Modeling SSA's Sequential Disability Determination Process Using Matched SIPP Data

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We model the Social Security Administration's (SSA's) disability determination process using household survey information exact matched to SSA administrative information on disability determinations. Survey information on health, activity limitations, demographic traits, and work are taken from the Survey of Income and Program Participation (SIPP). We estimate a multistage sequential logit model, reflecting the structure of the determination procedure used by State Disability Determination Services agencies. The findings suggest that the explanatory power of particular variables can be appropriately ascertained only if they are introduced at the relevant stage of the determination process. Hence, as might be expected by those familiar with the process, medical variables and activity limitations are major factors in the early stages of the process, while past work, age, and education play roles in later stages. The highly detailed administrative information on outcomes at each stage allows clarification of the roles of particular variables. Planned future work will include policy estimates, such as the number of persons in the general population eligible for the disability programs, as well as analysis of applications behavior in a household context.

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I. Introduction

The Social Security Administration (SSA) administers two programs providing cash assistance to persons unable to work due to severe health impairments: Disability Insurance (DI) and Supplemental Security Income (SSI). Over 7 million disabled adults now receive benefits and more than 2 million applicants are evaluated for disability annually. Between 1988 and 1993, disability benefits under the two programs grew from $31.9 billion to $54.6 billion, a 70-percent increase in 5 years. Total benefits for the disabled under the SSI program doubled over the same period.[1] Researchers are trying to understand and quantify the causes of program growth so that policymakers can respond.

There are a number of hypotheses concerning the program growth. They involve changes in (1) eligibility criteria, (2) factors affecting administration of the programs, and (3) incentives to apply for benefits. Eligibility changes have occurred as a result of actions taken by Congress and the courts. For example, Congress mandated changes in the evaluation of mental impairments and multiple impairments; also, court rulings have liberalized the programs, especially in the areas of children's disability, benefits to addicts, and the evaluation of evidence from applicants' treating physicians. In terms of administrative factors, SSA has faced major reductions in staff, consequent claims backlogs, and increases in litigation. For the impaired, incentives to apply for benefits have probably been affected by changes in institutional, economic, and demographic factors. Institutional factors include trends in State or State/Federal programs serving the impaired, specifically, General Assistance, workers' compensation, unemployment compensation, Medicaid, treatment programs for addiction and alcoholism, or Aid to Families with Dependent Children. Economic and demographic factors include an aging population, the loss of blue collar jobs, high unemployment, and the loss of health insurance coverage for workers.[2]

The Role of Eligibility

Several of the hypotheses relating to program growth involve changes in program eligibility. The eligibility criteria for a public program implement basic normative decisions; they act as a gatekeeper for the program, defining the population the program is intended to serve. To be sure, recent program growth cannot be attributed solely to changes in eligibility. Administrative factors affect backlogs and may affect eligibility determinations. Moreover, considerations such as the loss of a job by a member of the household or the loss of General Assistance benefits increase incentives to apply for benefits; such incentive factors are distinguishable from eligibility effects because they primarily affect applicant behavior. Hence, while the behavior of applicants (via application decisions) and the administering agency (via eligibility determinations) both play a role in determining program size and growth, it is the eligibility criteria that often represent direct choice opportunities for policymakers. For that reason, it is important to understand how given eligibility criteria affect the size of the pool of eligibles and the subgroups to whom the program is targeted.

Eligibility for major public programs involves two types of criteria, *categorical* and *financial*. Categorical criteria for some major programs are old age, disability, and single-parent status. These criteria embody an underlying normative premise—that the programs are not intended for all, but for those not able or not expected to work due to old age, disability, or parental responsibilities. Though SSI and DI have common categorical criteria, the financial criteria for the programs are distinct. Under SSI, applicants must have income and assets below statutory limits. By contrast, DI is contributory; a worker is insured for disability if he or she has worked and contributed at specified levels over a specified period.

Analytically, it is useful to distinguish the effects of eligibility criteria from the effects of factors that induce application. Formally, the enrollment of an individual in one of the disability programs results from two often mutually dependent contingencies: the probability that the individual will apply for disability benefits and the probability that the applicant will be approved by SSA, should he or she choose to apply. That is,

$$\Pr(\text{benefit receipt}) = \Pr(\text{applying}) \times \Pr(\text{eligible} \mid \text{applying}).$$

The probability that an individual will receive disability benefits is obtained by multiplying the two probabilities: the first reflects an individual's inclination to apply and the second gives the award probability (which is determined by the prevailing administrative and legal standards and practices), given that the individual has applied. As we extend this work, our approach will allow us to distinguish analytically between decisions of program administrators (eligibility determination) and decisions of applicants (applications behavior).

The Use of Household Surveys

Analysts face a daunting information problem in studying the growth in disability programs. They have been able to make only limited use of information on individuals and families, whether from administrative sources or household surveys, in studying factors affecting applications decisions or in estimating the size of the pool of program eligibles. On the one hand, administrative data, tied to day-to-day operations, have no information on those who have not applied and little socioeconomic information useful for understanding application behavior. On the other hand, household surveys of the general population provide information on nonapplicants and on a range of socioeconomic details; however, analysts have been unable to credibly estimate those eligible under programmatic disability criteria using survey responses. In particular, then, the use of household surveys in this area has been limited.

Using survey information to estimate those *categorically eligible* has proven especially problematic with respect to disability programs. Other programs—those for the aged or for single parents, for example—use criteria relating to self-evident traits and, as a consequence, survey information on those traits permits reasonable estimates of those categorically eligible. By contrast, the criteria for SSA disability status[3] are complex and involve judgmental elements. The central concept implicit in the program criteria is that of work disability—applicants are found eligible, not on the basis of the existence of an impairment, but because the impairment is judged to preclude substantial work. Hence, although medical conditions play a central role in establishing eligibility, other factors are also involved (see Nagi 1965, 1969a; Haber 1967). In fact, the programmatic concept of work disability is implemented through a multistaged disability determination process involving medical evidence, "vocational" factors (specifically—age, education, and past work), and a determination as to resulting activity limitations. The criteria, then, involve not only medical and vocational factors, but judgmental components. Moreover, the critical survey responses also involve judgmental elements. When surveys ask respondents about their health and the extent to which impairments limit activities, the responses are self-evaluative. Under one hypothesis, for example, of those with a given impairment, persons with a low tolerance for pain or a weak attachment to the labor force report more severe limitations.

Since disability determinations and survey responses both involve judgmental elements, it is not surprising that survey estimates of the size of the disabled population cover a wide range. Table 1, which summarizes estimates from a recent Bureau of the Census report (McNeil 1993), illustrates this point. The five estimates, each using conventional definitions, cover a disturbingly large range—from 3.4 million to 29.5 million working age adults. By comparison, the number of persons receiving disability benefits under DI and SSI during the period was about 5.7 million. Hence, depending on the definition of disability selected, the number of working age disabled can be up to five times the number of beneficiaries. In the end, efforts to use household survey data to study disability programs depend on a central methodological question: *How, if at all, can survey responses relating to health, demographic factors, activity limitations, and work be used to identify those who would be considered disabled under SSA criteria?*

While there has been little use of cross-sectional household surveys to analyze disability programs, some major exceptions

have involved the use of pioneering surveys conducted by SSA. Early in the history of the DI program, SSA recognized the need to study topics such as the prevalence of work disability, the dynamics of disability, and decisions to apply for benefits. It implemented three major surveys: the 1966 Social Security Survey of the Disabled, the 1972/1974 Survey of Disabled and Nondisabled Adults, and the 1978 Survey of Disability and Work. These surveys used batteries of questions on health and impairments, and were designed to reflect the disability criteria used by SSA. SSA has not fielded a disability survey since 1978; however, it will shortly launch a major data collection effort in the disability area, the Disability Evaluation Study (DES). The DES will combine a comprehensive socioeconomic survey—including more extensive self-reports of health and disability than are available from the survey used here—with complete medical examinations.[4]

Table 1.—Selected estimates of the number and percentage of the working age population[1] with disabilities[2] and the number of adults receiving Social Security or Supplemental Security Income benefits based on their own disability, late 1991

Category	Persons (in thousands)	Percent of total
Total persons	165,040	100.0
With a disability[3]	29,482	17.9
With a severe disability[4]	13,171	8.0
With a work disability and prevented from working[5]	7,588	4.6
With one or more severe functional limitations	6,596	4.0
Has difficulty performing one or more activities of daily living	3,442	2.1
Total receiving DI or SSI disability benefits	5,702	3.5
DI beneficiaries[6]	3,878	2.3
SSI recipients[7]	1,824	1.1

[1]Aged 15-64 except as noted.

[2]As estimated from the 1990 and 1991 panels of the Survey of Income and Program Participation. Interviews took place from October 1991 through January 1992.

[3]Persons identified as: (1) having a work disability or housework disability; (2) having difficulty in performing one or more of six functional activities, six activities of daily living (ADLs), five instrumental activities of daily living (IADLs); (3) using a wheelchair, crutches, a cane, or walker; (4) having one of five classes of impairments (a learning disability such as dyslexia, mental retardation, other developmental disability such as autism or cerebral palsy, Alzheimer's disease/senility/dementia, or any other mental or emotional condition); or (5) a nonaged beneficiary of the Medicare or SSI program.

[4]A person identified as: (1) prevented from working at a job or business or from doing work around the house; (2) unable to perform 1 of 17 functional, ADL, or IADL activities; (3) having one of three classes of impairments (mental retardation, a developmental disability, or Alzheimer's disease/senility/dementia); or (4) using a wheel chair or a long-term user of crutches, a cane, or walker.

[5]Aged 16-64.

[6]Number of Social Security beneficiaries, aged 18-64, receiving benefits as of December 1991 based on their own disabilities, for example, disabled workers, disabled widows and widowers, and disabled adult children.

[7]Number of adults aged 18-64 receiving a federally administered payment but not also receiving DI benefits as of December, 1991.

Source: John McNeil, "Americans with Disabilities: 1991-92," U. S. Bureau of the *Census, Current Population Reports, Series P-70-33,* U.S. Government Printing Office, Washington, DC, 1993. Beneficiary and recipient estimates based on SSA administrative data.

The first econometric model to study an individual's decision to apply for DI benefits was developed by Halpern and Hausman (1986) using the Survey of Disabled and Nondisabled Adults.[5] Recently, this structural model has been reformulated and reestimated by Kreider (1994b) using the Survey of Disability and Work. Halpern and Hausman (1986) found that the probability of applying is substantially affected by the expected benefit level, but not by the probability of acceptance. Kreider (1994b) found exactly the opposite effects. In both these studies, however, little effort was devoted to modeling the disability determination process actually used by SSA.

Contributions

We model the outcome of SSA disability determinations using survey responses on health, functional limitations, demographic traits, and work behavior for adult applicants.[6] For this study, data from the 1990 Survey of Income and Program Participation (SIPP) have been exact-matched[7] to SSA records on disability determinations. The study makes two broad contributions.

The first contribution relates to the use of matched data in constructing a disability measure relevant for the analysis of SSA's disability programs from information in a recurring household survey. Development of the matched data allows us to consider the relevance of household survey data in a rigorous empirical fashion, relating such data to SSA disability criteria and testing alternative model specifications. Information on the outcomes of SSA disability determinations permit estimation of a survey-based disability measure calibrated from SSA determinations, not based solely on self-reports of disability. Although there have been previous efforts to model this relationship, none has involved a recurring national household survey conducted by the Bureau of the Census. The promise of this line of research is that it will allow analysts to make more use of readily available information from household surveys to study disability programs, including, for example, the impact of household events on applications.

The second contribution relates to the form of the model. We adopt a structural approach, using a multistage logit model to represent SSA's sequential disability determination process. Some steps of the determination process are based solely on medical evidence and health-related activity limitations; others take into account vocational criteria. The multistage structural approach makes it possible to use survey information in a way that mimics the steps of the disability determination process.

The work reported here will be extended to an analysis of the factors affecting decisions to apply for benefits. However, such an application model cannot be correctly estimated without having an appropriately specified eligibility model because applications decisions are likely affected by an applicant's appraisal of whether he or she will be found eligible. A simultaneous analysis of both applicants and nonapplicants will be used to adjust for selectivity bias arising from the estimation of SSA disability status based on a population that includes only applicants. We will then use this adjusted model of disability determination for two purposes. First, we will estimate the size of the pool of persons eligible for disability benefits. Second, we will develop a comprehensive model—

involving both eligibility determinations and applications behavior—to explain and predict disability growth. This approach will allow us to distinguish the effects of categorical criteria, financial criteria, and the application incentives faced by households.

Section II provides background on the DI and SSI programs; it includes descriptions of the programs and some historical background. Section III outlines SSA's sequential disability determination process by step. Section IV describes the data used in the study, including the SIPP and SSA data on disability applicants. Section V discusses the derivation and characteristics of the study sample. Section VI describes the four-stage sequential logit model and section VII discusses results as well as limitations. Section VIII reports predictive results and section IX offers conclusions and discusses future research.

II. Disability Insurance and Supplemental Security Income

The two disability programs administered by the Social Security Administration use the same disability determination process, but have different, albeit complementary, objectives. The DI program is part of the comprehensive social insurance program, Old-Age, Survivors, and Disability Insurance (OASDI). It is funded through payroll tax contributions allocated to the DI Trust Fund. The fundamental purpose of a social insurance program such as OASDI is to provide partial protection from events that cause a loss of earnings for those contributing to the program (and, in some cases, for their dependents). DI, then, offers earnings insurance—a partial replacement of earnings lost due to impairments that prevent work. The SSI program, by contrast, is a means-tested program guaranteeing a minimal level of income to the poorest of the aged, blind, or disabled. In contrast to DI, SSI is funded by general revenues.

Under the disability determination procedure, the existence of an impairment alone does not qualify an applicant to receive benefits; eligibility requires that the impairment be severe enough to prevent significant work. Thus, disability is defined as

> the inability to do any substantial gainful activity by reason of any medically determinable physical or mental impairment which can be expected to result in death or which has lasted or can be expected to last for a continuous period of not less than 12 months.[8]

Thus, to be considered disabled, the applicant must be judged unable to do *any* jobs which exist in reasonable numbers in the economy. The evaluation is based on the applicant's impairment and, in certain cases, takes into account the applicant's age, education, and work experience.

DI: Program Description

Almost all workers, whether working for wages or self-employed, contribute to the DI Trust Fund as part of their Social Security payroll taxes. A wage earner, for example, contributes 7.65 percent of taxable earnings to three trust funds, Old-Age and Survivors Insurance (OASI), Disability Insurance (DI), and Hospital Insurance (HI).[9] The worker's employer contributes a like amount. A portion of the contributions from both the worker and employer is allocated to the DI Trust Fund; in 1994 this amounted to 1.88 percent of taxable wages. After contributing for an extended period, the worker becomes insured for disability; that is, in the event the worker becomes disabled, he or she is entitled to disability benefits.

To be insured for DI, a worker must be "fully" insured as well as "disability" insured. Intuitively, the former requires that the applicant has been a regular contributor to the system, while the latter requires that the applicant has been a recent contributor. To be fully insured, a worker must have contributed to the system for a minimum of 40 quarters during his or her working life. Being disability insured requires that the worker must have been covered for at least half the quarters in the 10 years prior to the onset of the disability. The requirements for being fully insured and disability insured are adjusted for younger workers (who would have had less time to accrue the necessary quarters).

There is a 5-month waiting period for DI benefits. If an applicant has substantial earnings during the waiting period, he or she becomes ineligible for disability benefits. DI benefits, like OASI benefits, are calculated based on the worker's past average monthly earnings, indexed for changes in earnings. The benefit structure is progressive—low earners receive as benefits a higher percent of average monthly earnings than high earners. However, unlike OASI, DI benefits are not reduced actuarially when benefits are taken before age 65. Dependents also receive benefits, subject to family maximums. Like OASI benefits, DI benefits are adjusted annually for changes in the cost of living, based on the Consumer Price Index. After receiving DI benefits for 2 years, beneficiaries are entitled to Medicare coverage.

SSI: Program Description

Supplemental Security Income provides an income guarantee to the aged, blind, and disabled who have low income and low assets. SSI recipients do not have to be fully insured or disability insured, because SSI is not contributory. Nor is there a waiting period under SSI. But the SSI applicant must meet a means test—the individual or couple must have income and assets below specified limits. An individual with *countable* assets over $2,000 or a couple with assets over $3,000 would be ineligible to receive SSI benefits.

The income limit used to determine eligibility for Federal SSI benefits constitutes the level of income guaranteed by SSI. That is, if the applicant's income is below the guarantee level then the benefit is calculated as the difference between the guarantee level and the applicant's income, taking into account certain exclusions. Guarantee levels are differentiated by whether the unit consists of an individual or couple and whether the unit lives independently or in a household owned or rented by others. The income guarantees, as of 1994, are $446 per month for an individual and $669 for a couple, assuming they live in a house or apartment that they own or rent. Guarantees are reduced by

one-third for those living in the household of another. The guarantee levels are price indexed. Some States have supplementation programs that provide higher income guarantees.

The Federal guarantee levels, taken alone, are not high enough to lift recipients out of poverty. For 1994, the annual SSI guarantee for an individual was $5,352; the poverty threshold for a nonaged adult was $7,710. Similarly, the Federal guarantee for a couple was $8,028, whereas the analogous poverty threshold for a nonaged couple was $9,977. In a few States, supplementation levels are high enough to bring some recipients out of poverty. Most SSI recipients are covered by Medicaid; in fact, in more than half the States the coverage is automatic.

DI: History and Rationale

Long before the Disability Insurance program was enacted, it was under debate. In 1938, an unpublished memo of the Social Security Board linked the idea of a disability program to the rationale for social insurance:

> By passing the Social Security Act, Congress has recognized the fact that workers cannot, without outside help, protect themselves against old age. Is there reason to believe that they are in a better position to put aside savings sufficient to carry them and their families through an illness which may last many years, or through a disability which may persist to death?[10]

It was recognized that enacting a new program did not imply that society was undertaking an entirely new burden; some support for the disabled was already provided by general relief or welfare. One rationale for a new program, then, was to provide some of the support for the disabled within the framework of an insurance program funded by the contributions of workers. After all, while disability befalls few workers, all are at risk. DI, then, provides group insurance against the risk of an impairment so severe that it prevents work.

Although the need for protection against the risk of disability was recognized in 1938, the DI program was not enacted until much later, largely due to concerns about how to define disability and a related concern about cost. When the program was enacted in 1956, it was narrowly targeted. Eligibility was limited to workers aged 50-64 who were permanently disabled and who had made contributions to Social Security for many years.

Amendments in later years extended the target population. Benefits are now paid to younger workers who have contributed for fewer years and to those with impairments that, though not permanent, are expected to last at least 12 months. In cases involving multiple impairments, the overall severity of the combined impairments is now considered.

SSI: History and Rationale

Supplemental Security Income addresses *residual* needs, needs not met by the Social Security program:

> "Income insurance" will not be sufficient for people who have not had regular earned income themselves or are dependent on someone who has. Thus, some social security benefits are not high enough to meet need, and an assistance program is necessary to complement the social insurance payments or to make payments to the relatively small number of people who are not eligible for social security.[11]

Before the enactment of SSI, these needs were often met by Federal-State programs that were State administered, namely Old-Age Assistance, Aid to the Blind, and Aid to the Permanently and Totally Disabled. SSI, which began paying benefits in 1974, brought a nationally uniform administration and benefit structure, although a number of States provided supplementary benefits.[12] In addition, SSI extended eligibility to disabled children under age 18.

SSI did not include some controversial features of the State programs it replaced. It did not include lien laws, which gave program administrators claims on the property of beneficiaries. Nor did it include provisions of some State programs obligating close relatives to provide financial support, although SSI deeming provisions take into account support from relatives in determining benefits. Moreover, in designing SSI, the objective of administrative simplicity went hand in hand with that of horizontal equity (giving the same benefit to those in like circumstances). The earlier State programs sometimes had county by county variation in benefits and, in some instances, benefit increments for special needs determined case by case. Under SSI, some such caseworker-intensive provisions were dropped. Instead, SSI has broad categories—individuals versus couples and own household versus the household of another—but for beneficiaries within those categories, benefits are based on the same income guarantee.

III. SSA Disability Determination

Disability determination serves a gatekeeping function for both the DI and SSI programs, distinguishing those allowed from those denied. It is unlike typical eligibility criteria for public programs. Such criteria often relate to self-evident or easily measurable traits, such as advanced age, single-parent status, or having income below a statutory limit. By contrast, disability determination is a complex evaluative process that is not widely understood. Yet, with the total number of applicants for the two programs now exceeding 2 million per year, its budgetary and income distributional effects are undeniable.

SSA's first effort in developing rules for disability determination was in February 1955 when the Commissioner of Social Security appointed a Medical Advisory Committee to provide technical advice on administrative guidelines and standards designed to provide equal consideration to all individuals in the evaluation of their disabilities. These rules were established under the "disability freeze" provisions, a 1954 Social Security law that protected the retirement benefits of workers who had experienced a period of disability. Under these provisions, disability determinations were to be made by State agencies; these agencies continued in that role when the DI program was enacted in 1956.

