Yet substantial discrepancies might arise. One possible cause of such discrepancies is that the structure placed on the transitional probabilities is too restrictive. The nature of the prediction errors might be suggestive of a specific problem of this type. If so, the transition equations will be re-specified and retested. Similarly, the structure of the earnings equation might also be too restrictive, and require modification.

1. Replication of National Outcomes over the Sample Period

This test will involve using the 2005 national beneficiary sample and new awardees for each year from 2006 to 2009 as data inputs to project outcomes over the sample period used to estimate the model. The projection used in this testing phase will differ from a projection into the future because (a) it will use as input the actual new awardees in 2006 through 2009, rather than SSA projections, and (b) the projections will be made over the same period used to estimate the parameters. The parameters to be tested will be based on the entire development sample.

The first step in this stage of the test will be based on differences between the transitions observed in the original data for 2006 and transitions projected for 2006. The exercise will be repeated for subgroups of beneficiaries, defined by characteristics— $X(i,t)$. Subgroup analyses will help identify any problems that might or might not be evident from the aggregate projections, as well as point toward possible corrections. If problems are not found at the aggregate level, we will also repeat the test for subgroups of beneficiaries.

This process can be repeated for the predictions of means of the within-state outcome variables. If transitions between states track actual experience, discrepancies in the mean outcomes within state suggest a deficiency in the method used to match projection-year beneficiaries in each state to baseline beneficiaries in the same state. It might be possible to correct such problems by making changes to the specification of the earnings equation, but it might also be necessary to refine the matching procedure or to match on some other variable in addition to predicted earnings.

The examination process will then be extended to longer projection intervals. If the model fits the data well, the projection outcomes should not drift away from actual outcomes in any one direction. Some drifting is to be expected, as small errors in early years tend to be magnified in later years, however pronounced trends toward a certain state, or for mean outcomes within a state, will be indicative of a substantial problem. This might lead to re-specification of individual equations related to the outcomes that drift. Introduction of second-order state variables, or interactions between state variables and variables in $X(i,t)$, might be needed to address some such problems.

2. Replication of National Outcomes Using Parameters Estimated with BOND Site Data

This test will repeat the previous exercise, but this time will use parameters that have been estimated with data from the BOND sites only. The specification will otherwise be the same as the specification arrived at via the previous test. The main goal of this test is to determine whether parameters estimated with BOND site data only will produce satisfactory national projections. BOSIM will not perform as well in this test as in the replication of national outcomes based on parameters estimated with the national sample. The test might point out specific shortcomings in the projections that would also potentially apply to the BOND model, which can only be estimated with BOND site data.

Recall that each equation of the model will initially be developed with the objective of minimizing differences between estimates based on BOND site data and estimates based on rest-of-country data. Hence, the most obvious sources of discrepancies are likely to have been eliminated prior to this test.

These projections are expected to deviate more from the actual outcomes than the projections based on parameters estimated with the national sample, even if the development effort successfully eliminates significant differences in estimates based on BOND site and rest-of-country samples. One likely source of differences is inadequacies in the specification for the environmental variables in $X(i,t)$, as these are the only way that BOSIM will explicitly account for differences between outcomes in the BOND sites and in the rest of the country. This possibility can be assessed by comparing the projections and actual values for individual geographic states.

If modifications to the specifications fail to eliminate substantive differences between projections using parameter estimates based on the national sample and those based on the BOND site sample, it might be worthwhile to update both sets of current-law parameter estimates as future data become available. Current-law projections based on parameters estimated with the BOND site

sample might arguably be a better base for comparison of BOND projections, also based on the BOND site sample. Proportional differences between current-law projections based on the national parameter estimates and those based on the BOND site estimates might serve as a basis for proportional adjustments to the BOND projections. The national current-law parameter estimates will be preferred for projections of current-law variants (i.e., work-incentive simplifications).

3. Projections of Future Outcomes

Any issues identified in the sample period tests will be addressed to the extent feasible. Once that process is complete, the model will be used to project outcomes for post-sample years. The 2009 baseline database will replace the 2005 baseline database used in the previous tests, and actuarial projections of new beneficiaries from 2010 through 2019 will be generated. The expectation is that actual 2010 data will be available by this time (from the 2010 TRF and the MEF), so it will be possible to compare the first 2010 output from the model to actual values.

Problematic projection errors in 2010 could lead to further modifications to the specification. It is very possible that the unusually severe recession of 2007-2009¹¹ will be reflected in the model's estimated parameters in a manner that leads to projection errors after 2009; i.e., the effects of the recession will not be fully captured via the model's environmental variables. This potentially serious problem might be reflected in the projections for 2010, although the effects might be more severe in later years.

For the years after 2010, until data for 2011 and beyond eventually become available, it will only be possible to review the projections for signs that they are problematic in some qualitative fashion. Problems are most likely to be encountered after the first five projection years (2016 and later), as the model will have been estimated with data from only a five-year sample. Some changes might be warranted as a result of implausible aspects of the projections.

Inaccuracies in the current law projections that are caused by changes in the economy or other environmental factors not fully captured in the model's environmental variables will be mirrored in the projections for the BOND model, described in the next chapter, and in those for the variants of the BOND and current law models, described in Chapter IV. The severity of the recession, and the difficulty of capturing the complex effects of a recession through environmental variables, makes it likely that there will be significant problems. If the effects were the same for all models, differences between the projections from any two models would not be affected. But the effects could vary by model. Hence, it is important to understand the nature of the inaccuracies in out-of-sample projections to the extent that they can be observed.

As data for future years become available, SSA will be able to update the current law model. Future data might support improvements to the model (e.g., changes in the specifications for the environmental variables) that will make the accuracy of the projections less sensitive to the economic environment.

SSA will eventually have the option of using data from the Stage 1 control group (C1) for purposes of estimating the current-law parameters. These could be used to produce projections for

¹¹ The National Bureau of Economic Research has dated the recession as starting in December 2007 and ending in June 2009. See <http://www.nber.org/cycles.html>, accessed February 16, 2011.

the BOND sites that are comparable to projections from the BOND version of BOSIM, estimated with data from the Stage 1 treatment group (T1). As discussed further at the end of the next chapter, this option would be especially attractive if current-law parameter estimates based on BOND site data from 2006 to 2009 perform poorly in the replication of national outcomes over the 2006 to 2009 period.

III. BOND VERSION OF BOSIM

A. Introduction

This chapter describes how the features of the BOND version of BOSIM will differ from those of the current-law version, as enhanced. It also describes how the equations for the BOND version will be developed. Final decisions about specific aspects of the BOND version described below will be made after the current-law model has been developed and assessed.

The structure proposed for the BOND version of BOSIM is essentially the same as the overall structure for the current-law version, but with a few additional enhancements that are needed to (1) incorporate specific features of the BOND design and (2) allow for potential behavioral differences between those who are on the rolls before BOND is introduced and those who enter SSDI after the implementation of BOND, other things constant.

The remainder of this introduction: (1) highlights key features of the BOND design that need to be incorporated into the BOND version of BOSIM, (2) summarizes the plan for developing preliminary, interim, and final estimates for the BOND parameters, (3) describes the nature of the projections for the introduction of BOND and for long-term outcomes, and (4) provides a roadmap for the rest of the chapter.

1. BOND Features to be Incorporated into BOSIM

Additional enhancements to the current-law version of BOSIM will account for the following features of the BOND design:

- The BOND benefit offset is applicable during a 60-month period, called the participation period, which begins in the later of (1) the month after TWP completion and (2) the demonstration entry month. One exception applies: if a treatment subject has not completed the TWP by September 2017, which will be 75 to 78 months after the beneficiary enters BOND, the subject returns to current law. This period replaces the re-entitlement period in the current-law model.
- The benefit offset is not applicable to beneficiary earnings until completion of the GP months. This is analogous to current law, under which benefits are not suspended during the re-entitlement period when the beneficiary engages in SGA until the GP months have been used.
- Once the GP is completed, the offset is applied to countable earnings for the remainder of the calendar year. Specifically, the primary SSDI benefit for the remaining portion of the year is equal to:
 - The current law's primary monthly benefit amount times the number of months remaining if countable earnings fall below the *prorata* value for BYA (i.e., the monthly SGA amount times the number of months); or
 - That amount reduced by \$1 for every \$2 of countable earnings above the *prorata* BYA.
- In the following four calendar years, the \$1-for-\$2 offset is applied to annual countable earnings above BYA.

- The Participation Period ends during the fifth calendar year after TWP completion—the last month is the 60th month after the TWP completion month. Benefits are reduced under the offset for the first part of the year, though the 60th month, after which current law again applies. After the 60th month, current-law benefits will be paid if the beneficiary is not engaged in SGA but terminated in the first month of SGA that occurs after the use of all remaining GP months.

The proposed BOND version of BOSIM incorporates all of the above features, as described in this chapter.

The BOND version of BOSIM does not explicitly incorporate any of the administrative features of the BOND design.¹² For example, the outreach effort and the processing of earnings data play no explicit role in the model. Instead, the parameter estimates, based on the data from the BOND Stage 1 Treatment Group (T1), will implicitly reflect these features.

The BOSIM parameters cannot reflect all potentially important differences between the demonstration and a national policy. BOND is a social experiment, under which some beneficiaries are randomly assigned to the BOND treatment and are informed about assignment via individual outreach. A national program would operate in a dramatically different context that could have consequences for impacts. For instance, because all beneficiaries will be eligible to use the benefit offset, many local organizations, state agencies and advocates will be much more knowledgeable about the BOND design than they will be during the demonstration, and they might influence the behavior of beneficiaries.¹³ The BOND version of BOSIM, however, does not incorporate any effects of administrative and contextual differences between the demonstration and a national program. There is no information available to support adjustments to the BOND parameters that would reflect anticipated administrative and contextual differences. The BOND version of BOSIM will, however, make adjustments for at least some observable environmental differences between the BOND sites; like the equations for the current-law version, the equations for the BOND version will include variables for environmental factors.

2. Estimation and Testing of BOND Parameters

At the end of the demonstration, nearly six years of data for 80,000 T1 subjects will be available for estimating the BOND parameters for BOSIM. The data will provide extensive information about how beneficiaries behave under the BOND design. The estimation process will extract information on behavior from the BOND data and embed it in the BOND parameters for BOSIM.

