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Characterizing the Experiences of High-Cost Users in Medicare

Thomas MaCurdy and Jeff Geppert

3.1 Introduction

Public expenditures on health care for the elderly are rising at a relentless rate, with government unable to maintain the current per capita level of services in the next decade without either substantial increases in taxes or radical reductions in other domestic spending. Medicare and Medicaid expenses for the elderly reached over 4 percent of gross domestic product (GDP) in 2000, having grown at more than a 4 percent real rate during the past decade. The majority of this growth has been concentrated among a small segment of Medicare beneficiaries. Those ranked in the top 5 percent of the expenditure distribution alone accounted for nearly half of the growth in total Medicare expenditures; those in the top 20 percent accounted for more than 80 percent of this growth. Clearly, any policy offering hope of success in mitigating the unsustainable rise in Medicare/Medicaid expenses must focus its impacts on these highest-cost groups.

A key source of knowledge required for policy design concerns identification of the high-cost users of health care and characterizing the patterns of their use. Discovering high-intensity users is not as easy a task as one might first surmise, for this alone provides few insights unless one can also

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develop profiles linking attributes of these groups to their intense utilization. Characterizing such attributes reveals what behaviors policies must alter to be successful in curtailing program costs. For example, studies indicating that the majority of high-cost users are in their last year of life suggest that a large fraction of expenditures go to postponing inevitable mortality, implying that society must value short extensions in life at high values to justify the expenditures. Further, it suggests that capping expenses per person over a year will have only a minor impact on mortality, for such a policy primarily brings about an inevitable death earlier. Alternatively, programs proposed in Medicare to manage diseases or chronic conditions maintain that these afflictions identify high-cost uses and improved treatment will lower overall expenditures by preventing worsening circumstances leading to utilization of expensive services.

Upon identifying high-cost users, a vital characteristic for policy design concerns the concentration and persistence of their utilization. Do the bulk of expenses for these users occur in a short period, such as a year, or are they spread out over time? If costs are concentrated over short periods, annual limits on spending will be effective in containing overall costs and programs such as medical savings accounts will have poor prospects in lowering costs. On the other hand, if persistence exists in costs per person over time, then lifetime limits on expenses must be in force to control total expenditures.

The following analysis explores patterns of expenses for high-cost users of Medicare, with the aim of creating a transparent approach for identifying those beneficiaries responsible for the bulk of expenditures and for discovering the concentration of their health care utilization. In undertaking this analysis, the study exploits a rich longitudinal sample that we have constructed from detailed Medicare claims data for the years 1989 to 1999 for 5 percent of all beneficiaries. This data set supplies comprehensive monthly information for each beneficiary, tracking expenditures, treatments, and diagnoses associated with each month. The analysis considers a variety of time frames and approaches for selecting groups of intense users of medical services and for summarizing their monthly experiences.

An important first step required in undertaking such a study involves understanding how secular growth in overall Medicare expenditures influences the incidence of high-cost users over time. Indeed, given the substantial and sustained growth in Medicare seen throughout most of the 1990s, highest-cost users would mostly consist of those beneficiaries who live in the later part of the period if one naively considers only the real levels of expenditures to define intensity of use. If, on the other hand, one defines intense use by indexing expenses in a way to capture the quantity of services consumed, then the consequences of secular growth depend on whether growth occurs differentially across the amounts of medical ser-

vices acquired by Medicare beneficiaries. In particular, if secular growth disproportionately induces larger increases for the most intense users, then their share of total expenditure rises; and it falls if the lowest-intensity users consume the services experiencing the larger growth in expenses.

To develop knowledge of how Medicare expenditures have grown during the 1990s, and the degree to which growth has occurred disproportionately across intensity of medical usage, we update a cohort-time empirical framework that we have implemented extensively in previous work. The analysis naturally accommodates such issues as the changing composition of the population of Medicare enrollees. Some hypotheses about the sources of expenditure growth can also be investigated well by this approach. For example, there have been proposals in the United States and elsewhere to limit the use of expensive procedures among the very old, based at least in part on the belief that expenditure growth has been concentrated among the very old. Alternatively, if expenditure growth is equally distributed across all ages and cohorts, then the most promising approaches to cost containment will not be limited to a particular demographic group. Although this descriptive work does not seek to identify the specific sources of expenditure growth, it provides important information needed for more detailed analyses.

Using our cohort framework and annual expenditure thresholds to define various classifications for high-cost users, we characterize the monthly experiences of these beneficiaries by describing properties of the intertemporal distribution of their expenditures. This includes not only the number of high-cost months experienced by these intense users of medical services, but also the number and length of spells associated with high-cost months. Knowledge of these properties informs one about not only the level of lifetime expenditures allotted to persons but also the degree of concentration in this spending within and across years. Moreover, it promises to offer a valuable approach for identifying high-cost users based on monthly experiences rather than annual measures, which might miss some of the more intense users whose experiences are spread out over longer periods of accumulated expenses. The work report provided here is not designed to assess the effectiveness of specific policies but instead is designed to provide insight into the potential usefulness of a variety of broad strategies toward cost containment.

The remainder of this paper consists of four sections. Section 3.2 describes our monthly longitudinal Medicare data, and section 3.3 summarizes methods for characterizing the growth in annual Medicare expenditures using our cohort approach that identifies separate trends among low- and high-cost users of Medicare services by beneficiary age. Section 3.3 ends with a discussion of our findings on the growth in expenditures. Section 3.4 presents an array of results revealing properties of the monthly ex-

periences of high-cost users over their lifetimes. Finally, section 3.5 offers a summary of our findings and concluding remarks.

3.2 Overview of Our Longitudinal Medicare Data

Developing a comprehensive picture of the concentration and persistence of health care expenditures across people and over time requires detailed longitudinal data summarizing the experiences of individuals during extended portions of their lifetimes while recognizing that profiles may be changing across years or cohorts. Our data consist of a 5 percent sample of all Medicare beneficiaries, starting with a random cross section of participants in 1989 supplemented by random samples of new entrants in each year covered by our data. For each sample member, our data provide information by month describing the expenses paid by Medicare for the person's medical services—both part A and B—along with the treatments and diagnoses assigned to the expenditure. No individual leaves our sample unless they die.

After describing the derivation and structure of our longitudinal Medicare data, the following discussion summarizes results from a comprehensive analysis undertaken to validate our variable constructions through comparison of statistics on the levels and trends in aggregate enrollment, program payments, and participation rates computed from our data to a variety of published statistics reported by the Centers for Medicare and Medicaid Services (CMS). The section goes on to present summary statistics characterizing the evolution of participation rates and averages for program payments and expenditures, distinguishing beneficiaries according to whether they received part A or part B services.

3.2.1 Description of the Data

The source of our longitudinal Medicare data is annual enrollment and claims data collected by the CMS. These are administrative data used by CMS to verify eligibility and to process hospital and physician claims for payment on behalf of Medicare beneficiaries. Enrollment data capture eligibility and demographic information at a point in time (typically July 1 of each calendar year). Claims data are requests for payment for a particular service provided during a given period of time, and they include information on the ICD-9-CM diagnosis and procedure codes, CPT-4/HCPCS codes, revenue center codes, provider type or specialty, Medicare reimbursement, third-party payments, beneficiary copayments, and deductibles. Claim formats vary depending on the type of provider and whether the claims were processed by a fiscal intermediary (hospital insurance under part A) or a carrier (supplemental medical insurance under part B). Only those beneficiaries enrolled in Medicare fee-for-service generate claims data. Medicare collects some encounter data on beneficiaries en-

Table 3.1 Summary of Medicare enrollment and claims data

File name	Description	Number of claims[a]
	Enrollment	
Denominator	Beneficiary eligibility, demographic and geographic data	38,000,000
Group health plan	Medicare managed care enrollment data	5,700,000
	Hospital insurance (part A)	
Inpatient	Claims for inpatient hospital services, including rehabilitation and psychiatric hospitals	618,159
Skilled nursing facility	Claims for skilled nursing facility services	166,782
Home health agency	Claims for home health agency	614,019
Hospice	Hospice enrollment and claims	57,078
	Supplement Medicare insurance (part B)	
Outpatient	Hospital outpatient claims	5,255,402
Physician/Supplier	Physician claims (including clinical laboratory)	30,101,027
Durable medical equipment	Durable Medicare equipment claims	1,978,433

[a]5 percent random sample of Medicare beneficiaries.

rolled in Medicare managed care, but the data are not complete.[1] Table 3.1 summarizes the enrollment and claim files and the number of claims per service type in a random 5 percent sample of Medicare beneficiaries.

Claims data in raw format are not useful for analyses of beneficiary utilization and expenditures over time because such an analysis requires aggregating enrollment, service use, program payments, and beneficiary payments across claims, service types, and dates of service. Information on diagnoses and procedures need to be summarized for analyses of beneficiaries with particular conditions and treatments. Enrollment data capturing point-in-time status must be validated and made consistent to reflect continuous enrollment status in Medicare fee-for-service and managed care.

To convert these data into a format useful for conducting analyses of beneficiary utilization and expenditures over time, we created longitudinal enrollment, utilization, and expenditure files that summarize data on approximately two million Medicare beneficiaries over an eleven-year time period

1. The absence of Medicare expenditures for the elderly enrolled in managed care plans is the one shortcoming of this data set, and it is difficult to predict how this limitation affects our results. Conventional wisdom suggests that managed care enrollees are likely to be healthier than fee-for-service Medicare recipients, meaning that their expenditures are likely to be lower. However, the growth in expenditures for Medicare managed care is likely to mirror that observed in fee-for-service claims, and it is the trends (rather than levels) in expenses in which we are primarily interested. Over time, the fraction of the Medicare population electing managed care has fallen, with the peak occurring in the early 1990s, followed by a steady decline.

from 1989 to 1999. These data contain the beneficiaries' monthly enrollment status, including part A and part B enrollment, managed care enrollment, and mortality using date of death information from linked Social Security records. These data also contain monthly utilization and expenditure data by service type, including inpatient hospital, skilled nursing facility (SNF), home health agency, hospice, outpatient hospital, physician (including clinical lab), and durable medical equipment. Inpatient hospital utilization and expenditure data are separated into two categories: inpatient stays paid under the prospective payment system (PPS) and non-PPS stays, which include rehabilitation and psychiatric stays, in addition to some non-PPS hospitals. Utilization data include monthly counts of the number of inpatient hospital and skilled nursing admissions by diagnosis-related group (DRG) and number of home health, outpatient hospital, and physician visits by principal diagnosis. Physician visits are further separated by physician specialty. Expenditure data include monthly Medicare program payments, third-party payments, and beneficiary payments (copayments and deductibles), with indicators supplied signaling assigned DRG (for inpatient hospital and SNF) or principal diagnosis (home health, outpatient hospital, and physician). ICD-9-CM diagnosis and procedure codes are summarized into monthly arrays by service type and separately by principal and secondary codes. Likewise, CPT-4/HCPCS codes and revenue center codes are summarized into monthly arrays by service type.

Our longitudinal Medicare data greatly facilitate analysis of beneficiary utilization and expenditures over the life of a beneficiary by allowing aggregation of service use and program payments over time (e.g., identifying high-cost monthly or annual expenditures), across services types (e.g., summarizing into total hospital insurance [HI] or supplemental medical insurance [SMI]), across beneficiary demographic characteristics (e.g., age or enrollment status), and across various conditions and treatments. These data permit a much richer set of analyses of the sources of Medicare expenditure growth than is possible with aggregate statistics on Medicare spending by broad demographic groups, such as those used by actuaries to forecast future Medicare trust fund balances.

3.2.2 Validation with CMS Published Statistics

To ensure, however, that our longitudinal Medicare data accurately reflect aggregate Medicare spending, we conducted a series of analyses to validate Medicare enrollment and spending calculated from claims against published statistics reported by the CMS in the annual statistical supplement of the *Health Care Financing Review.* Although the statistics published by the CMS are also derived from claims data, our claims data may potentially yield different results due to errors in data processing during the copying and conversion process from the CMS mainframe files or due to a lag in the claims reconciliation process when the claims data that we

use were extracted. There are also methodological issues to replicate, such as the determination of the appropriate denominator for calculation of participation rates and average spending. Here we present our results replicating CMS published statistics on enrollment and total spending.

The Balanced Budget Act of 1997 (BBA97) had a significant impact on aggregate Medicare spending and therefore on the trends in average Medicare spending that we report later in this paper. The major provisions of BBA97 included direct reductions to the PPS inpatient hospital annual operating update, PPS inpatient capital payments, indirect medical education (IME) payments, disproportionate share (DSH) payments, direct medical education (DME) payments, and expansion of the transfer policy (which reduces payments for transfers of short-term acute patients in ten DRGs who were discharged to an SNF, PPS-exempt facilities, or a home health agency). Other provisions included the implementation of prospective payment systems for outpatient hospital, skilled nursing facilities, and home health agencies, and the creation of Medicare+Choice managed care plans and more equitable payments for such plans across geographic areas. As the following results demonstrate, however, these changes appear to have caused a large one-time reduction in aggregate Medicare spending, but growth rates and trends appear largely to have reverted to pre-BBA97 levels.

Enrollment

Figure 3.1 compares Medicare enrollment as reported by the CMS in the statistical supplement through 2003 to the same statistic calculated by us

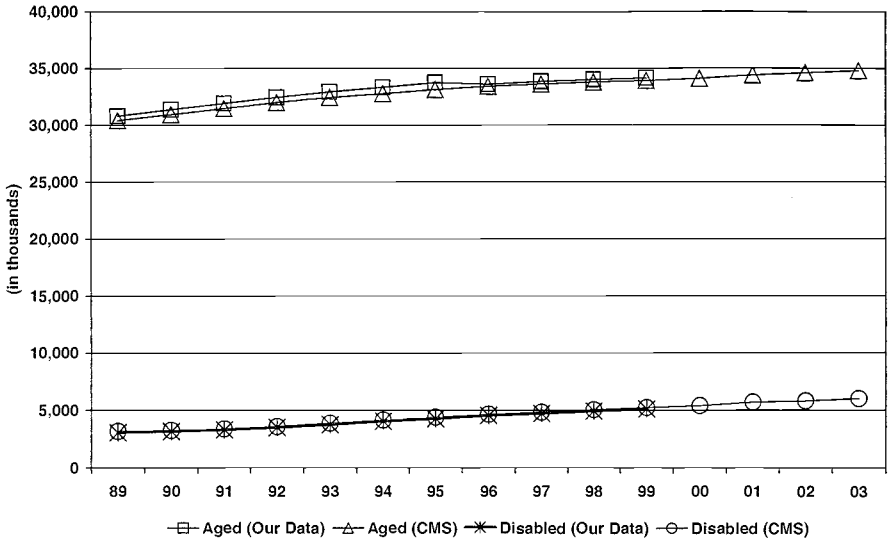

Fig. 3.1 Total Medicare enrollment

using Medicare enrollment files for calendar years 1989 to 1999. Enrollment is reported in units of one thousand. The CMS reports enrollment as a count of beneficiaries at a point in time, namely July 1 of the calendar year, rather than as a count of any beneficiary enrolled at any time during the calendar year. We follow the CMS methodology and report enrollment separately by entitlement (i.e., aged or disabled). In general, enrollment from claims and from the CMS is very close, differing by about 1–2 percent on average for aged beneficiaries, with the difference less than 1 percent for more recent years (since 1996). That amounts to a difference of about 300,000 per year out of 32 to 34 million aged beneficiaries. Our enrollment is slightly higher than the CMS's, which may reflect an imputation on our part of enrollment for beneficiaries that are Medicare eligible due to reaching age sixty-five but that do not appear in Medicare enrollment files until they use Medicare services at an age greater than sixty-five. For disabled beneficiaries, our enrollment counts are slightly lower than CMS's, differing by about 2–3 percent on average. The absolute magnitude of the difference is only about 100,000 beneficiaries out of three to five million.

