

# A CROSS-COUNTRY ANALYSIS OF HEALTH CARE EXPENDITURES

## Understanding the US Gap\*

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**Abstract.** This paper is concerned with growth patterns of US health care expenditures. Within a representative sample of OECD countries, we lay out a growth accounting exercise for health care expenditures to assess the influence of several explanatory variables. Our analysis demonstrates that the relative price of medical care and some health care laws can trace down fairly well the differential increase in US medical expenditures over the period 1970-2007. We then explore some major factors driving US medical care prices – including prescription drugs, the degree of competition, malpractice, and out-of-pocket expenditures. Some other explanatory variables – income growth, technological change, life expectancy, physicians’ compensation, trends in aging population, and defensive medicine – would seem unable to account for the differential increase in US medical expenditures over various time periods.

**Keywords.** Health Care Expenditures, Relative Price of Medical Care, Growth Accounting, Price Elasticity, Technological Change, Malpractice.

**JEL classification.** I10, I11, I18, E31.

## 1 Introduction

Over the last 40 years, the ratio of US health care expenditures (HCE) over total consumption (TC) has displayed a pronounced upward trend. Indeed, according to OECD data HCE accounted for less than 1/12 of TC in 1970, while it is now<sup>1</sup> over 1/5. Mounting US medical

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<sup>1</sup>Most researchers consider HCE over GDP [e.g., Chernew and Newhouse (2012)]. These ratios are quite similar when conditioning on GDP. As a matter of fact, our theoretical framework below requires HCE over

expenditures have become an issue of national concern and a continuing challenge for policy makers (e.g., the Clinton Health Care Plan of 1993 and more recently the *Obamacare*).

Our purpose here is to identify main macroeconomic forces underlying these well-known patterns of US medical expenditures. We include a sample of 10 other OECD countries with good quality data: Australia, Canada, Denmark, Finland, France, Germany, Ireland, Japan, Spain, and the United Kingdom. Our main quantitative analysis is intended to assess deviations of US medical expenditures from common forces over the sample period 1970-2007.

One major difficulty to uncover HCE growth patterns appears to be the high degree of uniformity presented by US expenditures in the categories of sources and uses. These regular trends are even preserved in periods of high expenditure growth. Figure 1.1 breaks down HCE into various categories by source. Some public programs such as Medicare and Medicaid have gained prominence at the expense of private funding and out-of-pocket expenditures, but such extra growth seems too small to account for the general evolution of HCE.

[Figure 1.1: The Evolution of US Health Care Expenditures by Source 1980-2007]

Figure 1.2 breaks down HCE into various categories by use. We can see a substantial increase in the categories of other personal health care, and prescription drugs, and a slight decline in physical and clinical services, and hospital care.<sup>2</sup> Again, these changes are just small departures from overall trends in HCE.

[Figure 1.2: The Evolution of US Health Care Expenditures by Use 1980-2007]

Therefore, to account for increasing trends in US medical expenditures over various time sub-periods one needs to identify a group of variables that must be driving together all the expenditure categories.

We should emphasize that the structure imposed in our exercise makes that our findings are not readily comparable with other related studies that focus on global trends. Indeed, it is not clear that previous studies could account for growth patterns in US medical expenditures over the various time sub-periods. For instance, Hall and Jones (2007) propose a model in which the share of medical expenditures keeps rising as a consequence of income growth and technology with the end result of increasing life expectancy. As is well known, there has been some catching-up in income levels by European countries. Moreover, US life expectancy has been slightly below the OECD average.<sup>3</sup> Hence, life expectancy could be instrumental to explain

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all other consumption goods. We prefer to condition on TC because the consumer price index (CPI) is readily available for all countries in the sample. The appendix lists definitions for our aggregate measures.

<sup>2</sup>As discussed below, relative prices could be shaping these expenditure categories.

<sup>3</sup>According to OECD health data, in 1970 average life expectancy was 70.1 years in the OECD and 70.9 years in the US. In 2007 average life expectancy was 78.8 years in the OECD and 77.9 years in the US.

global increasing trends in HCE, but would not be able to replicate observed differences at the cross-country level over short time periods.