Although the determination process is currently under review, the procedure described in this section and modeled in the study is that presently used by Disability Determination Services (DDS) agencies.[13] It is used in initial determinations or DDS reconsiderations. Other decisions made at higher levels under the multilayered appeal process—including those of Administrative Law Judges, for example—are not modeled in this analysis.[14]

As the initial step in establishing eligibility, the SSA field office screens out applicants who currently work (this earnings screen is discussed below). The field office also verifies insured status or, in the case of SSI, does a preliminary check for financial eligibility based on income and assets. If the applicant is eligible for either program or both, the application is referred to the DDS.

Disability determination involves a sequence of five steps, shown schematically in chart 1.[15] At each of the first four steps some applicants are either denied or allowed, with the residual group passing on to the next step for further evaluation. An applicant who has been neither allowed nor denied in the first four steps will either be allowed or denied at step 5.

The order of steps and the criteria implicit in each step regulate the flow of cases through the sequential process. That is, the number and characteristics of cases evaluated at each step reflect the effects of prior steps. Depending on the severity of the impairment, the disability determination may be based on medical criteria alone or on medical criteria in conjunction with vocational criteria (specifically—age, education, and work experience).

Former Commissioner Robert M. Ball provides an insight that is useful in trying to understand the determination process. For the sake of efficiency, the process implies a "screening strategy":

> The idea was to screen quickly the large majority of cases that could be allowed on reasonably objective medical tests and then deal individually with the troublesome cases that didn't pass the screen.[16]

In fact, the first three steps represent screens: those with substantial earnings are denied, those with the least severe impairments are denied, and those with the most severe impairments are allowed. Screening allows program administrators to sort applicants, so as to minimize costs incurred in making determinations. Determinations at step 1 are made solely on the basis of recent earnings, while step 2 and step 3 determinations are based on medical evidence. The medical screening in the determination process is illustrated in chart 2; step 2 and step 3 determinations deal with applicants at the tails of the severity distribution illustrated in chart 2. Under this procedure, only the remaining applicants undergo the analysis of residual functional capacity and the analysis of past work and other vocational factors. Such applicants—Ball calls them the "troublesome" cases—are evaluated in the final two steps.

The first step of SSA's process is an earnings screen. At this step applicants are denied if they engage in activities that are both *substantial* and *gainful.* Activities are defined as substantial if they involve significant physical or mental activities. They are considered gainful if done for pay or profit. Applicants earning more than the substantial gainful activity (SGA) amount are denied. The current maximum SGA amount is $500 per month. The members of the residual group are not allowed at this step; rather, they are evaluated further under step 2.

This step of the process is administered at the SSA field office. If the applicant is engaging in substantial gainful activity, he or she is denied immediately and the record is not referred to the DDS for disability determination. Because this step is not part of the medical-vocational determination made by DDS, it is not modeled in this article.[17] The remaining four steps, which are modeled here, are discussed below.

Step Two: Denials Based on a Medical Screen

An applicant is denied at step 2 if his or her impairment (or combination of impairments) is not *severe.* An impairment is considered nonsevere if it does not exceed a conceptual threshold—if it does not significantly limit the physical or mental abilities to accomplish basic work-related activities. Severe impairments are not distinguished from nonsevere impairments through codified medical criteria; rather, applicants are evaluated in terms of work-related activities. Basic work activities include: physical functions (such as walking, standing, or lifting); sensory capacities (such as seeing, hearing, or speaking); and routine mental functions (such as understanding simple instructions, responding to supervision, or adapting to changes in the work environment). Applicants are also denied at step 2 if their impairments do not meet the *duration test,* that is, if (1) the impairment is not expected to result in death and (2) the impairment has neither lasted 12 months nor is expected to last 12 months.[18]

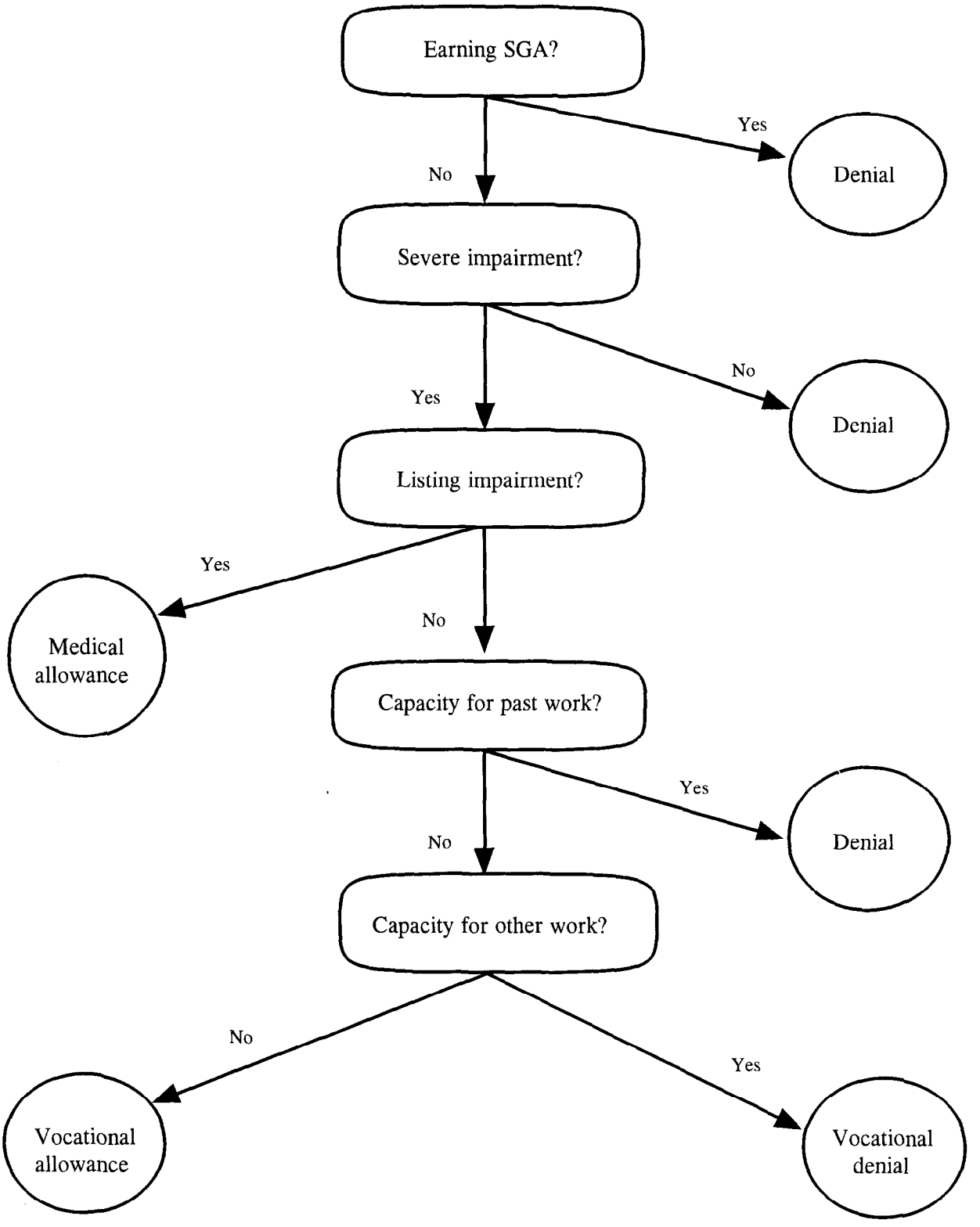
Step Three: Allowances Based Solely on Medical Criteria

Under step 3, the medical evidence obtained on an applicant's impairment is assessed using codified clinical criteria relating to both the nature and severity of the impairment. These codified criteria, currently including over 100 impairments, are referred to as the Listing of Impairments.[19] Applicants with impairments meeting these criteria are allowed immediately; remaining applicants are evaluated further in step 4.

The listings are detailed medical standards that lend objectivity and timeliness to the determination process. For major body systems, the listings describe impairments sufficiently severe that it is assumed they would prevent work that is both substantial and gainful. If an applicant's impairment presents the symptoms, signs, and laboratory findings as defined for one of the listed impairments, the applicant's impairment is said to "meet the listing," and the applicant is considered disabled. If an applicant has an impairment not included in the listings, but considered medically equivalent to a listed impairment, with evidence indicating the impairment is equal in severity to a listed impairment (or more severe), the impairment is said to "equal the listings" and the applicant is allowed.

Steps 2 and 3 both involve evaluating impairments in terms of medical severity. But, as suggested in chart 2, they deal with impairments at opposite ends of the continuum of medical

Chart 1.—SSA disability determination procedure



severity. The applicant is denied in step 2 if the impairment (or combination of impairments) is clearly not severe. Step 3, on the other hand, reflects the principle that some impairments are *so severe* that allowance is appropriate without further evaluation. Because the criteria used at this step are solely medical, applicants are not evaluated in terms of residual capacity for work; rather, there is a presumption that applicants with impairments meeting or equaling the listings cannot work in any practical sense. Hence, those with the least severe impairments are denied in step 2 and those with the most severe impairments are allowed in step 3. In both steps, determinations are made without expending resources on evaluations used in the last two steps of the sequential process, reflecting the screening strategy.

Applicants neither denied at step 2 nor allowed at step 3 have impairments that, although severe, are not severe enough that the applicant would be considered disabled purely on medical grounds. Those in this remaining group are evaluated in terms of their residual capacity and vocational factors in steps 4 and 5.

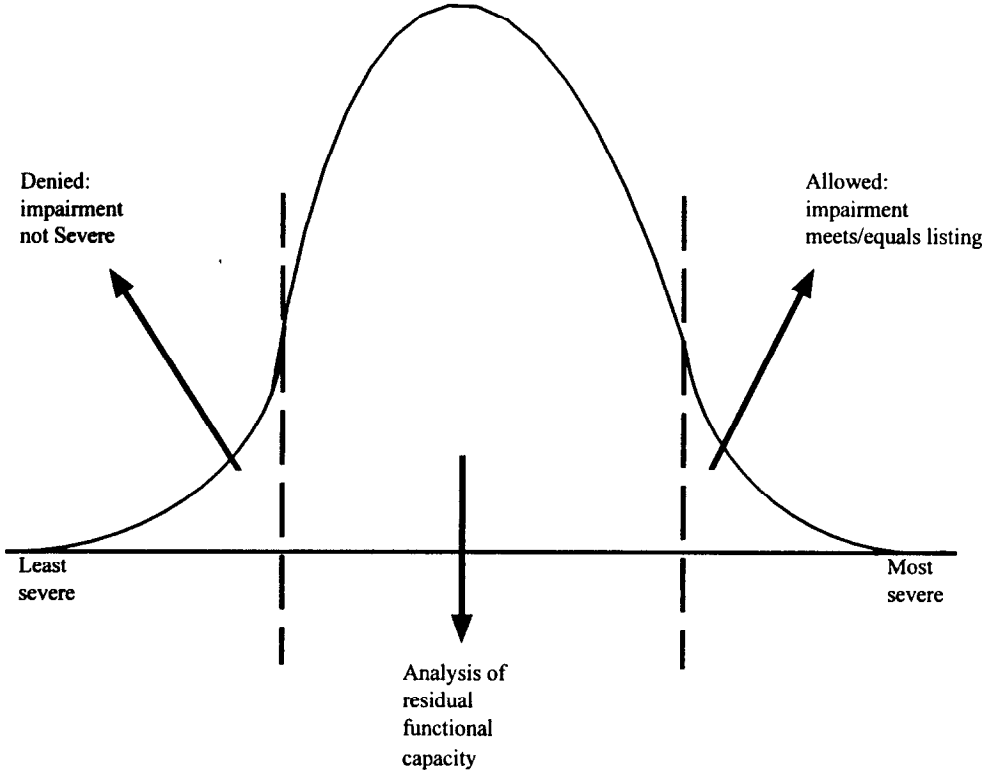
Step Four: Can Severely Impaired Applicants Work in Past Jobs?

Under step 4, an applicant's residual functional capacity to meet the requirements of the main jobs held in the past is considered. Applicants judged able to perform past work are denied; the remaining applicants, including those with no recent work, are evaluated further in step 5.

This step involves two determinations. The first is an analysis of an applicant's residual functional capacity; this analysis is used in steps 4 and 5. The evaluation of residual functional capacity presumes a severe impairment and determines to what extent the applicant can perform basic work-related activities despite of the impairment. This analysis takes into account, for example, whether the applicant can walk, lift objects, follow instructions, and tolerate environmental conditions encountered in the workplace. The basic work-related functions considered here are the same ones considered in step 2, but they are evaluated differently in the two steps. In step 2, the *presence* of such limitations would be taken as evidence of a severe limitation, but in step 4 the *extent* of such limitations is evaluated, to compare the applicant's *residual capacity* with the demands of past jobs.

Step 4 also requires a determination as to the requirements of past jobs. The jobs considered are those held in the 15 years prior to application, if they were held long enough for the applicant to learn the requisite skills. To illustrate, if two applicants have the same severe, arthritic impairment involving the lower extremities, an applicant who had held a desk job is the one more likely to be denied at this step, on grounds that he or she can continue to

Chart 2.—Medical screening in SSA disability determination



Note: This chart is illustrative; it does not reflect the use of data in constructing a severity distribution. It is intended to show how the determination process implicitly partitions the severity distribution, regardless of its precise shape.

perform sedentary work. By contrast, an applicant who held a physically-demanding job will probably be evaluated further in the fifth and final step.

Step Five: Can Severely Impaired Applicants Do Any Work in the Economy?

Under step 5, the applicant's *residual functional capacity* is considered in conjunction with *vocational factors*, to determine whether the applicant can work in jobs other than those he or she has held. Because this step represents the final step of the determination process, all applicants are either allowed or denied.

Applicants evaluated under this step have a severe impairment which, however, does not meet the listings; in addition, they no longer have the capacity to perform past work. The analysis of the applicant's residual capacity from step 4 indicates whether the applicant is able to perform sedentary, light, medium, heavy, or very heavy work.[20] Under step 5, the applicant's age, education, and work experience (if any) are used to determine whether the applicant can work in employment consistent with his or her residual capacity. This determination is based on a table called the vocational grid. To illustrate the use of the grid, suppose an applicant's impairment will permit only sedentary work. If the applicant is of advanced age, low educational attainment (6 years or less), and has worked only in arduous unskilled jobs, then the applicant will be judged disabled using the vocational grid.

IV. Study Data

The study relies on two principal sources of data: the 1990 panel of the SIPP and disability determination records (taken from the so-called 831 Disability Applicant Files) of SIPP sample members who applied for SSA-administered disability benefits and whose applications were acted upon in the calendar years 1986-93. In addition, information on occupational characteristics was added to the study data set from external sources. Record data on benefits received under the OASDI and SSI programs have also been linked to the study data set but are not being employed in these initial stages of the project.

The SIPP

The SIPP is a recurring household survey focusing on the economic circumstances of the civilian noninstitutional population of the United States. The 1990 panel of the survey was chosen for the project because of the substantial health and disability information it obtained on sample members and because the panel sample size is substantially larger than that for other recent panels available at the time the study was initiated.[21] The basic unit of analysis in the SIPP is the individual.[22] Sample members are interviewed a total of eight times (the initial contact plus seven subsequent interviews) at 4-month intervals. Two general classes of information (core and topical module data) are collected in each survey panel. The core data principally involve information on demographic characteristics (including family and household composition), monthly labor-force activity, and the sources and amounts of labor and nonlabor income. Information on these topics is collected on a monthly basis for the 4 months preceding each interview, yielding 32 months of information for sample members interviewed in all eight interviews.[23]

Information on a variety of topics of special interest is obtained in the topical module component of each interview. The topical module information of most interest at the current stage of this study relates to health and disability status. The 1990 SIPP panel includes a brief work disability history and characterizations of the sample person's work disability status, general health status, functional and activity limitations, health conditions, health care utilization, and related topics. This information was collected in four separate topical modules over the course of a 20-month period stretching from June-September 1990 to February-May 1992. Learning how to use this body of self-reported information on health to better represent SSA's administrative definition of work disability is the principal methodological task of our current study.

A more detailed accounting of the health and disability topics covered in the various topical modules is provided in table 2.[24] The information in the table may be summarized as follows: (1) the existence of a health-related work limitation, and whether or not it prevented work at a job or business, was established four times during the course of the 1990 panel (in topical modules for the second, third, sixth and seventh interviews);[25] (2) additional information related to the timing of onset, expected duration, and the extent to which a reported health limitation interferes with work activity for those who are work limited, but not prevented from working, was also obtained in topical modules for interviews two and seven; (3) a general health status question and a battery of items assessing the respondents' ability to perform six kinds of sensory and physical functional activities (seeing, hearing, having one's speech understood, lifting and carrying, climbing a flight of stairs, and walking three city blocks), five Activities of Daily Living (ADLs) (getting around inside the home, getting in or out of a bed or chair, taking a bath or shower, dressing, eating, and using the toilet) and five Instrumental Activities of Daily Living (IADLs) (going outside the home, keeping track of money or bills, preparing meals, doing light housework, and using the telephone); and (4) information about the use of aids and appliances, the presence of mental conditions, housework disabilities, and health care utilization. The third and fourth categories of information were obtained twice—once in the third interview and once in the sixth interview. With the exception of the separate battery of five questions about the existence of mental conditions, reports of health conditions *per se* are limited to those associated with work or other activity limitations.[26] The health conditions identified in the third and sixth topical module interviews as causing work limitations and their summarization by us into the categories employed by SSA to group, by body system, the individual medical conditions from its Listing of Impairments (the so-called SSA Body System Codes), are shown in table 3.

Table 2.—Information obtained on health status, activity limitations, work disability and related topics, 1990 SIPP panel topical modules

Class of information[1]	Interview number, months, and year collected			
	2nd	3rd	6th	7th
	Jun. 1990 to Sept.1990	Oct. 1990 to Jan. 1991	Oct.1991 to Jan.1992	Feb. 1992 to May 1992
General health status		X	X	
Use of cane, crutches, walker, or wheelchair		X	X	
Functional limitations				
Seeing words and letters		X	X	
Hearing normal conversation		X	X	
Having speech understood		X	X	
Lifting and carrying 10 lbs		X	X	
Climbing stairs without resting		X	X	
Walking three city blocks		X	X	
Activities of daily living (ADLs)				
Getting around inside the house		X	X	
Getting in or out of a bed or a chair		X	X	
Taking a bath or shower		X	X	
Dressing		X	X	
Eating		X	X	
Using the toilet, including getting to the toilet				
Instrumental activities of daily living (IADLs)				
Going outside the home, for example, to shop or to the doctor		X	X	
Keeping track of money and bills		X	X	
Preparing meals		X	X	
Doing light housework, for example, washing dishes or sweeping a floor		X	X	
Using the telephone		X	X	
Condition(s) causing activity limitation		X	X	
Main condition causing activity limitation		X	X	
Work disability				
Presence of a health-related work limitation	X	X	X	X
Date of onset of limitation	X			
Main condition causing work limitation	X	X	X	
Employment status at onset of limitation	X			
Was limitation caused by an accident or injury?	X			
Does health condition prevent work?	X	X	X	X
Date of onset of inability to work	X			
Has inability to work lasted 12 months or longer?				X
Likely to be able to resume work sometime in the next 12 months?				X
Ability to do full/ part-time work	X			
Ability to work regularly as opposed to occasionally or irregularly	X			
Ability to do same kind of work as before limitation began	X			
Housework disability				
Presence of a health-related housework disability		X	X	
Does health condition prevent doing housework?		X	X	
Condition(s) causing work/housework limitation		X	X	
Main condition causing work/housework limitation		X	X	

See footnotes at end of table.

Table 2.—Information obtained on health status, activity limitations, work disability and related topics, 1990 SIPP panel topical modules—*Continued*

Class of information[1]	Interview number, months, and year collected			
	2nd	3rd	6th	7th
	Jun. 1990 to Sept.1990	Oct. 1990 to Jan. 1991	Oct.1991 to Jan.1992	Feb. 1992 to May 1992
Presence of mental conditions				
Learning disability such as dyslexia		X	X	
Mental retardation		X	X	
Developmental disability such as autism or cerebral palsy		X	X	
Alzheimer's disease, senility, or dementia		X	X	
Any other emotional or mental condition		X	X	
Health care utilization				
Number of overnight hospital stays in last 12 months		X	X	
Reason for stay		X	X	
Stay in a psychiatric hospital or unit		X	X	
Number of nights spent in hospital—				
in last 12 months		X	X	
in last 4 months		X	X	
Number of bed days in last 4 months		X	X	
Number of doctor contacts—				
in last 12 months		X	X	
in last 4 months		X	X	

[1] For exact question wording see McNeil, 1993, Appendix C, or BOC 1991 and 1993, Appendix B-2.

