

At Any Price? What Research Evidence Says about  
Pharmaceutical Pricing, Innovation, and Patient Health

Word count (including front page and abstract): 5208

**Abstract:** The pricing of prescription drugs is again under the regulatory microscope. Some policy makers promote importation as a way to make drugs more affordable. Opponents counter that this will limit the industry's incentives and ability to shepherd innovative drugs through the costly regulatory approval process and that patients will be harmed. We present a model that illuminates the various elements of this debate. We review empirical research and find that the best studies generally support the major themes in the model but do not provide sufficient evidence to determine whether policies to reduce prices would do more harm than good.

## **1. The Parallel Trade Policy Debate**

Few issues in United States health policy spark more heated debate than the pricing of prescription drugs. A recent study by the Congressional Budget Office (CBO) estimates that average prices for patented drugs in the United States are 50 to 100 percent higher than in other industrialized nations.<sup>1</sup> Figures like this motivate attempts to make prescription drugs more affordable, especially for Americans who lack insurance coverage. The most recent regulatory efforts have focused on relaxing prohibitions against importation, or "parallel trade", of prescription drugs from Canada and other countries.<sup>2</sup> Congress passed the Medicine Equity and Drug Safety Act in 2000 to allow parallel imports from Canada, but the Department of Health and Human Services and the Food and Drug Administration declined to enforce it, citing safety concerns. A number of state and local governments currently import some pharmaceuticals for their Medicaid beneficiaries or government employees.

Support for parallel trade stems from the widespread perception that Americans pay more for prescription drugs than do consumers in other nations. For example, when Senator Chuck Grassley (R-Iowa) introduced a bill to legalize importation of drugs from Canada in 2004, he

stated that "[i]mports create competition and keep domestic industry more responsive to consumers...Reimportation will benefit consumers"<sup>3</sup>. While the CBO study cited above seems to suggest that drugs may be "overpriced" relative to other nations by as much 100 percent, the CBO acknowledges that this may overstate the potential savings from parallel trade, in part because many U.S. pharmacy benefit management firms negotiate substantial discounts from drug makers and also because Americans tend to use more generics, which are often less expensive in the United States. Even so, there is no doubt that many Americans can enjoy substantial savings by purchasing their drugs at Canadian prices, and according to a recent poll by the *Wall Street Journal*, 80 percent support having the option to do so.<sup>4</sup>

Industry opposition to policies such as the legalization of parallel imports is due in part to a natural desire to maintain high prices for patented drugs. Opponents of parallel trade also adopt a societal perspective, claiming that lower drug prices will reduce incentives for research and development. Former FDA commissioner Mark McClellan offered this perspective in 2003 when he stated that the lower prices in Europe and

Canada are "slowing down the process of drug development worldwide"<sup>5</sup>.

The classic justification for granting patents is to promote private sector innovation. Firms must be allowed to earn a return on R&D investments, and they can only do so by exploiting some degree of market power. This principle is well-accepted. The question for society is how much market power we are willing to tolerate, and for how long? Similar questions arose when Congress enacted the Patent Term Restoration Act of 1984. This law extended the effective patent lives of some drugs, while facilitating generic entry of others. Elsewhere, governments use a variety of strategies, including reference pricing (e.g., in Germany), requiring cost-effectiveness analysis (e.g., in Australia) and explicit price controls (e.g., in Greece) to constrain drug prices. In each case, the industry has raised concerns about how the rules would affect innovation.

Concerns about the impact of regulation on innovation are heightened in the pharmaceutical industry, where research and development (R&D) as a percentage of sales is 19.2 percent, among the highest of any major U.S. industry, and many of the industry's innovations save countless lives. As industry supporters correctly observe,

regulations that reduce industry profits have the potential to reduce R&D investments and choke off future innovation. Unfortunately, this *qualitative* statement about the cost of regulation is inadequate for rigorous policy analysis, which requires *quantifying* regulatory costs and benefits. It is not enough to know whether regulations affect R&D. It is imperative to project exactly how regulation affects R&D and whether the benefits in terms of lower prices will be worth the cost in terms of lower innovation.