Initial estimation of the BOND parameters could begin before the data are completed. For instance, once two years of BOND data are available (late in 2013), it would be feasible to estimate a set of BOSIM parameters that captures the behavior of T1 subjects in their first two years under the BOND design. As additional years of BOND data become available, SSA can continue to update the parameters. It will not, however, be feasible to estimate parameters for the equations that describe behavior for the BOND Participation Period Completed and Post-BOND Participation

¹² See *Final Design Report* for details on these features.

¹³ Technically, the stable unit treatment value assumption (SUTVA) might be violated (Cox, 1958). SUTVA is the assumption that the behavior of a treatment subject is independent of whether other beneficiaries are assigned to treatment.

Period status until the end of the BOND evaluation, and even then the data will be limited. For this reason, SSA might eventually find it useful to update BOSIM using post-demonstration data for T1 subjects. Until such data are available, SSA could use the equations from the current-law model for the Re-entitlement Period Completed and Post Re-entitlement Period to predict outcomes at the end of the BOND participation period.

The complete T1 data will be very informative about how beneficiaries behave under the BOND design. It is important to recognize, however, that even the complete BOND data will have limitations. Two have already been discussed: differences in the context of BOND and a national program, and the small number of T1 subjects that will have completed the BOND Participation Period by the end of the demonstration period. Others include:

- The T1 sample is much smaller than the sample that will be used to estimate the current-law version of BOSIM. Although 80,000 is a large sample in many contexts, a large share of the 80,000 T1 subjects will not work during the demonstration period, and a substantial number of those who work will not go on to complete the TWP and use the benefit offset. Historical data show that most beneficiaries who complete their TWP do so in their first five years on the rolls, and even after 10 years fewer than 10 percent do so (Stapleton et al. 2010). Hence, unless BOND has a very large impact on TWP completion, the number of T1 subjects that complete the TWP before the end of the demonstration period will be on the order of 10,000 or less. Consequently, the specifications for some equations for the BOND version will need to be more parsimonious than their current-law counterparts.¹⁴
- The requirement that subjects enter the participation period by September 2017 or return to current-law rules might accelerate entry into the participation period for some demonstration subjects. Presumably, a comparable rule would not apply in a national program. Therefore, it will be impossible to determine the extent to which this requirement affects behavior during the demonstration.
- The BOND data come from the 10 BOND sites. Although selected to be nationally representative, the sites are imperfectly so, making it impossible to formally assess how well the model makes predictions for the entire country. Such tests are possible for the current-law model, as described in Chapter II, and the insight gained from these tests might have implications for specification of the BOND version of BOSIM or the method used to make national projections.

Despite the above limitations, the information gathered at the end of the demonstration will make BOSIM's projections of outcomes for the national introduction of the BOND benefit design far more accurate than any projections that could be made today.

3. Projections for the Introduction of BOND and for the Long Term

The BOND version of BOSIM will be used to produce two types of projections:

¹⁴ One approach that would allow a richer specification would be to pool T1 and C1 data, and estimate models that allow some parameters to vary with the benefit design while constraining others to be the same. The restrictions could be readily tested.

- **Introduction of BOND (IB) Projections** predict outcomes that will occur when the BOND design is first implemented, nationally, and will reflect the fact that most beneficiaries will have entered SSDI many years before the introduction of BOND.
- **Long-Term (LT) Projections** predict outcomes that will occur after BOND has been in place long enough so that all beneficiaries on the rolls have entered the rolls since BOND's introduction.

IB and LT projections will likely differ because of the dynamic effects of changes in work incentives. It seems likely, for instance, that some beneficiaries entering SSDI after national implementation will return to work and complete the TWP more quickly than if national implementation had occurred several years after their entry into SSDI.

The BOND demonstration data are most directly pertinent to the IB projections because most BOND treatment subjects will have been on the rolls for many years before the start of the demonstration. As described in Section B, the BOND sample design will support estimates of how beneficiary behavior under BOND depends on the number of years a beneficiary was on the rolls before BOND entry. The estimates will be critical for BOSIM's ability to make long-term projections.

4. Roadmap

Section B describes how BOSIM will incorporate the BOND design. Section C describes the initial estimation of the BOND parameters for BOSIM, and how they can be updated as new data become available. The chapter concludes with a discussion of the IB and LT projection methodologies.

B. Incorporation of BOND Features into BOSIM

Three sets of changes to the enhanced current-law version of BOSIM are needed to incorporate the specific features of BOND described in the introduction. The first set of modifications is designed to distinguish between the behavior of those who enter BOND and SSDI at essentially the same time and the behavior of those who enter BOND after they have been on the SSDI rolls for an extended period, other things constant. The second set of enhancements is designed to identify the start and end of the participation period. The third set of modifications is designed to calculate benefits during the period in which the offset applies. Each set of changes could be developed from the final demonstration data.

1. BOND Entry Relative to SSDI Entry

BOND outcomes for individual beneficiaries will likely depend on when beneficiaries enter BOND. BOND introduces the changed incentives to the current caseload, most of whom have been on SSDI for many years. If implemented as a permanent policy, all individuals who enter SSDI thereafter would be eligible for the changed incentives from when they enter SSDI.

BOND was designed to support analysis of how the duration between entry into SSDI and entry into the BOND benefit design influences behavior. Two specific features of the demonstration's design will facilitate this analysis. First, half of the 80,000 T1 sample will be a random sample of "short-duration" beneficiaries—those on the rolls for 36 or fewer months before BOND entry. The sample of short-duration beneficiaries would have been considerably smaller if 80,000 T1 subjects were simply a random sample of all beneficiaries in the BOND sites. The

disproportionately larger sample of short-term beneficiaries provides an opportunity to observe with more precision how beneficiaries behave when they become eligible for BOND shortly after SSDI entry.

The second feature of the demonstration's design that will facilitate the analysis is the length of the sample period for the evaluation. It is expected that at least five and a half years of data will be available for all T1 subjects (from July 2011 through the end of 2015¹⁵).

The two features combined imply that there will be an opportunity to observe a substantial number of beneficiaries who become eligible for BOND shortly after SSDI entry and compare their behavior several years later to the behavior of those who had already been on the rolls for several years before they became eligible for BOND (see **Exhibit 3.1**). For instance, at the end of the demonstration, the BOND data will include observations for T1 subjects who were in their sixth year on the rolls and who entered BOND anywhere from zero to five years before that year (represented by the bold sixes in the exhibit). As developed by Bell et al. (2011, Chapter Two), theory predicts that the TWP completion rate as of the sixth year on the rolls for those who entered SSDI and BOND in the same year will be higher than the TWP completion rate for those in their sixth year on the rolls who entered BOND several years after they entered SSDI.

The proposed BOND version of BOSIM will model potential timing effects by including additional variables in the individual and environmental characteristics in the transitional and situational equations, $X(i,t)$, that capture the difference between SSDI entry and BOND entry. For instance, the specification could include the duration between SSDI and BOND entry and the interaction between this duration and the duration since SSDI entry. It is important to note that duration since SSDI entry is already included in $X(i,t)$. Alternative specifications will be considered as needed to ensure that the equations successfully replicate the distribution of sample outcomes for both short- and long-duration beneficiaries.¹⁶

The quality of the estimated coefficients for the variables will be limited by the fact that BOND subjects who enter SSDI and BOND will only be observed for their first six years on the rolls, as shown in Exhibit 3.1. BOSIM will be able to produce projections beyond this period for those that enter SSDI after the BOND rollout, but those projections will be extrapolations of behavior observed during the demonstration for the first six years. This reflects the broader challenge of projecting outcomes over a period that is longer than the demonstration period.¹⁷

It will be possible to perform a limited assessment of the quality of the extrapolations by shortening the observation period by one year and re-estimating the models. If doing so changes the coefficients substantively, then an increase in the observation period might also change them substantively, although perhaps by a smaller amount.

¹⁵ BOND entry for T1 subjects is scheduled for April through June 2011.

¹⁶ One option is to estimate separate models for short- and long-duration beneficiaries. Even in separate models it would make sense to include duration on the rolls prior to BOND as an explanatory variable, because there will be substantial variation in duration on the rolls prior to BOND entry within the short- and long-duration beneficiary groups. The combined approach seeks to use the data efficiently by restricting the parameters across the two samples. It will be important to test these restrictions; rejection of the restrictions would favor use of separate models.

¹⁷ See Greenberg et al. (2004) and Hotz et al. (2006).

Exhibit 3.1. Year on the Rolls by Demonstration Year for BOND Subjects*

	BOND Observation Year					
	2011	2012	2013	2014	2015	2016
Short-duration sample*	1	2	3	4	5	6
	2	3	4	5	6	7
	3	4	5	6	7	8
	4	5	6	7	8	9
Long-duration sample*	4	5	6	7	8	9
	5	6	7	8	9	10+
	6	7	8	9	10+	10+
	7	8	9	10+	10+	10+
	8	9	10+	10+	10+	10+
	9	10+	10+	10+	10+	10+
	10+	10+	10+	10+	10+	10+

*BOND is scheduled to begin in April 2011, and all T1 subjects are scheduled for enrollment notification by the end of June 2011. BOND data through 2016 are expected to be available for estimation of the final BOND version of BOSIM. The numbers in the table indicate the beneficiary's number of years on the rolls at the end of the indicated calendar year. The short-duration sample consists of the 40,000 T1 subjects who will have entered SSDI 36 or fewer months before BOND entry, and the long-duration sample consists of the 40,000 T1 subjects who will have entered SSDI three or more years before BOND entry. The table shows that some short-duration subjects will be in their fourth year on the rolls in 2011 as some complete their third year during 2011. Some long-duration subjects will also be in their fourth year on the rolls in at least part of 2011.

2. BOND Participation Period

Under both current law and the BOND design, in the months immediately after TWP, countable earnings can lead to benefit reduction (under BOND) or suspension (under current law or BOND) without loss of entitlement status. The lengths of the period of automatic re-entitlement differ under current law and the BOND design, making it important to capture the difference in BOSIM's structure. As discussed in the introduction, under current law, the period covering the first 36 months after TWP completion is called the re-entitlement period while, under BOND, the period covering the first 60 months after TWP completion is called the BOND participation period for those who complete TWP after BOND entry. For those who complete the TWP under current law before entering BOND, the BOND participation period starts at BOND entry and lasts for 60 months. Whether under current law or BOND, if the beneficiary engages in SGA after the end of the relevant period and uses up any remaining GP months, benefits are terminated. If the beneficiary does not engage in SGA after the end of this period, benefits continue until they are terminated for some other reason.