X - Information obtained.

Occupational Characteristics

In step 4 of SSA's sequential evaluation, information on an individual's prior occupations and a characterization of the physical and nonphysical demands of those occupations play important roles. Data obtained in the second and sixth SIPP topical module interviews identify past occupations (second interview) and the extent to which health problems have caused spells of nonwork over the course of the individual's work life (sixth interview). The second interview topical module provides a three-digit occupation code (based on the 1980 Census of Population Occupation Classification) for jobs held during the 12 years prior to the survey.

However, information about the physical and nonphysical demands of the individual's occupation(s) is not obtained by the survey. We obtained information on selected physical demands of occupations from the fourth edition of the Dictionary of Occupational Titles (DOT) (DOL 1981). Specifically, we used an occupational characteristics file developed by other SSA researchers that provides a limited characterization of the physical demands of each of the approximately 500 three-digit occupational categories of the 1980 Census occupational classification system on the basis of the much more detailed DOT classification.[27]

We chose to employ two of the classifying variables available on this SSA file for characterizing occupations in terms of physical demands (Olson 1990). The first deals solely with strength requirements; the second is a composite measure that combines the DOT strength variable with the DOT characteristics of stooping/crawling and climbing/balancing.[28]

Two versions, narrow and broad, are employed for each criterion, yielding four operational measures. All are dichotomous—for example, a job is classified as either demanding or nondemanding.[29] For a given criterion, the narrow version classifies fewer persons in demanding jobs than does the broad measure. Each DOT occupation is rated on an ordinal 1-5 scale as entailing sedentary, light, medium, heavy, or very heavy physical demands. The narrow strength measure classifies as demanding all occupations for which approximately half or more of the workers are in jobs, as inferred from the DOT, that involve heavy or very heavy work, that is, lifting 100 pounds maximum with frequent lifting or carrying of objects weighing up to 50 pounds. The broad strength measure classifies as demanding those occupations for which about half or more of the workers are in jobs that require lifting a maximum of 50 pounds, with frequent lifting or carrying of 25 pounds (the DOT criteria defining medium physical demands).

As noted, the strength-stoop-climb measures combine the DOT characteristics of stooping/crawling and climbing/balancing with the DOT strength variable. A composite criterion was constructed by incrementing the occupational DOT strength score by

Table 3.— Survey health condition categories for adults[1] as summarized according to SSA body system code

Study condition recode	Survey condition by SSA body system code[2]
01	**1.00 Musculoskeletal system**
	03 — Arthritis or rheumatism
	04 — Back or spine problems (including chronic stiffness or deformity of the back or spine)
	06 — Broken bone/fracture
	21 — Missing legs, feet, arms, hands, or fingers
	25 — Stiffness or deformity of the foot, leg, arm, or hand
02	**2.00 Special senses and speech**
	05 — Blindness or vision problems (difficulty seeing well enough to read a newspaper, even with glasses on)
	09 — Deafness or serious trouble hearing
	24 — Speech disorder
03	**3.00 Respiratory system**
	18 — Lung or respiratory trouble (asthma, bronchitis, emphysema, respiratory allergies, tuberculosis, or other lung trouble)
03	**4.00 Cardiovascular system**
	13 — Heart trouble (including heart attack (coronary), hardening of the arteries (arteriosclerosis))
	15 — High blood pressure (hypertension)
05	**5.00 Digestive system**
	14 — Hernia or rupture
	26 — Stomach trouble (including ulcers, gallbladder, or liver conditions)
05	**6.00 Genitourinary system**
	16 — Kidney stones or chronic kidney trouble
	7.00 Hemic and lymphatic system
	No survey categories
	8.00 Skin disorders
	No survey categories
05	**9.00 Endocrine system**
	10 — Diabetes
	28 — Thyroid trouble or goiter
	10.00 Multiple body systems
	No survey categories
02	**11.00 Neurological disorders**
	08 — Cerebral palsy
	11 — Epilepsy
	12 Head or spinal cord injury
	22 — Paralysis of any kind
	27 — Stroke
04	**12.00 Mental disorders [3]**
	01 — Alcohol or drug problem /disorder
	17 — Learning disability
	19 — Mental or emotional problem /disorder
	20 — Mental retardation
	23 — Senility/Dementia/Alzheimer's disease
05	**13.00 Neoplastic diseases**
	07 — Cancer
05	**14.00 Immune system**
	02 — AIDS or AIDS Related Condition (ARC)
05	*Other survey categories*
	29 — Tumor, cyst, or growth
	30 — Other

[1] Waves 3 and 6, 1990 Panel, health conditions causing work, functional, or activity limitations for adults.

[2] Survey condition code and descriptor in italics; SSA body system code and descriptor in bold.

[3] The presence of mental disorders also identified on the basis of a "yes" response to any one of five separate items identifying (a) a learning disability such as dyslexia; (b) mental retardation; (c) a developmental disability such as autism or cerebral palsy; (d) Alzheimer's disease, senility, or dementia; or (e) any other mental or emotional condition. The prior report of a limitation was not a precondition to the administration of these items.

1 each for jobs rated by the DOT as requiring either (a) frequent or continuous stooping/crawling or (b) frequent or continuous climbing/balancing. The resulting composite score ranges from 1 (a sedentary job with no strength-stoop-climb demand) to 7 (a job with very heavy strength and both stoop and climb requirements). Narrow and broad measures were derived on the basis of this criterion by assigning Census three-digit occupations for which at least 30 percent of the incumbents held jobs scoring at least 4 out of a possible 7 as conforming to the "narrow" group of demanding jobs and occupations for which at least 50 percent of the incumbents held jobs scoring at least 3 out of 7 to the "broad" group of demanding jobs. As intended, the narrow definition yielded fewer persons in physically demanding jobs than the broad definition. The distribution of the applicant sample according to these measures is given at the bottom of table 5 and is roughly similar to that for civilian workers in the United States as of 1980 (see Olson 1990, table 1).

Administrative Data on Disability Applicants

Our programmatic information on disability applicants is derived from the SSA form 831, which is used by the State Disability Determination Services to record information concerning the disability determination process for DI and SSI applicants. After the disability determination has been made and recorded on the 831 record, it becomes the basis for award and denial notices. Calculation and disbursement of actual benefit payments are executed by SSA subsequent to the DDS disability determination.

In general, the content and quality of the 831 data reflect the fact that SSA's disability determination procedure is an administrative process. The 831 record includes administrative, diagnostic, and statistical items related to the application process, although there is considerable nonreporting of items of mainly statistical interest.[30] Because we intend to extend our study to the nonapplicant universe, for which 831 data are not available, whenever survey analogs of 831 variables existed, we relied on the survey information.[31]

The principal item we used from the 831 record, the Regulation Basis (RB) code, characterizes the outcome of the determination process. The code is crucial because it allows us to categorize the determination outcome according to the steps of the sequential process as described and modeled in our study.[32] Thus the RB code not only indicates whether an applicant was allowed or denied, but also delineates the basis for the determination. That is, for those allowed it distinguishes between determinations made solely on the basis of medical criteria (step 3) and those in which vocational and occupational factors played a role (step 5). It also distinguishes among three types of denied applicants: (1) those with impairments that are judged as not severe (step 2); (2) those able to perform past work (step 4); and (3) those able to perform some type of work available in the economy (step 5).

V. Description of the Study Sample

Derivation of the Applicant Study Sample

The development of our study sample of disability applicants began with a roster of Social Security numbers (SSNs) for members of the SIPP sample.[33] The SSN roster was matched to SSA's disability benefit application files (the 831 files) pertaining to calendar years 1986-93.[34] Nominally, the disability benefit application files contain a record for each level at which an application is reviewed. Often we located multiple 831 records corresponding to the various application episodes and review levels experienced by each applicant.

Since we chose to focus our modeling effort on the sample member's most recent application for adult disability benefits and, for that application, on the last decision rendered by the State Disability Determination Services in the 1986-93 period, we retained only the 831 record corresponding to that decision.[35] Records representing adjudications rendered at administrative levels above the State DDS were excluded for two principal reasons: (1) because sample size considerations precluded statistically reliable modeling of decisions rendered above the State level separately and (2) because adjudications rendered subsequent to the DDS reconsideration level are not consistently represented in the 831 files. We decided to focus on the outcome of the most recent application for two principal reasons: (1) with few exceptions, it would be the application occurring closest in time to the measurement of health and disability status in the survey and (2) the outcome of the most recent application would represent the most considered judgment made by the DDS regarding the applicant's disability status that was observable in the context of our study. Clearly, the outcome of an application that preceded the most recent one might be different from that of the most recent application, yet it would be the most recent that determined the award or denial of disability benefits.[36]

The match between the SIPP sample and the 1986-93 disability application files yielded 4,733 adjudication records. The several steps involved in deriving the study sample from this collection of adjudication records are shown in table 4. Unduplication yielded 2,293 distinct SIPP sample members of all ages with 831 information meeting our general criteria, that is, that represented the final adjudication record through the reconsideration level and that corresponded to the most recent application for the 1986-93 period. After discarding records for applicants for whom neither an initial nor reconsideration record was located, child benefit applicants, and applicants whose application was terminated prior to an evaluation of their health and disability status,[37] 1,857 persons remained. These sample individuals were all aged 18 or older at the time of their most recent filing for disability benefits and had filed for disability benefits as an adult.[38]

In order to insure a full complement of survey health measures for each member of the study, the sample was further limited to persons who had been interviewed in all four of the pertinent topical modules. Approximately 630 sample members did not meet this final criterion. Thus the final study sample consisted of

1,230 survey cases representing the universe of persons who applied for DI or SSI adult disability benefits between 1986 and 1993 and who were members of the civilian noninstitutional population of the United States through the end of the time period covered by the 1990 panel health interviews (February-May 1992).[39]

Study Sample Disability Determination Outcomes

Another view of the study sample is provided in chart 3, which distributes the study sample according to the four steps of the SSA sequential evaluation modeled in this study.[40] The classification of the sample by step of the sequential evaluation and evaluation outcome by step is based on the Regulation Basis code. The number of sample cases dealt with in the four steps of the sequential determination procedure is given in the box corresponding to each step and ranges from the full study sample in step 2 (n = 1,230) to 460 cases in step 5. The disposition of the sample at each step is also provided. At step 2, 82 percent of the sample was "passed on" to step 3 and 18 percent was denied; 36 percent of the sample in step 3 was allowed for medical reasons (medical allowance) and 64 percent was passed on to step 4; and so forth for the remaining steps. Finally, as shown in the following tabulation, the percentage distribution of the study sample by step in the sequential process and outcome closely approximates the pattern experienced by the full universe of applicants.

The basic demographic and health characteristics of the full study sample, as portrayed by survey measures used to construct the bulk of the independent variables for our model, are provided in table 5 by overall allowance/denial status.[41]

Basis of allowance or denial	Study estimate	Administrative estimate for 1993
Total	100	100
Allowances	44	43
Denials	56	57
Allowances by type	100	100
Meets or equals listings	65	66
Vocational	35	34
Denials by type	100	100
Nonsevere impairment	33	34
Able to perform usual work	30	32
Able to perform other work	37	34

Note: survey estimates based on weighted counts.

Health Characteristics

As would be expected, the applicants indicate high levels of functional impairment and activity limitation.[42,43] For example, 49 percent report the presence of one or more severe functional limitations, 11 percent report needing assistance with one or more activities of daily living (ADLs), and 23 percent indicate a need for assistance with one or more instrumental activities of daily living (IADLs). The corresponding percentages for the entire nonaged adult population, for the same time period, are 4, 1, and 2 percent, respectively. Severe functional limitations with particularly high prevalence rates (20 percent or more) include being unable to lift or carry at least 10 pounds, inability to climb stairs without resting, and inability to walk three city blocks. Again, the corresponding percentages for persons in the general nonaged adult population are much lower (about 2 percent). Sixty-one percent of the applicants report being in fair or poor health. Sixty-three percent report being prevented from working, and 10 percent indicate an inability to do housework because of a health limitation. The corresponding percentages for the nonaged adult population are 5 and 1 percent. Finally, 11 percent of applicants, as opposed to 1 percent of the population of nonaged disabled adults, use a wheelchair or other assistive device, and 24 percent of applicants had at least one overnight stay in the hospital in the 12 months prior to interview.

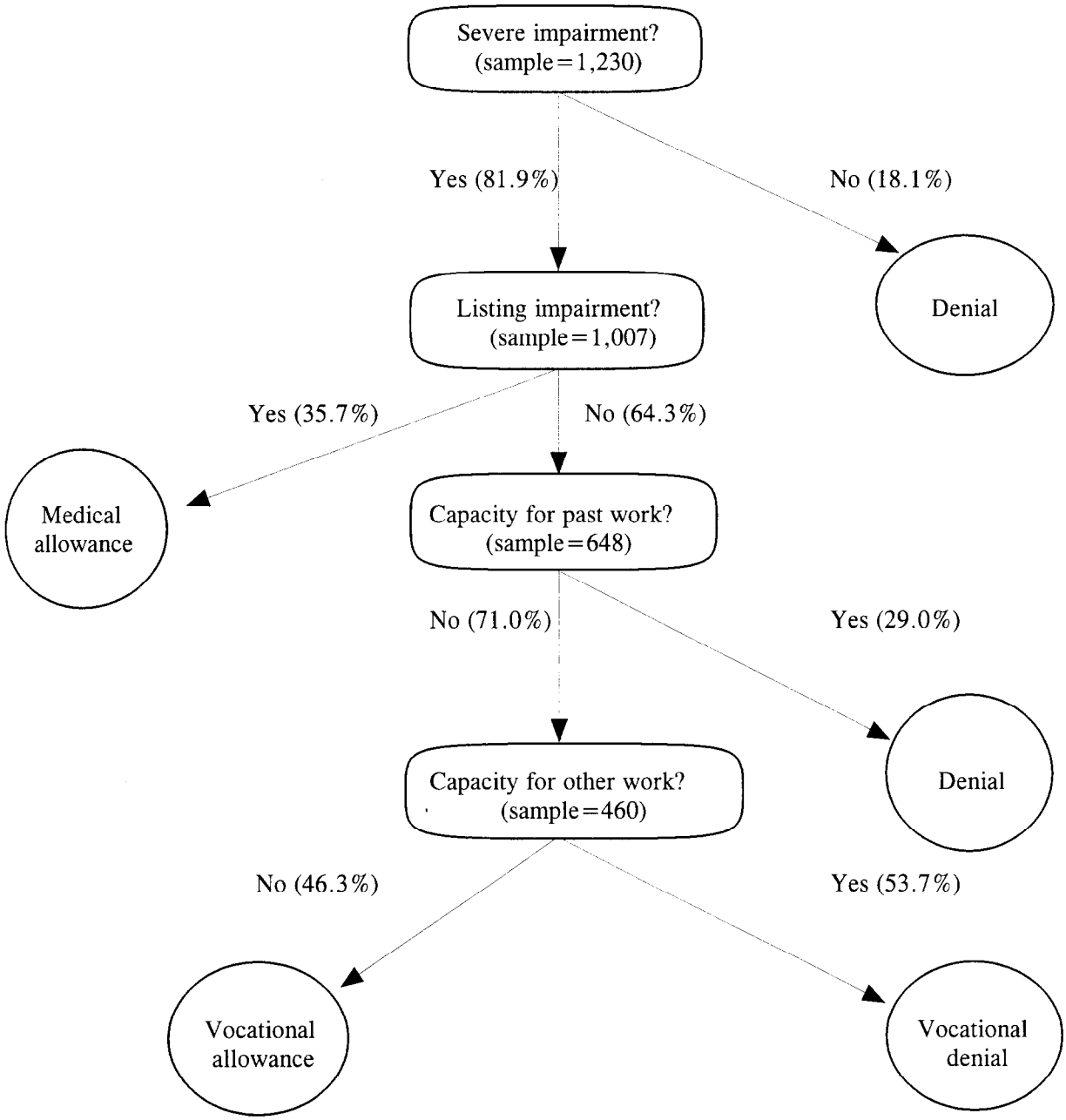
Table 4.—Derivation of the disability applicant study sample

Category	Sample count
Total matched adjudication records	4,733
Less:	
Duplicate records	2,440
Equals:	
Unduplicated number of applicants matched to the 1990 panel sample	2,293
Less:	
Applicants for whom no initial or reconsideration record was located	36
Equals:	
Applicants with an initial or reconsideration level adjudication and matched to the 1990 SIPP sample	2,257
Less:	
Applicants under age 18 as of the filing date of their most recent benefit application[1]	337
Equals:	
Applicants for adult benefits aged 18 or older as of the most recent date filed for adult disability benefits	1,920
Less:	
Administrative and SGA denials[2]	63
Equals:	
Matched sample cases meeting study conceptual criteria	1,857
Less:	
Cases not interviewed in one or more of the four health topical modules[3]	627
Equals:	
Final study sample	1,230

[1] Includes persons aged 18 or older and filing for child disability benefits.
[2] Fewer than 20 sample cases were denied on the basis of SGA criteria.
[3] Including 12 applicants older than age 67 who were interviewed, but not administered the work disability items in the second interview topical module.

Chart 3.—SSI disability determination procedure (as modeled)[1]

Universe: Applicants aged 18 or older, with Disability Determination Service adjudications occurring between 1986-93, and interviewed in each of the four health topical module interviews of the 1990 SIPP panel.
Sample size: 1,230 (Allowed: 572 - 46.3%; Denied: 658 - 53.7%)



[1] Assessment of substantial gainful activity (SGA), the first step in the SSA sequential evaluation, was not modeled. Fewer than 20 applicants in the study sample were denied on the basis of SGA.

Table 5.—Number and percentage distribution of adult disability benefit applicants[1] by final allowed/denied status through the reconsideration level of review, and selected program, demographic, and health characteristics

[Number in thousands]

Characteristic	Total		Status through reconsideration—				Denial rate and index	
			Allowed		Denied			
	Number	Percentage distribution	Number	Percentage distribution	Number	Percentage distribution	Rate	Index[2]
Total	6,656	100.0	2,956	100.0	3,700	100.0	55.6	100
Adjudicative level								
Initial	4,454	66.9	2,623	88.7	1,832	49.5	41.1	74 **
Reconsideration	2,201	33.1	334	11.3	1,868	50.5	84.8	153 **
Title								
DI only	2,755	41.4	1,267	42.9	1,488	40.2	54.0	97
SSI only	1,848	27.8	929	31.4	919	24.8	49.7	89 *
Concurrent	2,054	30.9	760	25.7	1,293	35.0	63.0	113 **
Year of decision								
1986	592	8.9	271	9.2	321	8.7	54.2	98
1987	565	8.5	250	8.5	314	8.5	55.7	100
1988	507	7.6	283	9.6	225	6.1	44.3	80 **
1989	738	11.1	316	10.7	421	11.4	57.1	103
1990	685	10.3	235	7.9	450	12.2	65.7	118 **
1991	954	14.3	479	16.2	474	12.8	49.7	89
1992	980	14.7	485	16.4	494	13.4	50.5	91
1993	1,635	24.6	637	21.5	998	27.0	61.1	110 *
Age at date of filing								
18-34	1,577	23.7	645	21.8	932	25.2	59.1	106
35-44	1,313	19.7	513	17.4	800	21.6	60.9	110
45 or older	3,766	56.6	1,798	60.8	1,968	53.2	52.3	94
45-54	1,742	26.2	701	23.7	1,040	28.1	59.7	107
55 or older	2,024	30.4	1,097	37.1	927	25.1	45.8	82 **
Age at interview								
18-34	1,397	21.0	589	19.9	808	21.8	57.8	104
35-44	1,235	18.6	485	16.4	750	20.3	60.8	109
45 or older	4,024	60.5	1,882	63.7	2,141	57.9	53.2	96
45-54	1,642	24.7	609	20.6	1,033	27.9	62.9	113 **
55 or older	2,382	35.8	1,274	43.1	1,109	30.0	46.5	84 **
Gender								
Male	3,321	49.9	1,524	51.5	1,798	48.6	54.1	97
Female	3,335	50.1	1,433	48.5	1,902	51.4	57.0	103
Race								
White	4,961	74.5	2,211	74.8	2,750	74.3	55.4	100
Black	1,471	22.1	599	20.3	872	23.6	59.3	107
Other	225	3.4	146	4.9	78	2.1	34.9	63 **
Hispanic origin [3]								
Yes	631	9.5	275	9.3	356	9.6	56.4	102
No	6,024	90.5	2,681	90.7	3,343	90.4	55.5	100
Marital status [4]								
Married	3,588	53.9	1,488	50.3	2,100	56.8	58.5	105
Widowed	438	6.6	211	7.1	228	6.2	52.0	94
Divorced, separated [5]	1,362	20.5	609	20.6	752	20.3	55.2	99
Never married	1,268	19.0	648	21.9	619	16.7	48.9	88 *
Educational attainment (in years)								
Less than 8	623	9.4	298	10.1	325	8.8	52.1	94
8 – 11	2,350	35.3	1,063	36.0	1,287	34.8	54.8	99
12 – 15	3,279	49.3	1,362	46.1	1,917	51.8	58.5	105
16 or more	403	6.1	233	7.9	170	4.6	42.2	76 **
Geographic region								
South	2,226	33.4	859	29.1	1,367	36.9	61.4	110 **
Nonsouth	4,430	66.6	2,097	70.9	2,333	63.1	52.7	95

See footnotes at end of table.

