The Welfare Effects of Public Drug Insurance

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Rewarding inventors with inefficient monopoly power has long been regarded as the price of encouraging innovation. Public prescription drug insurance escapes that trade-off and achieves an elusive goal: lowering static deadweight loss, while simultaneously encouraging dynamic investments in innovation. As a result of this feature, the public provision of drug insurance can be welfare-improving, *even for risk-neutral and purely self-interested consumers*. Even the relatively low benefit levels of the Medicare Part D benefit generate \$3.8 billion of annual static deadweight loss reduction, and at least \$3 billion of annual value from extra innovation. These two components alone cover more than 90% of the social cost of publicly financing the benefit. The analysis of static and dynamic efficiency also has implications for policies complementary to a drug benefit: in the context of public monopsony power, some degree of price-negotiation by the government is always strictly welfare-improving, but this should often be coupled with extensions in patent length.

I Introduction

Patents encourage innovation by awarding inefficient monopoly power to inventors. This leads to the familiar trade-off between inducing innovation, and ensuring efficient utilization of the invented good. Public prescription drug insurance provides a way out of this trade-off. By subsidizing co-insurance for drugs, public insurance encourages utilization by consumers, but without compromising innovators' profits and incentives for research. As such, public insurance can simultaneously promote static and dynamic efficiency, which are often at odds.

The social value of publicly provided drug insurance is typically thought to derive from its insurance value, and the value of care provided to less affluent groups. However, its static and dynamic efficiency effects imply that public drug insurance is valuable to *risk-neutral, self-interested consumers*. This point can be demonstrated theoretically, and the data suggest that it is of considerable quantitative importance. Even though Part D is not a particularly generous insurance plan, its provision to the aged in the US generates an annual value of $3.8 billion in static deadweight loss reduction, and $3 billion in additional innovation. The total value of $6.8 billion is within 10% of middle-of-the-road estimates of the true social cost of publicly insuring the aged.

Taken as a whole, the Part D legislation — like many public prescription drug insurance programs — addresses more than just insurance for prescription drugs. While economic theory suggests that prescription drug insurance is welfare-improving, the auxiliary provisions of the Part D benefit rest on shakier foundations. Two provisions in particular bear on its efficiency effects. First, the original legislation forbade the government from using its newfound buying power to negotiate prices downward. This was motivated by concern that price-negotiation

could lower pharmaceutical profits and dampen innovation incentives. Second, and in stark contrast, the legislation also placed limits on the ability of innovators to "game" the patent system, by acquiring extended patent protection. Many pharmaceutical companies use a variety of strategies to extend monopolies and block the entry of generic competitors; the Medicare Modernization Act placed explicit restrictions on such behavior.

The prohibition on price-negotiation is likely to be welfare-decreasing, even in a dynamic sense.[1] In particular, some degree of price-negotiation is always welfare-improving. The argument is a familiar application of the "second-best" principle. Patents create deadweight loss in the utilization of drugs, but the level of profits is privately optimal. Since it is *initially* costless to distort an efficient margin of decisionmaking, small deviations from the optimal monopoly price have no impacts on profits. In contrast, they strictly lower the degree of deadweight loss. Even in a dynamic sense, therefore, some degree of price-reduction is strictly welfare-improving. Therefore, the recent proposal in Congress to begin price-negotiation may rest on sounder economic footing than the original legislation.

The case for or against "patent-gaming" is not nearly as clear-cut, but there is an important interaction between the two provisions. Somewhat surprisingly, the recent push to negotiate prices actually undercuts the economic case for limiting patent-gaming. The key is the well-known result that the dynamically optimal patent is long, but "narrow," in the sense that it awards a negligibly small per-period profit over an infinitely long period of time (Gilbert and

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[1] While the current Congress has passed legislation that could end up overturning the prohibition on price-negotiation, it remains in place as of this writing. The Medicare Prescription Drug Price Negotiation Act of 2007 (H.R. 4) requires the Secretary of the Department of Health and Human Services to negotiate prescription drug prices for Medicare Part D starting in 2008. This has not yet been signed into law.

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Shapiro, 1990; Klemperer, 1990) . Viewed from this perspective, patent-gaming can be thought of as a *de facto* means of increasing patent length (albeit at some social cost). Since it is welfare-improving to simultaneously lengthen patents and narrow market power, it is similarly welfare-improving to couple longer patents with price-negotiation, which can be used to lower per-period profits and deadweight loss. In the context of a public drug benefit, therefore, it may be optimal to limit prices, but at the same time expand patent protection.

In this paper, we analyze the welfare economics of the Medicare Part D program, with special attention to its provisions for drug insurance, price-negotiation, and patent-gaming. We begin with some relevant background material, and then proceed to develop a simple theoretical model that demonstrates its welfare effects, and those of its auxiliary provisions. We use the model to quantify the welfare effects of drug insurance, as well as price-negotiation, and patent-extension.

II   The Medicare Part D Program

Design and Benefits of Medicare part D

Medicare Part D subsidizes the costs of prescription drugs for Medicare beneficiaries and was introduced by the passage of the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA). Beneficiaries can obtain the Medicare Drug benefit through two types of private plans: beneficiaries can join a Prescription Drug Plan (PDP) for drug coverage only or they can join a Medicare Advantage plan (MA) that covers prescription drugs (MA-PD). Beneficiaries are required to make premium payments to obtain Part D coverage. However, premiums are highly subsidized and Medicare Part D covers roughly 75% of the costs.