The results show that Medicare enrollment for aged beneficiaries has grown by about 1 percent per year from 1989 to 1999, from slightly over 30 million to slightly over 34 million. The growth rate was nearly 2 percent in the early years of the decade and declined to less than 1 percent in more recent years. Medicare enrollment for disabled beneficiaries has grown much more rapidly, averaging more than 5 percent per year over the eleven-year time period. As a consequence, the share of beneficiaries entitled due to disability has grown from 9 percent to 13 percent over the decade. Current CMS estimates show that the share reached nearly 15 percent by 2003. Because disabled beneficiaries use more services on average than aged beneficiaries, the growing share of disabled beneficiaries has potential implications for growth in Medicare spending.

Program Payments

Figure 3.2 shows total Medicare program payments from claims data for calendar years 1989 to 1999 and from the CMS through 2003. Medicare reports program payments, which only include monies dispensed from the Medicare trust funds and do not include third-party or beneficiary payments. They also do not include payments made to health plans for Medicare managed care enrollees. We report spending separately for part A (HI) and part B (SMI). For part A, total spending from claims differs from total spending reported by CMS by about 2 percent each year, with spending from claims slightly lower than spending reported by the CMS. In part, this might be due to a lag in claims for larger expenses that take more time to adjudicate. However, the trend in part A spending from claims tracks very closely with the trend in part A spending reported by

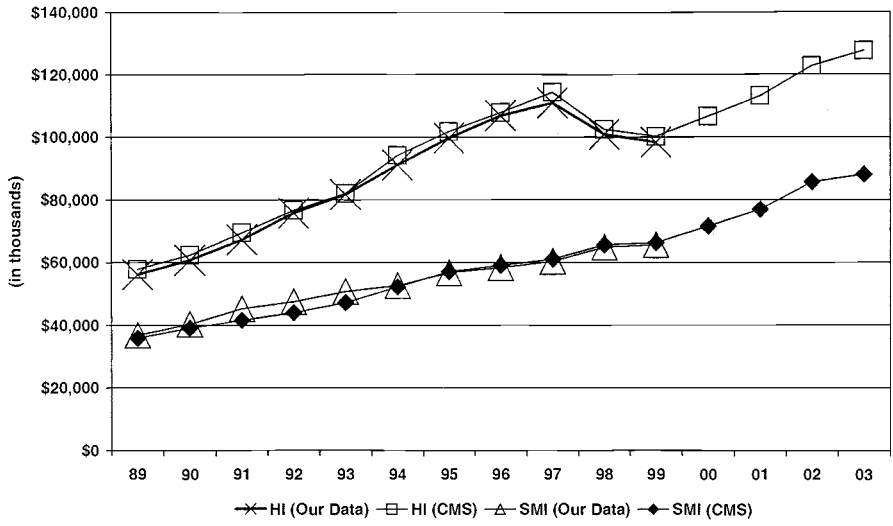

Fig. 3.2 Total Medicare program payments

CMS. Part A spending grew by more than 6 percent per year, with growth exceeding 9 percent per year until the BBA97, when total part A spending actually dropped by 3 percent per year on average. Part A spending grew from $56 billion in 1989 to a peak of $111 billion in 1996, before falling to $98 billion by 1999. More recent statistics reported by the CMS suggest that part A spending has returned to pre-BBA97 levels and growth rates. Part A spending reached $128 billion in 2003, growing at an annual rate of 6 percent since 1999.

Total part B spending from claims differs from part B spending reported by the CMS by 2.5 percent per year on average, although in more recent years the difference is only around 1 percent. The difference is greatest from 1991 to 1994, when CMS was converting to a different claims process for durable medical equipment. The trend in part B spending from claims tracks very closely to the trend in part B spending reported by CMS. Part B spending grew by more than 6 percent per year, and the rate of growth was not affected by the BBA97 as dramatically as part A spending. Part B spending grew from $36 billion in 1989 to $66 billion in 1999. In recent years, part B spending has continued to grow at 6–7 percent per year, reaching $88 billion in 2003. Before the BBA97, part B spending as a share of total Medicare spending had fallen from 40 percent to 35 percent, primarily because of rapid growth in nonacute part A spending in home health agency and skilled nursing facility services. After the BBA97, part B spending reverted to its earlier 40 percent share of total spending, and this share remained constant through 2003.

Participation Rates

Figure 3.3 shows participation rates under part A and part B for calendar years 1989 to 1999. The participation rate is defined as the number of Medicare beneficiaries receiving services paid for with program funds during the calendar year divided by the number of Medicare beneficiaries enrolled during the calendar year. For both part A and part B, participation rates calculated from claims and reported by CMS in published statistics are very close. Validation of participation rates (in addition to aggregate spending and enrollment) is important for accurately reflecting trends in average beneficiary spending. Part A participation rates rose slightly from 1989 to 1994, from 201 to 219 per 1,000 beneficiaries. Starting in 1995, CMS began excluding managed care enrollees from the denominator of participation rates, so the participation rates increased slightly to 230 per 1,000 beneficiaries, where it has remained relatively constant in recent years. Part B participation rates also rose slightly from 1989 to 1994, from 755 to 815 per 1,000 beneficiaries. After managed care enrollees were excluded from the denominator, the part B participation rate rose to 833 per 1,000 in 1996 and has continued to increase slightly, reaching 842 per 1,000 beneficiaries in 1999, an increase of around 1 percent per year from 1995 to 1999. Figure 3.3 also shows managed care enrollment, which increased from 5 percent in 1989 to 18 percent in 1999, an increase of 12 percent per year, with most of the increase occurring after 1994. The BBA97, which included provisions to encourage managed care enrollment, seems to have

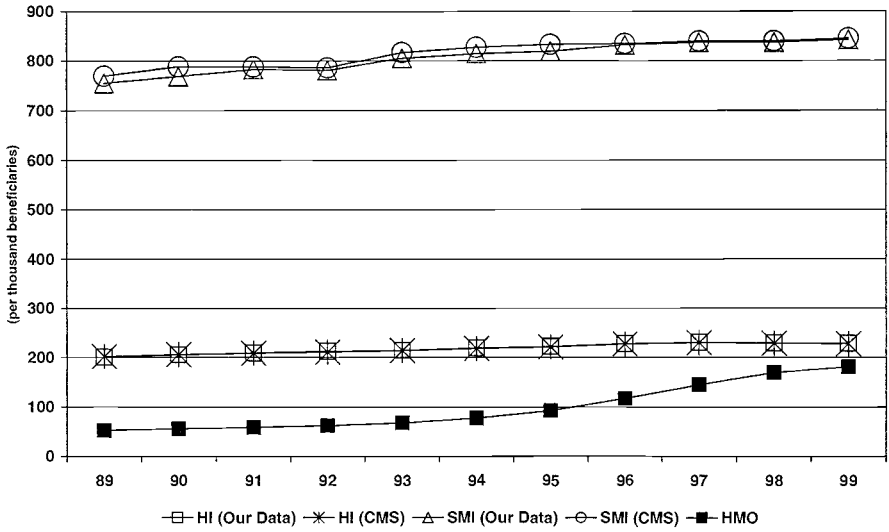

Fig. 3.3 Medicare participation rates

reduced or reversed the rate of growth. The most recent estimates from CMS place managed care enrollment at 5.3 million of 40.8 million beneficiaries (13 percent).

3.2.3 Simple Summaries of Trends in Aggregate Spending

Using the validated longitudinal Medicare data, we calculated summary statistics and trends on the average Medicare program payments and expenditures for the period 1989 to 1999. As mentioned earlier, program payments are funds paid by the Medicare program on behalf of the beneficiary. Expenditures include third-party payments, in addition to beneficiary copayments and deductibles. All results are reported in constant (2000) dollars.

Table 3.2 shows participation rates and average program payments and expenditures for beneficiaries with some part A service use and with some part A or B service use. In other words, the denominator of the averages excludes beneficiaries with no part A or no part A or B service use. For part A, participation rates have risen steadily over the time period, as mentioned earlier, at an average annual increase of 1 percent per year. In addition, for those receiving part A services, the average program payment has risen from $11,168 to $13,259 in constant dollars, an average annual increase of 1.7 percent per year. Prior to BBA97, the average annual increase was nearly 3 percent per year. Expenditures are approximately 8 percent higher than program payments due to third-party payments and beneficiary copayments and deductibles. For those receiving part A services, expenditures have grown slightly faster than program payments from $11,938 to $14,443, an average annual increase of 1.9 percent per year (3.1 percent per year prior to BBA97). Taken together, these results suggest

Table 3.2 **Average Medicare program payments, expenditures, and participation rates (2000 $)**

	Part A only			Parts A and B		
Year	Participation rate (%)	Program payments ($)	Expenditures ($)	Participation rate (%)	Program payments ($)	Expenditures ($)
1989	20.6	11,168	11,938	81.1	4,542	5,299
1990	21.1	11,020	12,125	82.3	4,552	5,434
1991	21.5	11,304	12,452	84.5	4,668	5,599
1992	21.8	11,971	13,134	84.4	4,896	5,862
1993	22.0	12,234	13,365	85.6	4,960	5,914
1994	22.6	12,847	14,030	85.9	5,188	6,170
1995	22.9	13,441	14,623	86.1	5,466	6,484
1996	23.6	13,868	15,037	87.4	5,640	6,675
1997	23.9	14,099	15,292	87.8	5,775	6,843
1998	23.8	13,542	14,738	87.6	5,632	6,734
1999	23.1	13,259	14,443	87.4	5,495	6,599

that the total increase in part A program payments from 1989 to 1999 can be approximately attributed to the following factors: the increase in beneficiaries (3.5 percent), the increase in the part A participate rate (37.8 percent), the increase in the average program payment per part A service recipient (53.7 percent), and residual (8 percent). Therefore, over one-half of the increase in part A program payments is attributable to an increase in program payments per part A recipient, even after the direct reductions in part A payments implemented by the BBA97.

For part A or B, participation rates have also risen steadily over the time period from 81 percent to 87 percent, an average annual increase of nearly 1 percent per year. In addition, for those receiving part A or B services, the average program payment has risen from $4,542 to $5,495 in constant dollars, an average annual increase of 1.9 percent per year. Prior to BBA97, the average annual increase was nearly 3 percent per year. Expenditures are approximately 17 percent higher than program payments due to third-party payments and beneficiary copayments and deductibles. For those receiving part A or part B services, expenditures have grown slightly faster than program payments, from $5,299 to $6,599, an average annual increase of 2.2 percent per year (3.2 percent per year prior to BBA97). Taken together, these results suggest that the total increase in part A or B program payments from 1989 to 1999 can be approximately attributed to the following factors: the increase in beneficiaries (3.8 percent), the increase in the part A or B participant rate (24.3 percent), the increase in the average program payment per part A or B service recipient (65.7 percent), and residual (6 percent). Therefore, almost two-thirds of the increase in part A or B program payments is attributable to an increase in program payments per part A or B recipient. An even larger share of the increase in part B program payments is attributable to an increase in program payments per part B recipient.

Table 3.3 shows average Medicare program payments and expenditures per Medicare beneficiary, including those with and without services. In other words, the change in the averages over time reflects both changes in the participation rate and changes in program payments or expenditures per service recipient. The top panel shows averages for both aged and disabled beneficiaries. The bottom panel shows averages for aged beneficiaries only. For all beneficiaries, the average part A program payment increased from $2,301 to $3,066, an average annual increase of 2.9 percent. The average part B program payment increased from $1,385 to $1,737, an average annual increase of 2.3 percent. The average total program payment increased from $3,686 to $4,803, an average annual increase of 2.6 percent. Expenditures were higher than program payments by 8 percent for part A, 31 percent for part B, and 17 percent overall, and they grew about 0.5 percent faster than program payments.

Table 3.3 **Average Medicare program payments and expenditures, by year and type of beneficiary (2000 $)**

	Part A		Part B		Total	
	Program payments ($)	Expenditures ($)	Program payments ($)	Expenditures ($)	Program payments ($)	Expenditures ($)
All beneficiaries						
1989	2,301	2,460	1,385	1,840	3,686	4,300
1990	2,324	2,557	1,422	1,915	3,746	4,472
1991	2,430	2,677	1,517	2,057	3,947	4,734
1992	2,611	2,865	1,520	2,081	4,131	4,945
1993	2,691	2,940	1,553	2,120	4,244	5,060
1994	2,901	3,168	1,557	2,134	4,458	5,302
1995	3,076	3,347	1,627	2,234	4,703	5,580
1996	3,271	3,547	1,658	2,286	4,929	5,833
1997	3,375	3,660	1,696	2,348	5,070	6,007
1998	3,218	3,502	1,713	2,394	4,931	5,896
1999	3,066	3,339	1,737	2,429	4,803	5,768
Aged						
1989	2,253	2,407	1,370	1,822	3,623	4,230
1990	2,273	2,500	1,406	1,896	3,680	4,396
1991	2,389	2,629	1,509	2,047	3,898	4,675
1992	2,570	2,816	1,507	2,065	4,077	4,881
1993	2,665	2,908	1,534	2,096	4,200	5,003
1994	2,898	3,161	1,544	2,115	4,442	5,276
1995	3,091	3,360	1,614	2,214	4,705	5,574
1996	3,299	3,573	1,643	2,265	4,942	5,838
1997	3,423	3,706	1,682	2,327	5,105	6,033
1998	3,254	3,537	1,709	2,383	4,963	5,921
1999	3,109	3,387	1,739	2,429	4,848	5,816

For aged beneficiaries, the average part A program payment increased from $2,253 to $3,109, an average annual increase of 3.2 percent. The average part B program payment increased from $1,370 to $1,739, an average annual increase of 2.4 percent. The average total program payment increased from $3,623 to $4,848, an average annual increase of 2.9 percent. Expenditures are higher than program payments in the same proportions as above, and grew slightly faster. Average part A program payments and expenditures for the aged are lower than program payments and expenditures overall until around 1995, when part A program payments and expenditures for the aged become greater than the equivalent amounts overall. Average part B program payments and expenditures for the aged are consistently lower than the equivalent amounts overall throughout the time period because average program payments and expenditures for disabled beneficiaries are greater, and disabled beneficiaries are becoming a

higher share of the total population. Despite the increase in the share, however, part A program payments and expenditures for the disabled population declined relative to the aged population since 1996.

