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Medicare Part D Program: Prescription Drug Plan Copayment Structure and Premium Sensitivity

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by

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Rui Dai

ABTRACT

Since January 2006 Medicare beneficiaries have the option to purchase prescription drug benefits from Medicare under the Part D program. The addition of outpatient drugs to the Medicare programs reflects Congress' recognition of the fundamental change in recent years in how medical care is delivered in the U.S. It recognizes the vital role of prescription drugs in the health care delivery system and the need to modernize Medicare to assure their availability to Medicare beneficiaries. The Medicare Prescription Drug Improvement and Modernization Act of 2003 (MMA) created the Medicare drug benefit and specified a standard plan. The law also enables plans to offer alternative benefit packages that are either actuarially equivalent or provide enhanced benefits above the basic benefits. A majority of these alternative plans offer multitiered formulary where different medications have different patient copayments.

Different from traditional Medicare, Part D benefits are provided by private sector plans through a competitive bidding process. Firms submit a bid to the Center for Medicare and Medicaid Services (CMS) which represents the expected cost to the firm for providing basic benefits to an individual of average health. The competition between plans was expected to drive premiums down toward marginal cost, ensuring that the beneficiaries receive maximum benefits for a given public expenditure (Biles et al. 2004).

This dissertation examines the stand-alone Medicare Prescription Drug Plans (PDPs) bid and premium from the following perspectives using the 2006-2008 PDP data. First, we examine the use of multiple-tier copayment structures. In particular, we tend to discover the relationship between enrollee cost sharing at each tier and prescription drug plan (PDP) bids. Bids are equivalent to the total premiums charged by an insurer. This includes the premium paid by the consumer and the portion paid by the federal government.

Further, we decompose plan bid and premium changes between 2006 and 2008 into two components, the proportion due to changes in plan characteristics and the proportion due to changes in marginal price. By doing so, we estimate whether the actuarial methods used to price those characteristics play a role in explaining the plan bid and premium difference across years.

Finally, we measure the Medicare beneficiaries' sensitivity to price in the PDP market, specifically the elasticity and semi-elasticity of enrollment with respect to PDP premium.

Chapter One

Introduction

This chapter consists of two sections. Section 1.1 introduces the background of the Medicare program, its current status and challenges faced. Section 1.2 discusses the Medicare Part D program and some specific issues. .

1.1 Medicare

Medicare, the social insurance program in the United States, was signed into law in 1965 by President Johnson as amendments to Social Security legislation. It provides health insurance coverage to the people who are aged 65 or older, or people under 65 with permanent disabilities, ESRD (End Stage Renal Disease), or Lou Gehrig's disease.

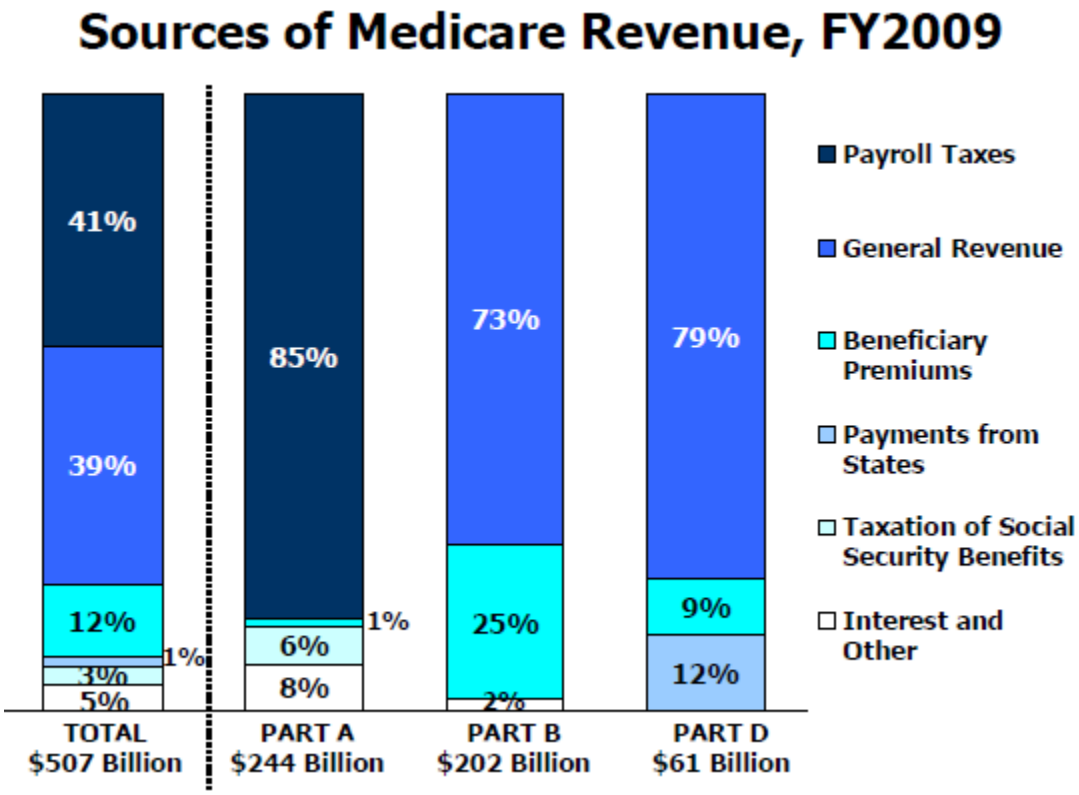
1.1.1 Eligibility

To be eligible for Medicare, people need to have made payroll tax contributions for at least 10 or more years. Their spouses, if not working, are only eligible for Part A.

1.1.2 Administration and Financing

Medicare is administered by the Centers for Medicare and Medicaid Services (CMS). As illustrated in Figure 1, it is partially financed by payroll taxes (41% in 2009) imposed by the Federal Insurance Contributions Act (FICA) and Self-Employment Contributions Act of 1954. Other financing sources include general revenue (39% in 2009), beneficiary premiums (12% in 2009), interest, and others.

Figure 1 Medicare Revenue



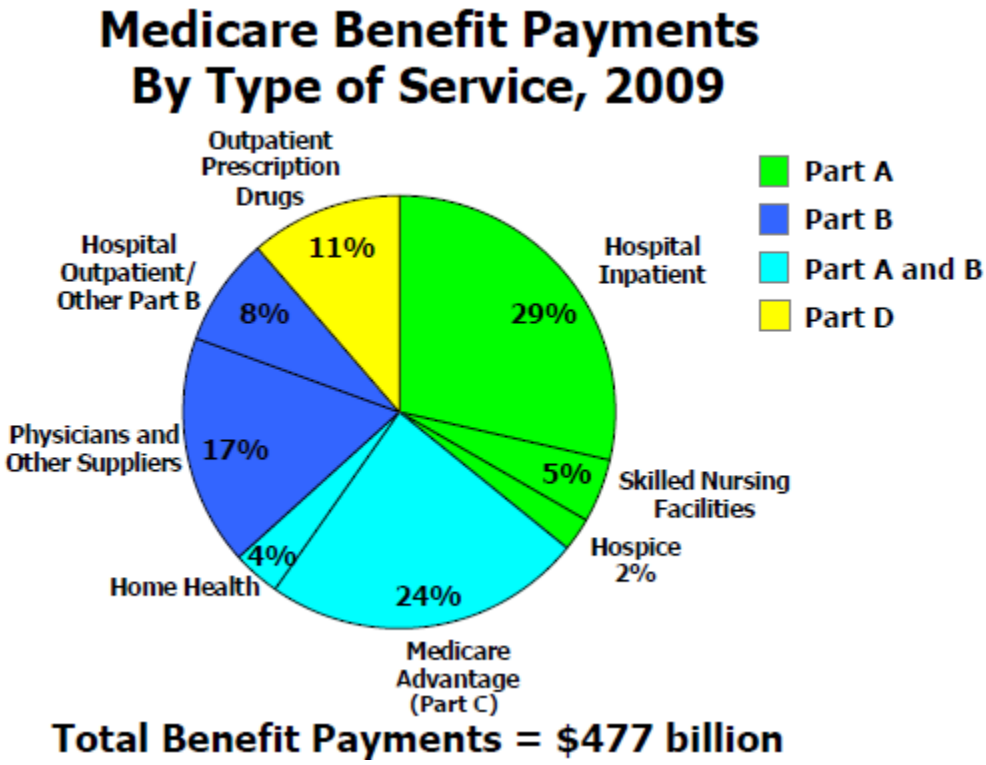
Data Source: Kaiser Family Foundation, "Medicare at a Glance", November 2008.
The original data is from 2008 Annual Report of the Boards of the Federal Hospital Insurance and Federal Supplemental Medical Insurance Trust Funds.

1.1.3 Medicare Benefits:

Medicare benefits are categorized as Part A, Part B, Part C, and Part D as illustrated in Figure 2. Part A (Hospital Insurance) and Part B (Medical Insurance) are the two parts in the original Medicare program. Part A covers inpatient hospital, skilled

nursing care, home health (also under Part B) and hospice care. Part A accounts for 36% of benefit spending in 2009 according to the Congressional Budget Office (CBO Medicare Baseline, March 2008).

Figure 2 Medicare Benefits



Notes: Doesn't include administrative expenses such spending to administer the Medicare Drug benefits and the Medicare Advantage program.
Data Source: Kaiser Family Foundation, "Medicare at a Glance", November 2008.
The original data is from CBO Medicare Baseline, March 2008.

Part B coverage includes services and products not covered by Part A, generally on an outpatient basis, such as physician and nursing services, x-rays, laboratory and diagnostic tests, durable medical equipment, etc. Part B accounts for 29% of benefit spending in 2009 (CBO). Part B coverage is optional and is allowed to be deferred if the Medicare beneficiary or their spouse is still actively working.

Part C refers to the "Medicare + Choice" program, which was passed by Balanced Budget Act of 1997. This program allows the Medicare beneficiaries to receive their Medicare benefits through private health insurance plans, instead of through the original Medicare program. The "Medicare + Choice" program was renamed as "Medicare Advantage" since the inception of the Medicare Part D program in 2006, but is still referred to as Part C. Most Medicare Advantage (MA) plans offer coverage that meet or exceed the standards set by the original Medicare program. Due to the flexibility of benefits they offer, Medicare Advantage plans have gained popularity since their inception. Medicare Advantage plans that offer prescription drug coverage are called Medicare Advantage Prescription Drug plan (MAPD). In recent years, Congress has increased payments to Medicare private plans to encourage plan participation throughout the country. As a result, the average Medicare payment to Medicare Advantage plans is 113% of the cost of similar benefits in the original fee-for-service (FFS) program (MedPAC, 2008). Now, Part C accounts for 24% of benefit spending.

Medicare Part D program started in January 1, 2006, providing the prescription drug coverage. Currently, more than 25 million beneficiaries are enrolled in Medicare Part D plans and Part D accounts for 11% of Medicare benefit spending in 2009 (CBO). Detailed discussion on Medicare Part D is presented in section 1.2.

1.1.4 Medicare Supplemental Coverage

Medicare has a high member cost-sharing requirement, no limit on the out-of-pocket spending and coverage gap in the Part D benefits. Therefore, most Medicare beneficiaries have some other forms of supplemental insurance, such as employer-sponsored retiree health plans, Medicaid and Medigap (supplemental private insurance for medical expenses that are not covered or partially covered by Medicare). Only 11% of Medicare beneficiaries had no supplemental coverage in 2006.

1.1.5 Reimbursement Method and Risk Scores

The 1997 Balanced Budget Act modified the Medicare Managed Care plans and pays private plans participating in the Medicare + Choice market a monthly capitated rate to provide health care services to enrolled Medicare beneficiaries (Pope et al. 2004). Historically the capitation payments were linked to the FFS expenditures and set at 95% of an enrollee's county's adjusted average per capita cost (AAPCC). The AAPCC rates were defined by age, sex, Medicaid enrollment status, institutional status, and working age status. Separate county factors were calculated for the aged and non-aged disabled, and at the state level only for ESRD entitled beneficiaries.

The AAPCC rates only account for 1% of the variation in Medicare beneficiaries' expenditures and do not pay more for sicker people. Thus it caused the Managed Care Organizations to select healthier members and as a result, the overall Medicare program expenditure increased. The Medicare + Choice program fundamentally changed the Medicare managed care capitation method in 2000 and implemented the Medicare risk adjustment CMS HCC (Hierarchical Condition Categories) model in 2004. During the

transitional period, the PIP-DCG (Principal Inpatient Diagnostic Cost Grouping) model was used as a health based payment adjuster (Pope et al. 2004).

The HCC diagnostic classification system first classifies each of over 15,000 ICD-9-CM (international statistical classification of diseases and related health problems) codes into 804 diagnostic groups, or DxGroups, which are further, aggregated into 189 Condition Categories, or CCs. CCs describe a broader set of similar diseases. Hierarchies are imposed among similar CCs. Some non-significant HCCs were excluded and only 70 HCCs were included in the final CMS HCC model.

The CMS HCC model also relies on demographic factors, Medicaid status, originally disabled status, and institutional status. These factors and the 70 HCCs are assigned coefficients which are estimated from clinical data. Individual Medicare beneficiary's Medical risk scores are calculated based his or her age, gender, Medicaid status, originally disabled or not, institutional status and HCCs. The coefficients are updated annually to account for changes. The nationwide overall risk scores are normalized at 1.0. A higher risk score indicates a worse health status while a lower risk score means a better health status.

The capitation payments using the CMS HCC model are proportional to the Medicare beneficiaries risk scores. Managed Care Organizations enrolling healthier members with lower risks scores receive less payment from CMS. On the other hand, they are compensated for enrolling sicker members. Thus, favorable selection or cherry-picking problem in the traditional managed care industry is alleviated.

1.1.6 Medicare Advantage Bidding Process

Starting from 2006, a competitive bidding process has replaced the Adjusted Community Rate Proposal filings required in 2005 and prior years (The Actuary Magazine, Oct, 2005). The insurance companies that want to participate in the Medicare Advantage market are required to submit their bids to CMS by the end of the first Monday of June prior to the contract year on a plan base. Each bid is associated with a unique contract ID and plan ID. Most insurance companies offer one contract but multiple plans each year. Some big insurance companies may offer multiple contracts.

For Part A and B benefits, Medicare Advantage plans bid on traditional Medicare benefits including traditional Medicare cost sharing levels. Lower cost sharing levels and Medicare non-covered benefits are optional. The projected claim costs for each line of the benefits, projected administration costs, and profits based on the projected enrollment are inputs required in the CMS bid forms. MMA declared plan bids would be based on a national profile population. In other words, each plan's bid is normalized at risk score of 1.0.

For Part D, a separate bid form has to be submitted. The Part D competitive bids are based on a national profile population as well. If a plan bid is higher than the national average bid, its member premium for Part D is increased by the difference. Similarly, if a plan bid is lower than the national average bid, it will have a lower Part D member premium.

The payments each plan receives from CMS are directly determined by the bids and adjusted by the risk scores. For sicker members who incur more claims, the plan will receive more payment from CMS. Similarly, for healthier members, the plan receives

less payment from CMS. This process alleviates the anti-selection problem that the Managed Care Organizations tend to enroll healthier members.

The competitive bidding process gives the plans little incentive to under or over bid because they are only compensated up to the benchmark payment set by CMS. If a plan bid is lower than the benchmark, they will receive 75% of the difference between the benchmark and the plan bid as a rebate in addition to its bid amount. On the other hand, if a plan bid is higher than the benchmark, the amount above the benchmark will be passed to its members in terms of a higher member premium.

1.1.7 Current Status and Challenges

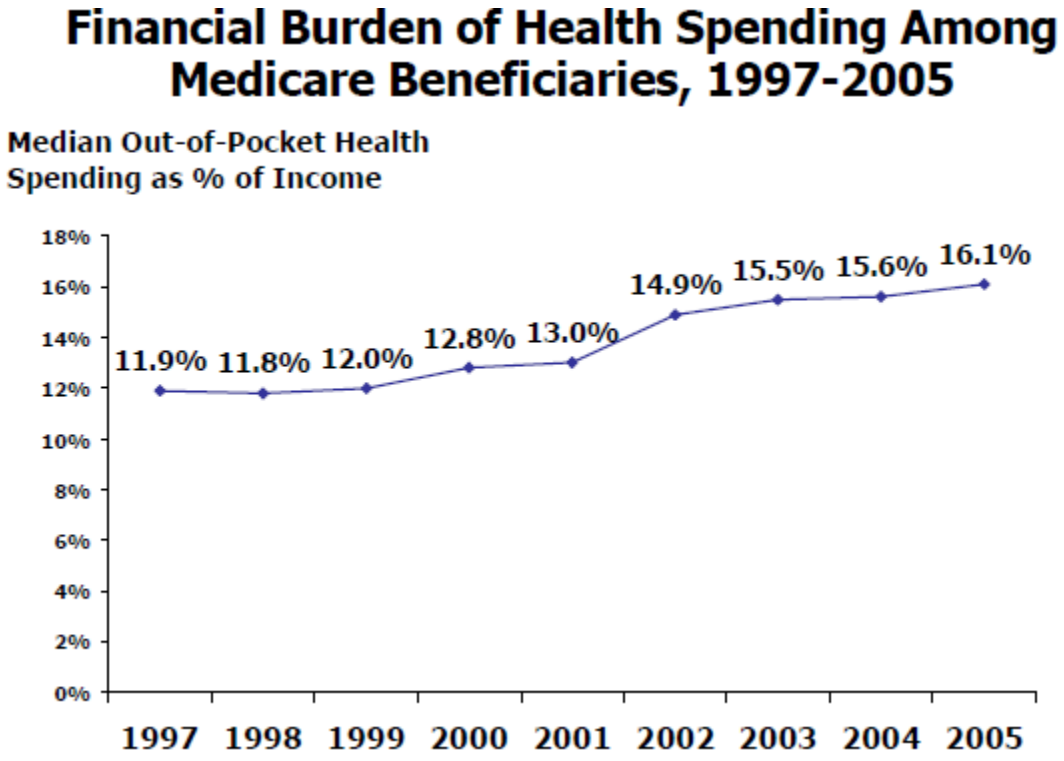
In 2007, Medicare provided health care coverage for 43 million Americans and currently covers 45 million Americans. Enrollment is expected to reach 77 million by 2031 when the baby boom generation is fully enrolled.

Medicare benefit outlays are expected to total $477 billion in 2009, accounting for 13% of the federal budget and 22% of personal health care expenditure (CBO). It is projected to reach $871 billion in 2018 according to CBO. Two main factors influencing the annual growth of Medicare spending are the increasing volume of services and rising prices. CBO estimates that a larger share of future growth in Medicare spending as a share of the Gross Domestic Product will result from growth in health care cost rather than from growth in enrollment. Efforts to control rising health costs would help mitigate Medicare's future funding shortfall (Kaiser, Medicare Nov 2008).

The greatest challenge for Medicare is the financing. According to the Medicare Trustees, Part A Trust Fund is projected to be depleted in 2019, with insufficient funds to

pay benefits (Kaiser, Medicare Nov 2008). Figure 3 shows the financial burden of health spending among Medicare beneficiaries from 1997 to 2005. While the spending is increasing, the speed has slowed down in recent years.

Figure 3 Medicare Spending



Data Source: Kaiser Family Foundation, "Medicare at a Glance", November 2008.
The original data is from Kaiser/UCLA analysis of Medicare Current Beneficiary Survey Cost and Use files, 1997-2005.

Other critical issues that Medicare faces include the management of care for chronically ill high-cost beneficiaries, fairness of payments to providers and plans, aging population, etc. For reference, Appendix B1 shows the characteristics of the Medicare population.

1.2 Medicare Part D

Medicare Part D refers to the Medicare Prescription Drug Program, which was established by section 101 of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 and went into effect in January 2006. The new Part D benefits constitute perhaps the most significant change to the Medicare program since its inception in 1965.

The prescription drug benefit is not part of the original Medicare program. The addition of outpatient drugs to the Medicare programs reflects Congress' recognition of the fundamental change in recent years in how medical care is delivered in the U.S. It recognizes the vital role of prescription drugs in the health care delivery system and the need to modernize Medicare to assure their availability to Medicare beneficiaries. Effective January 1, 2006, the Part D program established an optional prescription drug benefit for individuals who are entitled to Medicare Part A and/or enrolled in Part B.

1.2.1 Eligibility and Enrollment Process

Individuals who are entitled to Medicare Part A (whether actually enrolled or not) or currently enrolled in Part B are eligible for Medicare Part D benefits. Enrollment in Part D is voluntary except for individuals who are dual eligibles (those also in Medicaid). Individuals who are first eligible for Medicare are required to enroll three months before or three months after they turn 65. If they fail to enroll in that 6-month period, they have to pay a penalty in the form of a higher premium. Individuals who are already in Medicare can enroll in a Part D plan during the open enrollment period which starts on November 15 and lasts until the end of December of the year. During this period, they

can choose to enroll or switch plans. After this period, they must affirmatively stay enrolled in a Part D plan.

CMS will auto-enroll or facilitate enrollment for Medicare beneficiaries who are eligible for Low-income subsidy (LIS). Dual eligible LIS beneficiaries who stay in traditional FFS Medicare or enrolled in an MA only plan are randomly enrolled into one of benchmark PDPs. Dual eligibles enrolled in a MA only plan can also be auto assigned to a MAPD benchmark plan. The benchmark plans are those that offer defined standard benefits with a premium below the benchmark in each region set by CMS. Facilitated enrollment is the process for other LIS eligibles. The process is essentially the same as auto-enrollment, but the timing of the first round assignments differs. Furthermore, all LIS beneficiaries can switch plans anytime during the contract year whereas other beneficiaries can only switch plans during the annual open enrollment period.

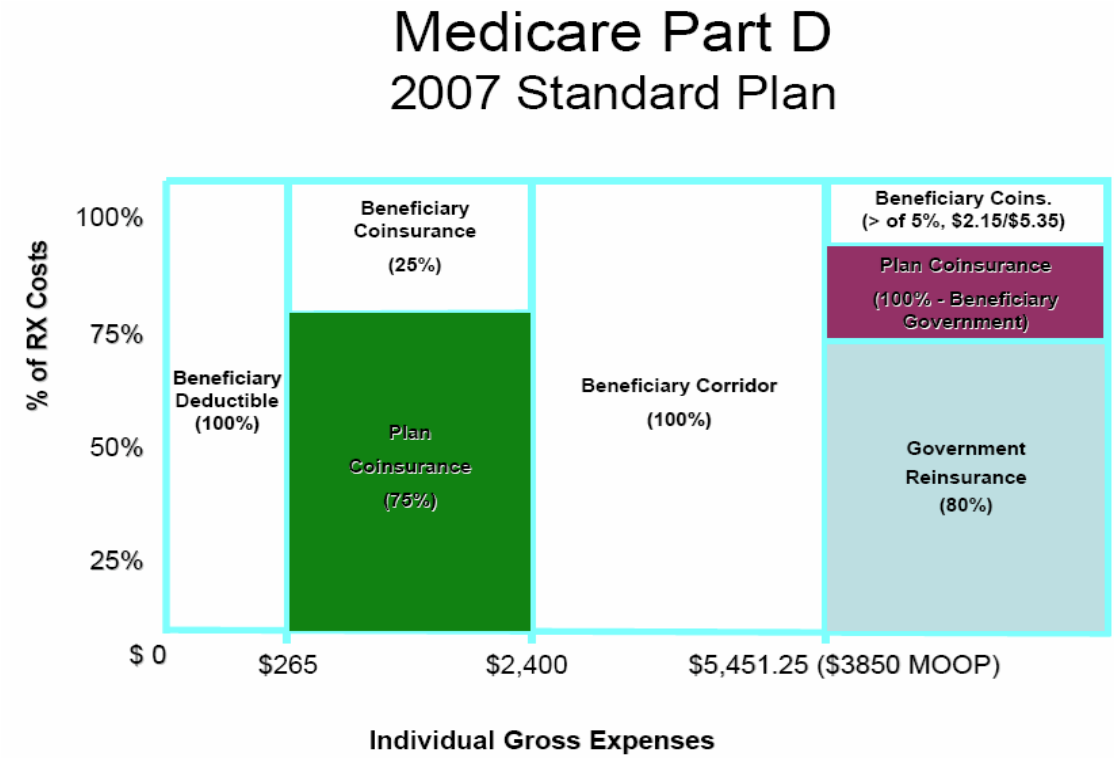
1.2.2 MAPD vs. PDP

Different from traditional Medicare, Medicare Part D is provided through private companies or entities approved by CMS. Beneficiaries can obtain drug benefits through two types of private plans, the stand-alone PDPs or MAPDs which cover both medical service and prescription drugs. Individuals enrolled in PDPs receive their medical benefits from traditional FFS Medicare or MA only plans. Different from the MAPDs, which are offered at the county level, the PDPs operates at the PDP region level. Defined by CMS, there are 34 PDP regions in the United States, each of which cover one or more states (see Appendix A, Table A2).

1.2.3 Part D Standard Benefits

The MMA established a standard Medicare Part D benefit package which is defined in terms of benefit structure, not in terms of the drugs that must be covered. As illustrated in Figure 4, in 2007,the standard benefits are $265 annual deductible, 25% coinsurance, $2,400 initial coverage limit (ICL), $3,850 member out of pocket threshold (OOP max). After meeting the $265 annual deductible, the beneficiary pays 25% of the cost of a covered Part D prescription drug up to an ICL of $2,400. Once the ICL is reached, the beneficiary is liable for the full drug cost, which is called the coverage gap or more commonly known as the "donut-hole".

Figure 4 Part D Standard Plan



Data Source: CMS.

When the beneficiary's total out-of-pocket cost (including the deductible, copayments, and spending in the coverage gap, but not the monthly premium) for the year reaches $3,850, he or she reaches the catastrophic coverage, in which he or she pays $2.15 for a generic or preferred drug and $5.35 for other drugs, or 5% coinsurance, whichever is greater. Federal government pays 80% of the drug cost with the remaining 15% paid by the private insurance plans.

The deductible, ICL, OOP max and catastrophic copayments are updated every year to account for the inflation and increasing drug costs. Table 1 shows the standard benefits from 2006 to 2009.