Table 5.—Number and percentage distribution of adult disability benefit applicants[1] by final allowed/denied status through the reconsideration level of review, and selected program, demographic, and health characteristics—*Continued*

[Number in thousands]

Characteristic	Total		Status through reconsideration—				Denial rate and index	
			Allowed		Denied			
	Number	Percentage distribution	Number	Percentage distribution	Number	Percentage distribution	Rate	Index[2]
Health status								
Excellent	347	5.2	145	4.9	201	5.4	58.1	104
Very good	752	11.3	259	8.8	492	13.3	65.5	118 **
Good	1,491	22.4	591	20.0	900	24.3	60.3	109
Fair	2,211	33.2	1,003	33.9	1,208	32.6	54.6	98
Poor	1,856	27.9	958	32.4	898	24.3	48.4	87 **
Work limitation status (waves 2-7)								
Ever prevented	4,190	62.9	2,018	68.2	2,172	58.7	51.8	93
Prevented all 4 waves	1,800	27.0	981	33.2	819	22.1	45.5	82 **
Ever limited, never prevented	1,198	18.0	482	16.3	716	19.4	59.8	108
Never limited	1,268	19.1	457	15.5	812	21.9	64.0	115 **
Functional limitation status								
None	2,507	37.7	1,056	35.7	1,451	39.2	57.9	104
One or more	4,149	62.3	1,900	64.3	2,249	60.8	54.2	98
Only one	1,113	16.7	432	14.6	681	18.4	61.2	110
Two or more	3,036	45.6	1,468	49.7	1,568	42.4	51.6	93
Three or more	2,081	31.3	1,033	35.0	1,048	28.3	50.4	91 *
Seeing words and letters	1,022	15.4	474	16.0	548	14.8	53.7	97
Unable	845	12.7	363	12.3	482	13.0	57.0	103
Hearing normal conversation	752	11.3	376	12.7	376	10.2	50.0	90
Unable	684	10.3	338	11.4	346	9.3	50.5	91
Having speech understood	383	5.8	257	8.7	126	3.4	32.9	59 **
Unable	340	5.1	218	7.4	122	3.3	35.9	65 **
Lifting and carrying 10 lbs	2,669	40.1	1,138	38.5	1,531	41.4	57.4	103
Unable	1,435	21.6	545	18.4	890	24.1	62.0	112 *
Climbing stairs without resting	2,786	41.9	1,365	46.2	1,421	38.4	51.0	92 *
Unable	1,357	20.4	642	21.7	715	19.3	52.7	95
Walking three city blocks	2,786	41.9	1,349	45.6	1,437	38.8	51.6	93
Unable	1,529	23.0	879	29.7	650	17.6	42.5	76 **
Number of severe functional limitations:								
None	3,415	51.3	1,523	51.5	1,891	51.1	55.4	100
One or more	3,241	48.7	1,433	48.5	1,808	48.9	55.8	100
Only one	1,422	21.4	620	21.0	801	21.7	56.4	101
Two or more	1,820	27.3	813	27.5	1,007	27.2	55.3	100
Three or more	868	13.0	405	13.7	463	12.5	53.3	96
ADL limitation status								
None	5,282	79.4	2,258	76.4	3,024	81.7	57.2	103
One or more	1,374	20.6	698	23.6	676	18.3	49.2	88 *
Only one	456	6.9	194	6.6	262	7.1	57.5	103
Two or more	918	13.8	504	17.1	414	11.2	45.1	81 **
Three or more	577	8.7	303	10.2	275	7.4	47.5	86
Getting around inside the home	603	9.1	379	12.8	224	6.1	37.1	67 **
Needs personal assistance	275	4.1	214	7.3	60	1.6	21.9	39 **
Getting in or out of bed or a chair	1,048	15.7	479	16.2	569	15.4	54.3	98
Needs personal assistance	445	6.7	244	8.3	201	5.4	45.2	81 *
Taking a bath or shower	749	11.3	416	14.1	333	9.0	44.5	80 **
Needs personal assistance	467	7.0	278	9.4	189	5.1	40.5	73 **
Dressing	617	9.3	341	11.5	276	7.5	44.7	80 **
Needs personal assistance	393	5.9	233	7.9	159	4.3	40.6	73 **

See footnotes at end of table.

Table 5.—Number and percentage distribution of adult disability benefit applicants[1] by final allowed/denied status through the reconsideration level of review, and selected program, demographic, and health characteristics—*Continued*

[Number in thousands]

Characteristic	Total		Status through reconsideration—				Denial rate and index	
			Allowed		Denied			
	Number	Percentage distribution	Number	Percentage distribution	Number	Percentage distribution	Rate	Index[2]
ADL limitation status—*Cont.*								
Eating	167	2.5	126	4.2	41	1.1	24.8	45 **
Needs personal assistance	58	0.9	44	1.5	13	0.4	(6)	(6)
Using the toilet, including getting to the toilet	341	5.1	221	7.5	119	3.2	35.0	63 **
Needs personal assistance	194	2.9	137	4.6	57	1.5	29.4	53 **
Number of ADLs for which personal assistance is needed:								
None	5,937	89.2	2,376	80.4	3,561	96.2	60.0	108 **
One or more	719	10.8	394	13.3	325	8.8	45.2	81 **
Only one	220	3.3	115	3.9	105	2.8	47.8	86
Two or more	500	7.5	306	10.4	194	5.2	38.7	70 **
Three or more	272	4.1	159	5.4	113	3.1	41.6	75 *
IADL status								
None	4,773	71.7	1,843	62.3	2,930	79.2	61.4	110 **
One or more	1,882	28.3	989	33.5	893	24.1	47.5	85 **
Only one	768	11.5	333	11.3	435	11.7	56.6	102
Two or more	1,115	16.7	656	22.2	459	12.4	41.2	74 **
Three or more	561	8.4	344	11.6	217	5.9	38.7	70 **
Going outside the home, for example, to shop or visit a doctor's office	1,185	17.8	645	21.8	540	14.6	45.6	82 **
Needs personal assistance	862	13.0	505	17.1	357	9.7	41.4	75 **
Keeping track of money and bills	546	8.2	368	12.5	178	4.8	32.5	59 **
Needs personal assistance	501	7.5	342	11.6	158	4.3	31.7	57 **
Preparing meals	680	10.2	414	14.0	266	7.2	39.2	70 **
Needs personal assistance	493	7.4	341	11.5	153	4.1	30.9	56 **
Doing light housework, such as washing dishes or sweeping a floor	1,104	16.6	549	18.6	555	15.0	50.3	90
Needs personal assistance	792	11.9	460	15.6	332	9.0	41.9	75 **
Using the telephone	310	4.7	195	6.6	115	3.1	37.1	67 **
Unable to use	207	3.1	112	3.8	94	2.6	45.7	82
Number of IADLs for which personal assistance is needed:								
None	5,135	77.1	1,983	67.1	3,151	85.2	61.4	110 **
One or more	1,521	22.9	840	28.4	682	18.4	44.8	81 **
Only one	766	11.5	310	10.5	456	12.3	59.6	107
Two or more	766	11.5	530	17.9	236	6.4	30.8	55 **
Three or more	382	5.7	265	9.0	117	3.2	30.7	55 **
Needs personal assistance with an ADL or IADL	1,629	24.5	915	30.9	714	19.3	43.8	79 **
Assistive devices								
Does not use an assistive device	5,973	89.7	2,597	87.9	3,375	91.2	56.5	102
Uses a wheelchair	683	10.3	359	12.1	324	8.8	47.5	85 *
Does not use a wheelchair but has used a cane, crutches, or a walker for 6 months or longer	48	0.7	43	1.4	5	0.1	(6)	(6)

See footnotes at end of table.

Table 5.—Number and percentage distribution of adult disability benefit applicants[1] by final allowed/denied status through the reconsideration level of review, and selected program, demographic, and health characteristics—*Continued*

[Number in thousands]

Characteristic	Total		Status through reconsideration—				Denial rate and index	
			Allowed		Denied			
	Number	Percentage distribution	Number	Percentage distribution	Number	Percentage distribution	Rate	Index[2]
Medical condition								
Survey[3]*:*								
Mental	1,040	15.6	629	21.3	411	11.1	39.5	71 **
Musculoskeletal	1,721	25.9	564	19.1	1,157	31.3	67.2	121 **
Neurological or sense organs	439	6.6	266	9.0	174	4.7	39.5	71 **
Cardiovascular/respiratory	845	12.7	385	13.0	460	12.4	54.5	98
Other specified[8]	874	13.1	421	14.2	453	12.2	51.8	93
Not available	1,737	26.1	692	23.4	1,045	28.2	60.2	108
831:								
Mental	1,417	21.3	977	33.1	440	11.9	31.0	56 **
Musculoskeletal	1,989	29.9	454	15.3	1,535	41.5	77.2	139 **
Neurological or sense organs	850	12.8	456	15.4	394	10.6	46.3	83 **
Cardiovascular/respiratory	1,212	18.2	509	17.2	703	19.0	58.0	104
Other specified[9]	1,112	16.7	540	18.3	572	15.4	51.4	92
Not available	76	1.1	20	0.7	56	1.5	73.6	132
One or more overnight hospital stays in the last 12 months								
Yes	1,562	23.5	760	25.7	801	21.7	51.3	92
No	5,094	76.5	2,010	68.0	3,085	83.4	60.6	109 **
Housework disability status								
No housework disability	3,503	52.6	1,436	48.6	2,067	55.9	59.0	106
With a housework disability	3,153	47.4	1,521	51.4	1,633	44.1	51.8	93
Unable to do housework	638	9.6	428	14.5	209	5.7	32.8	59 **
Physical demands of past work								
Strength (narrow definition)[10]	809	12.2	391	13.2	418	11.3	51.7	93
Strength (broad definition)[11]	2,758	41.4	1,201	40.6	1,557	42.1	56.5	102
SSC (narrow definition)[12]	2,074	31.2	903	30.5	1,171	31.7	56.5	102
SSC (broad definition)[13]	3,114	46.8	1,363	46.1	1,751	47.3	56.2	101

[1] Matched applicants aged 18 or older at date of filing for benefits, applying for adult disability benefits, and interviewed in all 1990 SIPP panel health and disability modules. Excludes administrative and SGA denials and persons aged 68 or older at interview. Weighted using full panel weight with an adjustment for nonmatches.

[2] Denial rate associated with characteristic divided by the all applicant denial rate. A double star (**) indicates that the probability of the observed departure of the index from 100 is due to chance is less than .05; a single star (*) less than .10. Estimated variances derived using generalized variance parameters developed by Bye and Gallicchio (1993) for use with SIPP-based estimates dealing with Social Security and Supplemental Security Income beneficiaries.

[3] Persons of Hispanic origin may be of any race.

[4] As of last completed interview.

[5] Includes married, spouse absent.

[6] Less than 15 sample cases in row total; statistic not computed.

[7] Conditions reported as "causing" work limitation.

[8] Includes survey conditions classified as belonging to the following SSA body system categories: digestive, genitourinary, endocrine, immune system, and neoplastic diseases.

[9] Includes categories cited in footnote 8 as well as the categories for which no survey cases were observed (the hemic and lymphatic systems and skin disorders).

[10] Occupations with jobs requiring heavy or very heavy strength—lifting of 100 lbs. maximum, with frequent carrying of objects weighting up to 50 lbs.

[11] Occupations with jobs requiring medium strength—lifting of 50 lbs. maximum, with frequent carrying of objects weighting up to 25 lbs.

[12] Strength-stoop-climb measure generally consistent with a narrow definition of physically demanding work.

[13] Strength-stoop-climb measure generally consistent with a broad definition of physically demanding work.

Source: 1990 Survey of Income and Program Participation exact matched to SSA disability benefit applicant files for 1986–93.

Demographic Characteristics

Given the nature of the program and the general age profile of the disabled, it is not surprising that persons aged 45-64 (at the time of filing for benefits) are substantially overrepresented among the applicants, as compared to the nonaged adult population (57 and 29 percent, respectively). Forty-five percent of applicants report less than 12 years of schooling, a figure comparable to that for severely disabled nonaged adults (41 percent). On the other hand, less than 20 percent of the noninstitutional population aged 25-64 has completed less than 12 years of schooling. Not surprisingly, only about 6 percent of the applicants have completed 16 or more years of schooling; again, that is about the same percentage as for the nonaged severely disabled (8 percent). However, about 24 percent of the noninstitutional population aged 25-64 have completed at least 16 years of schooling.

The share of applicants residing in the southern States (33 percent) is about the same as for the general nonaged adult population (34 percent). Whites represent 84 percent of the general population aged 18-64 and blacks 12 percent. The racial composition of the population shifts according to disability status, with the share of whites declining somewhat and that of blacks increasing, such that among the nonaged severely disabled, 78 percent are white and 19 percent are black. Not surprisingly, the racial composition of the applicant group more closely resembles that of the severely disabled than that of the general population of similar age. Seventy-five percent of applicants are white and 22 percent black. About 10 percent of applicants are of Hispanic origin, about the same proportion as found in the general population of similar age (9 percent) as well as among the disabled and severely disabled (8 and 10 percent, respectively). In terms of the physical demands of the applicants' past work, the distribution of the applicant sample, as noted previously, is roughly similar to that for civilian workers in the United States as of 1980.

Health, Demographic Traits, and Determination Outcomes

Table 5 also gives distributions of applicants allowed and denied by the characteristics displayed in the table. The denial rate and a denial rate index[44] are given in the last two columns. In general, the variation of denial rates with respect to health and limitation measures is as would be expected, that is, the more severe the level of impairment or reduced functioning, the lower the denial rate. On the other hand, frequently the bivariate associations are not as marked as one might naively expect. This finding serves to underscore the need to treat the relationship between this body of data and the outcome of the application process in a multivariate context. It also likely reflects the fact that applicants, as a group, are among the most severely impaired of the disabled. As a result, they display relatively less dispersion in observed health status and levels of functioning than the full population of disabled. The remainder of our article deals with the conceptualization and empirical estimation of a multivariate approach to specifying the relationship between the application outcome and the body of available survey data. The difficulty presented by the special degree of impairment evident in the applicant group will be dealt with in subsequent work on modeling the application decision itself.

VI. The Structural Model

Since the inception of the DI program, one of the main objectives of SSA has been to adjudicate claims as consistently, expeditiously, and cost effectively as possible.[45] In principle, all disabled applicants should be allowed and the able applicants should be denied; however, as a result of imperfections in the determination process, inevitably some able applicants are allowed and some disabled are denied. Due to incomplete information, and the inescapably judgmental nature of the disability determination, the screening procedure induces a link between the allowance rates for the able and the disabled. Typically, reducing the allowance rate for the able would reduce the allowance rate and well-being of the disabled. Conversely, increasing the allowance rate of the disabled would also increase the allowance rate of the able, as well as the cost of the programs. As it should be with any knowledgable social welfare maximizing government agency, SSA tries to balance these two conflicting objectives (that is, allowing the disabled and denying the able) based on available measures of physical, mental, and vocational traits of applicants (see Nagi 1974; Parsons 1991; and Diamond and Sheshinski 1995).

The intuition behind the sequential process with interrelated decisions is that decisions made in later steps need not be made for all applicants. To some extent, costs are minimized by sorting—by making some determinations based solely on the medical criteria associated with the earlier stages. The categorical process of segregating types of decisions by their informational requirements was thought to be the rational approach to the problem of processing a large volume of claims expeditiously. As we have explained, SSA's disability determination process involves a sequence of five decisions, each with two homogeneous choices. The choices at a given stage are homogeneous in that they are based on a common decision criterion; in this respect, the choices at any specific stage are more similar than choices relating to different stages. For example, allowances based on the listings are quite different kinds of decisions than allowances based, in part, on vocational factors. Furthermore, the cost and time required to make a decision at each stage is quite different. Hence, the process is made more efficient by breaking down the decision into separate stages, each with distinct decision criteria. Given the nature of the process, this seems reasonable. For instance, in step 2 some applicants can be readily screened out based on obvious medical impairments without any additional information on their residual capacity or vocational factors. The sequential process provides an operational definition of disability that can be applied and replicated with uniformity throughout the Nation. Over the years, SSA has aggressively and successfully defended the sequential process, which has, in principle, been endorsed by Congress and the courts.

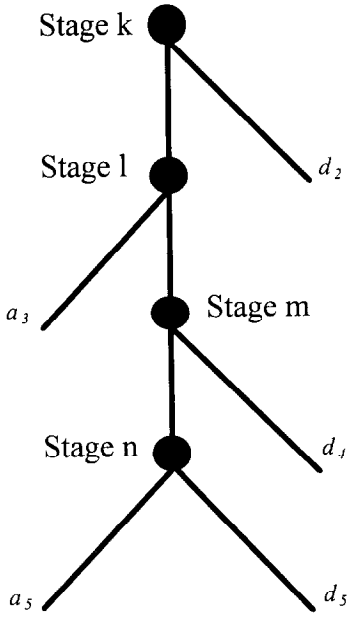
Under the determination process, then, each of the decisions involves two possible choices and the decisions made at different steps reflect distinct criteria. The estimating equations presented

below exhibit this structure. For each stage, based on applicants reaching that stage, we estimate how the *probability* of either outcome is affected by explanatory factors considered relevant to the decision criteria used at that stage. Thus, to some extent the factors affecting a decision at one stage are likely to differ from those at other stages.[46]

For the purpose of model development, steps 2, 3, 4, and 5 of the sequential disability determination can be diagrammed as a sequence of four binary choices, representing the chronological steps of the sequential determination:

The Disability Determination Process

Decision sequence



The last four steps of the determination process—which are implemented by DDS agencies and modeled here—include four decision nodes and five final outcomes, d_2, a_3, d_4, a_5, and d_5. The decision nodes are represented above as filled circles. As shown above, d_2 = denial at the second step (node 2) based on severity of medical impairments; a_3 = allowance at the third step (node 3) based on meeting listed impairments; d_4 = denial at the fourth step (node 4) based on residual capacity for past work; a_5 and d_5 are allowance and denial, respectively, at the fifth step (node 5) based on capacity for any other work in the economy. Of the decision nodes modeled, all except the last involve a *pass on* option as one of the choices at that step. Applicants passed on are allowed or denied at a later step. The indices (*k, l, m,* and *n*) denote the steps of the determination process, corresponding to decision nodes 2, 3, 4, and 5.

Since the decisions are made sequentially, the probability of a choice at a decision node can be taken to be independent of choices made at prior nodes. This gives rise to the sequential logit model that separates all choices into a series of conditional binary choices as diagrammed above. This results in considerable computational economy; see Amemiya (1975, 1985) and Kahn and Morimune (1979).

