Did Medicare Induce Pharmaceutical Innovation?

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The introduction of Medicare in 1965 was the single largest change in health insurance coverage in U.S. history. Providing nearly universal public health insurance coverage for the elderly, it is currently one of the largest health insurance programs in the world. Its introduction had dramatic effects on health insurance coverage and health care utilization for the elderly (Benjamin Cook et al., 2005; Finkelstein, 2005).

Since the introduction of Medicare, there has also been dramatic progress in the development of new pharmaceuticals. For example, Cutler and Srikanth Kadiyala (2003) estimate that the development of new pharmaceuticals was responsible for about one-third of the pronounced decline in cardiovascular disease mortality over the last half-century. Many economists have conjectured that Medicare provided part of the impetus for the development of new drugs, especially those most commonly used by the elderly (e.g., Cutler, 2004 and Frank Lichtenberg, 2004). There has been little systematic analysis of this hypothesis, however.

An impact of Medicare on pharmaceutical innovation would be consistent with recent empirical evidence of induced innovation in pharmaceuticals more generally. Acemoglu and Linn (2004) and Finkelstein (2004), for example, find that increases in expected demand for certain types of pharmaceuticals are associated with increases in clinical trials and Food and Drug Administration (FDA) approvals for these products.

For Medicare to induce innovation in new pharmaceuticals, a necessary (but not sufficient) condition is for it to have increased the demand for prescription drugs among the elderly. Although prior to 2006 Medicare did not cover prescription drugs, it may have indirectly increased demand for prescription drugs since it covered physician care, which may be highly complementary with prescription drug use. In addition, any increase in pharmaceutical demand among the elderly caused by Medicare would have to be large enough to induce technological change in this sector.

In this paper, we investigate the effect of Medicare on the development of new pharmaceuticals for the elderly. Our strategy follows the logical steps laid out in the previous paragraph.

Our reading of the evidence is that there is no compelling case that Medicare induced significant pharmaceutical innovation. We find no evidence that the introduction of Medicare is associated with an increase in drug consumption among the elderly. Consistent with this, we also find no evidence of an increase in the approval of new drugs more likely to treat diseases that affect the elderly, after Medicare's introduction.

I. The Impact of Medicare on Drug Spending

To investigate the impact of Medicare on demand for pharmaceuticals, we compare changes in drug spending for those aged 55 to 64 (interpreted as the control group not covered by Medicare and referred to as the "nonelderly") to changes in drug spending for elderly individuals between the ages of 65 and 74.[1] The 1963 and 1970 Surveys of Health Service Utilization and Expenditures and their follow-up versions, the 1977 and 1987 National Medical Expenditure

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[1] Results are similar if we extend the "treatment" and "control" groups to include older and younger individuals, respectively. All nonreported results in the paper and additional regressions are presented in Acemoglu et al. (2006), or are available upon request.

TABLE 1—PRESCRIPTION DRUG EXPENDITURE FOR ELDERLY VERSUS NON-ELDERLY, 1963–1987

	(1)	(2)	(3)
$M_{iat} \times POST_t$	−37.74	−27.73	−10.74
	(31.27)	(26.11)	(25.36)
Number of observations	2,834	9,073	15,337
Mean of dependent variable	184.90	164.93	231.90
Survey years	1963, 1970	1963, 1970, 1977	1963, 1970, 1977, 1987

Notes: The dependent variable is total prescription drug expenditures in 2000 dollars. M_{iat} is a dummy variable equal to one for individuals 65 and older. *POST* is a dummy variable equal to one for the 1970, 1977, and 1987 NMES. All regressions include individuals aged 55 to 74 from the corresponding surveys, a full set of survey-year and age dummies, and the demographic controls described in the text. Observations are weighted by the reciprocal of the number of observations in the corresponding survey year. Robust standard errors are in parentheses.

Surveys, contain individual-level data on total prescription drug expenditures.

Our basic estimating equation is a simple differences-in-differences equation of the form:

$$(1) \qquad Y_{iat} = \gamma_t + \alpha_a + \mathbf{X}'_{iat} \cdot \eta + \beta \cdot (POST_t \cdot M_{iat}) + \varepsilon_{iat}$$

where Y_{iat} denotes prescription drug spending (in 2000 dollars) by individual i in age group a and year t; the γ_t's denote a full set of time (survey) dummies; the α_a's denote a full set of age dummies; and $\mathbf{X}_{iat}$ is a vector of covariates (dummies for male, married, and three education categories). Finally, $POST_t$ is a dummy indicating the introduction of Medicare, thus taking the value of 1 after 1965, and M_{iat} is a dummy variable for whether the individual is in the 65–74 age category and thus covered by Medicare. The coefficient of interest, β, measures the differential change in drug spending by the elderly after the introduction of Medicare.