Table 1 Medicare Part D Defined Standard Benefits

Part D Standard Benefit Design	2006	2007	2008	2009
Deductible	$250	$265	$275	$295
Coinsurance (all tiers)	25%	25%	25%	25%
Initial Coverage Limit	$2,250	$2,400	$2,510	$2,700
Out-of-Pocket Threshold	$3,600	$3,850	$4,050	$4,350

1.2.4 Part D Alternative Benefits

The defined standard benefits are not the most common benefits offered by Part D plans. Only 10 percent of plans offer the defined standard benefits. Many plans have used the flexibility allowed by MMA to vary their benefit designs. A majority of plans eliminated at least part of the standard deductible, substituted flat copayments for coinsurance, and adopted tiered cost-sharing where beneficiaries pay different amounts for different types of drugs. The most common approach was to use three or four tiers

with different copayment amounts for generic drugs, preferred brand-name drugs, non-preferred brand-name drugs and sometimes specialty drugs (e.g. biotechnology products or injectable drugs) (Hoadley, 2006; Duggan, Healy, and Morton, 2008).

These alternative plans are categorized as actuarial equivalent, basic alternative, or enhanced alternative depending on benefit structure. Actuarial equivalent plans and basic alternative plans are actuarially equivalent to the defined standard plans. The difference lies in how the benefit structure is adjusted. Actuarial equivalent plans can only adjust the coinsurance and are not allowed to change the standard deductible. On the other hand, basic alternative plans can adjust both the deductible and coinsurance. Enhanced alternative plans offer richer benefits than defined standard plans, such as lower deductibles and copayments, and partial or full gap coverage.

For approval, these alternative bids need to pass certain tests specified by CMS. These tests include

Test 1: The total coverage is equal to or greater than that of the defined standard benefit.

Test 2: The unsubsidized value is equal to or greater than that of the defined standard benefit.

Test 3: The average cost at the ICL is equal to or greater than that of the defined standard benefit.

Test 4: Deductible is equal to or less than that of the defined standard benefit.

Test 5: Average catastrophic cost sharing is equal to or less than that of the defined standard benefit.

Actuarial equivalent bids only need to pass test 3 and test 5, while basic and enhanced alternative plans are required to pass all five tests.

1.2.5 Plan Formularies

One reason for an insurer to offer an alternative plan is to incorporate utilization controls, such as multi-tiered formularies, into benefit structure. Formulary is a list of drugs covered by the plans. Different from the benefits, there is no such a "standard formulary" although CMS releases a list of Part D covered drugs. Plans are not required to pay for all Part D covered drugs. Instead, plans can establish their own formularies as long as the formulary and benefit structure are not found by CMS to discourage enrollment by certain Medicare beneficiaries. In addition, plans can change drugs on their formulary during the course of the year with a 60-day notice to affected parties.

Generally, each plan's formulary is organized into tiers, and each tier is associated with a set of copayment amounts. Lower tiers are associated with lower copayments. Most plans offered four-tier formularies. Tier 1 is generic drugs, tier 2 is preferred brand drugs, tier 3 is non-preferred brand drugs, and tier 4 is specialty and injectable drugs. Some plans may offer 5 tiers by breaking generic drugs into preferred generics and non-preferred generics, while some plans may offer 3 tiers by combining preferred brand and non-preferred brand drugs.

The primary difference between the formularies of different Part D plans lies in the coverage of brand name drugs. Plans can also offer Part D excluded drugs as supplement benefits. However, plans offering excluded drugs are not allowed to pass on

those costs to Medicare, and are required to repay CMS if they are found to have billed Medicare on these cases.

Utilization control tools, such as prior authorization, quantity limit and step therapy, are used to help manage drug use and total costs (Hoadley, 2006). The application of such tools can be an important way for plans to steer beneficiaries to specific drugs as well as to control the use of certain drugs. Yet enrollees may not know whether these tools might create a real barrier to getting their medication until they first attempt to fill a prescription for a specific drug under their plans.

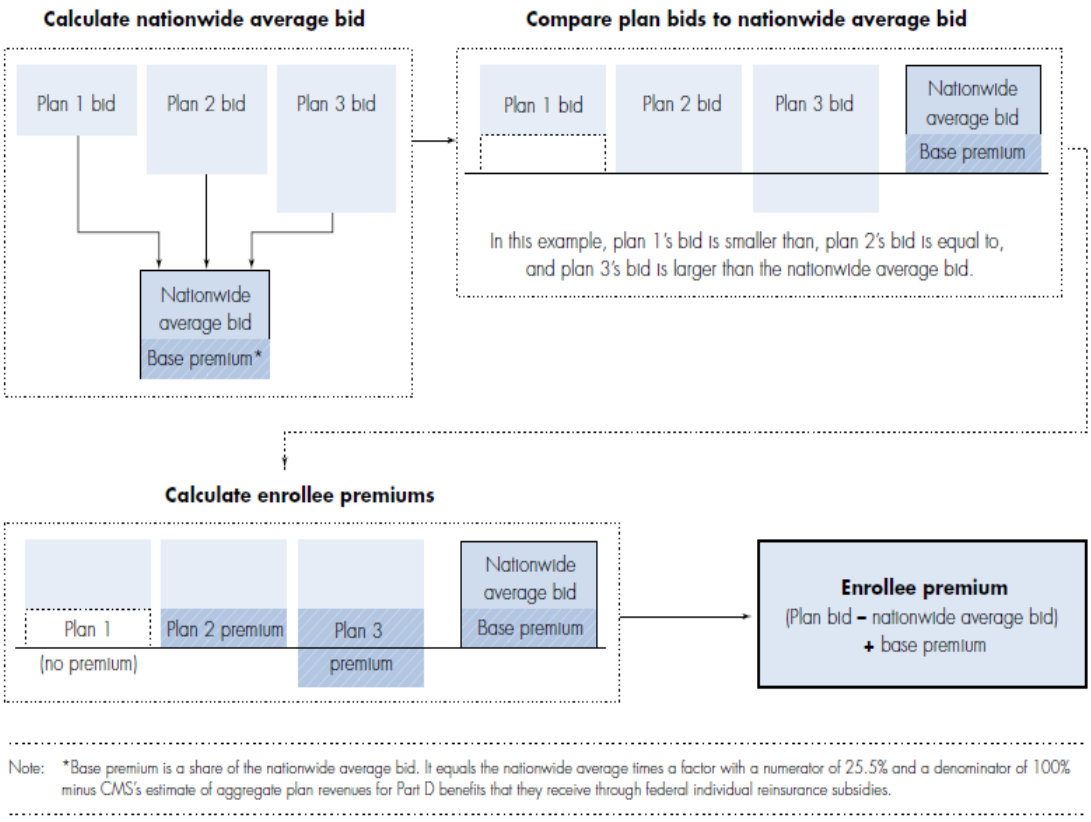
1.2.6 Part D Bidding Process and Beneficiary Premium

Similar to Medicare Part C, Medicare Part D premiums and subsidies are determined through a competitive bidding process. Firms submit separate Part D bids to CMS on a plan-by-plan base. These bids represent the expected cost to the firm for providing the basic benefits (defined standard benefits) to an individual of average health (individuals with a risk score equal to 1.0). In addition to the bid amount, the projected low income subsidy and federal reinsurance for catastrophic claims are required to be filled in the bid form.

Different from Part C, Part D member premium is also affected by the national average bid amount and national average federal reinsurance. Each year, CMS calculates the national average monthly bid amount and federal reinsurance amount. In 2006, the national average bid and federal reinsurance were calculated on an equal weighting base. In other words, all plans are given equal weights no matter how many members they enroll. Enrollment weighting replaced the equal weights in contract year 2009. In the

transitional years 2007 and 2008, the national average bid amount was a composite of the two approaches. For example, in 2008, 40% of the national average bid amount was based on the uniform weighted average and 60% was based on the enrollment weighted average (CMS, Apr, 2007).

Figure 5 National Average Bid and Member Premium



Data Source: Medpac, "Part D Payment System" (October, 2008)

Once the national average bid amount is determined, the national average member premium is calculated as 25.5% of the sum of national average bid and national average federal reinsurance. However, plans may bid higher or lower than the national average

bid, the difference becomes (or reduces) the member's liability. The members must pay the national average premium plus (or minus) any difference between the plan's bid and the national average bid.

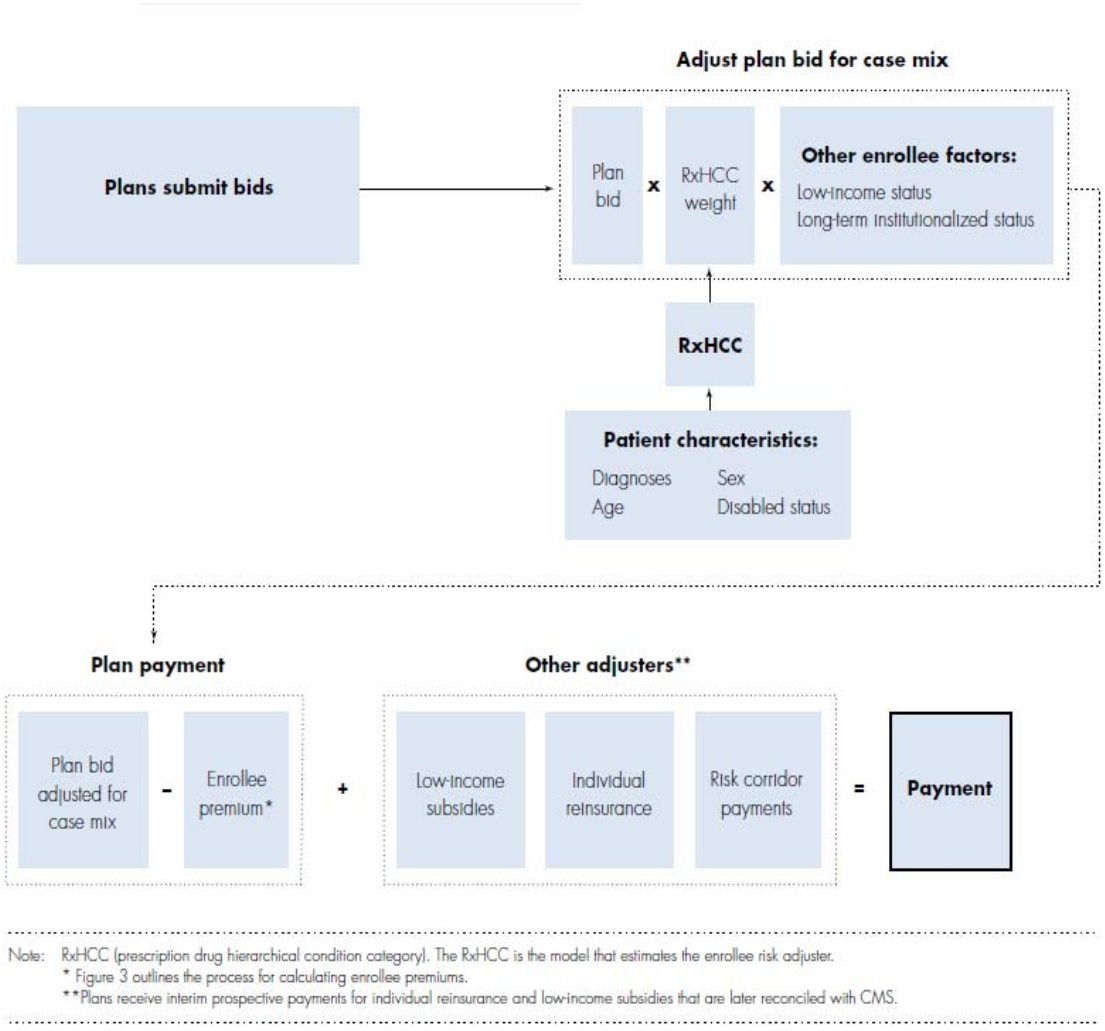
Figure 5 illustrates how the national average bid and member premium are calculated and how each plan's member premium is determined. In this example, members who choose plan 2 which is equal to the national average bid pay the national average member premium. Members who choose plan with a higher bid have to pay a higher premium than the national average premium. On the other hand, members who choose plan 1 with lower bid pay lower premiums.

1.2.7 Part D Reimbursement Method and Risk Scores

Using an approach similar to the medical CMS HCC model, the part D capitation payments are calculated using the CMS RxHCC (prescription drug) model. Different from the medical CMS HCC model, CMS RxHCC model uses the low-income status instead of Medicaid status. The low income beneficiaries include not only Medicaid beneficiaries, but also Medicare beneficiaries whose family income is below the 150% of the poverty line. In addition, the RxHCC model used different ICD-9-CM codes and aggregated them into RxHCCs.

Similar to the medical CMS HCC model, a Medicare beneficiary's Part D risk score is determined by his or her age, gender, low-income status, institutional status, disabled status, and RxHCCs in the CMS RxHCC model. A higher risk score indicates a poorer health status. In addition, the coefficients of the above factors in the RxHCC model are updated annually.

Figure 6 Part D Reimbursement Method



Data Source: Medpac, "Part D Payment System" (October, 2008)

As illustrated in Figure 6, the plan capitation payments is risk-adjusted. Specifically, the capitation payments are proportional to the Part D risk scores produced by the CMS RxHCC model. Plans are paid more for enrolling sicker members (with higher risk scores) while they are paid less if they enroll healthier members (with lower

risk scores). The plans are also compensated by enrolling high risk members in terms of federal reinsurance subsidy and low income members in terms of low income subsidy.

The Part D risks scores are not comparable to the medical risk scores since the CMS HCC model and RxHCC model are built based on different diagnostic codes. In other words, it is not necessary that Medicare beneficiaries with higher medical risk scores have higher Part D risk scores. Therefore, the capitation payments for medical service and for Part D coverage are independent of each other.

1.2.8 Government Subsidy

For each Medicare beneficiary enrolled in a MAPD or a PDP plan, Medicare provides plans with a subsidy that averages 74.5 percent of standard coverage for all types of beneficiaries (MedPac, Sep 2006). Or, with the exception of low income subsidy plans, the consumer premium is 25.5% of the sum of the bid and federal reinsurance on average. The subsidy takes two forms: direct subsidy and federal reinsurance subsidy.

Direct subsidy - a capitated payment to plans calculated as a share of the adjusted national average of plan bids. The direct subsidy is calculated as the difference between the risk-adjusted bid and the fixed member basic premium.

Federal reinsurance – Medicare subsidizes 80 percent of drug spending above an enrollee's catastrophic threshold. Reinsurance acts as a form of risk adjustment by providing greater federal subsidies for higher cost enrollees.

In addition, Medicare establishes symmetric risk corridors separately for each plan to limit the plan's overall losses or profits. Under risk corridors, Medicare limits a

plan's potential losses (or gains) by financing some of the higher-than-expected costs (or recouping excessive profits). These corridors are scheduled to widen, meaning that plans should bear more insurance risk over time. (MedPac, Sep 2006)

Since 2006, Medicare Part D replaced Medicaid as the primary source of prescription drug coverage for individuals who are dually eligible for Medicare and Medicaid. Special consideration has been given to the low-income beneficiaries in terms of providing them very rich benefits. Specifically, qualifying low-income beneficiaries are eligible for the special need plans that have no premiums, deductibles, or coverage gaps and limited cost sharing ($1 to $5 per prescription). The low income member cost sharing by year is provided in Appendix B, Figure B3 and Figure B4. Plans enrolling LIS members receive additional subsidies from the federal government to cover the beneficiary's premium and additional benefits.

1.2.9 Current Status

In 2006, about 65 organizations chose to participate in the Medicare Part D market offering 1,314 MAPD plans and 1,429 PDPs. In 2007 and 2008, the number of organizations and plans increased moderately. In 2009, a total of 1,689 PDPs are offered nationwide, down from 1,824 PDPs in 2008. These PDPs are provided by PDP region. In other words, a PDP is required to be open to all Medicare beneficiaries in the PDP region that it chooses to enter. In each of the 34 PDP regions defined by CMS, a total of 40-60 PDPs are available to the beneficiaries. In 2009, the number of PDPs per region ranges from a low of 45 PDPs in Alaska region to a high of 57 PDPs in the Pennsylvania/West Virginia region. These numbers are down slightly from a range of 47

PDPs (Alaska region) to 63 PDPs (Pennsylvania/West Virginia region) in 2008 (Kaiser, Nov, 2008).

The average monthly PDP premium in 2009 (unweighted by enrollment) is $45.45. This is a 14% increase from the unweighted average monthly premium of $41.02 in 2008, up from $37.43 in 2006. PDP premiums will vary widely by region, ranging from a low of $10.30 per month for a PDP in New Mexico to a high of $136.80 per month for a PDP in New York. (Kaiser, Nov, 2008). This premium variation by region may reflect heath difference beyond those captured by risk adjusters, variations in the prescribing practices of physicians, and the extent of expected competition from Medicare Advantage plans.

The market share of each organization is relatively stable, for instance, nine out of the top ten organizations with the highest enrollment in 2006 were also among the top ten organizations by enrollment in 2007. No significant change was found in the market share in 2008. United Health Group, Humana and Universal American Financial Corporation remain the top three in terms of total enrollment from 2006 to 2008.

In August 2008, CMS estimated that the 10-year cost of the Part D program would be $395 billion, down from the original estimated $634 billion. One factor contributing to the lower cost is the increased use of generic drugs. This trend is expected to continue as many brand drugs lost their patents recently.

As of November 2008, 17.5 million Medicare beneficiaries enrolled in PDPs and 8.6 million Medicare beneficiaries enrolled in MAPDs. The PDP penetration rate is 39% and the MAPD penetration is 19%. Of these 26 million members, 9.4 million are enrolled as low income members including 6.2 million as full-benefit dual eligibles.

Other Medicare beneficiaries have other sources of creditable coverage, such as employer group health plans, Veterans Administration, etc. However, based on Department of Health and Human Services (HHS) estimates, approximately 10% of the Medicare beneficiaries lacked creditable drug coverage in 2007 (Kaiser, Nov, 2008).

1.2.10 Challenges

The main challenges for the federal government are budgeting and financing. CMS, as the administrator of Medicare, has to deal with many issues, such as monitoring PDP and MAPD plan enrollment, market stability, cost sharing and formulary, low-income subsidy participation, and the impact of Part D on total drug expenditures and on out-of-pocket spending by Medicare beneficiaries.

The insurance companies face new challenges in addition to the risks in the regular insurance market. The MAPD plans and PDPs that choose to enter the Medicare Part D market have to determine what premiums to charge, whether to offer alternative benefits, and/or special need plans, and how to structure copayments and the formulary files in order to survive and succeed in the market. Similar to the commercial insurance market, adverse selection and moral hazard may exist in the Medicare Part D market. Adverse selection arises if only those most likely to have claims enroll in the plans while those least likely do not. Thus, part D could fail to meet financial targets if healthy fails to enroll. Adverse selection could also arise from consumer shopping across plans to find formularies that include drugs they need; this can cause plans with broad formularies to selectively attract consumers with expensive drug needs, making them unprofitable. The

plans also have to face potential moral hazard, in which the Part D coverage encourages doctors and patients to opt for more medications, and be less selective in keeping down drug costs and insurers respond by making the approval process for branded drugs burdensome (Winter, 2006).

In order to overcome the hurdles of the adverse selection and moral hazard, private insurance plan may choose use the utilization control tools such as prior authorization (.i.e., plan approval of a particular drug before the prescription can be filled), step therapy (i.e., requirement that a less expensive drug be used before the originally prescribed drug can be obtained), or quantity limits (i.e., restrictions on how many pills can be obtained at one time) (Hoadley, 2006). Early evidence has suggested that some plans are flagging a substantial number of drugs with these restrictions, while other plans use them far more sparingly, (Hoadley, 2006). These utilization control tools are expected to control the enrollees' prescription drug utilization and hence lower the plan's claim costs.

Implementation of the Medicare Part D program brought new challenges not only to the federal government and insurance companies, but also to Medicare beneficiaries. In order to receive Part D benefits, beneficiaries need to actively enroll in either stand-alone PDPs or MA-PDs during the open enrollment period. Online enrollment is available and encouraged. CMS provides convenient tools to help Medicare beneficiaries to choose the plans that best meet their needs. For example, Medicare beneficiaries can easily find the plans that cover their medications and compare the plan premiums on CMS website. However, some Medicare beneficiaries fail to enroll in a Part D plan due

to the lack of computer knowledge, access to computers or Part D information while some others complain about the complicated Part D benefits and enrollment process. Effectively educating Medicare beneficiaries is a critical issue for the successful implementation of the Medicare Part D program.

Chapter Two

Literature Review

This chapter consists of two sections. Section 1 provides an overview of existing literatures related to the Medicare Part D program. Section 2 specifically reviews the studies focusing on the impacts of insurance characteristics.

2.1 Medicare Part D Program

The Medicare Part D program received extensive attention from researchers and policy makers even before its inception in 2006. Criticisms were heard frequently as well. For example, the "donut-hole" made many, especially for those who need drug benefits most, without drug coverage for much of the plan year. Past studies have covered many different aspects of the Part D program, such as program costs, implementation, impacts, benefits, enrollment, etc. To avoid an exhaustive list, we have selected some representative studies, summarized as follows.

From the policy maker's perspective, Hoadley (2006) discussed the government's challenges in implementing the new Medicare prescription benefits, such as overseeing the enrollment, plan formularies and benefits. He mentioned that the program's success would be judged by whether beneficiaries enroll in plans that meet their needs and whether the program's costs are held within reasonable limits.

Researchers are more interested in the impacts that the new Medicare Part D program has brought. Lucarelli (2006) found that the Medicare Part D program has a positive effect on health status and life expectancy. Blum (2005) measured the impact of

enrollment assumptions in the Medicare prescription drug benefit on premiums and federal costs. In 2005, the Congressional Budget Office (CBO) in CMS projected that a significant proportion of Medicare beneficiaries would enroll in the new Medicare Part D program starting in 2006. Blum's analysis showed that the average premiums and total costs could be significantly higher than CBO projections if enrollment is significantly concentrated among beneficiaries who have higher expected drug spending.

Medicare Part D's specific benefits structures are also of interest, especially the "donut-hole". Stuart (2005) assessed the impact of coverage gaps ("donut-hole") in the Medicare Part D benefits. The author found that the discontinuities in drug benefits resulted in sizable reductions in medication use and spending, which is magnified in people with common chronic illness. Individuals with chronic illnesses that result in very high medication use are particularly likely to reach the donut-hole. For example, Patel and Davis (2006) found that the Medicare beneficiaries with ESRD face substantial total expenditure and most of them will reach the "donut-hole". Gold (2006) described the premiums and cost-sharing characteristics of the Medicare Part D benefits offered by all PDPs and MAPD plans in 2006. Hoadley (2006) compared the benefit design and formularies offered by plans in 2006 and 2007. Hoadley (2006) also gave an in-depth examination of formularies and other features of Medicare Part D plans and found significant variation across plans with respect to formularies, cost-sharing and utilization control tools.

As the consumer, Medicare beneficiaries have received much attention as well. Winter et al. (2006) found that a majority of the Medicare beneficiaries had information about the program and planned to enroll before the open enrollment began. They

expected that enrollees would benefit from the program and showed concern that elderly with poor health or cognitive impairment would make poor enrollment and plan choice due to complexity of the competing plans. Heiss, McFadden and Winter (2006) investigated why some Medicare beneficiaries failed to enroll in the Medicare Part D and found that majorities of the senior are troubled by the deductible and gap provision and the stability of the plan formularies.

Dual eligibles are not only given "extra help" from government, but also received "extra attention" from researchers. Buchsbaum, Varon and Kagel (2007) gathered information on the ongoing successes and challenges that dual eligibles faced. The dual eligibles reported problems with formulary, utilization control, enrollment, spend-down issues, communication with Part D plans and payment issues.

Simon and Lucarelli (2006) are the pioneer researchers who used the econometric models to measure the impacts of the Medicare Part D program. Using the 2006 (the first year of Medicare Part D program) PDP data, they tested how insurers set premiums in the Part D market. Particularly, they found that (1) the number of insurers in a market is big enough that it does not appear to affect the premium. (2) the full drug prices are listed appear to be reflected to some degree in the premium charged. (3) weak relationship between premiums and out-of-pocket payments for different set of drugs. (4) the institutional setting and the regional market characteristics affect the firm's bidding behavior and the resulting premiums. However, while premiums are clearly important to beneficiaries, given the substantial government subsidies, premiums may not reflect insurers' expected costs for offering a specific benefit package. The premium for a plan reflects the enrollee share of the bid, the difference between the firm's bid and the

national average bid, plus the full value of any enhanced benefits. The proportion of expected costs covered by the government subsidy can vary widely across plans.

2.2 Effects of Insurance and Plan Characteristics

This section specifically reviews the studies focusing on the impacts of insurance characteristics (cost sharing and utilization control tools) on the demand and utilization of medical services and prescription drugs, and the impact of plan characteristics on premium setting.

2.2.1 Cost Sharing

Many researchers have studied the effects of insurance characteristics on the demand and consumption of health services. For example, one focus of research has been examining how cost sharing affects the use of services. Low cost sharing is often linked to higher, potentially inefficient utilization, referred to as moral hazard. On the other hand, higher cost sharing (deductible and coinsurance) reduces the demand for medical service and hence the total health care expenditures (Manning, 1987). Such findings exist for total healthcare use as well as for specific services such as preventive services (Solanki, 2000).

Cost-sharing also affects prescription drug use. An increase in the prescription copayment is associated with a drop in the number of prescriptions filled (Harris, 1990). Such a reduction may enhance efficiency if the low cost sharing resulted in inefficient utilization. However, such a reduction may have negative consequences if the original utilization levels were not inefficient. Gibson, Ozminkowski, and Goetzel (2005) found

that cost-sharing reduces the consumption of prescription drugs, and suggests that such reductions have unintended effects on the process and outcomes of therapy. Such unintended effects were found by Tamblyn (2001) with increased cost-sharing for prescription drugs in elderly persons and welfare recipients leading to a reduction in drug utilization and a higher rate of adverse events.