Medicare Part D establishes a standard drug benefit that Part D plans may offer. The standard benefit is defined in terms of the benefit structure and not in terms of the drugs that must be covered. In 2007, this standard benefit requires payment of a $265 deductible. The beneficiary then pays 25% of the cost of a covered Part D prescription drug up to an initial coverage limit of $2400. Once the initial coverage limit is reached, the beneficiary is subject to another deductible, commonly as the "Donut Hole," in which they must pay the full cost of drugs. When total out-of-pocket expenses on formulary drugs for the year, including the deductible and initial coinsurance, reach $3850, the beneficiary then reaches catastrophic coverage, in which he or she pays a 5% coinsurance. In practice, Part D plans might deviate from this standard benefit but they must offer coverage that is equivalent or better that the standard benefit in actuarial terms. The law also stipulates that employers sponsoring prescription drug coverage for retirees can receive a federal subsidy if the coverage is at least actuarially equivalent to the standard Medicare drug benefit. Employers would receive a 28% subsidy to their portion of the individual retiree's drug costs between $250 and $5,000. Finally, Medicare Part D also provides more generous insurance and additional subsidies to low income beneficiaries. Currently, dual eligible (eligible for both Medicare and Medicaid) beneficiaries constitute the majority of the beneficiaries receiving low income subsidies as they are automatically enrolled in Part D plans.

Role of Price Negotiations

One of the controversial features of the MMA was it did not allow Medicare to directly negotiate prices with pharmaceutical companies. Many critics regard this as poor stewardship of tax dollars, while those in favor argue that price-negotiation could dampen innovation incentives by lowering pharmaceutical profits. However, this original legislation might be overturned by the

Medicare Prescription Drug Price Negotiation Act of 2007 (H.R. 4). This bill passed by the US

Congress would require the Secretary for Health and Human Services to negotiate directly with

manufacturers to lower covered part D drug prices on behalf of Medicare beneficiaries starting in

2008, reversing the MMA prohibition against the allowing the federal government to negotiate

drug prices.

MMA and Patent Gaming

Patent gaming refers to activities of pharmaceutical companies to extend monopolies and block

entry of cheaper generics in markets for blockbuster drugs near patent expiration. The most

common tactic is to file a lawsuit against a generic competitor for infringement of a patent on the

original product.[2] Under the Drug Price Competition and Patent Term Restoration Act of 1984

(commonly known as the Hatch-Waxman Act) the filing of any lawsuit—no matter how

frivolous—triggers an automatic 30-month delay in the introduction of generics.[3] An FTC study

found that brand name companies sued the first generic entrant and triggered the automatic 30-

month extension for 72% of the drugs analyzed in the study. The study also found that for cases

resolved in the courts generic entrants prevailed in 73% of the time (FTC, 2002). The MMA

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[2] Another tactic is to file multiple patents with the FDA after a potential generic entrant applies for FDA approval, and then to sue the new entrant for the infringement of these later patents. Such lawsuits have triggered multiple but staggered 30-month delays. For example, the manufacturers of Paxil, a blockbuster antidepressant, received 5 staggered 30-month extensions delaying the approval of generics by 65 months.   Still other tactics include the conduct of clinical trials in children, for which the Hatch-Waxman act guarantees six months of market exclusivity, or introducing new versions of a patented product that differ only in dosage, appearance or indications for use. For example, Eli Lilly (the manufacturer of the antidepressant Prozac), introduced Sarafem, a new drug chemically identical to Prozac but colored pink and lavender instead of green. Sarafem got more than 2 years of market exclusivity, because it was approved for treating premenstrual depression, anxiety and irritability (whereas Prozac was approved for major depression), and an additional 6 months extension because it was tested in clinical trials for children (Angell 2004).

[3] Drug Price Competition and Patent Term Restoration Act of 1984, Pub. L. No. 98-417, 98 Stat. 1585 (codified at 21 U.S.C. § 355 (1994) and 35 U.S.C. § 271(d)-(h) (1994)) ("Hatch-Waxman Act").

imposed limits on patent gaming by stipulating that brand name companies could not get more than one 30 month extension for lawsuits filed against generic entrants. The law also allows the generic applicant to assert a counterclaim to de-list a patent related to brand name drug further restricting the ability of branded companies to game patents.

III The Welfare Effects of Stand-Alone Public Drug Insurance

We begin by analyzing the welfare effects of stand-along public prescription drug insurance. Specifically, we consider the effects of providing insurance, without introducing price-negotiation, new regulations on patent protection, or any additional subsidies to the private insurance market. This analysis distills the key welfare effects of drug insurance alone, without the reinforcing or mitigating effects introduced by its auxiliary provisions. It demonstrates one of the unique features of prescription drug insurance: its potential to lower deadweight loss and raise monopoly profits, simultaneously. It can achieve this outcome by partially decoupling the consumer's price from the revenue earned by the monopolist.