Studies like the CBO report provide valid estimates of the potential price reductions that would result from parallel trade. It is more challenging to project the impact on innovation. The purpose of this review is to assess our current ability to do so. Our findings are disappointing - not to advocates or opponents of regulation, but to those seeking a definitive answer to the question of whether regulation would do more harm than good. Although it is possible to provide a theoretical framework for our undertaking and there are several excellent studies addressing various aspects of the drug development cycle, there are too many holes in the existing literature. At best, we can predict the direction of the effect of reduced prices on total R&D spending, but we can say little about the magnitude.

Another crucial weakness in the present literature is the failure to delve into important nuances of regulatory effects, such as the impact on breakthrough versus "me-too" innovations. To understand the importance of this distinction, consider the category of cholesterol-reducing drugs known as statins. There are currently eight brand name statins on the market. Merck's Mevacor (Lovastatin) was the first statin approved by the FDA (in 1987). Pfizer's Lipitor (Atorvastatin) was the fourth statin to reach the market. Introduced in 1997, it is now the leading selling drug in the world. Although we cannot be certain without detailed analysis, it seems likely that most of the available welfare gains from statins would have been realized even if Lipitor and the drugs that came afterwards never reached the market. The introduction of Mevacor alone may have been sufficient to generate most of the available welfare gains, with subsequent "me-too" introductions serving mainly to divide up available profits. A similar story may be told for most breakthrough drugs. The first drug creates enormous welfare benefits. "Me-too" drugs further increase welfare by reducing prices, but exist mainly to divide up the profits. If regulation chokes off all innovation, then the welfare effects can be

severe. If regulation only limits me-too innovation, then the welfare effects could be minimal.

The remainder of the paper is organized as follows. We provide our framework for thinking about the connections between regulation, innovation, and population health in Part 2. Part 3 reviews existing research that sheds light on the links between innovation incentives, innovation output, and population health. Part 4 discusses whether we can confidently predict the effects of regulations on innovation and patient welfare.

## **2. Evaluating the Effects of Regulation on R&D and Population Health**

In a seminal paper, Burt Weisbrod observes that technological change and health are endogenous: technology both affects and is affected by the health of a population.<sup>6</sup> It is obvious that technological change affects our health. It should be equally obvious that our health affects technological change through the marketplace - profit seeking firms will invest in those areas of R&D that have the greatest market potential, all else equal, and market potential depends to a large extent on the prevalence of disease.

This view comports very well with how pharmaceutical companies allocate their R&D dollars. In the typical firm, the Vice Presidents for Research and Marketing participate in R&D allocation decisions. Each R&D project is evaluated for its *technical feasibility* and *market feasibility*. The former depends on the state of scientific knowledge, which in turn may depend on both public sector investments in basic research and the firm's private investments in translational research and development. The latter depends on the forecasted demand for the drug, which in turn depends on several factors. These include prevalence of disease in the population, the availability and efficacy of

existing treatments, and the competitive/regulatory environment that ultimately affects pricing. There is almost always considerable uncertainty about scientific feasibility, owing to the challenges of drug discovery and the potential for unforeseen side effects during the drug testing process. There is also uncertainty about market feasibility, particularly because drugs under development today may not reach the market for a decade or longer.

Figure 1 illustrates the endogeneity of technology and health in the context of the R&D process. Four factors are shown to collectively affect the "market demand" for new drugs, where demand represents the willingness to pay for new drugs as expressed by individual patients, their private insurers, and public payers. These factors are (1) the prevalence of diseases that require treatment, (2) the efficacy of existing therapies, (3) general economic factors that influence the ability to pay for medical care, and (4) the specific rules and regulations governing pharmaceutical markets that have been established by insurers and regulators.

The demand for new drugs, as affected by these four factors, provides incentives for both public and privately funded research. Most publicly-funded research tends to be "basic" research that advances the state of science but

does not directly lead to new drugs. Private sector companies engage in some basic research, often to facilitate learning from government funded basic research. Most private sector research spending is for drug development - taking ideas from the lab bench into clinical practice. The U.S. FDA, the European Medicines Evaluation Agency, and similar organizations in other nations spell out the requirements for demonstrating safety and efficacy of new drugs.