Table 1 reports the results of estimating (1) with OLS. Column 1 uses the 1963 and 1970 data only, and shows no evidence that Medicare is associated with an increase in prescription drug spending for the elderly relative to the nonelderly. The estimate of β is negative, though statistically insignificant. The 95-percent confidence interval excludes an increase in prescription drug spending of more than \$21 (11 percent) associated with Medicare. Using the same data and methodology, Finkelstein and Robin McKnight (2005) find that the introduction of Medicare is associated with increases in spending on physician care and hospital stays by the elderly; unlike drugs, these services were covered by Medicare.

At the time of Medicare's introduction, there was little in the way of effective pharmaceuticals for the major chronic illnesses of the elderly (Cutler and Kadiyala, 2003). It is therefore possible that pharmaceutical companies may have responded to the expected increases in demand that would occur if they produced new, more effective drugs for the newly insured elderly. We therefore examined whether prescription drug spending for the elderly, relative to the nonelderly, increased with a lag after the introduction of Medicare. Column 2 adds 1977 data to the analysis in column 1 and column 3 adds the 1987 data as well; the estimate of β remains negative and insignificant.

II. The Impact of Medicare on Pharmaceutical Innovation

We next examine whether drugs approved after the introduction of Medicare are for diseases that are more disproportionately concentrated among the elderly than drugs approved prior to Medicare's introduction. Data on approval of new drugs from 1950 through 1999 come from the FDA. We can also identify whether a new drug is a new molecular entity, which contains active ingredients that have not been previously marketed in the United States and therefore provides a measure of more radical innovations than the typical new drug approval. There were 7,001 new drug approvals between 1950 and 1999, of which 725 are new molecular entities. Our key dependent variable is the number of new drug approvals (or new molecular entities) by year in each of 33 drug therapeutic classes.

To identify the impact of Medicare on new drug approvals, we create a variable measuring the cross-sectional variation in the elderly's share of the consumption of drugs across therapeutic categories, denoted by ES_c for category c. The basic logic of our approach is that if Medicare induced new innovation in drugs for the elderly, it would have more of an effect on new drug approvals in therapeutic categories that are disproportionately used by the elderly.

We measure ES_c using 1996–1998 data from the Medical Expenditure Survey (MEPS).[2] We compute this variable as the ratio of total prescription drug spending by individuals aged 65 and older on therapeutic class c to total prescription drug spending for all ages in the same therapeutic class. The average of ES_c is 0.34, with a standard deviation of 0.21. Anticoagulants (ES_c = 0.69) are a therapeutic category with a very high elderly share; antibiotics (ES_c = 0.15) are one with a low elderly share.

Because of the count nature of our dependent variable, we assume a conditional fixed effect Poisson model:

$$(2) \quad E[N_{ct}|\alpha_c, \bar{X}_c] = \exp(\alpha_c + \gamma_t + \phi \cdot X_{ct} + \beta_t \cdot ES_c)$$

where N_{ct} denotes the number of new drug approvals (or new molecular entities) in therapeutic category c in year t. The α_c's are therapeutic category fixed effects; γ_t's are year effects; X_{ct} is log potential market size for therapeutic category c as constructed in Acemoglu and Linn (2004); and $\bar{X}_c$ denotes the mean of X_{ct} for category c over the sample period. The variables of interest are the interaction between year dummies and ES_c; this is parameterized flexibly, with a different coefficient β_t for every year t. We estimate (2) by quasi-maximum likelihood by factoring out the fixed effects, which leads to consistent estimation under fairly general conditions (see Jeffrey M. Wooldridge, 1999). In addition, we report fully robust standard errors (clustered by drug category).

If Medicare had an effect on the direction of pharmaceutical innovation, we would expect β_t's to be positive at some point after 1965. The exact timing of the expected effect will depend on delays in the research and approval process, which could well be ten years or more (Joseph DiMasi et al., 1991; Finkelstein, 2004).