Static Implications

The provision of drug insurance can reduce deadweight loss, because copayments below the monopoly price increase utilization by consumers. Deadweight loss from monopoly can be written as net consumer surplus under competition, minus net surplus under monopoly. Define $D(p)$ as the demand function, $P(Q)$ as inverse demand, MC as the constant marginal cost of

production, and p_m as the equilibrium monopoly price. The social surplus generated by competitive provision of the good is given by:

$$SS_c \equiv \left(\int_0^{D(MC)} P(Q)dQ - MC * D(MC) \right) \qquad (1)$$

In the absence of insurance, deadweight loss in the branded pharmaceutical market has the standard definition:

$$DWL \equiv SS_c - \left(\int_0^{D(p_m)} P(Q)dQ - MC * D(p_m) \right) \qquad (2)$$

Now suppose that the government offers prescription drug insurance. Specifically, suppose the government covers the share $(1 - \sigma)$ of the market price, and leaves the consumer with the co-insurance rate σ. If the government continues to pay the monopoly price for pharmaceuticals, the actuarial cost of the insurance is $p_m(1 - \sigma)D(\sigma p_m)$. Since this cost is simply a transfer from the government to the pharmaceutical industry, it has no direct impact on welfare. The welfare effects emerge from the change in quantity induced by this policy.

Of course, the government need not pay the price p_m. It could use some of its bargaining power to lower the price paid to the monopolist to some value $p_g < p_m$. Deadweight loss is a function of what the government pays monopolists, and offers consumers in terms of co-insurance. This relationship can be expressed as:

$$DWL(p_g, \sigma) \equiv \left(\int_0^{D(MC)} P(Q)dQ - MC * D(MC) \right) - \left(\int_0^{D(\sigma p_g)} P(Q)dQ - MC * D(\sigma p_g) \right) (3)$$

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Observe that the effects of σ and p_g are symmetric. Ultimately, what matters for deadweight loss is simply σp_g, the price faced by consumers. The welfare effect of lowering the consumer price — either by lowering the co-insurance or by lowering the price paid to monopolists — is given by:

$$-\frac{dDWL}{d\sigma p_g}\big|_{p_g,\sigma} = D'(\sigma p_g)(\sigma p_g - MC) \tag{4}$$

From a static point of view, lowering the price paid by consumers always lowers deadweight loss, as long as $\sigma p_g > MC$, or that consumers continue to face a price that is at least as large as marginal cost.

Dynamic Implications

The original intent of Medicare Part D was to provide drug insurance without affecting prices paid to innovators. Earlier, we showed that drug insurance improves static welfare by lowering deadweight loss. We now show that this original aspect of Part D both induces more innovation and raises expected social surplus.

Let I denote industry investment in research, and let $g(I)$ denote the probability of discovery with $g'(I) > 0$ and $g''(I) < 0$. In other words, investing in R&D is costly but it increases the probability of discovery of the new drug at a decreasing rate. Suppose the patent authority offers a patent of length T for a new drug – the innovator will enjoy monopoly profits for T periods after the discovery and will make zero profits for rest of the product life. If the firm discounts the future at the rate r, it invests in research in order to maximize the present value of expected profits:

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$$\Pi(I) = g(I)\left[\int_0^T e^{-rt}\pi(\sigma, p_m)dt\right] - I \qquad (5)$$

By the envelope theorem, stand-alone drug insurance raises the expected profits of innovators, because $\frac{d\pi}{d\sigma} < 0$. It will also induce more innovation. The optimal level of innovation is given by:

$$g'(I) = \frac{1}{\left[\int_0^T e^{-rt}\pi(\sigma, p_m)dt\right]} \equiv \frac{1}{\Pi^m(\sigma, p_m, T)} \qquad (6)$$

The marginal product of research is the reciprocal of monopoly profits, Π^m and, by extension, of patent length (Nordhaus, 1969). Define $I_{pat}(\Pi^m)$ as the level of investment induced by monopoly profits Π^m. Expected social surplus can then be written as:

$$S(T, p_m, \sigma) \equiv g(I_{pat}(\Pi^m))\left[\int_0^\infty e^{-rt}SS_c dt - \int_0^T e^{-rt}DWL(\sigma p_m)dt\right] - I_{pat}(\Pi^m) \qquad (7)$$

The marginal value of introducing stand-alone drug insurance is given by:

$$S_\sigma\,|_{\sigma=1} = I_\pi\Pi_\sigma^m\left\{g'(I)\left[\int_0^\infty e^{-rt}SS_c dt - \int_0^T e^{-rt}DWL(p_m)dt\right] - 1\right\} + g\left[-\int_0^T e^{-rt}DWL'(p_m)p_m dt\right] < 0$$

$$(8)$$

The term in curly braces is strictly greater than unity, because total social surplus from the innovation must be strictly larger than the innovator's profits. Therefore, the first term is negative. The second term is negative, because $p_m > MC$, implying that deadweight loss will rise with a higher co-insurance rate σ.

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Notice that stand-alone drug insurance is strictly welfare-improving, so long as the profits of innovators do not exceed social surplus. Clearly, this condition always holds in a completely private market, even one afflicted by moral hazard in insurance provision (Lakdawalla and Sood, 2006). Intuitively, consumers would never voluntarily pay more than their consumer surplus for a drug in a spot market, and they would never pay more for an insurance policy than the expected value of its covered treatments. Public subsidies for employer-provided health insurance make it theoretically possible that profits could exceed social surplus, although this would require extremely large transfers. It is even less likely among the elderly population, where prescription drug insurance was relatively uncommon.[4]

It is possible that a co-insurance regime could achieve first-best innovation and utilization, but this would be a fairly special case. More generally, the optimal co-insurance rate has to generate either a negative marginal value of investment, or a negative marginal value of deadweight loss-reduction. In other words, either utilization or investment will exceed first-best. Later, we demonstrate how outcomes can be improved if the government has access to price-negotiation, and/or patent length instruments.