Many studies have shown that a tiered cost-sharing structure is an effective tool for insurance companies to control costs. Huskamp et al. (2005) examined the change in demand behavior after the introduction of a third tier for non-preferred brand drugs. They found that adding a third tier induces a shift to lower tiered drugs and strengthens the plan's negotiating power over drug prices. The introduction of a third tier caused individuals to shift from non-preferred brand medications to preferred brand name medications, however, the effect of a tier 2 copayment increase has not been consistently found to cause a shift towards generics (Gibson, Ozminkowski, and Goetzel, 2005). Overall, Joyce et al. (2002) found that plans with more tiers have less total plan spending. Motheral and Fairman (2001) showed that three-tier prescription copayments controls drug costs without changing the use of other medical resources.

Gilman and Kautter (2007) focused on Medicare beneficiaries. They found that higher tiered drug plans reduce overall expenditures and the number of prescriptions purchased by Medicare beneficiaries. However, they also showed that beneficiaries are less responsive (i.e., demand is less elastic) to cost sharing incentives when using drugs that treat chronic conditions.

There are a few studies that measure the relationship between plan benefit structure and premiums, but none of these are specific to drug plans. Jensen and

Morrisey (1990) measured the relationship between group health insurance premiums and policy characteristics including plan benefits, cost-sharing and out-of-pocket expense limits. They found that the member cost-sharing, especially for hospital care, significantly lowers fee-for-service premiums. Robst (2006) examined the Medigap insurance premiums and estimated the marginal prices for Medigap benefits. His study showed that the Medigap plans are generally priced in accordance with the actuarial value of the benefits.

Some studies focused on the impact of tiered copayments on the enrollees' demand behaviors. Overall, cost sharing has been found to reduce consumer demand. Most insurance products in these studies were priced using experience rating and thus reflect the expected costs of providing benefits to enrollees. Conversely, Part D plans started using experience rating in 2008, and bids reflect the expected cost of providing the standard benefits to a person of average health. Thus, a relationship between cost sharing and plan bids may be less apparent.

There are at least two reasons to expect a relationship between cost sharing and firm bids. First, plan bids vary from the national average bid, and also vary within each region. Thus, firms have different expectations within a region. In part, expected costs will differ based on the utilization management level of a firm. Given that Part D plans are required to price their products using appropriate actuarial methods, plan bids are expected to be lower for plans with lower expected costs that results from higher member cost-sharing. In addition, utilization management allows insurers to better control costs and reduce the degree of uncertainty. A reduction in uncertainty normally leads to a reduction in the risk spread that an insurer builds into the bid. It is, however, difficult to

predict how the effects will vary across tiers. For example, cost sharing may have a greater effect on brand name medications than generics if individuals respond to a tier 2 cost share by switching to cheaper generics. However, research results have not consistently shown that cost sharing induces a shift toward generics (Gibson, Ozminkowski, and Goetzel, 2005).

2.2.2 Utilization Control Tools

Plans may also face moral hazard, in which the coverage encourages doctors and patients to opt for more medical service, perhaps to the point where the marginal cost exceeds the marginal benefit. In order to reduce moral hazard, plans may choose to use cost management tools. These tools have been used widely by managed care organizations to control the costs. The effects have been confirmed by researchers. Feldstein, Wickizer and Wheeler (1988) showed that utilization review program by private insurance companies effectively control the health service utilization and costs.

The most commonly used utilization control tools include prior authorization, step therapy, and quantity limits (Hoadley, 2006). Some researchers have conducted the clinical analysis to examine the impacts of these tools on the utilization of certain drugs. For example, Goldfarb et al. (1999) showed that implementation of a monthly limit (four tablets or injections) on sumatriptan (a treatment for migraines) decreased an HMO's pharmacy costs. Smalley et al. (1995) found that the PA requirements may be highly cost effective with regard to expenditures for drugs that have very similar efficacy and safety, but substantial variation in costs. MacKinon and Kumar (2001) did a critical review of the literature of prior authorization programs. They found that the overall effect of PA

programs in controlling drug costs is efficient. Yokoyama et al. (2007) demonstrated that a step-therapy intervention for ARBs that required prior use of an ACEI or an ARB was associated with an approximately 13% lower drug cost per day compared with a health plan with no step-therapy intervention. On the other hand, some researchers hold different views. Panzer (2005) showed that implementing a generic step therapy formulary for selective serotonin reuptake inhibitors (SSRIs) in patients with anxiety disorders may be associated with an increased amount of therapy change and early treatment discontinuation, resulting in an overall cost increase to a health plan.

Since the inception of the Medicare Part D program, pharmacy utilization control tools , including prior authorization, quantity limit and step therapy have been used by insurance companies to manage drug utilization and total costs. According to Hoadley (2006), plans varied significantly in the type of utilization control tools used to restrict enrollees' access to specific drugs, and in the frequency these tools were applied. In addition, plans were more likely to apply quantity limits for covered drugs than to require step therapy, which was applied slightly more often than prior authorization requirements. He also mentioned that at least half of the plans used one or more utilization control tools on five of the top 10 brand-name drugs. Conversely, quantity limit restrictions were far less commonly used for the top 10 generic drugs.

2.2.3 Premium and Premium Elasticity

Insurance premium is one of the favorable research subjects as well. McLaughlin (2002) showed that Medigap premiums vary considerably among geographic markets. They also found a strong positive relationship between Medigap premiums and HMO

participation. Atherly (2004) demonstrated that premiums have a significant effect on plan selection in the Medicare program. As introduced in the previous sections, Jenson and Morrisey (1990) measured group health insurance premiums and Robst (2006) measured Medigap premium using hedonic pricing models. In 2007, Robst measured the market structure, regulations and adverse selection as the determinants of Medigap supplemental insurance premiums. Simon and Lucarelli (2006) have examined the determinants of premiums in the Part D program. They found that premiums in 2006 were weakly related to beneficiary out-of-pocket costs, and reflected regional characteristics to a greater degree.

The price sensitivity of Medicare beneficiaries is of interest to policy makers and researchers. The question of whether Medicare beneficiaries are sensitive to price in the PDP market pertains directly to the justification for private drug coverage under Medicare (Frakt and Pizer, 2009). However, limited studies have been done to measure Medicare beneficiaries' premium elasticities. Town and Liu (2003) estimated the monthly semi-elasticity to be -0.009 for a typical Medicare HMO using a mean utility logit model, while the median plan elasticity is -0.33 conditional on charging a positive premium. Frakt and Pizer (2009) estimated price elasticity in the PDP market using 2007 PDP enrollment data. The authors found a price elasticity of -1.45 with the elastic demand indicating that PDP premiums are closer to marginal cost than Medicare HMO premiums.

This dissertation reexamines price elasticity in the PDP market. There are at least two reasons to revisit this question. First, in 2006 and 2007, plans submitted bids using manual rating due to a lack of experience in the market. In other words, plans used

market characteristics to generate bids, which limited variability in pricing for similar products. In 2008, plans were required to use experience rating to price their products. Experience rating generates greater variability in bids and premiums for similar products than manual rating (Cutler, 1994). Such variation is expected to lead to greater price sensitivity among Medicare PDP enrollees.

Second, Frakt and Pizer (2009) assumed that individuals not enrolled in the PDPs purchased a composite "outside good", whose characteristics are not included in the utility function. However, individuals who are not enrolled in the PDPs are more likely to enroll in MAPDs, rather than an unknown "outside good". In this dissertation, we define MAPD plans as the "outside good" and include MAPD premiums into the utility function. Consistent with Town and Liu's (2003) analysis of HMOs, the price is defined as the difference in PDP and MAPD premiums.

2.3 Summary

Correctly pricing the Part D bid is critical for the successful implementation of the Medicare Part D program. As we know, an overpriced plan requires enrollees pay higher premiums and represent an inefficient use of the government subsidy. On the other hand, an underpriced plan drives the plan out of business in the long run. According to CMS's guidance, all plan bids should be priced using actuarial assumptions. In other words, correctly priced plan bids should be a function of the plan characteristics, such as the annual deductible, member cost sharing, drugs on the formulary, etc. Medicare beneficiaries are expected to enroll in plans that best meet their needs in terms of premium and coverage. The question whether Medicare beneficiaries are sensitive to

price in the PDP market pertains directly to the justification for private drug coverage under Medicare (Frakt and Pizer, 2009).

After reviewing the existing literature, we found that little research has been done to measure the relationship between Medicare Part D plan characteristics and the Part D bids/premiums, and premium elasticity.

Chapter Three

Research Design

This chapter consists of four sections. Section 3.1 outlines the objectives and hypotheses to be carried out in this dissertation. Section 3.2 first presents the data sources and information contained in each source, and then discuss briefly the compilation of the data, including the data cleansing and merging processes. Section 3.3 discusses, in detail, the variables included in our model specifications. Section 3.4 presents our methodology applied and the econometric models derived.

3.1 Objectives and Hypotheses

This dissertation examines the stand-alone PDP bids and premiums from different perspectives using 2006-2008 PDP data.

First, we consider how the plan characteristics affect the bids. Bids are equivalent to the total premiums charged by an insurer. This includes the premium paid by the consumer and the portion paid by the federal government. Specifically, we examine the effect of multiple-tiers copayment structure on the PDP bids. We also measure how the relationship between the copayment structure and the plan bids varies by tier. As such, we can assess the copayment elasticity across tiers.

Further, we decompose plan bid and premium changes between 2006 and 2008 into two components, the proportion due to changing plan characteristics and the proportion due to changes in the marginal prices associated with plan characteristics. While plan characteristics are an important determinant of bids and premiums, the

actuarial methods used to price those characteristics are also important. Since 2006 was the first year of the Medicare Part D program, insurers were unable to base their bids on experience and all plans submitted manual rated bids. Starting in 2008, plans were required to submit experience rated bids. Each plan's 2006 experience was required to be used to develop the 2008 bids. Due to different pricing methods, the relationship between plan characteristics and plan bids is likely to differ between 2006 and 2008.

Finally, we measure the Medicare beneficiaries' sensitivity to price in the PDP market. Specifically, we will combine the approaches by Town and Liu (2003) and Frakt and Pizer (2009) to estimate the elasticity and semi-elasticity of enrollment with respect to PDP premiums.

The hypotheses to be tested in this dissertation include

Hypothesis 1: The tiered copayments are consistent with their actuarial values.

Hypothesis 2: The utilization control tools lower the plan bids.

Hypothesis 3: Actuarial pricing methods play an important role in explaining the premium and bid difference between 2006 and 2008.

Hypothesis 4: Medicare beneficiaries are sensitive to PDP premiums.

3.2 Description of Data

The data used in this dissertation comes from several sources. The major source is the CMS Prescription Drug Plan and Pharmacy Network Files. Other sources include CMS Landscape Source Data, CMS Part D Risk Score by County Data, CMS PDP Penetration Files and CMS monthly Enrollment Files. Some Kaiser Family Foundation data is used, such as 2006-2007 Medicare Beneficiaries by State File. Sections 3.2.1

through 3.2.3 describe in detail each of these data sources while section 3.2.4 describes the construction of the datasets utilized in this dissertation.

3.2.1 Prescription Drug Plan and Pharmacy Network Files

The major data source for this dissertation is the 2006-2008 CMS prescription drug plan and pharmacy network files. These data are public-use files available to researchers for a fee. It contains formulary and pharmacy network data for Medicare PDPs and MAPD plans with the exception of employer and PACE plans. These files are updated monthly with updates being available at the end of the first week of each month.

This public file is composed of the following sub-files: Plan Information File, Formulary File, Geographic Locator File, Beneficiary Cost File, and Pharmacy Network File. These files contain a unique plan identifier and a formulary identifier that can be used to combine information in these files. Figure B2 in Appendix B shows the diagram of how these files are related. Two supporting crosswalk files are needed to interpret the codes for the identifiers in these files.

3.2.1.1 Plan Information File

The plan information file includes organization contract number assigned by CMS, plan identifier assigned by CMS, unique identifier assigned to the formulary, monthly premium amount, annual deductible amount, annual ICL, regional Medicare Advantage plan service area, PDP plan service area, state and county codes.

The unique contract number, plan identifier and formulary identifier allow us to link the plan information file to other files. Plans service area, state, and county indicators were used to link with geographic information files.

3.2.1.2 Formulary File

The formulary file provided detailed formulary information including a unique formulary identifier, the 11-digit NDC (national drug code), the tier level associated with the NDC, indicators for quantity limits, prior authorization requirements and step therapy requirement for each NDC.

The unique formulary identifier in this file was used to link the plan information file.

3.2.1.3 Beneficiary Cost File

Beneficiary cost file contains plan level cost-sharing details by tier. This file also contains contract number and plan number that can be used to link with the plan information file to obtain the characteristics of each plan.

3.2.1.4 Pharmacy Network File

The pharmacy network file contains National Association of Boards of Pharmacy (NABP) numbers for each network pharmacy. It includes indicators for preferred, retail, and mail order. NABP is the independent, international, and impartial association that assists in developing and maintaining the standards for the purpose of protecting public

health. NABP assigns a unique seven-digit code for each licensed pharmacy in the United States.

The Pharmacy network file also contains the common contract number and plan number that can be used to link to the other files.

3.2.1.5 Geographic Locator File

The geographic locator file contains county code and name, state name, MA and PDP region codes and description. CMS established 26 MA regions and 34 PDP regions for the administration. MA regional plans and PDPs operate at the regional level. They are required to be open to all the Medicare beneficiaries in each region they enter. The county code, MA and PDP region codes can be used to link with the plan information file to provide the description of service area for each plan.

3.2.1.6 Supporting Files

Two supporting files are needed to interpret the codes. One is national council for prescription drug programs (NCPDP) data that crosswalk the unique NABP pharmacy number to pharmacy names and addresses in the pharmacy network file. The other one is the MediSpan or First Data Bank data to crosswalk NDCs to drug names in the formulary file.

3.2.2 Other CMS Data

Other CMS data used include CMS Part D Risk Score by County, plan enrollment data, PDP Penetration data, and PDP landscape file, etc. These data are updated on either

a monthly or an annual basis. All of these data are open to public and can be downloaded from the CMS website.

3.2.2.1 Part D Risk Score File

CMS Part D Risk Score by County provide the county level Part D risk scores. Only 2006 Part D risk scores were released by CMS. CMS released county level risk score data to help insurance companies prepare for the 2006 Part D bids because 2006 was the first year of the Medicare Part D program and all plans lacked Medicare beneficiaries' Part D risk scores. After 2006, the Part D plans obtained their members' risk scores and CMS no longer released the risk score information. In this dissertation, the 2006 PDP level risk scores were weighted by over 65 populations in each county at the end of each year (2005-2007) to derive the 2006-2008 PDP region level risk scores.

3.2.2.2 PDP Penetration File

CMS started releasing the MA and PDP state-county penetration data on its website since May 2008. These files provide information on the number of Medicare beneficiaries, the number of enrolled, and penetration rate by county. In this dissertation, we converted this county level information to PDP region level information. Since the number of Medicare beneficiaries varies slightly by month, the 2008 Medicare beneficiaries in each PDP region were represented by the monthly average of the Medicare beneficiaries from May 2008 to September 2008 (the latest information when building the models).

3.2.2.3 CMS PDP Monthly Enrollment File

CMS has been releasing the plan enrollment data for MAPDs and PDPs on its website since 2006. The plan level enrollment information was updated in 2006 and 2007. Unfortunately, only July enrollment data are available for 2006 and 2007. Since May 2008, this information has been updated on a monthly basis. For consistency, July 2006, July 2007 and July 2008 plan enrollment data were used.

3.2.2.4 CMS Landscape File

Since 2006 CMS has been releasing the CMS MAPD Landscape Source Data and PDP Landscape Source Data on an annual basis. These files are generally released two or three months before the calendar year starts. Starting in 2008, the special need plans for dual eligibles or institutional members have been released separately. These files provides the basic plan information, such as contract ID, plan ID, annual deductible, plan type, plan member premium, service area, etc. The service area in the MAPD files and special need plan files is shown by county while the service area in the PDP files is shown by state.

3.2.3 Other Data

The 2006-2007 Medicare beneficiary count data were originally released by CMS, but are no longer available on the CMS website. These data were obtained from Kaiser Family Foundation. Kaiser Family Foundation is a US based non-profit private operating foundation focusing on the major health care issues facing the nations. It

provides summarized updated health data, policy and other healthcare related information obtained from CMS, states and other sources in a timely manner.

In this dissertation, the state level information in these files was converted to PDP region level information in order to merge with other files.

3.2.4 Data Compilation

The focus of this dissertation is on the stand-alone PDP's. The premiums (bids) of the MAPDs are mainly determined by the medical benefits, such as inpatient, outpatient, and physician services. Although these plans also cover prescription drugs, the portion of bids for providing drug benefits cannot be separated. Therefore, this dissertation excluded MAPDs and measures PDPs only. In addition, we study the PDPs in the Unites States only and the PDPs in the territories of the United States, such as Puerto Rico were excluded.

By examining the data more carefully, we found and removed some outliers. For example, there is one plan in 2006 (contract ID S5585, plan ID 001) which charged an unreasonably high premium for providing the defined standard benefits. As a result, this plan failed to enroll any members. This plan was likely priced incorrectly and therefore was excluded. Sixteen plans that offered defined standard benefits had only one tier on their formulary files with 25% coinsurance. It is likely these plans put all the drugs (both generic drugs and brand name drugs) on one tier. Since the focus of this dissertation is on the tiered copayment structure, these plans were excluded.

Each contact has a unique contract ID approved by CMS and each plan under the same contract has a unique plan ID. Each formulary file also has a unique formulary ID.

These IDs together with the geographic identifier were used to merge the files described above. For example, formulary IDs were used to combine the formulary file and the plan information file. Contract ID and plan ID were used to combine the plan information file, beneficiary cost sharing file, CMS enrollment data, and CMS landscape source data. The PDP region number was used to combine the plan information file with the Part D risk score file and Medicare beneficiary file.

Most plans covered medications in four tiers, including tier 1 for generic drugs, tier 2 for preferred brand drugs, tier 3 for non-preferred brand drugs, and tier 4 for specialty and injectable drugs. Some plans choose not to offer tier 3 or tier 4. In this case, tier 3 or tier 4 are coded as uncovered. Some plans do not offer the typical four tiers. For example, some plans may offer 5 tiers by breaking tier 1 into preferred generic and non-preferred generics. In this case, we converted it into the typical four tiers by combining the preferred generic and non-preferred generic tiers into one tier of generics. Some plans switched the tier orders, for example, they cover specialty drugs on tier 3 and non-preferred brand drugs on tier 4. In this case, the tiers are reconstructed to the typical four tier structure.

3.3 Description of Variables

This section describes the variables from a modeling perspective, i.e., dependent and independent variables.

3.3.1 Dependent Variables

Three dependent variables are selected depending on the modeling purposes and needs in this dissertation. To test Hypothesis 1 and Hypothesis 2, plan bid was chosen as the dependent variable. As introduced in Chapter One, the Medicare member premium is only 25.5 % of the total plan cost on average. The remaining is paid by the federal government in terms of subsidies. Similar to the member premiums in the commercial insurance market, the plan bids of the PDPs capture the total plan cost of providing the prescription drug coverage. Therefore, we selected the plan bid as the dependent variable instead of the member premiums.

Table 2 National Average Part D Numbers

Year	Bid	Basic Premium	Direct Subsidy
2006	$97.00	$33.00	$64.00
2007	$80.43	$27.35	$53.08
2008	$80.52	$27.93	$52.59

The bid each plan submitted to CMS is composed of two parts, the basic member premium and government direct subsidy. These amounts are required to be submitted to CMS at a normalized risk score (1.0) base to facilitate the calculation of risk adjusted payments. As introduced in Chapter One, the basic member premium is also determined by the national average bid, which is also normalized at the risk score of 1.0. For reference, the national average bid, national average member basic premium, and national average government direct subsidy from year 2006 to 2008 are summarized in Table 2.

The federal reinsurance which is used together with national average bid to determine the national average premium is not included.

The difference between plan bid and national average bid becomes the member's liability. In other words, the members must pay the national average premium plus any difference between the plan's bid and the national average bid. For the defined standard, actuarial equivalent, and basic alternative plans, members are only required to pay a basic premium while members enrolled in the enhanced alternative plans have to pay a supplemental premium in addition to the basic premium. The supplemental premium is not part of, but in addition to the plan bid. Different from the bid, it is based on the projected risk score, not the normalized risk score of 1.0.

However, the actual plan bid submitted to CMS is not directly obtainable. The available data only contains the information of total member premiums. For the enhanced alternative plans, the split of the premium (basic vs. supplemental) is unobtainable either.

Fortunately, using the national average bids and national average member basic premiums in Table 2, we were able to reconstruct the bids using the following steps.

(1) Calculate the national average direct subsidy as the difference of the national average bid and the national average member basic premium.

(2) Add the national average direct subsidy by year to the member total premiums of each plan.

In summary, we computed the plan bid as the sum of member premium and government direct subsidy for the basic benefit package assuming a risk score of 1.0. For the standard, actuarially equivalent, and basic alternative plans, the plan bid is simply

calculated as the sum of member premium and the national average direct subsidy, which equals the actual bids that each firm submitted to CMS. For the enhanced alternative plans, the actual bids submitted by the firm cannot be calculated with available data. Only total member premiums were reported which represents the beneficiary share of standard benefits and the total cost of the enhanced benefits. As with the other plans, the bid is computed as the sum of the member premium and government subsidy, but the computed "bid" differs from the actual bid submitted to CMS. The computed bid represents the cost of providing the basic benefits (at risk score equal to 1.0) plus the actual expected cost of providing the enhanced benefits, not simply the expected cost of providing the basic benefits.

The per member per month bid is transformed into the natural logarithm due to the skewed distribution of the variable. Using the transformed variable, White's (1980) test for heterskedasticity did not reject the null hypothesis of homoskedasticity. We also did the normality testing for the log transformed bid. As shown in Appendix B Figure 1, it is approximately normally distributed.

Other functional forms of the dependent variable were attempted too. For reference, we have provided, in Appendix A, the estimation results of using the square root transformation. Instead of plan bid, we also attempted to use the member premium as the dependent variable. Relevant results are presented in the Appendix A for the purpose of comparison.

To test Hypothesis 3, we used both the plan bid and plan premiums as the dependent variables. Logarithm transformation was applied to both variables.

For Hypothesis 4, each plan's market share was used as the dependent variable. The market share is calculated as the ratio of each plan's enrollment divided by the total number of Medicare beneficiaries in each PDP region.

3.3.2 Explanatory Variables

For clarity, we categorized the explanatory variables into six groups, including plan benefit variables, plan characteristic variables, formulary variables, time variables, and market characteristics variables.

The plan benefit variables used in this dissertation include annual deductible, tier 1 copayment, tier 2 copayment, tier 3 coinsurance, and tier 4 coinsurance. In the dataset, some plans offer flat copayments while some plans offer coinsurance (as a percentage of the total drug cost). In order to measure the benefits on the same base, tier 1 and tier 2 coinsurance were converted to copayments while tier 3 and tier 4 copayments were converted to coinsurance using the national median drug costs on each tier (Appendix A, Table A1). For tier 3 and tier 4, we used coinsurance instead of copayment because coinsurance can capture the fact that some plans don't cover tier 3 or tier 4 drugs. According to Kaiser Family Foundation's in-depth examination on the formularies of Medicare drug plans in 2006, the median price of generic drugs is $18.11 per script and the median price of brand name drugs is $92.16. For plans that offer tier 1 coinsurance, the tier 1 copayment is calculated as the product of tier 1 coinsurance and the average generic drug cost of $18. Similarly, for plans that offer tier 2 coinsurance, the tier 2 copayment is calculated as the product of tier 2 coinsurance and the average brand name drug cost of $92. For plans that offer tier 3 copayments, the tier 3 coinsurance is

calculated as tier 3 copayments divided by the average brand name drug cost of $92. For plans that offer tier 4 copayments, the tier 4 coinsurance is calculated as tier 4 copayments divided by $600 which is the minimal specialty drug cost per script defined by CMS. For plans that do not cover tier 3 or tier 4 drugs, the coinsurance is set to be 100%.

Three dummy variables capturing the plan characteristics are included. The first one is whether the plan charges $0 premium to members eligible for full LIS. In other words, these plans can be treated as benchmark plans which aim to enroll the low income people and their main revenue source is the government. The second one is whether the plan offers generic drug coverage in the gap or "donut hole". The third one is whether the plan offers all drugs coverage (both generic drugs and brand name drugs) in the "donut hole". The coverage gap or "donut hole" as a special feature of the Medicare standard plans aimed to control total drug spending. Some enhanced alternative plans (approximately 25% of the plans in the sample) choose to cover generic drugs or all drugs in the "donut hole" to attract Medicare beneficiaries to enroll.

The formulary variables selected include the numbers of drugs on tier 1 to tier 4. The number of drugs on tier 1 or tier 2 was transformed by natural logarithm function while the number of drugs on tier 3 or tier 4 was kept at the level due to fact that some plans do not cover tier 3 or tier 4 drugs. In addition, we also included the utilization control tool variables, including the numbers of drugs subject to quantity limit, prior authorization, and step therapy.

The PDPs are offered by contract year, which coincide with the calendar year. As the data used in this dissertation contains the PDPs from 2006 to 2008, two year dummy variables were used to capture the time effects. They are Year07 and Year08 with year 2006 as the reference year.

The PDPs are offered at a regional level, and a PDP is required to open to all Medicare beneficiaries in the region. Market characteristic data include beneficiary health status, market size, and the number of competing plans in each PDP region. Beneficiary health status is measured using the average 2006 Part D risk score in the region. The risk score is derived from a prospective model designed to predict medication needs in next year based on observed diagnoses in the prior year. Interested readers can refer to Robst, Levy, and Ingber (2007) for a detailed description of the Part D risk adjustment model. Only the 2006 county level risk score data were available from CMS. Thus the county level risk scores were assumed constant from 2006 to 2008. The calculated risk scores by PDP region from 2006 to 2008 are presented in Appendix A, Table A2.

Market size is defined as the number of Medicare beneficiaries in each PDP region, which is presented in Appendix A, Table A3.

Another market characteristic variable is the number of competing PDPs within each PDP region. This variable captures the competition level within each PDP market.

3.4 Methodology

This section describes the methodology used to test our hypotheses. Hedonic pricing model is used to test Hypotheses 1 and 2. The decomposition method by

Neumark is used to test Hypothesis 3. A mean utility logit model is used to test Hypothesis 4. In addition, we also discuss some empirical problems and the strategies we used to construct our models.