The outcome at each stage can take on one of two possible values, denoted by 1 and 0. For convenience, for each of the stages—*k*, *l*, *m*, and *n*—the value "1" will always indicate the more favorable outcome from the standpoint of the applicant, that is, either an allowance (at stages *l* and *n*) or a pass on (at stages *k* and *m*) to the next stage. Conceptually, in each step DDS examiners evaluate applicants in terms of an underlying latent index. In steps 2 and 3, the index relates to medical severity, whereas in later steps applicants are rated in terms of their ability to perform basic work-related functions. At each step, a particular outcome is obtained whenever the evaluated index exceeds (or falls short of) a pre-assigned "threshold" which is the same for all individuals. Suppose W_k, X_l, Y_m, and Z_n are the sets of explanatory variables and α, β, γ, and δ are the corresponding parameter vectors that are used to evaluate the index at the four stages. The probabilities of different outcomes at the four stages can be represented mathematically. The probability of a denial at the second stage can be written as:

$$P_{k=0} = Pr(d_2) = [1 - F(\alpha' W_k)], \quad (1)$$

where $P_{k=0}$ is the probability of being denied at step 2 (that is, stage *k* in the schematic diagram above) based on a logit regression: that is, logit $(P_{k=0}) = \log_e(P_{k=0}/(1 - P_{k=0})) = \alpha' W_k$, and $F(\alpha' W_k) = \exp(\alpha' W_k) / (1 + \exp(\alpha' W_k))$ (see Maddala 1985, p. 22). Similarly,

$$P_{l=1|k=1} = Pr(a_3) = F(\alpha' W_k) F(\beta' X_l), \quad (2)$$

where $P_{l=1|k=1}$ = the probability of being allowed at stage 3 (or *l* in our notation) conditional on not being denied at stage 2 (node *k*), and $F(\beta' X_l) = \exp(\beta' X_l)/(1+ \exp(\beta' X_l))$. Likewise,

$$\begin{aligned} P_{m=0|k=1,l=0} &= Pr(d_4) \\ &= F(\alpha' W_k)[1 - F(\beta' X_l)][1 - F(\gamma' Y_m)], \end{aligned} \quad (3)$$

where $P_{m=0|k=1,l=0}$ is the probability of being rejected at stage 4 (node *m*) conditional on not being rejected at step 2 (node *k*) and not being allowed at stage 3 (node *l*), and $F(\gamma' Y_m) = \exp(\gamma' Y_m)/(1+ \exp(\gamma' Y_m))$. Finally,

$$\begin{aligned} P_{n=1|k=1,l=0,m=1} &= Pr(a_5) \\ &= F(\alpha' W_k)[1 - F(\beta' X_l)] F(\gamma' Y_m) F(\delta' Z_n), \end{aligned} \quad (4)$$

where $P_{n=1|k=1,l=0,m=1}$ is the probability of being allowed in the last stage (node *n*) conditional on three contingencies—not denied at stage *k*, not allowed at stage *l*, and not denied at stage *m*. As before, $F(\delta' Z_n) = \exp(\delta' Z_n)/(1+ \exp(\delta' Z_n))$. The corresponding probability of being denied at this stage can be expressed as:

$$\begin{aligned} P_{n=0|k=1,l=0,m=1} &= Pr(d_5) \\ &= F(\alpha' W_k)[1 - F(\beta' X_l)] F(\gamma' Y_m)[1 - F(\delta' Z_n)]. \end{aligned} \quad (5)$$

We estimate parameter vectors α, β, γ, and δ sequentially over surviving subsamples. That is, the parameter vector α is estimated based on the entire sample by dividing it into two groups: all applicants denied because their impairments were not severe enough (outcome variable equals 0) and all applicants who passed on to the next step for further evaluation (outcome variable equals 1). The β vector, corresponding to stage 3 outcomes, can be estimated from the subsample of applicants who were found to have severe impairments at stage 2. To do this, the remaining sample is divided into two groups: all applicants allowed due to meeting the medical listings (at stage 3) and those not allowed, but passed on to stage 4 for further evaluation of vocational factors. An analogous procedure is used for vectors γ and δ. The successive sample splits representing the outcome at each step of the determination process are based on the SSA Regulation Basis code as described in section V. Note that the probability that an applicant with a set of characteristics will be eligible for disability benefits can simply be obtained as $\Pr(a_3) + \Pr(a_5)$.

It should be emphasized that even though the process is overtly sequential, the choices are not ordered in terms of any single underlying severity index of disability. For instance, the choices d_4, d_5 and a_5 are based on past occupation, education, age, and other vocational factors that are not directly related to a single "index of disability" in a monotonic way. Only d_2 and a_3 can unequivocally be ordered in terms of a single latent severity index (see chart 2).

In order to estimate the eligibility probability for an applicant, one needs to generate the outcome probabilities at each stage of an essentially discontinuous nonlinear process. Unfortunately, this point seems not to have been appreciated in much of recent research on the economic effects of disability. Disability determination has been modeled simply as the manifestation of one underlying index of severity and is expressed as a function of health and other factors. See, for instance, Halpern and Hausman (1986); Stern (1989); Haveman, Wolfe, and Huang (1989); Haveman, de Jong, and Wolfe (1991); and Kreider (1994a). The treatment of disability status in this body of research may be adequate in studying labor supply behavior, but it cannot be appropriate in the analysis of the determinants of disability program growth, the effect of eligibility probabilities on application behavior, or, more generally, the derivation of estimates of the number of persons eligible under SSA's disability criteria but not currently participating in the DI or SSI programs. See Bound (1989); Oi and Andrews (1992); and Loprest, Rupp, and Sandell (1995) for more discussion on a similar issue.

VII. Empirical Results

Overview

The purpose of our current empirical analysis is to see how well the health, disability, work history, and other socioeconomic information from the SIPP surveys can explain the outcomes of the determination process, based on a sample of SIPP records exact-matched to SSA disability applications records. We know that different sets of variables should be relevant in explaining the outcomes of different steps.[47] For example, steps 2 and 3 of the determination process are fundamentally medical in nature.[48] By contrast, determinations made in the last two steps start by assuming a severe medical impairment which, however, does not meet the listings, and proceed to an evaluation of the claimant's residual functional capacity to do past work or other work, based on the consideration of age, education, and prior work experience. On the other hand, determinations at steps 2 and 3 should not be directly affected by age, education, or occupation. Thus, the explanatory power of a particular variable can be appropriately ascertained only if it is introduced at the appropriate stage. This is an important point because researchers in this area have found very little predictive power of health-related survey data in explaining final disability application outcomes.[49]

Results for Step 2

Step 2 of the determination process, following the SGA assessment, involves the severity of claimed medical impairments. As we have discussed, an applicant is denied at this step if the impairment (or a combination of impairments) is not severe, judged in terms of a battery of work-related physical, mental, and sensory limitations. The main purpose of this step of the sequential process is to screen out the obviously nonsevere cases promptly so that the time and cost of processing these applicants are minimized.[50]

The dependent variable of our step 2 logit regression assumed the value 1 if the applicant was passed on to the next step for further evaluation, and 0 if denied. Since this is the first step modeled, we are using the whole sample of 1,230 applicants. The results are given in table 6.[51] As evidenced by the column "t-ratio," our reported regression equation contains only variables with absolute t-ratios exceeding 1.645; variables not meeting this criterion were dropped in the final run.

We find that individuals having three or more severe ADLs (SAL36), one or more severe IADLs (SIL13), poor health (T8800W6E), a work limitation due to the presence of a mental condition (MEDGRP31), a work limitation but able to do prior work (WORKV2D2), a reported inability to work in at least two of the four interview waves (TDIREP12), and reporting no work experience because of a disability (T8338W2D) are more likely to be passed on to the next step—that is, the signs of the parameter estimates are positive. While IADLs had the expected effect in general, one IADL variable—needs help in getting around the house (T8840W3D)—did increase the chance of denial very substantially. As expected, individuals reporting good health (T8800W6B), a work limitation but able to work occasionally or irregularly (WORKV1D3), and a work limitation of less than 12 months duration (WPRVDUD1) have a higher probability of being denied. The role of the last variable is particularly noteworthy in view of the fact that all successful applicants at this step should meet the duration test, which stipulates that the impairment should have lasted at least 12 months or be expected to last at least 12 months or until death. We also find that applicants who reported having a work disability due to an accident (T8326W2D) are more likely to be denied. This could be due to

the fact that accident victims are often counseled by hospitals to apply for disability, although many do not meet the duration or severity criteria. Halpern and Hausman (1986) found a similar negative effect of the accident variable, but it was not significant at the 10 percent level.

Many researchers have pointed out that individuals' survey responses to questions about work limitations may have significant reporting bias because they may be influenced by work preferences and participation in welfare programs.[52] In addition to the use of a number of more objective measures of health status such as the presence of severe ADLs (SAL36) or severe IADLs (SIL13), we have also used a number of rather subjective health status variables including health status very good (T8800W6B), health status poor (T8800W6E), and inability to work in at least two of the four interview waves (TDIREP12). Kreider (1994b) presented evidence that the reporting bias between beneficiaries and rejected applicants is not substantially different. However, he found a significant difference in reporting bias between applicants and nonapplicants. Thus, the use of these variables becomes more of a problem in the characterization of application behavior than in the estimation of an eligibility model that involves only applicants.

We find that applicants whose cases were adjudicated in 1990 and had recent work experience (WORK90C) tend to be denied. These are mostly DI and concurrent applicants. Concurrent applicants—those applying simultaneously for both DI and SSI—necessarily meet the recent work requirements of disability insured status. This finding is consistent with the longstanding observation that recessionary times induce disability applications by some who may have impairments of dubious severity.[53] Conceivably, at the height of the last recession (which officially lasted from July 1990 to March 1991) some who were out of work, with unemployment and health insurance benefits running out, may have found enrolling in a disability program an attractive alternative, even if only marginally impaired.[54] If applicants with marginal (nonsevere) impairments were more likely to be represented among those with recent work experience in the recessionary period than during other adjudication years included in our study, it is plausible that such an applicant subgroup would experience a higher denial rate, as indicated by our results.[55] It also is interesting to point out that no such time dummy variable representing the recession years played a role for people without recent work experience (that is, mostly SSI). This result is consistent with the evidence reported by Rupp and Stapleton (1995) that the recent recession affected the DI and concurrent applicants more than SSI applicants.

The regression results show that a few demographic variables (age, gender, race, and region), which are not intended to play a role in this step of the adjudication process, are associated with the likelihood of being found severely disabled. Determination outcomes at subsequent steps in the sequential process are also found to be related to gender (steps 4 and 5), age (step 3), and marital status (steps 3 and 4). These factors also do not have a formal role under the criteria used at these points in the sequential determination process. Nominally, of course, the effects of these variables are net of health and impairment status of the applicants

Table 6.—Logit regression results for the sequential model: Step two of the SSA disability determination

Variable description	Project mnemonic	Variable mean [1]	Parameter estimate	Standard error	t-ratio	Odds ratio	$Pr[y=1 \mid x_i=0]$ [2]	Marginal effect [3]
With recent work experience and disability determination occurred in 1990	WORK90C	0.0862	-0.6736	0.2573	-2.618	0.51	0.866	-0.099
Three or more severe ADLs, wave 6	SAL36	.0366	1.4710	.6659	2.209	4.35	.852	.110
One or more severe IADLs, wave 3	SIL13	.1675	.8034	.3170	2.534	2.23	.842	.081
Prevented from working (wave 2) and never able to work at a job	T8338W2D	.0382	1.4698	.7571	1.941	4.35	.852	.110
Gender (male)	SEXD	.4805	.4546	.1661	2.737	1.58	.830	.055
General health status very good (wave 6)	T8800W6B	.1179	-.4587	.2271	-2.020	.63	.865	-.063
General health status poor (wave 6)	T8800W6E	.2780	.3869	.2136	1.811	1.47	.845	.044
White—south (Black/other and north in base)	RACESTDA	.2081	-.5792	.2557	-2.265	.56	.873	-.079
White—north (Black/other and south in base)	RACESTDB	.5179	.5037	.2363	2.132	1.66	.824	.062
Black—south (White/other and north in base)	RACESTDC	.1244	-.9822	.2709	-3.626	.37	.873	-.153
Work limited because of mental condition	MEDGRP31	.1366	.6879	.3072	2.239	1.99	.847	.070
Reports inability to work in at least 2 waves	TDIREP12	.5309	.4654	.1983	2.347	1.59	.826	.057
Work limiting condition caused by accident	T8326W2D	.1813	-.4459	.2107	-2.116	.64	.868	-.060
Aged 18-34 (35 plus in base)	AGE12	.2268	-.3820	.1874	-2.038	.68	.869	-.050
Work limited less than 12 months	WPRVDUD1	.0984	-.5152	.2786	-1.849	.60	.865	-.072
Needs help in getting around the house	T8840W3D	.0333	-1.4339	.5587	-2.566	.24	.864	-.261
Work limited, but able to do prior work (both in wave 2)	WORKV2D2	.0715	1.1481	.3876	2.962	3.15	.848	.098
Work limited, but able to work occasionally or irregularly	WORKV1D3	.0260	-.8573	.4429	-1.936	.42	.859	-.011

Note: Sample total=1,230. Passed on to step 3=1; n=1,007, p=0.82. Rejected=0; n=223; p=0.18. Pseudo-R^2=0.23; gamma=0.48. Absolute t-values of all variables exceed 1.645.

[1] Proportion of the sample adjudicated at this step having the specified attribute.

[2] The probability of a favorable outcome, with all variables except for the one of interest evaluated at their means and the variable of interest evaluated at 0.

[3] Change in the probability of being passed on to step 3 due to the introduction of a given variable, with all other variables measured at their mean values.

because we have included the relevant survey variables in our models. However, it should also be obvious that the survey health measures we are employing provide an imperfect representation of actual criteria that SSA uses to reach its determinations. Thus, there may be significant unmeasured variation in the level of impairment relevant to the SSA determination across these demographic groups and it may be this unmeasured variation and not the groups' attributes per se that are responsible for the differential outcome probabilities. Of course, alternative explanations are also possible.[56] Two GAO (1992, 1994) reports found that, for the most part, the racial and gender differences in the crude allowance rates could be explained by differences in age, types of impairment, occupation, and demographic characteristics. Lando's (1976) research of some years ago found age, educational attainment, and higher application rates among blacks accounted for racial differences in overall allowance rates. As our research progresses, we will direct a good deal more effort toward clarifying the roles of these variables.[57]

We uncovered region and race effects by combining dummy variables related to each. The region variable took the value 1 if the applicant currently resided in any one of the 12 southern States (Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, South Carolina, Texas, Virginia, Kentucky, North Carolina, and Tennessee) and 0 otherwise. The race dummy was defined as 1 if the applicant was white and 0 for all others. We found that the probability of being denied based on medical severity is maximum for nonwhite/southern (RACESTDC) applicants, followed by white/southern (RACESTDA), nonwhite/northern (RACESTDD) and white/northern (RACESTDB) applications. Marvel (1982) has discussed differences in the administrative practices across States, which may explain some of these results. However, as just noted, we also believe that much of these effects could be due to unmeasured factors. Different regions of the country have different economic circumstances that drive applications and thereby produce differing mixes of more and less severely disabled among the regional applicant groups. Thus, unless we develop a structural model of application behavior, the real underlying reasons behind these region and race effects cannot be identified.

In table 6 we have also presented the odds ratios and the marginal effects associated with each explanatory variable. These two measures are alternative ways to judge the relative importance of individual variables.[58] We find that applicants with three or more severe ADLs or those prevented from working and reporting never having been able to work (both variables have an odds ratio of 4.35) are, all else equal, least likely to be denied. Among the variables having relatively large positive marginal effects are: being prevented from working and never have been able to work at a job (T8838W2D), having three or more severe ADLs (SAL36), reporting work a work limitation but able to do prior work (WORKV2D2), and having one or more severe IADLs (SIL13). Needing help in getting around the house (T8840W3D), residence in a southern State (RACESTDA and RACESTDC), and having recent work experience and a 1990 determination (WORK90C) are among those with the largest negative impacts.

The overall explanatory power of the model's independent variables is quite good. One measure of goodness of fit is the pseudo-R^2, which has the same type of interpretation as the ordinary least squares R^2 in a linear regression model.[59] The value was calculated to be 0.23, which implies that approximately 23 percent of the variation of the underlying latent dependent variable is explained by the explanatory variables of the estimated model. In addition, the Goodman-Kruskal Gamma measure of rank correlation between the observed outcomes and the predicted probabilities provides an indication of the predictive ability of the estimated model.[60] The gamma value for the stage 2 estimation is 0.48, which seems to be quite satisfactory by current standards of empirical logit models.

The percentage of correct classifications, based on a 0.50 decision criterion,[61] was a little over 80 percent. Comparison of estimated outcomes with observed outcomes would suggest that the model overstates the proportion of applicants passed on to step 3 (96.9 percent estimated *vs.* 81.9 percent observed). While we have serious doubts about classifications based on the 0.50 criterion, this finding did lead us to question how we had formulated the explanatory variables we employed in step 2. We tended to employ the available health measures from the survey to identify applicants with high levels of impairment (having multiple ADLs or IADLs, being prevented from working and so forth). On the other hand, the decision process in step 2 focuses on the identification of persons who are not severely disabled. Consequently, we intend to reformulate our step 2 explanatory variables to represent applicants presenting low levels of reported impairment in our future work in the expectation of obtaining a more valid representation of program criteria with the existing survey variable set. In addition, review of the available survey data items suggests that more comprehensive information from the survey for date of onset of functional limitations, ADLs, and IADLs (date of onset is currently available only for persons reporting work limitations) would also likely improve the model's ability to identify denials tied to the 12-month duration requirement.

Results for Step 3

Step 3 of the sequential process involves assessment of the severity and nature of an applicant's impairment(s), based on a detailed list of medical standards, the listings. This step is particularly noteworthy because over 60 percent of all allowances are based on impairments that meet or equal a listing. The purpose of this step is to allow expeditiously only those applicants whose impairments are so pathological that allowance is appropriate immediately without further evaluation on the basis of vocational factors. Out of a total sample of 1,230, 223 applications (18.1 percent) were denied in step 2, leaving a sample of 1,007 at step 3. Of these, 359 (35.7 percent) were allowed at this stage. The health and disability related survey data used here were not specifically designed to estimate eligibility under SSA codified medical standards. Thus, how well the survey disability information can be used to explain step 3 allowances becomes an empirical question.

In table 7 we have reported logit regression results for step 3, which contains a total of 17 explanatory variables with t-ratios exceeding 1.645 in absolute value. A number of variables on

health and activity limitations, including having two or more severe ADLs (TAS12W6D), having at least two IADLs (TIL12W3D), needing help doing house work (T8859W6D), having a work limitation together with difficulty walking up stairs (WUPCNW6D), and needing help in getting around inside the home (T8840W3D), contribute positively towards the probability of an allowance. Applicants reporting work limitations due to musculoskeletal conditions (MEDGRP32) tend to be passed on to the next stage (odds ratio 0.60) whereas those reporting work limitations due to sensory/neurological conditions (MEDGRP33) tend to be allowed more often at this stage (odds ratio 1.94). Our finding that persons reporting musculoskeletal impairments are less likely to be awarded benefits at stage 3 of the adjudication process is consistent with a range of studies conducted over the past three decades (GAO, 1989; Nagi, 1969b; Parsons 1994). We found the odds ratio for applicants with two or more mental conditions (TDI12W3D) to be 3.55. Throughout our analysis, the presence of a reported mental impairment turned out to be the most consistent health-related variable explaining allowances. Applicants who reported an overnight hospital stay during the last 12 months (T9100W3D) also had a higher probability of being allowed. We speculate that the hospitalization variable reflects variation in the severity of impairments that is not captured by the overt survey health measures.

There are a number of variables—for example, age 55 or older (AGE56), unable to walk one-fourth mile (T8832W3D), reports work limitation and has difficulty lifting 10 pounds (LFTCNW6D), reports work limitation caused by an accident (T8326W2D), and needs help in getting out of bed or chair (T8848W3D)—that contribute negatively towards allowances. Superficially, the negative finding for the two functional limitation variables (LFTCNW6D and T8832W3D) and the ADL variable (T8848W3D) seems anomalous. Other things being equal, the presence of such limitations would seem to indicate a more severe level of impairment and, thus, might be predictive of an allowance on the basis of a medical listing. However, it is worth remembering that there are no denials at this step; an applicant is either allowed or evaluated further in terms of residual functional capacity. Given these outcomes, it seems plausible that while some activity limitations increase the probability of an allowance, others may play a role in identifying applicants that, in SSA's judgment, warrant further evaluation.

Perhaps the major finding relating to this stage is that activity limitations, medical events, and medical conditions are key explanatory variables. This might be expected, because at this step the DDS judges whether the applicant's impairment meets or equals the medical listings. However, earlier researchers, using models that do not reflect the structure of the determination process, do not find these consistent effects for activity limitations and medical variables.

We also find that the variable never married (MSF) contributes positively towards allowances (odds ratio 1.50). Again, we

Table 7.—Logit regression results for the sequential model: Step three of the SSA disability determination

Variable description	Project mnemonic	Variable mean [1]	Parameter estimate	Standard error	t-ratio	Odds ratio	Pr[y=1| x_i=0] [2]	Marginal effect [3]
At least 1 overnight hospital stay in last 12 months	T9100W3D	0.2294	0.3123	0.1682	1.857	1.37	0.325	0.072
Reports at least two mental conditions (wave 3)	TDI12W3D	.0189	1.2672	.5327	2.379	3.55	.336	.306
Has two or more severe ADLs, (wave 6)	TAS12W6D	.0725	.6326	.3332	1.899	1.88	.331	.151
Has at least two IADLs (wave 3)	TIL12W3D	.1380	.4722	.2444	1.932	1.60	.327	.111
With recent work experience and disability determination occurred in 1991	WORK91C	.1142	.4286	.2206	1.943	1.54	.330	.101
With recent work experience and disability determination occurred in 1992	WORK92C	.1410	.4321	.1995	2.166	1.54	.327	.101
Never married	MSF	.1927	.4035	.1804	2.237	1.50	.324	.094
Work limiting condition caused by accident	T8326W2D	.1768	-.6039	.2218	-2.723	.55	.365	-.126
Aged 55 or older (18–54 in base)	AGE56	.3148	-.2642	.1598	-1.653	.77	.360	-.058
Work limited because of musculoskeletal condition	MEDGRP32	.2314	-.5087	.2063	-2.466	.60	.368	-.109
Work limited because of sensory/neurological condition	MEDGRP33	.0735	.6599	.2764	2.387	1.94	.330	.158
Unable to walk 3 city blocks	T8832W3D	.1778	-.4162	.2039	-2.041	.66	.358	-.089
Needs help in doing light house work	T8859W6D	.1241	.6176	.2564	2.409	1.85	.324	.147
Has difficulty lifting 10 lbs. and reports presence of work limitation (both in wave 6)	LFTCNW6D	.3932	-.5515	.2016	-2.736	.58	.391	-.121
Has difficulty walking up stairs and reports presence of work limitation (both in wave 6)	WUPCNW6D	.4022	.4910	.1938	2.534	1.63	.298	.112
Needs help in getting out of bed or chair	T8848W3D	.0487	-.9112	.4848	-1.880	.40	.351	-.172
Needs help in getting around inside the home	T8840W3D	.0328	.9409	.5201	1.809	2.56	.334	.228

Note: Sample total=1,007. Awarded benefits=1; n=359; p=0.36. Passed on to step four=0; n=648; p=0.64. Pseudo-R^2=0.19; gamma=0.42. Absolute t-values of all variables exceed 1.645.

