The Contribution of Pharmaceutical Innovation to Longevity Growth in Germany and France

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Abstract

I investigate the contribution of pharmaceutical innovation to recent longevity growth in Germany and France. First, I examine the effect of the vintage of prescription drugs (and other variables) on the life expectancy and age-adjusted mortality rates of residents of Germany, using longitudinal, annual, state-level data during the period 2000-2007. The estimates imply that almost half of the 1.7-year increase in German life expectancy during the period 2000-2007 was due to the replacement of older drugs by newer drugs. Next, I examine the effect of the vintage of chemotherapy treatments on age-adjusted cancer mortality rates of residents of France, using longitudinal, annual, cancer-site-level data during the period 2002-2006. The estimates imply that chemotherapy innovation accounted for at least one-sixth of the decline in French cancer mortality rates, and may have accounted for as much as half of the decline.

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I. Introduction

Longevity increase is an important part of economic growth and development. Nordhaus (2002) estimated that, "to a first approximation, the economic value of increases in longevity over the twentieth century is about as large as the value of measured growth in non-health goods and services" (p. 17). Murphy and Topel (2005) observed that "the historical gains from increased longevity have been enormous. Over the 20th century, cumulative gains in [U.S.] life expectancy were worth over $1.2 million per person for both men and women. Between 1970 and 2000 increased longevity added about $3.2 trillion per year to national wealth, an uncounted value equal to about half of average annual GDP over the period." In its Human Development Reports, the United Nations Development Program ranks countries by their value of the Human Development Index, which is based on life expectancy at birth as well as on the adult literacy rate and per capita GDP.

Since the 1950s, economists have recognized that, in the long run, the rate of economic growth is determined by (indeed equal to) the rate of technological progress. In neoclassical growth models developed by Nobel laureate Robert Solow (1956, 1957) and colleagues, an economy will always converge towards a steady state rate of growth, which depends only on the rate of technological progress.

In early models of economic growth, the rate of technological progress was assumed to be given, or exogenous: technological progress was regarded as "manna from heaven." Economists began to relax this clearly unrealistic assumption in the 1980s, by developing so-called "endogenous growth models." In Paul Romer's (1990) model, "growth…is driven by technological change that arises from intentional [R&D] investment decisions made by profit-maximizing agents."[1] Jones (1998) argues that "technological progress [is] the ultimate driving force behind sustained economic growth" (p.2), and that "technological progress is driven by research and development (R&D) in the advanced world" (p. 89).

Technological change may be either disembodied or embodied. Suppose firm X invests in R&D, and that this investment results in a valuable discovery. If the technological advance is disembodied, consumers and other firms could benefit from the discovery without purchasing

[1] Growth may also be driven by technological change arising from R&D investment by public organizations, e.g. the National Institutes of Health.

firm X's goods or services; they could benefit just by reading or hearing about the discovery. However, if the technological advance is embodied, consumers and other firms must purchase firm X's goods or services to benefit from its discovery. Solow (1960, p 91): argued that "many if not most innovations need to be embodied in new kinds of durable equipment before they can be made effective. Improvements in technology affect output only to the extent that they are carried into practice either by net capital formation or by the replacement of old-fashioned equipment by the latest models…"[2] Romer also assumes that technological progress is embodied in new goods: "new knowledge is translated into goods with practical value," and "a firm incurs fixed design or research and development costs when it creates a new good. It recovers those costs by selling the new good for a price that is higher than its constant cost of production." Grossman and Helpman (1993) argued that "innovative goods are better than older products simply because they provide more 'product services' in relation to their cost of production." Bresnahan and Gordon (1996) stated simply that "new goods are at the heart of economic progress," and Bils (2004) said that "much of economic growth occurs through growth in quality as new models of consumer goods replace older, sometimes inferior, models."

When technological progress is embodied in new goods, the welfare of consumers (and the productivity of producers) depends on the *vintage* of the goods (or inputs) they purchase. In this context, "vintage" refers to the year in which the good was first produced or sold. For example, the vintage of the drug simvastatin is 1993: that is the year it was approved by the FDA, and first sold. Solow was the first economist to develop a growth model that distinguished between vintages of (capital) goods. In Solow's model, new capital is more valuable than old capital because--since capital is produced based on known technology, and technology improves with time--new capital will be more productive than old capital.[3] A number of econometric studies (Bahk and Gort (1993), Hulten (1992), Sakellaris and Wilson (2004)) have shown that manufacturing firms using later-vintage equipment have higher productivity.

The extent to which the welfare of consumers or the productivity of producers depends on the vintage of the goods they purchase should depend on the research intensity of those goods. The greater the research intensity of the goods, the greater the impact of their vintage on consumer welfare and producer productivity. According to the National Science Foundation, the

[2] We hypothesize that innovations may be embodied in nondurable goods (e.g. drugs) and services as well as in durable equipment.
[3] http://en.wikipedia.org/wiki/Exogenous_growth_model

pharmaceutical and medical devices industries are the most research intensive industries in the economy.[4]

In the next section, I will investigate the effect of the vintage of prescription drugs (and other variables) on the life expectancy and age-adjusted mortality rates of residents of Germany, using longitudinal, annual, state-level data during the period 2000-2007. The analysis will be based on data on the utilization of over 600 active ingredients in a variety of drug classes, which account for about 250 million prescriptions (43% of all prescriptions in Germany) per year.

In the following section, I will investigate the effect of the vintage of chemotherapy treatments on age-adjusted cancer mortality rates of residents of France, using longitudinal, annual, cancer-site (breast, colon, lung, etc.) -level data during the period 2002-2006.[5] The analysis will be based on data on the utilization of 11 cancer drugs by about 4000 cancer patients per year.

II. Germany longevity

A. Econometric model

I will estimate models of the following form:

$$OUTCOME_{st} = \beta\ VINTAGE_{st} + \gamma\ X_{st} + \alpha_s + \delta_t + \varepsilon_{st} \qquad (1)$$

where OUTCOME is one of the following variables:

LE_{st} = life expectancy at birth in state s in year t (s = 1,…,16; t = 2000,…,2007)

ln_AAMORT_{st} = the log of the age-adjusted mortality rate in state s in year t[6]

[4] In 1997, "medical substances and devices firms had by far the highest combined R&D intensity at 11.8 percent,…well above the 4.2-percent average for all 500 top 1997 R&D spenders combined. The information and electronics sector ranked second in intensity at 7.0 percent." The pattern of 1997 R&D spending per employee is similar to that for R&D intensity, with medical substances and devices again the highest at $29,095 per employee. Information and electronics is second at $16,381. Combined, the top 500 1997 R&D firms spent $10,457 per employee.

[5] Cancer was the cause of about 30% of deaths in France in 2006.

[6] Age-adjusted death rates are weighted averages of age-specific death rates, where the weights represent a fixed population by age. They are used to compare relative mortality risk among groups and over time. An age-adjusted rate represents the rate that would have existed had the age-specific rates of the particular year prevailed in a population whose age distribution was the same as that of the fixed population.

VINTAGE is one of the following variables:

FDA_YEAR_{st} = the (weighted) mean FDA approval year of ingredients contained in prescriptions consumed in state s in year t

$POST1990\%_{st}$ = the percent of prescriptions consumed in state s in year t that contained ingredients approved by the FDA after 1990

$POST1995\%_{st}$ = the percent of prescriptions consumed in state s in year t that contained ingredients approved by the FDA after 1995

and X includes a subset of the following variables:

ln_GDP_{st} = the log of GDP per person in state s in year t

$UNEMP_{st}$ = the unemployment rate in state s in year t

$ln\_N\_RX_{st}$ = the log of the number of prescriptions per person in state s in year t

$ln\_NOTIF\_DISEASES_{st}$ = the log of the number of notifiable diseases per 100,000 persons in state s in year t

ln_AIDS_{st} = the log of the number of new AIDS cases per 100,000 persons in state s in year t

α_s and δ_t represent state fixed effects and year fixed effects, respectively. Due to the inclusion of these effects, eq. (1) is a difference-in-differences model. A significant negative drug vintage coefficient (β) in a model in which the dependent variable is life expectancy would indicate that states that had above-average increases in drug vintage had above-average increases in life expectancy, controlling for other regressors.

Eq. (1) will be estimated by weighted least squares (WLS), weighting by pop_{st}, state s's population in year t. The estimation procedure will account for clustering of disturbances within states.

The drug vintage measure FDA_YEAR will be constructed as follows:

$$FDA\_YEAR_{st} = \frac{\Sigma_d \, N\_RX_{dst} \, APP\_YEAR_d}{\Sigma_d \, N\_RX_{dst}}$$

where

N_RX_{dst} = the number of prescriptions for drug d in state s in year t

APP_YEAR_d = the year in which the active ingredient of drug d was first approved by the FDA[7]

The drug vintage measure POST1990% will be constructed as follows:

$$POST1990\%_{st} = \frac{\Sigma_d \, N\_RX_{dst} \, APP\_YEAR\_GT\_1990_d}{\Sigma_d \, N\_RX_{dst}}$$

where

$APP\_YEAR\_GT\_1990_d$ = 1 if the active ingredient of drug d was first approved by the FDA after 1990

= 0 otherwise

The drug vintage measure POST1995% will be constructed as follows:

$$POST1995\%_{st} = \frac{\Sigma_d \, N\_RX_{dst} \, APP\_YEAR\_GT\_1995_d}{\Sigma_d \, N\_RX_{dst}}$$

where

$APP\_YEAR\_GT\_1995_d$ = 1 if the active ingredient of drug d was first approved by the FDA after 1995

= 0 otherwise

B. Data and descriptive statistics

Pharmaceutical data. Data on the number of prescriptions, by drug, state, and year (N_RX_{dst}) were obtained from the IMS Health National Prescription Analysis database (http://www.imshealth.de/sixcms/detail.php/375), which covers more than 99% of prescriptions reimbursed by German Sick Funds. It does not contain drugs used in a hospital, drugs completely paid out-of-pocket, and drugs prescribed for members of private health insurance companies (approximately 10% of the German population, particularly high-income employees, self-

[7] If drug d contains 2 or more active ingredients, APP_YEAR_d is the *mean* of the years in which the active ingredients of drug d were first approved by the FDA.

employed persons, military, and government officials). We were unable to obtain data on all drugs sold in Germany. Data were available for drugs included in the following drug classes[8]:

- Cardiovascular (C***)
- Oncology (A04A, L***, B03A, B03C, V03D)
- Parkinson (N04A)
- Alzheimer/Dementia (N07D)
- Antidiabetics (A10*)
- Asthma/COPD (R03*)
- NSAID/Coxibs (M01A)

Appendix Table 1 compares 2008 data from our sample of drugs to data on all drugs dispensed in the Statutory Health Insurance system. Overall, our dataset provides information on about 250 million prescriptions per year for over 600 active ingredients, which account for 43% of total prescriptions and about 50% of total drug expenditure.

Data on the initial year of FDA approval of active ingredients (APP_YEAR_d) were obtained from the Food and Drug Administration's Drugs@FDA database (http://www.fda.gov/Drugs/InformationOnDrugs/ucm079750.htm).[9] We were able to determine the initial FDA approval year of products accounting for over 80% of the prescriptions in our sample.