3.4.1 Hedonic Pricing Model

The term "hedonics" is derived from Greek word *hedonikos*, which means "related to pleasure". The term is frequently used by both economists and scientists in other fields. It simply means that one item or measure is judged better than another. In the economic context, "hedonics" refers to the utility or satisfaction one derives through the consumption of goods or services. The essence of hedonic pricing is that the price of good is related to the attributes of the product. Hedonic pricing models examine the relationship between the observed prices and the attributes of the product. In this sense, it estimates the implicit price of each attributes the product has, or the consumer's willingness to pay for certain attributes associated with the product of interest.

Two researchers have made major contributions to the theoretical work on Hedonic pricing. Lancaster (1966) developed a new approach to consumer theory. He broke away from the traditional approach that goods are the direct objects of utility. Instead, he supposed that it is the properties or characteristics from which utility is derived, or the consumer's preferences are exercised. Rosen (1974) formulated a theory of hedonic prices as a problem in the economy of spatial equilibrium in which the entire set of implicit prices guide both consumer and producer locational decisions in characteristics space. Both approaches linked the observed product prices and the

specific amounts of characteristics associated with each good defining a set of implicit or "hedonic" prices.

Rosen also advanced the hedonic pricing theory by identifying the inverse demand curve and examined both consumer and supplier decisions in a perfectly competitive market. Specifically he built the hedonic pricing model through two distinct stages. In the first stage, the marginal or implicit price function was estimated using the regression of the product price on the characteristics. In the second stage, the inverse demand curve or the marginal willingness-to-pay function was derived by taking the first derivative of the implicit price function estimated in stage one.

Other researchers also made considerable contributions to the development of hedonic pricing theory, such as relaxing the assumptions of perfect competition in hedonic pricing models. Lucas (1977) included buyer characteristics and Berndt (1995) added firm effects.

Recently, the hedonic pricing has been used in the health insurance market. Using a hedonic pricing model, Jensen and Morrisey (1990) measured the relationship between group health insurance premiums and policy characteristics including plan benefits, cost-sharing and out-of-pocket expense limits. They also considered other group (buyer) characteristics, such as location and industry of the enrollee, and plan (supplier) characteristics, such as whether it is a self-insured plan or a commercial plan. More recently, Robst (2006) used a hedonic pricing model to examine the Medigap insurance premiums and estimated the marginal prices for Medigap benefits. He considered both product attributes, and buyer/supplier characteristics.

In this dissertation, we proposes to use a hedonic pricing model to estimate the bid (price) of PDPs as a function of plan characteristics, the characteristics of PDP regions, and the characteristics of insurance companies (see Equation (3.1)).

$$Bid_{ijk} = f(Plan_i, PDP\_region_j, Insurer_k) \quad (3.1)$$

where i indexes PDP plans, j indexes PDP regions and k indexes insurers. Bid_{ijk} is the monthly bid for plan i offered in region j by insurer k.; $Plan_i$ represents a vector of plan characteristics including cost-sharing, formulary etc; PDP_region_j represents a vector of CMS defined PDP region (one or more states) characteristics; $Insurer_k$ represents a vector of insurance company characteristics.

3.4.1.1 Missing Variable Problem

Assuming a linear specification in parameters and using the natural logarithm transformation of the PDP bid, Equations (3.1) can be more specifically written as:

$$Ln(Bid_{ijk}) = \beta_0 + \beta_1 Plan_i + \beta_2 PDP\_region_j + \beta_3 Insurer_k + \beta_4 Year_t + u_i \quad (3.2)$$

To account for time effects, we added a vector of year dummy variables ($Year_t$). u_i represents the error term.

Assuming that the model specification in Equation 4.2 is correct, we cannot directly estimate this model due to some missing variables. Many firm level characteristics such as discounts negotiated with drug companies are not public

information. However, these variables are likely to be correlated with the plan benefit variables. For example, plans that receive higher discounts from their PBM (pharmacy benefit manager) are likely to offer richer benefits or lower member cost sharing. Simply excluding these variables will make the model suffer from the omitted variable problem and cause the estimation to be biased.

3.4.1.2 Firm Fixed Effects Model Specification

In order to account for the missing firm level characteristics, a firm fixed effects model is proposed under the assumption that firm level variables are time-invariant. This is not an unreasonable assumption as most insurance companies keep the same PBM over years and the PBM contracts are not likely to change significantly over years. Use of the firm fixed effects model will remove insurer characteristics and produce consistent estimates for the plan characteristic variables and market characteristic variables.

The fixed effects transformation, also called within transformation, is obtained by first averaging equation (3.2) for all plans offered by the same contract at year t for all contracts, resulting in the following equation:

$$\overline{Ln(Bid_k)} = \beta_0 + \beta_1 \overline{plan}_k + \beta_2 \overline{PDP\_region}_{jk} + \beta_3 \overline{Insurer}_k + \beta_4 \overline{Year}_{tk} + \bar{u}_k \qquad (3.3)$$

where $\overline{Ln(Bid_k)}$ is the average plan bid and $\overline{plan}_k$ is the averaged plan characteristics in the same contract k, $\overline{Insurer}_k$ is the averaged insurer characteristics,

$\overline{PDP\_region}_{jk}$ is the averaged PDP characteristics, and $\bar{u}_k$ is the average error for contract k .

Next, to erase the insurer characteristics, Equation (3.3) is subtracted from Equation (3.2), resulting in Equation (3.4).

$$Ln(Bid)_i - Ln(\overline{Bid})_k = \beta_1(plan_i - \overline{plan}_k) + \beta_2(PDP\_region_j - \overline{PDP\_region}_{jk}) +$$
$$\beta_3(Insurer_k - \overline{Insurer}_{jk}) + \beta_4(Year_t - \overline{Year}_{tk}) + (u_i - \bar{u}_k)$$
$$= \beta_1(plan_i - \overline{plan}_k) + \beta_2(PDP\_region_j - \overline{PDP\_region}_{jk}) + \beta_4(Year_t - \overline{year}_{tk}) + (u_i - \bar{u}_k)$$

Or, we can simply write:

$$\ddot{Ln}(Bid)_i = \beta_1 \ddot{Plan}_i + \beta_2 \ddot{PDP\_region}_j + \beta_4 \ddot{Year}_t + \ddot{u}_i \qquad (3.4)$$

where $\ddot{Ln}(Bid)_i = Ln(Bid)_i - \overline{Ln(Bid)}_k$ is the contract-demeaned data on the plan bids, and similarly for $\ddot{Plan}_i$, $\ddot{PDP\_region}_j$, $\ddot{Year}_t$ and $\ddot{u}_i$.

The fixed effect model assumes strict erogeneity of the explanatory variables on the unobserved effects, which can be expressed as Equation (3.5).

$$E(u_i \mid Plan_{i,} PDP\_region_j, Insurer_k) = 0 . \qquad (3.5)$$

For the fixed effect analysis, $E(Insurer_k \mid Plan_i, PDP\_region_j)$ is allowed to be any functions of the explanatory variables.

Equation (3.4) can be estimated using standard econometric methods, such as Ordinary Least Square (OLS), given Equation (3.5) is satisfied and no unobserved heterogeneity. However, the interpretation of the estimated coefficients of β s is based on Equation (3.2).

3.4.2 Decomposition Model

Oaxaca (1973) developed empirical techniques to decompose the wage difference between men and women into two components. The first component is the proportion of the wage gap due to difference in characteristics between men and women while the second component is the proportion due to difference in the returns to those characteristics. Neumark (1988) built on Oaxaca's method to develop a general theoretical model of employer discriminatory behavior.

Here we follow Neumark's approach to decompose the plan bid and premium difference between 2006 and 2008. Let $Ln(\overline{Bid}_{2006})$ and $Ln(\overline{Bid}_{2008})$ be the mean of the natural logarithm transformed plan bids for 2006 and 2008, respectively. The average difference in 2006 bids and 2008 bids can be expressed as:

$$Ln(\overline{Bid}_{2008}) - Ln(\overline{Bid}_{2006}) = \overline{\Delta X}'\beta + [\overline{X}'_{2008}(\beta_{2008} - \beta) - \overline{X}'_{2006}(\beta_{2006} - \beta)] \qquad (3.6)$$

where $\overline{X}'_{2006}$ and $\overline{X}'_{2008}$ are vectors containing the means of the explanatory variables for 2006 and 2008 samples respectively, while $\overline{\Delta X}' = \overline{X}'_{2008} - \overline{X}'_{2006}$. β_{2006} and β_{2008} are the estimated coefficients from estimating equation (3.2) separately for each year, and β is estimated coefficients using combined data from both years. The coefficients represent

the marginal price of the associated plan characteristics. The first term on the right hand side of Equation (3.6) is the proportion of bid difference that is due to changes in plan characteristics while the second term is the proportion of the difference due to changes in pricing associated with plan characteristics.

3.4.3 Premium Elasticities

This section discusses the methodology for estimating the premium elasticities. Section 3.4.3.1 introduces Berry's mean utility function. Section 3.4.3.2 discusses, in detail, the instrument variables and 2SLS specification. Finally, Section 3.4.3.3 presents the premium elasticity definition.

3.4.3.1 Mean Utility Function

Berry (1994) developed a discrete choice model to measure the endogenously determined price by price-setting firms. Specifically, a utility logit model was used to estimate demand parameters under imperfect competition in markets with product differentiation. Berry's approach is well suited to the PDP market (Frakt and Pizer, 2009).

This study follows Berry's (1994) approach by assuming the consumer indirect utility function as:

$$U_{ijr} = \alpha \,\mathrm{Pr}emium_{jr} + \beta Plan_{jr} + \delta Market_{r} + \xi_{f} + \varepsilon_{ijr} \qquad (3.7)$$

where, *i* indexes individual, j indexes the plan, *f* denotes firms, and *r* indexes PDP regions. $\mathrm{Pr}emium_{jr}$ is a scalar for plan premium; $Plan_{jr}$ is a vector of plan characteristics;

$Market_r$ is a vector of market characteristics; ξ_f indicates unobservable firm characteristics; and ε_{ijr} denotes the random error. According to the utility theory, a Medicare beneficiary chooses the plan that maximizes his or her utility. Utility is a function of the plan premium and known plan characteristics including member cost sharing, drugs on the formulary, and coverage in the gap. Market characteristics (regional risk scores and the number of competing PDPs) were also included in the utility function assuming that the utility derived may be a function of health, and that individuals benefit from competition both directly (through lower premiums) and indirectly (due to better customer service, more choices).

Assuming the random error ε_{ijr} is independently and identically distributed across individuals, regions and products, the individual's choice of PDPs can be modeled using a conditional logit model (Berry, 1994). Equation (3.7) can be rewritten as the following linear marker share equation (Town and Liu, 2003):

$$Ln(\mathrm{Pr}_{jr}) - Ln(\mathrm{Pr}_{0r}) = \alpha\,\mathrm{Pr}emium_{jr} + \beta Plan_{jr} + \delta Market_r + \xi_f \qquad (3.8)$$

where Pr_{jr} is the probability of an individual in region r choosing plan j. Pr_{0r} is the probability of an individual in the same region not choosing a PDP, instead choosing an outside good.

The outside good is defined using two different approaches. First, Frakt and Pizer's approach is used by defining a "composite good" that is consumed by Medicare beneficiaries who are not enrolled in any PDPs. Second, MAPDs are explicitly defined as the outside good, which is similar to Town and Liu's approach of defining the

Medigap policies as the outside good of Medicare HMOs. Medigap plans are viewed as the alternative to MA coverage because the majority of Medicare FFS members who are not enrolled in Medicare HMOs supplement their coverage with Medigap policies. This reasoning also applies to the Medicare Part D market since Medicare beneficiaries who do not enroll in PDPs are most likely to enroll in MAPDs. In the second approach, the premium in Equation (3.8) becomes the difference between the PDP premium and the average MAPD premium in the same PDP region. MAPDs are responsible for medical care and prescription drug coverage. Premiums for medical and drug coverage are not reported separately. Thus, the Part D premium for MAPD plans in each region is calculated as the difference between the average premium for MAPD plans and MA-only plans.

While MAPDs are the most common alternative to PDPs, there is not a direct correlation between service areas of managed care plans and PDPs. PDPs must offer products in an entire region, while managed care plans can offer products in specific counties. Given that managed care plans tend to focus on urban areas, individuals in some rural areas may not have a MAPD option. However, while acknowledging this shortcoming, most enrollees have a MAPD option and thus the effect on the estimated price elasticity is examined by explicitly including this option in the utility function.

Using market shares as an empirical measure of the probability of enrollee choices, Equation (3.8) can be rewritten as:

$$Ln(MS_{jr} / MS_{0r}) = \alpha \,\mathrm{Pr}\, emium_{jr} + \beta Plan_{jr} + \delta Market_{r} + \xi_{f} \qquad (3.9)$$

where MS_{jr} is the market share of plan j in region r and MS_{or} is the market share of the outside good in region r. In order to remove company-specific unobserved characteristics from the error terms in Equation (3.9), firm fixed effects models are estimated by including categorical variables (ξ_f) for each firm in the specification.

3.4.3.2 Instrumental Variables

OLS estimation of Equation (3.9) generates biased results because the plan premium is likely to be correlated with ξ_f. It is standard to assume plan characteristics to be exogenous leaving only the possibility of endogenous premiums (Frakt and Pizer, 2009). Thus, two-stage least squares (2SLS) is used to obtain unbiased estimates.

Valid instruments must be correlated with the plan premium but not with unobservable factors that affect utility. Town and Liu's approach is followed by selecting the maximum, minimum, and mean premiums of the plans offered by the same insurance company in other PDP regions as instruments. These premiums are suitable for instruments because shocks to the marginal cost are reflected in changes in premiums in other regions, holding the characteristics in other regions constant, and those shocks are uncorrelated with the change in plan quality (Town and Liu, 2003). The mean number of competing MAPDs and PDPs in those regions are also included among the instruments leading to a total of five instruments for one endogenous variable.

3.4.3.2 Premium Elasticity Definition

The premium elasticity and semi-elasticity of demand are calculated for PDP enrollees using definitions by Dowd et al. (2003). The estimated coefficient on the

relative premium ($\hat{\alpha}$ in Equation (3.9)) can be transformed into the average plan-level premium elasticity of demand, ε , using Equation (3.10). The percent change in market share due to \$1 change in premium is given by the semi-elasticity, k , using Equation (3.11).

$$\varepsilon = \hat{\alpha} \times (1 - \overline{MS}) \times \overline{\Pr emium} \tag{3.10}$$

$$k = \hat{\alpha} \times (1 - \overline{MS}) \tag{3.11}$$

where, $\overline{MS}$ and $\overline{\Pr emium}$ are the sample average market share and premium across all regions.

Chapter Four

Research Results

This chapter presents our research results. Section 4.1 presents descriptive statistics of the variables, and the results of the hedonic pricing model with firm fixed effects. Section 4.2 discusses the decomposition model results. Section 4.3 describes statistics of the variables used in the OLS and 2SLS models and presents the model estimates, together with the PDP premium elasticities.

4.1 Hedonic Pricing Model Results

The following section describes the summary statistics of the final dataset used in the hedonic pricing models to test Hypothesis 1 and Hypothesis 2. Statistical data analysis and fixed effects model estimation results are also discussed in detail in this section.

4.1.1 Descriptive Statistics

The sample used for estimating the firm fixed effects model includes 5,101 stand alone PDPs with 1,414 in 2006, 1,865 in 2007, and 1,822 in 2008. 89% of the plans are alternative plans and 25% of the plans offer some coverage in the "donut hole". The descriptive statistics of the variables in this sample are shown in Table 3.

As shown in Table 3, the dependent variable varies significantly from the lowest plan bid of $62.39 offered by Well Point, Inc. in 2008 to the highest plan bid of $188.78 offered by United Health Group in 2007. The average plan bid is $94.08. Consistent

with the plan bid, the member premium varies significantly too, from the lowest member premium of $1.87 offered by Humana in 2006 to the highest member premium of $135.70 offered by United Health Care Group in 2007. It is interesting to see that both the highest bid and the lowest bid are offered by large insurance companies.

Significant variations were also found for majority of the explanatory variables in the sample. For example, tier 1 copayment for generic drugs ranges from $0 to $25 with an average of $5. Tier 2 copayment for preferred brand name drugs ranges from $10 to $73 with an average of $28. Instead of using fixed copayments, coinsurance is used for tier 3 and tier 4 member cost sharing. Average coinsurance is 67% for tier 3 medications (drugs) and 36% for tier 4 medications. The maximum coinsurance in tier 3 and tier 4 is 100%, which indicates the plan does not offer medications in these tiers. Such medications may be covered in a lower tier or not covered at all. The minimum values of tier 3 and tier 4 are 25% and 4% coinsurance respectively, which indicates that members enrolled in these plans only pay 25% or 4% of the total drug cost.

Most firms offer a considerable number of medications on their formulary. For the purposes of this study, each NDC is considered to be a "medication". NDC refers to the "National Drug Code", which is a unique 11-digit, 3-segment number assigned to each medication listed under the Section 510 of the U.S. Federal Food, Drug and Cosmetic Act. The first segment identifies the manufactures; the second segment identifies a specific strength, dosage form and formulation for a particular firm; the third segment identifies the package size.

Table 3 Descriptive Statistics of Variables for the Firm Fixed Effects Model

(n=5,101)

Variables	Mean	STD	Max	Min
Bid	94.08	17.14	188.78	62.39
Premium	38.15	16.53	135.7	1.87
Cost sharing				
Tier 1copayment	5.16	3.3	25	0
Tier 2 copayment	28	7.44	73	10
Tier 3 coinsurance	0.67	0.24	1	0.25
Tier 4 coinsurance	0.36	0.23	1	0.04
# drugs on each tier (in thousands)				
# drugs on tier 1	4,162	5,623	106,958	599
# drugs on tier 2	1,136	581	10,910	410
# drugs on tier 3	1,093	1,652	20,863	0
# drugs on tier 4	365	393	4,559	0
Utilization controls (in thousands)				
Quantity limits	756	2,414	37,001	4
Prior authorization	525	412	3,829	13
Step therapy	76	220	3,687	0
Other population and plan characteristics				
Risk score	0.99	0.04	1.05	0.91
Medicare population (in millions)	1.31	0.98	4.47	0.05
LIS_0prem	0.3	0.46	1	0
Deductible	96.92	122.79	275	0
Gap coverage (Generics only)	0.25	0.43	1	0
Gap coverage (All Drugs)	0.01	0.11	1	0
Year 2007	0.37	0.48	1	0
Year 2008	0.36	0.48	1	0

In this dataset, the average number of generics on tier 1 is over 4,000 and there are over 1,000 preferred brand name medications on an average formulary. The tier with fewest medications is tier 4 (specialty drugs), which has 365 medications on an average

formulary. The number of medications on each tier varies significantly. Specifically, tier 1 medications range from 599 to over 100,000 and tier 2 medications range from 410 to over 10,000. Some plans do not offer tier 3 or tier 4 while some other plans cover over 20,000 non-preferred drugs and thousands of specialty drugs.

The drugs that have utilization control represent a fairly small percentage of the sample, approximately 11% with quantity limits, 8% required for prior authorization, and 1.1% required for step therapy on an average formulary. As seen, quantity limits are most commonly used and step therapy is least commonly used. Overall, some plans have a few medications subject to utilization control while other plans put thousands of medications under utilization control.

Not surprisingly, the average risk score (.99) is close to the intended national average of 1.0. The budget neutrality requires the national average risk score to be normalized at 1.0 every year. Medicare advantage plans actively seek coding improvements to increase their members' risk scores in order to receive more money from CMS. However, Medicare payments come from a fixed pool of money. If increase in risk scores causes the total Medicare spending to increase from previous year, CMS applies an adjustment factor to compensate this fluctuation.

Another market characteristic variable, the average number of Medicare beneficiaries in each PDP region is about 1.31 million.

Only a small percentage of plans offer the defined standard benefit (11%), of which most offer alternative plans (42%) or enhanced benefit plans (47%). The annual deductible ranges from $0 to $275 with many firms covering a portion or all of the deductible. The mean value of the annual deductible is $96.92. Approximately 25% of

plans offer generic drug coverage and 1.2% of plans offer both generic and brand name drug coverage in the donut hole. 30% of the plans in this sample enrolled qualified low-income Medicare beneficiaries with $0 member premium.

The mean values of plan bid amounts and member premiums by year are shown in Appendix A (Table A5). The average plan bid is $94.10 and the average member premium is $38.16 over the three-year study period. The average plan bid in 2006 is highest at $101.48 while the average plan bid in 2007 is the lowest at $89.89. Consistently, the average member premium is the lowest at $36.81. However, the highest average member premium ($40.04) was found in 2008.

The mean values of plan bid amounts and member premiums are also shown by PDP region in Appendix A (Table A6). These mean values across PDP regions are relatively stable. The highest average bid ($97.21) and member premiums ($41.23) were found in PDP region 15 (Indiana and Kentucky). However, the regions with lowest average bid and lowest member premium ($89.87) differ. PDP region 26 (New Mexico) has the lowest average bid at $89.87 and the PDP region 32 (California) has the lowest member premium at $33.89. Given all other factors constant higher risk regions are expected to have higher bids for taking more risk. However these unadjusted mean values are not consistent with the average Part D risk score in each PDP region. As shown in Appendix A Table A 2, region 11 (Florida) has the highest risk score while region 24 (Alaska) has the lowest risk score. This indicates that the plan characteristics vary across regions.

In addition, the average PDP bid and member premium across contracts vary considerably as shown in Appendix A (Table A7). The number of plans each contract

offers differs, from 1 to 306. There are four contracts that have the highest number of plans (306) for the three-year study period, which are offered by Cigna, Universal American Corporation, Aetna, and United Health Group. Contract S5932 offered by Healthspring, Inc. had the lowest average bid ($75.56) and the lowest member premium ($22.26). Contract S4231 offered by United Health Care, Inc. has the highest average bid ($139.44) and member premium ($75.44).

However, by simply looking at these unadjusted average plan bids and member premiums, we cannot draw any conclusions about the relationship between the firm/market characteristics and plan bids.

4.1.2 Statistical Analysis

To identify the relationship between the plan bids and member cost sharing, the average plan bids across cost sharing rates are summarized in Table 4.

As expected, tier 1 copayments tend to be low in order to encourage the use of generic medications. Tier 2 copayments are much higher for preferred brand medications. Approximately 20% of the plans do not offer medications in tier 3. Of those that do, coinsurance rates are quite high with more than half of the plans requiring over 50% of the cost to be borne by the consumer. The high rates are intended to encourage enrollees to use preferred brand name medications. Specialty medications are typically covered in tier 4. Most plans offer coverage of some specialty medications, of which coinsurance rates are lower than the coinsurance of the non-preferred brand medications. This is not surprising because CMS requires that the maximum member coinsurance of specialty drugs shall not exceed 33%.

However, by looking at the average bids we cannot identify a consistent trend. While bids are expected to decline as cost sharing increased, none of the tiers exhibit such a monotonic relationship. For tier 1, plans with medium level costing sharing has the lowest average bid, but for tier 2 plans with the highest level cost sharing has the lowest average bid. For tier 3, although the plans without coverage on tier 3 drugs have the lowest average bid, the medium level cost sharing is associated with the higher average bid than the low level cost sharing. Indeed, in tier 4 the average bid increased as enrollee cost sharing increased.

Table 4 Average Bids by Cost Sharing at Each Tier

	Observations	Average bid
Tier 1 copayment		
$0-$4.14	1,503	$97.64
$4.5-$6	2,207	$91.14
$6.5-$25	1,391	$94.91
Tier 2 copayment		
$10-$24.5	1,842	$90.99
$25-$30	2,069	$98.79
$30.36-$73	1,190	$90.68
Tier 3 coinsurance		
≤50%	1,283	$95.32
>50%	2,745	$95.39
Not Covered	1,073	$89.25
Tier 4 coinsurance		
≤25%	2,586	$92.11
>25%	1,969	$95.26
Not Covered	546	$99.23

Of course, there are numerous potential reasons for this unexpected relationship. In Table 5, the relationship between cost sharing and other plan and market characteristics is explored. For example, firms with lower cost sharing may have other plan characteristics that are associated with lower or higher bids. For each tier, the sample is divided based on enrollee cost sharing (low, medium, and high) and the average numbers of medications available on each tier, and the percentage of medications subject to quantity limits, prior authorization, and step therapy are examined. The enrollee cost sharing levels (low, medium, and high) are consistent with those in Table 4. These variables examined are treated as plan characteristics, and thus the percentages are not specific to the medications in the tier. Each tier is treated separately, thus plans in the lowest group for tier 1 are not necessarily in the lowest group for tier 2, tier 3 or tier 4 and vice versa.

For tier 1 the clearest finding is that plans covering more medications and imposing fewer utilization controls tend to have higher bids. The medium cost sharing group has the lowest average number of medications covered and also the lowest bids. The medium cost share group also has the greatest proportion of medications subject to quantity limits and prior authorization, which also contributes to the lower bids.

In tier 2, there is little difference in the number of brand name drugs covered as enrollee cost sharing increases. However, the number of drugs subject to the utilization control tools differs across levels of cost sharing. For example, quantity limits are most common among plans with lower cost sharing. Interestingly, firms with the highest cost sharing are the most likely to require prior authorization and step therapy. Plans with low level and high level cost sharing have approximately the same percentage of total drugs

subject to the utilization control tools. These plans also the approximately same average bid.