Some researchers [cf. Anderson and Frogner (2008)] argue that even though the US presents the highest ratios of medical spending among all OECD countries, its residents are not granted the highest value per dollar spent in health care – suggesting a higher level of inefficiency in the US. For our cross-country study, one would have to show that the US inefficiency gap, or the gap in defensive medicine, has grown over time. Our results do not pick a higher residual for the US, and do not seem to leave room for significant increasing gaps in many other directions.

The spread of health care insurance has been suggested as an explanatory variable for the growth in US medical expenditures. Finkelstein (2007) estimated that between 1965 and 1970 the introduction of Medicare produced an increment in hospital spending of the order of six times larger than a private insurance program would have produced. At about the same dates, however, many OECD countries implemented universal health care systems (e.g., Japan in 1961, Denmark in 1973 and Spain in 1986). Thus, changes in insurance markets would not be able to account for observed differences in HCE between the US and the rest of the OECD countries. Of course, these international medical reforms will be echoed in our quantitative study.

A large literature has related the rapid increase in HCE in the US to technological change.<sup>4</sup> For example, Di Matteo (2005) finds that technological change accounts for 2/3 of health care spending growth in the US over the 1975-2000 period. An excellent review of this literature is presented in Chernew and Newhouse (2012). Here, we control for the impact of technological change by considering a sample of developed countries with similar technology. As a matter of fact, our identifying assumption is that the US technology gap remains constant over the sample period. Smith, Newhouse and Freeland (2009) point out that early diffusion of new technologies is frequently linked to similar GDP levels [Moise (2003)].

Broadly speaking, our analysis attests that the explosive behavior of HCE in the US can be mimicked by similar responses of the relative price of medical care. Therefore, what we will call the US medical care expenditure gap will be replicated by the US medical care price gap – under commonly accepted price elasticities coupled with some changing trends attached to health care laws and public programs. It should be stressed that combining the expenditure and price gaps we get a real quantity gap for HCE over TC, while most of the literature has centered on nominal expenditures. That is, it matters for our analysis to consider real health care expenditures because relative inflation in the US medical care sector has been much higher than the OECD average.

We support these findings with a further evaluation of US time series for real output and the

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<sup>4</sup>The economics literature usually estimates technological change from price data. According to the Boskin report (1996) the US consumer price index does not take into account a 2.76 percent yearly increase in the quality of health care goods. Unfortunately, we were not able to find data on technological change for other OECD countries. Hall and Jones (2007) assume an annual 1 percent extra increase of technological change in the US health care sector over the US economy average.

relative price of medical care. We provide further evidence of international health care prices at the micro level including hospital and related services and prescription drugs. It transpires that increases in US health care prices have greatly benefited companies in the industry. The labor income share, however, has remained roughly constant over the period. Physicians' services does not appear to be a major source of the continued inflation in the medical care sector.

The paper is organized as follows. In section 2 we highlight some basic empirical facts regarding the share of medical expenditures and the relative price of medical care. In section 3 we set out our framework of analysis. We derive our main quantitative results from a growth accounting exercise. In section 4 we search for major determinants of US health care prices. We conclude in section 5.

## 2 Basic Empirical Facts

As already pointed out, our sample is made up of 11 OECD countries (including the US) over the period 1970-2007. Yearly HCE are available for all countries but France. All the missing years for France occur between 1970 and 1990, where data are only available every 5 years. For prices we use the consumer price index (CPI) and the consumer price index–medical care (CPIMC). Again, some few observations are missing for price data; simple interpolations were performed whenever necessary. All expenditure and price measures reported in this section are explained in a separate appendix below.

### 2.1 The US medical care expenditure gap

Let us refer to the US medical care expenditure gap as the ratio HCE/TC of the US over the ratio HCE/TC of the other OECD countries. The US was already among the top health care spenders in 1970 but far from being an outlier. In fact, the US medical care expenditure gap went from 1.1 in 1975 to 1.55 in 1990. Then, the gap trended downwards during the eight-year period of Clinton's presidency, and it has slightly gone up during the last decade.