For the current-law version of BOSIM, the re-entitlement period is reflected in the SSDI program status variable, $DIS(i,t)$. Along **Exhibit 3.2's** left-hand side, the nine proposed categories of that variable under current law are presented. The BOND version of BOSIM retains the nine proposed categories and redefines and renames three of them, reflecting the BOND participation period (right-hand side of the exhibit).

Two other specification changes are proposed to reflect post-TWP differences under the two benefit designs. The first pertains to the length of time as tracked by an annual counter set to one when a beneficiary is assigned to TWP completion year status and then increased by one for the next four years. The value of the counter determines SSDI status in the following year unless benefits are terminated. The counter is also an explanatory variable in the earnings equations for

Exhibit 3.2. SSDI Status Categories under Current Law and BOND*

Current Law		BOND		
Category Name	Definition	Category Name	Definition	
			If TWP completed after BOND entry	If TWP completed before BOND entry
TWP Not Completed	All years before TWP completion	TWP Not Completed	All years before TWP completion	Not applicable
TWP Completed	Year of TWP completion	TWP Completed	Year of TWP completion	Not applicable
Re-Entitlement Period	Years 1 and 2 after TWP completion year	BOND Participation Period	Years 1 to 4 after TWP completion year	Years 1 to 5 of BOND
Re-Entitlement Period Completed	Year 3 after TWP completion	BOND Participation Period Completed	Year 5 after TWP completion year	Year 6 after BOND entry
Post-Re-Entitlement Period	Year 4 and later years after TWP completion	Post-BOND Participation Period	More than 5 years after TWP completion	More than 6 years after BOND entry and later
Termination for Age	Benefits terminated for indicated reason	Termination for Age	Benefits terminated for indicated reason	Benefits terminated for indicated reason
Mortality		Mortality		
Work		Work		
Medical Recovery or Other		Medical Recovery or Other		

*Omits four termination status categories, which are the same under current law and BOND.

those who have completed the TWP. The same counter will be used in the BOND version of BOSIM for the same purposes, but over six years rather than four, reflecting the length of the BOND participation period. For those who completed the TWP before BOND entry, the counter will start in their first BOND year.

The second proposed specification change is to include at least one variable in $X(i,t)$ to capture T1 subjects who will have entered TWP before entering BOND. A simple option is to include a dummy variable indicating TWP completion. Other variables that could be added and tested include (1) another dummy variable to differentiate between those who completed the re-entitlement period before BOND entry and those who are in the re-entitlement period and (2) a variable for the duration since completion of the TWP interacted with an indicator of completion of the TWP before BOND entry.

3. Variables Related to Calculation of BOND Benefits

Under BOND, annual benefits for the primary beneficiary depend on the current-law monthly benefit amount and annual countable earnings above the BYA. For years in which the offset applies to only part of the year, benefits are based on countable earnings for that part of the year and the prorated BYA. During other months of the year, the primary benefit is either (1) the full current-law benefit if the participation period has concluded and countable earnings exceed SGA or (2) zero.

The BOND version of the model will include two within-state outcome variables not in the current-law version of the model: the number of months subject to the benefit offset (i.e., months during the year that are in the BOND participation period and follow use of all GP months) and countable earnings during that period. For most beneficiaries in the SSDI status “BOND Participation Period,” the number of months is expected to be 12, and the offset will be applied to

countable earnings for the entire year. The number of months that benefits will be subject to the offset will generally be fewer than 12 for beneficiaries in their TWP completion year or the BOND participation period completion year, with the offset applied to countable earnings for those months only.

C. Estimation and Testing of BOND Parameters

Estimation and testing of the BOND parameters will proceed only after SSA has had an opportunity to fully assess the current-law version. SSA will also consider the timing of the BOND version's development, given the projected availability of BOND data and the value of developing initial estimates with incomplete data.¹⁸

In many respects, estimation and testing of the BOND parameters for BOSIM can follow the procedures described in Chapter II for the current-law model, but the development process for the BOND parameters will reflect the more restrictive nature of the available data—much smaller sample size (80,000 treatment subjects), and all in the BOND sites. These limitations will be compounded for initial development if development proceeds with just a few years of demonstration data.

D. Projections

This section describes how BOSIM can be used to produce IB and LT projections. Before proceeding, however, it is worth repeating a point made in the introduction: the econometric equations estimated to support the BOND impact evaluation for the Stage 1 treatment group could be used to make the projections instead of BOSIM. As described in Bell et al. (2011, Chapter Six), these will be a series of single-equation, reduced form models for individual outcome variables (e.g., annual earnings and benefits), each with controls for baseline beneficiary and environmental characteristics.

In fact, it is important to implement that more direct approach for the purposes of the evaluation, because it might well be more accurate than use of BOSIM for the same purpose—at least for projection periods that are no longer than the length of the BOND observation period. The reason is that the impact evaluation models will impose less structure on the data, so are less vulnerable to model misspecification. BOSIM's structure serves a useful purpose, but that purpose is to support assessments of how variants to the BOND and current-law designs will affect outcomes, not to support projections of outcomes under the BOND or current-law designs.

1. National Introduction of BOND (IB)

Once a BOND version of BOSIM has been fully developed, SSA can use it to project outcomes for the national implementation of the BOND design in some future year. SSA will be

¹⁸ Significant numbers of treatment subjects are not likely to complete the BOND participation period before 2017. Projections based on data through 2017 will be too late to inform the BOND final report, due in 2017, because the data for 2017 will not be fully available until late in 2018. The final BOND report might be able to incorporate projections based on data through 2016, but it seems more likely that it will only be able to use projections based on data through 2015 because the 2016 data will not be available until late in 2017.

able to compare the BOND projections to the current-law projections for the same period to predict the impacts of BOND's introduction. Before the BOND version is fully developed, it will be feasible to make preliminary projections with the hybrid or intermediate versions of the model.

As mentioned in the introduction, it is likely that 10-year projections will be of greatest interest to policymakers. It is important to recognize that projections for periods that are longer than the period observed under BOND will be extrapolations beyond the demonstration's experience. They must rely on the assumption that beneficiaries will continue to transition between states and continue to have within-state outcomes that reflect demonstration-period experience. This assumption will be problematic if the parameter estimates are based on data that include few, if any, observations for beneficiaries who are completing the BOND participation period and returning to current-law rules. Hence, until such data are available it would be advisable to project outcomes for a period that is no longer than the BOND observation period.

Either of two approaches could be used to produce the national projections, or both. The first approach is relatively simple. It would apply the BOND parameter estimates to a national sample of beneficiaries. This approach would be appealing if the process of developing the current law model shows that national current-law outcomes can be successfully projected by application of current-law parameter estimates based on data from the BOND sites to a national beneficiary sample.

The second approach will be preferred if national current-law outcomes cannot be successfully projected from a current-law model estimated from BOND site data. Under this approach, SSA would first produce and compare BOND and current-law projections for a baseline sample from the BOND sites. The current-law parameters used for this projection would be based on data for the BOND Stage 1 control group rather than on a national sample. The projections would also use the actuaries' projections of new beneficiaries as inputs, scaled down in proportion to the number of new beneficiaries in the BOND sites relative to all new beneficiaries in the baseline year. Percentage differences between key outcome variables would be used to estimate the percentage impact attributable to the introduction of BOND on those outcomes in the BOND sites. National differences would be projected by applying the percentage differences to national current-law projections, with the latter based on current-law parameters estimated with a national sample.

2. Long-Term Projections

Long-term projections—longer than 10 years—are of interest for two reasons. The first is to determine whether outcomes for beneficiaries who enter SSDI after the introduction of BOND differ substantially from the outcomes of those who enter BOND well after SSDI, after controlling for number of years on the rolls. The second is to analyze the implications of BOND's introduction for the long-term SSDI Trust Fund balance.

It is important to recognize that many beneficiaries stay on the rolls for a long time. For instance, in December 2009, 8.2 percent of SSDI beneficiaries had first entered the rolls more than 30 years earlier, and another 25.2 percent had entered the rolls between 21 and 30 years earlier (SSA 2010, Table 5.D4). The data suggest that percentage impacts 30 or 40 years in the future will be different than those 10 or even 20 years in the future.

Although BOSIM will be able to calculate projections under both BOND and current law for as many years as the actuaries project new beneficiaries, the quality of the projections might deteriorate substantially beyond five years, for reasons previously discussed, and even more so beyond 10 years.

BOSIM can produce a more accurate answer to a more limited question. How different will the impacts of the BOND design be for beneficiaries who enter SSDI after the introduction of BOND *during their first six years on the rolls* than from those for beneficiaries who had been on the rolls for up to six years when BOND is introduced, holding years on the rolls constant? **Exhibit 3.3** shows a table shell designed to facilitate such comparisons.

The left-most column of Exhibit 3.3 pertains to those who entered the rolls in the first projection year, and the seven estimates in the first column represent the long-term projected impacts for those on the rolls from zero to six years, i.e., estimates for beneficiaries who entered SSDI after BOND implementation. The columns to the right represent successively shorter-term impacts for those on the rolls for the same number of years but who entered SSDI before the first projection year. The shaded cells indicate impacts that are non-existent because the beneficiaries in the column's group entered BOND after they had been on the rolls for the number of years corresponding to the row. For instance, the second column shows the projected impacts for those who entered SSDI in the same year that BOND was introduced for their first through sixth year on the rolls, and the third column shows the projected impacts for those who entered SSDI in the year before BOND was introduced for their second through sixth year on the rolls. Large differences across the columns imply that long-term impacts for those on the rolls for fewer than seven years are quite different than the short-term impacts.