[1] Proportion of the sample adjudicated at this step having the specified attribute.

[2] The probability of a favorable outcome, with all variables except for the one of interest evaluated at their means and the variable of interest evaluated at 0.

[3] Change in the probability of being awarded a benefit in step 3 due to the introduction of a given variable, with all other variables measured at their mean values.

feel that this variable is likely picking up a number of unmeasured dimensions of impairment severity, which our model specification has failed to capture. Specifically, in the case of marital status, we conjecture that the never married state may reflect that the most severely impaired are less likely to be married.

Note that WORK91C and WORK92C (1991 and 1992 year dummies crossed against applicants having recent work experience) are positive and increase the odds for an allowance. Interestingly, WORK90C had a positive effect on denials in stage 2. We argued that many marginally impaired workers, after being laid off, tend to apply for benefits and tend to be denied at step 2. However, there are many individuals with severe physical and mental impairments who continue to work successfully. During high unemployment periods, this is the group of workers who, if laid off, can potentially apply for disability benefits and can qualify. When unemployment is low, employers are more inclined to accommodate employees' health problems, rather than to seek and train new workers to replace them. Based on a rather small sample, Brehm and Rush (1988) estimated that about 1 in 8 men had an impairment that met or equaled SSA's medical listings and yet continued to work even 4 years after the disabling condition. WORK91C and WORK92C may reflect the presence of applicants drawn from this latter group of people.[62] For more discussion on this point see Stapleton et al. (1995).

The overall explanatory power of this equation was again quite good. The pseudo-R^2 was 0.19 and the Gamma coefficient was 0.42. The percentage of correct classifications, based on a 0.50 cutoff point, was 66.9 percent; our model predicted a total of 168, compared with 359 actual allowances. As in stage 2, the model tends to pass on more applications to the next stage, implying that our estimated model can be improved if better information on the severity of medical impairments were available.

Results for Step 4

Step 4 of the process involves an evaluation of the applicant's residual functional capacity to meet the requirements of past work. In evaluating the residual functional capacity, physical, mental, and other limitations are considered. Out of 648 applicants passed on to this stage, 188 (29 percent) were denied; the remaining applicants were passed on to the final step in which their ability to do any work is considered. The regression estimates, mainly involving explanatory variables with program-specific underpinnings, are reported in table 8.

Most of these variables related to the applicant's past work. Lack of recent work experience (NOWORKD) increases the likelihood of being passed on to the next step with an odds ratio of 2.16. This finding is quite appropriate given that step 4 involves the assessment of applicants' ability to perform past work, and that persons lacking recent work experience are appropriately evaluated in step 5. The presence of a mental condition (MENTDISD) also adds to the probability of being passed on to the subsequent stage (odds ratio 1.69 and a marginal effect of 0.096). As expected, applicants who used to work in physically demanding jobs (SIPPOCC4) are more likely to be found unable to do their previous work and are passed on to stage 5. Similarly, those unable to lift 10 pounds but who used to work in very physically demanding jobs (NSTRLIFT) also had a higher probability of being passed on. On the other hand, the variables WORKV2D2 (work limited but reported to be able to perform past work) and OCCSIPP3 (principal prior occupation in sales and service) add noticeably to the odds of being denied. Another variable increasing the probability of denial—work limitation and difficulty lifting and carrying 10 pounds. (LFTCNW6D)—involves activity limitations but is not linked to information on the demands of past work. The signs of these variables seem reasonable in that they reflect judgments about applicants who, though impaired, are nevertheless found able to do their past work.

As in the previous stage, people who reported being never married (MSF) tend to be passed on to the next stage rather than to be denied. Once again, this result suggests that our specification is incomplete; MSF is likely picking up the effects of other unspecified factors. One of the four region/race variables, white/northern (RACESTDB) also increased the probability of denial.

The predictive power of the step 4 logit regression, although lower than for the other steps, appears acceptable. The pseudo-R^2 was estimated to be 0.14, and the gamma measure for model fit was 0.39. The percentage of correctly classified predictions was nearly 73 percent. As with the previous stages, the estimated model identified relatively more applicants as being passed on. Concomitantly, the estimated proportion denied is understated.

Results for Step 5

At stage 5, the applicant's age, education, and work experience, in conjunction with an analysis of residual functional capacity, are used to determine whether he or she can do any work in the economy. All applicants are either allowed or denied at this stage. The regression results are presented in table 9. Out of 460 applicants who were referred to this stage, 213 (46.3 percent) were allowed and 247 (53.7 percent) were denied.

The variables we found to have notable positive effects on the probability of allowance are aged 55 or older (AGE56), work or activity limitation caused by mental condition (MENTDISD), prior work required lifting 50 pounds (SIPPOCC4), unable to work (WORKV1D4), and under age 35 and has a mental condition (YONDMENT). Of these, AGE56 is the most dominant variable, with an odds ratio of 11.7 and a marginal effect of 0.542. It is noteworthy that many of the younger applicants (under age 35) allowed at this stage have mental conditions and that this circumstance was handled well by the survey indicators of mental impairment. This group is likely to include younger applicants for SSI benefits who have developmental disabilities involving a mental handicap. This finding is consistent with research showing more generally that mental health affects several labor market outcomes of younger people (Mullahy and Sindelar 1993). Unlike in the two previous stages, males (SEXD) seem to have smaller odds of being allowed than females on the basis of their capacity to do any work. As in the case of some of the demographic factors found to be related to outcomes in other steps of the decision process, this gender effect may well reflect the un-

measured influences of other factors, both those included in the current model, as well as those of omitted variables.

Factors that were found to have a negative effect on allowances were being able to work only occasionally or irregularly (WORKV1D3), having one or more severe functional or ADL limitations and being under age 55 (FLADLEDY), and having no severe functional limitations, no ADLs and under age 55 (NFLADLYD). The latter variables were developed for the stage 5 model to reflect, within the constraints imposed by our data, the structure of the so-called vocational grid tables (CFR 20, Chapter 3, Part 404, Subpart P, Appendix 2).[63] In general, the survey variables do play roles consistent with the basic intent of step 5 of the determination process.

In addition, three year dummies for 1988, 1991, and 1992 were strongly positive, indicating that applications reaching step 5 were more likely to result in allowances if the adjudications took place in these years.[64] We cannot fully account for a tendency towards higher allowance rates at step 5 for decisions rendered in these particular years. Over the 8 years considered in this study, the disability programs were subjected to many different influences. Most dramatic was the substantial increase in the number of applicants, increases that became particularly noticeable and sustained beginning in 1991. During the middle and later 1980's the institutional milieu of the adjudication process was affected by a number of important developments. SSA experienced a 20-percent reduction in staff between 1985 and 1989. The State

Table 8.—Logit regression results for the sequential model: Step four of the SSA disability determination

Variable description	Project mnemonic	Variable mean[1]	Parameter estimate	Standard error	t-ratio	Odds ratio	Pr[y=1| x_i=0][2]	Marginal effect[3]
Any one of five mental disabilities reported or a mental condition reported as causing a work or activity limitation	MENTDISD	0.2191	0.5251	0.2401	2.187	1.69	0.706	0.096
Unable to lift 10 lbs., and prior work was very physically demanding using strength stoop, climb criteria	NSTRLIFT	.0756	.7042	.4077	1.727	2.02	.719	.119
No recent work experience	NOWORKD	.2130	.7717	.2703	2.855	2.16	.696	.136
Work limited, but able to perform prior work (both in wave 2)	WORKV2D2	.0864	-.7796	.3095	-2.519	.46	.743	-.173
Principal occupation of prior work was in sales or service	OCCSIPP3	.1883	-.7721	.2376	-3.250	.46	.757	-.167
Never married	MSF	.1590	.7055	.2963	2.381	2.03	.707	.123
Prior work physically demanding according to broad strength, stoop, climb criteria	SIPPOCC4	.4630	.5974	.2171	2.752	1.82	.672	.116
Has work limitation and has difficulty lifting and carrying 10 lbs.	LFTCNW6D	.3980	-.4542	.1909	-2.379	.64	.764	-.091
White—north (Black/other and south in base)	RACESTDB	.5679	-.4121	.1894	-2.176	.66	.773	-.080

Note: Sample total=648. Passed on to step 5=1; n=460; p=0.71. Denied benefit =0; n=188; p=0.29. Pseudo-R^2=0.14; gamma=0.39.
Absolute t-values of all variables exceed 1.645.

[1]Proportion of the sample adjudicated at this step having the specified attribute.

[2]The probability of a favorable outcome, with all variables except for the one of interest evaluated at their means and the variable of interest evaluated at 0.

[3]Change in the probability of being passed on to step 5 due to the introduction of a given variable, with all other variables measured at their mean values.

Table 9.—Logit regression results for the sequential model: Step five of the SSA disability determination

Variable description	Project mnemonic	Variable mean[1]	Parameter estimate	Standard error	t-ratio	Odds ratio	Pr[y=1| x_i=0][2]	Marginal effect[3]
Aged 55 or older (18–54 in base)	AGE56	0.3217	2.4594	0.3222	7.633	11.70	0.273	0.542
Gender (male)	SEXD	.5239	-.6585	.2457	-2.680	.52	.539	-.162
Disability determination occurred in 1988	SSAY88D	.0609	.9238	.4900	1.885	2.52	.439	.224
Disability determination occurred in 1991	SSAY91D	.1239	.6803	.3751	1.814	1.97	.432	.168
Disability determination occurred in 1992	SSAY92D	.1652	.7835	.3158	2.481	2.19	.421	.193
Mental condition is cause of work or activity limitation	MENTDISD	.2413	1.0304	.3174	3.246	2.80	.392	.252
Prior work physically demanding according to broad strength, stoop, climb criteria	SIPPOCC4	.4826	.4838	.2588	1.869	1.62	.396	.119
Able to work only occasionally or irregularly (wave 2)	WORKV1D3	.0304	-1.9553	.9044	-2.162	.14	.468	-.357
Unable to work (wave 2)	WORKV1D4	.4848	.5135	.2578	1.992	1.67	.392	.127
Under age 35 and has a mental condition	YONDMENT	.0717	1.4840	.5077	2.923	4.41	.427	.340
Has one or more severe functional or ADL limitations, has more than 12 years of education, under age 55	FLADLEDY	.4304	-.6467	.2612	-2.476	.52	.522	-.158
No severe functional limitation, no ADL, under age 55	NFLADLYD	.3630	-.6019	.3077	-1.956	.55	.507	-.147

Note: Sample total =460. Allowed=1; n=213; p=0.46. Denied benefit =0; n=247; p=0.54. Pseudo-R^2=0.44; gamma=0.68.
Absolute t-values of all variables exceed 1.645.

[1]Proportion of the sample adjudicated at this step having the specified attribute.

[2]The probability of a favorable outcome, with all variables except for the one of interest evaluated at their means and the variable of interest evaluated at 0.

[3]Change in the probability of being awarded a benefit in step 5 due to the introduction of a given variable, with all other variables measured at their mean values.

Disability Determination Services experienced similar reductions in personnel (HRCWM, 1994, section 2). Significant changes in adjudication criteria were introduced through congressional action and court review of SSA procedures during roughly the same period. In the late 1980's, SSA put in place a more vigorous outreach effort, particularly with regard to the SSI program. Changes in State and local programs may have increased incentives to apply for DI and SSI as well. The effects of the economic downturn of the early 1990's, and the longer term structural changes in the job market adversely affecting low-skilled workers, occurred in the context of these prior events. Our evidence suggests that the economic downturn may have had a significant effect on the growth in applications that appeared after 1990. As noted earlier, it might have changed the mix between more severely and less severely disabled applicants as well. Other things being equal, this would have had an effect on allowance rates. Although the latest recession lasted officially from July 1990 to March 1991, its adverse effect on the employment situation, like most recessions, continued for a much longer period. Also, as Burkhauser, Haveman, and Wolfe (1993) have shown, the more vulnerable sections of the labor force, like the disabled and minorities, take the longest to recoup the ground they lose during a recession.

The interactions among all of these factors are necessarily highly complex and regretably little understood. Despite our inability to lay out specific linkages, it seems reasonable that the interaction of the effects of the recession, large increases in the number of applicants, reduced staffing levels, and changes in the adjudicative climate and institutional accommodations to this combination of forces, would appear in our estimates in terms of year-specific effects on adjudication outcomes. Furthermore, it is worth noting that it is the final step in the determination process, involving the vocational grid, that seems most sensitive to such effects (although, as discussed above, we found evidence of year-specific effects at stages 2 and 3 for recent workers). As we bring additional variables to bear in our future modeling work, we hope to better clarify these year effects.

Summing up, the model fit for stage 5, in our evaluation, was excellent. The pseudo-R^2 was 0.44 and the gamma coefficient was estimated to be 0.68. The percentage of correct classifications was 74.1 percent; the estimated model correctly identified 145 of the 213 allowances and 196 of 247 denials. Thus, the observed and predicted distributions of the sample between allowances and denials were quite similar.

Structural Model Versus Reduced Form Model

We have mentioned that it is difficult to identify the effect of appropriate variables on the final eligibility probability unless they are introduced at the appropriate stages. The typical approach has been to calculate the eligibility probabilities by regressing the final allowed/denied decisions on a host of health, socioeconomic, and demographic variables (see Hausman 1985; Halpern and Hausman 1986; and Kreider 1994a, 1994b). In order to illustrate this point, we ran a similar logit regression with all 45 distinct explanatory variables that played a role in our four individual regressions. The results are reported in table 10 and are summarily compared with the four stages of the structural model in table 11.

The reduced form (or binary outcome) regression has a good deal of explanatory power, as indicated by the pseudo-R^2 value of 0.23 and the gamma value of 0.47, but only 11 of the independent variables have t-ratios exceeding 1.645 in absolute value. Six of the 11 are disability-related: work limiting condition caused by accident (T8326W2D), at least 1 overnight hospital stay in last 12 months (T9100W3D), work limitation because of sensory/neurological condition (MEDGRP33), difficulty lifting 10 pounds and work limited (LFTCNW6D), work limited but able to work only occasionally or irregularly (WORKV1D3), and under age 35 and has a mental condition (YONDMENT). The five nondisability variables are: with recent work experience and determination occurred in 1990 (WORK90C), never married (MSF), white and south (RACESTDA), black and south (RACESTDC), and age 55 or older (AGE56). The first point to note is that even though the signs of all these variables are found to be the same as those in the four staged regressions, the quantitative magnitudes are generally quite different.[65]

As shown in the top two panels of the table 11, under the structural approach the more objective measures of disability, based on ADLs, IADLs, functional limitations, and mental conditions, are major factors in stages 2 and 3; yet under the reduced form model their role is considerably diminished (the t-ratio of only a single functional limitation—difficulty lifting 10 pounds combined with a work limitation—exceeds 1.645 in absolute value). Oi and Andrews (1992) have emphasized the role of these more objective measures of impairment in disability research.

In addition, many of the variables that we created for the last two stages are no longer prominent. Although five of the variables relating to the applicant's past work (see the third panel of the table) played a notable role in the fourth stage under the structural model, none had t-ratios exceeding 1.645 in absolute value under the reduced form model. Indeed, in all but one instance (work limited, but able to work occasionally or irregularly) the associated t-ratios were less than 1.0 in absolute value. Both advanced age (AGE56) and younger age combined with a mental condition (YONDMENT), play important roles at the fifth stage in the context of the vocational grid; their parameter estimates were associated with relatively large t-ratios in the binary model as well. However, other variables (FLADLEDY, NFLADLYD) designed to reflect the interaction of factors used in the vocational grid (specifically, residual capacity, education, and age) and which performed well in the context of the structural model yielded only very low t-ratios under the reduced form specification (both less than 1 in absolute value).

There is also a noteworthy difference relating to variables involving the year of the disability determination, as indicated in table 11. These variables probably reflect cyclical effects as well as administrative backlogs. Six such variables were important under the structural model; however, all but one had t-ratios less than 1 under the reduced form model. The structural model also suggests

Table 10.—Logit regression results for the binary outcome model

Variable description [1]	Project mnemonic	Mean value	Parameter estimate	Standard error	t-ratio	Odds ratio	Pr[y=1| x_i=0] [2]	Marginal effect [3]
With recent work experience and disability determination occurred in 1990	WORK90C	0.0862	-0.5547	0.2874	-1.93 *	0.57	0.464	-0.132
Three or more severe ADLs, wave 6	SAL36	.0366	.0014	.6419	.00	1.00	.452	.000
One or more severe IADLs, wave 3	SIL13	.1675	-.2254	.2990	-.75	.80	.461	-.055
Prevented from working (wave 2) and never able to work at a job	T8338W2D	.0382	.3174	.4307	.74	1.37	.449	.079
Gender (male)	SEXD	.4805	.1453	.1567	.93	1.16	.434	.036
General health status very good (wave 6)	T8800W6B	.1179	-.2782	.2353	-1.18	.76	.460	-.068
General health status poor (wave 6)	T8800W6E	.2780	.2823	.1848	1.53	1.33	.432	.070
White—south (Black/other and north in base)	RACESTDA	.2081	-.5377	.2465	-2.18 *	.58	.480	-.130
White—north (Black/other and south in base)	RACESTDB	.5179	-.2672	.2129	-1.26	.77	.486	-.066
Black—south (White/other and north in base)	RACESTDC	.1244	-.9290	.2817	-3.30 *	.40	.480	-.213
Work limited because of mental condition	MEDGRP31	.1366	.2976	.3328	.89	1.35	.442	.074
Reports inability to work in at least two waves	TDIREP12	.5309	.3151	.2414	1.31	1.37	.411	.078
Work limiting condition caused by accident	T8326W2D	.1813	-.7253	.2198	-3.30 *	.48	.484	-.172
Aged 18–34 (35 plus in base)	AGE12	.2268	-.3365	.2674	-1.26	.71	.471	-.082
Work limited less than 12 months	WPRVDUD1	.0984	.0789	.2604	.30	1.08	.450	.020
At least 1 overnight hospital stay in last 12 months	T9100W3D	.2195	.3522	.1800	1.96 *	1.42	.433	.088
Reports at least two mental conditions (wave 3)	TDI12W3D	.0171	.8390	.6607	1.27	2.31	.448	.205
Has two or more severe ADLs, (wave 6)	TAS12W6D	.0659	.6127	.4849	1.26	1.85	.442	.152
Has at least two IADLs (wave 3)	TIL12W3D	.1268	.5065	.3386	1.50	1.66	.436	.126
With recent work experience and disability determination occurred in 1991	WORK91C	.1122	.1818	.5349	.34	1.20	.447	.045
With recent work experience and disability determination occurred in 1992	WORK92C	.1431	.2182	.5347	.41	1.24	.444	.054
Never married	MSF	.1927	.4524	.2158	2.10 *	1.57	.430	.113
Aged 55 or older (18–54 in base)	AGE56	.3106	.4996	.1931	2.59 *	1.65	.414	.124
Work limited because of musculoskeletal condition	MEDGRP32	.2325	.0402	.2907	.14	1.04	.449	.010
Work limited because of sensory/neurological condition	MEDGRP33	.0667	.6699	.3362	1.99 *	1.95	.441	.166
Unable to walk 1/4 mile	T8832W3D	.1683	-.0301	.2464	-.12	.97	.453	-.007
Needs help in doing light house work	T8859W6D	.1146	.4593	.2810	1.63	1.58	.439	.114
Has difficulty lifting 10 lbs. and reports presence of work limitation (both in wave 6)	LFTCNW6D	.3764	-.5188	.2080	-2.49 *	.60	.500	-.127
Has difficulty walking up stairs and reports presence of work limitation (both in wave 6)	WUPCNW6D	.3854	.2578	.2116	1.22	1.29	.427	.064
Needs help in getting out of bed or chair	T8848W3D	.0472	-.7593	.4706	-1.61	.47	.461	-.175
Needs help in getting around inside the home	T8840W3D	.0325	.5025	.5450	.92	1.65	.448	.125
Mental condition is cause of work or activity limitation	MENTDISD	.2398	.0540	.2616	.21	1.06	.448	.013
Unable to lift 10 lbs., and prior work was very physically demanding using strength stoop, climb criteria	NSTRLIFT	.0626	-.0060	.3870	-.02	.99	.452	-.001
No recent work experience	NOWORKD	.2138	-.2558	.2814	-.91	.77	.465	-.063
Work limited, but able to perform prior work (both in wave 2)	WORKV2D2	.0715	-.3214	.3090	-1.04	.73	.457	-.078
Principal occupation of prior work was in sales or service	OCCSIPP3	.1959	.0423	.1979	.21	1.04	.450	.010
Disability determination occurred in 1988	SSAY88D	.0756	.0407	.2828	.14	1.04	.451	.010
Disability determination occurred in 1991	SSAY91D	.1398	.1771	.4817	.37	1.19	.446	.044
Disability determination occurred in 1992	SSAY92D	.1675	.2220	.4930	.45	1.25	.442	.055
Prior work physically demanding according to broad strength, stoop, climb criteria	SIPPOCC4	.4512	.0189	.1831	.10	1.02	.450	.005
Work limited, but able to work only occasionally or irregularly (wave 2)	WORKV1D3	.0260	-1.0691	.5580	-1.92 *	.34	.459	-.233
Unable to work (wave 2)	WORKV1D4	.4667	.0041	.2582	.02	1.00	.451	.001
Under age 35 and has a mental condition	YONDMENT	.0837	1.0332	.3917	2.64 *	2.81	.430	.249
Has one or more severe functional or ADL limitations, has more than 12 years of education, under age 55	FLADLEDY	.4187	-.1500	.1828	-.82	.86	.467	-.037
No severe functional limitation, no ADL, under age 55	NFLADLYD	.3740	-.1983	.2141	-.93	.82	.470	-.049

Note: Sample total = 1230. Awarded = 1, n=572, p=0.465; Rejected=0, n=658, p=0.535; (*)—t-ratio exceeds 1.645 in absolute value; Pseudo-R^2=0.23; Gamma=0.47.