The introduction of new drugs feeds into the cycle by affecting the clinical capabilities for treating disease and, therefore, the demand for additional drugs if patients or insurers are willing to pay more for new or improved treatments. In this way, the cycle repeats itself. Note that incentives for privately funded research depend not only on the level of demand, but also on the share of the value created by innovation that firms are able to capture. Even if willingness-to-pay were high for an innovative treatment, firms would not invest if they expect patients (or insurers) to extract all the surplus.

**Figure 1 about here**

To return to the pharmaceutical policy example we started with, we consider how parallel trade might affect the entire cycle by synthesizing a number of recent papers on this topic. Several theoretical papers on parallel trade, such as Malueg and Schwartz (1994), evaluate welfare impact of a move from international price discrimination to a uniform world (or regional) price.<sup>7</sup> It is clear that profits are the same, at best, with this change; the only question is whether and by how much consumer welfare increases. A limitation of applying these models to the pharmaceutical industry is that they do not explicitly consider how an inability to price discriminate (and the corresponding reduction in profits) affects incentives to invest in R&D. More recent research attempts to deal with this issue, including Danzon (1998), Rey (2003), and Szymanski and Valletti (2005a, 2005b). These papers point out that parallel trade can reduce investment in quality or R&D as a result of reducing profits to patent-holders, so that even in cases where parallel trade benefits many consumers in the short run, welfare can be lower in the long run.

Parallel trade has the potential to change not only the amount of R&D invested, but also to change the type of R&D performed. If parallel trade is more attractive for

some products than others, the changes induced by parallel trade will also differ across products. There are a number of reasons why certain products are more or less vulnerable to parallel trade. Because hospitals may prefer not to trust parallel importers with biotech drugs, or others that are extremely sensitive to storage conditions, these products may face less competition from parallel trade and see little change in profits. Drugs for "lifestyle" diseases such as obesity, acne, and erectile dysfunction are not always covered by government health insurance and not subject to stringent price controls. With greater freedom to adjust prices, firms that make these types of products may not experience the same loss in profits as those with drugs that treat high-profile diseases, such as AIDS. Drug firms may also direct their R&D towards marginal adjustments to their existing product portfolios, consistent with the "product proliferation" strategy discussed in Kyle (2006).<sup>8</sup>

Parallel trade would reduce the share of value innovators expect to capture, as patients, their insurers, or parallel traders enjoy a greater share. This reduction of demand (and expected profits) in turn would affect research, the development of new marketable drugs, and, eventually, clinical capabilities to treat disease. These

steps are depicted by the heavy line in Figure 2. The magnitude of these effects is an empirical question. Numerous studies sheds light on many of the individual steps in the R&D cycle and one could, in principle, piece these together to draw conclusions about the overall effect of parallel trade. These studies are of variable quality, and none examine whether the allocation (not just the total amount) of R&D spending changes in response to a shift in demand. Thus, it is difficult to draw solid conclusions about the effects of importation laws and suggesting the need for additional research.

The next section reviews some of the key papers in the extensive literature on drug development and patient outcomes. As we will see, the extent to which the promise of higher prices generates additional R&D, and the nature of the new products that get developed, remain open empirical questions.

**Figure 2 about here**

### 3. Studies linking Demand to R&D

Several studies explore the link between demand and various phases of the R&D cycle. By and large, they confirm that R&D spending and output increase in response to favorable market conditions.

#### *Ward and Dranove*<sup>9</sup>

Ward and Dranove (1995) estimate the magnitude of the link between demand and R&D spending. They examine 23 years of industry R&D in seven therapeutic areas. They measure the demand for care in each therapeutic area by the number of MD specialists. They also control for lagged spending on NIH-funded basic research. They find that a 10 percent increase in demand for care in a therapeutic area (measured as a 10 percent increase in the number of specialists in that area) is associated with roughly a 5-8 percent increase in R&D spending. They also find that a 10 percent increase in NIH spending in a therapeutic area leads 5-7 years later to a 6-8 percent increase in industry spending. Thus, *the industry is both pulled by market demand and pushed by developments in basic science*. Both effects are substantial in magnitude.

#### *Cockburn and Henderson*<sup>10</sup>

Demand may drive R&D spending, but does the resulting spending translate into new drugs? The study that comes closest to linking spending and output is Cockburn and Henderson (JHE 2001). They examine whether there are economies of scale and scope in drug research. Using patents as their output measure, they determine that more spending in a given clinical area is associated with proportionately higher research output. They also find that firms engaged in a broader scope of research activities (i.e., studying a wider range of diseases) are more productive than focused firms.