Table 1 shows data on the top 25 drugs in our sample, ranked by the number of prescriptions during 2000-2008. Figure 1 shows data on the vintage distribution of prescriptions consumed during the period 2000-2008: it shows the percent of prescriptions consumed during 2000-2008 that were for drugs approved after year t (t = 1940,...,2010). About 75% of prescriptions were for drugs approved after 1975, 50% were for drugs approved after 1986, and 25% were for drugs approved after 1993.

Age-adjusted mortality and life expectancy data. We will analyze two different measures of longevity: the age-adjusted mortality rate, and life expectancy at birth. The Information System of the Federal Health Monitoring (http://www.gbe-bund.de/) provides data on age-adjusted mortality rates, by state and year. It also provides time-series data on life expectancy in Germany as a whole, but not life expectancy by state. However, it provides data on age-specific

[8] European Pharmaceutical Market Research Association (EphMRA) drug classification codes are shown in parentheses. The EphMRA classification is a modified modified version of the ATC classification. See http://www.ephmra.org/classification/anatomical-classification.aspx.

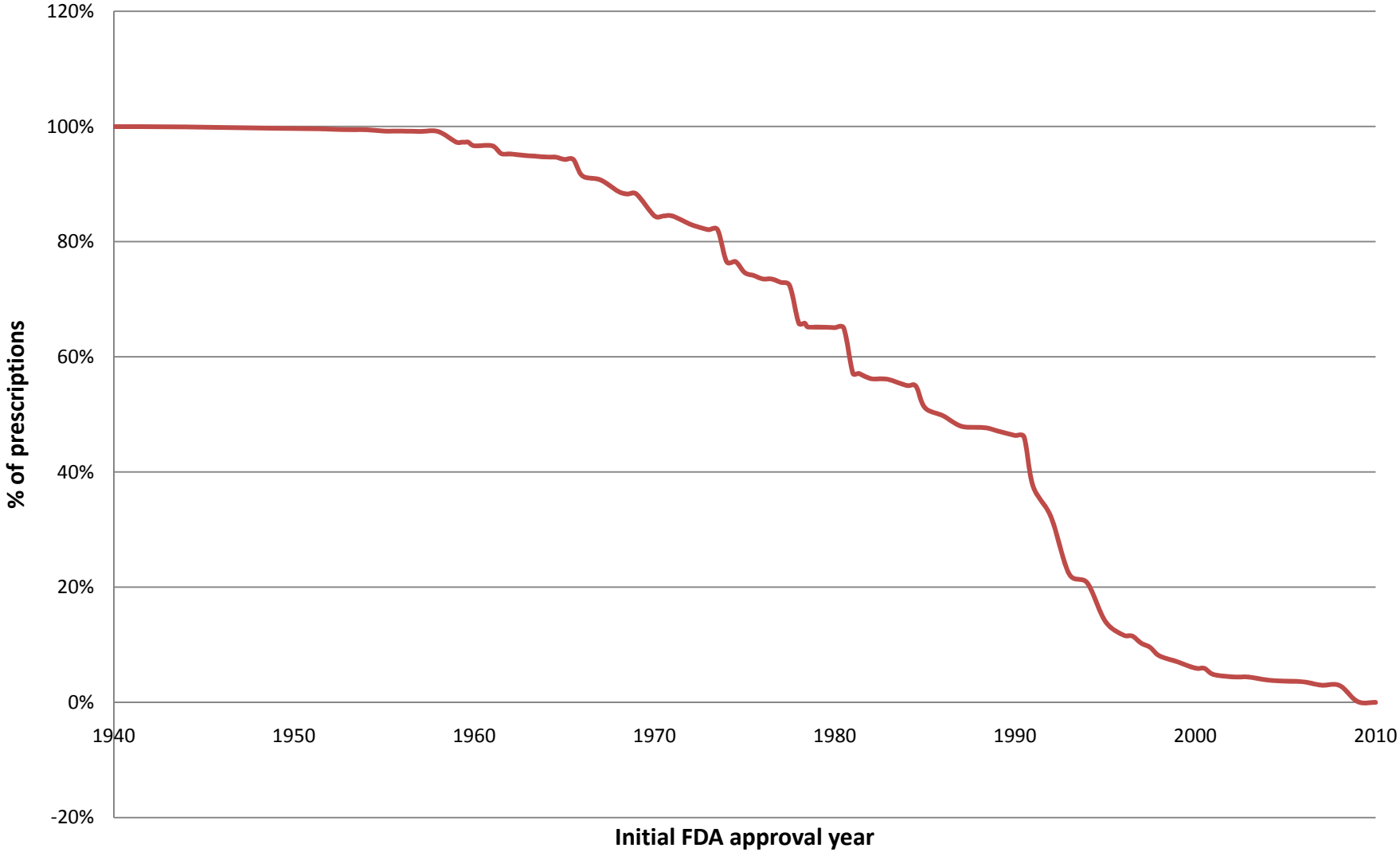
[9] The U.S. is the country in which many drugs are first launched. Also, it is difficult to obtain data on the date at which drugs were first launched in Germany.

Table 1

Top 25 drugs in sample, ranked by number of prescriptions during 2000-2008

Rank	Compound	Number of prescriptions during 2000-2008 (millions)	FDA approval year
1	DICLOFENAC	167.7	1993
2	METOPROLOL	108.0	1978
3	IBUPROFEN	93.8	1974
4	METFORMIN	65.3	1995
5	BISOPROLOL	62.8	1992
6	ENALAPRIL	58.8	1985
7	SIMVASTATIN	55.4	1991
8	FUROSEMIDE	50.8	1966
9	SALBUTAMOL	44.6	1981
10	RAMIPRIL	41.7	1991
11	CAPTOPRIL	40.6	1981
12	AMLODIPINE	40.0	2009
13	VERAPAMIL	36.4	1981
14	THEOPHYLLINE	35.0	1970
15	GLIBENCLAMIDE	32.5	1984
16	TORASEMIDE	32.1	1993
17	LISINOPRIL	29.0	1987
18	INSULIN HUMAN BASE/INSULIN HUMAN ISOPHANE	28.4	.
19	ISOSORBIDE DINITRATE	28.1	1968
20	HYDROCHLOROTHIAZIDE	27.3	1959
21	NIFEDIPINE	26.8	1981
22	HYDROCHLOROTHIAZIDE/TRIAMTERENE	24.4	1961.5
23	HYDROCHLOROTHIAZIDE/RAMIPRIL	24.1	1975
24	NITRENDIPINE	23.5	.
25	ISOSORBIDE MONONITRATE	22.9	1991

Figure 1
% of prescriptions consumed during 2000-2008 that were for drugs approved after year t (t = 1940,...,2010)



mortality rates by state and year, from which life expectancy by state and year can be calculated.[10]

Data on life expectancy at birth during 2000-2007 in selected states are shown in Figure 2. The rate of increase of life expectancy varied across states and over time. In 2000, Saarland's life expectancy was higher than Mecklenburg-Vorpommern's; in 2007, it was slightly lower. In 2000, Schleswig-Holstein's life expectancy was slightly higher than Berlin's; in 2007, it was lower.

Data on other variables. Data on population, the number of notifiable diseases per 100,000 persons,[11] and on the number of new AIDS cases per 100,000 persons, by state and year, were also obtained from The Information System of the Federal Health Monitoring. Data on GDP per person and the unemployment rate, by state and year, were obtained from Eurostat's regional statistics database (http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home).[12]

Summary statistics, by year, are reported in Table 2. The FDA_YEAR, POST1990%, and POST1995% statistics are weighted means, where the weight is the number of prescriptions. The other statistics (with the exceptions of the number of prescriptions and population) are weighted means, where the weight is the population. The mean FDA approval year increased by 3.0 years between 2000 and 2008. The fraction of prescriptions that contained ingredients approved after 1990 increased from 32% in 2000 to 46% in 2008. Life expectancy at birth increased by 1.8 years between 2000 and 2007.

The complete dataset used for estimation is shown in Appendix Table 2.

C. Empirical results

Estimates of models of life expectancy and the age-adjusted mortality rate are presented in Table 3. We present estimates of 12 (= 2 × 3 × 2) different models. We use two alternative outcome measures and three alternative drug vintage measures, and estimate models both excluding and including the vector of other explanatory variables (X in eq. (1)).

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[10] We verified that population-weighted averages of our state-level life expectancy estimates were very consistent with published estimates for Germany as a whole.

[11] In the Federal Republic of Germany, health authorities must be informed about cases of certain notifiable diseases, which are listed in the Infection Protection Act. Depending on the disease the suspicion, the disease and/or the death must be reported. (Source: www.rki.de). Data on the incidence and prevalence of other diseases are not available.

[12] Data on educational attainment by state and year were not available.