[Figure 2.1: The US Medical Care Expenditure Gap 1970-2007]

This figure suggests the existence of three well differentiated periods: *(i) The 1970-1977 period:* The US medical care expenditure gap hovered around 1.1, *(ii) The 1978-1990 period:* The US medical care expenditure gap increased steadily from 1.1 to 1.55, and *(iii) The 1991-2007 period:* The US medical care expenditure gap roughly stabilized around 1.5. Therefore, the 1978-1990 period stands up as a transitional time episode with a marked change in the US medical care expenditure gap. Note that during this transitional episode there are no noticeable changes in HCE in the various categories by source and use; *viz.* Figures 1.1. and 1.2 above. Of course, the striking increase in the expenditure gap during 1978-1990 is certainly puzzling.

It does not seem plausible to explain such an increase by some aggregate variables with smooth long-term trends such as GDP, life expectancy, the size of the elderly population, the prevalence of some modern health care trends (e.g., obesity), and new medical treatments.

## 2.2 The US medical care price gap

The medical care price gap picks the evolution of the consumer price index–medical care (CPIMC) over the consumer price index (CPI). That is, we refer to the US medical care price gap as the ratio of CPIMC/CPI of the US over the average ratio CPIMC/CPI of the other OECD countries. Again, these prices along with their data sources are formally defined in the appendix. Note that combining these two gaps we can get a corresponding US gap for real expenditures: The ratio of real HCE over real TC.

Figure 2.2 considers changes in the CPIMC and CPI for our sample of countries over the 1978-1990 transition period. Figure 2.3 amplifies these trends over the whole sample period 1970-2007. The solid line displays the final increase in the ratio CPIMC/CPI over the reported period. Some countries in the sample experienced similar rates of inflation in both medical care and total consumption, and so the ratio CPIMC/CPI remains close to one. In the US, however, the ratio CPIMC/CPI has doubled over the sample period. Hence, the US is the leading country to undergo an excess acute inflation in medical care consumption. These two figures confirm that the sharpest changes in the price gap did occur over the transition period 1978-1990; during the other periods 1970-1977 and 1993-2007, the price gap did not increase so much. It should be stressed that inflation in US medical care is not higher than in many other countries. What it seems high is the change in the *relative* price of medical care.

[Figure 2.2: The Medical Care Price Gap 1978-1990]

[Figure 2.3: The Medical Care Price Gap 1970-2007]

## 2.3 The US medical care expenditure gap vs. the price gap

Figure 2.4 plots the US medical care expenditure gap against the price gap; both ratios are made equal to 1 in 1977. The figure makes forcefully the case that the price gap is a major driving factor of the medical care expenditure gap in the period 1978-1990 in which both increased by about 35 percent. Then, there is a mild disconnect: The relative price of medical care appears to increase faster than HCE. More precisely, between 1993 and 2007 the US medical care price gap goes from 1.35 to 1.50, whereas the US medical care expenditure gap appears quite flat. This suggests that real medical consumption may have declined in the US in the last part of the sample period. Indeed, it follows from these definitions that if the US medical expenditure gap grows less than the price gap, then the ratio of real HCE over real TC will go down in the US as compared with the other OECD countries.

[Figure 2.4: The US Medical Care Expenditure Gap vs. the Price Gap 1970-2007]

## 2.4 The stability of real HCE over real GDP in the US

For the 1970-2007 sample period, HCE per capita at constant TC prices in the US has increased by 300 percent. For the same time period, HCE per capita at constant medical care prices (real HCE) has increased less than 100 percent. Further, there is no significant growth when real HCE per capita is adjusted for real TC growth or for real GDP growth. More precisely, real HCE over real TC increased by 28 percent and real HCE over real GDP did not increase at all.<sup>5</sup> Hence, Figure 2.5 reports: (i) HCE per capita at constant TC prices; (ii) Real HCE per capita: HCE per capita at constant medical care prices; (iii) Real HCE over real TC; and (iv) Real HCE over real GDP.

[Figure 2.5: The Evolution of US Health Care Expenditures 1970-2007]

Real HCE has not increased faster than real income. Of course, this is not to deny that certain regulations are shaping these trends. First, the Medicare and Medicaid programs have gained weight over time (see Figure 1.1). Second, there has been a shift to “managed care” [Cutler, McClellan and Newhouse (2000)], which was mainly accomplished by the late 1990s. Indeed, Figure 2.6 documents the shift from private indemnity plans and conventional insurance to more incentive-compatible mechanisms for private insurance such as HMOs, PPOs, and POSs. This could be reflected in the relative decline of hospital care in expenditures by use (Figure 1.2). In the 2000s, among other things, the Bush reforms appear to have increased pharmaceutical expenditures (Figure 1.2).