The study seems to suggest that each 10 percent increase in R&D spending results in 10 percent more research output, but there are several caveats. The most obvious is their measure of productivity. Patents are a popular measure because they are closely linked in time to drug spending (minimizing the need to use complex lagged structures in the empirical analysis) and show considerable variation across firms and over time (unlike "drugs approved", which is usually zero for any firm/year/clinical area.) However, patents are just the first step in the discovery process, with years of clinical trials before the ultimate outcome - an approved drug for treatment of a disease.

Another limitation is that Cockburn and Henderson are unable to rule out the possibility that firms with greater scale/scope have other unobservable characteristics that directly cause higher productivity. It is therefore difficult to be certain whether increases in spending resulting from increases in demand, as opposed to, say, increases in technological capabilities within the firm, would generate a proportionate increase in patents.

*Finkelstein*<sup>11</sup>

Finkelstein (2004) combines and improves upon the best features of prior studies. Like Dranove and Ward, she focuses on changes in demand. Like Cockburn and Henderson, she examines R&D activity. Specifically, she examines the effects of changes to three federal policies affecting the demand for six vaccines. Each policy boosted the demand for specific vaccines and Finkelstein can estimate the magnitude of the demand effect for two vaccines - against hepatitis B and the flu. Moreover, the policies were not responses to technological change. Thus, any resulting change in R&D activity would be attributable to the increase in demand. Her measure of R&D activity is clinical trials - moving one step closer to the ultimate outcome of interest.

Finkelstein's main finding is that the demand-boosting policy changes were associated with a statistically significant increase of slightly more than 1 new vaccine trial per year for each affected disease. This more than doubled the number of new trials. Focusing on hepatitis B and the flu, she estimates that each additional \$1 in expected annual market revenue generates about 6 cents in additional R&D spending. Finally, she observes that this additional spending had the potential to boost the quality of the vaccine or vaccination rates for just one disease, suggesting that the additional R&D spending may have been socially wasteful. This concern may not apply to other areas of pharmaceutical R&D where there are still opportunities for quality improvements. This is a careful and convincing study whose limitations are obvious - it studies clinical trials (as opposed to marketed products) for a small set of vaccines.

*Acemoglu and Linn (2004)*<sup>12</sup>

Acemoglu and Linn (2004) provide the only study to date that links demand to drug output. They examine drug introductions in the United States between 1970 and 2000. They divide drugs into 20 major categories, such as cardiovascular drugs, and 159 subcategories such as Beta

Blockers. Using data from the 1996-1998 Medical Expenditure Panel Survey supplemented with older data from the National Ambulatory Medical Care Survey, they identify the age profiles of consumers of each category of drug, and compute market size based on the population and income in each age category. They then use census data from 1965-2000 to determine how changes in market size affect the demand for each category of drug.

They find that the entry of new drugs responds to both current and five year leads of market size. Specifically, they report that each one percent increase in market size (based on demographic trends) is associated with a 4 percent increase in the rate of entry of new non-generic drugs, and obtain roughly the same estimate for anticipated market size. This holds after controlling for government funding of research in each major drug area. This result implies that each 2.5 percent increase in current market size is associated with one additional drug. In an interesting calculation, they comment that the 2.5 percent increase in market size translates into about \$1.5 billion over 15 years, which is roughly double the estimated cost of bringing a drug to the market. Acemoglu and Linn do caution that their results disappear if they include a simple linear time trend. Perhaps drug were responding to

some other factor besides demand that was also increasing over time.

This study has a number of advantages over other work. It exploits exogenous shifts in demand, occurring at different points in time for different therapeutic classes, to identify the supply of new pharmaceuticals. The authors also distinguish between generic entry and the more innovative category of new molecular entities. However, there remain substantial differences in the social benefits of different non-generic drugs. Some represent therapeutic advances; others are "me-too" drugs whose primary benefit is to introduce price competition. The study also makes the strong assumption that there is a one-to-one relationship between market size and profits. Yet during the time that markets have grown, we have seen the introduction and intensification of world-wide price controls as well as extensions to patent lives. These may bias the estimated effects of demand. Finally, the productivity of R&D may have changed by quite a lot over the 35 year time frame of the study. For all of these reasons, we are hesitant to use the results in this paper to project the impact of parallel trade on drug development.