Public Financing and Deadweight Cost

In the analysis above, we abstracted from the costs of public-financing. When the government has access to an efficient lump-sum tax mechanism, it does not matter whether insurance is publicly or privately financed. Clearly, the deadweight costs of public financing play a

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[4] As of 2003, 60% of the aged (65+) population had no drug insurance, or insurance that was less generous on average than the standard Part D benefit.

substantial role in the optimal policy configuration. However, in this section, we show that they do not change the basic conclusion that some public financing of drug insurance is welfare-improving —they merely change the optimal *level* of financing. When deadweight costs of taxation rise, the optimal degree of public financing falls, but some public subsidy for drug insurance is always optimal, because of its value as a deadweight-loss reduction device.

Paying more money out of the public treasury, as opposed to private pockets, incurs social cost. This has two effects. First, providing insurance to the uninsured becomes less beneficial, on balance. Second, it now becomes strictly costly to attract the currently insured to a public plan with the same co-insurance rate. Public subsidies for insurance premia represent a pure transfer to such people; with deadweight costs of public money, this transfer imposes net costs on society.

In spite of these costs, some degree of subsidization remains optimal. Intuitively, providing a small subsidy to the uninsured always provides some positive benefit, because of the reduction in deadweight loss. Moreover, the cost of attracting currently insured consumers to a less generous public plan is initially zero, because in an unsubsidized equilibrium, they strictly prefer their private plans.

This intuition can be seen most easily by calculating the optimal degree of subsidy, given a public co-insurance rate σ and a private co-insurance rate σ_p. Specifically, suppose that there are $\bar{N}$ initially uninsured consumers, and $\bar{I}$ privately insured consumers. Without loss of generality, we assume that the insured consumers are all identical, and all have policies with co-insurance rate σ_p.

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Define s as the share of the consumer's premium that is publicly financed. Define $N(s)$ as the number of uninsured consumers choosing the public drug plan at the premium subsidy s, and define $I(s)$ as the number of insured consumers doing the same.[5] The social marginal cost of public funds is μ: for example, if raising \$1 of revenue introduces \$0.50 of deadweight loss, we say that $\mu = 0.5$. Finally, $D(p)$ as per person demand at the price p. We assume this is uniform across people, but relaxing this assumption leaves the analysis unchanged. The social cost of a publicly financed drug benefit offering co-insurance rate σ is thus:

$$DWC = s\mu D(\sigma p_m)(1-\sigma)p_m[N(s)+I(s)] \tag{9}$$

The total reduction in deadweight loss for all consumers is given by:

$$N(s)\int_{D(p_m)}^{D(\sigma p_m)} P(q)dq + I(s)\int_{D(\sigma_p p_m)}^{D(\sigma p_m)} P(q)dq \tag{10}$$

The optimal degree of public financing maximizes deadweight loss reduction, net of social cost, according to:

$$\max_s \left\{ N(s)\int_{D(p_m)}^{D(\sigma p_m)} P(q)dq + I(s)\int_{D(\sigma_p p_m)}^{D(\sigma p_m)} P(q)dq \right\} - s\mu D(\sigma p_m)(1-\sigma)p_m[N(s)+I(s)] \tag{11}$$

The first-order condition can be written as:

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[5] Both I and N also depend on the co-insurance rates σ and σ_p, but since we regard these as fixed, we do not explicitly consider them.

$$N_s \int_{D(p_m)}^{D(\sigma p_m)} P(q)dq + I_s \int_{D(\sigma_p p_m)}^{D(\sigma p_m)} P(q)dq - s\mu D(\sigma p_m)(1-\sigma)p_m\left[N_s + I_s\right] - \mu D(\sigma p_m)(1-\sigma)p_m\left[N + I\right] \leq 0$$

$$(12)$$

To show that the optimal value of s exceeds zero, it suffices to show that the marginal return to s is strictly positive when $s = 0$. Without subsidies, neither insured nor uninsured consumers will choose the public drug benefit; otherwise, they would have chosen such an insurance policy in the private market. Therefore, evaluated at zero, the marginal return to public financing is given by:

$$N_s \int_{D(p_m)}^{D(\sigma p_m)} P(q)dq + I_s \int_{D(\sigma_p p_m)}^{D(\sigma p_m)} P(q)dq \qquad (13)$$

If $MC < \sigma \leq \sigma_p$, both terms are strictly positive. If $\sigma > \sigma_p$, the first term is strictly positive, and the second term is zero. To see this, observe that $I_s(0) = 0$. This is because there is some $s^* > 0$ such that insured consumers are exactly indifferent between the public and private plans: it requires some positive subsidy to compensate the insured consumers for their partial loss of coverage. Therefore, $I(s) = 0$, for all $s \leq s^*$; this implies that $I_s(0) = 0$.

Two other points follow from the first-order condition for public financing. Not surprisingly, the optimal degree of public financing is lower when the marginal cost of public funds μ is higher. In addition, the degree of public financing is *higher* when the deadweight loss from monopoly is higher. In markets without monopoly (i.e., where $p_m = MC$), there are no static grounds for the public financing of health insurance. Arguments would need to be made on the conventional bases of insurance value, altruism, or merit goods.