[1] Variables are included in this model if their absolute t-value exceeded 1.645 in at least one the four sequential models.

[2] The probability of a favorable outcome, with all variables but the one of interest evaluated at their means and the variable of interest evaluated at 0.

[3] Change in the probability of being awarded a benefit (such as "found eligible") due to the introduction of a given variable, with all other variables measured at their mean values.

Table 11.—Comparing reduced form and structural models of SSA disability determination

Explanatory variables		Reduced form (award/deny) model	Structural model			
			Stage two: Impairment severity	Stage three: Meeting the listings	Stage four: Residual functional capacity for past work	Stage five: Residual functional capacity for any work
Programmatic survey variables						
Medical events and conditions:						
General health status	(T8800W6B,T8800W6E)		✓			
Overnight hospital stay	(T9100W3D)	✓		✓		
Accident caused work limitation	(T8326W2D	✓	✓	✓		
Musculoskeletal causes work limit	(MEDGRP32)			✓		
Sense/neur. cond. causes work limit	(MEDGRP33)	✓		✓		
Mental condition and work limitation	(MEDGRP31,TDI12W3D, MENTDISD)		✓	✓	✓	✓
Activity limitations:						
ADLs	(SAL36,TAS12W6D, T8848W3D,T8840W3D)		✓	✓		
IADLs	(SIL13,TIL12W3D,T8859W6D)		✓	✓		
Functional limitations and work limited	(T8832W3D,WUPCNW6D)			✓		
Difficulty lifting 10 lbs, work limited	(LFTCNW6D)	✓		✓	✓	
Prevented from working or limited	(TDIREP12,WORKV1D4)		✓			✓
Prevented and never worked	(T8338W2D)		✓			
Work limited and						
Only able to do occasional or irregular work	(WORKV1D3)	✓	✓			✓
Duration LTE 12 months	(WPRVDUD1)		✓			
Past work:						
In sales or services	(OCCSIPP3)				✓	
Physically demanding	(SIPPOCC4)				✓	✓
Physically demanding and unable to lift 10 lbs	(NSTRLIFT)				✓	
Work limited, able to do past work	(WORKV2D2)		✓		✓	
No recent work experience	(NOWORKD				✓	
Vocational grid:						
Age (55 or older)	(AGE56)	✓		✓		✓
Age LT 35 and mental condition	(YONDMENT)	✓				✓
Severe functional or ADL limitation, age LT 55, and 12+ yrs schooling	(FLADLEDY)					✓
No functional or ADL limitation and age LT 55	(NFLADLYD					✓
Nonprogrammatic variables						
Demographic:						
Age (18-34)	(AGE12)		✓			
Never married	(MSF)	✓		✓	✓	
Gender	(SEXD)		✓			✓
Race by region	(RACESTDA,RACESTDB, RACESTDC)	✓	✓		✓	
Time:						
1988 disability determination	(SSAY88D)					✓
1991 disability determination	(SSAY91D)					✓
1992 disability determination	(SSAY92D)					✓
Recent work, 1990 determination	(WORK90C)	✓	✓			
Recent work, 1991 determination	(WORK91C)			✓		
Recent work, 1992 determination	(WORK92C)			✓		
Pseudo R^2		.23	.23	.19	.14	.44
Gamma		.47	.48	.42	.39	.68

Source: SSA/ORS/DER (Lahiri, Vaughan, Wixon)

Notes: Explanatory variables are from the Survey of Income and Program Participation, 1990 panel, except for time variables, which also use SSA administrative data. Programmatic variables have program-specific underpinnings; demographic and time variables do not. Checks represent estimates with absolute t-values exceeding 1.645. When variables are grouped, check indicates at least one met t-value requirement. LT means "less than." LTE means "less than or equal to."

which stages of the determination process are most sensitive to such effects.

While we have not comprehensively compared the structural and reduced form approaches, some preliminary results are encouraging. Despite the fact that the reduced form regression is based on a much larger set of regressors than any of the stage models, the explanatory power of the reduced form regression, as judged by pseudo-R^2 values, gamma values, and the percentage of correct classifications, is probably no better than that of the four individual regressions.[66] For instance, the pseudo-R^2 value for the binary outcome model is 0.23, compared with 0.23, 0.19, 0.14, and 0.44 for the four steps, respectively. Similarly, the gamma value for the binary outcome model is 0.47 as opposed to 0.48, 0.42, 0.39, and 0.68 for the separate sequential regressions. The percentage of correct classifications from this regression is 64.7, while, as noted above, those for the four sequential regressions are 81.9, 66.9, 72.8, and 74.1, respectively.

Finally, in order to test the force of our structural specifications we ran each of the four regressions with all 45 variables collected from all regressions. That is, in stages 2 and 3 we introduced the occupational and vocational variables from stages 4 and 5, and likewise in the last two stages, the health-related variables from stages 2 and 3 were introduced. The results were remarkable. None of the t-ratios for the additional variables in each of the four regressions reached 1.645; in addition, the t-ratios for the original sets of selected variables (tables 6-9) remained above that threshold in their respective equations.[67] These results lend more confidence to our finding that our set of independent variables are related in a conceptually appropriate way to the character of the separate steps of the sequential determination process.

Limitations

There are certain potentially undesirable features of our analytical sample and variables. Firstly, the SSA adjudication records in our sample are from 1986 to 1993, whereas the survey window is 1990-92. The difference between the decision date and the first survey encounter date can be as much as 3 or 4 years in either direction.[68] To the extent that true health status is expected to deteriorate relatively more for the allowed applicants than the denied applicants, we can infer that for the sample observations whose adjudications took place earlier than the survey date, the effects of survey health variables on the outcomes may be overstated. On the other hand, we might expect the opposite for applicants whose survey data were collected prior to application. These effects may occur because true health status can change between the survey and the SSA adjudication (whichever comes first). But there are also reporting effects. Beneficiaries, when surveyed, may exaggerate impairments to justify benefits; also, some truly nondisabled may overstate their poor health in anticipation of applying for disability benefits. In order to check the robustness of our estimation results with regard to these possible problems with the survey health variables, we reestimated each of the staged regressions after deleting observations for 1986-89. The same was done after deleting 1993 observations. We found that the behavior of the variables reported in tables 6-9 was quite stable. This result is consistent with the view that neither time between interview and measurement of health status in the survey, nor its interaction with anticipated or actual benefit receipt, seriously distort the relationship between the body of survey data on health and disability and the outcome of the SSA determination. It also likely reflects the long-standing observation that the disability applications are generated mostly due to long-term morbidity as opposed to unexpected events like accidents. For example, Marvel (1982) reported that in 1975 only 5.8 percent of DI awards arose from accidents, poisoning, and violence.

Secondly, as we have discussed, a number of individuals had multiple determination (form 831) records. A significant number of the duplications arise from reapplications by rejected applicants. We chose to model the final determination made by the DDS; for most of our sample this choice implies that the survey data will be more contemporaneous to the date of determination. Conceivably, this approach could have introduced selectivity bias in our sample. For example, one might argue that the chance of being allowed is higher for a sample including reapplicants than for one including only first-time applicants, because re-applicants may have learned from earlier application experiences. Also, the applicants who reapply may do so because they think they have a better chance of being allowed than the rejected applicants who chose not to reapply because of certain unobservable individual traits. In addition, there may be a tendency for the reapplicants to condition their answers to the survey health and disability items to be consistent with decisions to reapply. These hypotheses imply that our regression coefficients might be biased upwards. In order to check this hypothesis, we estimated our regressions only with one-time applicants. This left us with 896 observations in the stage 2 regression. The four regression results were almost the same as before with slight deterioration in the significance levels of some variables, which is not surprising due to the reduction of sample size. Thus, we find no evidence that sample selection bias was introduced by our decision to model only the determination arising from the most recent application. This is consistent with the evidence presented by Bound (1989, 1991) who reported that most applicants who eventually qualify after being initially rejected do so through the appeals process and not through reapplication.

Finally, the measures of occupational characteristics that we have used in this study are admittedly limited. Most importantly, they deal only with the physical requirements of jobs. Non-exertional job demands[69] are also important in assessing an applicant's ability to perform relevant past work. We are in the process of obtaining such information and will introduce it into our modeling work at a later point. A further limitation relates to the nature of the strength and strength/stoop/climb measures we are currently using. As dichotomous variables focusing on occupations with medium, high, or very high physical demand requirements, in every case the majority or near majority of sample applicants are thrown together in one group which combines persons whose occupations necessarily have widely varying physical requirements ranging from sedentary to light or sedentary to medium. Most notably this means we are not able to identify separately occupations classified as sedentary, a grouping

which might be highly useful in predicting denials in the fourth step of the sequential evaluation process. Finally, by their very nature, the measures represent only the probability that a particular occupation requires the specified level of strength. This is bound to attenuate their performance as predictors in our modeling of the outcome of the disability evaluation process. However, we intend to introduce information on additional dimensions of job demands from the DOT as our work progresses and expect to obtain improvements in model fit for stages 4 and 5 as a result.

VIII. Predictive Performance

One of the advantages of structural modeling is that covert changes in the nature of the applicants will get reflected in model predictions in the appropriate manner. The ultimate success of the structural model will depend on how well it predicts the final allowances and denials. The prediction of an aggregate percentage such as the percentage of the population eligible for a given public benefit, or as in our case, the percentage of applicants allowed for disability benefits, is often an important problem faced by policymakers. There are two ways a disability applicant can be allowed in the determination process: (i) at step 3, one's impairment can meet or equal the listings, conditioned on not being denied at step 2, and (ii) at step 5 one can be allowed conditioned on not being denied at step 2, not being allowed in step 3, and finally not being denied in step 4. Thus, as explained in section VI, the final probability of being eligible can be expressed as:

$$\begin{aligned} Pr(a_3) + Pr(a_5) &= F(\alpha' W_k)F(\beta' X_l) \\ &+ F(\alpha' W_k)[1 - F(\beta' X_l)]F(\gamma' Y_m)F(\delta' Z_n) \\ &= P_{l=1|k=1} + P_{n=1|k=1, l=0, m=1} \end{aligned} \quad (6)$$

See also equations (2) and (4). Note that each applicant will have a non-zero probability of a particular outcome at each step of the sequential process. Given the observed health indicators and other characteristics of an individual, we first generate $F(\alpha' W_k)$, $F(\beta' X_l)$, $F(\gamma' Y_m)$ and $F(\delta' Z_n)$ for each individual from the four estimated logit regressions. These individual probabilities are appropriately multiplied and added as shown in equation (6) to calculate the total probability of allowance for that particular individual. The probabilities are then averaged over the sample to obtain a consistent estimate of the prediction for the percentage of allowances (see Amemiya 1985, p. 285). Note that [Pr (a_3) + Pr (a_5)] + [Pr (d_2) + Pr (d_4) + Pr (d_5)] = 1, that is, the final probabilities of allowance and denial must sum to unity for each individual.

As an in-sample exercise, we first generated the total final probabilities for allowance from our estimated sequential logit model for each of the 1,230 applicants of the sample. The average accumulated probability over the whole sample gives an estimate of the in-sample predicted percentage of allowances, which was estimated to be 47.1. The actual percentage of allowances in the sample was 46.5. Thus, our model overestimated the true allowances by only 0.6 percentage points and correspondingly underestimated the percentage of denials. In table 12 we present the aggregate probabilities and the actual outcomes by the four steps of the sequential process modeled here. This helps us to monitor the predictive power of the model by stage. By comparing the first two rows of the table we see that the predictions were remarkably similar to the actual outcomes for each of the steps. Note that for a logit regression, one implication of the normal equations is that the sum of predicted probabilities will be exactly the same as the percentage of that outcome in the sample. Thus, in table 12, the step 2 average probability of denial (0.181) is the same as what was observed in the sample. However, for the other steps, and hence for the final prediction, the equality need not hold. The reason is that this is not strictly an in-sample predictive exercise. The predictive probabilities were generated for all 1,230 applicants for all four stages although fewer and fewer individuals were used in the estimation of the latter stage regressions.[70]

We have also studied the out-of-sample predictive capacity of the model. In order to do so, we first estimated the regressions corresponding to the four steps of the sequential determination

Table 12.—Aggregate disability determination outcomes by step in the sequential determination process for in-sample and out-of-sample predictions

Estimation	Step 2 (k)		Step 3 (l)		Pr(a2) †	Step 4 (m)		Step 5 (n)		Pr(a4) ††	Pr(a2) + Pr(a4)
	Pass on (1)	Deny (2)	Allow (1)	Pass on (2)		Pass on (1)	Deny (2)	Allow (1)	Deny (2)		
In-sample results:[1]											
Observed	0.819	0.181	0.357	0.643	0.292	0.710	0.290	0.463	0.537	0.173	0.465
Estimated	.819	.181	.352	.648	.288	.716	.284	.466	.534	.177	.465
Out-of-sample results:[2]											
Observed	.818	.182	.308	.692	.252	.747	.253	.339	.661	.143	.395
Estimated	.754	.246	.317	.683	.239	.687	.313	.324	.676	.115	.354

† $P_{l=1|k=1}$

†† $P_{n=1|k=1, l=0, m=1}$

[1] 1986–93 determinations.
[2] 1993 determinations.

process using data from 1986 to 1992. The sample sizes for the regressions were 944, 773, 486, and 399, respectively, at each stage. These estimated regressions were used to predict a_3 and a_5 probabilities as in equation (6) for each of the 286 applicants of 1993. The out-of-sample predicted allowance rate (that is, the percentage of allowances) was 35.7 percent. The actual allowance rate for the 1993 applicants was 39.5 percent, indicating some underestimation of allowances. In the last two rows of table 12, we have again reported the average predicted probabilities by stage. We find that the aggregate probabilities of denial in steps 2 and 4 were overestimated by nearly 6 percentage points, with a corresponding underestimate of the proportion passed on, whereas the estimated outcome probabilities in steps 3 and 5 were very close to the actuals. In the final analysis, the predicted percentage of allowances was calculated to be 35.4 percent against the observed 39.5 percent. This is similar to what we found for the in-sample exercise, and shows that the out-of-sample prediction of the sequential model is reasonably close to the actual as well.

As a first attempt to explain the structure of the SSA disability determination process using self-reported SIPP survey data, we find that predictive performance of the sequential model is quite promising. This is so despite evidence that the standard (*viz.*, the SSA adjudicative decision) against which we are evaluating the value of the survey predictors is subject to some level of uncertainty as well. For instance, Nagi (1969a) found that the SSA adjudicators allowed almost 27 percent of applicants that an independently appointed group of clinicians found to have capacity to work, and of the group that clinicians found unable to work, almost a similar percentage were denied benefits.[71]

Nonetheless, we expect that introduction of additional survey information representing the economic incentives associated with the decision to apply for benefits, and further development of our model specification, will improve our ability to use the survey to predict administrative outcomes by allowing adjustment for selectivity bias.

IX. Conclusions and Future Research

The main purpose of this article has been to model the SSA disability determination process using household survey data on health, demographic traits, work, and activity limitations. Data from the 1990 panel of the Survey of Income and Program Participation have been exact-matched to administrative records on disability determinations for the period 1986 through 1993. Also, information on the current and past occupations of the applicants from the Dictionary of Occupational Titles (DOT) has been added. Using matched data for a sample of applicants has allowed us to model disability determination, as implemented by State DDS agencies, with data from a recurring household survey. This approach will allow us to distinguish analytically between the effects of eligibility criteria—which reflect the efforts of policymakers to control the size and targeting of the programs—and application incentives.

A major innovation of the article is that we have modeled the structure of the disability determination process in terms of a four-stage sequential logit model. Under program regulations, different criteria dictate the outcomes at different stages of the determination process. For instance, steps 2 and 3 are basically medical in nature, whereas the last two steps are based, in part, on residual functional capacity of applicants in relation to their age, education, and past occupations. Thus, for example, determinations at steps 2 and 3 are not be affected by vocational factors. But we should note that it is detailed administrative information on outcomes at each stage of the determination that makes such a multistage approach possible.

The typical estimation approach in previous studies has been to run a single reduced form logit regression of final allowed/denied decisions, explained by a host of health, socioeconomic, and demographic variables. We used our data to compare such a reduced form logit regression with a staged structural approach, demonstrating that without the staged structural approach it is very difficult to estimate the impact of more objectively measured survey health variables like the functional limitations, ADLs, and IADLs on the disability determination outcome. Variables representing the effect of the vocational grid also did not play a role under the reduced form model. Hence, many variables with program-specific underpinnings, which we found to be important in our staged regressions, were not important in the single reduced form logit regression.

The overall explanatory power of the staged structural model was found to be reasonably good. Pseudo-R^2 values for the four steps were 0.23, 0.19, 0.14, and 0.44, respectively. For the four steps estimated, the Goodman-Kruskal Gamma measure of rank correlation between observed outcomes and the predicted probabilities—another measure of goodness of fit—were 0.48, 0.42, 0.39, and 0.68, respectively. The percentage of correct classifications for each step of the process varied from 80 percent (step 2) to 67 percent (step 3). These measures seem to be quite satisfactory.

We found the out-of-sample predictive power of the estimated four-stage sequential logit model to be highly promising. The actual allowance rate for the 1993 sample of applications was 39.5 percent. The out-of-sample predicted allowance rate was calculated to be 35.7 percent, which implies only a 3.8 percentage point underestimation of the actual. The in-sample results, needless to say, were even better.

Throughout our analysis, the presence of a reported mental impairment turned out to be a very important health-related variable explaining allowances and pass ons. This is of particular interest given the changes in the handling of mental impairments that were introduced in the mid- and late 1980's. We found that applicants with musculoskeletal conditions tend to be denied more often than, for example, applicants with sensory and neurological conditions. Our regression results also demonstrate that survey data on functional, ADL, IADL, and work limitations—including those related to mental impairments—can, when used in the context of a structural model, be of considerable value in predicting SSA allowances and denials. We have noted effects of gender, race, and region which have been considered in earlier research. Finally, we found evidence suggesting that recessionary periods induce people with recent work experience to apply for benefits,

many of whom meet the SSA criterion for disability and qualify on the basis of SSA's Listing of Impairments.

There are many ways we can improve upon this study. As we have pointed out, the occupational characteristics from the Dictionary of Occupational Titles have to be harnessed more thoroughly to represent the determination process in steps 4 and 5. Nonexertional, in addition to exertional, factors have to be brought in. In addition, the outcomes under step 3 of the sequential process are determined by a codified list of impairments; however, our survey health measures are most inadequate in this step. The planned Disability Evaluation Study (DES) will undoubtedly play an important role in deciding which of the currently available health questions are useful and what additional questions should be added to the battery of survey questions. Moreover, estimates based on DES data should further refine models that relate survey responses to SSA determinations.

This study supports a central methodological point: information routinely available from an ongoing household survey has considerable relevance for policy research related to Federal disability income programs. We have shown that survey information on health, work, and demographic characteristics, in combination with administrative data on disability applications, allows estimation of a program-relevant disability measure. This measure will be exploited to estimate the pool of eligibles in the general population; there is currently no accepted procedure for producing an estimate of the pool. The pool of eligibles is of interest for two reasons. For policymakers, it reflects the potential for further program growth. For analysts, the pool of eligibles represents a critical group *at risk*, in terms of applications decisions. Using the rich set of socioeconomic information in the SIPP, we will then consider the incentives to apply, for both eligibles and ineligibles. We will be able to evaluate applications behavior in the light of household-specific events and traits. Moreover, our analytical approach will distinguish the effects of eligibility criteria (medical and financial) from application incentives.