Taken together, these studies do that increases in market demand lead to increases in drug development and new drugs. This confirms several of the links posited in Figure 2. We now turn our attention to studies documenting another key link in the Figure, that between new drugs and the health status of the population.

#### ***4. Studies Linking New Drugs to Improvements in Patient Outcomes***

There are two broad categories of studies linking new drugs to patient outcomes. By far the most common are traditional cost-effectiveness studies. Neumann et al. (2000) reviewed over 200 published cost-effectiveness studies of prescription drugs. They report that in 79 percent of these studies, the drug had a positive cost per quality adjusted life year. The median cost per quality adjusted life year was \$12,000, which is well below the threshold used by government panels such as England's National Institute for Clinical Excellence or Australia's Pharmacy Benefit Advisory Committee.<sup>13</sup>

Although strongly suggestive that new drugs are worth the cost, there are two important limitations from the perspective of trying to anticipate the effects of pricing and profit regulation. First, it appears that many if not

most of the studies reviewed by Neumann et al. are based on clinical trials rather than the use of drugs in real world practice. Second, the median cost-effectiveness may overstate the cost-effectiveness of the "marginal drug" that may or may not come to market in the event of a change in regulations. The second criticism applies to all of the remaining studies and will not be repeated.

#### *Cutler and McClellan*

In the study "Is Technological Change in Medicine Worth It?", David Cutler and Mark McClellan (2001) directly examine the changes in costs and life expectancy for elderly Americans who have had a heart attack.<sup>14</sup> Using fifteen years of Medicare claims data linked to Social Security death records, they find that the cost of treating a heart attack increased by \$10,000 over the period 1984-1998, while life expectancies increased by one year. Using a dollar value for an additional year of life of \$100,000 (conservatively derived from surveys and labor market studies) they conclude that the discounted benefits exceed the costs sevenfold. Cutler and McClellan summarize the findings of similar studies of other diseases conducted by Cutler and various coauthors. For treatment of low-birthweight babies, depression and cataracts, the benefits

of new treatment technologies vastly exceed the costs. Only for breast cancer were the benefits and costs roughly the same.

The Cutler studies provide compelling evidence that technological change in medicine is worth the cost. However, they do not pinpoint whether the benefits are due to new drugs as opposed to improved diagnostics, devices, or surgical techniques.

*Lichtenberg and Virabhak<sup>15</sup>*

Frank Lichtenberg has written several studies that focus specifically on the economic costs and benefits of new prescription drugs. These studies reach similar conclusions and have similar limitations. We will discuss two of them.

Lichtenberg and Virabhak (2002) examine how the "vintage" of drugs affects patient health outcomes. They use data from the 1997 Medical Expenditure Panel Survey, which contains detailed health information for 34,551 people collected at several point during the year. They regress various measures of respondent health status at the end of the survey period on the "vintage" of drug used by the respondent, while controlling for diagnosis and initial health status. The drug "vintage" is based on the year of

FDA approval for the key active ingredient in the drug. The find that patients who used newer drugs had better outcomes. They estimate that the cost of newer vintage drugs required to keep a person alive is only \$8214, while the cost of preventing limitations to activity is only \$1745.

A fatal weakness in this paper is the failure to address selection bias. It is possible, perhaps even likely, that patients who receive newer drugs may differ from patients who receive older drugs in ways that are unobservable to the researcher and therefore excluded from the regression analysis. For example, patients receiving newer drugs may have visited better trained physicians or may have also received newer diagnostic tests and surgical interventions. Thus, it is difficult to be certain that the improvements in health status are due to the use of newer drugs.

*Lichtenberg*<sup>16</sup>

This 2005 study examines the effect of drug availability on the average age of death. The data is drawn from 52 countries for the period 1982-2001. Data on the age distribution of deaths (i.e., the average age at which individuals are dying) is drawn from the World Health Organization. Data on drug launches is drawn from IMS

Health. The key dependent variable is the percentage of the population that is over age 65 at death in disease  $i$  in country  $j$  at time  $t$ . Lichtenberg calls this the age-65 survivor probability. The key predictor variable is the cumulative number of drugs approved by time  $t$  in disease  $i$  in country  $j$ . The regression includes controls for demographics, nutrition, and other factors that might affect mortality rates and also includes disease and country fixed effects.