3.3 Characterizing Growth in Annual Expenditures

The subsequent discussion presents a concise characterization of the growth in annual Medicare spending during the 1990s, characterizing the experiences of cohorts and describing how cross-section distributions have changed over time. Descriptive tables provide the foundation for more formal models summarizing the secular growth in expenditures, along with the disproportionate impact of this growth on various segments of Medicare beneficiaries distinguished by their age and intensity of medical-care use. Our cohort analysis offers a rich framework for describing the rate of growth of expenditures by percentile groups by age, along with the cross-sectional relationship between expenditures and age. In addition, our analysis summarizes growth in participation rates in part A and part B services.

3.3.1 Shifts in the Distribution of Medicare Expenditures

We characterize the growth in annual Medicare expenditures by identifying separate trends among low- and high-cost users of Medicare services by beneficiary age.

Annual Expenditure Percentiles

Table 3.4 shows the level of annual expenditures by beneficiary percentile by year from 1989 to 1999. Percentiles shown are the 10th, 25th, 50th, 80th, 90th, 95th, and 98th. Expenditures are highly concentrated. In

Table 3.4 **Percentiles for annual expenditures for Medicare participants**

	Levels of annual cost percentiles (2000 $)						
Year	10	25	50	80	90	95	98
1989	117	316	960	6,892	14,779	24,753	40,578
1990	124	334	1,020	7,090	15,221	25,313	41,261
1991	136	362	1,088	7,301	15,707	26,075	42,351
1992	151	384	1,142	7,576	16,479	27,418	43,841
1993	145	379	1,142	7,464	16,618	27,968	44,879
1994	153	394	1,202	7,754	17,677	29,702	46,879
1995	161	415	1,279	8,114	18,655	31,430	49,323
1996	161	415	1,308	8,337	19,317	32,539	51,384
1997	167	433	1,372	8,520	19,940	33,647	53,011
1998	179	459	1,436	8,265	19,256	32,592	51,849
1999	196	495	1,501	8,134	18,678	31,551	49,928

1989, annual expenditures for the 90th percentile were 125 times greater than the annual expenditures for the 10th percentile. The levels ranged from $117 to $14,779. Annual expenditures for the 98th percentile were 2.7 times greater than the annual expenditures for the 90th percentile, with the level of the 98th percentile reaching $40,578. The median annual expenditure was $960. In any given year there are a few Medicare beneficiaries with extremely high expenditures, while most beneficiaries spend less than $1,000 annually.

In general, the growth rates have been greater for the lower percentiles than for the higher percentiles over the decade. For example, average annual expenditures for the 10th percentile increased from $117 to $196, an average annual growth rate of 5.1 percent. The average annual expenditure for the 50th percentile increased from $960 to $1,501, an average annual growth rate of 4.5 percent. The average annual expenditure for the 98th percentile increased from $40,578 to $49,928, an average annual growth rate of 2.1 percent. Post-BBA97 growth rates for the 80th, 90th, 95th, and 98th percentiles were actually negative, at –2.3 percent, –3.3 percent, –3.2 percent, and –3.0 percent, respectively. The BBA97 had the greatest impact on the high end of the annual expenditure distribution.

Share of Total Expenditures by Percentile

Table 3.5 shows the share of total Medicare expenditures accounted for by beneficiaries in the 0–50, 50–80, 80–90, 90–95, 95–98, and 98+ average annual expenditure percentile categories. In 1989, beneficiaries below the median average annual expenditure accounted for only 3.5 percent of total Medicare expenditures; beneficiaries in the 50–80 percentile category accounted for 16.7 percent; beneficiaries in the 80–90 percentile category

Table 3.5 **Share of annual Medicare expenditures accounted for by annual percentile groups (%)**

	Annual percentile categories						
Year	0–50	50–80	80–90	90–95	95–98	98+	Total
1989	3.5	16.7	19.3	18.3	18.0	24.2	100.0
1990	3.6	17.0	19.4	18.3	17.9	23.8	100.0
1991	3.8	17.1	19.4	18.3	17.9	23.6	100.0
1992	3.8	17.1	19.5	18.4	17.9	23.4	100.0
1993	3.8	16.6	19.2	18.5	18.1	23.9	100.0
1994	3.7	16.5	19.3	18.7	18.2	23.6	100.0
1995	3.8	16.5	19.4	18.8	18.1	23.4	100.0
1996	3.7	16.3	19.4	18.8	18.2	23.6	100.0
1997	3.7	16.3	19.3	18.9	18.2	23.6	100.0
1998	4.0	16.5	19.0	18.6	18.1	23.9	100.0
1999	4.4	16.9	19.0	18.4	17.8	23.6	100.0

accounted for 19.3 percent; beneficiaries in the 90–95 percentile category accounted for 18.3 percent; beneficiaries in the 95–98 percentile category accounted for 18.0 percent; and beneficiaries in the 98+ percentile category accounted for 24.2 percent. Because average annual expenditures grew more slowly for the higher percentiles, the share of total expenditures accounted for by the higher percentiles fell slightly. In 1999, the share of total Medicare expenditures accounted for by the 98th percentile fell from 24.2 percent to 23.6 percent. Overall, however, the share of total Medicare expenditures accounted for the various percentile categories has been quite stable over time.

3.3.2 A Cohort Framework for Describing Differential Growth in Medicare Expenditures

These descriptive tables provide the foundation for more formal models describing the sources of Medicare expenditure growth, therefore illuminating growth forecasts and more effective simulations of policy reforms. We have already developed and applied such models (Garber, MaCurdy, and McClellan 1997). This section summarizes our cohort analysis methods, which model expenditure growth for groups of Medicare beneficiaries as a function of various characteristics, including birth year, time, and rankings in the expenditure distribution. This approach is particularly useful for assessing whether and how expenditure growth has differed between high-cost and low-cost enrollees, as our descriptive analyses suggested.

Specifications for Characterizing Trends

Considering the types of statistical formulations found in the empirical literature for describing the growth of variables—such as expenditures—in a population where differential rates operate across ages and time, two basic frameworks are well suited for our purposes: (a) one that describes the evolution of the cross-sectional relationships between age and a variable y over a sequence of years, and (b) one that models the movements of the life-cycle profiles of y associated with successive cohorts. Without arbitrary identifying assumptions, these two frameworks are statistically indistinguishable. Whereas existing studies of Medicare expenditures invariably apply some variant of the first framework as a basis for projecting growth, our research exploits frameworks falling into the second category for capturing the underlying features of Medicare growth.

To describe the trends of an aggregate quantity y over time—where y may represent a measure of Medicare expenditures, participation rates, and so on—one can model movements in the quantities $y(c, \alpha)$ measuring the values of y associated with cohort c at age α in the year $c + \alpha - 65$. The most popular approach for describing the evolution of y is to specify the relationship

$$y(t - \alpha + 65, \alpha) = f(t, \alpha) + u. \tag{1}$$

The deterministic function f measures the systematic variation in y, and the errors u capture the contribution of period effects reflecting either cyclical or transitory phenomena. For fixed t, estimating f via equation (1) with observations on different values of y and α yields an estimate of the mapping between age and y at a point in time of the sort obtained in conventional cross-section analyses. Knowledge of how f behaves as a function of t determines how cross-section profiles shift from one year to the next.

The second approach for describing variation in y focuses on modeling the life-cycle profiles of cohorts by specifying the relationship

$$y(c, \alpha) = g(c, \alpha) + u. \tag{2}$$

The deterministic function g measures trends, and the errors u reflect the deviations from these trends. For fixed c, estimating g via equation (2) with observations on different values of y and α yields an estimate of the life-cycle profile followed by y for cohort c. Knowledge of how g shifts as a function of c determines how the age-y relationships differ across cohorts.

The two approaches for characterizing profiles of y are linked by the equalities

$$f(t, \alpha) = g(t - \alpha + 65, \alpha). \tag{3}$$

Thus, there is no statistical advantage to using either f or g to model the growth of y because both functions convey the same information. This observation reflects nothing more than the inherent identification problem, which is well known in the literature (e.g., Heckman and Robb, 1985), that prevents one from being able to distinguish among age, period, and cohort effects. Using equation (3), it is straightforward to translate cross-section estimates into cohort estimates and vice versa. Our research strategy focuses on estimating g, and we will construct f from these results.

Cohort Profiles and Expenditure Growth

In the empirical analysis, we develop parameterizations of the cohort profiles $g(c, \alpha)$ to model the growth of two categories of quantities: (a) the fraction of the population using services under part A or part A or B, $R(c, \alpha)$ (i.e., the participation rate); and (b) statistics describing the distributional characteristics of the expenditure variables m_{it} (the value of real Medicare expenditures in year t incurred for individual i who is a member of cohort c and is age α in year t). These quantities jointly determine how distributions of Medicare outlays evolve across ages and over time. Use of the cohort profile $g(c, \alpha)$ to examine the trends followed by the various determinants of Medicare expenses offers a simple framework for understanding the process underlying the growth of health expenses.

To illustrate the concept of a cohort profile, consider the use of such a formulation to characterize the evolution of an expenditure statistic, $\mu_{c\alpha}$, measuring, for example, average annual expenditures per individual in cohort c at age α. Members of the cohort who are sixty-five years old in year 0 experience a life-cycle profile of Medicare expenditures designated by $g(c_2, \alpha)$. Members of an older cohort who turn sixty-five in year c_1 (< 0) have expenditures following the path given by $g(c_1, \alpha)$. Finally, members of a younger cohort who turn sixty-five in year c_3 (> 0) have lifetime expenditures tracking the profile $g(c_3, \alpha)$. The growth of health expenditures experienced by cohort c in year t corresponds to the derivative

$$\left.\frac{\partial g}{\partial t}\right|_c = \left.\frac{\partial g}{\partial \alpha}\right|_c \equiv g_\alpha(c, \alpha) = g_\alpha,$$

evaluated at the point $\alpha = t - c$. Letting α^* denote any particular age, the function $g(t - \alpha^*, \alpha^*)$ specifies the level of expenditure in year t. The growth of this level is

$$\left.\frac{\partial g}{\partial t}\right|_\alpha = \left.\frac{\partial g}{\partial c}\right|_\alpha \equiv g_c(c, \alpha) = g_c(t - \alpha, \alpha).$$

Plotting $g(t - \alpha^*, \alpha^*)$ against t shows how the level of Medicare outlays were expended at age α^* or how participation at this age shifted over time. In the figure this plot is designated as "entry expenditure" when α^* is set equal to age sixty-five. In the figure the cross-section profile of expenditures in year t^* is given by the values of g intersecting the vertical line drawn at t^*.

Describing the Evolution of the Distribution of Expenditures

Using this framework, we describe many attributes of the distributions of Medicare expenses by choosing the dependent variables $y(c, \alpha, x)$ as various statistics computed using the individual observations on y making up cell (c, α, x). Choosing $y(c, \alpha, x)$ as the fraction of persons with Medicare service use ($R[c, \alpha]$) implies that the function g describes the life-cycle profile of Medicare participation rates of a cohort at different ages. Finally, choosing $y(c, \alpha, x)$ as percentiles of the Medicare expenditure distribution describes the profile of different points in the distribution of utilization by a cohort.

To estimate how the distribution of Medicare outlays evolve, we model the behavior of several percentiles by interpreting the quantity $y(c, \alpha)$ in equation (2) as a particular percentile of the distributions of the variables m_{it} corresponding to a specified cohort for a given age or year. In particular, we interpret $y(c, \alpha) = P\#\#_{c\alpha}(m_{kt})$, which represents the ##th percentile of the distribution of Medicare expenditures in year t per patients who are members of cohort c at age α. With $y(c, \alpha)$ calculated as a specified percentile, g depicts its life-cycle profile. By combining information on several

such formulations of g, we can infer how the distributions of Medicare expenditures vary across cohorts, within cohorts, across ages, and over time during our five-year horizon. We consider three percentile formulations for $y(c, \alpha)$: the 10th, 50th, and 90th. Knowledge of these three percentiles provides a useful tool with which to examine changes in the shape of the distribution of Medicare utilization since it allows us to describe the entire conditional distribution, including the life-cycle and time-series patterns of the spreads of the distributions.

Parameterization and Estimation of Cohort Specifications

To outline our approach for estimating parameterizations of g, denote y_{it} as the observation on the ith individual in year t. Let the quantities $y(c, \alpha, x)$ correspond to the statistics computed using the values of y_{it} associated with the appropriate cohort c, age α, and set of demographic characteristics x. After forming the variables $y(c, \alpha, x)$, an observation on equation (2) may be written as

$$y(c, \alpha, x) = g(c, \alpha, x) + u_{c\alpha x}. \tag{4}$$

We assume that the disturbances follow the error components model

$$u_{c\alpha x} = \overline{u}_t + \overline{u}_{t\alpha x}, \tag{5}$$

where the subscripts (c, α) map into the subscripts (t, α) via the relation $c = t - \alpha$, the errors $\overline{u}_t$ are common time effects, and the errors $\overline{u}_{t\alpha x}$ are the idiosyncratic deviations from trends for cohort c at age α after the removal of common year components. The time effects $\overline{u}_t$ are estimated as parameters subject to the restrictions that they are orthogonal to $g(c, \alpha, x)$ for any c. Thus, the $\overline{u}_t$s represent deviations from trends; they can be interpreted as (macroeconomic) cyclical variations in Medicare utilization.

We estimate a formulation of g that is a variant of the parameterization

$$g(c, \alpha) = \sum_j \beta_j(c)\, \phi_j(\alpha). \tag{6}$$

The quantities $\phi_j(\alpha)$ determine the shape of a cohort's lifetime profile with respect to age, and the functions $\beta_j(c)$ capture cross-cohort variation in life-cycle profiles. One can readily consider transformations of expenditures other than logarithms as a dependent variable when using equation (6) as a specification of g; and one can incorporate individual characteristics in the functions β_j and ϕ_j to allow profiles to vary across demographic groups.

The particular parameterization of equation (6) estimated in this analysis is

$$\begin{aligned} g(c, \alpha) &= \beta_0(c) + \beta_1(c)\alpha + \beta_2(c)\alpha^2 \\ \beta_j(c) &= \beta_{0j} + \beta_{1j}c + \beta_{2j}c^2, \quad j = 1, 2, 3. \end{aligned} \tag{7}$$

According to this parameterization, each cohort's expenditure function is a quadratic in age, and the coefficients of these cohort profiles vary according to a quadratic polynomial in cohort year.

The analysis estimates the coefficients β_{kj} and the time effects $\overline{u}_t$ by applying ordinary least squares (OLS) to equation (6) with g specified by equation (7). The sample includes all available annual observations, with regressions run separately for demographic groups under consideration. As mentioned, the time effects are constrained to be orthogonal to $g(c, \alpha)$ for all c, thus requiring $\overline{u}_k$ to satisfy the restrictions

$$\sum_{k=86}^{90} \overline{u}_k k^j = 0 \text{ for } j = 0, 1, 2$$

Our empirical work indicates that specification (7) is sufficiently rich to capture the shifts in Medicare expenditures that occurred during the 1990s. Increasing the degree of either the polynomial in age or the polynomial in cohort year fails either to improve the goodness of fit of the statistical model at conventional significance levels or to change the main empirical findings.