Figure 2
Life expectancy at birth, Germany, 2000-2007, selected states

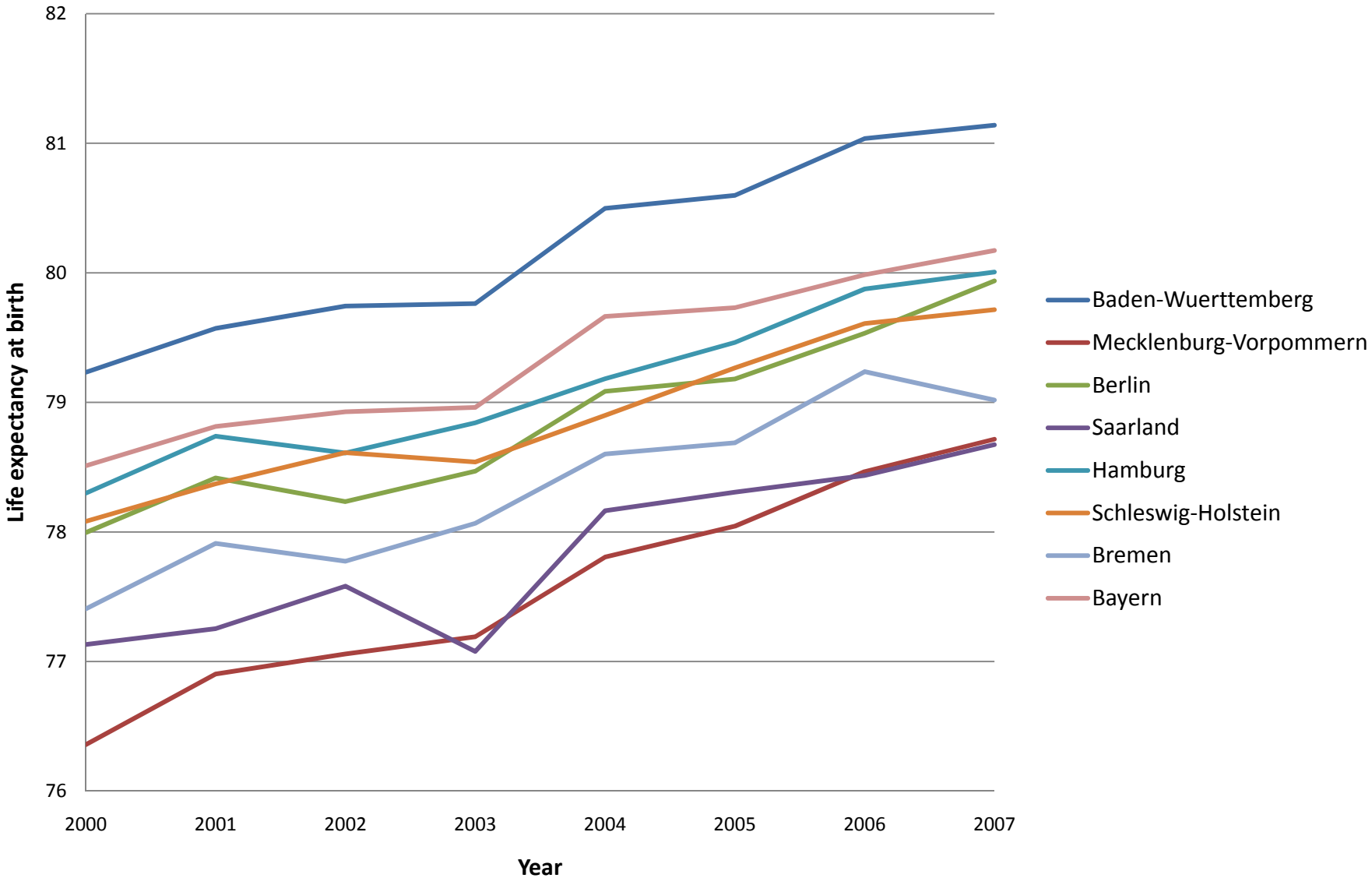

Table 2

Sample statistics by year

Year	Number of prescriptions (millions)	Number of prescriptions per person	FDA_YEAR	post1990%	post1995%	Population (millions)	Life expectancy at birth	Age-adjusted mortality rate (per 100,000)	unemployment rate	GDP per person (Euros)	new aids cases per 100,000	Notifiable diseases per 100,000 inhabitants
2000	230	2.50	1983.0	32%	8%	82.2	78.1	886.0	7.8%	25,095	1.010	.
2001	241	2.59	1983.6	34%	10%	82.3	78.5	857.4	7.6%	25,664	0.954	298.4
2002	251	2.71	1983.9	35%	11%	82.5	78.5	858.3	8.4%	25,984	0.867	347.6
2003	265	2.86	1984.3	37%	12%	82.5	78.6	861.1	9.7%	26,222	0.844	308.8
2004	235	2.54	1984.7	39%	13%	82.5	79.2	811.1	10.6%	26,798	0.918	323.7
2005	241	2.60	1984.9	40%	12%	82.5	79.4	801.0	11.0%	.	0.824	353.7
2006	245	2.64	1985.3	42%	13%	82.4	79.7	775.8	10.1%	28,182	0.813	361.7
2007	250	2.69	1985.6	44%	14%	82.3	79.9	766.0	8.6%	.	0.733	541.0
2008	259		1986.0	46%	15%							

Table 3

Estimates of models of life expectancy at birth and age-adjusted mortality rate, Germany, 2000-2007

Dependent variable: life expectancy at birth						Dependent variable: log of age-adjusted mortality rate				
Model	Regressor	Estimate	Z	ProbZ		Model	Regressor	Estimate	Z	ProbZ
1	fda_year	0.271	3.605	0.000		7	fda_year	-0.022	-5.094	0.000
2	fda_year	0.326	3.153	0.002		8	fda_year	-0.031	-4.814	0.000
2	lunits_pop	-0.135	-0.293	0.769		8	lunits_pop	-0.021	-0.641	0.521
2	unemp	-0.014	-0.009	0.993		8	unemp	-0.032	-0.284	0.777
2	lgdp	-1.314	-1.667	0.095		8	lgdp	0.125	1.752	0.080
2	laids	-0.027	-0.565	0.572		8	laids	0.002	0.531	0.595
2	lnotif	-0.241	-2.064	0.039		8	lnotif	0.019	1.975	0.048
3	post1990	7.711	3.992	0.000		9	post1990	-0.646	-4.191	0.000
4	post1990	8.611	3.415	0.001		10	post1990	-0.814	-2.820	0.005
4	lunits_pop	-0.115	-0.316	0.752		10	lunits_pop	-0.024	-1.162	0.245
4	unemp	-0.410	-0.272	0.786		10	unemp	0.008	0.067	0.946
4	lgdp	-1.084	-1.527	0.127		10	lgdp	0.101	1.385	0.166
4	laids	-0.015	-0.323	0.747		10	laids	0.001	0.230	0.818
4	lnotif	-0.239	-1.981	0.048		10	lnotif	0.019	1.812	0.070
5	post1995	9.803	4.849	0.000		11	post1995	-0.821	-6.918	0.000
6	post1995	10.064	3.226	0.001		12	post1995	-0.957	-4.896	0.000
6	lunits_pop	-0.206	-0.483	0.629		12	lunits_pop	-0.015	-0.426	0.670
6	unemp	-0.021	-0.013	0.990		12	unemp	-0.030	-0.254	0.799
6	lgdp	-0.925	-1.356	0.175		12	lgdp	0.087	1.325	0.185
6	laids	-0.017	-0.402	0.688		12	laids	0.001	0.319	0.750
6	lnotif	-0.154	-1.354	0.176		12	lnotif	0.011	1.189	0.234

The estimates are weighted least-squares estimates, weighting by state population. All equations include fixed state effects and fixed year effects. Standard errors are clustered within states.

In model 1, the dependent variable is life expectancy at birth, and there is only one explanatory variable: the (weighted) mean FDA approval year of ingredients contained in prescriptions consumed. The coefficient on this variable is positive and highly significant (p-value < .001). This indicates that states with larger increases in drug vintage had larger increases in life expectancy. However, the estimate of this coefficient may be biased if other determinants of life expectancy are correlated with drug vintage.

Model 2 includes other plausible determinants of life expectancy: the per capita *quantity* of drugs consumed, per capita income, the unemployment rate, the notifiable disease rate, and the AIDS case rate. Controlling for these other variables increases the magnitude of the drug vintage coefficient by 20%. The coefficients on the per capita *quantity* of drugs consumed, the unemployment rate, and the AIDS case rate are far from significant. The coefficient on ln_NOTIF_DISEASES is negative and significant, which is to be expected: an increase in the number of notifiable diseases per 100,000 persons is associated with a decline in life expectancy.

The coefficient on per capita income is *negative* and nearly significant (p-value=.095): states with high income growth had smaller longevity increases, *ceteris paribus*. Some previous investigators have also found evidence of a non-monotonic or even inverse relationship between income and longevity. Uchida et al (1992) found that "for [Japanese] females high income was the factor significantly decreasing life expectancy at 65 years of age in 1980." Hupfeld (2008) theoretically derived a non–monotonic relationship between income and longevity, based on heterogeneous elasticities of labor supply and otherwise standard assumptions. He analyzed this relationship empirically for pensioners in the public pension system in Germany, and find that "the relationship between income and life expectancy is indeed non–monotonic for major sub–groups in the data." And Ruhm (2004) argued that "although health is conventionally believed to deteriorate during macroeconomic downturns, the empirical evidence supporting this view is quite weak and comes from studies containing methodological shortcomings that are difficult to remedy. Recent research that better controls for many sources of omitted variables bias instead suggests that mortality decreases and physical health improves when the economy temporarily weakens. This partially reflects reductions in external sources of death, such as traffic fatalities and other accidents, but changes in lifestyles and health behaviors are also likely to play a role."

Models 3 and 4 are similar to models 1 and 2, but instead of FDA_YEAR, the measure of drug vintage is the fraction of prescriptions containing ingredients approved by the FDA after

1990 (POST1990%). The estimates of these two models are qualitatively similar to the estimates of models 1 and 2. The coefficient on POST1990% is positive and highly significant, and is larger when other factors are included than it is when they are excluded.

Models 5 and 6 use the third measure of drug vintage: the fraction of prescriptions containing ingredients approved by the FDA after 1995 (POST1995%). Once again, the drug vintage coefficient is positive and significant, and larger (albeit by a smaller margin) when other factors are controlled for. In this case, however, none of the coefficients on the other factors are close to being statistically significant.

The estimates of models 1-6 indicate that (1) there is a highly significant relationship across states between the increase in drug vintage and the increase in life expectancy, and (2) controlling for some other potentially important determinants of life expectancy, and changing the measure of drug vintage, has little effect on this relationship. Models 7-12 are similar to models 1-6, but in these models the dependent variable is the log of the age-adjusted mortality rate. The age-adjusted mortality rate and life expectancy at birth both depend on (are functions of) age-specific mortality rates, but they depend on them in different ways. The estimates of models 7-12 indicate that (1) there is a highly significant relationship across states between the increase in drug vintage and the decline in the age-adjusted mortality rate, and (2) controlling for some other potentially important determinants of the age-adjusted mortality rate, and changing the measure of drug vintage, has little effect on this relationship.

The parameter estimates can be used to estimate how much of the 1.7-year increase in life expectancy during the period 2000-2007 was attributable to the increase in drug vintage, i.e. to the use of newer drugs. These calculations are shown in the following table.

Model	2	4	6
Vintage measure	FDA_YEAR	post1990%	post1995%
2000-2007 change in vintage measure (Δ)	2.6	12%	5%
β	0.326	8.611	10.064
$\beta * \Delta$	0.8	1.0	0.5

Model 2, based on the FDA_YEAR drug vintage measure, implies that use of newer drugs increased life expectancy at birth by 0.8 years (almost half of the actual increase in life expectancy) during the period 2000-2007. Model 4, based on the POST1990% drug vintage measure, implies that use of newer drugs increased life expectancy by a larger amount: 1.0 years.

Model 6, based on the POST1995% drug vintage measure, implies that use of newer drugs increased life expectancy by a smaller amount: 0.5 years. The mean of these three estimates is 0.8 years.

The parameter estimates can also be used to obtain a rough assessment of the overall cost-effectiveness of pharmaceutical innovation. We define the incremental cost-effectiveness ratio (ICER) as follows:

$$\text{ICER} = \frac{\text{change in lifetime drug expenditure due to pharmaceutical innovation}}{\text{change in life expectancy due to pharmaceutical innovation}}$$

The underlying calculations are shown in the following table.

Year	Life expectancy	annual drug expenditure in constant 2000 €[1]	lifetime drug expenditure (= life expectancy * annual drug expenditure)
2000	78.1	€ 300	€ 23,430
2006	78.8[2]	€ 364	€ 28,683
change	0.7		€ 5,253

1: Source: 2009 OECD Health Database

2: "Predicted" life expectancy in 2006 = $LE_{2000} + \beta\ (VINT_{2006} - VINT_{2000})$

German life expectancy at birth was 78.1 years in 2000. The mean of the estimates of β from models 2, 4, and 6 implies that the increase in drug vintage increased life expectancy by 0.7 years between 2000 and 2006. According to the 2009 OECD Health Database, per capita expenditure (in constant 2000 €) on prescription drugs increased from € 300 in 2000 to € 364 in 2006. Assuming that this increase was entirely due to use of newer drugs, pharmaceutical innovation increased lifetime drug expenditure by € 5,253. The implied ICER is € 7512 (= € 5,253 / 0.70 years) per life-year. This is a small fraction of leading economists' estimates of the value of (willingness to pay for) an additional year of life. Moreover, while use of newer drugs undoubtedly increases pharmaceutical expenditure, there is evidence that it reduces other medical expenditure (especially hospital expenditure (Lichtenberg (2009)), so the true ICER may be lower than € 7512.

III. French cancer mortality

Now I will investigate the effect of the vintage of chemotherapy treatments on mortality rates of French cancer patients, using longitudinal, annual, cancer-site (breast, colon, lung, etc.) level data during the period 2002-2006.