The key finding is that the age-65 survivor probability increases with the stock of new drug approvals. Almost all of the measured effect is due to across-the-board increases in the availability of new drugs rather than heterogeneity in approval rates across countries. Lichtenberg estimates that the drugs approved over the 18 year time period of the study increase life expectancy by nearly 3 months. As with other studies cited above, Lichtenberg does not have information about other factors that might be correlated with drug availability and might also affect life expectancy, such as improvements in diagnostic and surgical techniques. Indeed, Lichtenberg does not distinguish his findings from a simple upward time trend in health outcomes.

*Vernon, Santerre and Giaccotto Synthesis*<sup>17</sup>

The overall effect of a regulatory change such as the legalization of parallel trade will depend on the factors we outlined above: first, the amount by which R&D is lowered in response to the reduction in profitability; second, the relationship between the amount of R&D spending and the number or quality of innovative drugs; and finally, the relationship between innovative drugs and patient outcomes. It might be possible to estimate the overall welfare loss by tying together each of these individual factors. This is the approach taken by Vernon, Santerre and Giaccotto (2004), which we now summarize.

Vernon et al. focus on how the participation of the U.S. government in the pharmaceutical market has affected prices and R&D investment. First, they estimate how the growth of real pharmaceutical prices is related to the government's share of pharmaceutical spending (through various programs such as Medicaid, Medicare and Veteran's Administration benefits), and conclude that government involvement has reduced the rate of price increases for drugs. Next, they use an estimate of the elasticity of R&D with respect to price computed in an earlier paper (Giaccotto et al. 2005) to determine the amount of R&D that drug firms would have invested if government involvement

had not dampened the rate of price increases. Finally, they make use of an estimate in Lichtenburg (2002) to arrive at an estimate of the total life years lost due to reduced R&D.

There are a number of important drawbacks to an approach like this. First, the estimated relationship between drug prices and government spending relies on a single observation per year, aggregated over a subset of firms and all products. This makes it difficult to rule out other explanations for changes in the dependent variable, including simple time trends. Second, the estimate for the elasticity of R&D with respect to price is derived using data on the R&D/sales ratio for large pharmaceutical firms only. This measure ignores all R&D spending by biotech firms, which generate no sales for many years after founding. Vernon et al. rely in part on findings from Lichtenburg that have problems of their own. Finally, their calculations assume that the relationships between profits, R&D, output, and health benefits are all linear, which is almost certainly not the case. The results can therefore not be interpreted as marginal effects; for these, which are really the parameters of interest, a more sophisticated approach is required.

## 5. Can We Predict the Effects of Policy?

Parallel trade is an example of a policy that could reduce profits to pharmaceuticals and therefore might affect R&D. Some recent theoretical research analyzes the welfare consequences of parallel trade for R&D, including Danzon (1998), Rey (2003), and Szymanski and Valletti (2005a, 2005b).<sup>18</sup> Drawing on the logic of the R&D cycle that we presented above, these papers point out that parallel trade can reduce profits to patent holders and therefore reduce investments in R&D. In addition, the possibility that parallel trade makes investment more attractive for marginal "me-too" products, or for certain categories of disease, also has welfare consequences.

We seem to have a classic economic theorist's dilemma. On the one hand, parallel trade reduces prices, helping social welfare. On the other hand, it reduces innovation and may even lead to the wrong kinds of innovation, harming welfare. How one stands in the policy debate could easily be driven by ideology or self interest. More facts are clearly needed. We need to empirically measure the implications of parallel trade on drug development. A similar logic applies to other policy choices such as the length of patent protection or market exclusivity, the use

of price controls, and the requirements for clinical trials.