3.3.3 Underlying Trends in Medicare Expenditures

We estimate the previous specifications for annual Medicare participation rates and expenditure percentiles—the 10th, 50th, 90th, 95th, and 98th—using all years covering the 1989 to 1999 period.

Growth in Participation

Figure 3.4 shows the rate of growth in participation rates for part A and part A or B. The cross-sectional curves (marked with Xs) show the 1995 participation rates by age. For both part A and part A or B, participation rates increase with age until around age ninety, when participation rates begin to decrease. Part A participation rates increase with age more rapidly than participation rates for part A and B combined until more than 40 percent of beneficiaries in their late eighties or early nineties receive some part A service (i.e., inpatient hospitalization, skilled nursing facility, home health agency, or hospice). The figure also shows three cohort profiles for beneficiaries that turned sixty-five in 1991 (marked with squares), 1981 (marked with diamonds), or 1971 (marked with triangles), respectively. Each cohort profile intersects the cross-sectional curve in 1995 (that is, at age sixty-nine, seventy-nine, and eighty-nine, respectively). The fact that the cohort profiles are steeper than the cross-sectional curve indicates that Medicare participation rates for each cohort increase more rapidly than can be attributed to pure aging. For the 1991 cohort, the percentage change in the part A participation rate was 44 percent (of the 1995 level) and the percentage change in the part A or B participation rate was 27 percent. For the 1981 cohort, the percentage change in the part A participation rate was

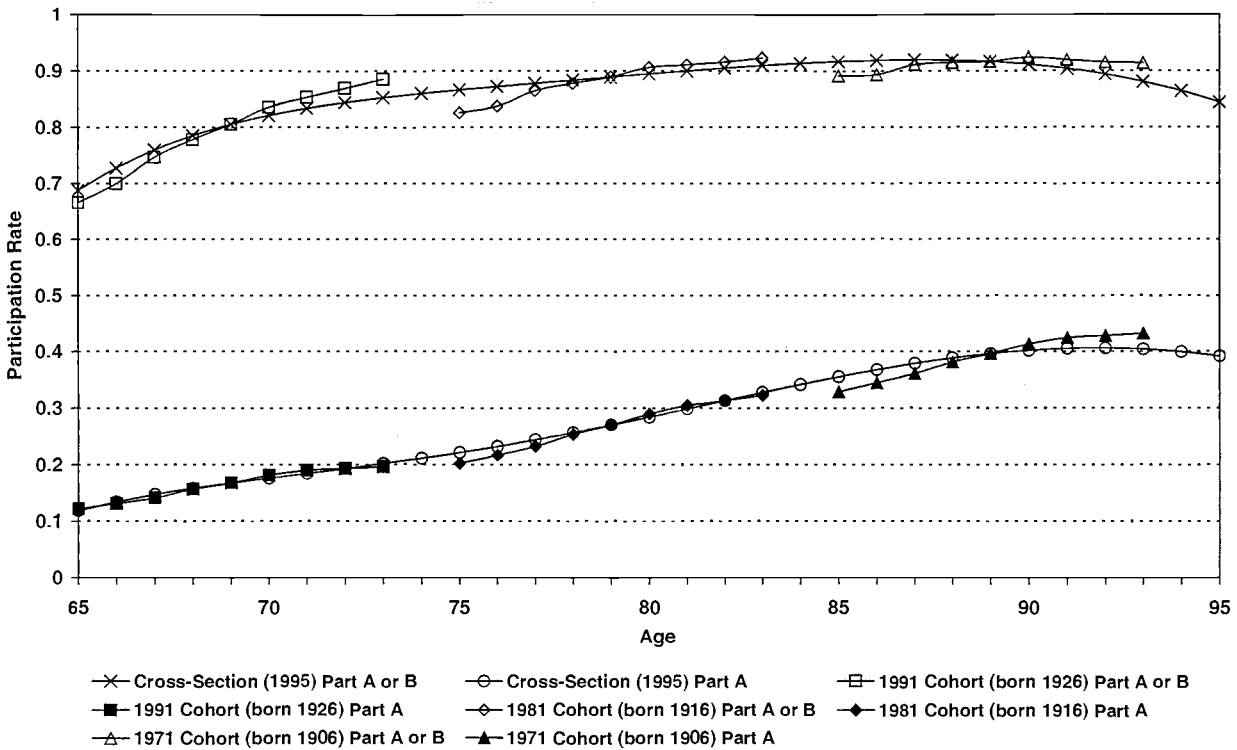

Fig. 3.4 Predicted annual reimbursement participation rates, including time effects, cross section (1995), and cohort profiles for part A and part A or B

44 percent, and the percentage change in the part A or B participation rate was 11 percent. For the 1971 cohort, the percentage change in the part A participation rate was 26 percent, and the percentage change in the part A or B participation rate was only 2 percent. Service use was increasing more rapidly for the younger cohorts, at least until the later years of the decade.

The rapid increase in the part A participation rate was due primarily to an increase in service use for skilled nursing facilities, home health agencies, and hospices, although inpatient hospital service use increased as well. Our estimates indicate that the participation rate for skilled nursing facility services increased from 1.9 percent to 4.3 percent from 1989 to 1997; the participation rate for home health agency services increased from 4.9 percent to 9.8 percent; and the participation rate for inpatient hospital services increased from 18.7 percent to 19.5 percent. After BBA97, part A and part A or B participation rates actually decreased, as shown in table 3.2. The participation rate for home health agency services decreased from 9.8 percent to 7.1 percent from 1997 to 1998. Participation rates for inpatient hospital and skilled nursing facility services remained constant. In figure 3.4, the part A participation rate cohort profiles increase until 1997, and then either flatten or decrease slightly, especially in the youngest (1991) cohort. The fact that the cohort profiles are less steep than the cross-sectional curve after 1997 indicates that part A participation rates for the 1991 and 1981 cohorts decreased more rapidly during this time period than can be attributed to pure age effects. Part A participation rates for the oldest cohort (1971) continued to increase despite the policy changes, but at a much lower rate.

Growth across Different Intensities of Use

Figure 3.5 shows the rate of growth across the distribution of annual Medicare expenditures. The cross-sectional curves show a snapshot of average annual Medicare expenditures in 1995 for the 10th, 50th, and 90th percentiles by age. Intensity of service use increases with age for all three percentile categories, at least until the late eighties or early nineties, when intensity of service use declines. Intensity of service use by age actually increases the most for the median percentile, as can be seen more clearly in figure 3.6, which shows only the 10th and median percentile categories. From age sixty-five to age ninety, the percent change in average annual expenditures is 162 percent for the 10th percentile, 266 percent for the median, and 133 percent for the 90th percentile.

Three cohort profiles are shown for the same percentiles for beneficiaries that turned sixty-five in 1991, 1981, or 1971. The cohort profiles show the actual life cycle growth in Medicare expenditures for the specified percentiles of each cohort. The cohort profiles intersect the cross-section profile at the ages of the cohorts in 1995 (that is, at age sixty-nine, seventy-nine, and eighty-nine). The fact that the cohort profiles are steeper than the

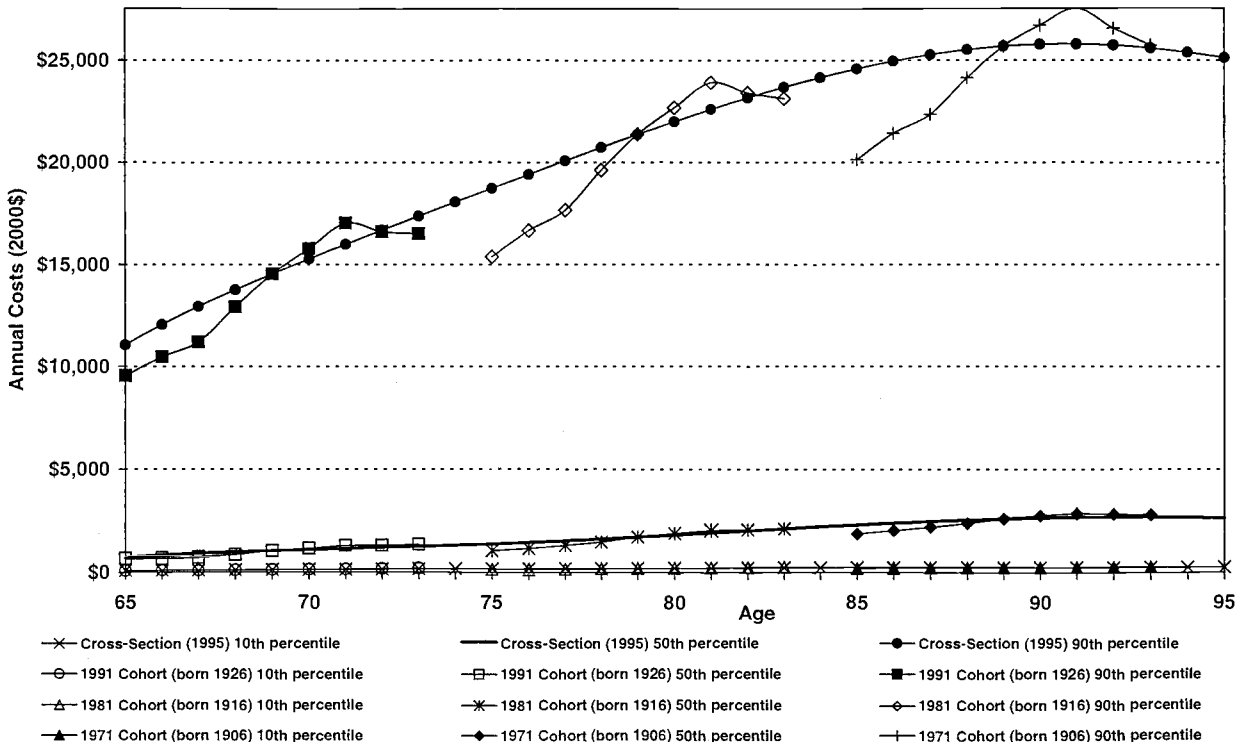

Fig. 3.5 Predicted annual total costs per patient, including time effects, cross section (1995), and cohort profiles for 10th, 50th, and 90th percentiles

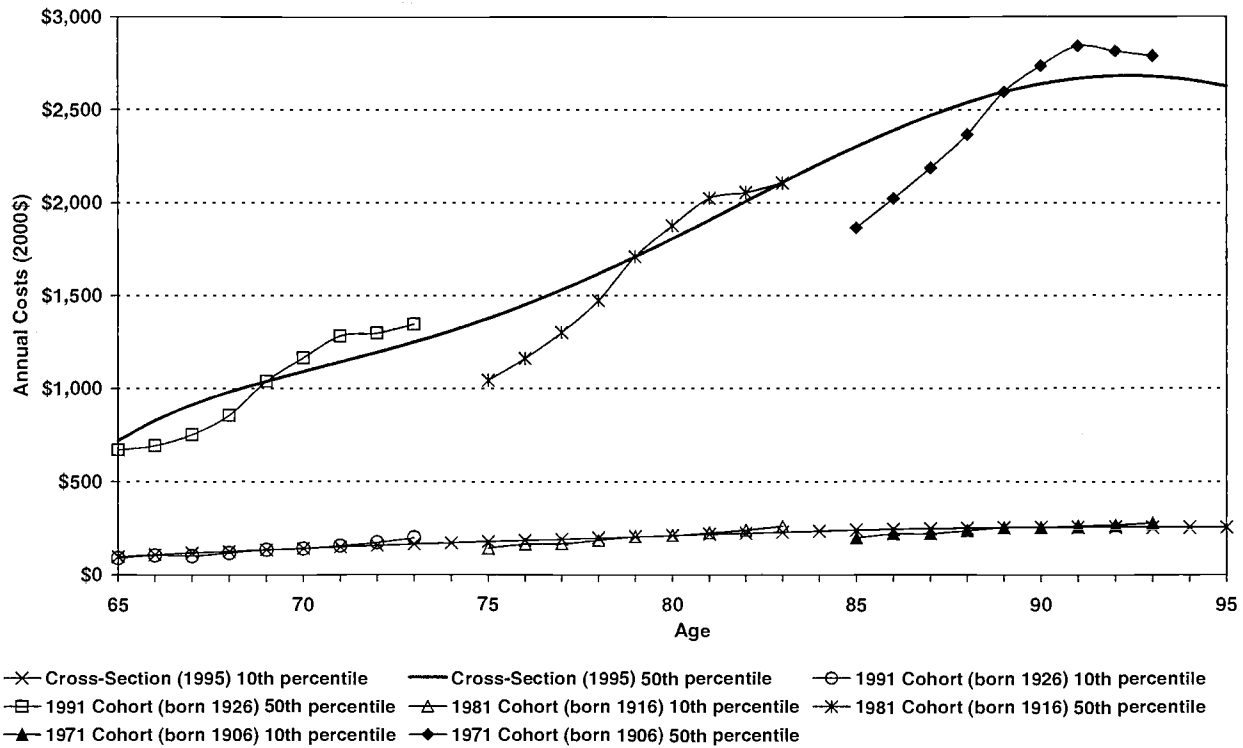

Fig. 3.6 Predicted annual total costs per patient, including time effects, cross section (1995), and cohort profiles for 10th and 50th percentiles

cross-sectional curve indicates that average annual Medicare expenditures grew much more rapidly for each cohort than can be attributed to pure aging, especially for the 90th percentile. However, the cohort profiles also show that annual Medicare expenditures after 1997 declined rapidly in the 90th percentile, remained constant in the median percentile (except for the oldest cohort, where there was a decline; see figure 3.6), and increased for the 10th percentile. The fact that the cohort profiles for the 10th percentile are steeper than those for the 50th or 90th percentiles indicates that Medicare expenditures grew more rapidly at the lower end of the expenditure distribution. The growth at the higher end was mitigated by the impact of BBA97, as indicated by the downward slope of the curves after 1997.

For the youngest (1991) cohort, the percentage change in total expenditures for the period from 1991 to 1999 was 48 percent (of the 1995 level) for the 90th percentile, 65 percent for the 50th percentile, and 80 percent for the 10th percentile. The pre-BBA97 percentage changes were 58 percent, 71 percent, and 57 percent, respectively. For the 1981 cohort, which was seventy-five years old in 1991, the rates of growth were 36 percent, 62 percent, and 57 percent, respectively. The pre-BBA97 percentage changes were 43 percent, 66 percent, and 44 percent, respectively. For the 1971 cohort, which was eighty-five years old in 1991, the rates of growth were 22 percent, 35 percent, and 32 percent, respectively. The pre-BBA97 percentage changes were 30 percent, 41 percent, and 27 percent, respectively. Collectively, our results indicate that expenditures grew more rapidly in the 10th and median percentile expenditure categories than for the 90th percentile category. Expenditures also grew more rapidly in the youngest cohort and less rapidly in the oldest cohort, with the middle cohort in between. Finally, the BBA97 reduced the rate of growth across all cohorts for the median and 90th percentile categories, but especially for the oldest cohort. The BBA97 actually increased the rate of growth for the 10th percentile, especially for the younger cohorts.