Exhibit 3.3. Table Shell to Display Projected Impacts for a Key Outcome by Years on the Rolls and Years on the Rolls in the First Projection Year

Years on Rolls	Years on Rolls in First Projection Year						
	0	1	2	3	4	5	6
0							
1							
2							
3							
4							
5							
6							

3. Confidence Intervals

Thus far, the projection methodologies presented have focused on point estimates. It would be desirable to have confidence intervals around these point estimates. While confidence intervals are important for current-law projections as well as for BOND projections, they are more important for the BOND projections because of the relatively small size of the estimation sample.

In principal, confidence intervals could be constructed by using the bootstrap method to produce many (e.g., 1,000) sets of BOND parameter estimates from the BOND data and then use the estimates to generate 1,000 sets of each type of projection, generating a distribution for each key outcome variable in each year. Then, for instance, the 5th and 95th percentiles of the distributions could be used to construct the 90 percent confidence interval for the value. The entire process could be automated once a final specification for the BOND model is developed.

Once the current-law model has been developed, it will be possible to assess the computational feasibility of this approach. SSA will revisit this issue while considering how and when to move forward with the development of the BOND version.

BOSIM's projections for current law and the BOND benefit design will be based on the observed behavior of beneficiaries under the two designs. The next chapter considers the use of

BOSIM for the projection of outcomes under variants of the two designs, conditional on assumptions about the effect of the change in benefit design on employment and earnings. Projections for each variant will be compared to either the current-law projections or the BOND design projections.

IV. VARIANTS OF THE CURRENT-LAW AND BOND BENEFIT DESIGNS

A. Introduction

The previous two chapters described the proposed enhancements to the structure of BOSIM and how the structure can be fit to data that reflect actual beneficiary behavior under current law and under the BOND benefit design (i.e., how the current-law and BOND versions of the model's parameters can be estimated). The two versions of the model are designed to produce projections under current law and the BOND benefit design. However, SSA, Congress, and others will likely be interested in variants of each of these designs. The second major goal of BOSIM, and the primary reason for BOSIM's complex design, is to help SSA assess likely outcomes under such variants.

No available data capture behavior under alternative benefit designs. Hence, BOSIM cannot predict how the employment and earnings of beneficiaries will respond to such designs. BOSIM's structure, however, allows it to project all outcomes other than employment and earnings under selected variants of current law or the BOND design *if beneficiary employment and earnings are unchanged*. For example, if the TWP is eliminated under current law and it is assumed that employment and earnings will be the same as under current law, BOSIM can project what benefits, taxes, household disposable income and other outcomes will be. BOSIM can make analogous projections for elimination of the TWP under BOND.

Similarly, if beneficiaries adjust their earnings in ways that are consistent with their observed behavior under either current law or the BOND design, BOSIM can project the effects on all outcomes. For instance, if the TWP is eliminated under current law, beneficiaries who are in what would otherwise be their TWP completion year can be assumed to behave like beneficiaries in the first year after TWP completion under current law—when some presumably restrain their earnings to avoid loss of benefits. An analogous assumption can be applied to elimination of the TWP under BOND.

Henceforth, such projects are called “conditional” projections—*i.e., the projections are conditioned on maintained assumptions about how the designs will affect beneficiary behavior relative to behavior observed under either current law or BOND*. It is extremely important to recognize that, for each variant, there is a broad, but bounded range of plausible assumptions about behavioral effects. To avoid misleading policymakers and others about the accuracy of the projections, BOSIM should be used to produce a range of conditional projections for each variant, corresponding to the range of plausible assumptions.

This chapter describes proposed enhancements to BOSIM to support production of a range of conditional projections for a specific set of current-law and BOND variants. The remainder of the introduction describes these variants, discusses the approach to making a range of conditional projections for each variant, and concludes with a roadmap for the rest of the chapter.

1. Variants to the Current-Law and BOND Benefit Designs

The proposed enhancements will support projections of the variants of the current-law and BOND benefit designs shown in **Exhibit 4.1**.

Exhibit 4.1. Variants to the Current-Law and BOND Benefit Design

Current-Law Benefit Design Variants	BOND Benefit Design Variants
<ul style="list-style-type: none"> • Elimination of the TWP • Extension of the re-entitlement period until termination occurs for a reason other than work • The two changes combined 	<ul style="list-style-type: none"> • Elimination of the TWP • Change to the duration of the BOND participation period • An offset that starts at BYA/2 • Alternative offset rates • Combinations of the above

The enhanced version of BOSIM will produce projections for each of these variants that are conditioned on assumptions about the effects of each variant on beneficiary earnings.

Interest in *elimination of the TWP under either current law or a benefit offset* is considerable, in part because of the administrative challenges associated with determining TWP completion and in part to reduce benefit costs. Advocates for the benefit offset have, for instance, suggested elimination of the TWP to counter the costs from induced SSDI entry. The enhanced BOSIM will be able to produce a range of projections for the effects of TWP elimination under either current law or a benefit offset, conditional on a range of assumptions about the effects on earnings.

There is also considerable interest in *extension of the re-entitlement period under current law*. The 1999 Ticket to Work and Work Incentives Improvement Act required SSA to develop an expedited re-entry process for those whose benefits are terminated for work after the re-entitlement period. The expedited process can be viewed as a step in the direction of extending the re-entitlement period indefinitely. Extension of the re-entitlement period would eliminate the need for the expedited reinstatement process, which is administratively more complex than the re-entitlement process. The effect of extending the re-entitlement period on benefit costs is unknown. The enhanced BOSIM will produce a range of projections for the effects on benefit costs, conditioned on a range of assumptions about the effects on beneficiary earnings.

Combining TWP elimination and extension of the re-entitlement period under current law would greatly simplify SSDI work incentives and their administration. Because the effects of these two changes on two key outcomes—earnings and benefits—presumably work in opposite directions—the first is likely to reduce earnings and benefits while the latter is likely to do the opposite—the direction of the effects of the combined change on the same variables cannot be predicted from theory. The enhanced BOSIM will be able to project a range of effects on net costs, conditional on a range of assumptions about the effects on earnings.

The 60-month *length of the BOND participation period* is a feature of the BOND design that might be changed in a national benefit offset program. The expectation is that some policymakers will support an unlimited participation period, thereby permitting beneficiaries who work to continue receiving partial benefits indefinitely. Other policymakers are likely to be concerned that an unlimited participation period will be too costly.

Under a *benefit offset that starts at BYA/2*, beneficiaries who have completed the TWP and the grace period and are in the BOND participation period would receive full annual benefits in years when their countable earnings are half the annual equivalent of the SGA amount, BYA/2, rather than BYA as under BOND, and their benefits would be reduced by \$1 for every \$2 of countable earnings in excess of BYA/2, rather than when they are in excess of BYA. Although this

less generous design would likely cause some beneficiaries to reduce their earnings relative to what they would be under BOND, some relatively high earners might decide to increase their earnings relative to their earnings under BOND and exit SSDI. Hence, the predicted sign of the impact on mean earnings is ambiguous. The predicted sign of the impact on mean benefits relative to BOND benefits is negative, however, as benefits will be reduced for those who increase their earnings and will be reduced, or at least not increased for all those who reduce their earnings. Hence, this design has appeal from the perspective of reducing benefit costs, even if not from the perspective of increasing beneficiary earnings and disposable income. Concerns about the cost of SSDI benefits under a benefit offset are likely to depend on the findings from the BOND evaluation. The evaluation might find, for instance, that the offset has a *positive* impact on benefits net of any impact on federal revenues, because many of those whose benefits would be suspended or terminated for work under current law might receive partial benefits under BOND. Further, even if the demonstration showed the opposite, concerns about the cost of induced entry are likely to persist.

Another reason for consideration of an offset that starts at $BYA/2$ is interest in synchronizing the SSDI benefit offset with the rules for the reduction of SSI benefits as monthly earnings increase: a \$1-for-\$2 offset applies above a small earnings disregard. The SSI disregard can be as low as \$65 per month (the earned income exclusion)—currently just 6.5 percent of the non-blind SGA. In addition, a \$20 exclusion for any income (i.e., not just earnings) can be applied to earnings if the SSI recipient earns no other income. For concurrent beneficiaries, the latter is typically used to reduce the effect of SSDI benefits on SSI benefits by \$20.

The Social Security Advisory Board (2009) has recommended adjusting the two exclusions for the considerable inflation that has occurred since the exclusions were initially set at SSI's inception in 1974. The Board estimated that the inflation-adjusted value of the earned income exclusion would have been \$284 in 2009, or 28.4 percent of the (non-blind) SGA amount. The addition of the inflation-adjusted value of the exclusion for other income brings the figure to \$371, or 37.1 percent of the SGA amount.¹⁹

One option for synchronizing the SSDI and SSI work incentives would increase the sum of the monthly SSI earnings and income exclusions and set the annual disregard for the SSDI benefit offset at 12 times that sum. Given the interest in increasing the SSI exclusions for earlier inflation, a value of $BYA/2$ (the monthly equivalent of half the SGA amount) would be a reasonable candidate for such a disregard. The proposed enhancements for BOSIM will support projections of this change to the BOND benefit design conditional on specific assumptions about the effects of the change on earnings. SSA could choose another value when final decisions are made about the BOND version of BOSIM.

Under an *alternative offset rate*, beneficiaries who have completed the TWP and the grace period and are in the BOND participation period would receive full annual benefits in years when their countable earnings are less than or equal to the BYA, but their benefits would be reduced by applying an alternative offset rate, such as \$1 for \$3 or \$1 for \$4., for countable earnings above BYA

Any *combination of the BOND variants* could potentially be considered. For instance, a lower offset rate (e.g., \$1 for \$3) could potentially be combined with an offset that starts at $BYA/2$,

¹⁹ The Board's estimate was based on a projection for the 2009 price level.

or elimination of the TWP could be combined with extension of the participation period. The specifications needed for all possible combinations have not been considered. SSA can consider combinations of special interest in the future, as it deliberates about the development of the BOND version.

2. Approach to Conditional Projections

The general approach to developing conditional projections for each variant is to identify a pair of assumptions that set plausible bounds for the effect of the proposed change on beneficiary earnings relative to earnings under the base design (i.e., either current law or the BOND design, depending on the variant). For each assumption about earnings, the model used to adjust benefits and other outcomes in a manner that reflects the modified benefit design. For instance, if earnings are assumed to be insensitive to extension of the re-entitlement period, the earnings of those who would have completed the re-entitlement period under current law remain the same, but they are suspended for work rather than terminated for work, if they engage in SGA, and they remain in re-entitlement status in the following year unless benefits are terminated for another reason.