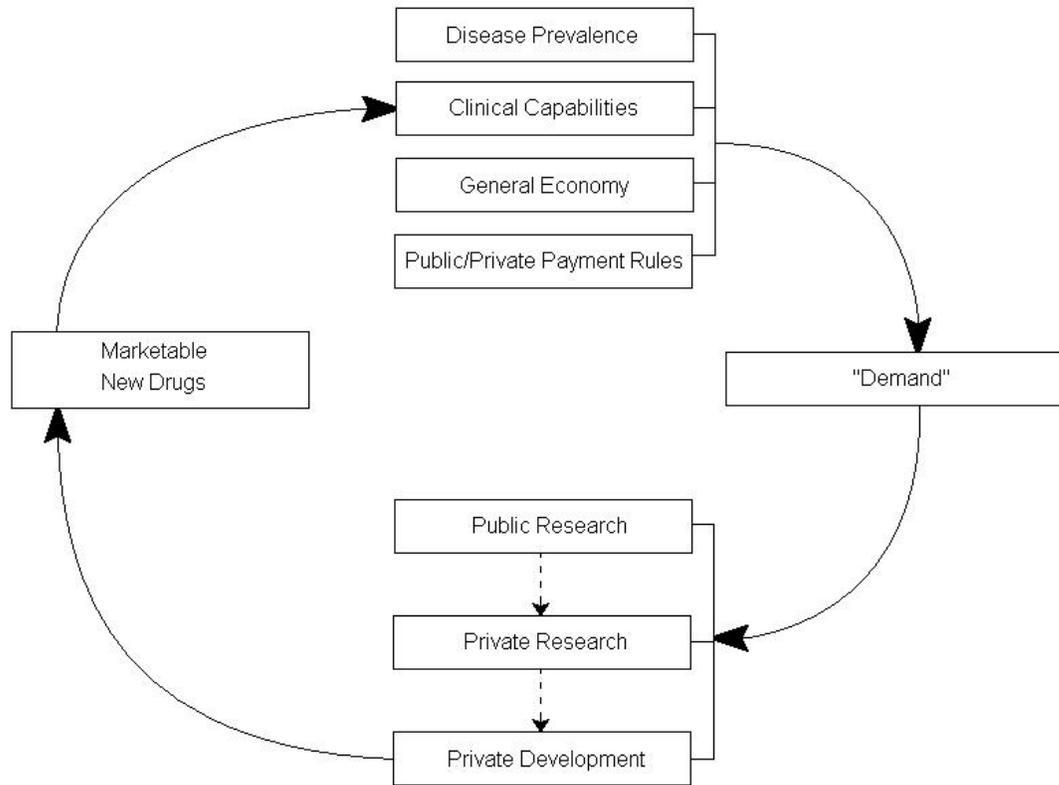
Empirical research does provide some answers. We can reach the following reasonably firm conclusions:

- On average, more profits leads to more R&D
- On average, more profits leads to more drugs

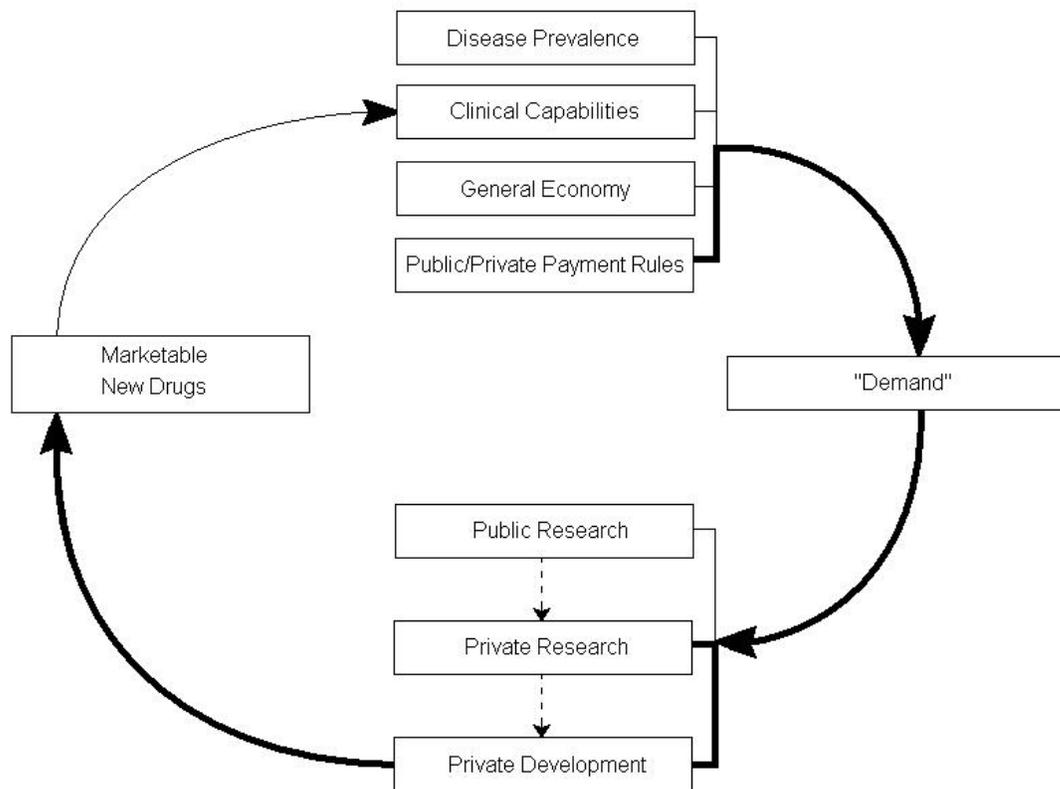
We can probably also conclude the following:

- On average, more drugs lead to better outcomes, and the benefits exceed the costs

Even if validated, these research findings are insufficient for us to opine on the welfare implications of public policies such as reimportation. We cannot begin to quantify the marginal effects on overall drug output, let alone output of new versus me-too drugs. We cannot make any definitive statements about the subsequent effects on patient outcomes. While the current research literature allows us to make rough estimates of how changes in profits might affect pieces of the innovation cycle, many gaps in our knowledge remain. Knowing the magnitude of these effects, and how they change incentives to develop particular types of treatments, is critical for assessing policy.



**Figure 1**



**Figure 2**

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<sup>1</sup> Congressional Budget Office (2004) "Would Prescription Drug Importation Reduce U.S. Drug Spending" Economic and Budget Brief, April 29, 2004.

<sup>2</sup> Importation is sometimes referred to misleadingly as reimportation. These drugs are usually produced overseas and so they are not reimported.

<sup>3</sup> Grassley, C., Press release, April 8, 2004.  
<http://grassley.senate.gov/releases/2004/p04r04-08a.htm>

<sup>4</sup> "Most Americans Support Legalizing Drug Imports From Canada, Poll Finds" *Wall Street Journal*, August 31, 2006.

<sup>5</sup> McClellan, M. (2003), Speech before First International Colloquium on Generic Medicine.

<sup>6</sup> Weisbrod, B., 1991 "The Health Care Quadrilemma" *Journal of Economic Literature*, 29, 523-52.

<sup>7</sup> Malueg, D. and M. Schwartz (1994), "Parallel imports, demand dispersion, and international price discrimination," *Journal of International Economics*, 37(3-4), 167-195.

<sup>8</sup> Kyle, M. (2006), "Strategic Responses to Parallel Trade," Duke University Working Paper.

<sup>9</sup> Ward, M. and D. Dranove, "The Vertical Chain of Research and Development in the Pharmaceutical Industry," *Economic Inquiry*, vol. 33 n. 1 (January, 1995) 70-87.

<sup>10</sup> Cockburn, I. and R. Henderson "Scale and Scope in Drug Development: Unpacking the Advantages of Size in Pharmaceutical Research." *Journal of Health Economics*, 2001, 20(6), pp.1033-1057.

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- <sup>12</sup> Acemoglu, D. and J. Linn (2004), "Market Size in Innovation: Theory and Evidence from the Pharmaceutical Industry," *Quarterly Journal of Economics*, August 2004, volume 119, pp. 1049-1090.
- <sup>13</sup> For example, see Birkett, D. et al., (2001), "A Cost-effectiveness Approach to Drug Subsidy and Pricing in Australia" *Health Affairs* 18(3): 104-14.
- <sup>14</sup> Cutler, D., and M. McClellan, (2001), "Is Technological Change in Medicine Worth It?" *Health Affairs* 20(5): 11-30.
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- <sup>17</sup> Vernon, J. R. Santerre, and C. Giacotto, (2004), "Are Drug Price Controls Good for your Health?" *Medical Progress Report* No. 1, December 2004.
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