Figure 3.7 shows the rate of growth of average annual Medicare expenditures in 1995 for "high-cost" beneficiaries in the 90th, 95th, and 98th percentiles by age. Intensity of service use increases with age for all three percentile categories, at least until the late eighties or early nineties, when the intensity of service use declines. For the 98th percentile, the intensity of service use begins to decline around age eighty. Intensity of service use by age increases the most for the 90th percentile. From age sixty-five to age ninety, the percent change in average annual expenditures is 133 percent for the 90th percentile, 67 percent for the 95th percentile, and 29 percent for the 98th percentile.

Three cohort profiles are shown for the same percentiles for beneficiaries that turned sixty-five in 1991, 1981, or 1971. Similar to the results in figure 3.5, the cohort profiles are much steeper than the cross-sectional curve, indicating that average annual Medicare expenditures grew much more

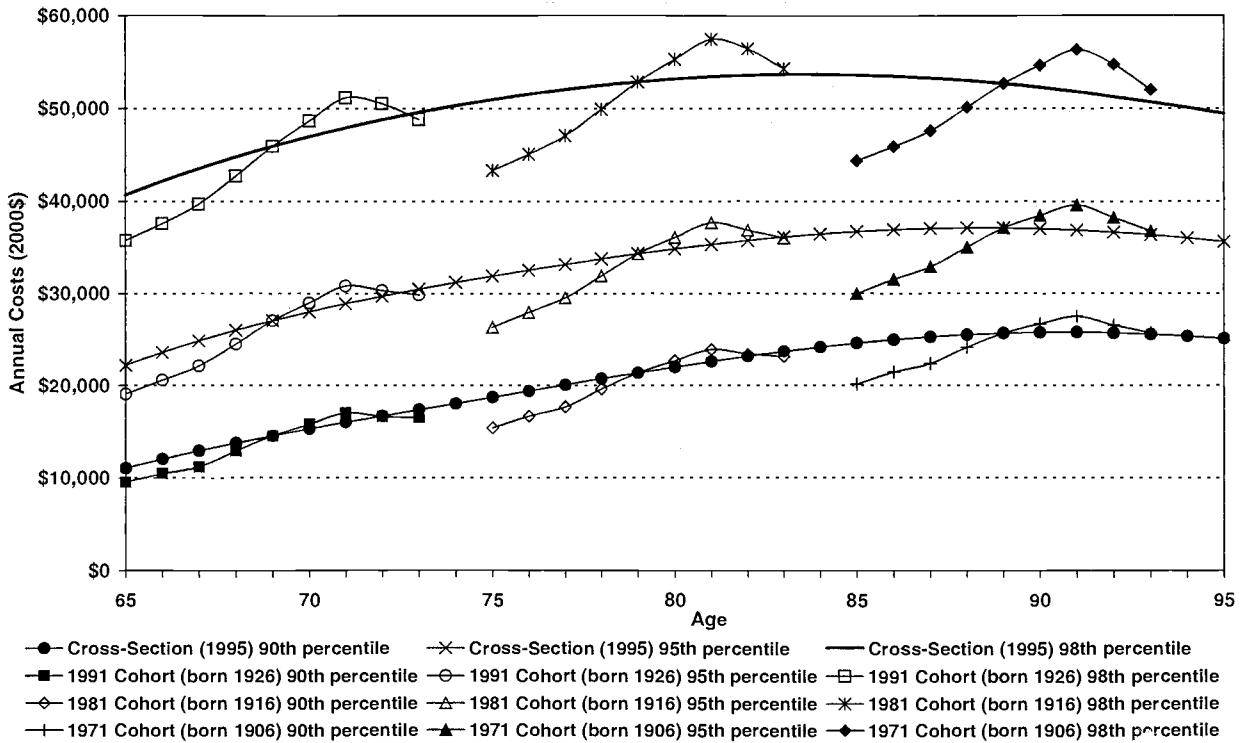

Fig. 3.7 Predicted annual total costs per patient, including time effects, cross section (1995), and cohort profiles for 90th, 95th, and 98th percentiles

rapidly for each cohort that can be attributed to pure aging, especially in the 98th percentile. The cohort profiles show that average annual Medicare expenditures for high-cost beneficiaries declined rapidly after 1997 in the 90th, 95th, and 98th percentiles. The fact that the cohort profiles for the 90th percentile are steeper than for the 95th or 98th percentiles indicates that Medicare expenditures grew less rapidly for the highest-cost users of Medicare services.

For example, for the youngest (1991) cohort, the percentage change in total expenditures for the period from 1991 to 1999 was 28 percent (of the 1995 level) for the 98th percentile, 40 percent for the 95th percentile, and 48 percent for the 90th percentile. The pre-BBA97 percentage changes were 36 percent, 48 percent, and 58 percent for the 98th, 95th, and 90th percentiles, respectively. For the 1981 cohort, seventy-five years of age in 1991, the rates of growth were 21 percent, 28 percent, and 36 percent, respectively. The pre-BBA97 percentage changes were 28 percent, 35 percent, and 43 percent, respectively. For the 1971 cohort, those eighty-five years of age in 1991, the rates of growth were 14 percent, 18 percent, and 22 percent, respectively. The pre-BBA97 percentage changes were 24 percent, 27 percent, and 30 percent, respectively. Collectively, our results indicate that expenditures grew more rapidly in the 90th percentile category, less rapidly in the 95th percentile category, and the least rapidly in the 98th percentile category. Expenditures also grew the most rapidly in the youngest cohort across each percentile category and less rapidly in the oldest cohort, with the middle cohort in between. Finally, the BBA97 reduced the rate of growth across all cohorts and all percentile categories, but especially for the oldest cohort and the 98th percentile category.

Trends Have Changed

Figures 3.8, 3.9, and 3.10 show the growth rate of expenditures for an earlier time period than the previous figures. Figures 3.8 and 3.9 show the cross-sectional curves and the cohort profiles using the 1991 cross section as reference for the 10th, median, and 90th percentiles by age. The cohort profiles intersect the cross-section profile at the ages of the 1967, 1977, and 1987 cohorts in 1991 (that is, at age sixty-nine, seventy-nine, and eighty-nine, respectively). Comparison of figures 3.8 and 3.5 demonstrates that the trends forecasted by previous studies were not realized. Using the earlier cohort suggests growth rates of 49 percent, 62 percent, and 58 percent for the 90th, median, and 10th percentiles, respectively. For the 1977 cohort, the growth rates were 41 percent, 67 percent, and 50 percent. For the 1967 cohort, the growth rates were 36 percent, 43 percent, and 30 percent. The policy changes of the late 1990s mitigated these growth rates, especially for the older cohorts and the higher percentiles.

Similarly, figure 3.10 shows the cross-sectional curves and the cohort profiles using the 1991 cross section as reference for the 90th, 95th, and

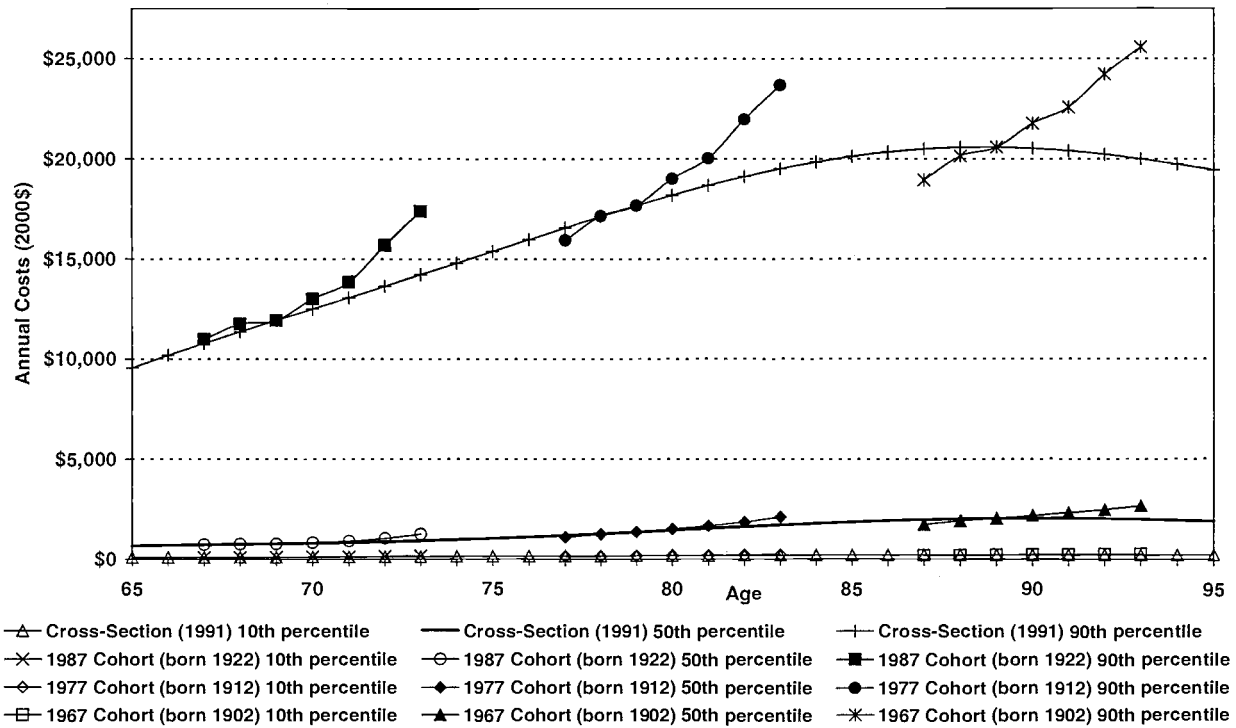

Fig. 3.8 Predicted annual total costs per patient, including time effects, cross section (1991), and cohort profiles for 10th, 50th, and 90th percentiles

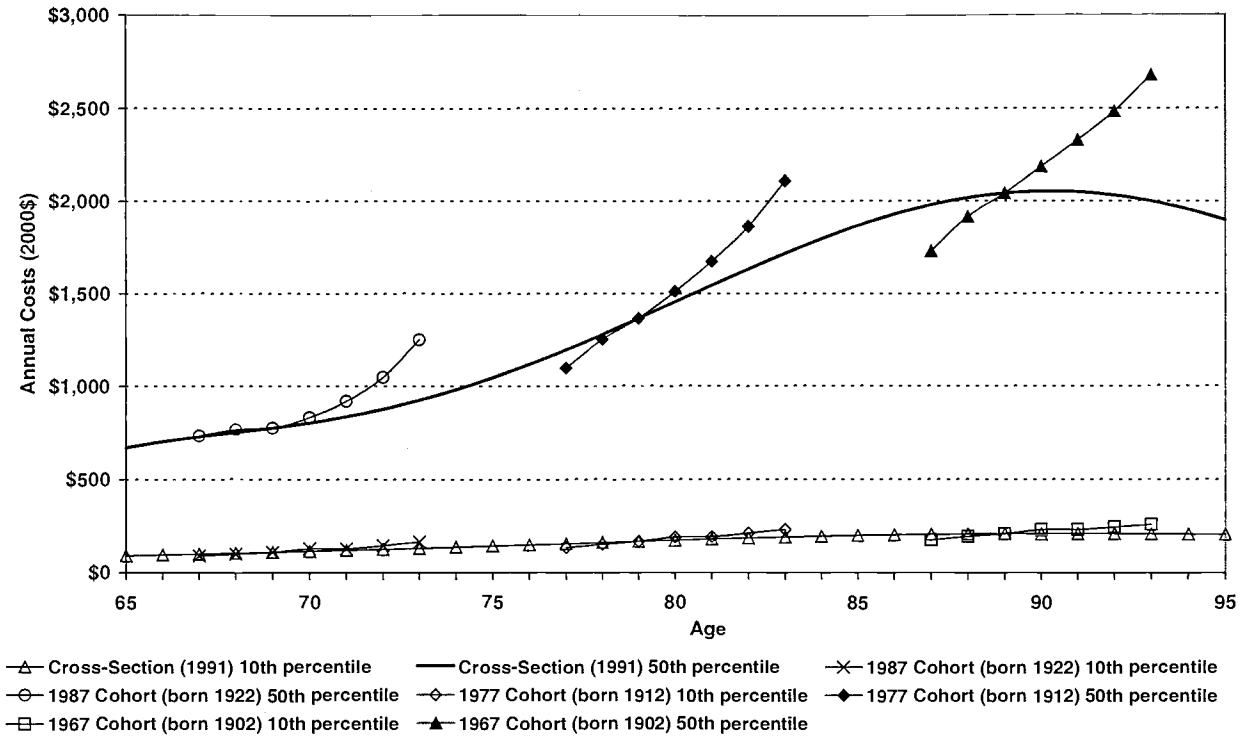

Fig. 3.9 Predicted annual total costs per patient, including time effects, cross section (1991), and cohort profiles for 10th and 50th percentiles

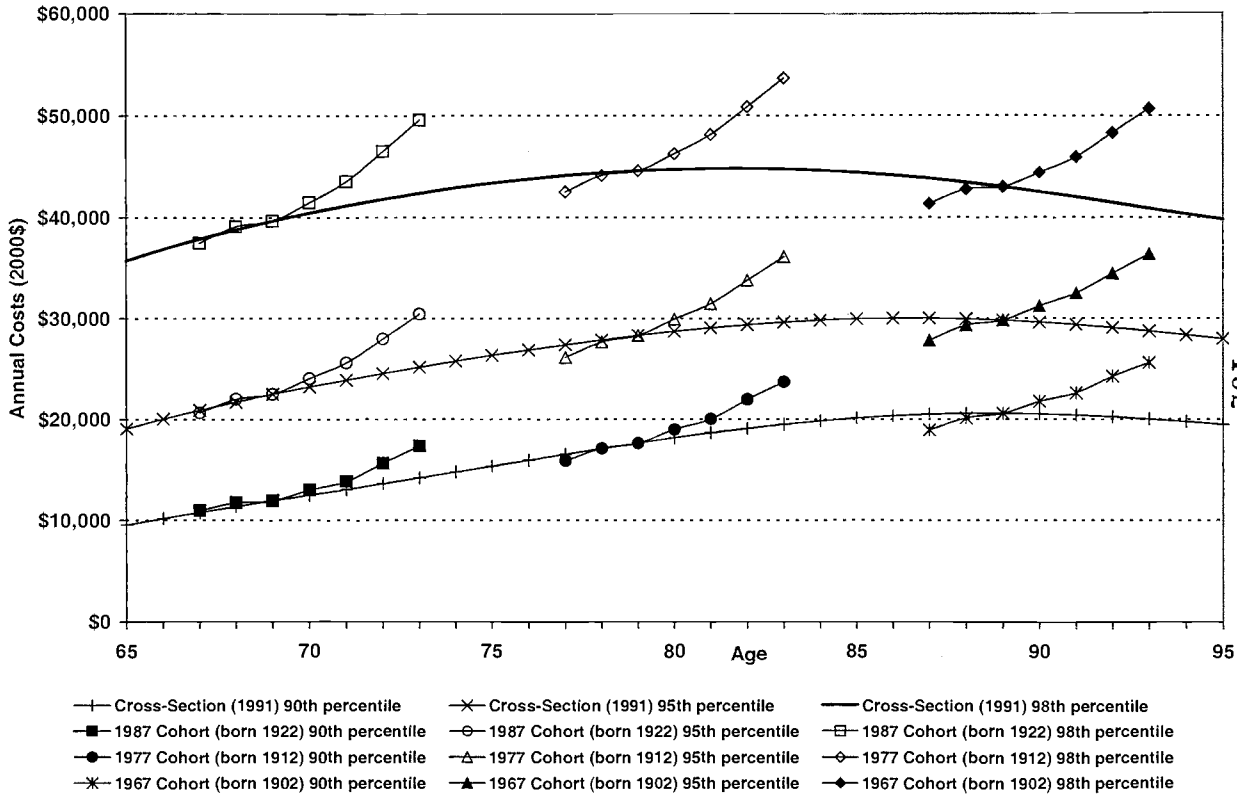

Fig. 3.10 Predicted annual total costs per patient, including time effects, cross section (1991), and cohort profiles for 90th, 95th, and 98th percentiles

98th percentiles by age. Using the earlier cohort suggested growth rates of 29 percent, 41 percent, and 49 percent for the 98th, 95th, and 90th percentiles, respectively. For the 1977 cohort, the growth rates were 24 percent, 33 percent, and 41 percent. For the 1967 cohort, the growth rates were 21 percent, 27 percent, and 30 percent. Again, the policy changes of the late 1990s mitigated these growth rates, especially for the older cohorts and the higher percentiles. However, the results from section 3.2 suggest that this reduction in the growth rate represents only a temporary change as the result of policy changes implemented concurrently with BBA97. Administrative data from recent years through 2003 indicate that Medicare expenditures have reverted back to the trends suggested by the 1991 cross section. Therefore, the growth profiles suggested by figures 3.5 and 3.7 are unlikely to be realized as well. The trends in administrative data presented in section 3.2 indicate that the growth in Medicare expenditures has reverted to previous rates and may have even accelerated.