IV   A Calibrated Example

In this section, we calculate—in a "back-of-the-envelope" fashion – the welfare impacts of Medicare Part D. We consider both the static and dynamic benefits of increased drug consumption and the associated increase in pharmaceutical innovation induced by Medicare Part D. We also estimate the social costs of financing this benefit due to deadweight loss from increased taxation. We exclude dual eligibles from the analysis as they already receive generous public prescription drug insurance from Medicaid. The introduction of Medicare Part D does not substantially change the generosity of insurance for dual eligibles; all it does is transfer insurance from Medicaid to Medicare Part D.

Prescription Drug Coverage Among Medicare Beneficiaries

The first step in estimating the benefits of Medicare Part D is to estimate who is enrolled in Medicare Part D and who is covered by employer insurance and thus eligible for the employer subsidy. We used data from the 2003 Medical Expenditure Panel Survey (MEPS) to estimate the above quantities.

First, we used the data to estimate the number of respondents eligible for Medicare Part D, that is, those who are already covered by Medicare or those who are 65 years or older. Using the MEPS sampling weights we estimate that, excluding dual eligibles, 36 million beneficiaries would be eligible for Medicare Part D. Next, for each MEPS respondent we then calculate the average coinsurance for prescription drugs under 2 scenarios: (1) status quo, (2) enrollment in a plan with the features of the standard Medicare Part D benefit described earlier. Based on this analysis we classify respondents into 2 groups those who have "No creditable coverage" and those with "Creditable" coverage. Respondents with no creditable coverage have higher average

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coinsurance under status quo and are assumed to enroll in Medicare Part D. We estimate that

59% or roughly 21 million beneficiaries would enroll in Part D. The remaining 15 million

already have more generous insurance compared to the standard Part D benefit and are thus

unlikely to enroll in Part D. Based on information about the source of coverage in MEPS we

estimate that roughly 26% of beneficiaries have creditable insurance from employer/union and

would thus receive the employer subsidy instituted by Medicare part D. Finally, 14% of

beneficiaries have creditable insurance from other sources such as Veterans Administration,

Indian Health Service and state pharmaceutical assistance programs.

Our enrollment estimates are fairly close to actual enrollment rates reported by the Department

of Health and Human Services (HHS). Both HHS estimates and our estimates from MEPS are

reported in Table 1. Similar to our estimates, the HHS estimates show that as January, 2007,

excluding dual eligibles, 36 million beneficiaries were eligible for Medicare Part D. Of these 21

million were estimated to have no creditable coverage prior to Part D[6]. The remaining 15

million had creditable coverage from employer/union or from other sources such as Veterans

Administration, Indian Health Service and state pharmaceutical assistance programs.

Table 1: Prescription Drug Coverage Sources Among Medicare Beneficiaries

	HHS Estimates		MEPS Estimates	
	Population	**Percent**	**Population**	**Percent**
Coverage Type				
Enrolled/No creditable Coverage	21	59%	21	59%
Creditable Employer Coverage	10	28%	9	26%
Others with Creditable Coverage	5	13%	5	14%
Total	36	100%	36	100%

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[6] Of the 21 million beneficiaries, 17 million enrolled in Part D and the remaining 4 million continued to have no creditable coverage.

Static Benefits

Using a linear approximation to demand, the static benefit associated with a particular change in price and quantity is simply the size of deadweight loss reduction "triangle," or $\frac{1}{2}(-\Delta p)(\Delta q)$ — one half times the reduction in price, times the increase in quantity. Some simple algebra yields that the static benefit of Medicare part D for a consumer who enrolls in a Part D plan is simply:

$$SB = \frac{1}{2}\left[\frac{(\sigma_{ND} - \sigma_D)}{\sigma_{ND}}\right]\left[\frac{(\sigma_{ND} - \sigma_D)}{\sigma_{ND}} e\right]OOP_{ND} \tag{14}$$

Where, σ_D and σ_{ND} are the average share of price paid by the consumer when enrolled in Part D and when not enrolled in part D (status quo) respectively. OOP_{ND} is the out of pocket prescription drug expenditure of the consumer under the status quo and e is the elasticity of demand. Thus, the above equation shows that to calculate the static welfare impact of Medicare Part D we need empirical estimates of: (1) The percentage change in price to the consumer induced by Medicare Part D, (2) the elasticity of demand for prescription drugs, and (3) the out of pocket costs of purchasing prescription drugs.

With this structure, we can estimate all of the above quantities for each MEPS respondent with no creditable coverage by using the policy parameters of the standard Medicare Part D benefit, data on cost sharing and prescription drug costs from MEPS and available estimates from the literature.

Percentage Change in Price

We calculate the percentage price change that consumers would enjoy if they took up the program by estimating average coinsurance for each elderly consumer in MEPS under 2 scenarios: (1) status quo, (2) enrollment in a plan with the features of the standard Medicare Part D benefit described earlier. We thus calculate the percentage change in price that would be enjoyed by each MEPS respondent with no creditable coverage, in the event they took up Part D. Respondents with creditable coverage are assumed not to enroll in Part D and thus experience no change in price of prescription drugs.

Price Elasticity of Demand

Long-run generic prices (assumed to be equal to marginal cost) are approximately 20% of the prices charged for the corresponding on-patent drug (Lakdawalla, Philipson, and Wang, 2006). Thus we assume that the mark-up on pharmaceutical prices is roughly 80%. The standard theory of monopoly would then imply, based on a 80% mark-up by monopolists, a price elasticity of uninsured demand around 1.25, or the inverse of the markup.

Out-of-Pocket Costs

The out of pockets costs of purchasing drugs are available directly from MEPS.