The pair of earnings assumptions for each variant includes (1) the assumption that earnings are highly insensitive to the change in the benefit design (i.e., beneficiaries continue to earn as projected under the base design), and (2) the assumption that earnings are highly sensitive to the change in design, but in a manner consistent with observed behavior under current law and/or the BOND design. The specific implementation of these assumptions is unique to each variant, as described later in this chapter. The specifics might change as BOSIM is developed, but the approach will remain the same.

3. Roadmap

The remainder of this chapter describes how the proposed assumptions for each variant will be incorporated into BOSIM. The next section describes the current-law variants, and the last section describes the BOND variants.

B. Current-Law Variants

This section describes how the two earnings assumptions will be implemented for the conditional projections under the variants of current law described above. The current-law projections will be used for comparison purposes.

1. Elimination of TWP

The specific assumptions for conditional projections of outcomes if the TWP is eliminated under current law are listed in **Exhibit 4.2**. They are based on the current-law specification, but differ in their use of the various components of the current-law specification. The most critical deviations from the current law model are highlighted in italics.

The goal behind the first set of assumptions is to project benefits and other outcomes if beneficiaries do not change their earnings at all. BOSIM will not exactly replicate the current-law earnings projections under this set of assumptions, but any changes to earnings are expected to be small. The TWP Completed status is eliminated. Instead, beneficiaries may transition directly from TWP Not Completed status to Re-entitlement Period. The transition will be based on their earnings while in TWP Not Completed status. If their earnings are predicted to be positive, they will be

matched via predicted earnings to the baseline record of a beneficiary who is in the Re-entitlement Period at baseline. If that record includes at least one month off the rolls for work, the beneficiary transitions to Re-entitlement Period status in the following projection year. If not, the beneficiary remains in TWP Not Completed status in the following projection year unless benefits are terminated for some other reason.

The goal behind the second set of assumptions is to allow beneficiaries to adjust their earnings in a manner that minimizes the negative effect of TWP elimination on their benefits. Under this specification, beneficiaries in the TWP Not Completed status with positive earnings are matched to a record from the subset of records for Re-entitlement Period Status with no months off the rolls for work. Hence, the value of earnings drawn is expected to be lower, on average, than the value of predicted earnings. Transitions to TWP Completed status occur as under current law, but this status is reinterpreted as the first year of Re-entitlement Period status. The TWP Completed status earnings model is used to predict earnings, but the record is matched to a record from the Re-entitlement Period status. The beneficiary automatically enters Re-entitlement Period status in the next year unless terminated for a reason other than work, but stays in that status for only one year, rather than two, before entering Re-entitlement Period Completed status. Hence, they are predicted to behave as they would when they complete the re-entitlement period one year earlier than under current law.

Exhibit 4.2. Assumptions for TWP Elimination under Current Law

SSDI Status	Maintained Assumptions	
	Earnings-Insensitive	Earnings-Sensitive
TWP Not Completed	<ul style="list-style-type: none"> If earnings zero, same within-state outcomes as current law If earnings positive, expected earnings predicted from model for TWP Not Completed status, <i>but matched case drawn from Re-entitlement Period sample</i> Termination for age, mortality or medical recovery same as current law <i>If not terminated: (1) transition to Re-entitlement period if at least one month off the rolls for work or if predicted to transition to TWP completed; (2) otherwise remain in TWP Not Completed</i> 	<ul style="list-style-type: none"> If earnings zero, no change from current law If earnings positive, expected earnings predicted from current law, <i>but matched case drawn from Re-entitlement Period sub-sample with no months off the rolls for work</i> <i>Transition equations for next year are same as current law except TWP Completed status is interpreted as Re-entitlement Period Entry</i>
TWP Completed	<ul style="list-style-type: none"> State eliminated 	<ul style="list-style-type: none"> Interpreted as first full year of re-entitlement period If earnings zero, same as current law. For those in each positive Earnings Status category, expected earnings based on current-law Re-entitlement period earnings equation for same Earnings Status and <i>matched case drawn from Re-entitlement period sample for same Earnings Status</i>
Re-entitlement Period	<ul style="list-style-type: none"> Same as current law 	<ul style="list-style-type: none"> Same as current law <i>except ends after one year instead of two. in the next year the beneficiary enters the Re-entitlement Period Completed status automatically unless benefits are terminated for some other reason</i>
Re-entitlement Period Completed	<ul style="list-style-type: none"> Same as current law 	<ul style="list-style-type: none"> Same as current law
Post-Re-entitlement Period	<ul style="list-style-type: none"> Same as current law 	<ul style="list-style-type: none"> Same as current law

2. Extension of the Re-entitlement Period

Exhibit 4.3 lists the two sets of assumptions to support conditional projections for extension of the re-entitlement period until termination for some other reason. The first set assumes little or no effect on earnings relative to current law. The second set assumes that earnings change in a manner consistent with earnings observed under current law for those in the re-entitlement period.

Under the first set of assumptions, the conditional projections for extension of the re-entitlement period are expected to show little impact on earnings for the duration of the current re-entitlement period. After that, earnings and other within-state outcomes will be projected to have the same distribution, conditional on $X(i,t)$, as for current Re-entitlement Period Completed status, except that those who would have been terminated for work under current law will now be in this

category. Benefits will increase because those who would have been terminated for work under current law will remain on the rolls until termination occurs for other reasons.

Exhibit 4.3. Assumptions for Extension of the Re-entitlement Period under Current Law

SSDI Status	Maintained Assumptions	
	Earnings-Insensitive	Earnings-Sensitive
TWP Not Completed	<ul style="list-style-type: none"> • Same as current law 	<ul style="list-style-type: none"> • Same as current law
TWP Completed	<ul style="list-style-type: none"> • Same as current law 	<ul style="list-style-type: none"> • Same as current law
Re-entitlement Period	<ul style="list-style-type: none"> • Same as current law except that those predicted to transition from this state to Termination for Work status under current law will transition to Re-entitlement Period Completed status 	<ul style="list-style-type: none"> • Same as current law except that those predicted to eventually transition from this state to Termination for Work status under current law will remain in Re-entitlement Period status until termination occurs for another reason
Re-entitlement Period Completed	<ul style="list-style-type: none"> • Formally, this status no longer exists. Beneficiaries will transition into this status, but the status will be treated as continuation of the re-entitlement period • Within-state outcomes will be the same as for current law • Those predicted to transition from this status to Termination for Work status under current law will instead return to this status in the following year 	<ul style="list-style-type: none"> • Status eliminated
Post-Re-entitlement Period	<ul style="list-style-type: none"> • Status eliminated 	<ul style="list-style-type: none"> • Status eliminated

Projected earnings are expected to be higher and benefits lower under the second set of assumptions. Under current law, beneficiaries who reach the end of the current re-entitlement period must keep earnings below SGA to remain on the SSDI rolls. If the re-entitlement period were extended, beneficiaries reaching and passing the end of the current re-entitlement period are assumed to have earnings and within-state outcomes similar to those still within the re-entitlement period under current law, when termination for work is also not a possibility.

It is possible that earnings will eventually increase to a higher level for those who continue to work for many years under the extended re-entitlement period. As the current-law model is developed, it will be possible to determine whether those terminated for work under current law experience substantial growth in real earnings thereafter. This analysis could potentially provide the basis for adding a trend to the earnings equation under the second set of assumptions.

3. Elimination of the TWP and Extension of the Re-entitlement Period

The assumptions for conditional projections under TWP elimination coupled with extension of the re-entitlement period combine assumptions for the separate changes (**Exhibit 4.4**). Because the expected impacts of the separate changes on benefits are in opposite directions, the predicted sign of the change in benefits is ambiguous, along with the sign of the predicted impact on earnings. It is

also possible that the projected impact on benefits will have a different sign under one assumption versus another.

Exhibit 4.4. Assumptions for TWP Elimination and Extension of the Re-entitlement Period under Current Law

SSDI Status	Maintained Assumptions	
	Earnings-Insensitive	Earnings-Sensitive
TWP Not Completed	<ul style="list-style-type: none"> • If earnings zero, same within-state outcomes as current law • If earnings positive, expected earnings predicted from model for TWP Not Completed status, but matched case drawn from Re-entitlement Period sample • Termination for age, mortality or medical recovery same as current law • If not terminated: (1) transition to Re-entitlement period if at least one month off the rolls for work or if predicted to transition to TWP completed; (2) otherwise remain in TWP Not Completed 	<ul style="list-style-type: none"> • If earnings zero, no change from current law • If earnings positive, expected earnings predicted from current law, but matched case drawn from Re-entitlement period sub-sample with no months off the rolls for work • Transition equations for next year are same as current law except TWP Completed status is interpreted as Re-entitlement Period Entry
TWP Completed	<ul style="list-style-type: none"> • State eliminated 	<ul style="list-style-type: none"> • If earnings zero, same as current law. • For those in each positive Earnings Status category, expected earnings based on current-law Re-entitlement period earnings equation for same Earnings Status and matched case drawn from Re-entitlement period sample for same Earnings Status
Re-entitlement Period	<ul style="list-style-type: none"> • Same as current law except that those predicted to transition from this state to Termination for Work status under current law will transition to Re-entitlement Period Completed status 	<ul style="list-style-type: none"> • Same as current law except that those predicted to eventually transition from this state to Termination for Work status under current law will remain in Re-entitlement Period status until termination occurs for another reason
Re-entitlement Period Completed	<ul style="list-style-type: none"> • Formally, this status no longer exists; beneficiaries will transition into this status, but the status will be treated as continuation of the re-entitlement period • Within-state outcomes will be the same as for current law • Those predicted to transition from this status to Termination for Work status under current law will instead remain in this status 	<ul style="list-style-type: none"> • Status eliminated
Post-Re-entitlement Period	<ul style="list-style-type: none"> • Status eliminated 	<ul style="list-style-type: none"> • Status eliminated

C. BOND Variants

This section presents assumptions for the conditional projections under the variants of BOND described in the chapter's introduction. The BOND version of BOSIM will be used to generate the projections for comparison purposes, and each set of assumptions describes a set of changes to the BOND version.