Table 5 Statistics by Tier Member Cost Sharing

	Cost sharing		
	Low	Medium	High
T1 Copayment	*$0-$4.14*	*$4.5-$6*	*$6.5-$25*
Bid	$97.64	$91.14	$94.91
Avg. # drugs on tier 1	4,950	3,612	4,185
Avg. # drugs on tier 2	1,175	1,138	1,090
Avg. # drugs on tier 3	1,113	1,101	1,058
Avg. # drugs on tier 4	266	374	457
% of drugs subject to:			
Quantity limits	8.90%	14.20%	9.50%
Prior authorization	7.50%	8.20%	7.40%
Step therapy	1.40%	1.10%	0.80%
Observations	1,503	2,207	1,391
T2 Copayment	*$10-$24.5*	*$25-$30*	*$30.36-$73*
Bid	$90.99	$98.79	$90.68
Avg. # drugs on tier 1	4,425	4,441	3,271
Avg. # drugs on tier 2	1,100	1,174	1,125
Avg. # drugs on tier 3	1,278	1,275	490
Avg. # drugs on tier 4	271	474	320
% of drugs subject to:			
Quantity limits	14.50%	9.30%	9.00%
Prior authorization	7.10%	7.40%	10.00%
Step therapy	1.00%	1.00%	1.60%
Observations	1,842	2,069	1,190

Table 5 Statistics by Tier Member Cost Sharing (Continued)

	Cost sharing		
	Low	*Medium*	*High*
T3 Coinsurance	*<=50%*	*>50%*	*Not Covered*
Bid	$95.32	$95.39	$89.25
Avg. # drugs on tier 1	3,270	4,261	5,027
Avg. # drugs on tier 2	1,037	1,133	1,271
Avg. # drugs on tier 3	1,480	1,306	0
Avg. # drugs on tier 4	294	374	430
% of drugs subject to:			
Quantity limits	16.60%	8.70%	12.40%
Prior authorization	7.60%	8.20%	6.70%
Step therapy	1.50%	1.10%	0.70%
Observations	1,283	2,745	1,073
T4 Coinsurance	*<=25%*	*>25%*	*Not Covered*
Bid	$92.11	$95.26	$99.23
Avg. # drugs on tier 1	3,844	4,074	5,983
Avg. # drugs on tier 2	1,056	1,118	1,580
Avg. # drugs on tier 3	1,033	1,141	1,203
Avg. # drugs on tier 4	401	418	0
% of drugs subject to			
Quantity limits	14.90%	7.90%	7.80%
Prior authorization	7.00%	8.50%	8.50%
Step therapy	0.90%	0.90%	2.50%
Observations	2,586	1,969	546

A similar relationship exists between cost sharing and quantity limits for tier 3. Plans with the lowest cost sharing are more likely to have quantity limits. Those plans with the low and medium tier 3 cost sharing cover tier 3 medications, but also have higher bids than plans not covering non-preferred brand name medications. The majority of plans (2,745) charge substantial coinsurance (>50%) for non-preferred brand name drugs, although most plans (4,028) do have some coverage for such medications.

Similarly, most plans (4,555) offer coverage for specialty drugs (tier 4). There is little difference in the number of specialty drugs covered between the plans charging lower coinsurance and the plans charging higher coinsurance. These plans with lower coinsurance have more medications subject to the utilization controls but also have higher bids than the plans with higher coinsurance. However, plans without coverage on tier 4 drugs tend to have the highest bids, which is counterintuitive. One possibility is that these plans placed specialty drugs on lower tiers, which resulted in higher costs to the plans and thus the higher bids.

4.1.3 Firm Fixed Effects Model Results

Through the data discussion in the preceding section, it is difficult to draw any quantitative conclusions on the relationship underlying the data. To further explore the data variation, we used a firm fixed effects model. The estimation results are summarized in Table 6, with the natural logarithm of the PMPM (per member per month) bid as the dependent variable.

Three different specifications are attempted. The first specification includes limited utilization control measures, namely the enrollee cost sharing variables. The second specification adds the number of medications covered at each tier, and the third specification adds additional utilization controls (numbers of medications subject to quantity limits, prior authorization, and step therapy). Note that the grouping of explanatory variables is consistent with those in Chapter Three.

Table 6 Regression Results: Firm Fixed Effects Model
Dependent Variable: Ln (Bid)

	Base Specification	**+ # Drugs Covered**	**+ Utilization Controls**
Cost sharing			
Tier 1 copayment	-0.0037***	-0.0035***	-0.0036***
	(0.0005)	(0.0005)	(0.0005)
Tier 2 copayment	-0.0019***	-0.0020***	-0.0023***
	(0.0002)	(0.0002)	(0.0002)
Tier 3 coinsurance	-0.0018	-0.0085	-0.0237**
	(0.0085)	(0.0089)	(0.0093)
Tier 4 coinsurance	-0.0175**	-0.0289***	-0.0223**
	(0.0082)	(0.0097)	(0.0099)
# drugs covered			
ln(# drugs on tier 1)	--	-0.0210***	-0.0227***
		(0.0042)	(0.0042)
ln(# drugs on tier 2)	--	0.0731***	0.0651***
		(0.0091)	(0.0092)
# drugs on tier 3			
(in thousands)	--	0.0018*	-0.0045***
		(0.0010)	(0.0016)
# drugs on tier 4	--	0.00004***	0.00005***
		(0.0000)	(0.0000)
# drugs subject to:			
Quantity limits			
(in thousands)	--	--	0.0048***
			(0.0010)
Prior authorization			
(in thousands)	--	--	-0.0373***
			(0.0065)
Step therapy			
(in thousands)	--	--	0.0457***
	--	--	(0.0075)

Table 6 Regression Results: Firm Fixed Effects Model
Dependent Variable: Ln (Bid) (Continued)

	Base Specification	+ # Drugs Covered	+ Utilization Controls
Other plan characteristics Deductible	-0.0003*** (0.0000)	-0.0003*** (0.0000)	-0.0003*** (0.0000)
Gap coverage for generics	0.1767*** (0.0037)	0.1752*** (0.0037)	0.1780*** (0.0037)
Gap coverage for all drugs	0.1675*** (0.0135)	0.1824*** (0.0137)	0.1872*** (0.0136)
LIS_0prem	-0.0551*** (0.0038)	-0.0560*** (0.0038)	-0.0527*** (0.0038)
Year 2007	-0.1535*** (0.0039)	-0.1510*** (0.0052)	-0.1603*** (0.0054)
Year 2008	-0.1182*** (0.0040)	-0.1134*** (0.0060)	-0.1250*** (0.0062)
Regional risk score	0.2052*** (0.0405)	0.2035*** (0.0400)	0.2028*** (0.0399)
Regional Medicare population	-0.0118*** (0.0016)	-0.0119*** (0.0010)	-0.0118*** (0.0015)
N	5,101	5,101	5,101
R squared	0.73	0.73	0.74

Notes:
(1) *** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level.
(2) The specification also includes a categorical variable for each firm.

Among the plan benefit variables, higher copayments for tier 1 and tier 2 medications lower bids by insurers in all three specifications. Similarly, higher coinsurance for specialty medications lowers bids. We also find a negative relationship between tier 3 coinsurance and plan bids in the third specifications. Overall, there is a

negative relationship between enrollee cost sharing and the plan bid which is consistent with actuarial principles.

Enrollee cost sharing affects plan bids in two ways. First, lower enrollee cost sharing means the plan is responsible for larger portion of the drug cost on a per script base. Second, lower cost sharing encourages enrollees to use more scripts of the prescription drugs, which is called induced utilization. Through these two different ways, lower enrollee cost sharing results in higher plan liability (claim costs). In order to cover these claim costs and survive in the Medicare Part D market, plans need to charge higher bids.

While the coefficients are statistically significant, the magnitude of the effects is rather small. For example, a $1 increase in the tier 1 copayment reduces the bid by a mere 0.36%. The marginal effect is also small for tier 2, with a $1 increase in the copayment leading to a 0.2% reduction in bid. However, $1 represents a far larger proportion of the median cost of a generic medication compared to the median cost of a brand name medication. Hoadley (2006) examined the prices of the top 150 medications in the Part D program. Based on his results, the median costs are $18.11 and $92.16 for generic medications and brand name medications, respectively. This implies that plans pay about $13 ($18 minus $5) for a generic medication and $64 ($92 minus $28) for a brand name medication.

In terms of elasticity, a 10% decline in the price of a tier 1 medication (from $13 to $11.70) reduces the bid by 0.4%, while a 10% decrease in the median tier 2 medication price (from $64 to $57.60) decreases bids by 1.4%. Despite the bid being quite inelastic, the effect is larger for preferred brand name medications than generics. Our finding is

consistent with the study performed by Simon and Lucarelly (2006). They found a weak relationship between the PDP premiums and the simulated out-of-pocket payments for different sets of drugs. Overall, the small effects suggest that firms do not expect consumers to substantially reduce their quantity demanded in response to a change in cost sharing. In addition, the relative higher elasticity of the preferred brand name medications indicates that firms expect Medicare enrollees to switch to low cost generic drugs if these generic drugs are the substitutes for the preferred brand name drugs.

Similarly, small effects exist for tier 3 and tier 4 enrollee costing sharing. For example, as shown in the third specification in Table 6, one percentage point increase in tier 3 enrollee cost sharing would result in a 0.02% decrease in plan bid. A plan going from no coinsurance in tier 3 to 100% coinsurance would reduce plan bid by about 2.3%. Similarly, the third specification in Table 6 indicates that one percentage increase in tier 4 enrollee coinsurance would reduce plan bid by approximately 0.02%. Plans going from 0% to 100% coinsurance are expected to have 2.2% lower bids.

The formulary variables that measure the number of covered medications in each tier are significantly related to the plan bids. The number of drugs in tier 1 is inversely related to the bid. Specifically, if the plans increase the number of generic drugs on tier 1 by 1%, the plan bid would be reduced by approximately 2.3% indicated by the third specification in Table 6. On the other hand, the numbers of medications in tiers 2, 3, and 4 are positively related to the plan bid. The third specification in Table 6 also shows that 1% increase in the number medications in tier 2 would increase the plan bid by approximately 6.5%. The second specification indicates an even higher increase in the plan bid. In the third specification, the number of medication covered in tier 3 is not

statistically significant. However, the second specification shows a positive relationship between the number of medications in tier 3 and the plan bid. Specifically, if a plan increases the number of non-preferred brand name drugs by 1,000, the plan bid would increase by approximately 0.18%. Similar results are found for the number of tier 4 medications. If a plan covered 1,000 more specialty drugs, the plan bid would increase by approximately 4% in the second specification and 5% in the third specification in Table 6.

In conclusion, the more generic medications covered by the plan, the lower the expected costs and the lower the plan bid. In contrast, the more brand name medications covered by the plan, the higher the expected costs and the higher the plan bid. More importantly, the number of medication in tier 2 shows the highest elasticity across the four tiers, which indicates the tier shifting from the preferred brand name drugs to the low cost generic drugs. This finding further confirms the tier shifting effect found in the copayment elasticities.

Firms employ additional utilization control tools to control drug spending. Such utilization controls (quantity limits, prior authorization, and step therapy) are expected to reduce expected costs and lower plan bids. However, the results in Table 6 indicate that only prior authorization is associated with lower bids. If a plan required prior authorization for 1,000 more medications, the plan bid would be reduced by approximately 3.7%. The numbers of drugs with quantity limits or requiring step therapy are positively related to the plan bids. Contrary to expectations, adding one thousand more medications subject to quantity limit or step therapy would increase the plan bid by approximately 0.48% and 4.6%, respectively, according to the model results in Table 6.

There are many possible reasons for this inconsistency. First, quantity limits and step therapy may be put into place when insurers include very high cost medications on their formulary. Second, quantity limits and step therapy may be difficult for plans to actually control. For example, when the quantity limit is reached or step therapy limits access to certain medications, Medicare enrollees may be able to switch to other medications that have equivalent therapeutic effects. These alternative medications may enable enrollees to work around some utilization controls. Third, quantity limits and step therapy require approval from the insurance company, which increases administrative costs and thus increase the plan bids. Finally and most likely, since the Medicare Part D plans are still at their early age, the firms may not be able to sophisticatedly utilize these complicated utilization control tools to control the drug costs as they are intended to. Or they may not have reflected the potential savings of these tools in the plan bids.

Among the other plan characteristics, plans waiving part or all of the deductible have higher bids than plans that require higher deductibles. According to the model results in specification 3 in Table 6, a $100 deduction (increase) in the annual deductible would increase (decrease) the plan bid by approximately 3%. Consistent results are found in the first and second specifications in Table 6.

The signs and magnitudes of the other plan characteristic variables (LIS_0prem, gap coverage of generics, and gap coverage of brand name drugs) are also expected. Bids for plans that offer $0 premium with full low income subsidy are 5.1% lower (e^{β}-1 using the beta from specification #3). CMS randomly auto-assigns the new dual eligible enrollees to the Part D plans that are below the regional low income subsidy benchmark.

In order to get the auto-assigned members, these plans generally bid lower than the plans that do not intend to enroll low income members.

Covering medications in the gap also increases plan bids. Plans with gap coverage of generics have a 19% higher bid as indicated by specification 3 in Table 6. Plans that cover brand name drugs in the gap tend to bid 20% higher than the plans that only cover generic drugs in the gap. In total, plans covering both generic and brand name drugs in the gap are approximately 39% higher than plans without any gap coverage. All three specifications show consistent results in terms of sign and magnitude. Our finding shows the huge impact of gap coverage to the plan bids. The gap or the "donut hole" plays an important role in controlling the total drug spending as expected.

We also measured the effects of market characteristic variables. The results in Table 6 also show that the plan bid is positively related to the PDP region Part D risk scores. In other words, plans in high risk regions tend to bid higher for bearing higher financial risks. Specifically regions with 10% higher risk scores tend to bid approximately 2% higher in all three specifications. This is what we expected because for the enhanced alternative plans, the risk scores are directly reflected in the member supplemental premium. For the other types of plans, plans may view regions with less healthy beneficiaries as riskier and put more margins in the bids. Cost controls may also be deemed less effective in high risk regions.

On the other hand, the number of Medicare beneficiaries in a PDP region is negatively correlated with plan bids. According to the actuarial pricing principles, large population pools mitigate the plan's potential risks. The plan bids which capture the plan expected claim costs are expected to be lower. In addition, large population pool may

lower per person administrative costs due to economies of scale. Specifically, an increase of one million Medicare beneficiaries in a PDP region results in an approximately 1.2% lower bid as illustrated in Table 6. All the three specifications show consistent results in terms of sign and magnitude.

The results in Table 6 also show that the bids vary across years. Year 2007 bids are found to be 15% lower and year 2008 bids are found to be 12% lower than year 2006 bids by specification 3 in Table 6. The first two specifications in Table 6 show consistent results. These results are not surprising. Since 2006 was the first year of the Part D program, most plans priced their bids conservatively due to the lack of any historical information. In 2007, plans tended to price competitively after learning that the 2006 bids were overpriced and there was the potential for substantial risk corridor payments to CMS. Plans also priced aggressively in order to increase market share. In 2008, plans are more mature after two years of experience in the Medicare Part D market and CMS required plans to develop 2008 bids based on the plan's 2006 claim experience if they had any. Thus, 2008 bids are expected to be more stable, which is consistent with our results.

4.1.4 Low and High Risk Region Analysis

We further tested whether the relationship between the bids and the tiered copayments differ for the plans in high risk regions versus plans in low risk regions. Gilman and Kautter (2007) found that Medicare beneficiaries with chronic conditions are less responsive to the cost sharing incentives of prescription drugs. In this dissertation, we used the Part D risk scores as the proxy variable of chronic conditions or health status.

If the insurers are sophisticated enough, they would anticipate that the cost sharing would have a smaller marginal effect on the demand of enrollees in areas with higher risk scores and consider this marginal effect when pricing their plan bids.

Table 7 Differentiating between Low and High Risk Regions
Dependent Variable: Ln (Bid)

	Regions with risk ≥ 1		Regions with risk < 1			
	Coef	Std err	Coef	Std err	Diff	Std err
Tier 1 copayment	-0.0041***	0.0007	-0.0031***	0.0007	0.0010	0.0010
Tier 2 copayment	-0.0022***	0.0003	-0.0025***	0.0004	-0.0003	0.0005
Tier 3 coinsurance	-0.0240*	0.0128	-0.0237*	0.0134	0.0003	0.0185
Tier 4 coinsurance	-0.0235*	0.0132	-0.0191	0.0146	0.0044	0.0197
N	2,584		2,517			
R squared	0.757		0.73			

Notes: (1) *** Significant at 1% level; ** Significant at 5% level; * Significant at 10% level.

In order to explore the effect of cost sharing in high risk areas versus low risk areas, we separate the sample based on the average Part D risk in the region. The full specification including all formulary and utilization control variables in Table 6 was estimated separately for regions with risk scores less than 1.0 and for regions with risk scores greater than or equal to 1.0. The results are provided in Table 7. We found that cost sharing does not have significantly different effects on plan bids in PDP regions with healthier versus less healthy residents. While the coefficients differ, none of the differences are statistically significant. Thus, while insurers overall price plans higher

when the residents of a region are less healthy, the marginal effect of cost sharing on plan bids is not found to differ based on the health of residents.

While Gilman and Kautter (2007) found less elastic demand of enrollees with chronic conditions using prescription drug claims data, we did not find such evidence in the pricing of plan bids in our study.

The model results of the full specification are provided in Appendix A (Table A8 and Table A9).

4.1.5 Other Model Forms, Function Forms and Variables

As introduced in Chapter Three, to measure the impact of copayment structure on the plan bids, we also attempted different set of explanatory variables and model forms.

First, the inclusion of explanatory variables denoting whether the plan was an actuarial equivalent plan, basic alternative plan, or enhanced benefit plan was considered. However, the characteristics that differentiate these plans are already included in the plan benefit variables in the specification. In Chapter One, we introduced the five tests that the alternative plans have to pass in order to get the bids approved. All the tests are directly related to the plan benefits. In other words, the type of plan is determined by the plan benefits including annual deductible and member cost sharing. Thus, the addition of these variables did not add explanatory power to the model.

For comparison purposes, we ran ordinary least square (OLS) regressions with the results summarized in the Appendix (Table A10). A majority of the explanatory variables in the OLS model have the same signs as those in the firm fixed effects model.

However, OLS was abandoned due to the omitted variable problem described in Chapter Three.

Different dependent variables were attempted too. The firm fixed effects model results using natural log transformed member monthly premium as the dependent variable are provided in Appendix (Table A11). All the variables except for the year dummy variables have the same sign as those in Table 6. However, the magnitudes are significantly different. In this dissertation, we used the plan bid as the dependent variable because it captures the total expected claim costs of the plan. The importance of using the bid (particularly when transformed) can be seen with a simple example. Assuming a national average bid of $90 and federal reinsurance is $10, a plan bidding $115 would have a premium of $50.50 (25.5% of $100 plus the $25 difference between the plan bid and national average bid). A plan bidding $90 would have a premium of $25.50. Thus, a 28 percent difference in bids leads to almost a 100 percent increase in the premium.

Finally, different functional forms of the dependent variable were attempted. The firm fixed effects model results using square root transformed plan bid on a per-member per-month base as the dependent variable is provided in Appendix A (Table A12). All estimated coefficients have the same sign as those in specification 3 in Table 6. The log transformation is finally chosen because it is more likely to resemble the relationship between the plan bids and the explanatory variables. For example, the percentage change in member cost sharing, number of medications, and risk scores are likely to impact the plan bids by certain percentage, rather than fixed amounts.

4.2 Decomposition Model Results

Different actuarial methods were used by firms to price plan bids in 2006 and 2008 (manual rating vs. experience rating). This section tests Hypothesis 3 whether the pricing methods play an important role in determining the plan bids and premiums. First, we compare the variable statistics in three datasets (sample of 2006 data, sample of 2008 data, and the full sample of combined 2006 and 2008 data). Following this, regression results using the three datasets are presented. Meaningful decomposition results showing whether the bid/premium change can be attributed to changes in plan characteristics or marginal price associated with plan characteristics (or different pricing methods) are discussed.

4.2.1 Descriptive Statistics

Table 8 presents descriptive statistics of three samples previously described, including 1,414 and 1,822 standalone PDPs in 2006 and 2008, respectively. The average bid declined between 2006 and 2008 from $101 to $93, while the average premium increased from $37 to $40. No significant change was found for the member cost sharing variables. Cost sharing changed with insurers reducing tier 1 copayments for generics, and increasing tier 2 copayments for preferred brand name medications. Tier 3 coinsurance stayed almost constant at .69 in 2006 and .68 in 2008. Coinsurance for tier 4 specialty medications declined from .50 to .31.

Most firms entered the program in 2006 offering a considerable number of medications on their formulary. Firms have covered fewer medications over time as the average number of generics on tier 1 declined from 9,375 in 2006 to 1,860 in 2008.

Similarly, the average number of preferred brand name medications has declined from 1,508 to 937. Only tier 4 has seen an increase in the number of medications, which likely represents some of the brand name medications no longer covered in tiers 2 and 3.

Table 8 Descriptive Statistics, (2006 and 2008 Data)

Variables	2006 Means (Std err)	2008 Means (Std err)	Difference# (p value)	Full Sample (Std err)
	(N=1,414)	(N=1,822)		(N=3,236)
Bid	101.48 (12.80)	92.63 (19.95)	-8.85 <.0001	96.5 (17.74)
Premium	37.48 (12.80)	40.04 (19.95)	2.56 0.0479	38.92 (17.24)
Cost sharing				
Tier 1 copayment	5.52 (3.20)	5.24 (3.44)	-0.28 0.0002	5.36 (3.34)
Tier 2 copayment	26.69 (8.35)	29.78 (7.22)	3.10 <.0001	28.43 (7.88)
Tier 3 coinsurance	0.69 (0.24)	0.68 (0.24)	-0.01 0.6964	0.68 (0.24)
Tier 4 coinsurance	0.498 (0.34)	0.309 (0.13)	-0.19 <.0001	0.392 (0.26)
# drugs on each tier				
# drugs on tier 1	9,375 (8,699)	1,860 (282)	-7,516 <.0001	5,144 (6856)
# drugs on tier 2	1,508 (786)	937 (357)	-571 <.0001	1,186 (650)
# drugs on tier 3	1,515 (2,707)	834 (793)	-680 0.0336	1,131 (1916)
# drugs on tier 4	284 (426)	400 (355)	116 <.0001	349 (392)

Table 8 Continued

Variables	2006 Means (Std err)	2008 Means (Std err)	Difference# (p value)	Full Sample (Std err)
Utilization controls				
Quantity limits	1,414 (4,482)	552 (361)	-862 0.1283	929 (3,005)
Prior authorization	662 (547)	473 (242)	-189 <.0001	555 (415)
Step therapy required	103 (383)	79 (113)	-24 <.0001	90 (267)
Other population and plan characteristics				
Risk score	0.99 (0.037)	0.99 (0.037)	0.00 0.400	0.99 (0.037)
Medicare Population (in millions)	1.30 (0.976)	1.33 (0.998)	0.03 0.126	1.31 (0.988)
LIS_0prem	0.28 (0.449)	0.27 (0.444)	-0.01 0.520	0.28 (0.446)
Deductible	90.58 (115.2)	104.85 (128.8)	14.28 <.0001	98.61 (123.3)
Gap coverage (Generics)	0.16 (0.362)	0.29 (0.454)	0.13 <.0001	0.23 (0.421)
Gap coverage (All drugs)	0.02 (0.151)	0.00 (0.023)	-0.02 <.0001	0.01 (0.102)

Note: # p-value from two tailed Mann Whitney U test.

A minority of covered medications had utilization controls such as quantity limits, prior authorization requirements, or step therapy requirements in both years. Approximately 11% of covered medications were subject to quantity limits in 2006. Despite an insignificant change in the number of medications subject to quantity limits, given the decline in the number of covered medications the percentage of covered

medications subject to quantity limits increased to 13.7%. While the number of medications subject to prior authorization and step therapy declined, they also comprised a higher percentage of covered medications in 2008. Five percent of covered medications were subject to prior authorization in 2006 and 12% in 2008, while .8% were subject to step therapy in 2006 and 2.0% in 2008.

In 2006, approximately 16% of the plans covered generic drugs in the coverage gap and 2% of the plans covered brand name drugs. In 2008, 29% of the plans covered generic drugs while less than 0.1% of the plans covered brand name drugs in the coverage gap. Covering brand names drugs in the gap increased plan liability while covering generic drugs in the gap encouraged enrollees to use more low-cost generic drugs.

The average risk score was close to the national average of 1.0 in both years. The number of plans offering $0 premium to qualified low-income people (LIS_0prem) was consistent between the two years. The average deductible increased as CMS updated the standard deductible amount over time.

4.2.2 Firm Fixed Effects Model Results

Table 9 presents the results from the firm fixed effects regressions using the natural log of the per member per month bid as the dependent variable. The results from three regression models are reported. The first uses data from 2006, the second uses data from 2008, while the third uses the combined sample.

In 2006, higher cost sharing was associated with lower bids. The relationship between bids and the number of drugs covered was not strong with only the number of tier 4 specialty medications was associated with higher bids. The only other utilization control related to bids was the number of drugs subject to prior authorization which was associated with lower bids. Plans with gap coverage or offered in regions with higher risk scores had higher bids, while plans offering $0 premium low-income plans or offered in regions with more Medicare residents had lower bids.

By 2008, the relationship between plan bids and cost sharing in tiers 1, 2, and 3 declined in magnitude. Only the tier 4 coinsurance rates became more strongly associated with plan bids, although unexpectedly, higher cost sharing was associated with higher plan bids. The marginal bid associated with the number of covered medications in tiers 1 and 2 increased in magnitude. The number of covered generics had a more negative effect on plan bids, while marginal price associated with the number of preferred brand name medications increased. Tier 3 and tier 4 medications are not found to have a significant impact to 2008 plan bids, although they are larger in magnitude in 2008 than in 2006.

Among the utilization control variables, only the marginal importance of step therapy changed significantly, although this utilization control became significantly related to higher bids.

The relationship between other plan and population characteristics changed differently from the 2006 sample to the 2008 sample. For example, the importance of regional characteristics including regional Part D risk scores and number of Medicare

beneficiaries, declined between 2006 and 2008, while the relative importance of generic gap coverage increased.