Results

Based on these estimates, we estimate that the aggregate static benefit of Medicare Part D to be $3.8 billion or $106 per eligible beneficiary. There is wide variation in the per capita benefit enjoyed by beneficiaries depending on insurance coverage, or lack thereof, prior to the introduction of Medicare Part D. For example, we assume that those with creditable insurance coverage prior to Part D will not enroll in Part D plans and thus enjoy no static benefits. Since

insurance coverage in this population is highly correlated with income, the poor enjoy greater

benefits than the rich. For example, we estimate the per capita benefit to be $122 for those with

incomes less than $15,000 per year, $102 for those with income between 15,000 and 50,000, and

$49 for those with incomes greater than $50,000. Similarly, beneficiaries in poor health and

those with higher prescription drug costs will also enjoy greater benefits. This is confirmed by

estimates of per capita benefits with respect to self reported health status. Those in poor health

enjoy per capita benefit of $207, those in good health enjoy per capita benefit of $116 and those

in excellent health only receive $53 in per capita benefits.

Dynamic Benefits

Since Medicare Part D likely increases pharmaceutical company profits, it has the dynamic

benefit of inducing additional innovation. We can estimate the value of this induced innovation

just as we estimated the static value of the program. First, we maintain the assumption (inherent

in the original MMA legislation) that Part D continues to forbid price-negotiation, and that

pharmaceutical firms will continue to receive the monopoly prices set before Medicare Part D

(p_m). However, firms do experience an increase in demand for their products due to the

reduction in price for consumers after the introduction of Medicare Part D.

Step 1: Change in Pharmaceutical Revenues

For a given consumer, the percentage change in total drug expenditures is equal to the percentage

increase in the quantity of drugs consumed, $\dfrac{(\sigma_{ND} - \sigma_D)}{\sigma_{ND}}e$. This then yields the percentage

change in revenues received by the innovator. As discussed above, the quantity $\frac{(\sigma_{ND} - \sigma_D)}{\sigma_{ND}} e$

can be calculated from the MEPS and the existing literature.

Step 2: Creation of New Chemical Entities

The increase in pharmaceutical revenue will induce more R&D and innovation. The number of

new drug introductions induced by Part D will depend on the elasticity of new drug introductions

with respect to pharmaceutical revenues. Acemoglu and Linn (2004) estimate that the elasticity

of non-generic drug approvals with respect to revenues is roughly 3.5. We use this elasticity and

the estimate of change in pharmaceutical revenues to calculate the number of additional number

of new drugs or new chemical entities (NCEs) introduced each year as a function of Medicare

Part D take-up rate. The baseline rate of NCE introduction is assumed to be 32 NCEs per year.

This is the average number of NCEs introduced per year during the period 1995 to 2004 as

reported in the FDA Orange Book.

Step 3: Innovator's Private Value of New Chemical Entities

The next step is to compute the annual private value of these additional drugs to their innovators.

Theory suggests that the expected marginal private value of an additional drug is equal to the

marginal cost of bringing it to market.[7]   Di Masi et al. (2003) estimate that the marginal

research and development cost of bringing an NCE to market is $939 million (year 2006 dollars).

To annualize this cost, we use a standard estimate of the annual cost of capital in the

pharmaceutical industry, of 12% per year. This estimate is based on the empirical cost of capital

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[7] Grabowski et al (2002) provide empirical evidence that the theory is consistent with the data in the pharmaceutical
industry.

faced by pharmaceutical firms.[8] Therefore, the annual private value of an additional drug is expected to be (0.12)*($939m) = $113 million.

Step 4: Marginal Social Value of New Chemical Entities

The last step is to infer the marginal social value, which theory predicts will exceed the private value to the innovator. To estimate the social return, we need estimates of the fraction social surplus from innovation that is captured by the innovator. Several estimates are available from the literature. For example, Nordhaus (2004) analyzes data from 1948 to 2001 and estimates that a mere 2.2% of the total present value of social returns to innovation are captured by innovators. More recently, Philipson and Jena (2006) use data from over 200 published studies of healthcare innovations to estimate the distribution of the fraction of social surplus captured by the innovator. They find that the median producer share of social surplus is 17%, the first quartile is roughly 10% and the third quartile is roughly 25%. To be conservative, we assume that innovators are able to capture as much as a quarter of the social surplus from pharmaceutical innovation which corresponds to a social rate of return (private return/fraction captured by innovator) on pharmaceutical R&D investments of 48% per year. This suggests that the annual social value of the marginal drug is equal to ($113 million)/(0.25) = $452 million.

Gross Benefit of Part D

Using the methods described in step 1 we estimate that Medicare Part D would increase pharmaceutical sales by 16.4 billion dollars per year. Given pharmaceutical sales of $275 billion

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[8] Latest estimates of the cost of capital by industry are available online at http://pages.stern.nyu.edu/~adamodar/. Based on these data we estimate the cost of capital for the pharmaceutical industry to be 12% per year. This estimate of cost of capital is similar to estimates of private rate of return on R&D investments in the pharmaceutical industry (Grabowski, Vernon, and DiMasi, 2002).

in the US, this corresponds to a 6.0% increase in pharmaceutical sales. The innovation elasticity

estimates from Acemoglu and Linn (2004) imply that number of new drugs per year would

increase by roughly 21% or 6.7 NCEs per year. Earlier, we calculated an annual social value of

$452 million for the marginal drug, which yields a gross dynamic benefit of $3 billion annually.