Two types of statistics are used to measure cancer mortality: survival rates and mortality rates. Survival rates are typically expressed as the proportion of patients alive at some point subsequent to the diagnosis of their cancer. For example, the observed 5-year survival rate is defined as follows:

5-year Survival Rate = Number of people diagnosed with cancer at time t alive at time t+5 / Number of people diagnosed with cancer at time t
= 1 – (Number of people diagnosed with cancer at time t dead at time t+5 / Number of people diagnosed with cancer at time t)

Hence, the survival rate is based on a *conditional* (upon previous diagnosis) mortality rate. The second type of statistic is the *unconditional* cancer mortality rate: the number of deaths, with cancer as the underlying cause of death, occurring during a year per 100,000 population.

The outcome measure I will analyze is the *unconditional* (age-adjusted) cancer mortality rate. Longitudinal, cancer-site level data on conditional mortality (or survival) are not available during the period for which we have chemotherapy treatment data (2002-2006), although they are available for earlier years.[13] Moreover, Welch et al (2000) argued that "while 5-year survival is a perfectly valid measure to compare cancer therapies in a randomized trial, comparisons of 5-year survival rates across time (or place) may be extremely misleading. If cancer patients in the past always had palpable tumors at the time of diagnosis while current cancer patients include those diagnosed with microscopic abnormalities, then 5-year survival would be expected to increase over time even if new screening and treatment strategies are ineffective." Consequently, Welch et al (2000) concluded that "to avoid the problems introduced by changing patterns of diagnosis…progress against cancer [should] be assessed using [unconditional] population-based mortality rates."

[13] The Eurocare 3 and Eurocare 4 databases (http://www.eurocare.it/Home/tabid/36/Default.aspx) provide data on survival rates of French cancer patients diagnosed during the following periods: 1983-1985, 1986-1988, 1989-1991, 1992-1994, and 1995-1999.

A. Econometric model

I will estimate models of the following form:

$$\ln (AAMORT)_{st} = \beta\ VINTAGE_{st} + \alpha_s + \delta_t + \varepsilon_{st} \qquad (2)$$

where

$\ln (AAMORT_{st})$ = the log of the age-adjusted mortality rate from cancer at site s in year t (s=1,…,24; t=20002,…,2006)

VINTAGE is one of the following variables:

$LAUNCH\_YEAR_{st}$ = the (weighted) mean world launch year of chemotherapy treatments for cancer site s in year t

$POST1985\%_{st}$ = the percent of chemotherapy treatments for cancer site s in year t that contained ingredients launched after 1985

$POST1990\%_{st}$ = the percent of chemotherapy treatments for cancer site s in year t that contained ingredients launched after 1990

α_s and δ_t represent cancer-site fixed effects and year fixed effects, respectively. A significant negative drug vintage coefficient (β) in eq. (2) would indicate that cancer sites that had above-average increases in drug vintage had above-average reductions in the age-adjusted mortality rate.

Eq. (2) will be estimated by weighted least squares, weighting by the mean of each cancer site's mortality rate during the entire sample period ($(1 / T) \sum_t AAMORT_{st}$). The estimation procedure will account for clustering of disturbances within cancer sites.

The drug vintage measure LAUNCH_YEAR will be constructed as follows:

$$LAUNCH\_YEAR_{st} = \frac{\Sigma_c\ N\_PATIENTS_{cst}\ INTRO\_YEAR_c}{\Sigma_c\ N\_PATIENTS_{cst}}$$

where

$N\_PATIENTS_{cst}$ = the number of patients with cancer at site s who were treated with chemotherapy agent c in year t

$INTRO\_YEAR_c$ = the year in which chemotherapy agent c was first launched

The drug vintage measure POST1985% will be constructed as follows:

$$POST1985\%_{st} = \frac{\Sigma_c \, N\_PATIENTS_{cst} \, INTRO\_YEAR\_GT\_1985_c}{\Sigma_c \, N\_PATIENTS_{cst}}$$

where

$INTRO\_YEAR\_GT\_1985_c$ = 1 if chemotherapy agent c was first launched after 1985

= 0 otherwise

POST1990% will be constructed in a similar fashion.

The only explanatory variable in eq. (2) (aside from the cancer-site fixed effects and year fixed effects) is chemotherapy vintage. Cancer mortality rates are also likely to depend on other cancer-site-specific, time-varying variables, and these might be correlated with drug vintage. In particular, mortality rates are likely to depend on (1) incidence rates, and (2) non-pharmaceutical innovation. Unfortunately, data on cancer incidence and non-pharmaceutical innovation, by cancer site, are not available for France during the period covered by our chemotherapy data.[14] However, in a recent paper based on U.S. cancer data during the period 1996-2006, Lichtenberg (2010) found that, although pharmaceutical innovation, non-pharmaceutical innovation, and incidence all had significant effects on cancer mortality rates, controlling for the latter two variables had virtually no effect on the pharmaceutical innovation coefficient.

B. Data and descriptive statistics

Pharmaceutical data. Data on the number of patients with cancer at site s who were treated with chemotherapy agent c in year t ($N\_PATIENTS_{cst}$) were obtained from IMS Health's Oncology Analyzer database.[15] IMS collected data on the frequency with which 11 chemotherapy agents were administered to a sample of about 20,000 French cancer patients during the period 2002-2006. As the following table shows, the size of the sample increased over time:

Year	Number of sample patients
2002	2713
2003	3195
2004	3767
2005	5063
2006	5217

[14] Data on non-pharmaceutical innovation are not available for any period. According to the European Cancer Observatory, annual data on cancer incidence, by site, are only available during the period 1983-1997 (http://eu-cancer.iarc.fr/16-table.html,en).

[15] If a patient was treated with n chemotherapy agents, that patient would be counted n times.

The eleven drugs (ranked by frequency of use), and the years in which they were launched, are shown in the following table:

frequency rank	chemotherapy agent	world launch year
1	doxorubicin	1971
2	epirubicin	1984
3	gemcitabine	1995
4	carboplatin	1985
5	docetaxel	1995
6	paclitaxel	1992
7	vinorelbine	1989
8	imatinib	2001
9	capecitabine	1998
10	temozolomide	1999
11	pemetrexed	2004

Table 4 shows the number of sample patients during 2002-2006, by cancer site. The two cancer sites with the largest number of patients were breast and lung. The three chemotherapy agents most frequently used to treat each of the five cancer sites with the largest numbers of patients are shown in Table 5.[16]

Mortality data. Data on age-adjusted[17] mortality rates, by cancer site, were obtained from the Centre d'épidémiologie sur les causes médicales de décès, Institut national de la santé et de la recherche médicale (http://www.cepidc.vesinet.inserm.fr/inserm/html/index2.htm).

The complete dataset used for estimation is shown in Appendix Table 3.

C. Empirical results

Estimates of chemotherapy vintage coefficients (β) from different versions of eq. (2) are shown in Table 6. The first three estimates are based on the full set of cancer sites. In model 1, the vintage measure is the (weighted) mean world launch year of chemotherapy treatments. The coefficient on LAUNCH_YEAR is negative and highly significant (p-value = .008). This indicates that cancer sites for which there were larger increases in chemotherapy vintage had larger reductions in the age-adjusted mortality rate. A 10-year increase in mean drug vintage is estimated to reduce the age-adjusted mortality rate by about 6%. Models 2 and 3 indicate that

[16] Only two drugs were used to treat Hodgkin's disease among sample patients.
[17] The age distribution of the French population in 2002 was used to obtain age-adjusted mortality rates.

Table 4
Number of sample patients during 2002-2006, by cancer site

Cancer site	Number of sample patients, 2002-2006
BREAST	5027
LUNG	4270
NHL	2245
OVARIAN	1534
HODGKINS DISEASE	834
PANCREAS	819
CML	648
BRAIN	461
M.MYELOMA & MALIG PLASMA CELL	401
HEAD & NECK	379
COLORECTAL	332
BLADDER	277
PROSTATE	246
LIVER	243
STOMACH	152
CLL	146
CORPUS UTERI	94
OESOPHAGUS	77
ALL	59
MELANOMA	26
KIDNEY	20
OTHER LEUKAEMIAS	9
AML	4
THYROID	4
CERVIX UTERI	2
MYELOID LEUKAEMIA OTHER/UNSPEC	1
OTHER	1645

Source: IMS Oncology Analyzer

Table 5

Chemotherapy agents most frequently used to treat French cancer patients during 2002-2006, by cancer site

Chemotherapy agent	Rank
BREAST	
EPIRUBICIN	1
DOCETAXEL	2
DOXORUBICIN	3
LUNG	
VINORELBINE	1
GEMCITABINE	2
CARBOPLATIN	3
NHL	
DOXORUBICIN	1
EPIRUBICIN	2
TEMOZOLOMIDE	3
OVARIAN	
CARBOPLATIN	1
PACLITAXEL	2
GEMCITABINE	3
HODGKINS DISEASE	
DOXORUBICIN	1
VINORELBINE	2

Source: IMS Oncology Analyzer

Table 6

Estimates of models of age-adjusted cancer mortality rate, France, 2002-2006

Model	Regressor	Estimate	Stderr	LowerCL	UpperCL	Z	ProbZ
	All cancer sites						
1	Launch_Year	-0.006	0.002	-0.011	-0.002	-2.665	0.008
2	post1985%	-0.122	0.034	-0.187	-0.056	-3.618	0.000
3	post1990%	-0.107	0.029	-0.165	-0.049	-3.644	0.000
	Excluding lung cancer						
4	Launch_Year	-0.008	0.002	-0.011	-0.005	-5.035	0.000
5	post1985%	-0.094	0.028	-0.150	-0.039	-3.328	0.001
6	post1990%	-0.131	0.019	-0.168	-0.094	-6.936	0.000

The estimates are weighted least-squares estimates, weighting by the mean of each cancer site's mortality rate during the entire sample period ($(1 / T) \sum_t AAMORT_{st}$). All equations include fixed cancer-site effects and fixed year effects. Standard errors are clustered within cancer sites.

the change in the age-adjusted mortality rate was also inversely correlated with the other two measures of chemotherapy vintage (POST1985% and POST1990%). Model 2 implies that the mortality rate would be about 12% lower if only post-1985 drugs were used than it would be if only pre-1986 drugs were used.

As noted earlier, these are weighted least-squares estimates, where the weight is the mean of each cancer site's mortality rate during the entire sample period. As shown in Figure 3, the mortality rate for lung cancer is far higher than it is for other types of cancer. Therefore, the estimates of models 1-3 give a great deal of weight to the lung cancer data. Models 4-6 are estimates based on the full set of cancer sites except lung cancer. All three drug vintage coefficients remain negative and highly significant when lung cancer is excluded from the sample. Excluding lung cancer increases the magnitude of β by about 25% in models 4 and 6, but reduces the magnitude of β by about 25% in model 5.

According to Eurostat,[18] the age-adjusted mortality rate from malignant neoplasms in France declined by 6% between 2002 and 2006. The parameter estimates can be used to estimate how much of this decline was attributable to the increase in drug vintage, i.e. to the use of newer chemotherapy agents. The decline in the age-adjusted mortality rate attributable to the 2002-2006 increase in drug vintage is $\beta * \Delta$, where $\Delta = (V_{2006} - V_{2002})$ and V_t = mean drug vintage in year t.