3.4 Concentration of Expenditures among High-Cost Users

Characterizing Medicare beneficiaries by their annual expenditures severely limits both the identification of high-cost users of health care and the intensity of utilization over short periods. It is possible that a beneficiary who has high expenses over two adjacent years may not register as being in a high-cost category in either of the years, even though total costs expended on treating this person's health affliction exceed the annual thresholds in the years when treatment occurs. Further, assessing the extent of concentration in expenditures becomes fuzzy because expenses overlapping two calendar years suggest persistence, whereas none would be inferred if these expenses were merely shifted slightly in time to fit more expenditure months into a single calendar year.

The following analysis explores several options for overcoming these shortcomings by developing profiles of Medicare costs from our monthly longitudinal expenditure data. Although the discussion relies on calendar years as a reference time frame to integrate the analysis with previous results, it also considers a variety of other time frames with the aim of creating a transparent approach for identifying the high-cost users and for discovering patterns of their use. This section initially considers alternative definitions of high-cost months, paralleling the analysis done characterizing high-cost years. Using several candidate definitions, the analysis then summarizes experiences across various populations of Medicare beneficiaries. The discussion next takes up the problem of using monthly experiences to explore simple ways of identifying beneficiaries responsible for the bulk of Medicare expenditures. Finally, this section ends with a summary of the monthly experiences of the high-cost users.

3.4.1 Allocation of Expenditures across High-Cost Months

After considering several time frames for computing the percentiles associated with monthly expenditures, we selected the following procedure: (a) index all expenditures to be in 2000$, (b) compute percentiles for the sample consisting of all months having positive expenditures in a given calendar year, and (c) assign months based on whether they lie above the 80 percent, 90 percent, 95 percent, and 98 percent portion of the distribution of months for the year in which they fall. This procedure produces a classification for all months, with the 80 percent months referring to the 20 percent of months with the highest expenditures during the year, the 90 percent months designating the 10 percent of months with the highest expenditures during the year, and so on.

We examined the implications of using time frames both shorter and longer than a year when computing percentiles for months. For time frames shorter than a year, substantial influences of seasonality occur. This results in many lower-cost months being classified in high-cost categories due to their occurrence in periods of the year when patients disproportionately elect less intensive health treatments. For time frames longer than a year, the secular growth in health expenses over time means that a disproportionate number of months are selected in the latest year, when costs are higher overall.

Table 3.6 presents the percentiles of monthly expenditures by year, measured in 2000$ including only months with positive expenses. Generally, the 98th percentile is about 350 times greater than the 10th percentile, nearly 100 times larger than the 50th percentile, almost five times the size of the 90th percentile, and about twice as large as the 95th percentile. Not surprisingly, the distribution of monthly expenditures exhibits extreme

Table 3.6 **Percentiles for monthly expenditures for Medicare participants**

	Levels of monthly cost percentiles (2000 $)					
Year	10	50	80	90	95	98
1989	28	101	452	1,588	5,063	9,884
1990	28	104	475	1,628	4,983	9,806
1991	29	107	501	1,636	4,845	9,667
1992	30	113	539	1,762	4,933	9,846
1993	29	111	554	1,773	4,755	9,737
1994	31	111	577	1,937	4,961	10,295
1995	33	117	622	2,075	5,087	10,712
1996	32	115	634	2,106	5,160	11,023
1997	32	115	644	2,127	5,178	11,233
1998	32	114	583	1,959	5,028	11,075
1999	33	117	558	1,863	4,863	10,631

Table 3.7 **Share of annual Medicare expenditures accounted for by monthly percentile groups (%)**

	Monthly percentile categories						
Year	0–50	50–80	80–90	90–95	95–98	98+	Total
1989	2.6	6.9	9.1	17.1	22.9	41.4	100.0
1990	2.7	7.2	9.5	17.0	22.7	40.9	100.0
1991	2.8	7.6	9.9	16.6	22.5	40.7	100.0
1992	2.9	7.8	10.3	16.6	22.3	40.1	100.0
1993	2.8	7.9	10.6	16.2	21.9	40.5	100.0
1994	2.8	7.6	10.9	16.4	22.0	40.4	100.0
1995	2.8	7.8	11.2	16.3	21.8	40.1	100.0
1996	2.7	7.7	11.3	16.1	21.9	40.3	100.0
1997	2.7	7.5	11.4	15.9	21.7	40.7	100.0
1998	2.8	7.3	10.7	15.6	21.9	41.8	100.0
1999	3.0	7.5	10.4	15.6	21.8	41.7	100.0

skewness, as found for annual expenditures. Also, the trends followed by the various percentiles over time mirror the trends discussed previously for the annual percentiles.

Table 3.7 reports the shares of total Medicare expenditures accounted for by the various monthly percentile ranges by year. Similar to the findings for annual ranges, the shares for the monthly ranges remain remarkably stable over the 1989 to 1999 period. This phenomenon has occurred even though the growth rates in overall Medicare expenditures have varied considerably over the period. According to the table, the 2 percent of months making up the 98+ percentile account for about 41 percent of total annual expenditures, the 5 percent of months making up the 95+ percentile cover nearly 63 percent of yearly Medicare expenditures, the 10 percent of months in the 90+ group include 79 percent of total expenses, and the top 20 percent of months in the 80+ group account for almost 90 percent of expenditures. Thus, describing the occurrence of months with expenditures above the 80th percentile captures essentially all of Medicare expenditure, and these months make up far less than 20 percent of all months since many months have zero expenditures.

3.4.2 Patterns for Monthly Medicare Expenditures across Participants

Tables 3.8 through 3.11 present an array of statistics summarizing the incidence of high-cost months for various populations of Medicare beneficiaries. Each table describes the distributions of experiences for months classified as high cost by the table, with definitions of "high cost" different across tables. In addition to months of experience, these tables report shares indicating the size of the beneficiary population and the fraction of total Medicare expenditures accounted for by each group identified in rows of the tables.

Table 3.8 **Summary of incidence of 80%-high-cost months among Medicare patients with experience: Elderly (1989–99)**

Patient characteristics	Share of Medicare patients (%)		Total no. of high-cost months				No. of high-cost month spells				Length of high-cost spells				Share of Medicare expenditures (%)	
				Percentiles				Percentiles				Percentiles				
	All	High-cost month group	Mean	20	50	80	Mean	20	50	80	Mean	20	50	80	All months	High-cost months
Patients w/ experience	86.8	100.0	9.1	2	6	14	4.9	2	4	8	2	1	1.4	2	99.6	89.7
Gender																
Male	36.2	41.7	8.8	2	6	13	4.8	1	4	8	1.9	1	1.4	2	41.9	38.2
Female	50.6	58.3	9.4	2	6	14	5	2	4	8	2	1	1.4	2	57.7	51.4
Age																
65–69	26.5	30.5	4.7	1	3	7	2.8	1	2	4	1.7	1	1	2	15.7	14.0
70–74	28.3	32.7	5.4	1	3	8	3.1	1	2	5	1.8	1	1.2	2	19.4	17.4
75–79	25.0	28.8	5.9	2	4	9	3.2	1	3	5	2	1	1.3	2	18.8	17.0
80–84	18.8	21.7	6.3	2	4	9	3.2	1	3	5	2.1	1	1.4	2.3	14.9	13.6
85–89	11.8	13.6	6.4	2	4	9	3.1	1	2	5	2.3	1	1.5	2.5	9.4	8.6
90+	5.5	6.4	6.8	2	4	10	3.1	1	2	5	2.4	1	1.5	2.7	4.7	4.3
Cost percentile any year																
GE 80th percentile	58.5	67.4	12.1	4	9	17	6	2	5	9	2.3	1.2	1.6	2.5	93.1	85.6
GE 90th percentile	38.1	43.9	14.7	6	11	21	6.6	3	6	10	2.8	1.3	1.8	3	79.4	74.3
GE 95th percentile	22.4	25.8	17.3	7	14	25	7	3	6	11	3.3	1.5	2	3.6	59.9	56.9
GE 98th percentile	10.1	11.6	20.5	9	16	30	7.2	3	6	11	4	1.7	2.4	4.5	36.2	34.8
Cost percentile any 2 years																
GE 80th percentile	32.0	36.9	17.2	8	14	24	7.8	4	7	11	2.8	1.3	1.8	3	72.1	67.1
GE 90th percentile	14.6	16.8	22.8	12	19	31	8.6	4	8	12	3.7	1.6	2.2	4	47.1	44.8
GE 95th percentile	5.9	6.8	28.7	15	24	40	8.8	4	8	13	5.1	1.9	2.8	5.7	26.1	25.2
GE 98th percentile	1.7	2.0	35.6	20	31	49	8.5	4	8	13	7.5	2.3	3.7	9	11.0	10.7

Table 3.9 **Summary of incidence of 90%-high-cost months among Medicare patients with experience: Elderly (1989–99)**

Patient characteristics	Share of Medicare patients (%)		Total no. of high-cost months				No. of high-cost month spells				Length of high-cost spells				Share of Medicare expenditures (%)	
				Percentiles				Percentiles				Percentiles				
	All	High-cost month group	Mean	20	50	80	Mean	20	50	80	Mean	20	50	80	All months	High-cost months
Patients w/ experience	75.3	100.0	5.3	1	3	8	3.3	1	3	5	1.6	1	1.2	1.9	98.1	79.1
Gender																
Male	31.6	41.9	5.2	1	3	8	3.3	1	3	5	1.6	1	1.2	2	41.3	34.1
Female	43.8	58.1	5.3	1	3	8	3.4	1	3	5	1.6	1	1.1	1.8	56.8	45.0
Age																
65–69	18.9	25.1	3.2	1	2	4	2.1	1	1	3	1.5	1	1	1.7	14.9	12.3
70–74	21.6	28.7	3.5	1	2	5	2.2	1	2	3	1.6	1	1	2	18.6	15.3
75–79	20.1	26.7	3.7	1	2	5	2.3	1	2	3	1.6	1	1	2	18.2	15.0
80–84	15.8	21.0	3.8	1	3	5	2.4	1	2	3	1.6	1	1	2	14.6	12.0
85–89	10.2	13.5	3.8	1	3	5	2.4	1	2	3	1.6	1	1	2	9.2	7.6
90+	4.9	6.5	4	1	3	6	2.5	1	2	4	1.7	1	1.2	2	4.6	3.8
Cost percentile any year																
GE 80th percentile	58.4	77.6	6.3	2	5	9	3.9	2	3	6	1.7	1	1.3	2	93.1	76.6
GE 90th percentile	38.1	50.6	8	3	6	11	4.5	2	4	7	2	1.1	1.5	2.1	79.4	67.4
GE 95th percentile	22.4	29.7	10	4	8	14	5	2	4	7	2.3	1.3	1.7	2.5	59.9	52.4
GE 98th percentile	10.1	13.4	12.6	5	10	17	5.4	2	5	8	2.9	1.4	2	3	36.2	32.6
Cost percentile any 2 years																
GE 80th percentile	32.0	42.4	9.1	4	7	12	5.3	3	5	7	1.9	1.1	1.4	2	72.1	60.1
GE 90th percentile	14.6	19.4	12.9	7	10	17	6.4	4	6	9	2.5	1.3	1.7	2.5	47.1	40.8
GE 95th percentile	5.9	7.8	18	9	14	24	7.2	4	7	10	3.5	1.5	2	3.5	26.1	23.4
GE 98th percentile	1.7	2.3	25	13	20	35	7.5	4	7	11	5.5	1.8	2.6	6	11.0	10.2

Table 3.10 **Summary of incidence of 95%-high-cost months among Medicare patients with experience: Elderly (1989–99)**

Patient characteristics	Share of Medicare patients (%)		Total no. of high-cost months				No. of high-cost month spells				Length of high-cost spells				Share of Medicare expenditures (%)	
				Percentiles				Percentiles				Percentiles				
	All	High-cost month group	Mean	20	50	80	Mean	20	50	80	Mean	20	50	80	All months	High-cost months
Patients w/ experience	60.7	100.0	3.3	1	2	5	2.6	1	2	4	1.2	1	1	1.5	93.3	62.9
Gender																
Male	26.0	42.8	3.2	1	2	5	2.5	1	2	4	1.3	1	1	1.5	39.6	27.6
Female	34.8	57.2	3.3	1	2	5	2.6	1	2	4	1.2	1	1	1.5	53.7	35.3
Age																
65–69	12.7	21.0	2.3	1	1	3	1.8	1	1	2	1.2	1	1	1.3	13.5	9.8
70–74	15.1	24.9	2.4	1	2	3	1.9	1	1	3	1.3	1	1	1.5	17.0	12.2
75–79	14.6	24.0	2.5	1	2	4	1.9	1	1	3	1.3	1	1	1.5	16.8	11.9
80–84	12.0	19.7	2.5	1	2	4	2	1	1	3	1.3	1	1	1.5	13.5	9.5
85–89	8.1	13.4	2.5	1	2	4	2	1	2	3	1.3	1	1	1.5	8.6	6.1
90+	4.1	6.8	2.6	1	2	4	2	1	2	3	1.3	1	1	1.5	4.4	3.1
Cost percentile any year																
GE 80th percentile	56.2	92.6	3.4	1	2	5	2.7	1	2	4	1.3	1	1	1.5	91.7	62.1
GE 90th percentile	38.0	62.5	4.3	2	3	6	3.2	1	3	5	1.4	1	1.2	1.7	79.2	55.8
GE 95th percentile	22.4	36.9	5.4	3	4	8	3.8	2	3	5	1.5	1	1.3	1.9	59.9	44.1
GE 98th percentile	10.1	16.6	7	3	6	10	4.5	2	4	6	1.7	1.1	1.5	2	36.2	28.0
Cost percentile any 2 years																
GE 80th percentile	31.6	52.1	4.8	2	4	7	3.7	2	3	5	1.3	1	1.1	1.5	71.7	48.7
GE 90th percentile	14.6	24.0	6.8	4	6	9	4.9	3	4	7	1.4	1	1.3	1.7	47.1	33.5
GE 95th percentile	5.90	9.70	9.3	5	8	12	6.1	4	6	8	1.6	1.2	1.4	1.8	26.1	19.3
GE 98th percentile	1.70	2.90	13	8	11	17	7.4	4	7	10	1.9	1.3	1.6	2.2	11.0	8.5