1. Elimination of the TWP

Exhibit 4.5 presents the maintained assumptions for elimination of the TWP under the BOND design. The assumptions are analogous to those for elimination of the TWP under current law. The first set assumes that earnings will change very little, but that benefits will adjust to reflect the earlier start of the BOND Participation Period for those whose annual countable earnings exceed BYA when in TWP Not Completed status. Under the second set of assumptions, beneficiaries reduce their earnings to avoid benefit reductions in the first year of the Participation Period. After that, they behave as they do under BOND for the rest of the BOND Participation Period, the BOND Participation Period Completed Year, and the Post-BOND Participation Period.

Exhibit 4.5. Assumptions for TWP Elimination under BOND Design

SSDI Status under Current Law	Maintained Assumptions	
	Earnings-Insensitive	Earnings-Sensitive
TWP Not Completed	<ul style="list-style-type: none"> • If earnings zero, same within-state outcomes as BOND design • If earnings positive, expected earnings predicted from BOND model for TWP Not Completed status, but matched case drawn from Participation Period sample • Termination for age, mortality or medical recovery same as BOND design • <i>If not terminated: (1) transition to Participation Period status countable earnings above BYA, or part-year countable earnings above pro-rata BYA; (2) otherwise remain in TWP Not Completed</i> 	<ul style="list-style-type: none"> • If earnings zero, no change from BOND design • If earnings positive, expected earnings predicted from BOND equations for TWP Not Completed Status, but matched case drawn from Participation Period sub-sample with no months off the rolls for work • <i>Transition equations for next year are same as for BOND design except TWP Completed status is interpreted as entry into BOND Participation Period</i>
TWP Completed	<ul style="list-style-type: none"> • State eliminated 	<ul style="list-style-type: none"> • If earnings zero, same as BOND design. • <i>For those in each positive Earnings Status category, expected earnings based on BOND Participation Period earnings equation for same Earnings Status and matched case drawn from Bond Participation Period sample for same Earnings Status</i>
BOND Participation Period	<ul style="list-style-type: none"> • Same as BOND 	<ul style="list-style-type: none"> • Same as BOND
BOND Participation Period Completed	<ul style="list-style-type: none"> • Same as BOND except occurs one year earlier • <i>Equation from BOND Participation Period used to predict earnings, but matched case is drawn from the BOND Participation Period Completed</i> 	<ul style="list-style-type: none"> • Same as BOND except occurs one year earlier
Post-BOND Participation Period	<ul style="list-style-type: none"> • Same as BOND except starts one year earlier • <i>Equation from BOND Participation Period Completed to predict earnings in the first year, but matched case is drawn from the BOND Participation Period Completed sample</i> 	<ul style="list-style-type: none"> • Same as BOND except starts one year earlier

2. Duration of the Participation Period

Exhibit 4.6 presents the maintained assumptions for changing the duration of the BOND participation period. Except in one important respect, the assumptions are analogous to those for extension of the re-entitlement period under current law. The duration of the participation period can be shortened or lengthened in 12-month increments. Enhancements to BOSIM will allow the analyst to choose the length of the period.

More specifically, the assumptions use a counter (hereafter C) to denote the number of years since TWP completion. The analyst will be able to change the value of C that triggers completion of the BOND participation period. C is set at zero in the beneficiary's TWP completion year and increased by one in each subsequent year. Under BOND, if benefits are not terminated for some reason other than work, the year in which C reaches four is the last year that the beneficiary's SSDI status is BOND Participation Period; when it reaches five, the beneficiary's status is BOND Participation Period Completed, and when it reaches six or higher, the status is Post-BOND Participation Period.

C plays a key role in the assumptions in Exhibit 4.4. Let D represent the duration, in years, of the BOND participation period; D is five under the BOND design. The analyst will be able to set the value of D to any positive integer. The assumptions used for a given value of D will depend on whether D is greater or less than five. A very large value of D will, in effect, extend the participation period until benefit termination for a reason other than work.

Analogous to the maintained assumptions for extension of the re-entitlement period under current law, the first set of assumptions is expected to lead to small changes in earnings because expected earnings in each post-TWP year are based on the same model as for the BOND design. Benefit changes can be large, however, because matched subjects are chosen from BOND samples for the relevant period. For instance, if $D = 7$ and $C = 5$, earnings are predicted from the BOND equation for the BOND Participation Period Completed status, but the matched case is drawn from the BOND Participation Period sample.

In contrast, under the second set of assumptions, the beneficiary is assumed to behave in the same way that a BOND beneficiary would behave in the same status, conditioned on $X(i,t)$. Expected earnings will be based on the BOND equation for the individual's SSDI status under the specified value of D. Thus, for instance, if $D = 7$ and $C = 6$, the beneficiary's expected earnings are based on the earnings model for the BOND participation period, and the match is drawn from the sample for the same period, even though the beneficiary's status under BOND would be BOND Participation Period Completed.

3. Starting the Offset at BYA/2

The earnings status categories in BOSIM include a category for earnings between BYA/2 and BYA specifically to support conditional projections for this variant. As with earlier variants, two sets of assumptions are specified, one under which the earnings effects will be small, and a second under which the opposite will be true.

Exhibit 4.6. Assumptions for Changing the Duration of the BOND Participation Period*

SSDI Status under Current Law	Maintained Assumptions	
	Earnings-Insensitive	Earnings-Sensitive
TWP Not Completed	<ul style="list-style-type: none"> • Same as BOND design 	<ul style="list-style-type: none"> • Same as BOND design
TWP Completed	<ul style="list-style-type: none"> • Same as BOND design; C set to zero 	<ul style="list-style-type: none"> • Same as BOND design; C set to zero
BOND Participation Period	<ul style="list-style-type: none"> • As under BOND design, beneficiary stays in this status until $C = 4$ unless terminated • Predicted earnings always based on the earnings equation for this status • Match is also from this category unless $D < 5$ and $C \geq D$ <ul style="list-style-type: none"> - If $C = D$, match is drawn the BOND Participation Period Completed sample - If $C > D$, match is drawn from sample for Post-BOND Participation Period 	<ul style="list-style-type: none"> • Beneficiary stays in this status until $C = D - 1$ unless benefits are terminated • Predicted earnings and match same as BOND design for this category regardless of the value of C
BOND Participation Period Completed	<ul style="list-style-type: none"> • Beneficiary is in this status if $C = 5$ and not terminated • Predicted earnings always based on the earnings equation for this category • If $D > 5$, match is drawn from BOND Participation Period sample • If $D < 5$, match is drawn from Post-BOND Participation Period sample 	<ul style="list-style-type: none"> • Beneficiary is in this status if $C = D$ unless benefits have been terminated • Predicted earnings and match same as BOND design for this category
Post-BOND Participation Period	<ul style="list-style-type: none"> • Beneficiary is in this status if $C > 5$ and not terminated • Predicted earnings always based on the earnings equation for this category • If $D < C$, match is drawn from this category's sample • If $D = C$, match is drawn from BOND Participation Period Completed sample • If $D > C$, match is drawn from BOND Participation Period sample 	<ul style="list-style-type: none"> • Beneficiary is in this status if $C > D$ unless benefits have been terminated • Predicted earnings and match same as BOND design for this category

* C is the counter for years after TWP completion. D is the duration of the BOND participation period, in years, specified by the analyst.

The approach proposed for making conditional projections for this variant is only partially developed. It is fairly straightforward to produce projections based on no impact on earnings (relative to earnings under the BOND design), as detailed below. It will be more challenging to develop projections under the assumption of a large impact on earnings. One option is to rely on current-law earnings distributions. If this variant of the offset is regarded as “closer” to current law than the BOND design, then earnings under this variant seem likely to be closer to current-law earnings than earnings under the BOND design. This assumption seems extreme, however. As results from the BOND evaluation start to emerge, they might provide guidance on how to develop a less extreme but supportable approach for the large-impact-on-earnings assumptions.

For the maintained assumption of “no-impact on earnings” the BOND design parameters and matching methodology can be used without modification once adjustments have been made to a few of the within-state outcomes in the matching samples. Given the earnings outcomes (both annual earnings and countable earnings during any part of the year that is subject to the offset) on each record, benefits on the record will be reduced as needed to reflect the lower starting point for the

benefit offset, and taxes and disposable income will be adjusted as needed to reflect the change in benefits.

Specifically:

- No changes will be made to the benefits of those in the two lowest earnings status categories (“no earnings” and “positive earnings no greater than $BYA/2$ ”).
- The benefits of those in earnings status category “ $BYA/2$ to BYA ” and the SSDI status categories of TWP Completed, BOND Participation Period, or BOND Participation Period Completed will be reduced by up to $BYA/4$ to reflect the fact that part of their earnings might be subject to the offset under this variant.²⁰ Their SSI benefits, taxes, and disposable income will also be adjusted as needed to reflect the change in benefits.
- For those in the earning status categories “ BYA to $2 BYA$ ” and “ $2 BYA+$ ” and the SSDI status categories of TWP Completed, BOND Participation Period, or BOND Participation Period Completed:
 - If the benefit offset is applied to the whole year, the amount of the reduction will be $BYA/4$ (i.e., one-half of the earnings to which the offset would be applied under this variant, but not under BOND);
 - If the benefit offset is applied to countable earnings for part of the year, benefits for that part of the year will be reduced by the pro-rata value of $BYA/4$; except that
 - If benefits are negative as a result of the reduction, the benefit will be reduced to zero instead.
- If the beneficiary has a positive SSI benefit, it will be increased by the amount of the reduction in the SSDI benefit.
- Taxes and disposable income will be recalculated to reflect net changes in benefits.

Once these adjustments are made to the matching samples, the BOND design version of BOSIM can project outcomes for this variant conditional on the assumption of no impact on earnings.

4. Alternative Offset Rates

As with an offset that starts at $BYA/2$, it is a fairly simple matter to project impacts under a different offset rate under the low earnings sensitivity assumption. Development of a set of assumptions for high earnings sensitivity will be more challenging.

²⁰ The obvious benefit reduction of half the difference between earnings and $BYA/2$ would be too large in many cases because all earnings for the year might not be subject to the offset (e.g., because of TWP or GP months, or because of IRWE). It is not possible to determine what these would be. Hence, the amount of the benefit reduction will be some fraction of half the difference between annual earnings and $BYA/2$. The fraction will be based on the size of the benefit reduction experienced by BOND subjects with earnings between BYA and $2 BYA$ in the same SSDI status group divided by half the difference between their annual earnings and $BYA/2$.