There are two different data sources from which we can calculate Δ. The first is the IMS Oncology Analyzer database. As noted above, this contains data on the use of 11 cancer drugs by about 4000 patients per year during the period 2002-2006. The second data source is the Groupement pour l 'Elaboration et la Réalisation de Statistiques (GERS, http://www.gie-gers.fr/index.php3). This source provides annual data on the use of all (106) cancer drugs by all cancer patients in France during the period 1998-2007.[19]

Table 7 shows a comparison of chemotherapy vintage measures derived from the IMS Oncology Analyzer and GERS databases.[20] The GERS estimates of the 2002-2006 increase in mean vintage are about three times as large as the IMS estimates. For example, the GERS data

[18] Source: Eurostat hlth_cd_asdr dataset.
[19] GERS provides data on the quantity of each drug, by year, but not by cancer site.
[20] The GERS vintage measures are based on the year each drug was first commercialized in France, rather than the world launch year, which is not available for all drugs. For the 11 drugs for which both dates were available, there is generally a close correspondence between the two dates. For 8 out of the 11 drugs, the year of commercialization in France was 0-2 years after the world launch year.

Figure 3
Number of deaths per 100,000 population, by cancer site, France, 2006

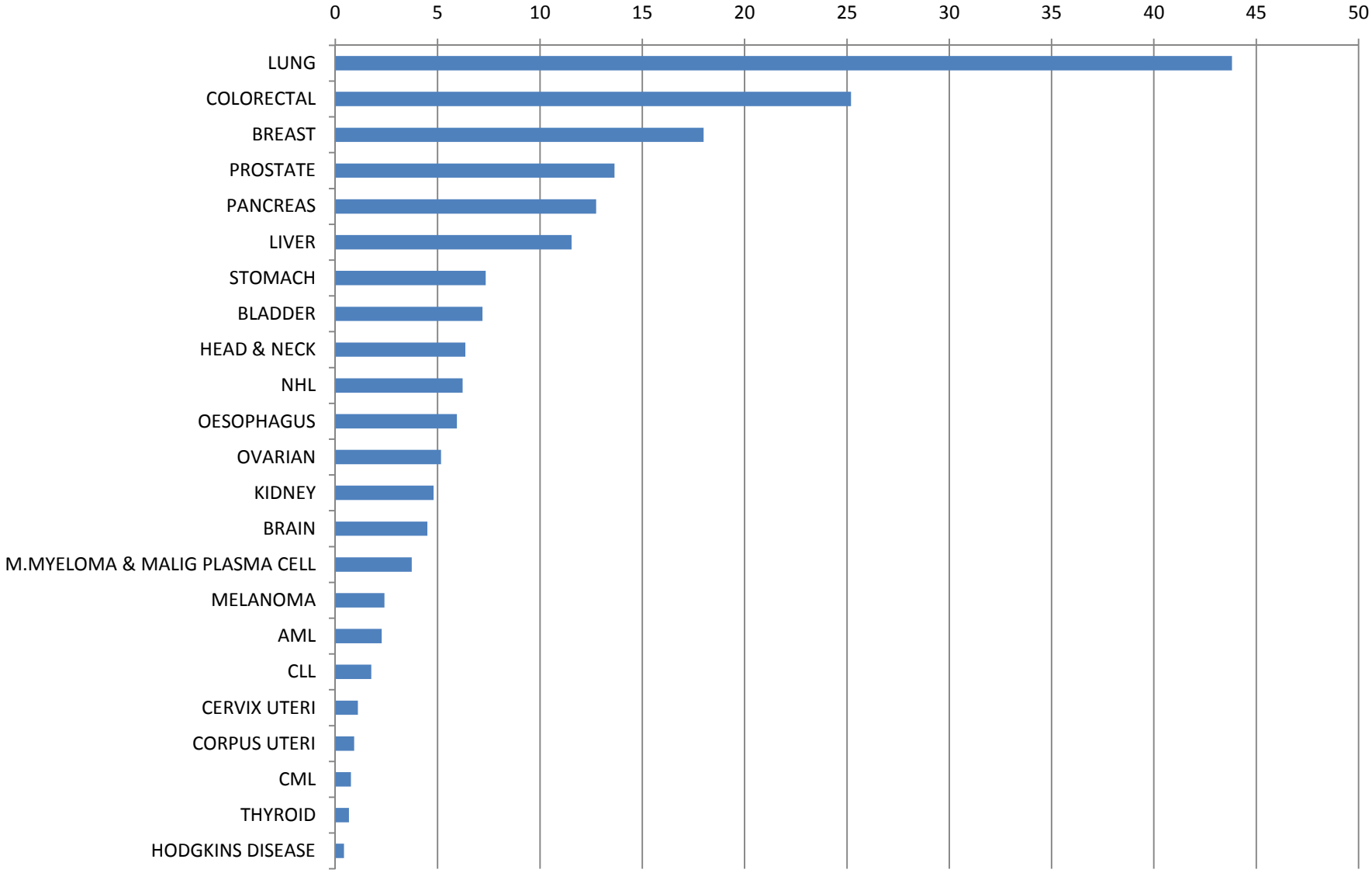

Table 7

Comparison of chemotherapy vintage measures derived from IMS Oncology Analyzer and GERS databases

year	N		LAUNCH_YEAR		POST1985%		POST1990%	
	IMS	GERS	IMS	GERS	IMS	GERS	IMS	GERS
1998		109,507,687		1978.3		30%		10%
1999		111,235,927		1978.9		32%		15%
2000		115,983,400		1979.6		35%		19%
2001		124,227,347		1980.7		38%		25%
2002	2713	138,344,711	1985.6	1982.1	47%	44%	37%	32%
2003	3195	150,057,851	1986.2	1984.0	50%	53%	39%	41%
2004	3767	156,556,767	1986.3	1985.7	49%	60%	43%	49%
2005	5063	157,138,449	1987.3	1986.8	53%	64%	46%	57%
2006	5217	167,624,451	1987.4	1987.6	53%	67%	46%	61%
2007		175,757,939		1988.1		69%		63%
2006 - 2002			1.8	5.5	7%	23%	9%	29%

imply that mean LAUNCH_YEAR increased by 5.5 years, while the IMS data imply that it increased by only 1.8 years.

Estimates of the decline in the age-adjusted mortality rate attributable to the 2002-2006 increase in drug vintage based on both the IMS data and the GERS data are shown in the following table.

Model	1	2	3
Vintage measure	LAUNCH_YEAR	POST1985%	POST1990%
β	-0.006	-0.122	-0.107
	IMS Oncology Analyzer database		
2002-2006 change in vintage measure (Δ)	1.8	7%	9%
β ∗ Δ	-0.011	-0.008	-0.010
	GERS database		
2002-2006 change in vintage measure (Δ)	5.5	23%	29%
β ∗ Δ	-0.034	-0.028	-0.031

The estimates of Δ derived from the IMS database imply that the increase in drug vintage reduced the age-adjusted cancer mortality rate by about 1% during 2002-2006, which is about 1/6 of the total decline in the mortality rate. The estimates of Δ derived from the GERS database imply that the increase in drug vintage reduced the age-adjusted cancer mortality rate by about 3% during 2002-2006, which is about half of the total decline in the mortality rate.

IV. Summary

Longevity increase is an important part of economic growth and development. In the long run, the rate of economic growth is determined by the rate of technological progress, which is generated by private and public R&D investment. Most technological progress is embodied in new goods. Therefore, the welfare of consumers (and the productivity of producers) depends on the *vintage* of the goods (or inputs) they purchase, especially when those goods are R&D-intensive. The pharmaceutical and medical devices industries are the most R&D-intensive industries in the economy

In this paper, I have investigated the contribution of pharmaceutical innovation to recent longevity growth in Germany and France. First, I examined the effect of the vintage of

prescription drugs (and other variables) on the life expectancy and age-adjusted mortality rates of residents of Germany, using longitudinal, annual, state-level data during the period 2000-2007. Then, I examined the effect of the vintage of chemotherapy treatments on age-adjusted cancer mortality rates of residents of France, using longitudinal, annual, cancer-site-level data during the period 2002-2006.

The analysis of Germany was based on data on the utilization of over 600 active ingredients, which account for about 250 million prescriptions per year. I found that states with larger increases in drug vintage had larger increases in life expectancy. Controlling for some other potentially important determinants of life expectancy (the per capita *quantity* of drugs consumed, per capita income, the unemployment rate, the notifiable disease rate, and the AIDS case rate) and changing the measure of drug vintage, had little effect on the relationship between drug vintage and life expectancy. There was also a highly significant relationship across states between the increase in drug vintage and the decline in the age-adjusted mortality rate.

German life expectancy at birth increased by 1.7 years during the period 2000-2007. The estimates imply that almost half of this increase was due to the replacement of older drugs by newer drugs. My estimate of the cost per life-year gained from the use of newer drugs is a small fraction of leading economists' estimates of the value of (willingness to pay for) an additional year of life.

The analysis of France was based on data on the utilization of 11 cancer drugs by about 4000 cancer patients per year. I found that cancer sites for which there were larger increases in chemotherapy vintage had larger reductions in the age-adjusted mortality rate. A 10-year increase in mean drug vintage was estimated to reduce the age-adjusted mortality rate by about 6%. Changing the measure of drug vintage, and excluding lung cancer—by far the largest cause of cancer deaths in France—had little effect on the relationship between drug vintage and the cancer mortality rate. My estimates implied that chemotherapy innovation accounted for at least one-sixth of the decline in French cancer mortality rates during 2002-2006, and may have accounted for as much as half of the decline.

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Appendix Table 1
Sample coverage of drugs in 2008

	Universe (Statutory Health Insurance)				Sample				Sample/Universe	
ATC-group name	Prescriptions (millions)	Sales (millions)	Average price		Prescriptions (millions)	Sales (millions)	Average price		Prescriptions (millions)	Sales (millions)
Overall market	608.1	26677	44		259	7748	30		43%	29%
A01 Stomalogical preparations	1.2	14	11							
A02 Ulcer therapeutics	25.3	1139	45							
A03 Spasmolytics	8.5	115	14							
A04 Antiemetics and agents for sickness	2.1	73	35		2	43	20		101%	59%
A05 Bilious and liver therapy	0.4	31	76							
A06 Laxatives	2.2	42	19							
A07 Antidiarrheals	4.4	187	42							
A09 Digestives, including enzymes	0.7	58	82							
A10 Antidiabetics	29.5	1691	57		30	1084	37		101%	64%
A11 Vitamins	3.2	76	24							
A12 Minerals	3.1	78	25							
A16 Enzyme substitute	0.1	183	1833							
B01 Antithrombotical agents	15.0	862	57							
B02 Antihemorrhagics	0.3	112	373							
B03 Antianemic combinations	3.6	372	103		1	233	269		24%	63%
B05 Blood substitute drugs and perfusion solutions	3.1	161	52							
C01 Cardiac therapeutics	11.7	279	24		12	132	11		104%	47%
C02 Antihypertensives	4.3	257	60		4	78	18		100%	30%
C03 Diuretics	20.7	399	19		21	151	7		102%	38%
C04 Peripheral vasodilators	1.6	62	39		2	25	14		108%	41%
C05 Vasoprotectives	1.5	30	20		0	1	19		3%	3%
C06 Antihypotonics	0.2	5	25		0	101	1498		34%	2016%
C07 Beta-receptor blocker	35.0	691	20		35	253	7		100%	37%
C08 Calcium antagonists	17.4	331	19		18	135	8		103%	41%
C09 Angiotensin inhibitor	46.2	1889	41		47	1109	24		101%	59%
C10 Antilipemics	16.9	736	44		17	433	25		101%	59%
D01 Antifungals (topical)	4.2	90	21							
D02 Agents for skin protection	0.8	9	11							
D03 Wound treatment agents	0.5	6	12							
D04 Antipruriginous agents	0.8	6	7							
D05 Antipsoriatics	0.8	70	87							
D06 Antiinfectives (dermatological)	2.5	49	20							
D07 Corticosteroids (dermatological)	9.1	163	18							
D08 Antiseptics and disinfective agents	0.8	7	9							