Table 9 Firm fixed effects Model Estimates,
Dependent Variable: Ln(Bid) (2006 and 2008 Data)

Variables	2006 Sample	2008 Sample	Difference	Full Sample
Cost sharing				
Tier 1 Copay	-0.0107 ***	-0.0036 ***	0.0071 ***	-0.0023 ***
	(0.0009)	(0.0008)	(0.0012)	(0.0007)
Tier 2 Copay	-0.0021 ***	-0.0009 *	0.0012 **	-0.0034 ***
	(0.0002)	(0.0006)	(0.0006)	(0.0003)
Tier 3 Coinsurance	-0.2099 ***	-0.0165	0.1934 ***	-0.1316 ***
	(0.0139)	(0.0222)	(0.0262)	(0.0131)
Tier 4 Coinsurance	0.1104	0.5267 ***	0.4163 ***	-0.0142
	(0.1103)	(0.0962)	(0.1463)	(0.0125)
# drugs on each tier				
LN (# drugs on tier 1)	-0.0893	-0.5449 ***	-0.4556 **	0.0155 ***
	(0.1100)	(0.1632)	(0.1968)	(0.0044)
LN(# drugs on tier 2)	0.0231	0.104 **	0.0809 *	0.111 ***
	(0.0148)	(0.0436)	(0.0460)	(0.0110)
# drugs on tier 3 (in 1,000s)	-0.0071	-0.0285	-0.0214	-0.0185 ***
	(0.0048)	(0.0258)	(0.0263)	(0.0020)
# drugs on tier 4	0.0018 ***	0.0011 ***	-0.0008	0 **
	(0.0006)	(0.0002)	(0.0006)	0.0000
Utilization controls				
Quantity limits (in 1,000s)	0.001	-0.016	-0.017	0.0156 ***
	(0.0061)	(0.1065)	(0.1066)	(0.0013)
Prior authorization (in 1,000s)	-0.1064 **	-0.0433	0.0631	-0.0301 ***
	(0.0500)	(0.1350)	(0.1439)	(0.0075)
Step therapy required (in 1,000s)	0.0114	1.9315 ***	1.9201 ***	0.0483 ***
	(0.0202)	(0.2413)	(0.2422)	(0.0089)

Table 9: Continued

Variables	2006 Sample	2008 Sample	Difference	Full Sample
Other population and plan characteristics				
Risk score	0.3751 ***	0.053	-0.3221 ***	0.1959 ***
	(0.0355)	(0.0550)	(0.0654)	(0.0513)
Medicare Population (in millions)	-0.0136 ***	-0.0065 ***	0.0071 ***	-0.0101 ***
	(0.0014)	(0.0021)	(0.0025)	(0.0020)
LIS_0prem	-0.0709 ***	-0.0147 **	0.0562 ***	-0.0517 ***
	(0.0038)	(0.0066)	(0.0076)	(0.0049)
Deductible	-0.0005 ***	-0.0002 ***	0.0002 ***	-0.0004 ***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Gap coverage (Generics only)	0.0533 ***	0.287 ***	0.2336 ***	0.1766 ***
	(0.0052)	(0.0055)	(0.0076)	(0.0048)
Gap coverage (All Drugs)	0.3748 ***	-0.0412	-0.416 ***	0.213 ***
	(0.0103)	(0.1045)	(0.1050)	(0.0182)
	(N=1,414)	(N=1,822)		(N=3,236)
R-Square	0.8981	0.8679		0.743
Percent due to characteristics change				72%
Percent due to coefficients change				28%

*** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level

At the bottom of Table 9, the coefficients along with the variable means from Table 8 are used to estimate the percentage difference in bids due to changes in plan characteristics and the proportion due to changes in the marginal prices associated with the plan characteristics. Using Neumark's (1988) approach, 72% of the difference in plan bids is due to changes in plan characteristics while 28% of the difference is due the marginal prices associated with the plan characteristics. Thus, the majority of the change in bids is due to changes in the plan characteristics.

Using the same approach, plan premium change between 2006 and 2008 is also decomposed into characteristic change and marginal price change. Table 10 presents the results from the firm fixed effects regressions using the natural log of member monthly premium as the dependent variable.

Table 10 Firm fixed effects Model Estimates,
Dependent Variable: Ln(Premium) (2006 and 2008 Data)

Variables	2006 Sample	2008 Sample	Difference	Full Sample
Cost sharing				
Tier 1 Copay	-0.0263 ***	-0.0112 ***	0.015 ***	-0.0138 ***
	(0.0029)	(0.0020)	(0.0035)	(0.0018)
Tier 2 Copay	-0.0076 ***	-0.001	0.0066 ***	-0.0084 ***
	(0.0007)	(0.0013)	(0.0015)	(0.0008)
Tier 3 Coinsurance	-0.2513 ***	-0.0318	0.2196 ***	-0.2877 ***
	(0.0478)	(0.0539)	(0.0720)	(0.0324)
Tier 4 Coinsurance	0.335	1.8003 ***	1.4654 ***	-0.0961 ***
	(0.3800)	(0.2330)	(0.4458)	(0.0309)
# drugs on each tier				
LN (# drugs on tier 1)	-0.9931 ***	-2.5928 ***	-1.5997 ***	-0.0846 ***
	(0.3792)	(0.3953)	(0.5478)	(0.0108)
LN(# drugs on tier 2)	0.2799 ***	0.6227 ***	0.3428 ***	0.2665 ***
	(0.0510)	(0.1056)	(0.1173)	(0.0273)
# drugs on tier 3 (in 1,000s)	0.023	-0.0715	-0.0945	-0.0522 ***
	(0.0166)	(0.0625)	(0.0647)	(0.0050)
# drugs on tier 4	0.0051 ***	0.0041 ***	-0.001	0.0001 ***
	(0.0020)	(0.0005)	(0.0020)	0.0000
Utilization controls				
Quantity limits (in 1,000s)	-0.0168	0.0299	0.0467	0.0425 ***
	(0.0209)	(0.2579)	(0.2587)	(0.0031)
Prior authorization (in 1,000s)	0.1918	0.4476	0.2558	-0.1791 ***
	(0.1723)	(0.3269)	(0.3696)	(0.0185)
Step therapy required (in 1,000s)	0.0324	4.857 ***	4.8246 ***	0.1696 ***
	(0.0697)	(0.5846)	(0.5888)	(0.0220)

Table 10: Continued

Variables	2006 Sample	2008 Sample	Difference	Full Sample
Other population and plan characteristics				
Risk score	1.2604 ***	0.2877 **	-0.9727 ***	0.7065 ***
	(0.1222)	(0.1331)	(0.1807)	(0.1270)
Medicare Population (in millions)	-0.045 ***	-0.0195 ***	0.0255 ***	-0.0322 ***
	(0.0047)	(0.0050)	(0.0069)	(0.0048)
LIS_0prem	-0.2275 ***	-0.0576 ***	0.1699 ***	-0.1594 ***
	(0.0131)	(0.0161)	(0.0207)	(0.0122)
Deductible	-0.0013 ***	-0.0004 ***	0.0009 ***	-0.0011 ***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Gap coverage (Generics only)	0.1185 ***	0.613 ***	0.4945 ***	0.4333 ***
	(0.0180)	(0.0133)	(0.0224)	(0.0120)
Gap coverage (All Drugs)	1.2687 ***	0.0147	-1.254 ***	0.6226 ***
	(0.0356)	(0.2531)	(0.2556)	(0.0452)
	(N=1,414)	(N=1,822)		(N=3,236)
R-Square	0.8772	0.8551		0.732
Percent due to characteristics change				99%
Percent due to coefficients change				1%

*** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level

As shown in Table 10, three regression results using different samples are presented. The results for premiums are consistent with the bid results. Cost sharing is associated with lower premiums, while the number of covered brand name medications and gap coverage are associated with higher premiums. The estimates of other plan and population variables are consistent with the bid results too. For example, coverage of a greater number of generic medications is associated with lower premiums. Medicare beneficiaries in regions with higher risk scores had higher premiums, while Medicare

beneficiaries in regions with a greater number of Medicare enrollees had lower premiums.

The marginal effect of cost sharing (in tiers 1, 2, and 3) and the regional characteristics declined between 2006 and 2008. On the other hand, the marginal effect of the quantity of covered medications (in tiers 1 and 2) and the availability of gap coverage increased. The utilization controls became more important in determining the plan premiums in 2008 than in 2006.

Despite changes in a number of coefficients, the effects largely offset. Surprisingly, nearly all of the premium difference was due to changes in plan characteristics between the two years while only 1% of the difference is due to changes in the marginal price of the plan characteristics.

In conclusion, changes in the average bids and premiums are primarily due to changes in plan characteristics between year 2006 and year 2008. 72% of the change in bid and 99% of the change in premium can be attributed to changes in plan characteristics. Different actuarial pricing methods are not found to be the key factor in explaining the bid and premium difference between 2006 and 2008.

4.3 Premium Elasticities

As introduced in section 1.2.1, CMS auto-enrolls or facilitate-enrolls for Medicare beneficiaries who are eligible for LIS. The LIS beneficiaries pay no or little premium and cost sharing; therefore, plan premiums will not be related to their demand for prescription drug coverage. They must be excluded from the analysis of enrollment with respect to premium (Frakt and Pizer, 2009). Although LIS beneficiaries can choose to

enroll in any plans, the vast majority of them remain in the plans to which they were auto-assigned (Neuman et al., 2007). Given this fact and the fact that Medicare non-LIS beneficiaries are not allowed to enroll in the benchmark plans, we excluded the benchmark plans from our analysis. Specifically, a subset of 2008 PDP data containing only non-benchmark plans is used to measure the price sensitivity of Medicare beneficiaries.

Following the descriptive statistics in Subsection 4.3.1, Subsection 4.3.2 presents the OLS and 2SLS regression results together with the estimated premium elasticity and semi-elasticity.

4.3.1 Descriptive Statistics

Table 11 presents the descriptive statistics of the sample data comprising 1,296 non-benchmark PDPs in the United Stated for year 2008. As indicated in Table 11, the data indicate reasonable variation across most of the variables. For example, the minimum tier 1 copayment is $0 in contrast to the maximum of $18. Some plans choose to cover over 2,000 medications on tier 1 while some other plans covered only a few hundred on tier 1. Also indicated in Table 11, the minimum PDP premium is $12.90 per month while the highest is over $100. The average PDP premium of $45.72 is $20 higher than the premium for MAPDs. The differential partly reflects the fact that the majority of PDP enrollees are Medicare fee-for-service members, who are generally less healthy than MAPD enrollees. For market share, the mean is 0.48% with a maximum of 10.7%. This indicates that the PDP market was dominated by a few large insurance companies in 2008.

Table 11 Descriptive Statistics, 2008 Non-benchmark Plans

(n=1,296)

Variables	Mean	Std. Dev	Max	Min
PDP premium	45.72	20.48	107.5	12.9
Premium - avg. MAPD premium	20.15	21.49	85.79	-28.58
Market ahare	0.48%	1.20%	10.70%	0.00%
Cost sharing				
Tier 1 copayment	5.28	3.16	18	0
Tier 2 copayment	30.29	7.1	45	15
Tier 3 coinsurance	68%	21%	100%	25%
Tier 4 coinsurance	30%	8%	100%	8%
# of drugs on each tier				
# of drugs on tier 1	1,885	271	2,282	599
# of drugs on tier 2	933	352	3,360	468
# of drugs on tier 3	897	782	3,007	0
# of drugs on tier 4	357	288	1,359	0
Utilization controls				
Quantity limits	565	365	1,860	4
Prior authorization	471	233	2,961	71
Step therapy	84	114	424	0
Other plan characteristics				
Deductible	56.29	104.12	275	0
Gap coverage	0.4	0.49	1	0
Market characteristics				
Risk score	0.99	0.04	1.05	0.91
Number of Competing PDPs	53.84	3.08	63	47
Instrument variables				
Mean premium	41.63	12.46	82.86	19.9
Max premium	69.9	22.88	107	0
Min premium	19.94	10.77	63	9.8
Number of PDPs	51	1	56	50
Number of MAPDs	56	4	105	25

We also introduced a new variable of market characteristics, the number of competing PDPs, and 5 instrument variables for the endogenous premium, including the mean, maximum, and minimum premiums, the number of PDPs and the number of MAPD plans in other service regions. The number of competing PDPs varies moderately from 47 to 63. The mean, maximum and minimum premiums in other service regions show considerable variation in the range of $53 to $107. The number of PDPs in other service regions is relatively stable ranging from 50 to 56. Conversely the number of MAPD plans in other service regions starts as low as 25 while ends as high as 105.

Compared to the full sample of 2008 in Table 8, the non-benchmark plans have slightly higher member cost-sharing except for tier 4. In addition, these non-benchmark plans cover approximately the same amount of medications on each tier and utilization controls as the full sample. No significant difference was found for other plan and market characteristics variables between the two samples.

4.3.2 OLS and 2SLS Model Results

Equation (3.9) using the composite outside good was estimated by OLS and 2SLS with the firm fixed effects model. The regression results, elasticities (*e*) and semi-elasticities (*k*) are presented in Table 12. The OLS-estimated elasticity and semi-elasticity are -0.5 and -0.01, respectively. However, given that plan premiums are endogenous, OLS estimates are biased. Consistent estimates are obtained via 2SLS. The 2SLS-estimated elasticity and semi-elasticity are -1.80 and -0.04 are over three times the magnitude of the OLS-estimated elasticities. Frakt and Pizer (2009) also found that the 2SLS-estimated elasticities were greater in magnitude than the OLS ones.

Table 12 Regression Results Assuming Composite Outside Goods

	Two-Stage Least Square				OLS	
	First Stage Coefficient		Second Stage Coefficient			
Variables	Estimates	Standard Error	Estimates	Standard Error	Estimates	Standard Error
PDP Premium	-	-	-0.04	(0.0047) ***	-0.011	(0.0032) ***
Intercept	-346.849	(44.5126) ***	1.848	(3.2797)	9.811	(2.9980) ***
Cost Sharing						
Tier 1 Copayment	-0.482	(0.0976) ***	-0.011	(0.0135)	-0.025	(0.0140) *
Tier 2 Copayment	0.446	(0.0567) ***	0.013	(0.0076) *	0.007	(0.0080)
Tier 3 Coinsurance	-4.695	(1.9313) **	-0.238	(0.2564)	0.378	(0.2516)
Tier 4 Coinsurance	9.805	(4.3833) **	1.64	(0.6362) **	1.148	(0.4746) **
# of Drugs on Each Tier						
Ln (# of Drugs on Tier 1)	8.617	(2.4408) ***	0.924	(0.3689) **	0.061	(0.3432)
Ln (# of Drugs on Tier 2)	-3.613	(0.9110) ***	-1.327	(0.1382) ***	-1.387	(0.1354) ***
# of Drugs on Tier 3	-0.001	(0.0006)	0.001	(0.0001) ***	0.001	(0.0001) ***
# of Drugs on Tier 4	0.003	(0.0012) **	0.001	(0.0002) ***	0.001	(0.0001) ***
Utilization Controls						
Quantity Limits	0.005	(0.0011) ***	0.001	(0.0001) ***	0.001	(0.0001) ***
Prior Authorization	0	(0.0017)	-0.002	(0.0002) ***	-0.002	(0.0002) ***
Step Therapy	-0.002	(0.0035)	-0.004	(0.0005) ***	-0.005	(0.0005) ***
Other Plan Characteristics						
Annual Deductible	-0.024	(0.0034) ***	-0.007	(0.0005) ***	-0.006	(0.0005) ***
Gap Coverage	27.712	(0.5924) ***	-0.718	(0.1316) ***	-1.169	(0.1321) ***
Market Characteristics						
Risk Score	-1.693	(7.0763)	-2.7	(1.0461) **	-3.225	(1.0745) ***
Number of Competing PDPs	-0.054	(0.0923)	-0.056	(0.0129) ***	-0.073	(0.0133) ***
Instrument Variables						
Mean Premium	0.345	(0.1698) **	-	-	-	-
Max Premium	0.138	(0.0476) ***	-	-	-	-
Min Premium	0.467	(0.1425) ***	-	-	-	-
Number of PDPs	5.949	(0.7579) ***	-	-	-	-
Number of MAPDs	-0.069	(0.0667)	-	-	-	-
	R-square =	0.84	R-Square =	0.54	R-Square =	0.48
			e =	-1.804	e =	-0.496
			k =	-0.04	k =	-0.011

*** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level

These estimates are greater in magnitude than Frakt and Pizer (2009) found for 2007 (e = -1.45 and k = -0.039). As expected, with the implementation of experience rating, the estimated elasticity and semi-elasticity for 2008 are greater in magnitude than the estimated elasticity in 2007. The results may also suggest that with another year of knowledge on the PDP products, Medicare beneficiaries are more informed to choose the plans that best fit their needs and thus are more sensitive to plan premiums.

Although the welfare study of Medicare HMOs by Town and Liu (2003) does not include the Part D market, it is worth comparing our elasticity estimated with theirs. They estimated a premium elasticity of demand of -0.33 in the Medicare HMOs between 1993 and 2000, which is significantly lower than our 2SLS estimates.

Frakt and Pizer (2009) gave explanation for the higher PDP premium elasticity. The PDP market has a large number of entrants due to the low fixed costs of entry. PDPs do not have to establish provider networks as Medicare HMOs or employer sponsored plans do. Medicare beneficiaries have a large number of PDPs available to choose from and hence are more sensitive to price change.

Equation (3.9) is also estimated by defining MAPDs as the outside good. Both OLS and 2SLS estimates, together with the premium elasticity and semi-elasticity, are presented in Table 13. It is important to point out that the plan premium in Equation (3.9) now becomes the difference between the PDP premium and the average MAPD premium in each PDP region. The market share of the outside good, MS_0, is the market share of aggregate MAPDs in each PDP region.

Table 13 Regression Results Assuming MAPDs as Outside Goods

	Two-Stage Least Square				OLS	
	First Stage Coefficients		Second Stage Coefficients			
Variables	Estimates	Standard Error	Estimates	Standard Error	Estimates	Standard Error
PDP Premium - MAPD Premium	-	-	-0.039	(0.0052) ***	-0.002	(0.0031)
Intercept	-389.525	(57.0340) ***	6.39	(3.6245) *	16.791	(3.2397) ***
Cost Sharing						
Tier 1 Copayment	-0.443	(0.1251) ***	-0.016	(0.0149)	-0.034	(0.0152) **
Tier 2 Copayment	0.412	(0.0727) ***	0.012	(0.0084)	0	(0.0086)
Tier 3 Coinsurance	-5.618	(2.4745) **	-0.336	(0.2833)	0.435	(0.2722)
Tier 4 Coinsurance	16.814	(5.6163) ***	1.909	(0.7031) ***	1.252	(0.5172) **
# of Drugs on Each Tier						
Ln (# of Drugs on Tier 1)	8.198	(3.1273) ***	0.976	(0.4077) **	-0.235	(0.3683)
Ln (# of Drugs on Tier 2)	-3.854	(1.1673) ***	-1.334	(0.1527) ***	-1.396	(0.1477) ***
# of Drugs on Tier 3	-0.001	(0.0008)	0.001	(0.0001) ***	0.001	(0.0001) ***
# of Drugs on Tier 4	0.004	(0.0016) ***	0.001	(0.0002) ***	0.001	(0.0002) ***
Utilization Controls						
Quantity Limits	0.005	(0.0014) ***	0.001	(0.0001) ***	0.001	(0.0001) ***
Prior Authorization	0	(0.0021)	-0.002	(0.0003) ***	-0.002	(0.0002) ***
Step Therapy	-0.004	(0.0045)	-0.004	(0.0006) ***	-0.005	(0.0005) ***
Other Plan Characteristics						
Annual Deductible	-0.021	(0.0044) ***	-0.008	(0.0005) ***	-0.007	(0.0005) ***
Gap Coverage	27.597	(0.7591) ***	-0.734	(0.1454) ***	-1.429	(0.1345) ***
Market Characteristics						
Risk Score	-36.208	(9.0668) ***	-1.904	(1.1560) *	-2.606	(1.1721) **
Number of Competing PDPs	0.224	(0.1182) *	-0.136	(0.0143) ***	-0.151	(0.0145) ***
Instrument Variables						
Mean Premium	0.488	(0.2176) **	-	-	-	-
Max Premium	0.13	(0.0610) **	-	-	-	-
Min Premium	0.307	(0.1826) *	-	-	-	-
Number of PDPs	6.775	(0.9711) ***	-	-	-	-
Number of MAPDs	-0.136	(0.0855)	-	-	-	-
	R-square =	0.75	R-Square =	0.51	R-Square =	0.46
			e =	-0.778	e =	-0.043
			k =	-0.039	k =	-0.002

*** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level

In Table 13, the OLS-estimated elasticity (e = -0.04) and semi-elasticity (k = -0.002) are much lower than those for the composite outside good in Table 12. The 2SLS-estimated elasticity (e = -0.78) is less than half of that in Table 12 while the semi-elasticity (k = -0.04) is similar to that in Table 12.

The estimated price elasticity is much smaller when explicitly including an outside good. The reason for this is straightforward. Given the average PDP premium of $45, a ten percent price increase would be a $4.50 premium increase. However, when following Town and Liu (2003) and defining the price as the difference between the premium and the premium of the outside good, *ceteris paribus*, that 10% increase in premium results in a 22% increase in the premium difference (the $4.50 increase in the $20 average difference). Thus, consumers appear much more price sensitive when the outside good is not explicitly included in the analysis. Including the MAPD product as the outside good indicates that consumers are less sensitive to price. The fact that both methods found a similar semi-elasticity in Table 12 and Table 13 is consistent with this argument.

In Table 12 and Table 13, the relationships between most variables and market share are as expected. Among plan characteristics, higher premiums and annual deductibles are associated with lower market share. Inclusion of more drugs on formulary tiers tends to encourage enrollment except for Tier 2 brand name medications. Enrollees are responsive to the number of generic drugs (tier 1 drugs). This is not surprising given the fact that the generic drugs comprise over 60% of overall drug utilization. Thus, consumers are sensitive to access to medications. Among the

utilization controls, prior authorization and step therapy tend to lower enrollment while quantity limits do not.

Market characteristics also affect enrollment significantly. Intuitively, the greater the number of competing plans, the lower the enrollment in each plan. As more plans enter the PDP market, each can only get a small slice of the market given a fixed number of Medicare beneficiaries.

Not all results are as expected. First, tier 1 copayment and tier 3 coinsurance have negative signs while rates of cost sharing in tiers 2 and tier 4 have positive signs. However, only tier 4 coinsurance is statistically significant. This finding along with the positive relationship between the number of covered medications and market share suggests that individuals are more concerned with coverage of medications than the level of copayment. In addition, whether medications are covered, and the overall premium and deductible are relatively transparent to consumers when deciding which plan to purchase. The implications are levels of copayments across tiers may be less clear to consumers. Second, controlling for the number of PDPs in the region, plans tend to have a smaller market share in regions with sicker Medicare beneficiaries. It was expected that enrollees with poorer health would derive greater utility from prescription drug coverage.

Another counterintuitive observation is the sign associated with gap coverage. Gap coverage is expected to attract individuals to enroll. However, in Table 12 and Table 13, offering gap coverage was associated with lower market share. The results in Section 4.1.3 showed that covering generic drugs in the gap increases the plan bid by approximately 19% and covering brand names drugs increases the plan bid by an

additional 20%. Since gap coverage is a supplemental benefit, the cost of providing gap coverage is completely passed on to Medicare beneficiaries. In other words, plans offering gap coverage charge significantly higher premiums than plans that do not because the premium will cover the expected cost of providing the benefit plus administrative costs. While gap coverage is quite useful for individuals that are high users of medications, most individuals do not have sufficient drug spending to reach the donut hole. Thus, such consumers may not be willing to pay extra out-of-pocket cost to get gap coverage that may not be necessary to them.

4.4. Summary

Given the relative short history of the Medicare Part D program, not much research has been done to examine the Part D plans. Serving as one of the pioneer studies, this dissertation has taken a three-step approach to test four hypotheses in the Medicare PDP market.

First, using Hedonic pricing models with firm fixed effects, we found evidence to support Hypothesis 1 that the tiered copayments are consistent with their actuarial values. Our results show that higher copayment on each tier is associated with lower plan bid. However, no evidence was found for Hypothesis 2 that utilization control tools lower plan bids.

Second, adopting the decomposition method by Neumark (1988), we decomposed the difference in bid and premium between 2006 and 2008 into two parts: changes in plan characteristics and changes in marginal price. We found that the difference was primarily caused by the difference in plan characteristics. As a result, Hypothesis 3 that actuarial

pricing methods play an important role in explaining the premium and bid difference between 2006 and 2008 was rejected.

Finally, we estimated the premium elasticity and semi-elasticity of demand using a mean utility logit model. The estimated elasticity of -1.804 and semi-elasticity of -0.04 supports Hypothesis 4, that Medicare beneficiaries are sensitive to PDP premiums.

Chapter Five

Discussion

5.1 Conclusions

The Medicare Part D program represents the largest expansion of the Medicare program in Medicare history. While the MMA provided a basic benefit structure by law, most firms have chosen to provide alternative benefit structures that included the use of tiered cost sharing. The firms are also given the flexibility to establish formularies and apply utilization control tools to covered drugs, such as prior authorization, quantity limits, and step therapy. The plan design is subject to the approval of CMS, the agency that administers the Medicare program.

This dissertation is one of the pioneer studies in the field that measure the PDPs in the context of the highly regulated Medicare Part D market. Specifically, this dissertation tested four hypotheses related to PDPs from different perspectives, including benefit structure, pricing method and sensitivity of enrollees to premium, using 2006-2008 Prescription Drug Plan (PDP) data.

We found that the tiered copayments are consistent with their actuarial values. The results of the firm fixed effects model show that plan bid is inversely related to enrollee's cost sharing. However, despite being statistically significant, the marginal effects are quite small. The effects were larger for preferred brand name medications than generic medications, suggesting that insurers expect an increase in tier 2 cost sharing to induce a small shift toward generic drugs. However, we did not find evidence on tier shifting from non-preferred brand name drugs and specialty drugs to preferred name

drugs. The effect of cost sharing on consumer demand for medications and plan bids has important policy implications. One of the primary goals of prescription drug coverage was to increase access to medications for the elderly. Reductions in consumer demand due to high cost sharing would need to be monitored to ensure this goal is not compromised. In addition, the Part D plan price elasticities can be informative to CMS in monitoring plans and consumer behavior.

Among the utilization control tools, we found that only prior authorization lowers plan bid. Although counterintuitive, step therapy and quantity limits were found to increase plan bid. These utilization control tools are designed to lower the expected claim cost which is positively related to plan bid. But we did not find consistent evidence to support the hypothesis that these tools lower plan bid. However, this does not necessarily imply that these utilization control tools fail to function as they were designed to. The insurers may have failed to reflect the potential savings in the plan bids.