Combining the dynamic with the static benefit yields the gross risk-neutral welfare benefit of

Medicare Part D of $6.8 billion annually.

Deadweight Costs of Financing Medicare Part D

It remains to compare the aggregate benefits of Part D with its social cost. The program itself is

just a costless transfer. However, since it is publicly financed, there is the usual deadweight

costs associated with its financing.

The per capita actuarial cost of the Medicare Part D insurance for those who enroll in Part D

plans is simply:

$$p_m(1-\sigma_D)Q_{ND} + (1-\sigma_D)p_m(Q_D - Q_{ND}) \tag{15}$$

The first term is the actuarial cost of the benefit under the initial demand for pharmaceutical and

the second term is the actuarial cost for additional demand induced by Medicare Part D. As

discussed earlier all the above quantities can be easily estimated from available data. Using data

from MEPS, we can calculate the price-change consumers would enjoy if they took up the

program; price-elasticities of demand for pharmaceuticals (taken from the literature) then imply

the associated increase in quantity. As discussed earlier, Medicare Part D pays 75% of the

actuarial cost of the benefit. Similarly, the costs of providing the employer subsidy (28% of costs

between $250 and $5000) can be estimated easily using data on prescription drug expenditures

for those with creditable employer/union provided insurance. The results show that for those

receiving the premium subsidy, Medicare costs are $922 per enrollee and for those receiving the

employer subsidy, Medicare costs are $584 per enrollee. These estimates are similar to those

obtained by HHS. For example, the average premium for a Part D plan was roughly $27 per

month or $327 per year. Since Medicare subsidizes premiums by 75%, Medicare costs of

providing the premium subsidy equal $985 ($327*3) per year. Similarly, HHS estimates indicate

that the cost of employer subsidy was $549 per beneficiary receiving the subsidy (KFF, 2007).

The true social cost of the program is the deadweight cost associated with paying the actuarial

cost out of public funds. While there is a great deal of controversy in the public finance

literature on the magnitude of deadweight loss, we use a conventional estimate — that each

additional dollar spent on Medicare Part D generates 30 cents of deadweight costs due to

increased taxation (cf, Jorgenson and Yun, 2001).[9]

Based on these estimates, we estimate the deadweight costs of financing Medicare Part D to be

$7.4 billion per year, 90% of which is covered by the risk-neutral benefits of the program. This

analysis reveals that conventional estimates of demand, dynamic benefit, and deadweight loss

yield the surprising result that Part D insurance is nearly "break-even" for a society of risk-

neutral and self-interested consumers.

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[9] Different authors have suggested that the number could be as high as $1 of deadweight loss for each $1 of public
spending (cf, Feldstein, 1999).

V   Drug Insurance and the Rewards for Innovation

The government has at its disposal more instruments than just the co-insurance rate. It can use its bargaining power to influence prices paid to innovators, and it can increase or decrease de facto patent length by regulating patent-gaming. We show that using all these instruments can in theory allow the government to achieve first-best utilization and innovation. Of course, there may be significant informational political constraints to pursuing the first-best policy. Therefore, we go on to show that it is always strictly welfare-improving to negotiate prices down, and we derive the conditions under which the government should tighten or loosen patent enforcement.

The First-Best Benchmark

Suppose the government can now set a co-insurance rate, a price paid to innovators, and patent length. The government is not perfectly free to dictate terms to innovators. Define Π^R as the minimum profits innovators will accept. The government now solves:

$$\max_{T, p_g, \sigma} g(I_{pat}(\Pi^m)) \left[\int_0^\infty e^{-rt} SS_c dt - \int_0^T e^{-rt} DWL(\sigma p_g) dt \right] - I_{pat}(\Pi^m) \tag{16}$$
$$s.t. \Pi^m \geq \Pi^R$$

This has the first-order conditions:

$$I_\pi \Pi_T^m \left(g'(I) \left[\int_0^\infty e^{-rt} SS_c dt - \int_0^T e^{-rt} DWL(\sigma p_g) dt \right] - 1 \right) - g(I) e^{-rT} DWL(\sigma p_g) + \lambda \Pi_T^m = 0$$

$$I_\pi \Pi_p^m \left(g'(I) \left[\int_0^\infty e^{-rt} SS_c dt - \int_0^T e^{-rt} DWL(\sigma p_g) dt \right] - 1 \right) - g(I) \int_0^T e^{-rt} dt DWL'(\sigma p_g) \sigma + \lambda \Pi_p^m = 0$$

$$I_\pi \Pi_\sigma^m \left(g'(I) \left[\int_0^\infty e^{-rt} SS_c dt - \int_0^T e^{-rt} DWL(\sigma p_g) dt \right] - 1 \right) - g(I) \int_0^T e^{-rt} dt DWL'(\sigma p_g) p_g + \lambda \Pi_\sigma^m = 0$$

If the government knows all the parameters of the problem, and can freely adjust its policy instruments, it can always achieve the first-best outcome. Given the usual result that first-best innovation requires profits equal to total social surplus, the family of first-best policy solutions would satisfy:

$$\sigma p_g = MC$$
$$D(\sigma p_g)(p_g - MC)\left(1 - e^{-rT}\right) = SS_c$$

The first condition guarantees efficient utilization in the goods market. The second ensures that the innovator earns the total social value of his invention. Under these conditions, deadweight loss is zero, and $g'(I)\left[\int_0^\infty e^{-rt} SS_c dt - \int_0^T e^{-rt} DWL(\sigma p_g) dt\right] = 1$.