Table 3.11 **Summary of incidence of 98%-high-cost months among Medicare patients with experience: Elderly (1989–99)**

Patient characteristics	Share of Medicare patients (%)		Total no. of high-cost months				No. of high-cost month spells				Length of high-cost spells				Share of Medicare expenditures (%)	
				Percentiles				Percentiles				Percentiles				
	All	High-cost month group	Mean	20	50	80	Mean	20	50	80	Mean	20	50	80	All months	High-cost months
Patients w/ experience	39.7	100.0	2	1	1	3	1.8	1	1	2	1.1	1	1	1	78.6	40.8
Gender																
Male	17.5	44.0	2	1	1	3	1.7	1	1	2	1.1	1	1	1	34.0	18.5
Female	22.2	56.0	2	1	1	3	1.8	1	1	2	1.1	1	1	1	44.6	22.3
Age																
65–69	7.3	18.5	1.7	1	1	2	1.5	1	1	2	1.1	1	1	1	10.8	6.6
70–74	9.0	22.7	1.7	1	1	2	1.5	1	1	2	1.1	1	1	1	13.8	8.2
75–79	8.8	22.1	1.7	1	1	2	1.5	1	1	2	1.1	1	1	1	13.5	7.9
80–84	7.0	17.8	1.7	1	1	2	1.5	1	1	2	1.1	1	1	1	10.6	6.0
85–89	4.6	11.6	1.7	1	1	2	1.5	1	1	2	1.1	1	1	1	6.6	3.7
90+	2.3	5.8	1.7	1	1	2	1.5	1	1	2	1.1	1	1	1	3.3	1.8
Cost percentile any year																
GE 80th percentile	39.7	100.0	2	1	1	3	1.8	1	1	2	1.1	1	1	1	78.6	40.8
GE 90th percentile	34.1	86.0	2.1	1	2	3	1.9	1	1	3	1.1	1	1	1	74.3	38.8
GE 95th percentile	21.7	54.6	2.6	1	2	4	2.2	1	2	3	1.2	1	1	1.5	58.5	31.9
GE 98th percentile	10.0	25.2	3.4	2	3	5	2.7	1	2	4	1.3	1	1	1.5	36.0	21.2
Cost percentile any 2 years																
GE 80th percentile	25.8	65.0	2.4	1	2	3	2.1	1	2	3	1.1	1	1	1.2	64.5	31.7
GE 90th percentile	13.9	35.1	3.2	2	3	4	2.7	2	2	4	1.2	1	1	1.3	45.6	23.1
GE 95th percentile	5.80	14.60	4.3	2	4	6	3.5	2	3	5	1.2	1	1	1.5	25.8	13.7
GE 98th percentile	1.70	4.40	6.2	4	6	8	4.7	3	4	6	1.4	1	1.3	1.6	10.9	6.2

Characteristics of High-Cost Users and Structure of Tables

The first column of tables 3.8 through 3.11 lists the groups of Medicare beneficiaries whose experiences are summarized in the remaining columns. The rows designated in the first column specify the classifications of beneficiaries considered in the analysis. The table groups rows into five categories:

- *Patients w/experience:* This row describes population shares and attributes of the distributions of high-cost months for all beneficiaries who experience at least one month classified as high cost by the table any time during the 1989–99 period. All of the remaining rows report results for segments of this population.
- *Gender:* The top set of rows reports experiences for males and females separately.
- *Age:* The next set of rows presents distributions of high-cost months by age groups. Groups consist of beneficiaries who were the age indicated at the start of the bracket, with observations included for years covered by the bracket, or until the person died if this event occurred before reaching the age at the end of the age bracket. Beneficiaries can, of course, be members of more than one age group if they experience multiple high-cost episodes that occur at different ages.
- *Cost percentile, any year:* This set of rows summarizes the incidence of high-cost months for groups of beneficiaries classified by whether their calendar-year expenditures reach particular thresholds. The "GE 80th percentile" refers to all beneficiaries who had expenditures above the 80th calendar-year percentile in any year during the 1989–99 period, the "GE 90th percentile" group includes all beneficiaries with expenditures above the 90th annual percentile in any year of the period, and so on through the 98 percent level of annual expenditures.
- *Cost percentile, any 2 year:* The final set of rows categorizes beneficiaries according to whether their calendar-year expenditures attain the "GE 80th percentile," "GE 90th percentile," "GE 95th percentile," and "GE 98th percentile" categories in two or more years.

The second through the last columns of tables 3.8 through 3.11 present five categories of statistics for each of the Medicare beneficiary groups:

- *Share of Medicare patients:* These columns report the share of Medicare patients in the group (defined by the row) for two different Medicare populations. The first column ("All") shows the share of all patients, where "patients" refers to all beneficiaries who received any Medicare services during the 1989–99 period. The second column ("High-cost month group") gives the percentage of the group of patients with at least one month classified as high cost by the table.

For example, table 3.8 shows that female patients who experienced at least one of month falling into the 80th expenditure percentile category comprise 50.6 percent of all the beneficiaries who received at least one Medicare service between 1989 and 1999. Further, females account for 58.3 percent of all the patients who make up the 80th percentile group.

Referring to the rows designating age brackets, table 3.8 shows that 26.5 percent of elderly receiving at least one Medicare service between 1989 and 1999 were ages sixty-five to sixty-nine when they experienced a high-cost month falling into the 80th expenditure percentile category, and 30.5 percent of those in the 80th expenditure percentile category were sixty-five to sixty-nine years old when they experienced at least one high-cost month. The corresponding figures for the seventy to seventy-four age group are 28.3 percent and 32.7 percent, implying that more of the 1989–99 Medicare beneficiary population experienced a high-cost month during ages seventy to seventy-four. Because members of the 1989–99 Medicare beneficiary population are typically represented in several age groups and may experience multiple high-cost episodes at different ages, percentages in these rows do not add up to 100 percent or to the overall population.

- *Total no. of high-cost months:* This group of columns summarizes properties of the distribution of the total number of high-cost months experienced during the 1989–99 period. The column labeled "Mean" presents the average number of months experienced by beneficiaries in the specified row, and the next three columns show the percentiles of the distribution of the number of high-cost months.

  Referring again to female patients, this group of columns in table 3.8 shows that women with at least one high-cost month (i.e., in top 20 percent of months) had an average of 9.4 high-cost months during the 1989–99 decade. Twenty percent had two or fewer high-cost months during this period, half had six or fewer such months, and 80 percent experienced up to fourteen high-cost months.
- *No. of high-cost spells:* The next set of columns reports statistics describing the number of high-cost month spells experienced by the prescribed population during the 1989–99 period, with a spell defined as a continuous series of high-cost months. These columns show the average number of spells, along with percentiles associated with the distribution.

  Continuing the above example for table 3.8, women with at least one high-cost month (i.e., in top 20 percent of months) had an average of five high-cost spells during the 1989–99 decade. The median such woman had four high-cost spells. Twenty percent had two or fewer high-cost spells, and 80 percent had eight or fewer of these spells.
- *Length of high-cost spells:* This set of columns presents statistics characterizing the lengths of all high-cost spells experienced by beneficiar-

ies in the specified group of beneficiaries, giving the average and percentiles describing the lengths (in months) of completed spells.

According to table 3.8, the average length of high-cost spells for women with at least one high-cost month (i.e., in top 20 percent of months) was two months. The 20th, 50th, and 80th percentiles were 1, 1.4, and 2 months, respectively.

- *Share of Medicare expenditures:* The last set of columns reports two shares of total Medicare expenditures spent during the 1989–99 period attributable to the group of beneficiaries in a given row, with all quantities measured in nondiscounted 2000$. The left column in this set ("All months") shows the share of total expenditures accounted for by the sum of expenditures for all months for the population of beneficiaries specified in the row. The right column ("High-cost months") lists the share of total expenditures due to the sum of expenditures in only over those months classified as high cost by the table.

  Inspection of table 3.8 reveals that female patients who experienced at least one of month classified in the 80th expenditure percentile category account for 57.7 percent of total Medicare expenditures during the 1989–99 period. Counting expenditures for this group that occur only in their high-cost months accounts for 51.4 percent of total Medicare expenditures.

Portrait of High-Cost Month Experiences

Tables 3.8 through 3.11 present results considering only the elderly segment of the Medicare population—beneficiaries 65 years and older. Results differ only marginally considering Medicare beneficiaries of all ages (which also includes the younger disabled population). Table 3.8 reports the distributions of experiences for months classified as having expenditures above the 80th percentile. Table 3.9 gives findings for months with expenditures above the 90th percentile. Table 3.10 lists distributions for the 95th percentile of monthly expenditures. Finally, table 3.11 presents findings for months in the 98th percentile of expenditures.

Inspecting the first row of table 3.8, we see in the first set of columns that 86.8 percent of elderly Medicare beneficiaries experience at least one month during the 1989–99 decade in which they receive medical services costing above the 80th percentile for months during the year of expenditures. So practically everyone can be considered a high-cost user at some time in their lifetime over a short enough period.

Moving to the farthest left set of columns, we see that this group of beneficiaries accounts for 99.6 percent of all Medicare expenditures totaled over the 1989–99 decade. Counting only expenses incurred during their high-cost months covers 89.7 percent of total expenditures. Thus, knowledge of the expenses incurred during only high-cost months for this group essentially accounts for all but a minor portion of Medicare spending.

According to the other columns in table 3.8 for the "Patients w/ experi-

ence" row, the average number of high-cost months experienced was 9.1, with 20 percent of the group having two or fewer months, 50 percent having six or fewer months, and 20 percent having fourteen or more months classified as high cost. This group experienced an average of 4.9 spells, with 20 percent having eight or more. Spells are short, lasting two months on average, with less than 20 percent of beneficiaries experiencing spells lasting longer. On average, women had slightly more high-cost months than men (9.4 versus 8.8).

Examining table 3.9 for the group of elderly beneficiaries who received health services during a month costing above the 90th percentile level for months during the year, we see that 75.3 percent of all beneficiaries make up this group. Total spending on this group accounts for 98.1 percent of all Medicare expenditures for the 1989–99 decade, and expenses incurred during high-cost months for this group cover 79.1 percent of total expenditures. Thus, considering only this classification of high-cost months covers all but about 20 percent of the decade's expenditure on Medicare. The average number of months defined as high cost by this definition equals 5.3, occurring in an average of 3.3 spells per recipient. Only 20 percent of the group had eight or more months classified as high cost, and 20 percent had five or more spells. Once again, spells tend to be short. Further, women had slightly more high-cost months than men (5.3 versus 5.2 months).

Turning to tables 3.10 and 3.11, which classify high-cost months as achieving expenses reaching the 95th and 98th percentiles for monthly expenditures, reference to the top row indicates that the fraction of beneficiaries experiencing these high levels of spending still involves a substantial segment of the elderly population: 60.7 percent have at least one 95th percentile month, and 39.7 percent have one or more 98th percentile months. Spending on the 98th percentile group consumes 78.6 percent of all Medicare expenditures accumulated over the 1989–99 decade, and the sum of those expenses incurred during only high-cost months covers 40.8 percent of total expenditures. The spending on the 95th percentile group accounts for 62.9 percent of total expenditures for the decade according to the last column of table 3.10. Thus, knowledge of the incidence of 95th percentile months alone explains nearly two-thirds of Medicare spending over the decade.

Inspecting the rows in tables 3.8 through 3.11 describing experiences by age groups reveals that average high-cost months are nondecreasing in age, consistent with the view that costs rise with age given the onset of chronic illness. A notable increase in averages can be seen for the 80th percentile months; however, the difference decreases at higher percentiles. In particular, for 98th percentile months, averages and distributions remain constant across age groups. The shares of total Medicare expenditures accounted for by high-cost-month beneficiaries and by high-cost months do not exhibit a monotonic relationship with age. This reflects the fact that although average Medicare experiences generally rise with age, the overall

size of age groups declines the older the group. Consequently, the contribution of age groups to the high-cost month population depends on how mortality rates balance against the occurrence of illnesses leading to the incidence of intense use of medical services.

Across all demographic groups considered in tables 3.8 through 3.11, spells of high-cost months are short. Higher months of experience come about due to the occurrence of more spells rather than the length of spells.

3.4.3 Experiences for High-Cost Users of Medicare

The lower rows of tables 3.8 through 3.11 summarize the monthly experiences of the highest-cost users of Medicare defined by their expenses accumulated over calendar years. The group in the top row of the "Cost percentile, any year" portion of the tables refer to beneficiaries who had expenditures above the 80th calendar-year percentile in any year during the 1989–99 period, and the top row of the "Cost percentile, any 2 years" portion selects beneficiaries who had annual costs exceeding the 80th calendar-year percentile in two or more years. The other rows designate equivalent groups for the 90th, 95th, and 98th annual percentiles.

Calculations based on the first columns of these tables imply that all of the high-cost groups experienced at least one 80th percentile month, a hardly surprising result given their large annual expenses. All but a trivial number of the "GE 80th percentile" group also incurred one or more 90th percentile months, and all but a very small proportion of the "GE 80th percentile" and "GE 90th percentile" groups also experienced 95th percentile months. The vast majority of these users further realized at least one 98th percentile month of expenses, with only 10 percent of the "GE 90th percentile in any year" group being excluded from this experience.

Regarding the statistics summarizing the distributions of high-cost months, patterns correspond fully with intuition. We see that more intense users classified by annual measures experience more high-cost months considering both the total number of months over the decade and the number of spells; this pattern holds irrespective of the level of percentile considered. Also, the number of high-cost months experienced is notably large. For example, the "GE 90th percentile in any year" group averaged eight of the 90th percentile months, 4.3 of the 95th percentile months, and 2.1 of the 98th percentile months. The "GE 98th percentile in any year" group averaged seven of the 95th percentile months and 3.4 of the 98th percentile months, with 20 percent of this group experiencing seventeen or more 90th percentile months. As for variation in spell length, we see once again that all spells of high-cost months are short, and more months of experience come about due to the incidence of more spells.