Considerable changes in average plan characteristics had occurred between 2006 and 2008. Many plans have been adjusted to cover fewer medications and encourage beneficiaries to use generic medications over brand name medications. In addition, the bids in 2006 were based on manual rates due to the lack of experience. Starting in 2008, experience-based bid has been required by CMS as plans accumulate Part D experience. This would lead to considerable changes in the marginal prices associated with plan characteristics.

Overall, changes in average bids and premiums were primarily due to changes in plan characteristics. Nearly three quarters of the change in bid and virtually all of the change in premium was attributed to plan characteristics. Thus, the move to increasing

cost sharing for brand name medications and covering fewer medications has led to a reduction in plan bid.

A number of additional results are worthy of discussion. The average bid declined in 2008 compared to 2006 while the average beneficiary premium increased. This is likely due to the weighting method used by CMS to arrive at the national average bid. As discussed earlier, all bids were weighted equally in 2006 due to the lack of enrollment history. By 2008, the national average bid was a blended average of the unweighted average bid and an enrollment weighted average bid. The beneficiary premium is a percentage of the national average bid, suggesting that in 2008 weighted average bid was greater than the unweighted average. This led to an increase in the national average bid used to calculate the beneficiary premium.

Many of the changes in plan characteristics likely reflect the lack of knowledge insurers had in serving this market. Given this lack of experience, many plans covered all the drugs on CMS formulary file although they were not required to in 2006. After gaining two years' experience in the Medicare Part D market, in 2008, plans are more sophisticated in benefit design and formulary controls. Similarly, in 2006 the plan bid is positively related to the PDP region Part D risk scores and negatively related to the Medicare population in the region. However, the importance of the regional variables declined by 2008. As insurers gained more knowledge and began to use experience rating, regional characteristics become less important.

One interesting aspect of the part D program is the generous benefits offered to low-income beneficiaries. Individuals meeting certain income requirements have their premiums and deductibles covered by the federal government. In addition, cost sharing

is quite limited. CMS randomly auto-assigns the new dual eligible enrollees to the PDPs that are below the regional low income subsidy benchmark. In order to get the auto-assigned members, these plans generally bid lower than the plans that do not intend to enroll low income members.

Enrollment is very important in measuring the success of implementing the Medicare Part D program. Another goal of the program was to encourage competition between plans in order to maximize consumer benefits and minimize costs. However, in order to achieve this goal, enrollees must be responsive to price differences between plans. Consequently, enrollee price sensitivity to plan premiums is of great interest to many researchers and policy makers. We estimated the elasticity of Medicare PDP enrollment with respect to plan premium (-1.80 using a composite outside good and -0.78 using MAPDs as the outside good). Such estimates are higher in magnitude than prior research on enrollee price sensitivity in the Medicare HMO market. According to Frakt and Pizer (2009), the higher PDP premium elasticity is consistent with the nature of the PDP market. Due to the lower fixed cost of entry, PDPs can easily enter the Medicare Part D market. In each PDP region, Medicare beneficiaries generally have over 50 PDPs to choose from. These PDPs are more similar than plans than those of the Medicare HMO market. In addition, PDPs do not require restrictive provider networks that Medicare HMOs have. Therefore, PDP enrollees are more sensitive to premiums than Medicare HMO enrollees.

The estimated premium elasticity using a composite outside good is larger in magnitude than Frakt and Pizer's estimates (-1.804 vs. -1.475). The increased sensitivity to price was expected with the change to experience rating. Experience rating was

expected to result in greater premium variation among similar plans (Cutler, 1994), and thus results in consumers being more price sensitive. The results may also indicate that with one more year experience in the Part D market, PDP enrollees are more knowledgeable about the PDP products. As such, they are more responsive to the PDP premiums. Plan premium is an important factor in determining the plan's market share.

This study also expanded on Frakt and Pizer's (2009) paper by including MAPD premiums and enrollment as an outside good. The estimated price elasticity is much smaller when explicitly including an outside good. Thus, consumers appear more price sensitive when the outside good is not explicitly included in the analysis. Including the MAPD products as an outside good resulted in consumers appearing much less sensitive to price. However, the semi-elasticity which is measures the consumer's response to a $1 change in premiums indicates little difference between the two methods.

Insurance companies aimed to attract Medicare beneficiaries to enroll by offering tiered copayments instead of fixed member cost-sharing. However, our results showed that lower copayments do not necessarily affect market share. Gap coverage was associated with lower market share. The relationship may reflect the higher premiums associated with gap coverage and the fact that most enrollees do not use sufficient medications to reach the gap. Consumers may not be willing to pay a known higher price for benefits that are unlikely to be used.

5.2 Limitations

Although a systematic method has been employed to explore the relationship between plan bids and plan characteristics, and premium elasticities, this dissertation

does have some limitations. First, the results need to be interpreted carefully. The results cannot be applied to the MAPD plans as the enrollees in the MAPD plans may have different utilization patterns than the PDP enrollees. A majority of the PDP enrollees are Medicare FFS members who are usually less healthy than the MAPD enrollees.

Another possible concern is that the use of a fixed effect model specification may not be appropriate. If insurers do not vary their cost sharing structure across plans or geographic regions, then the fixed effects specification will not be able to accurately estimate the relationship between cost sharing and bids, and a specification without firm fixed effects may be more appropriate. For this purpose, we estimated an OLS model without the firm fixed effects to determine whether the results differ or not. The results are qualitatively similar, although the effects for tier 1 and tier 2 cost sharing are even weaker without the firm fixed effects. Thus, it does not appear that the use of a firm fixed effects specification leads to the small measured relationship between cost sharing and plan bids.

No evidence was found on the differential effects of low risk and high risk regions. This result is consistent with a number of previous studies that have not found medications for chronic conditions to be more sensitive to cost sharing. However, it is important to note that this dissertation used a market level variable to measure health status within the region. Firms may attract different risks across regions, and the market level variable may not be strongly correlated with a firm's experience.

Given the limitation imposed by the data used, we could not examine specific drugs. While CMS set the minimum standards for the formulary files, they also give the firm latitude to modify their formulary, subject to review and approval. As a result, some

plans may cover some brand drugs on tier 2, some plans may cover the same drugs on the tier 3 while others may not cover them at all. The impact of specific drugs to the bids and the effect of adding the same drug on different tiers are not provided in this dissertation. Further, we used the median negotiated prices for generic drugs and brand name drugs to convert the tier 1 and tier 2 coinsurance into copayments, and convert tier 3 and tier 4 copayments into coinsurance. However, the median drug cost of each tier may differ by plan due to the different number and type of drugs covered. The coefficient estimates associated with the tier cost sharing variables in the firm fixed effects model cannot be used to predict individual plan's behavior.

More importantly, since the Medicare Part D program started in 2006, both the 2006 and the 2007 bids were developed using manual rates. Although the 2008 bids were supposed to be experience based, some plans continued to use manual rates in lack of creditable experience. Some of these early age bids used in this dissertation may not be mature enough to accurately capture actual utilization patterns and claim costs associated with each plan. In other words, these projected plan costs may differ from the actual costs. The significant risk corridor reconciliation amounts in Appendix B (Figure B5 and Figure B6) in the end of years 2006 and 2007 support this point of view. As more claims experience becomes available and the plans have more creditable experience in the Medicare Part D market, the plan bids in the future will be fully experience based, which may have different copayments elasticities than the plan bids documented in this dissertation.

Similarly, these early age bids used in this dissertation have not gained expertise to effectively use the utilization control tools. The manual rates used in the bids may not

correctly reflect the potential savings. That may explain the counterintuitive results produced by the models in this dissertation. We expect the future fully experience based bids would more accurately capture the savings caused by these utilization control tools.

From the enrollees' perspective, PDPs are new products that they have little knowledge about. Given the short history of the Part D program, they may not be knowledgeable enough to choose the plans that best meet their needs. In other words, enrollment behavior may occur that would not appear to maximize utility because of enrollees' incomplete information. If the lack of information or the ability to use the information resulted in a large number of seemingly irrational plan enrollments, the premium elasticity estimated in this study may not be valid. This problem is expected to be alleviated as the level of information increases with the greater experience gained by enrollees in the future.

In addition, due to data limitation, we did not consider the government subsidies, such as low income subsidy and federal reinsurance subsidy. Although the bid amount reflects the plan's portion of potential claim liabilities, the government subsidies do impact enrollees' overall utilization patterns, especially for the low income enrollees. Thus, the plan's liability may be impacted indirectly.

For the same reason, this dissertation did not take into account of the risk corridor reconciliation payments since the plan level data were not available. The significant risk corridor payments at the end of years 2006 and 2007 also indicate that not all plan bids were priced accurately to reflect the actual claim costs incurred by each plan. In other words, not all plan bids captured the plans' expected claim costs correctly. Thus, the

copayment elasticities estimated may not reflect the enrollees' demand for prescription drugs.

The final limitation is the missing insurer characteristic data, such as rebates received from pharmaceutical companies and/or AWP (average wholesale price) discounts with the PBM, underwriting and administrative costs, etc. Inclusion of these data, when they are available, would be expected to improve the model accuracy and reduce the variation.

5.3 Future Research

Since the inception of the Medicare Part D program, criticisms have been frequently heard, such as, the limited access to medical care service due to the specific design of "donut hole", the complicated benefit structure design, the government's lack of negotiating power on drugs with pharmaceutical companies, premium hikes, etc. These criticisms and concerns should be addressed using prescription drug claims data when they become available in the future.

Other limitations mentioned in the preceding section should also be addressed in future research. Fortunately, CMS has recently planned to initiate a phased schedule to release the Medicare Part D experience data (detailed claims data by enrollee) to researchers. With these experience data being available, most limitations discussed can be addressed. For example, with information on cost per script, dispensing fees, and plan paid amount becoming available, the average drug cost can be measured more accurately.

Moreover, following the work from this dissertation, future research could be directed to measure the impact of government subsidies using accumulated Part D experience data.

Risk corridor reconciliation is another interesting topic for future research. Starting in 2008, the risk corridor threshold band has widened and the risk sharing percentage has changed as mandated by the MMA (Appendix B Figure B7 and Figure B8). Eventually the plans will bear more risk. Whether and how the participating firms will change their pricing strategies is one of the potential research directions in this field.

Currently, a few large insurance companies are dominant in the PDP market. Benefiting from the economy of scale, they are more likely to charge lower premiums than the small firms in the future. Our results show that PDP enrollees are very sensitive to plan premiums. As such, these large insurance companies are likely to further expand their market share and put the small firms in an even worse situation. Will the Medicare Part D market eventually become a monopoly or an oligopoly market? Or instead, will the government play the provider role like Canada? These concerns are also of interest to us and should be addressed in future research.

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Appendix A: Tables

Table A 1 Median Negotiated Prices for Medicare Part D Sample Drugs

All Drugs	$49.82
Generic Drugs	$18.11
Brand Name Drugs	$92.16

Notes: The median price is from Hoadley (2006) who examined prices of the top 150 medications in the Part D program.

Table A 2 Average Risk Score by PDP Region

PDP Region	States	Average Risk Score		
		2005	2006	2007
1	ME/NH	0.9707	0.9707	0.9707
2	CT/MA/RI/VT	1.0141	1.0140	1.0138
3	NY	1.0402	1.0403	1.0402
4	NJ	1.0335	1.0335	1.0334
5	DE/DC/MD	1.0132	1.0131	1.0130
6	PA/WV	1.0272	1.0270	1.0268
7	VA	0.9954	0.9950	0.9946
8	NC	1.0120	1.0119	1.0119
9	SC	1.0217	1.0217	1.0216
10	GA	1.0215	1.0212	1.0210
11	FL	1.0503	1.0502	1.0501
12	AL/TN	1.0323	1.0323	1.0324
13	MI	1.0057	1.0055	1.0052
14	OH	1.0228	1.0227	1.0225
15	IN/KY	1.0038	1.0039	1.0039
16	WI	0.9514	0.9512	0.9509
17	IL	0.9699	0.9698	0.9697
18	MO	1.0063	1.0063	1.0063
19	AR	0.9833	0.9833	0.9832
20	MS	1.0004	1.0004	1.0004
21	LA	1.0243	1.0229	1.0230
22	TX	0.9979	0.9978	0.9978
23	OK	0.9842	0.9843	0.9843
24	KS	0.9616	0.9618	0.9621
25	IA/MN/MT/NE/ND/SD/WY	0.9268	0.9268	0.9268
26	NM	0.9374	0.9373	0.9372
27	CO	0.9328	0.9325	0.9322
28	AZ	0.9548	0.9548	0.9547
29	NV	0.9583	0.9581	0.9580
30	OR/WA	0.9349	0.9349	0.9348
31	ID/UT	0.9211	0.9212	0.9214
32	CA	1.0026	1.0025	1.0025
33	HI	0.9627	0.9627	0.9627
34	AK	0.9067	0.9070	0.9073

Notes:
Source file: CMS 2006 Part D risk score by county file - Avg risk Part D.xls.
Weighed by census data - 2005-2007 over age 65 population by county.

Table A 3 Medicare Population by PDP Region

PDP Region	States	Medicare Eligibles		
		2006	2007	2008
1	ME/NH	239,424	243,190	251,595
2	CT/MA/RI/VT	2,002,074	2,020,204	2,044,099
3	NY	2,858,747	2,879,429	2,882,739
4	NJ	1,261,180	1,270,110	1,276,946
5	DE/DC/MD	914,799	928,255	953,905
6	PA/WV	2,537,956	2,556,932	2,583,239
7	VA	1,002,150	1,023,400	1,071,683
8	NC	1,288,827	1,318,782	1,390,313
9	SC	654,600	673,878	714,218
10	GA	1,045,818	1,076,986	1,144,013
11	FL	3,094,899	3,135,438	3,189,991
12	AL/TN	1,698,204	1,736,672	1,796,704
13	MI	1,519,223	1,537,840	1,569,168
14	OH	1,797,320	1,811,669	1,827,984
15	IN/KY	1,613,801	1,639,637	1,680,069
16	WI	844,212	854,772	869,604
17	IL	1,734,572	1,749,064	1,766,839
18	MO	930,083	942,794	959,988
19	AR	479,834	489,388	504,941
20	MS	465,962	471,940	475,855
21	LA	659,249	642,618	652,137
22	TX	2,570,082	2,641,789	2,779,572
23	OK	550,500	559,862	574,386
24	KS	408,800	412,026	434,408
25	IA/MN/MT/NE/ND/SD/WY	1,933,426	1,953,686	2,018,057
26	NM	270,105	277,591	291,894
27	CO	529,442	542,294	574,368
28	AZ	797,108	818,639	861,625
29	NV	302,537	308,802	327,742
30	OR/WA	1,377,990	1,409,270	1,474,709
31	ID/UT	431,107	443,820	473,591
32	CA	4,325,861	4,386,037	4,466,044
33	HI	186,157	189,271	193,033
34	AK	53,218	55,058	59,324

Notes:
(1) 2006 and 2007 data are from Kaiser Family Foundation, 2006 Med Beneficiary.pdf and 2007 Med Beneficiary.pdf.

The state level data are summarized by PDP region.
(2) 2008 data is taken from CMS monthly penetration files (May2008-Sep 2008). The average members by county are calculated and then summarized by PDP region.

Table A 4 Company Information by Contract

Contract Number	Start Date	Tax Status	Parent Company
S0043*	1/1/2006	For Profit	Aveta, LLC.
S0197	1/1/2006	For Profit	Coventry Health Care Inc.
S1030	1/1/2007	Not-for-Profit/Non-Profit	BCBS OF AL & BCBS OF TN
S1516*	1/1/2008	Not-for-Profit/Non-Profit	Mennonite General Hospital, Inc
S1566	1/1/2006	For Profit	Bravo Health, Inc.
S2321	1/1/2006	Not-for-Profit/Non-Profit	Independence Blue Cross
S2468	1/1/2006	Not-for-Profit/Non-Profit	Blue Shield of California
S2505	1/1/2007	For Profit	Windsor Health Group
S2770	1/1/2006	Not-for-Profit/Non-Profit	Independence Blue Cross
S2874*	1/1/2007	For Profit	Humana Inc.
S2893	1/1/2006	For Profit	Wellpoint, Inc.
S3230	1/1/2007	For Profit	MEDICAL MUTUAL OF OHIO
S3389	1/1/2006	For Profit	University of Pittsburgh Medical Center
S3440	1/1/2008	For Profit	Health Alliance Plan (HAP)
S3521	1/1/2006	Not-for-Profit/Non-Profit	Lifetime Healthcare, Inc.
S3994	1/1/2007	Not-for-Profit/Non-Profit	Hawaii Medical Service Association
S4231	1/1/2006	For Profit	Universal Health Care, Inc.
S4248	1/1/2007	For Profit	Geisinger Health System
S4496	1/1/2007	For Profit	Independence Blue Cross
S4749*	1/1/2008	For Profit	Preferred Health Inc
S4802	1/1/2006	For Profit	Munich American Holding Corporation
S4877*	1/1/2007	Not-for-Profit/Non-Profit	Cooperativa de Seguros de Vida de Puerto Rico
S5540	1/1/2006	Not-for-Profit/Non-Profit	Blue Cross and Blue Shield of North Carolina
S5552	1/1/2006	For Profit	Humana Inc.
S5555*	1/1/2006	For Profit	Medical Card System, Inc.
S5557	1/1/2006	For Profit	Fox Rx Inc.
S5566	1/1/2006	For Profit	Health Care Service Corporation
S5569	1/1/2006	For Profit	Coventry Health Care Inc.
S5578	1/1/2006	For Profit	HealthSpring
S5580	1/1/2006	For Profit	Torchmark Corporation
S5581	1/1/2006	For Profit	Universal American Financial Corporation
S5584	1/1/2006	Not-for-Profit/Non-Profit	Blue Cross Blue Shield of Michigan
S5585	1/1/2006	Not-for-Profit/Non-Profit	HealthNow New York Inc.
S5588	1/1/2006	For Profit	Promedica Health System
S5593	1/1/2006	For Profit	Highmark Inc.
S5596	1/1/2006	For Profit	Wellpoint, Inc.

Table A4 Continued Company Information by Contract

Contract Number	Start Date	Tax Status	Parent Company
S5597	1/1/2006	For Profit	Universal American Corp.
S5601	1/1/2006	For Profit	CVS Caremark Corporation
S5609	1/1/2006	Not-for-Profit/Non-Profit	The Regence Group
S5617	1/1/2006	For Profit	CIGNA
S5644	1/1/2006	For Profit	Longs Drug Stores Corporation
S5650	1/1/2006	For Profit	AmeriHealth Mercy Health Plan
S5660	1/1/2006	For Profit	Medco Health Solutions, Inc.
S5670	1/1/2006	For Profit	Coventry Health Care Inc.
S5674	1/1/2006	For Profit	Coventry Health Care Inc.
S5678	1/1/2006	For Profit	Health Net, Inc.
S5704	1/1/2006	For Profit	GlobalHealth Incorporated
S5715	1/1/2006	For Profit	Health Care Service Corporation
S5726	1/1/2006	For Profit	Blue Cross Blue Shield of Kansas
S5740	1/1/2006	For Profit	NewQuest Health Solutions LLC
S5741	1/1/2006	Not-for-Profit/Non-Profit	EmblemHealth Inc.
S5743	1/1/2006	Not-for-Profit/Non-Profit	Blue Cross and Blue Shield of Minnesota
S5753	1/1/2006	Not-for-Profit/Non-Profit	Wisconsin Physicians Service Ins Corporation.
S5755	1/1/2006	For Profit	Torchmark Corporation
S5766	1/1/2006	Not-for-Profit/Non-Profit	CareFirst, Inc.
S5768	1/1/2006	For Profit	Coventry Health Care Inc.
S5775*	1/1/2006	For Profit	Pharmacy Insurance Corporation of America
S5783	1/1/2006	For Profit	QCC Insurance Company
S5795	1/1/2006	Not-for-Profit/Non-Profit	Arkansas Blue Cross Blue Shield
S5803	1/1/2006	For Profit	Universal American Corp.
S5805	1/1/2006	For Profit	UnitedHealth Group, Inc.
S5810	1/1/2006	For Profit	Aetna Inc.
S5815	1/1/2006	For Profit	NewQuest Health Solutions LLC
S5820	1/1/2006	For Profit	UnitedHealth Group, Inc.
S5822	1/1/2006	For Profit	Bravo Health, Inc.
S5825	1/1/2006	For Profit	Universal American Corp.
S5840*	1/1/2007	For Profit	First Medical Health Plan
S5857	1/1/2006	For Profit	Spectrum Health System
S5860	1/1/2006	Not-for-Profit/Non-Profit	Rocky Mountain Health Maintenance , Inc.
S5877	1/1/2006	Not-for-Profit/Non-Profit	Educators Mutual Insurance Association
S5884	1/1/2006	For Profit	Humana Inc.
S5902	1/1/2006	For Profit	Presbyterian Healthcare Services

Table A4 Continued Company Information by Contract

Contract Number	Start Date	Tax Status	Parent Company
S5904	1/1/2006	Not-for-Profit/Non-Profit	Blue Cross and Blue Shield of Florida
S5915	1/1/2006	Not-for-Profit/Non-Profit	Scott and White
S5916	1/1/2006	Not-for-Profit/Non-Profit	The Regence Group
S5907*	1/1/2006	For Profit	Blue Shield of Puerto Rico
S5917	1/1/2006	For Profit	UnitedHealth Group, Inc.
S5921	1/1/2006	For Profit	UnitedHealth Group, Inc.
S5932	1/1/2006	For Profit	HealthSpring, Inc.
S5937	1/1/2006	Not-for-Profit/Non-Profit	BlueCross BlueShield of Louisiana
S5946	1/1/2006	For Profit	BlueCross BlueShield of South Carolina (BCBSSC)
S5953	1/1/2006	For Profit	BlueCross BlueShield of South Carolina (BCBSSC)
S5954	1/1/2006	For Profit	Dean Health Systems Inc.
S5960	1/1/2006	For Profit	Wellpoint, Inc.
S5966	1/1/2006	Not-for-Profit/Non-Profit	EmblemHealth Inc.
S5967	1/1/2006	For Profit	WellCare Health Plans, Inc.
S5975	1/1/2006	For Profit	The ODS Companies (ODS)
S5983	1/1/2006	For Profit	Medco Health Solutions, Inc.
S5993	1/1/2006	Not-for-Profit/Non-Profit	Horizon Blue Cross Blue Shield of New Jersey, Inc.
S5998	1/1/2007	For Profit	Bravo Health, Inc.
S6874*	1/1/2008	For Profit	Capital BlueCross
S6875*	1/1/2006	Not-for-Profit/Non-Profit	Independence Blue Cross
S7694	1/1/2007	For Profit	Envision Insurance Company
S7950	1/1/2007	For Profit	Express Scripts, Inc.
S8067	1/1/2006	For Profit	Capital BlueCross
S8201	1/1/2007	For Profit	University of Pittsburgh Medical Center
S8277	1/1/2007	For Profit	Carolina Care Plan, Inc
S8465	1/1/2008	For Profit	Citrus Health Care, Inc.
S8475	1/1/2007	For Profit	Quality Health Plans, Inc.
S8841	1/1/2007	For Profit	National Medical Health Card Systems, Inc.
S9086	1/1/2006	For Profit	America's Health Choice Medical Plans, Inc
S9176	1/1/2007	Not-for-Profit/Non-Profit	Capital District Physicians' Health Plan, Inc.

Notes:
(1) * are the contracts in US territories, which are excluded in this study.
(2) For contracts that changed company names, used 2008 company information.