If the first-best is achieved, the constraint on price-negotiation would fail to bind, since profits would be higher than monopoly profits. As such, we can solve for the optimal policy configurations using the two equations above:

$$\sigma = \frac{D(MC)MC}{\dfrac{SS_c}{1 - e^{-rT}} + D(MC)MC} \tag{17}$$

$$p_g = \frac{SS_c}{(1 - e^{-rT})D(MC)} + MC$$

Notice that, for any nonzero value of T, this yields a co-insurance rate strictly between zero and one, a strictly positive price, and positive profits.

Clearly, identifying the first-best policy parameters is much more complex in a world with many drugs and heterogeneous consumers. Nonetheless, the first-best configuration provides us with

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intuition about how to achieve welfare improvements. The aim is to reduce deadweight loss without paying too high a price in terms of foregone innovation.

Price-Negotiation

Provided that consumers face prices above marginal cost, some degree of price-negotiation is always welfare-improving. At the monopoly price, the marginal return to price-reduction is always positive:

$$I_\pi \Pi_p^m \left(g'(I) \left[\int_0^\infty e^{-rt} SS_c dt - \int_0^T e^{-rt} DWL(\sigma p_m) dt \right] - 1 \right) - g(I) \int_0^T e^{-rt} dt DWL'(\sigma p_m) \sigma + \lambda \Pi_p^m \quad (18)$$

At the privately optimal monopoly price,[10] profits are maximized, and the envelope theorem implies that $\Pi_p^m = 0$. Therefore, the value of an initial price-reduction is given by:

$$g(I) \int e^{-rt} dt DWL'(\sigma p_m) \sigma \quad (19)$$

Since deadweight loss is minimized when the consumer faces a price equal to marginal cost, the marginal return to price-reduction is positive if and only if $\sigma p_m > MC$.

The usual intuition of the second-best applies here. There are two interconnected margins of decisionmaking: profits, and utilization. It is not optimal to leave the margin of profits undistorted, while leaving utilization distorted. Therefore, a government that has the leverage to lower prices ought to do so, at least to some degree.

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[10] This applies to the optimal price that obtains under any co-insurance and patent regime.

Note, however, that this does not justify an unlimited amount of price-negotiation. Inframarginal reductions in the price will tend to be costly, because they lower profits, innovation, and expected surplus. In addition, the returns to price-negotiation — and thus the optimal degree of price-negotiation — may fall with the generosity of the drug benefit, because it lowers deadweight loss, and increases the cost in terms of foregone profits.

Patent Gaming and Patent Length

Finally, drug insurance affects the social return to patent protection:

$$I_{\pi}\Pi_T^m\left(g'(I)\left[\int_0^{\infty}e^{-rt}SS_c dt - \int_0^T e^{-rt}DWL(\sigma p_g)dt\right]-1\right)-g(I)e^{-rT}DWL(\sigma p_g)+\lambda\Pi_T^m \quad (20)$$

The drug benefit has two competing effects on this expression: it raises profits and innovation, which lower the marginal benefit of patent extension, but it also lowers deadweight loss, which decreases the marginal cost of patent extension. In general, therefore, the introduction of drug insurance has uncertain effects on the optimal patent length.

However, observe that aggressive price-controls are actually complementary with more generous patent-extension policies. If price-negotiation eliminates the positive impact of drug insurance on profits, it should be coupled with longer patents. While some price-negotiation is always optimal, it is not clear that it ought to be this aggressive. Nonetheless, one possible optimal policy configuration turns out to be: public drug insurance, price-negotiation, and longer patents.

VI Conclusion

It is conceivable that, from an economic point of view, Part D would pay for itself, even if it provided no insurance, and no redistributive purpose. This is a rather surprising result, considering that the program itself was designed to provide insurance, and provide therapy to poorer groups. In the design of the benefit, a great deal of attention was paid to traditional "insurance" issues of adverse selection and moral hazard, but less effort was devoted to understanding the risk-neutral efficiency effects on utilization and innovation. Our analysis suggests that the pure efficiency effects are important.

Our analysis also reveals some surprising conclusions about the auxiliary provisions of Part D. First, the original legislation prohibited the government from negotiating prices. We showed that this prohibition is inefficient. In fact, some degree of price-negotiation is strictly welfare-improving. Banning price-negotiation may be useful if the regulator is unable to commit to an optimal degree of negotiation, but instead seeks low prices at any cost. However, even in this case, legislative limits on price-negotiation would make more sense than a legislative prohibition.

Second, price-negotiation is often thought of as being a complement to limits on patent-gaming. Both are thought to be means of curtailing "excessive" pharmaceutical profits generated by the new drug benefit. Surprisingly, however, the two legislative approaches are more substitutable than complementary. By lowering profits, price-negotiation actually lowers the cost of patent-extension, and thus *lowers* the return to limits on patent-gaming. When patent monopolies earn fewer per-period rents, longer patents become cheaper means of encouraging innovation.

Therefore, price-negotiation — if it succeeds politically — should likely be coupled with more tolerance for patent-gaming and other forms of de facto patent-extension activity by innovators.

The economic case for the Part D benefit, and its auxiliary provisions, is quite a bit different than it may initially appear. The public provision of drug insurance can have significant efficiency benefits, as can some degree of price-negotiation.

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