To assist in understanding the circumstances of these high-cost groups, table 3.12 extracts selected statistics from tables 3.8 through 3.11 and supplements the information for these groups. Moreover, table 3.12 introduces

Table 3.12 **Annual high-cost users of Medicare and their share of expenditures: Elderly (1989–99)**

	Intensity and duration of utilization							
Data: HCFA (1989–1999)	Top 5% in at least 1 year	Top 5% in at least 2 years	Top 10% in at least 1 year	Top 10% in at least 2 years	Top 10% in at least 3 years	Top 20% in at least 1 year	Top 20% in at least 2 years	Top 20% in at least 3 years
Percent of all beneficiaries	22.4	5.9	38.1	14.6	5.7	58.5	32.0	17.0
Percent in age categories								
65–69	21.7	24.9	22.9	24.3	26.6	27.0	26.5	26.9
70–74	23.2	24.9	22.7	23.9	25.0	22.9	23.4	24.2
75–79	22.0	22.4	21.2	22.0	22.3	20.1	21.2	22.0
80–84	16.9	15.7	16.6	16.4	15.3	15.2	15.8	15.7
85–89	10.6	8.4	10.6	9.3	7.8	9.5	9.0	8.2
90–100	5.7	3.6	6.0	4.1	2.9	5.3	4.1	3.1
Percentiles for “decade” costs (2000 $)								
10th percentile	43,379	91,669	29,443	61,078	95,066	16,644	34,626	52,922
25th percentile	58,682	114,791	41,749	77,995	116,394	26,100	47,167	68,457
50th percentile	84,731	150,159	62,971	104,832	149,304	44,339	68,980	94,092
75th percentile	124,439	201,244	97,343	146,138	199,046	76,304	104,518	134,762
90th percentile	179,510	270,712	147,175	205,106	269,359	123,081	156,203	192,722
Mean “decade” costs (2000 $)	102,151	169,945	79,491	123,134	170,057	60,785	86,063	112,606
Percent of total costs accounted for by group	59.9	26.1	79.4	47.1	25.5	93.1	72.1	50.2

additional groups specifying beneficiaries whose Medicare expenditures place them in the upper percentiles for multiple years as persistently high-cost users. In addition to showing the shares of beneficiaries and expenses encompassed by these high-cost groups, the second set of rows in table 3.12 gives the age composition of the groups. The third and fourth set of rows list the percentiles and means of the distribution of expenditures for the individuals comprising these groups accumulated over the 1989–99 decade.

According to table 3.12, 22.4 percent of the elderly Medicare beneficiaries experience at least one year with expenses placing them in the 95th percentile in calendar-year expenditures, and this group accounts for 59.9 percent of all Medicare expenditures totaled over the 1989–99 decade. Half of this group has expenses over $84,731 during the decade, and 10 percent has expenditures exceeding $179,510. About 6 percent of the beneficiaries are in the top 5 percent of expenditures for two or more years, and they consume slightly more than a quarter of Medicare spending.

Table 3.12 suggests the importance of persistence in expenditures over long periods of time. More than a quarter of beneficiaries in the top 5 percent of expenditures in one year end up in this category in at least one other year as well. Nearly 6 percent of beneficiaries have expenditures placing them in the top 10 percent of expenditures in three or more years, and 17 percent receive services costing amounts falling into the upper two deciles in three or more years. Such evidence clearly reveals that the spells of high-cost months experienced by many users are spread out over several years. This knowledge, combined with our evidence of short spells, implies that sophisticated specifications will be required to build duration models that effectively capture monthly expenditure patterns.

3.5 Summary and Concluding Remarks

Our findings reveal several valuable insights into the growth of Medicare expenditures in recent years, both in projecting aggregate trends and in discovering the extent to which the concentration of spending on high-cost users contributes to overall expenditures.

In the analysis validating our monthly longitudinal Medicare data set, summary statistics reveal that 20–30 percent of the total growth in Medicare program payments from 1989 to 1999 arises from an increase in the participation rate, and 50–60 percent results from an increase in average program payments per service recipient. Comparing spending on the elderly segment of the Medicare population to all beneficiaries (including qualified individuals below age sixty-five), average payments and costs for part A services are lower for the elderly until around 1995, when the relationship reverses. Averages for part B spending for the aged remain consistently lower than comparable quantities for overall population, reflecting the facts that the disabled have higher average expenditures and also

become a steadily increasing share of the total Medicare population. Despite the increase in this share, however, part A program payments and expenditures for the disabled population declined relative to the aged population continually after 1996.

Examining the extent to which the growth in Medicare expenditures differs across various segments of the beneficiary population, receipt of part A services increased more rapidly for the younger cohorts, at least until later years of the decade. This rise in the part A participation rate primarily reflected greater utilization of skilled nursing facilities, home health agencies, and hospices, although use of inpatient hospital services rose as well. Further, our results indicate that expenditures grew more rapidly in the lower percentile categories and for the youngest cohort. The BBA97 appears to have reduced the rate of growth across all cohorts, especially in the upper half of the expenditure distribution, with the greatest reductions occurring for the oldest cohorts. Indeed, after BBA97, expenditures actually fell for the highest-cost users of Medicare services. However, the results in section 3.2 relying on administrative data extending beyond our sample period suggest that policy impacts achieved in the late 1990s are only temporary; starting in 2000, the overall growth in Medicare expenditures reverted to its previous rate and may have even accelerated.

Annual Medicare spending is highly concentrated among a small segment of the beneficiary population, and shares of spending attributable to high-cost users have been remarkably stable over the 1989–99 decade, even though growth rates have varied considerably during the period and across intensity of use. Those beneficiaries classified in the top 2 percent of the annual expenditure distribution alone account for about one-quarter of total expenditures; those in the top 5 percent cover almost half of annual expenditures; and the beneficiaries in the highest 10 percent of annual expenditures account for nearly two-thirds of total Medicare spending in a year. Considering spending by months only reinforces this picture of concentration. The 2 percent of months making up the 98+ percentile account for around two-fifths of total annual expenditures; the top 5 percent of months cover nearly two-thirds of yearly Medicare expenditures; and around four-fifths of annual spending occurs in the top 10 percent of months.

Viewed over a decade, the majority of beneficiaries experience high-cost episodes at some point in their lifetime, implying far less concentration in expenditures. Three-quarters of the elderly receive medical services during a month costing above the 90th percentile level for months during a year, and total spending for this group covers virtually all expenditures during the 1989–99 decade. Three-fifths of the beneficiaries experienced at least one 95th percentile month in the decade, and two-fifths realize one or more 98th percentile months. Knowledge of the incidence and expenditures of 95th percentile months alone explains nearly two-thirds of Medicare

spending over the decade. Spending accumulated for those in the 98th percentile months comprises almost four-fifths of total decade expenditures. Concentration of Medicare expenditures will dissipate even further if one were to extrapolate our findings to lifetime experiences rather than over just a decade. In particular, this decade-based study ignores the consequences of both left and right censoring in the data, which unambiguously result in lower estimates of the incidences of high-cost events.

A major challenge faced by researchers involves identifying intense users of health care services along with the factors leading to the incidence and duration of their utilization. Such a task requires a detailed understanding of the patterns of medical care for periods much shorter than a year to adequately capture the onset of health events and the relationships linking the persistence of costs in the short and long runs. Many surmise that restricting attention to those individuals in their last year of life identifies most of the high-cost users, but existing work shows that the majority of the most-intense users (measured by accumulating expenses annually) live beyond a year after incurring their high expenses. Further, previous work has met with limited success in associating large fractions of the highest-cost users with particular diagnoses or chronic conditions. The availability of our monthly longitudinal Medicare data greatly enhances options for improving our understanding of the sources of high-cost utilization.

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Comment Jonathan Skinner

In this paper, the authors have created a first-order data set to address first-order research questions. The data are a longitudinal sample of Medicare claims data for more than two million enrollees between 1989 and 1999. This allows MaCurdy and Geppert to capture the longitudinal life-cycle patterns of utilization, as well as measuring secular change in Medicare expenditures during the 1990s. The research questions they address—to identify, measure, and (one hopes) ultimately to affect utilization of the high-cost users—are critical for the financial stability of the Medicare program.

We need all the help we can get to put Medicare on a firm financial basis. Unlike Social Security, where potential policy levers include shifting back monthly benefits or changing the degree of progressivity in monthly benefits, the options available for reducing Medicare costs are few and far between. As an insurance program, the Medicare program can reduce reimbursement rates, but this is neither an equitable nor a particularly effective way to effect long-term reductions in expenditures. In the fee-for-service program, health care providers (and their patients) still control quantities of services, so it is entirely possible—and indeed, policymakers in Washington came to expect that—reductions in reimbursement rates will be offset in part by increases in quantities of service. While the Balanced Budget Act of 1997 (BBA97) made it clear that the government *could* cut back on expenditures by restricting payments, those cuts were short-lived; within a few years, as MaCurdy and Geppert show, the previous trend had reasserted itself. Furthermore, cutting reimbursement rates across the board tends to harm the more conservative hospitals and physicians, given that providers are paid more only when they perform more services. As well, even with current reimbursement rates, some physicians no longer accept new Medicare patients, and cutting back further will simply exacerbate the problem of access.

The Medicare+Choice program attempted to save money using a different approach, to attract elderly patients into risk-bearing managed care. Unfortunately, this program was no more successful at saving money; either healthier low-cost patients enrolled (thus earning profits for the health maintenance organization [HMO]), or insurance companies didn't want to offer policies under the prevailing reimbursements when they didn't keep pace with the fee-for-service costs. In recent years, as a consequence, there has been a sharp decline in Medicare+Choice enrollment (Thorpe and

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Atherly 2002). Thus, neither adjusting reimbursement rates, nor trying to attract managed care coverage, seems likely to solve the looming imbalance in funding for the Medicare program.

MaCurdy and Geppert have followed a different strategy, which is to identify those who are likely to be the high-cost patients who account for the majority of Medicare spending. As the authors have shown, there is typically a great deal of concentration in Medicare spending, with a small fraction of elderly people accounting for most of the overall spending. The authors pursue this approach along two dimensions. The first is to test whether some groups over time have accounted for a disproportionate share of the increases in Medicare spending during the 1990s. For example, if the top 2 percent of people accounted for an ever larger share of expenditures over time, it would suggest that the Medicare program has focused increasingly on health care for the very sickest of the Medicare population.

The surprising answer to this question was that expenditures seemed to rise reasonably consistently across different groups of patients, with the share of spending accounted for by the top 5 percent or 10 percent of patients remarkably stable over time. As well, there was somewhat higher growth in Medicare expenditures among younger Medicare enrollees compared to older enrollees during the 1990s, but that pattern may reflect a reversion to the mean following an earlier relative growth in spending among older Medicare enrollees (Cutler and Meara 1999). Nearly all of the variation observed over time reflects a common aggregate year effect that appears to cause expenditures among all groups at the national level to rise. In short, the demographic composition of the population does not provide much information regarding future expenditures. Instead, there is some aggregate shock to spending (typically positive), and this common factor, reflecting both health provider behavior, and changes in Medicare reimbursement rates and rules, largely determines future aggregate spending.

MaCurdy and Geppert's second approach to modeling expenditures is to examine properties of life-cycle Medicare expenditures at the monthly level. As they show, identifying the small number of months with high expenditures essentially captures nearly all Medicare spending. Furthermore, a large fraction of Medicare enrollees end up in at least one or two of the high-expenditure months. This latter fact, however, is probably less surprising than one might think. In 1999, the 80th percentile Medicare expenditure was $558, and the 90th percentile $1,863. It does not take much in the way of utilization to spend more than $558 in a month (e.g., an angiogram or a sigmoidoscopy), and one visit to an emergency room can easily result in several thousand dollars in spending. Thus I am not entirely convinced that monthly data provide a clearly superior perspective compared with annual data.

A major component of this paper is simply to create a data set that is accurate and matches official Center for Medicare and Medicaid Services

(CMS) aggregate statistics on annual expenditures (as in their figure 3.2). As one who has encountered the raw Medicare claims data, I know that getting it into usable format and one that is consistent over time is a tremendous task. Given this enormous fixed cost, the question now is—what's next on the research agenda? In other words, what are some additional hypotheses that might be tested using these data?

Given that their primary objective is to identify high-cost users, a first step would be to begin using the rich diagnostic data contained in the Medicare claims data. Knowing that an individual has been diagnosed with congestive heart failure (CHF) or with chronic obstructive pulmonary disease (COPD) is a very strong predictor of a long-term and expensive interaction with the health care system. Similarly, metastatic lung cancer would also predict high expenditures, but with a much shorter time horizon, as there is less variability with regard to impending death. In recent studies, Lunney, Lynn, and Hogan (2002) and Lunney et al. (2003) have characterized the different patterns of health declines prior to death depending on the type of disease. For patients experiencing sudden death, functioning does not decline prior to the date of death; these are presumably otherwise healthy (and low-cost) elderly people who experience a sudden cardiac arrest or other catastrophic illness. By contrast, those with cancer experienced the sharpest dropoff in functioning during the five months prior to death, while those with organ failure (e.g., chronic illnesses) were subject to sharp declines in functioning, followed by recovery, followed by decline, recovery, and finally death. Because these patients often survive for many years, albeit years punctuated with hospital admissions and adverse events, they are likely to account for a large fraction of health care costs. In sum, using the detailed clinical data on diagnosis can provide one of the most straightforward ways of identifying high-cost patients.

Even when high-cost patients can be identified, there is another, more difficult question—are we spending too much on these patients, or too little? It's not a shock that spending should be greatest on the sickest patients, but the real question is, what's the right amount of spending? One strategy is to identify regions in the United States where health care expenditures or utilization appears to be consistently higher than in others and focus on those regions as potential sources of saving to the Medicare program. The *Dartmouth Atlas of Health Care* has documented the wide ranges in health care utilization in the last six months of life (Wennberg and Cooper 1999). Physician visits per decedent in the last six months, for example, range from an average of eleven in Salem, Oregon, to forty-eight visits in Miami, Florida (see Skinner, Fisher, and Wennberg, chap. 4 in this volume). Expenditures for the top 5 percent of the population exhibit a similar degree of variation. As Anderson and others demonstrate (2003), average expenditures for the top 5 percent of Medicare enrollees averaged $50,809 during 1995–99. However, across hospital referral regions, the

standard deviation in expenditures was $9,122. Assuming a normal distribution, the 10th percentile region in terms of spending for this expensive group of patients would be $39,132 in contrast to the 90th percentile region, where spending would be $62,485. Some of the difference may be attributed to differences in burdens of disease. However, identifying regions or even hospitals that cost much more to treat patients with similar clinical diagnoses would certainly be a first step in identifying "excess" Medicare spending.

Finally, these data could be used as a valuable proving ground for testing economic or epidemiological models of health and health care. For example, one could estimate a simultaneous equations model of health care expenditures and health care outcomes, and attempt to test for links between the two, again using the very detailed clinical data to provide covariates or to stratify the data. Similarly, one could test the impact of the BBA97 on health outcomes, particularly among patients where the cutbacks were the greatest in magnitude. For example, one of the major changes in Medicare reimbursement policies following BBA97 was to sharply restrict the use of home health care payments, in part by limiting the number of visits to 100 annually. In some regions of the country—particularly in Texas—this was a major change in overall reimbursements. Did the patients suffering from the sudden cutbacks experience any change in health outcomes, as measured by mortality, emergency room use, or hospital admissions? To sum up, it is difficult to imagine a better data set to address the important issues facing Medicare in the future, and I look forward to the next installment in the authors' research agenda.

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