For low earnings sensitivity, it will be possible to produce projections under the assumption of no impacts on earnings. Under this assumption, the only changes in outcomes will be for those who are in BOND Participation Period status and have earnings above BYA. Suppose that the alternative reduction rate is \$1 for \$R, that the difference between the earnings of such a beneficiary and BYA is D, and that the benefit under BOND is B. Then under the \$1 for \$R offset the same beneficiary's benefit will be $B + D/2 - D/R$. If R is greater than (less than) 2, the benefit will be higher (lower) than under the BOND offset design. Taxes and disposable income will be adjusted to reflect the adjustment to benefits.

It will be necessary to develop the high earnings sensitivity assumptions. The impact estimate for BOND will provide guidance. Presumably a more generous offset ($R > 2$) would result in larger earnings impacts, and a less generous offset would result in smaller impacts. The challenge will be to decide on upper bounds and to incorporate the bounds into the model. This is complicated by the fact that the direction of the impacts of the BOND design on earnings may vary by the level of earnings under current law.²¹

5. Combination Variants

Conditional projections for variants that combine TWP elimination with alternative durations for the BOND participation period can be readily generated under “low earnings sensitivity” and “high earnings sensitivity” assumptions analogous to the combined assumptions for TWP elimination and extension of the re-entitlement period under current law; the assumptions in Exhibits 4.5 and 4.6 would be combined for this purpose. Conditional projections for a variant that combines an offset starting at $BYA/2$, an offset rate of \$1 for \$R, TWP elimination and/or an alternative duration for the BOND participation period could be fully developed once reasonable assumptions are developed for a large impact on earnings under an offset that starts at $BYA/2$ or an offset rate of \$1 for \$R.

The next chapter describes how SSA analysts using BOSIM will be able to select the assumptions required to produce conditional projections under the current-law and BOND variants described above.

²¹ Impacts are expected to be positive, on average, for those who would work but remain on the SSDI rolls under current law, but might be negative for those who would earn enough to leave the SSDI rolls under current law.

V. ENHANCEMENTS TO ACCESS

The current version of BOSIM consists of a data set and a Statistical Analysis System (SAS) program that was intended for use only by the model's developers. SSA has asked for enhancements that will allow its analysts to produce runs from the model and update its data and parameters as new data become available. This chapter describes the proposed technical characteristics of the enhanced model and provides an overview of how SSA analysts will be able to use it.

Section A describes the model's software and hardware environment, its data files, and program file. The subsequent sections describe the user interface for BOSIM and summarize how SSA analysts will be able to execute three types of tasks with BOSIM: produce a projection (Section B); produce output tables from a single projection or comparison tables from two projections (Section C); and update the model's parameter estimates from new data (Section D).

A. Technical Characteristics

BOSIM will be developed in PC SAS, version 9.1. SSA will be able to use the PC version of the model or adapt the model to SSA's UNIX or PC computing environment. In general, SSA has the choice of working within a PC environment using SAS/CONNECT or incorporating JCL language at the beginning of SAS code to work directly on its UNIX mainframe. Typically, SSA works within a PC environment if the data files can be processed by a PC; otherwise, the data processing is performed on the SSA mainframe. Mathematica will adapt the SAS programs to SSA's preferred environment. This will not be difficult because, with the exception of the specification of SAS libraries and file references, SAS code operates in the same manner in UNIX and PC systems. SAS libraries and file references can be assigned using input parameters, as needed.

The proposed BOSIM will contain the following data files and programs.

1. Data Files

The model will be based on the following SAS data sets.

- The **analytic data set** will contain the data needed to estimate parameters for the model (see Section 2.1 for a description of the analytic file used to estimate model parameters for the current-law model). The name of the data set's variables will be standardized so that the SSA analyst can easily update the analytic file from the TRF and other sources and re-estimate model parameters.
- The **baseline data set** will contain records from a large sample of SSDI beneficiaries in the year prior to the first projection year. BOSIM will project future outcomes for this sample. Because this data set is an input to the model, its contents can vary from projection to projection. In general, the data sets will be created from the sources described in Chapter 2 (the 2009 TRF and future updates) and Chapter 3 (the T1 BOND demonstration sample). Other sources could be used as well, for example, the BOPD data. Regardless of its source, this data set must contain variables that describe each

beneficiary's characteristics, baseline state (that is, values for the four categorical variables that define each state) and within-state outcomes for the base year.²²

- The **new beneficiary data set** will contain projections of the number of new beneficiaries by year, age, and sex for the number of years made available by OACT. This data set will also vary across projections.
- The **transition data sets** will contain the estimated coefficients of the transition equations used to determine the beneficiary's state in the next year, given the beneficiary's current-year state and characteristics. There will be two variants of this data set, one for current law and the other for the BOND design.
- The **earnings equation data set** will contain the estimated coefficients for the equations used to calculate the beneficiary's expected earnings given his or her state and characteristics. There will be two variants of this data set, one for current law and the other for the BOND design.
- The **projection output data set** will store the results of a projection. Hence, there will be one set for each completed projection.
- In the **projection specification data set**, the specification of each projection will be stored as a record containing the information that governs how the projection was completed. This information can be used to replicate a specific projection, or to apply the same projection specification to a new set of data. Each record will include the following:
 - an identification code (ID) for the projection,
 - the projection's title,
 - a brief description of the projection,
 - the names of the transition data set and the earnings equation data set,
 - the version number of the BOSIM model,
 - the date the projection was made, and
 - the names of the following data sets: baseline, new beneficiary, and projection output.

2. Program Files

BOSIM.SAS, a SAS program file, will serve as the main driver for BOSIM. It will offer the analyst the option to output stored model results, create an analytic file, produce comparative statistics from any pair of BOSIM runs, re-estimate and store model parameters, or run a projection. BOSIM.SAS will use macros to do the following tasks:

²² When delivered, SSA staff will need to match the records to the MEF and add the earnings data to the within-state outcome variables.

- Present the analyst with a SAS graphic user interface with fields to choose the type of task to be performed²³:
 - a projection
 - production of output tables from previous runs
 - update estimates of model parameters
- Present the analyst with a task-specific second screen in which the analyst will be asked to specify the names and locations of all the required files for the task requested (see Sections C–E).
- Using the inputs provided by the analyst, load the data sets required for the task desired.
- Perform the task desired.

The following sections describe the performance of each of the three tasks.

B. Projections

Once the analyst launches the program and selects the projection option from the task list in the initial screen (see Section B.2), a new screen will open. The analyst will be required to provide specifications for the projection. Typically, the analyst will first choose from a menu of previous runs. This will populate the input fields with information from a record in the projection specification data set. The analyst will then make changes to the input fields, as needed, for the desired projections. The input fields will require the following information:

- A name for the projection, to be included in the output data set and on all pages containing output tables
- Comments, also to be included in the output data set and on pages containing output tables
- Projection type
 - current law
 - BOND design
 - Current-law variant
 - no TWP
 - extended re-entitlement period
 - no TWP and extended re-entitlement period
 - BOND variant
 - no TWP
 - alternative duration of BOND participation period (analyst to specify length)

²³ The user interface will be developed with SAS macro called SAS%Window.

- offset starts at BYA/2
- \$1 for \$R offset
- combinations of the variants above
- The transition, earnings, baseline, and new beneficiary data sets to be used
- Duration of the projection period
- The discount rate (for computation of present values)

Specification of the projection type will determine the transition and earnings data sets available for use in the projection. Initially, only one pair of these data sets will be available for each specification. Once SSA uses new data to update parameter estimates, the analyst will be able to choose between two or more versions of the estimates.

The analyst will then execute the analysis by hitting the return key. BOSIM will automatically generate the ID for the run. The ID will reflect the nature of the specification, following rules that remain to be developed. The projection data will be written in a projection output data set. BOSIM will generate a name for this data set that includes the ID. A record for the projection will be added to the projection specification data set.

BOSIM will automatically produce a summary output table, showing key outcomes by projection year, plus present values for monetary variables (see Table 2.4). The key outcomes are number of SSDI beneficiaries, SSDI benefits received, SSI benefits received, earnings, payroll taxes paid, federal income taxes paid, SSA payments for employment services, and household disposable income per beneficiary.

C. Output and Output Options

When the analyst selects the output option from the task list in the initial screen (see Section B.2), a new screen will open. The analyst will be required to provide specifications for output tables. The analyst will first choose between:

- Output tables for a single projection
- Comparative output tables for two projections

After making the selection, the analyst will be asked to choose the output data set(s) for the relevant projection(s). The analyst will be able to choose from a list of all available output files (that is, those identified in the projection specification data set).

1. Output Tables for a Single Projection

As indicated in Section C, BOSIM will automatically produce a summary table for each projection. SSA might find it useful to examine output for specific subgroups, such as beneficiaries in specific age or impairment groups, DI-only or concurrent beneficiaries, and beneficiaries offered the offset within the first three years after award. Results for the last of these groups are of special interest because in the long-term, the benefit offset would likely be offered to all beneficiaries when they first enter DI.

The analyst will have the option of replicating the summary table for a subgroup or subgroups of beneficiaries identified by baseline characteristics. For example, the analyst might choose to produce tables by age group and SSI status. The analyst will be provided with a list of characteristics from which to choose, and will be able to choose as many as needed. This list will tentatively include: age category (under 40, 40-49, 50-59, 60-full retirement age), primary impairment category (categories to be determined), SSI status, TWP status (completed or not), PIA group, and SSDI duration (24 months or less, 25 months to 60 months, 61 months to 120 months, 121 months or more).

The analyst will also be able to produce tables that show more detail about the simulation outcomes. These tables could be useful in the interpretation of the findings, diagnosing limitations of the projections, and assessing the implications of the projections for administrative effort.

The first table will show the distribution of all transitions in each year from one state to any other feasible state. A second table will show the distribution of beneficiaries across all end-of-year states. A third table will provide descriptive statistics (means or percentages and standard deviations) for within-state outcomes in each state. The output will be stored in a format that can be imported easily into a spreadsheet.