Figures 1 and 2 show the pattern of β_t's for total new drug approvals and new molecular entities. The figures make it clear that there is no statistically or economically significant change toward elderly therapeutic categories following Medicare, even when we look ten or more years out to allow for a possibly lagged induced innovation effect.

An important limitation of our results is that,

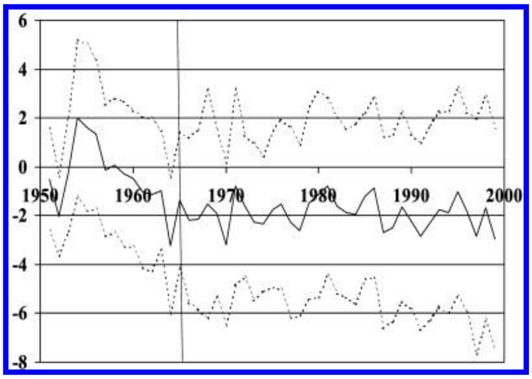

FIGURE 1. IMPACT OF MEDICARE ON TOTAL NEW DRUG APPROVALS

Notes: A Poisson conditional fixed-effects model is estimated by quasi-maximum likelihood, where the dependent variable is total approvals by year and category. Data points are the estimated coefficients on the interactions of year dummies with the elderly market share. The coefficient on the omitted year (1950) is normalized to zero. The regression also includes year dummies and log market size. The dashed lines are the 95-percent confidence intervals, and the vertical line indicates the beginning of Medicare in 1965.

[2] Ideally, we would measure ES_c before Medicare's introduction. Unfortunately, data on drug use by age and therapeutic category do not exist from this time period. If there have been substantial changes in ES_c over time, there will be downward attenuation bias in our estimates. Somewhat reassuringly, data from the National Ambulatory Care Survey (NAMCS) indicate that the age distribution of drug use is fairly similar between 1980 and 2000 (Acemoglu and Linn, 2004). Furthermore, all of our results remain essentially unchanged if we instead use data on the number of drugs used by age group from the 1980–1981 NAMCS to construct ES_c.

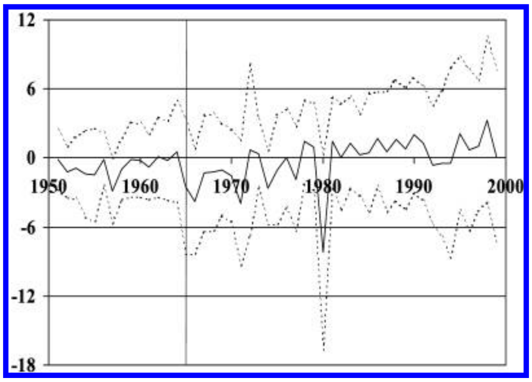

FIGURE 2. IMPACT OF MEDICARE ON NEW MOLECULAR ENTITY APPROVALS

Note: The graph is constructed similarly to Figure 1, except that the dependent variable is approvals of new molecular entities.

as discussed above, the spending patterns in the 1960s may have been substantially different from those captured by our measure of ES_c. Significant measurement error in our key right-hand-side variable could bias the coefficients of interest, the β_t's, toward zero. However, the fact that our analysis in the previous section did not show much of an increase in drug spending by the elderly following Medicare makes us believe that the main reason for the absence of significant effect in Figures 1 and 2 is not data quality, but a lack of a significant effect of Medicare on the direction of pharmaceutical innovation.

While our estimates suggest that Medicare did not affect the development of new drugs for the elderly on average, they do not rule out the possibility that Medicare might have had a disproportionate effect on the relatively more important new drugs, for example, new anti-hypertensive drugs that have been important in reducing cardiovascular disease mortality (Cutler and Kadiyala, 2003). Although we cannot test the impact of Medicare on the development of new anti-hypertensives per se, Cook et al. (2005) find no evidence that the introduction of Medicare was associated with an increase in medication use for high blood pressure among the elderly with hypertension, which does not support an induced innovation effect of Medicare on anti-hypertensives either.

III. Conclusion

We found no evidence of an effect of the introduction of Medicare on new innovation for pharmaceuticals for the elderly. Rather than contradict a role for induced innovation, however, our evidence suggests that there was no "first stage" of Medicare increasing the market size of drugs used by the elderly. Medicare covered hospital and doctor expenses, but not pharmaceuticals, so the lack of a first stage is not entirely surprising. Our findings leave open the question of whether the new 2006 Medicare prescription drug benefit will have an induced innovation effect toward pharmaceuticals used by the elderly.

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