Appendix Table 1
Sample coverage of drugs in 2008

	Universe (Statutory Health Insurance)				Sample				Sample/Universe	
ATC-group name	Prescriptions (millions)	Sales (millions)	Average price		Prescriptions (millions)	Sales (millions)	Average price		Prescriptions (millions)	Sales (millions)
D09 Medical bandages	0.5	19	38							
D10 Anti-acne preparations	1.7	41	24							
D11 Other dermatological preparations	1.4	39	28							
G01 Gynaecological antiinfectivs	1.5	22	15							
G02 Other gynecologicals	0.4	15	38							
G03 Sexual hormones	12.8	424	33							
G04 Urological drugs	6.2	313	51							
H01 Pituitary/hypothalamic hormones	0.4	324	810							
H02 Corticosteroids (systemic)	7.9	155	20							
H03 Thyroids therapeutics	20.0	316	16							
H05 Calcium homoeostasis	0.1	58	583							
J01 Antibiotics	39.1	753	19							
J02 Antifungals	0.6	68	113							
J05 Antivirals	1.6	663	414							
J06 Immune sera and immunoglobulins	0.3	185	617							
J07 Vaccines	1.3	134	103							
L01 Antineoplastic agents	1.0	843	843		1	619	612		101%	73%
L02 Hormone antagonists	1.5	578	385		2	442	285		103%	77%
L03 Immunostimulants	1.2	1156	964		1	787	1163		56%	68%
L04 Immunosuppressants	2.1	1370	652		1	464	310		71%	34%
M01 Antiphlogistics/anti-inflammatory drugs	37.4	607	16		35	163	5		94%	27%
M02 Anti-inflammatory agens (topical)	1.3	16	12							
M03 Muscle relaxants	4.0	134	33							
M04 Gout agents	6.5	94	14							
M05 Osteoporosis agents	3.0	417	139							
N01 Anesthetics	0.3	8	26							
N02 Analgesics	33.9	1398	41							
N03 Antiepileptics	7.9	630	80							
N04 Anti parkinson drugs	5.7	499	87		5	330	64		91%	66%
N05 Psycholeptics	25.4	1103	43							
N06 Psychoanaleptics	20.7	1159	56							
N07 Anti vertiginous and addiction therapeutics	2.7	109	40		1	198	157		47%	182%

Appendix Table 1
Sample coverage of drugs in 2008

	Universe (Statutory Health Insurance)				Sample				Sample/Universe	
ATC-group name	Prescriptions (millions)	Sales (millions)	Average price		Prescriptions (millions)	Sales (millions)	Average price		Prescriptions (millions)	Sales (millions)
P01 Agents againt protozoa	0.7	14	20							
P02 Anthelmintics	0.3	8	25							
P03 Insecticides and repellents	0.7	14	20							
R01 Rhinologic drugs	11.1	85	8							
R02 Throat and pharynx therapeutics	0.6	4	7							
R03 Anti-asthma medication	24.3	1458	60		24	953	40		99%	65%
R04 Chest ointment and other inhalants	0.4	3	7							
R05 Cough and cold preparations	17.5	181	10							
R06 Antihistamines	3.1	73	23							
S01 Ophthalmic drugs	15.6	448	29							
S02 Otologicals	1.3	19	15							
S03 Ophthalmic drugs/otologicals	0.7	12	17							
V01 Allergenes	0.9	300	333							
V03 Antidotes/other agents	0.6	114	190		0	16	157		17%	14%
V10 Therapeutic radiopharmaceuticals	0.0	1								

Sales figures from the Statutory Health Insurance are at the level of public price (pharmacy selling price including VAT), whereas sales figures from IMS in the sample are at the level of ex-factory price. According to the VFA (http://www.vfa.de/en/statistics/pharmaceuticalmarket/), sales at ex-factory price level accounted for 58% of sales at public price level (23.8 bn. EUR of 41 bn. EUR) in the total pharmacy market (=SHI + private insurance + OTC). Therefore the sample covers approx. 50% of SHI pharmaceutical expenditures rather than the directly calculated 29% shown in the table. Also, SHI data are based on the ATC drug classification, while IMS data are based on the EphMRA classification, which may cause some drugs to be classified differently between “universe” and sample.

Pharmaceutical groups in the Statutory Health Insurance (prescriptions in millions, turnover in million €).
Classification: years, Germany, ATC-groups (2. level)
http://www.gbe-bund.de/
Home > Health Care System > Pharmaceutical Supply, Aids and Appliances/Non-medical Therapy > Pharmaceuticals > Table (ad hoc): Pharmaceutical by ATC-groups
Year: 2008

Appendix Table 2
Complete German dataset

State	year	Number of prescriptions (packs) (millions)	Mean FDA approval year	Post-1990 prescriptions as % of total prescriptions	Post-1995 prescriptions as % of total prescriptions	Number of prescriptions per person	Life expectancy at birth	Age-adjsuted mortality rate	Population (millions)	Unemployment rate	GDP (Euros per inhabitant)	Notifiable diseases per 100,000 inhabitants	New aids cases per 100,000
Baden-Wuerttemberg	2000	25.2	1983.3	33%	8%	2.41	79.2	810.6	10.49	4.1%	28,343		0.32
Baden-Wuerttemberg	2001	26.6	1983.9	36%	10%	2.52	79.6	782.9	10.56	3.7%	29,308	284.1	0.36
Baden-Wuerttemberg	2002	27.4	1984.3	37%	11%	2.58	79.7	778.0	10.63	4.4%	29,350	257.9	0.23
Baden-Wuerttemberg	2003	28.9	1984.6	38%	13%	2.71	79.8	783.1	10.68	5.7%	29,530	229.8	0.19
Baden-Wuerttemberg	2004	26.1	1985.1	41%	14%	2.44	80.5	725.9	10.71	6.6%	29,845	230.3	0.27
Baden-Wuerttemberg	2005	26.6	1985.1	42%	12%	2.48	80.6	721.7	10.73	7.0%		252.4	0.26
Baden-Wuerttemberg	2006	27.1	1985.5	44%	13%	2.52	81.0	692.9	10.74	6.3%	31,427	279.9	0.17
Baden-Wuerttemberg	2007	27.9	1985.9	46%	14%	2.60	81.1	687.0	10.75	4.9%		402.8	0.15
Baden-Wuerttemberg	2008	29.0	1986.2	48%	15%					4.2%			
Bayern	2000	30.0	1983.1	34%	8%	2.46	78.5	858.5	12.19	4.0%	29,487		0.48
Bayern	2001	31.8	1983.9	37%	10%	2.59	78.8	833.5	12.28	3.8%	30,090	234.4	0.42
Bayern	2002	32.5	1984.3	39%	11%	2.63	78.9	831.6	12.36	4.5%	30,671	255.0	0.37
Bayern	2003	34.4	1984.6	40%	12%	2.77	79.0	834.5	12.40	6.1%	30,783	234.9	0.30
Bayern	2004	30.5	1985.0	43%	13%	2.46	79.7	783.4	12.43	6.8%	31,601	244.1	0.43
Bayern	2005	31.4	1985.2	44%	12%	2.52	79.7	780.5	12.46	7.0%		292.5	0.32
Bayern	2006	32.1	1985.6	46%	13%	2.57	80.0	762.8	12.48	6.5%	33,217	295.2	0.27
Bayern	2007	32.7	1985.9	48%	14%	2.61	80.2	744.3	12.50	5.3%		427.3	0.23
Bayern	2008	33.9	1986.3	50%	15%					4.2%			
Berlin	2000	8.6	1982.8	30%	9%	2.54	78.0	879.0	3.38	14.4%	23,162		6.50
Berlin	2001	8.9	1983.3	32%	10%	2.63	78.4	855.2	3.39	15.1%	23,245	351.7	5.11
Berlin	2002	9.5	1983.7	34%	11%	2.79	78.2	866.3	3.39	15.6%	23,210	417.0	5.10
Berlin	2003	10.1	1984.0	35%	12%	2.99	78.5	857.4	3.39	18.0%	23,046	340.2	5.04
Berlin	2004	9.0	1984.3	37%	13%	2.65	79.1	814.7	3.39	19.1%	22,896	392.2	5.79
Berlin	2005	9.1	1984.5	38%	12%	2.70	79.2	802.1	3.39	19.2%		465.2	5.22
Berlin	2006	9.4	1985.0	40%	13%	2.77	79.5	774.7	3.40	18.7%	23,689	425.3	5.50
Berlin	2007	9.4	1985.5	43%	14%	2.77	79.9	752.6	3.41	16.3%		654.1	5.05
Berlin	2008	9.8	1986.0	46%	15%					15.1%			
Brandenburg	2000	8.2	1983.2	31%	9%	3.16	77.1	965.6	2.60	16.3%	17,298		0.38
Brandenburg	2001	8.5	1983.7	33%	10%	3.29	77.5	933.5	2.60	16.9%	17,697	372.5	0.27
Brandenburg	2002	8.8	1984.2	35%	11%	3.39	77.6	934.1	2.59	16.9%	18,015	509.7	0.54
Brandenburg	2003	9.5	1984.7	37%	13%	3.69	77.6	931.5	2.58	18.3%	18,199	465.5	0.43
Brandenburg	2004	8.4	1985.2	39%	14%	3.27	78.2	875.5	2.57	19.2%	18,778	479.3	0.54
Brandenburg	2005	8.7	1985.3	40%	13%	3.38	78.6	853.9	2.56	18.1%		541.2	0.23
Brandenburg	2006	8.9	1985.6	42%	13%	3.47	78.8	837.9	2.55	16.5%	19,652	518.7	0.74
Brandenburg	2007	9.0	1986.0	44%	14%	3.53	79.0	825.3	2.54	13.8%		879.5	0.90
Brandenburg	2008	9.3	1986.5	47%	15%					11.5%			
Bremen	2000	2.0	1982.5	30%	8%	2.96	77.4	883.8	0.66	10.0%	33,423		1.21
Bremen	2001	2.0	1982.9	32%	9%	3.05	77.9	849.4	0.66	8.7%	34,421	271.8	1.21
Bremen	2002	2.1	1983.1	33%	9%	3.13	77.8	871.2	0.66	10.0%	35,279	429.5	1.51