Notes

[1] *Annual Statistical Supplement* to the *Social Security Bulletin, 1994,* tables 4.A6, 5.A1, 7.A1, 7.A3, and 7.D2. *Annual Statistical Supplement* to the *Social Security Bulletin, 1989*, table 9.D2.

[2] For a recent review of the literature, see Stapleton, Barnow, Coleman, Furman, and Antonelli (1994) or Koitz, Kollman, and Neisner (1992).

[3] We will use the phrases "SSA disability" and "SSA disabled" to refer to the disability determination process used by SSA in establishing eligibility for DI and SSI, and those found disabled under it. This will serve to distinguish the programmatic measure from self-reported disability measures obtained from surveys.

[4] In principle, this combination of extensive self-reports and medical examinations will support critical refinements in policy-relevant disability measures such as those developed here. In turn, modeling work undertaken in this study should prove to be of considerable help in making use of the DES data set.

[5] See also Hausman (1985). Two interesting working papers by SSA researchers considered the effects of local labor markets on disability; see Muller (1982) and Levy and Krute (1983).

[6] This work has been undertaken in the context of a broader project initiated several years ago (see Vaughan and Wixon, 1991). This effort involves the use of microsimulation models of OASDI and SSI using Survey of Income and Program Participation data matched to SSA records on benefits and earnings to analyze distributional effects of current or alternative benefit structures.

[7] Exact matching involves linking information on a given individual from two or more information sources, using a unique identifier (in this case, the Social Security number). All matching activities under this project have been carried out as part of a joint SSA-Bureau of the Census statistical project under the aegis of the agencies' Memorandums on the Exchange of Statistical Information and Service. All work involving the development and analysis of the matched data set at SSA has been carried out by SSA employees (or on-site contractors) acting as special sworn agents of the Bureau of the Census.

[8] U.S. National Archives and Records Administration (1990), part 404.1505.

[9] Taxable earnings are defined as earnings in covered employment up to the taxable maximum ($60,600 in 1994) for OASI and DI. There is no taxable maximum for HI.

[10] Unpublished memorandum of the Social Security Board, prepared for the Advisory Council on Social Security, 1938.

[11] Ball (1978, p. 349).

[12] One rationale for State supplementation was to allow States to compensate for geographic variation in the cost of living.

[13] DDSs are State administered, but federally financed. Smaller States have one DDS, but heavily populated States may have more than one.

[14] There are five levels of review: (1) initial, (2) reconsideration, (3) Administrative Law Judge, (4) Appeals Council, and (5) Federal District Court.

[15] Even though all the elements of the disability determination procedures were in place by the end of 1961, albeit in rudimentary form, a clear description of the sequential process as rules first appeared in *Federal Register* (Vol. 43, No. 229, November 28, 1978). The stated purpose was to consolidate and elaborate the long-standing medical/vocational evaluation policies, which, up to that point, had been reflected only in fragmented guides not readily available in the same format at all levels of adjudication. The need for the publication of this more definitive medical-vocational sequential rule was heightened by the advent of SSI legislation, which introduced a factor not normally present in the DI program—the need for vocational assessment of adults who have no relevant work experience.

[16] Ball, op. cit. p. 157.

[17] Even though the earnings screen is not modeled here, the SIPP data will allow us to implement it in estimating disabled eligibles in the general population. However, when trying to count those in the general population who are eligible under SSA disability criteria, irrespective of work behavior, we would not use the earnings screen.

[18] Prior to September 1965, the medical screen was less specific in terms of duration. It required ". . . impairments which can be expected to continue for a long and indefinite period of time or to result in death," see *Federal Register* (Vol. 33, No. 162, August 20, 1968).

Although usually invoked at step 2, the duration test can also be invoked at other steps. In this analysis, duration test denials are included in step 2 denials.

[19]The listings were drafted originally by agency medical advisors and policy specialists and were first issued as operating guides in 1954 for the disability "freeze" provisions that preceded the disability benefits program. Regulations published in 1957 to define disability included nine examples of "impairments which would ordinarily be considered as preventing substantial gainful activity." The listings were not published as administratively binding regulations until 1968. Although partially revised in 1979, the listings were not comprehensively republished until 1985.

[20] This description applies to exertional impairments. In the analysis of residual functional capacity, a separate but analogous procedure is used for nonexertional impairments such as mental or environmental impairments (for example, sensitivity to dust, fumes, extremes of heat, cold, or humidity).

[21] The initial (1984) SIPP operational panel yielded approximately 20,000 interviewed households. Budgetary limitations resulted in sample sizes ranging from 12,000-15,000 households for the 1985-88 and 1991 panels. The 1990 panel size returned to approximately 20,000 households. The 1992 and 1993 panels were also at the 20,000 household level, but are not yet available for use by the Census and SSA with matched administrative data.

[22] Information was obtained via personal interview through the latter part of the 1990 panel. Interviewers switched to telephones beginning with the seventh interview of the panel. Typically, 65 percent of sample persons have acted as self-respondents in personal interviews.

[23] Of course not all sample members complete all eight interviews. Approximately 20 percent of original sample members have left the sample because of noninterview by the end of the panel (interview eight).

[24] La Plante (1992) and Adler (1992) provide discussion on the usefulness of the SIPP for disability research.

[25] The calendar months associated with each interview are given in column heads of table 2.

[26] The lack of health condition information for persons who may be in poor health but report no work, functional, or activity limitations, represents a significant limitation of the SIPP data set. For example, survey-based health condition is missing for a significant minority of our applicant sample.

[27] This discussion is adapted with very little modification from Olson (1990). She and her colleagues developed the occupational strength measures we employ as part of a congressionally mandated study of the effects of increasing the Social Security normal retirement age on older workers in physically demanding occupations or ill health (DHHS 1986). See also Miller et al. (1980).

[28] The DOT (DOL 1981, pp. 466-467) specifies six factors as expressing the physical requirements of a job: (1) strength; (2) stooping, kneeling, crouching, and/or crawling; (3) climbing and/or balancing; (4) reaching, handling, fingering, and/or feeling; (5) talking and/or hearing; and (6) seeing.

[29] As noted by Olson (1990, p. 10), the treatment of probabilistic measures of occupational attributes that result from these sorts of procedures has varied in previous research. In applications involving dichotomous classifications, such as she and her colleagues developed and that we have adopted, she cites the use of cutoff values set at the 50th percentile (Hayward and Hardy 1985) and 60th percentile (Quinn 1977).

[30] There is also a very considerable amount of missing information in the 831 records for such programmatically relevant variables as occupation, educational attainment, and the specific vocational criterion (vocational rule number) employed in arriving at award and denial decisions in the last stage of the sequential process.

[31] We did experiment with some of the 831 versions of variables also available from the survey, such as occupation and body system of impairment, and we provide the distribution of the complete study sample by the 831 body system code in table 5. With the very few exceptions noted in the discussion of our results, independent variables employed in the estimation work reported on here were taken from the survey.

[32] The RB code tells us the step at which a determination was made for a given applicant and, by implication, the decision criteria used. Since allowances and denials can be made at different steps in the sequential process, under varying criteria, the RB code is critical for clarifying the relationship between the body of survey health information and the relevant determination criteria. The code was not routinely available to researchers within SSA on a 100 percent basis until the 831 records system was fully computerized over the course of the last several years. A study such as ours, involving a multistage model, would not have been possible prior to this development.

[33] As part of the ongoing SIPP program, the Bureau of the Census and SSA routinely validate Social Security numbers reported for SIPP sample members in the course of normal survey operations. An attempt is also made to locate SSNs for persons for whom an SSN is not reported in the survey (except for persons refusing to provide their SSNs). In the 1990 panel context, this process resulted in a "validated" SSN for approximately 90 percent of original sample members aged 18 or older and for about 80 percent of persons under age 18. About 94 percent of persons who met the criteria for inclusion in our study sample had validated SSNs.

[34] The year corresponds to the year in which an application was allowed or denied by the State DDS. The year 1986 is the first year for which the 831 file is available.

[35] The overwhelming share of eligibility determinations are made by State DDSs. For example, of determinations rendered at all levels of adjudication in fiscal year 1990, approximately 80 percent of awards and 90 percent of denials were carried out by DDS (*1991 Green Book*, table 6, p. 59).

[36] We present the results of our attempt to deal with the possible selectivity problem presented by modeling the outcome of the "most recent" application in section VII of the study.

[37] The applications process was terminated for the bulk of these individuals for reasons such as failure to supply required information, to cooperate with the information gathering process, or to comply with some other administrative requirement. This group also includes a small number of persons (less than 20) who were denied because their earnings exceeded the substantial gainful activity (SGA) amount (the maximum SGA amount was $300 between 1986 and 1989 and $500 thereafter).

[38] Age at filing and type of benefit were identified on the basis of the applicant's 831 record.

[39] Because of the definition of the survey population, and the passage of time between the application and the survey reference period, the study sample necessarily excludes certain subgroups of the applicant universe, principally persons who died or moved from the United States subsequent to the processing of their application or who were residing in an institution at the time of the survey. From a practical standpoint, decedents represent the largest segment of the applicant universe that is excluded from the survey universe and thus from the study sample, and given that the probability of death increases with the passage of time, the earlier applicant cohorts are more likely to be affected by exclusion due to death than the applicants whose cases were processed more recently.

[40] For reasons noted earlier, we model only the last four steps of the sequential evaluation.

[41] The population estimate of the number of applicants based on the matched sample of 1,230 is approximately 6.7 million, accounting for about half of the number of applications received by SSA for adult DI and SSI disability benefits during the 1986-93 period. We estimate that somewhat less than half of this discrepancy is attributable to differences between the survey universe and the program population. That is, as pointed out in note 39, applicants living overseas or in institutions at the time of the interview, or who died between the time of application and time of interview (particularly the latter) are not included in our data set. The balance of the difference likely arises from administrative denials and repeat applications (with the latter accounting for more than two-fifths of the overall difference between the number of applications and the study estimate of the number of applicants). Our population estimate is based on weighting the study sample using a modified version of the Bureau of the Census full panel weight, a survey weight that is intended to compensate for attrition over the course of the panel. We modified the panel weight by adjusting it upward to account for sample member applicants with missing SSNs, assuming that applicants had the same rate of missing SSNs as the general sample aged 18-64 with a positive panel weight.

[42] Estimates of the prevalence of activity limitations and demographic characteristics of the disabled and general population of working age adults under age 65 are based on combined 1990 and 1991 SIPP panels (McNeil 1993, tables 2, 7, and 12). The McNeil estimates typically include persons aged 15-17. Our applicant population excludes persons in this age group. This difference is not likely to materially affect the comparisons presented in the text. Note that persons living in institutional settings are excluded from both the general SIPP estimates and the study population of applicants.

[43] Use of the term "severe" to describe the nature of a particular limitation or impairments of a subgroup of the adult disabled population is adopted from McNeil (1993) as described in footnotes 3 and 4 of table 1.

[44]The denial rate index standardizes the denial rate associated with a given characteristic to the overall denial rate experienced by the entire applicant population (see also footnote 2 of the table). Thus, a value of more than 100 indicates that the characteristic is associated with a higher than average rate; a value of less than 100 with a lower than average rate. A single star (*) to the right of the index indicates that the probability that the observed departure of the index from 100 is due to chance is less than 0.10; a double star (**), that the probability is less than 0.05. The probabilities are derived on the basis of generalized variance parameters estimated by Bye and Gallicchio (1993) for Social Security beneficiaries and SSI recipients in the context of the 1990 SIPP panel.

[45] Mashaw (1983) characterizes this as the "bureaucratic rationality." According to him, this objective has been of crucial importance in the historical development of the sequential disability determination process. The *Federal Register* (Vol. 43, No. 229, Nov. 28, 1978) contains an early legislative history of the determination process. See Bloch (1992) for more discussion of the statutory and regulatory development of the disability process.

[46] The estimating equations for each stage are described in the remainder of this section. Nontechnical readers may wish to skip to section VII which describes our findings.

[47] The explanatory variables used here are defined as binary variables; that is, they take on values of 0 or 1. The dependent variables, representing the two possible outcomes at each step of the determination, also take on values of 0 or 1. For each step, the dependent variable takes on a value of 1 for the more favorable outcome, from the standpoint of the applicant, and 0 for the less favorable outcome. Thus, for example, a value of 1 indicates a pass on in steps 2 and 4 or it indicates an allowance in steps 3 and 5.

[48] However, in step 2 there is an explicit consideration of severity in terms of the impact of the claimant's medical impairment(s) on basic work activities. In the third step, the issue is whether the claimant has a medical condition(s) which meets or equals the requirements of one of the more than 100 medical conditions included in SSA's Listing of Impairments. The level of impairment entailed by conditions included in the Listing of Impairments is, by design, so severe that inability to work is assumed, and so the impact of the impairment on ability to work is not explicitly considered.

[49] See, for instance, Kreider (1994b), in which his only measure of disability was statistically significant at the 14 percent level in explaining application outcomes.

[50] In 1987, the Supreme Court upheld the severity requirement as both efficient and reliable since it allows SSA to identify "at an early stage those claimants whose medical impairments are so slight that it is unlikely they would be found to be disabled even if their age, education, and experience were taken into account." See Bloch (1992).

[51] All empirical results reported here were generated using two econometric software packages—LIMDEP (version 6.0) and SAS/STAT (version 6.10).

[52] See, for instance, Bound (1991); Gordon and Blinder (1980); Zabalza, Pissarides, and Burton (1980); and Myers (1982).

[53] See Leonard (1986) and Stapleton, Barnow, Coleman, Dietrich, Furman, and Lo (1995).

[54] The programs are intended to provide benefits to those not able to work due to impairment(s), without respect to the availability of jobs.

[55] If all else were equal, such an effect would have caused overall award rates to decrease; however, award rates increased over the course of the recession, suggesting there were countervailing forces at work. Note other evidence, discussed below, that some applicants with impairments meeting the listings may have applied as a result of job loss.

[56] See for instance GAO (1989, 1992, 1994); Lando (1976); Levy (1980); Loprest, Rupp, and Sandell (1995); McCoy, Davis, and Hudson (1994); McCoy, Iams, and Armstrong (1994); and Parsons (1994).

[57] To the extent that differential outcomes across these demographic groups represent unmeasured variation in the severity of impairments, the unmeasured variations in health status may partly reflect the extent to which various subgroups are relatively more attracted to apply for disability benefits as a source of financial last resort. In particular, we might expect evidence of a greater prevalence of labor market difficulties (layoffs, extended periods of unemployment, low earnings) among such applicant subgroups. Using available survey data, we have some significant ability to identify applicants who experience such difficulties themselves prior to application. Labor market problems experienced by other members of applicants' families may also play an important role. For example, a recent SSA survey of applicants indicated that about half of applicant families had experienced significant labor market difficulties in the 12 months preceding application. Introduction of this type of information into our determination outcome model, or, at a later stage, into our models of the decision to apply for benefits, may allow us to identify a significant component of the variation in "true" health status among pertinent demographic groups that is not being captured by the survey's overt measures of health status.

[58] An example may assist the reader. A variable's *marginal effect* is its impact on the probability that an event (that is, an award or pass on) occurs, holding the effects of all other explanatory factors constant. Consider any categorical explanatory variable, say, X. Let P_0 be the probability that an event occurs if an individual does not have characteristic X. To calculate P_0, use the estimated logistic regression for that stage, setting X equal to zero and the values of all other explanatory variables equal to their sample means. The *odds* that the event will occur, in this circumstance, are given by the expression $P_0/(1- P_0)$. Similarly, define P_1 as the probability that the event occurs if the individual has characteristic X. P_1 is calculated in an analogous fashion to P_0, setting X equal to 1 and all other variables equal to their means. The odds of occurrence for an individual with the characteristic are $P_1/(1- P_1)$. If these ideas are applied to the "age 18-34" variable in our model, P_0 is .869 and P_1 is .819 (see table 6). The marginal effect of this variable is .819 - .869 = -.050. P_1 is less than P_0 because younger applicants are less likely to be passed on to step 3; that is, the sign of the parameter estimate for "age 18-34" is negative. The odds that an applicant aged 18-34 will be passed on to step 3 are .819/(1-.819) = 4.52, while the odds for a person aged 35 or older are .869/(1-.869) = 6.63. The *odds ratio* is defined as the ratio of the odds of occurrence *with* the characteristic to the odds of occurrence *without* the characteristic. In this example the odds ratio is 4.52/6.63 = 0.68. Applicants from the 18-34 age group have 32 percent lower odds of being passed on to step 3 than their older counterparts. Odds ratios greater (less) than one correspond to positive (negative) marginal effects. Finally, note that the odds ratio for any explanatory variable can also be computed by exponentiating the parameter estimate; that is, e^{β}.

[59] We report the pseudo-R^2 measure proposed by McKelvey and Zavoina (1975). Many recent studies have favored the McKelvey-Zavoina measure over a number of competing pseudo-R^2 measures for logit models. This measure mimics the ordinary least squares R^2 in the underlying linear latent model the best, and also it is least vulnerable to the varying proportion of any particular outcome in the sample. See Windmeijer (1995), Laitila (1993), and Veall and Zimmerman (1992) for details.

[60] The maximum value for the gamma statistic is 1, representing complete agreement between the ranks of predicted and observed outcomes. Thus the closer the gamma value is to 1, the greater the level of association between the predicted and observed outcomes. For a description of the gamma statistic, see Goodman and Kruskal (1963, 1972) and Agresti (1990).

[61] The percentage of correct classifications is derived by dividing the sum of the number of correctly predicted outcomes (for example, at stage 2, pass ons to stage 3 and denials) by the total number of outcomes dealt with in the particular estimation. The estimated probability of the favorable outcome is a continuous variable taking on values in the range (0-1). It is converted to a binary outcome by treating all cases with an estimated probability ≥ 0.50 as having a favorable outcome, that is, as pass-ons in stages 2 and 4 or awards in stages 3 and 5. Cases with an estimated probability <0.50 are treated as denials in stages 2, 4, and 5 or as pass-ons at stage 3. There is one obvious problem with this measure: whether the estimated probability is close to 0.50 or departs substantially from it does not make any difference for the percent of correct classifications. As noted in the discussion that follows in the text, we also have observed that the outcome probabilities based on cross-classification tables of observed and estimated outcomes employing the 0.50 criterion may diverge considerably from the average outcome probabilities stemming directly from the model estimates (as presented in table 12, for example). We feel that other approaches for converting the continuous distribution of probabilities as estimated by the model to discrete binary outcomes will yield a distribution of outcomes in the aggregate that are more closely aligned with the observed outcome probabilities. Experimenting with such alternatives is beyond the scope of this article, but will be pursued in future work.

[62] Note that although the recession of the early 1990's officially ended in March 1991 the percentage of individuals with declining family incomes remained elevated through 1991-92 (BOC 1995).

[63] In 1979, SSA published these tables in its regulations; they were intended to introduce more objectivity in the assessment of applicants' residual functional capacity and vocational factors (age, education, and work experience) in considering their ability to work.

[64] Recall that we also found year effects, for applicants with recent work experience, in steps 2 and 3.

[65] Interestingly, there is one exception to the consistency of signs. Advanced age (AGE56) is positive in the binary outcome model (table 10) but was found to be both negative (step 3) and positive (step 5) with the sequential models.

[66] Note that the measures of fit for the individual stages are not fully comparable to those for the reduced form model, given that the dependent variables, sample sizes, and number of explanatory variables differ.

[67] This finding—that job characteristics are not related to an SSA determination of a "severe" disability or a Listing Impairment, but are related to an applicant's ability to engage in past work, or more generally, in any work in the economy—is consistent with the sequential determination process, as well as with earlier research. Luft (1978) first articulated, and Burtless (1987) and Duleep (1995) also found, that much of the estimated relationship between subjective disability measures and job characteristics is due to the effect of the latter on a person's ability to continue working rather than the effect of job characteristics on the probability of becoming medically disabled.

[68] A similar problem was also present in Halpern and Hausman (1986) and Kreider (1994b). In addition, they had no information about the timing of the repeat applications.

[69] These include environmental conditions and the amount of mathematical and language skill, and specific vocational preparation required of a worker to perform the duties of a particular occupation.

[70] The final probability of allowance in table 12 is calculated to be 0.465, which deviates slightly from 0.471 reported in the text. The latter was obtained by first calculating the final probability for each individual using equation (6) and then averaging the probabilities over the sample. What we are doing in table 12 is first to obtain the average probabilities for each stage and then use the formula (6) to obtain the final probability of allowance. This, of course, is only approximately correct.

[71] Similar findings are reported in Smith and Lilienfield (1971) and Gallicchio and Bye (1980).

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