2. Comparative Tables

Projection of the impacts of a change from one benefit design to another requires the analyst to compare projected outcomes across the two benefit designs. The analyst will accomplish this by first selecting the comparison option and then specifying the output data sets for the two projections to be compared.

The comparative table options will be the same as those for a single projection, but the value in each cell of the table will be the difference between the corresponding values from the two separate projections. The analyst will have the option of producing the corresponding separate output tables for the two projections at the same time. The output will be stored in a format that can be imported easily into a spreadsheet.

D. Updating the Parameter Estimates

When the enhanced version of BOSIM is delivered to SSA in 2012, its parameter estimates will be based on the data available for the model's development. SSA will be able to update these estimates as new data become available—especially new data from BOND.

The analyst will first need to create an analytic SAS data set from the updated or new data sources using the specification of the analytic data set that will be provided when BOSIM is first delivered. Detailed specifications for the data set will also be provided. At the end of the creation of the analytic data set process, the analyst will also have the option to create an updated baseline data set from the sources of the analytic data set.

Once the new analytic data set is created and stored, the analyst will open BOSIM and select the “update parameters” option. After selecting this option, a new screen will open and the analyst will be asked for the following input:

- Name of the analytic data set
- Version of the model's equations to be estimated (current law or BOND design)

- Names of the transition and earnings equation data sets (to be created)

When ready, the analyst will execute the analysis. BOSIM will then produce new parameter estimates, to be stored in the specified transition and earnings equation data sets. The analyst can then use these new files to make new projections.

Many details of the user interface remain to be developed. These details will be described in the BOSIM User Guide and the BOSIM Technical Documentation. The next chapter describes these two documents.

VI. DOCUMENTATION

When complete, SSA analysts will be able to use BOSIM to project key outcomes under two benefit designs (current law and BOND), produce conditional projections based on specific assumptions for variants of these designs, prepare outcome tables, compare outcomes across pairs of projections, and allow SSA to update the model's parameter estimates based on new data. Successful use of this program requires that SSA analysts adequately understand how to navigate the model's inputs and interpret its output.

The development team, which will deliver the current-law version of BOSIM to SSA in 2012, will install the program on SSA's platform and ensure it is operational. To facilitate SSA's use of BOSIM, the development team will produce two documents: the BOSIM User Guide and the BOSIM Technical Documentation Report. SSA analysts will be able to review the model's SAS code and data files. The model's developers will be available to provide technical assistance on an as-needed basis for the duration of the BOND contract.

The BOSIM User Guide will:

- Provide background information about the model and its purposes and discuss the strengths and limitations of BOSIM, describing how these will affect interpretation of the model's projections
- Describe the structure of the model
- Define the state variables and the within-state outcome variables
- Define and describe the BOSIM databases
- Explain how to launch BOSIM
- Explain how to complete each of the three types of tasks (that is, produce a projection, produce output tables, and update the parameter estimates)
- Explain how to produce the output tables and download them into a spreadsheet
- Discuss the interpretation of the output

The BOSIM Technical Documentation Report will:

- Provide detailed descriptions of the BOSIM databases and how they were constructed
- Describe how the parameters were estimated
- Include tables containing the initial parameter estimates for transition and earnings equations
- Provide a detailed description of how the earnings and benefit projections are made and how all outputs are calculated.

This chapter describes plans for these two documents in more detail, presenting the planned content for the User Guide and the Technical Documentation Report in Sections A and B, respectively. Reference is made on occasion to the BOND version of BOSIM. Inclusion of material on the BOND version is contingent on future decisions about development of that version.

A. User Guide

The User Guide will provide a roadmap to successfully using BOSIM. Although the guide will be written for new users of BOSIM, it will be geared to those who have substantial knowledge of BOND and the SSDI and SSI programs and how these programs affect work incentives. The user will also need to have at least rudimentary knowledge of SAS and SSA administrative data.

The guide will provide background information on microsimulation modeling and development of the model, as well as information on how to run simulations and interpret output. The preliminary table of contents for the User Guide is presented in **Exhibit 6.1**. The details of the guide's content are discussed in the remainder of this section.

Chapter I will briefly introduce BOSIM and describe the available documentation (that is, the User Guide and the Technical Documentation Report). This chapter will also provide brief descriptions of BOND benefit design and evaluation reports for those interested in further information about the demonstration and its evaluation. The chapter will conclude with a roadmap for the rest of the User Guide.

Chapter II will present background information on microsimulation modeling, including a discussion of what results microsimulation models can and cannot provide. It will define a microsimulation model and describe the various types of microsimulation models, their characteristics, and the goals for their use. It will then go on to place BOSIM within the broader context of microsimulation models, summarize BOSIM's history, and describe the current goals for its use. In addition, the chapter will explain its inherent limitations, paying particular attention to the quality of the parameter estimates and the conditional nature of projections for benefit design variants that have not been used previously by SSA.

Chapter III will provide an overview of BOSIM, including a diagram of the model's structure, and descriptions of states, transitions between states, and within-state outcomes. It will also describe how BOSIM projects outcomes under the current-law and (potentially) BOND designs and how it makes conditional projections under variants to these designs.

Chapter IV will describe the hardware and software environment for BOSIM as well as the eight BOSIM data files and the model's program file.

Chapter V will introduce the user to BOSIM's graphic user interface. It will describe work that must be performed prior to launching BOSIM as well as how to launch the program and select the task. Chapters VI, VII and VIII will describe how to carry out each of the three tasks—produce a projection, create output tables, and update the data and parameters, respectively. The information in the chapters will lead the user through task examples, illustrated by screen shots.

Exhibit 6.1. User Guide Draft Table of Contents

BOSIM User Guide	
I.	Introduction to BOSIM and Its Documentation
II.	Background
A.	SSDI
B.	BOND
C.	Nature and Purposes of Microsimulation Models
D.	Model Types and Characteristics
E.	BOSIM's Type and Characteristics
F.	History of BOSIM
G.	BOSIM's Objectives and Capabilities
H.	BOSIM's Limitations
III.	BOSIM Specifics
A.	BOSIM's Structure
B.	States
C.	Transitions
D.	Within-state Outcomes
E.	Current Law Projections
F.	BOND Design Projections
G.	Conditional Projections for Current Law Variants
H.	Conditional Projections for BOND Design Variants
IV.	BOSIM Files
A.	Software and Computer Environment
B.	Analytical Data
C.	Baseline Data
D.	New Beneficiary Data
E.	Transition Parameters
F.	Earnings Equation Parameters
G.	Projection Output
H.	Projection Specification Data
I.	Program File
V.	Introduction to the User Interface
A.	Preparing to Launch BOSIM
B.	Launching BOSIM
C.	Task Selection
VI.	Task 1: Producing a Projection
A.	Model and Data File Selection
B.	Output File and Tables
VII.	Task 2: Producing Output Tables
A.	Tables for a Single Projection
B.	Comparative Tables for Two Projections
C.	Interpretation of Output
VIII.	Task 3: Updating Parameter Estimates
A.	Preparing Analytic and Baseline Data Files
B.	Estimating Transition and Earnings Equations
	References

B. Technical Documentation Report

The primary purpose of the Technical Documentation Report is to provide information about BOSIM that is not needed for routine usage of the program, but will be needed by those seeking to more fully understand the model's details and potentially improve the model. The reader will need to have substantial familiarity with econometric modeling, programming, SSA administrative data, and the SSDI and SSI programs. The reader will also need to have access to the User Guide. The report will frequently refer to material in the guide (for example, the descriptions of BOSIM's files) and

will, in essence, serve as an appendix. The table of contents for the Technical Documentation is presented in **Exhibit 6.2**.

Exhibit 6.2. Technical Documentation Report Draft Table of Contents

BOSIM Technical Documentation	
I.	Introduction
II.	Data
	A. Contents of Analytical Data Files
	B. Contents of Baseline Data Files
	C. Sources
	D. Selection of Administrative Records for BOSIM Samples
	E. Construction of Variables from Administrative Records
	F. Construction of Imputed Variables
III.	States
	A. Definition of States
	B. Model Specifications for Transitions Between States
	C. Parameter Estimates for Current-Law Transition Models
	D. Parameter Estimates for BOND Transition Models
IV.	Within-state Outcomes
	A. Specification of Earnings Equations
	B. Use of Predicted Earnings to Impute Within-state Outcomes from BOSIM Samples
	C. Parameter Estimates for Current-Law Earnings Equations
	D. Parameter Estimates for BOND Earnings Equations
V.	Components of the SAS Program for BOSIM
	A. Program Structure
	B. Projection Components
	C. Output Components
	D. Update Components
	E. Macros
VI.	Troubleshooting Guide
	A. Potential Problems and Solutions
	B. Contact Information for BOSIM Developers
	References

Chapter I will provide a brief introduction to BOSIM and its documentation, mirroring the introduction of the User Guide. Chapter II will provide details about the analytical and baseline data delivered with the model. It will include descriptive statistics for the current-law analytic data; comparable statistics for BOND treatment subjects could eventually be added. It will also include descriptive statistics for the initial baseline data. The detailed descriptions of these files will be followed by a detailed explanation of how they were created. This will include how the file sources were assembled to create the initial baseline data, how administrative data were transformed to produce variables in the files, and how the NBS data were used to impute values for variables not found in the administrative data.

Chapter III will provide details about the states in the current-law and (potentially) BOND versions of the model, including the specifications for transition equation, details about how they were estimated, and the parameter estimates. Similarly, Chapter IV will provide specifications for the earnings equations and how they are used to match records for purposes of imputing within-state outcomes.

Chapter V will provide a description of BOSIM's SAS code for SAS programmers who would like to make changes to the code. The code will not be included in full, but will be available

electronically to the user from the program's file. Portions of the code will be included, as needed, to support the description in the text. The first section of Chapter V will include a description of the program's structure, including a schematic representation. The next three sections will describe the three main components of the code, corresponding to the program's three tasks. The final section will describe the macros used to construct the user interface and facilitate use of the program.

In an effort to address any technical problems that users might experience with the model, the technical documentation will include a brief troubleshooting guide and contact information for the creators of BOSIM, should a technical problem arise. The troubleshooting guide will reflect the developers' experience using the model prior to delivery to SSA.

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