Appendix Table 2
Complete German dataset

State	year	Number of prescriptions (packs) (millions)	Mean FDA approval year	Post-1990 prescriptions as % of total prescriptions	Post-1995 prescriptions as % of total prescriptions	Number of prescriptions per person	Life expectancy at birth	Age-adjsuted mortality rate	Population (millions)	Unemployment rate	GDP (Euros per inhabitant)	Notifiable diseases per 100,000 inhabitants	New aids cases per 100,000
Bremen	2003	2.1	1983.2	33%	9%	3.23	78.1	863.3	0.66	11.4%	35,904	319.0	0.45
Bremen	2004	1.9	1983.4	35%	9%	2.85	78.6	820.8	0.66	14.6%	36,666	332.4	0.75
Bremen	2005	1.9	1983.7	37%	9%	2.93	78.7	812.7	0.66	16.5%		316.2	0.60
Bremen	2006	2.0	1984.1	38%	10%	2.96	79.2	777.4	0.66	14.4%	38,211	231.8	1.96
Bremen	2007	2.0	1984.4	40%	11%	3.05	79.0	778.3	0.66	11.9%		444.6	1.06
Bremen	2008	2.1	1984.8	42%	11%					9.5%			
Hamburg	2000	4.5	1983.1	31%	8%	2.65	78.3	849.6	1.71	7.7%	42,422		4.27
Hamburg	2001	4.7	1983.5	33%	10%	2.72	78.7	820.7	1.72	7.0%	44,402	360.0	4.13
Hamburg	2002	4.8	1983.9	34%	11%	2.81	78.6	841.5	1.73	8.2%	44,908	466.2	4.05
Hamburg	2003	4.9	1984.1	35%	12%	2.85	78.8	829.6	1.73	9.6%	45,020	357.9	4.44
Hamburg	2004	4.4	1984.3	36%	12%	2.54	79.2	801.6	1.74	10.6%	45,724	369.7	4.55
Hamburg	2005	4.4	1984.5	37%	11%	2.52	79.5	782.9	1.74	10.4%		385.3	3.56
Hamburg	2006	4.4	1984.9	39%	12%	2.54	79.9	762.6	1.75	9.8%	48,611	509.7	3.03
Hamburg	2007	4.5	1985.3	41%	13%	2.55	80.0	753.2	1.76	8.9%		705.4	2.72
Hamburg	2008	4.6	1985.7	44%	14%					7.1%			
Hessen	2000	16.2	1982.6	31%	7%	2.67	78.6	856.5	6.06	5.8%	30,223		1.54
Hessen	2001	17.0	1983.1	33%	9%	2.79	79.0	825.1	6.07	5.5%	31,203	224.2	1.45
Hessen	2002	17.4	1983.4	34%	10%	2.86	78.9	828.9	6.08	5.9%	31,407	242.0	1.28
Hessen	2003	18.2	1983.8	36%	11%	2.99	78.9	835.8	6.09	7.1%	32,151	228.8	1.10
Hessen	2004	16.4	1984.3	38%	12%	2.69	79.6	784.0	6.09	7.9%	32,641	224.1	1.23
Hessen	2005	16.7	1984.6	40%	12%	2.74	79.9	762.8	6.09	8.4%		244.4	1.15
Hessen	2006	16.9	1985.1	42%	13%	2.78	80.3	736.5	6.08	8.1%	34,369	243.7	1.00
Hessen	2007	17.0	1985.5	44%	13%	2.81	80.3	740.2	6.07	7.3%		425.3	0.64
Hessen	2008	17.5	1985.9	47%	15%					6.4%			
Mecklenburg-Vorpommern	2000	6.4	1983.1	31%	9%	3.59	76.4	1000.6	1.78	16.4%	16,860		0.17
Mecklenburg-Vorpommern	2001	6.6	1983.8	34%	11%	3.74	76.9	958.8	1.77	18.5%	17,343	456.7	0.45
Mecklenburg-Vorpommern	2002	6.8	1984.3	35%	12%	3.89	77.1	947.5	1.75	19.1%	17,624	739.0	0.40
Mecklenburg-Vorpommern	2003	7.3	1985.0	38%	14%	4.19	77.2	947.2	1.74	20.2%	17,904	621.9	0.52
Mecklenburg-Vorpommern	2004	6.4	1985.5	40%	15%	3.69	77.8	895.9	1.73	22.1%	18,450	681.2	0.46
Mecklenburg-Vorpommern	2005	6.6	1985.7	42%	14%	3.83	78.0	882.1	1.71	21.3%		664.0	0.41
Mecklenburg-Vorpommern	2006	6.7	1986.1	43%	15%	3.94	78.5	851.5	1.70	19.2%	19,193	707.9	0.24
Mecklenburg-Vorpommern	2007	6.7	1986.4	45%	15%	3.98	78.7	843.5	1.69	17.4%		981.6	0.18
Mecklenburg-Vorpommern	2008	7.0	1986.9	48%	16%					14.6%			
Niedersachsen	2000	21.7	1982.6	30%	7%	2.74	78.0	884.6	7.91	6.6%	22,767		0.34
Niedersachsen	2001	23.1	1983.1	32%	9%	2.91	78.4	860.5	7.94	6.4%	22,904	257.0	0.43
Niedersachsen	2002	24.2	1983.5	34%	10%	3.04	78.4	860.7	7.97	7.2%	22,796	333.2	0.43
Niedersachsen	2003	25.6	1983.9	35%	11%	3.21	78.3	868.9	7.99	8.5%	22,965	277.3	0.43
Niedersachsen	2004	22.6	1984.3	37%	12%	2.82	79.0	815.2	8.00	9.5%	23,402	279.3	0.48
Niedersachsen	2005	23.0	1984.5	39%	11%	2.88	79.2	807.7	8.00	10.4%		295.2	0.43

Appendix Table 2
Complete German dataset

State	year	Number of prescriptions (packs) (millions)	Mean FDA approval year	Post-1990 prescriptions as % of total prescriptions	Post-1995 prescriptions as % of total prescriptions	Number of prescriptions per person	Life expectancy at birth	Age-adjsuted mortality rate	Population (millions)	Unemployment rate	GDP (Euros per inhabitant)	Notifiable diseases per 100,000 inhabitants	New aids cases per 100,000
Niedersachsen	2006	23.5	1984.8	40%	12%	2.94	79.5	784.2	7.99	9.7%	24,897	311.4	0.41
Niedersachsen	2007	24.1	1985.2	42%	13%	3.03	79.7	771.6	7.98	7.9%		434.3	0.45
Niedersachsen	2008	25.0	1985.5	44%	14%					7.1%			
Nordrhein-Westfalen	2000	52.2	1983.0	31%	8%	1.51	77.9	906.3	18.00	6.5%	25,236		1.33
Nordrhein-Westfalen	2001	54.7	1983.4	34%	10%	1.53	78.2	877.1	18.03	6.0%	25,622	242.7	1.20
Nordrhein-Westfalen	2002	56.4	1983.7	35%	10%	1.61	78.2	880.9	18.06	7.2%	25,944	243.4	1.13
Nordrhein-Westfalen	2003	59.1	1984.1	36%	11%	1.69	78.2	883.6	18.08	8.8%	26,073	232.4	1.15
Nordrhein-Westfalen	2004	52.5	1984.5	38%	12%	1.50	78.8	840.3	18.07	9.5%	26,728	254.6	1.00
Nordrhein-Westfalen	2005	53.6	1984.6	39%	11%	1.53	78.9	828.7	18.06	10.4%		290.9	1.01
Nordrhein-Westfalen	2006	53.9	1984.9	40%	12%	1.54	79.4	799.7	18.04	9.8%	28,022	311.8	0.98
Nordrhein-Westfalen	2007	55.3	1985.3	42%	12%	1.58	79.4	791.4	18.01	8.3%		493.6	0.92
Nordrhein-Westfalen	2008	57.2	1985.6	44%	13%					7.4%			
Rheinland-Pfalz	2000	11.8	1983.2	33%	8%	2.94	78.1	885.0	4.03	5.8%	22,587		0.67
Rheinland-Pfalz	2001	12.2	1983.7	35%	10%	3.03	78.4	867.5	4.04	5.0%	22,531	279.7	0.74
Rheinland-Pfalz	2002	12.8	1984.0	36%	10%	3.16	78.5	865.3	4.05	5.6%	23,042	345.8	0.47
Rheinland-Pfalz	2003	13.5	1984.2	37%	11%	3.32	78.4	879.7	4.06	6.3%	23,161	369.6	0.35
Rheinland-Pfalz	2004	11.9	1984.7	39%	12%	2.94	79.2	819.3	4.06	7.0%	23,853	386.6	0.15
Rheinland-Pfalz	2005	12.2	1984.9	41%	12%	3.02	79.2	818.6	4.06	8.7%		388.5	0.39
Rheinland-Pfalz	2006	12.4	1985.3	42%	13%	3.06	79.7	786.9	4.05	8.0%	24,618	362.4	0.44
Rheinland-Pfalz	2007	12.7	1985.7	44%	14%	3.14	79.8	774.7	4.05	6.0%		632.6	0.22
Rheinland-Pfalz	2008	13.2	1986.1	47%	15%					5.6%			
Saarland	2000	2.8	1983.0	32%	8%	2.62	77.1	961.9	1.07	7.3%	23,124		0.19
Saarland	2001	2.9	1983.6	34%	9%	2.76	77.3	946.2	1.07	5.9%	23,566	230.8	0.19
Saarland	2002	3.9	1984.0	36%	10%	3.69	77.6	937.4	1.07	7.6%	23,691	342.4	0.38
Saarland	2003	4.1	1984.3	37%	12%	3.87	77.1	960.9	1.06	8.3%	23,939	281.3	0.19
Saarland	2004	3.6	1984.8	39%	13%	3.40	78.2	886.3	1.06	8.7%	25,170	291.0	
Saarland	2005	3.7	1984.9	41%	12%	3.49	78.3	886.3	1.05	10.8%		335.9	
Saarland	2006	3.7	1985.3	42%	13%	3.51	78.4	867.4	1.05	9.5%	27,317	300.0	
Saarland	2007	3.7	1985.7	45%	14%	3.52	78.7	852.5	1.04	7.3%		475.4	
Saarland	2008	3.7	1986.1	47%	15%					7.1%			
Sachsen	2000	15.6	1983.1	30%	8%	3.51	77.8	901.1	4.44	16.1%	17,032		0.14
Sachsen	2001	16.2	1983.8	33%	10%	3.67	78.4	860.3	4.40	17.0%	17,731	540.8	0.11
Sachsen	2002	16.6	1984.4	35%	12%	3.80	78.4	865.9	4.37	17.8%	18,632	733.9	0.14
Sachsen	2003	17.5	1985.0	37%	13%	4.04	78.4	868.4	4.33	17.8%	19,187	645.4	0.05
Sachsen	2004	15.5	1985.4	39%	14%	3.61	79.1	812.4	4.31	19.4%	19,860	698.9	0.05
Sachsen	2005	15.9	1985.7	41%	14%	3.71	79.3	801.3	4.28	18.7%		745.3	0.28
Sachsen	2006	16.3	1986.2	43%	15%	3.81	79.7	773.0	4.26	16.6%	20,747	716.0	0.16
Sachsen	2007	16.1	1986.6	45%	16%	3.81	79.7	772.0	4.23	14.4%		974.7	0.24
Sachsen	2008	16.4	1987.0	47%	17%					12.9%			