Table A 5 Average Plan Bid and Member Premium by Year

Year	Obs.	Avg. PDP Bid	Avg. Member Premium
2006	1,414	$101.48	$37.48
2007	1,865	$89.89	$36.81
2008	1,822	$92.63	$40.04
Total	5,101	$94.10	$38.16

Table A 6 Average Plan Bid and Member Premium by PDP Region

PDP Region	States	Obs.	Avg. Plan Bid	Avg. Member Premium
1	ME/NH	147	$94.53	$38.58
2	CT/MA/RI/VT	146	$93.24	$37.04
3	NY	161	$90.38	$34.42
4	NJ	158	$93.89	$37.94
5	DE/DC/MD	153	$94.37	$38.17
6	PA/WV	180	$93.49	$37.48
7	VA	146	$94.81	$38.84
8	NC	140	$96.41	$40.62
9	SC	155	$95.40	$39.53
10	GA	148	$94.91	$39.06
11	FL	156	$92.69	$36.93
12	AL/TN	149	$96.05	$40.21
13	MI	149	$94.40	$38.57
14	OH	160	$93.96	$38.19
15	IN/KY	146	$97.21	$41.23
16	WI	156	$94.48	$38.43
17	IL	151	$94.30	$38.36
18	MO	146	$95.11	$39.14
19	AR	153	$94.24	$38.48
20	MS	139	$96.15	$40.26
21	LA	140	$96.14	$40.28
22	TX	163	$93.35	$37.29
23	OK	150	$96.41	$40.44
24	KS	145	$95.39	$39.47
25	IA/MN/MT/NE/ND/SD/WY	146	$94.35	$38.38
26	NM	155	$89.87	$33.93
27	CO	153	$93.57	$37.60
28	AZ	147	$90.72	$34.62
29	NV	151	$91.41	$35.32
30	OR/WA	157	$94.35	$38.32
31	ID/UT	154	$97.11	$41.08
32	CA	158	$90.04	$33.89
33	HI	124	$90.92	$35.48
34	AK	119	$96.48	$41.12

Table A 7 Average Plan Bid and Member Premium by Contract

Contract	Number of Plans	Avg. Plan Bid	Avg. Member Premium
S5617	306	$96.14	$39.58
S5803	306	$94.57	$38.02
S5810	306	$104.90	$48.34
S5921	306	$94.65	$38.10
S5884	288	$94.70	$38.37
S5597	285	$93.48	$37.00
S5601	272	$92.91	$37.28
S5967	272	$88.98	$31.93
S5960	258	$88.50	$31.32
S5644	210	$85.70	$30.78
S5820	201	$86.75	$30.08
S5670	189	$91.81	$35.25
S5678	182	$83.28	$29.67
S4802	166	$105.90	$50.91
S5660	165	$94.81	$39.84
S5755	163	$93.69	$38.73
S5768	159	$84.38	$30.76
S7694	136	$121.45	$68.61
S5674	108	$91.10	$34.55
S5917	96	$101.08	$47.25
S5596	90	$93.05	$36.49
S5932	69	$75.56	$22.56
S5581	66	$116.89	$52.89
S5557	34	$88.33	$34.26
S7950	34	$100.93	$47.85
S8841	34	$84.82	$31.74
S5825	30	$107.98	$46.22
S5715	27	$93.47	$36.91
S5998	21	$77.88	$24.97
S5946	12	$90.17	$33.61
S2505	10	$77.94	$25.06
S0197	9	$90.33	$33.77
S2893	9	$96.25	$39.69
S5552	9	$95.48	$38.93
S5566	9	$91.36	$34.80
S5593	9	$91.11	$34.55
S5726	9	$91.55	$35.00
S5743	9	$113.92	$57.36
S5795	9	$95.32	$38.77
S5877	9	$105.91	$49.35
S3521	8	$89.89	$32.83
S5904	8	$101.65	$46.03
S5954	8	$98.83	$41.84
S2321	7	$103.81	$46.19
S5753	7	$98.76	$42.77
S5783	7	$87.82	$23.82

Table 7 Continued

Contract	Number of Plans	Avg. Plan Bid	Avg. Member Premium
S5805	7	$86.52	$28.90
S5822	7	$80.26	$25.76
S5915	7	$100.00	$43.94
S5993	7	$99.26	$43.27
S8067	7	$88.91	$34.48
S1030	6	$99.42	$46.58
S2468	6	$90.86	$34.31
S5540	6	$115.50	$58.94
S5569	6	$83.64	$28.99
S5584	6	$94.32	$37.76
S5766	6	$98.98	$42.42
S5902	6	$86.63	$30.08
S5953	6	$94.68	$38.12
S3389	5	$89.89	$34.82
S5580	5	$89.14	$34.08
S5588	5	$90.07	$35.00
S5609	5	$104.54	$49.48
S5650	5	$83.90	$28.83
S5741	5	$83.79	$28.72
S5860	5	$101.38	$44.03
S5916	5	$106.17	$51.11
S5975	5	$106.11	$51.04
S5983	5	$94.62	$39.65
S1566	4	$82.58	$26.89
S3230	4	$95.29	$42.45
S4248	4	$78.96	$26.13
S4496	4	$92.66	$39.83
S5704	4	$110.05	$51.51
S8475	4	$85.46	$32.63
S2770	3	$83.55	$26.99
S3440	3	$93.26	$40.67
S5585	2	$86.49	$33.65
S5857	3	$89.54	$32.99
S5937	3	$97.65	$41.09
S5966	3	$79.64	$23.08
S9176	3	$86.81	$33.73
S4231	2	$139.44	$75.44
S8201	2	$85.09	$32.25
S8277	2	$96.58	$43.50
S8465	2	$89.94	$37.35
S3994	1	$82.08	$29.00
S5578	1	$88.78	$24.78
S5740	1	$88.78	$24.78
S5815	1	$89.73	$25.73
S9086	1	$77.98	$24.90

Table A 8 Regression Results: Firm Fixed Effects Model, Dependent Variable: Ln (Bid), Plans with Risk Scores < 1.0

Explanatory Variables	Estimates	Standard Error
Cost sharing		
Tier 1 copayment	-0.0031***	0.0007
Tier 2 copayment	-0.0025***	0.0004
Tier 3 coinsurance	-0.0237*	0.0134
Tier 4 coinsurance	-0.0191	0.0146
# drugs covered		
ln(# drugs on tier 1)	-0.0142**	0.0060
ln(# drugs on tier 2)	0.0573***	0.0134
# drugs on tier 3 (in thousands)	-0.0036*	0.0022
# drugs on tier 4	0.00005***	0.0000
# drugs subject to:		
Quantity limits (in thousands)	0.0036***	0.0013
Prior authorization (in thousands)	-0.0487***	0.0102
Step therapy (in thousands)	0.0574***	0.0120
Other plan characteristics		
Deductible	-0.0004***	0.0000
Gap coverage for generics	0.1791***	0.0053
Gap coverage for brands	0.1763***	0.0198
LIS_0prem	-0.0449***	0.0055
Other Variables		
Year 2007	-0.1540***	0.0079
Year 2008	-0.1180***	0.0092
Regional risk score	0.0331	0.0778
Regional Medicare population	0.0000	0.0028

N	2,517
R squared	0.73

Notes:
(1) *** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level.
(2) The specification also includes a categorical variable for each firm.

Table A 9 Regression Results: Firm Fixed Effects Model, Dependent Variable: Ln (Bid), Plans with Risk Scores >= 1.0

	Estimates	Standard Error
Cost sharing	-0.0041***	0.0007
Tier 1 copayment	-0.0022***	0.0003
Tier 2 copayment	-0.0240*	0.0128
Tier 3 coinsurance	-0.0235*	0.0132
Tier 4 coinsurance		
# drugs covered		
ln(# drugs on tier 1)	-0.0338***	0.0058
ln(# drugs on tier 2)	0.0811***	0.0126
# drugs on tier 3 (in thousands)	-0.0056**	0.0022
# drugs on tier 4	0.00005***	0.0000
# drugs subject to:		
Quantity limits (in thousands)	0.0061***	0.0014
Prior authorization (in thousands)	-0.0292***	0.0084
Step therapy (in thousands)	0.0356***	0.0095
Other plan characteristics		
Deductible	-0.0003***	0.0000
Gap coverage for generics	0.1769***	0.0050
Gap coverage for brands	0.1921***	0.0184
LIS_0prem ***	-0.0617***	0.0052
Other Variables		
Year 2007	-0.1665***	0.0074
Year 2008	-0.1311***	0.0082
Regional risk score	-0.2804**	0.1341
Regional Medicare population	-0.0178***	0.0018

N	2,584
R squared	0.76

Notes:
(1)*** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level.
(2) The specification also includes a categorical variable for each firm.

Table A 10 Regression Results: OLS, Dependent Variable: Ln (Bid)

Explanatory Variables	Estimates	Standard Error
Intercept	4.2882***	0.0610
Cost sharing		
Tier 1 copayment	-0.0022***	0.0005
Tier 2 copayment	-0.0004*	0.0002
Tier 3 coinsurance	-0.0676***	0.0078
Tier 4 coinsurance	-0.0337***	0.0082
# drugs covered		
ln(# drugs on tier 1)	0.0123***	0.0035
ln(# drugs on tier 2)	0.0274***	0.0046
# drugs on tier 3 (in thousands)	-0.0071***	0.0015
# drugs on tier 4	-0.00002***	0.0000
# drugs subject to:		
Quantity limits (in thousands)	0.0019**	0.0009
Prior authorization (in thousands)	-0.0290***	0.0046
Step therapy (in thousands)	0.0248***	0.0074
Other plan characteristics		
Deductible	-0.0001***	0.0000
Gap coverage for generics	0.1954***	0.0041
Gap coverage for brands	0.1811***	0.0151
LIS_0prem	-0.1042***	0.0042
Other Variables		
Year 2007	-0.1374***	0.0058
Year 2008	-0.1104***	0.0065
Regional risk score	0.1549***	0.0464
Regional Medicare population	-0.0116***	0.0018

N		5,101
R-square		0.61
Adj. R-square		0.61

Notes:
*** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level.

Table A 11 Regression Results: Firm Fixed Effects Model
Dependent Variable: Ln (Premium)

Explanatory Variables	Estimates	Standard Error
Cost sharing		
Tier 1 copayment	-0.0103***	0.0013
Tier 2 copayment	-0.0075***	0.0006
Tier 3 coinsurance	0.0014	0.0240
Tier 4 coinsurance	-0.0381	0.0254
# drugs covered		
ln(# drugs on tier 1)	-0.0606***	0.0108
ln(# drugs on tier 2)	0.2270***	0.0237
# drugs on tier 3 (in thousands)	-0.0113***	0.0040
# drugs on tier 4	0.0001***	0.0000
# drugs subject to:		
Quantity limits (in thousands)	0.0131***	0.0025
Prior authorization (in thousands)	-0.0817***	0.0169
Step therapy (in thousands)	0.0809***	0.0194
Other plan characteristics		
Deductible	-0.0009***	0.0000
Gap coverage for generics	0.3903***	0.0095
Gap coverage for brands	0.5182***	0.0351
LIS_0prem ***	-0.1745***	0.0098
Other Variables		
Year 2007	-0.0653***	0.0140
Year 2008	0.0249	0.0159
Regional risk score	0.6553***	0.1030
Regional Medicare population	-0.0353***	0.0039

N		5,101
R-square		0.69

Notes:
(1) *** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level.
(2) The specification also includes a categorical variable for each firm.

Table A 12 Regression Results: Firm Fixed Effects Model
Dependent Variable: Square Root (Bid)

Explanatory Variables	Estimates	Standard Error
Cost sharing		
Tier 1 copayment	-0.0152***	0.0026
Tier 2 copayment	-0.0113***	0.0012
Tier 3 coinsurance	-0.1683***	0.0469
Tier 4 coinsurance	-0.0718	0.0497
# drugs covered		
ln(# drugs on tier 1)	-0.1040***	0.0211
ln(# drugs on tier 2)	0.2867***	0.0463
# drugs on tier 3 (in thousands)	-0.0268***	0.0079
# drugs on tier 4 (in thousands)	0.0003***	0.0001
# drugs subject to:		
Quantity limits (in thousands)	0.0254***	0.0049
Prior authorization (in thousands)	-0.1983***	0.0330
Step therapy (in thousands)	0.2359***	0.0379
Other plan characteristics		
Deductible	-0.0017***	0.0001
Gap coverage for generics	0.8904***	0.0185
Gap coverage for brands	1.0138***	0.0685
LIS_0prem ***	-0.2362***	0.0192
Other Variables		
Year 2007	-0.7749***	0.0274
Year 2008	-0.5866***	0.0311
Regional risk score	0.9644***	0.2011
Regional Medicare population	-0.0560***	0.0077

N		5,101
R-square		0.73

Notes:
(1) *** Significant at 1% level; ** Significant at 5% level; * Significant at the 10% level.
(2) The specification also includes a categorical variable for each firm.

Appendix B: Figures

Figure B 1 Normal Probability Plot – Ln(Bid)

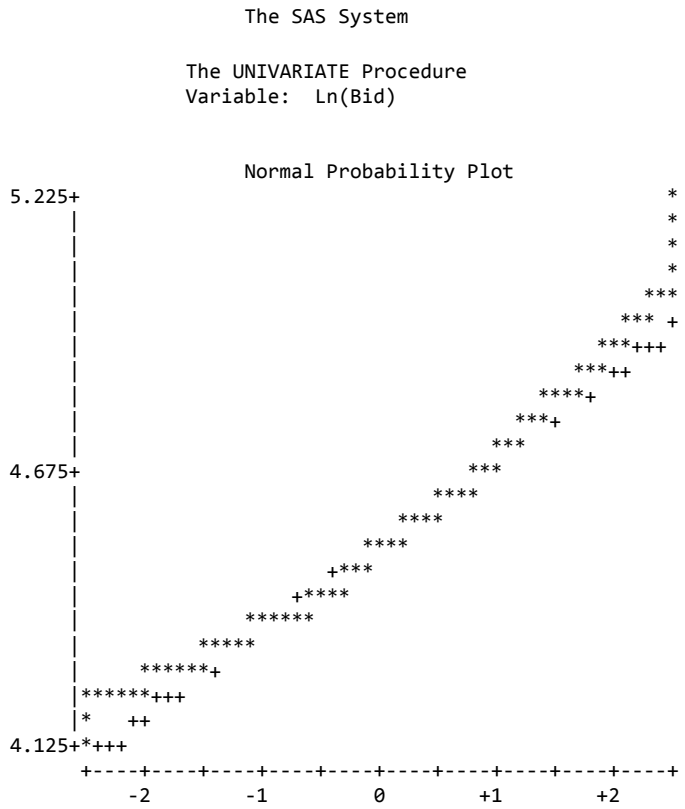
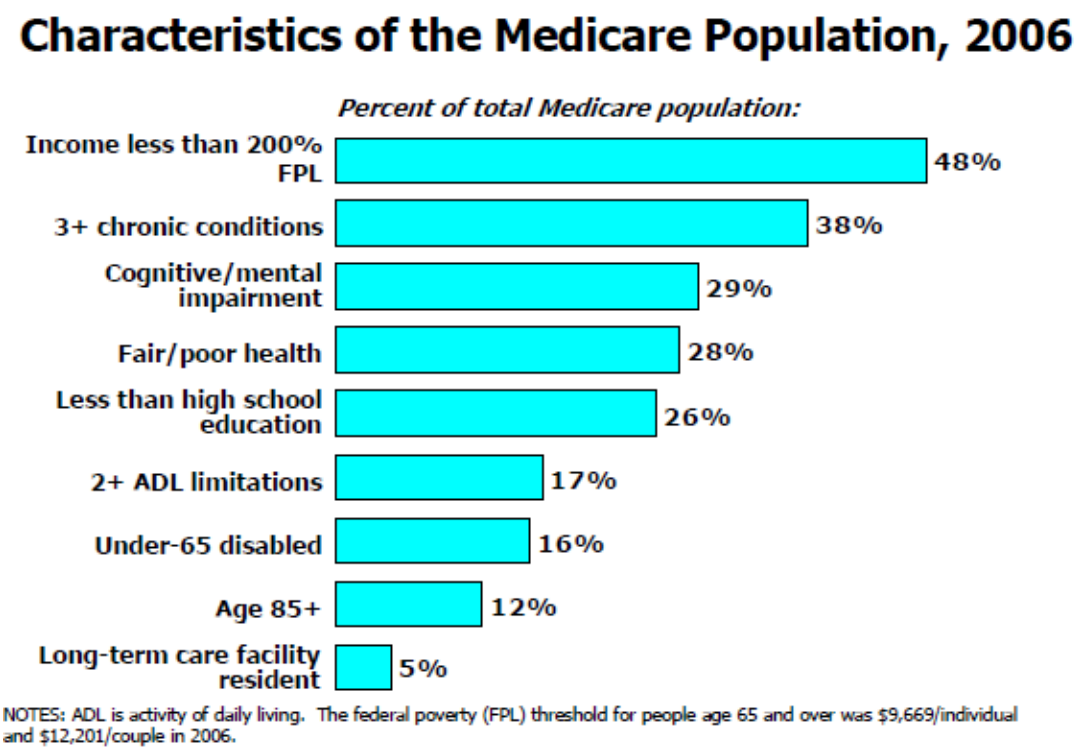
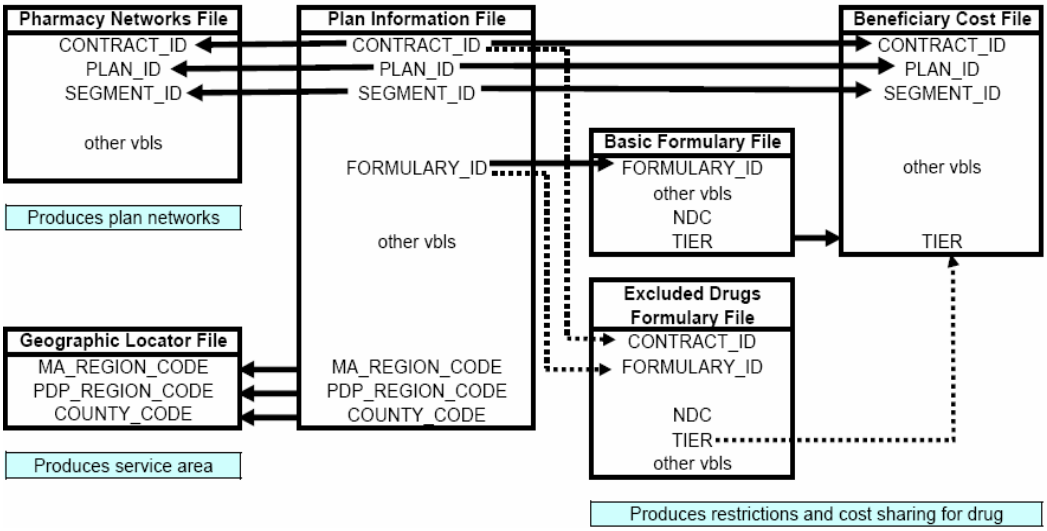


Figure B 2 Medicare Population Characteristics



Data Source: Kaiser Family Foundation, "Medicare at a Glance", November 2008.
The original data is from Income data from US Census Bureau, Current Population Survey published on statehealthfact.org; all other data from Kaiser Family Foundation analysis of the Medicare Current Beneficiary Survey 2006 Access to Care file.

Figure B 3 Data File Layouts



Data Source: CMS Prescription Drug Plan Formulary and Pharmacy Network File layouts.

Figure B 4 2006-2007 Part D Plan Standard Benefits

Part D Benefit Parameters	2006	2007
Standard Benefit Design Parameters		
Deductible	$250	$265
Initial Coverage Limit	$2,250	$2,400
Out-of-Pocket Threshold	$3,600	$3,850
Total Covered Part D Drug Spend at OOP Threshold (2)	$5,100	$5,451.25
Minimum Cost-sharing in Catastrophic Coverage Portion of Benefit		
Generic/Preferred multi-source drug	$2.00	$2.15
Other	$5.00	$5.35
Part D Full Benefit Dual Eligible Parameters		
Copayments for Institutionalized Beneficiaries	$0.00	$0.00
Maximum Copayments for Non-Institutionalized Beneficiaries		
Up to or at 100% FPL		
Up to Out-of-Pocket Threshold (1)		
Generic/Preferred multi-source drug	$1.00	$1.00
Other	$3.00	$3.10
Above Out-of-Pocket Threshold	$0.00	$0.00
Over 100% FPL		
Up to Out-of-Pocket Threshold		
Generic/Preferred multi-source drug	$2.00	$2.15
Other	$5.00	$5.35
Above Out-of Pocket Threshold	$0.00	$0.00
Part D Non-Full Benefit Dual Eligible Full Subsidy Parameters		
Resources ≤ $6,000 (individuals) or ≤ $9,000 (couples) (3)		
Maximum Copayments up to Out-of-Pocket Threshold		
Generic/Preferred multi-source drug	$2.00	$2.15
Other	$5.00	$5.35
Maximum Copayments above Out-of-Pocket Threshold	$0.00	$0.00
Resources bet. $6,000-$10,000 (ind) or $9,000-$20,000 (couples) (3)		
Deductible	$50.00	$53.00
Coinsurance up to Out-of-Pocket Threshold	15%	15%
Maximum Copayments above Out-of-Pocket Threshold		
Generic/Preferred multi-source drug	$2.00	$2.15
Other	$5.00	$5.35
Part D Non-Full Benefit Dual Eligible Partial Subsidy Parameters		
Deductible	$50.00	$53.00
Coinsurance up to Out-of-Pocket Threshold	15%	15%
Maximum Copayments above Out-of-Pocket Threshold		
Generic/Preferred multi-source drug	$2.00	$2.15
Other	$5.00	$5.35
Retiree Drug Subsidy Amounts		
Cost Threshold	$250	$265
Cost Limit	$5,000	$5,350

Data Source: CMS 2007 Part D Parameter Update 5_30_2006.pdf.

Figure B 5 2007-2008 Part D Standard Benefits

Part D Benefit Parameters	2007	2008
Standard Benefit Design Parameters		
Deductible	$265	$275
Initial Coverage Limit	$2,400	$2,510
Out-of-Pocket Threshold	$3,850	$4,050
Total Covered Part D Drug Spend at OOP Threshold (2)	$5,451.25	$5,726.25
Minimum Cost-sharing in Catastrophic Coverage Portion of Benefit		
Generic/Preferred Multi-Source Drug	$2.15	$2.25
Other	$5.35	$5.60
Part D Full Benefit Dual Eligible Parameters		
Copayments for Institutionalized Beneficiaries	$0.00	$0.00
Maximum Copayments for Non-Institutionalized Beneficiaries		
Up to or at 100% FPL		
Up to Out-of-Pocket Threshold (1)		
Generic/Preferred Multi-Source Drug (3)	$1.00	$1.05
Other (3)	$3.10	$3.10
Above Out-of-Pocket Threshold	$0.00	$0.00
Over 100% FPL		
Up to Out-of-Pocket Threshold		
Generic/Preferred Multi-Source Drug	$2.15	$2.25
Other	$5.35	$5.60
Above Out-of Pocket Threshold	$0.00	$0.00
Part D Non-Full Benefit Dual Eligible Full Subsidy Parameters		
Resources ≤ $6,120 (individuals) or ≤ $9,190 (couples) (4)		
Maximum Copayments up to Out-of-Pocket Threshold		
Generic/Preferred Multi-Source Drug	$2.15	$2.25
Other	$5.35	$5.60
Maximum Copayments above Out-of-Pocket Threshold	$0.00	$0.00
Resources bet $6,120-$10,210 (ind) or $9,190-$20,410 (couples) (4)		
Deductible (3)	$53.00	$56.00
Coinsurance up to Out-of-Pocket Threshold	15%	15%
Maximum Copayments above Out-of-Pocket Threshold		
Generic/Preferred Multi-Source Drug	$2.15	$2.25
Other	$5.35	$5.60
Part D Non-Full Benefit Dual Eligible Partial Subsidy Parameters		
Deductible (3)	$53.00	$56.00
Coinsurance up to Out-of-Pocket Threshold	15%	15%
Maximum Copayments above Out-of-Pocket Threshold		
Generic/Preferred Multi-Source Drug	$2.15	$2.25
Other	$5.35	$5.60
Retiree Drug Subsidy Amounts		
Cost Threshold	$265	$275
Cost Limit	$5,350	$5,600

Data Source: CMS PartDannouncement2008.pdf.

Figure B 6 2006 Part D Risk Corridor Reconciliation Amount

2006 Part D Payment Reconciliation

Parent Organization[1]	# of Plans[2]	Reconciliation Amount[3]	Risk Sharing[4]	Reinsurance[5]	Low Income Cost Sharing[6]
TOTALS	3,423	-$4,300,000,000	-$2,700,000,000	-$1,600,000,000	-$37,000,000

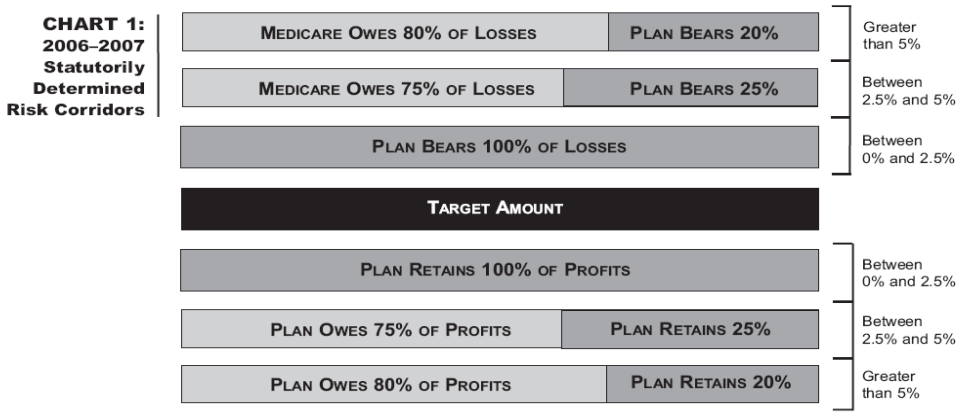
Note: The totals include all MAPDs and PDPs in 2006.
Data Source: CMS 2006_Part_D_Payment_Recon.pdf.

Figure B 7 2007 Part D Risk Corridor Reconciliation Amount

2007 Part D Payment Reconciliation					
Parent Organization[1]	# of Plans[2]	Reconciliation Amount[3]	Risk Sharing[4]	Reinsurance[5]	Low Income Cost Sharing[6]
TOTALS	4,410	-$18,000,000	-$599,000,000	$187,000,000	$407,000,000

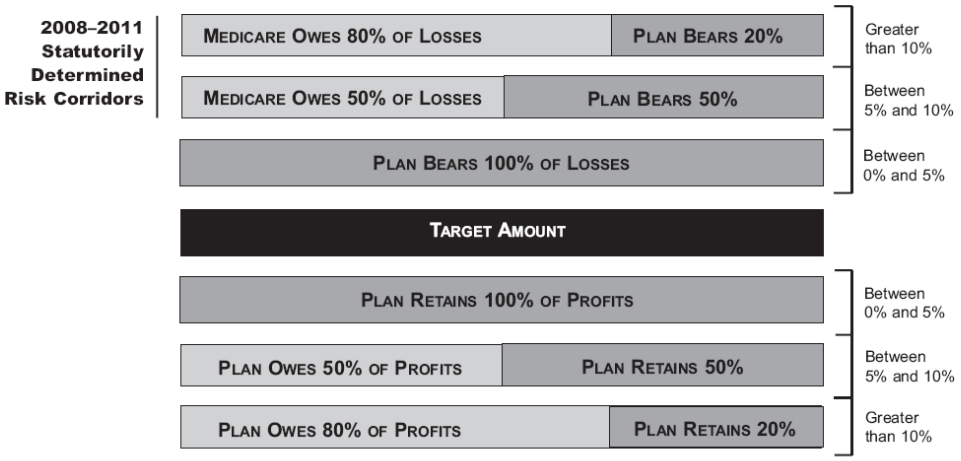
Note: The totals include all MAPDs and PDPs in 2007.
Data Source: CMS Part_D_2007_Reconciliation.pdf.

Figure B 8 2006-2007 Risk Corridors



Data Source: Department of Health and Human Services, Office of Inspector General. "Medicare Part D Sponsors: Estimated Reconciliation Amounts for 2006.

Figure B 9 2008-2011 Risk Corridors



Data Source: Department of Health and Human Services, Office of Inspector General. "Medicare Part D Sponsors: Estimated Reconciliation Amounts for 2006.

About the Author

Rui Dai obtained her undergraduate degree in Japanese Foreign Affairs from China Foreign Affairs University in 1999. After earning her MA in International Relations at Waseda University in Japan in 2001, she entered the PhD program in the Department of Economics at the University of South Florida. Her main area of research is Health Economics.