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Sachsen-Anhalt	2000	9.7	1982.7	30%	8%	3.68	76.5	1000.8	2.63	20.2%	16,437		0.19
Sachsen-Anhalt	2001	9.9	1983.4	32%	10%	3.83	77.0	965.7	2.60	19.9%	16,937	561.9	0.23
Sachsen-Anhalt	2002	10.2	1983.8	33%	11%	3.98	76.9	972.3	2.56	19.2%	17,848	680.5	0.08
Sachsen-Anhalt	2003	10.9	1984.3	36%	13%	4.30	77.3	945.8	2.54	19.9%	18,165	554.6	0.32
Sachsen-Anhalt	2004	9.6	1984.8	37%	14%	3.83	77.7	907.8	2.51	22.4%	18,758	500.2	0.32
Sachsen-Anhalt	2005	9.8	1985.0	39%	13%	3.95	77.9	894.9	2.48	20.3%		574.8	0.20
Sachsen-Anhalt	2006	9.9	1985.4	40%	14%	4.03	78.3	870.9	2.46	17.8%	20,057	540.2	0.33
Sachsen-Anhalt	2007	10.0	1985.7	42%	15%	4.14	78.5	862.7	2.43	15.7%		813.1	0.12
Sachsen-Anhalt	2008	10.4	1986.2	45%	16%					14.6%			
Schleswig-Holstein	2000	7.5	1983.0	33%	8%	2.69	78.1	881.9	2.78	6.4%	23,309		0.83
Schleswig-Holstein	2001	7.7	1983.4	34%	10%	2.77	78.4	857.1	2.80	6.4%	23,775	265.6	0.89
Schleswig-Holstein	2002	8.0	1983.7	35%	10%	2.83	78.6	848.2	2.81	7.6%	23,331	295.8	0.78
Schleswig-Holstein	2003	8.4	1984.1	37%	11%	2.97	78.5	860.1	2.82	8.6%	23,540	267.0	1.10
Schleswig-Holstein	2004	7.5	1984.4	38%	12%	2.64	78.9	824.8	2.83	9.7%	23,917	248.4	1.10
Schleswig-Holstein	2005	7.6	1984.6	40%	11%	2.70	79.3	799.9	2.83	10.2%		262.5	0.95
Schleswig-Holstein	2006	7.8	1985.0	41%	12%	2.74	79.6	784.2	2.83	9.0%	24,680	266.0	0.95
Schleswig-Holstein	2007	8.0	1985.5	44%	13%	2.82	79.7	774.5	2.84	7.9%		378.3	0.63
Schleswig-Holstein	2008	8.3	1985.8	45%	14%					6.8%			
Thueringen	2000	7.6	1983.0	30%	8%	3.12	77.3	965.3	2.44	13.5%	16,638		0.04
Thueringen	2001	7.8	1983.7	33%	10%	3.20	77.7	926.1	2.42	13.9%	17,211	490.5	
Thueringen	2002	9.2	1984.3	35%	11%	3.84	77.8	927.1	2.40	15.1%	17,666	662.9	0.08
Thueringen	2003	9.8	1984.9	37%	13%	4.11	77.8	926.3	2.38	16.3%	18,223	541.1	0.04
Thueringen	2004	8.6	1985.4	39%	14%	3.65	78.3	872.1	2.36	16.3%	18,878	661.0	
Thueringen	2005	8.9	1985.7	40%	13%	3.79	78.7	859.7	2.35	17.1%		612.3	0.04
Thueringen	2006	9.1	1986.1	42%	15%	3.91	78.8	840.0	2.32	15.6%	19,877	677.8	0.13
Thueringen	2007	9.0	1986.4	44%	15%	3.92	79.1	827.0	2.30	13.7%		872.6	
Thueringen	2008	9.1	1986.9	46%	16%					10.6%			

Appendix Table 3
French cancer data

Cancer site	Year	Age-adjusted mortality rate (per 100,000 pop)	Number of patients in IMS sample	Weighted mean world launch year	post1985 %	post1990 %
ALL	2002	0.45	7	1975.3	14%	14%
ALL	2003	0.43	3	2001.0	100%	100%
ALL	2004	0.39	14	1998.9	93%	93%
ALL	2005	0.34	16	1987.9	56%	56%
ALL	2006	0.40	19	1986.8	53%	53%
AML	2003	2.32	1	2001.0	100%	100%
AML	2005	2.40	2	2001.0	100%	100%
AML	2006	2.27	1	2001.0	100%	100%
BLADDER	2002	7.17	32	1993.4	84%	84%
BLADDER	2003	7.53	40	1991.2	63%	63%
BLADDER	2004	7.41	59	1993.1	80%	80%
BLADDER	2005	7.46	71	1992.0	70%	70%
BLADDER	2006	7.19	75	1991.5	65%	65%
BRAIN	2002	4.74	37	1998.8	97%	97%
BRAIN	2003	4.82	46	1997.5	89%	89%
BRAIN	2004	4.58	80	1996.9	85%	85%
BRAIN	2005	4.52	148	1997.1	86%	86%
BRAIN	2006	4.50	150	1997.0	86%	86%
BREAST	2002	19.03	664	1986.2	36%	27%
BREAST	2003	18.68	792	1986.2	37%	28%
BREAST	2004	18.50	926	1986.5	35%	30%
BREAST	2005	18.31	1300	1987.5	42%	38%
BREAST	2006	17.99	1345	1987.8	43%	39%
CERVIX UTERI	2005	1.18	1	1984.0	0%	0%
CERVIX UTERI	2006	1.10	1	1984.0	0%	0%
CLL	2002	1.83	31	1971.0	0%	0%
CLL	2003	1.90	28	1972.1	4%	4%
CLL	2004	1.79	23	1971.0	0%	0%
CLL	2005	1.71	28	1971.0	0%	0%
CLL	2006	1.75	36	1971.0	0%	0%
CML	2002	0.93	89	2001.0	100%	100%
CML	2003	0.95	112	2001.0	100%	100%
CML	2004	0.89	126	2001.0	100%	100%
CML	2005	0.92	163	2001.0	100%	100%
CML	2006	0.76	158	2001.0	100%	100%
COLORECTAL	2002	27.03	22	1998.0	100%	100%
COLORECTAL	2003	27.16	45	1998.0	100%	100%
COLORECTAL	2004	26.68	53	1998.2	100%	100%
COLORECTAL	2005	26.33	108	1998.0	100%	100%
COLORECTAL	2006	25.20	104	1998.1	100%	100%
CORPUS UTERI	2002	0.89	16	1988.5	50%	50%
CORPUS UTERI	2003	0.99	11	1989.5	64%	64%
CORPUS UTERI	2004	0.90	20	1988.2	45%	45%
CORPUS UTERI	2005	1.02	25	1988.6	52%	52%
CORPUS UTERI	2006	0.93	22	1988.5	50%	50%
HEAD & NECK	2002	7.67	49	1987.7	35%	33%

Appendix Table 3
French cancer data

Cancer site	Year	Age-adjusted mortality rate (per 100,000 pop)	Number of patients in IMS sample	Weighted mean world launch year	post1985 %	post1990 %
HEAD & NECK	2003	7.35	62	1987.2	32%	31%
HEAD & NECK	2004	6.95	55	1986.7	22%	18%
HEAD & NECK	2005	6.72	105	1988.7	42%	39%
HEAD & NECK	2006	6.35	108	1988.8	43%	40%
HODGKINS DISEASE	2002	0.46	88	1971.4	2%	0%
HODGKINS DISEASE	2003	0.46	132	1971.4	2%	0%
HODGKINS DISEASE	2004	0.48	201	1971.5	3%	0%
HODGKINS DISEASE	2005	0.44	208	1971.5	3%	0%
HODGKINS DISEASE	2006	0.43	205	1971.9	5%	0%
KIDNEY	2003	5.17	3	1971.0	0%	0%
KIDNEY	2004	4.91	5	1971.0	0%	0%
KIDNEY	2005	4.94	6	1971.0	0%	0%
KIDNEY	2006	4.80	6	1971.0	0%	0%
LIVER	2002	11.63	38	1993.1	92%	92%
LIVER	2003	11.66	47	1993.3	91%	91%
LIVER	2004	11.48	42	1995.3	100%	100%
LIVER	2005	11.65	55	1989.4	71%	71%
LIVER	2006	11.55	61	1990.1	75%	75%
LUNG	2002	41.89	533	1990.6	80%	47%
LUNG	2003	42.98	724	1990.8	79%	48%
LUNG	2004	43.22	739	1991.4	83%	57%
LUNG	2005	44.09	1080	1991.6	78%	56%
LUNG	2006	43.81	1194	1991.5	77%	54%
M.MYELOMA & MALIG PLAS	2002	3.92	85	1971.0	0%	0%
M.MYELOMA & MALIG PLAS	2003	4.07	69	1971.0	0%	0%
M.MYELOMA & MALIG PLAS	2004	3.73	79	1971.0	0%	0%
M.MYELOMA & MALIG PLAS	2005	3.79	83	1971.0	0%	0%
M.MYELOMA & MALIG PLAS	2006	3.73	85	1971.3	1%	1%
MELANOMA	2002	2.32	3	1999.0	100%	100%
MELANOMA	2003	2.36	2	1999.0	100%	100%
MELANOMA	2004	2.32	3	1996.7	100%	100%
MELANOMA	2005	2.41	10	1996.6	100%	90%
MELANOMA	2006	2.41	8	1995.1	100%	88%
NHL	2002	7.19	303	1971.9	0%	0%
NHL	2003	6.81	361	1971.6	1%	1%
NHL	2004	6.65	455	1971.7	0%	0%
NHL	2005	6.56	553	1972.2	2%	2%
NHL	2006	6.22	573	1972.3	3%	2%
OESOPHAGUS	2002	6.99	10	1987.9	50%	10%
OESOPHAGUS	2003	6.59	7	1986.1	29%	0%
OESOPHAGUS	2004	6.23	11	1986.3	18%	9%
OESOPHAGUS	2005	6.22	23	1989.5	61%	39%
OESOPHAGUS	2006	5.94	26	1989.9	62%	42%
OVARIAN	2002	5.53	226	1988.5	48%	48%
OVARIAN	2003	5.35	231	1988.5	48%	48%
OVARIAN	2004	5.23	313	1988.5	50%	50%

Appendix Table 3
French cancer data

Cancer site	Year	Age-adjusted mortality rate (per 100,000 pop)	Number of patients in IMS sample	Weighted mean world launch year	post1985 %	post1990 %
OVARIAN	2005	5.27	398	1988.4	47%	47%
OVARIAN	2006	5.17	366	1988.4	47%	47%
PANCREAS	2002	12.44	106	1995.0	99%	99%
PANCREAS	2003	12.25	130	1995.0	100%	100%
PANCREAS	2004	12.52	180	1994.9	99%	99%
PANCREAS	2005	12.76	200	1995.0	99%	99%
PANCREAS	2006	12.74	203	1994.9	99%	99%
PROSTATE	2002	15.53	23	1994.7	100%	96%
PROSTATE	2003	15.64	36	1993.2	100%	69%
PROSTATE	2004	14.87	58	1993.9	100%	81%
PROSTATE	2005	14.46	60	1994.8	100%	97%
PROSTATE	2006	13.64	69	1994.8	100%	97%
STOMACH	2002	8.57	19	1986.5	21%	21%
STOMACH	2003	8.04	12	1990.1	42%	42%
STOMACH	2004	8.03	18	1993.4	72%	72%
STOMACH	2005	7.69	52	1994.2	75%	75%
STOMACH	2006	7.35	51	1993.2	69%	69%
THYROID	2005	0.62	2	1993.5	100%	100%
THYROID	2006	0.67	2	1993.5	100%	100%

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