[Figure 2.6: The Structure of the Insurance Market]

## 2.5 Malpractice and health care insurance costs

To get a better sense of these growth patterns, we now look at some measures of malpractice and health care insurance costs. The 2003 *GAO Report on Medical Malpractice Insurance* provides estimated total *incurred losses*, which, in contrast to *paid losses*, reflect insurers’ expectations of the quantities that would have to be paid on claims reported in that year and any amounts expected to be paid out on claims from previous years. We shall also consider a third measure based on the malpractice insurance premiums as defined in the appendix. A

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<sup>5</sup>For the sample period 1970-2007, the ratio of nominal TC over nominal GDP was quite stable – it just went down by 4.5 percent. Hence, the above difference mainly stems from the unequal evolution of the CPI and the GDP price deflator. The ratio of the CPI over the GDP deflator went up by 22.5 percent over the sample period.

main argument against malpractice is that these costs are rather low: About 1.25 percent of US medical expenditures.

[Figure 2.7: US Medical Malpractice Insurance Premia and Real Health Care Expenditures Per Capita]

Figure 2.7 displays the evolution of these three measures of malpractice costs (adjusted by the CPIMC) against real HCE per capita. Again, sharp growth rates are observed during the 1978-1990 transition period. The health economics literature [e.g., Harrington, Danzon and Epstein (2008)] usually refers to the 1980s as the “crisis” of medical malpractice because of the frequency and severity of claims and the dramatic increase in the cost of malpractice insurance. Then, this transition period was superseded by a “soft” market for medical malpractice insurance in the 1990s. According to some writers (cf., *opt. cit.*) such swings in the malpractice insurance market may have led some companies to mispricing of malpractice insurance policies. There is therefore a well known disconnect between the insurance-premium based measure and the two measures for incurred and paid losses. Nevertheless, it appears from Figure 2.7 that these malpractice cycles do not seem to affect real HCE per capita. Of course, changes in malpractice insurance costs may be affecting medical care prices.

Finally, Figure 2.8 reports real costs for health care insurance policies against real HCE per capita. As before, all these costs are adjusted by the CPIMC, and are made equal to 100 at the starting date. Medicare cost per enrollee evolves along the lines of real HCE per capita but the average cost of subscribing a private insurance policy has increased more rapidly; this latter fact may be partly explained by the diminishing weight of out-of-pocket expenditures as reported in the figure.

[Figure 2.8: US Health Care Insurance Premia and Real Expenditures Per Capita]

To conclude, let us summarize these basic empirical facts. First, major trends in the US medical care expenditure gap can be traced down to changes in the US medical care price gap. The correlation between the expenditure and price gaps is quite strong during the transitional period 1978-1990. There is a mild disconnect between these two gaps at the end of the 1990s which comes along with a progressive shift to “managed care.” Second, the ratio of real HCE to real GDP (or to real TC) has been fairly stable in the US over the last 40 years. Again, this implies that episodes of high inflation in the health care sector are translated into higher medical expenditures. Of course, underlying these expenditure patterns there could be some subtle effects of technological change. Our cross-country analysis is intended to offer further insights into the impact of technology. And third, pronounced cycles in malpractice and private health care insurance policies do not seem to affect directly the stability of real HCE per capita.

While private health care insurance premiums have been trending up, the fraction of out-of-pocket expenditures has been trending down.

### 3 A Simple Model of Health Care Expenditures

This section presents our quantitative assessment of the evolution of US medical expenditures. Underlying this computational approach there are some key parameter values such as the income elasticity for health care expenditures (assumed to be equal to unity), the price elasticity, and the pace of technological change. In our growth accounting exercise, technological change is subsumed under the residual. We later report simulations for a calibrated version of the model under the identifying assumption that the US technology residual is equated to the sample average excluding the US.

#### 3.1 The economic environment

We consider an endowment economy with a representative agent. At every time  $t = 0, 1, \dots$ , the economy receives  $y_t$  units of an aggregate commodity which can be transformed into two types of consumption goods: A composite consumption good  $c$  and a variety of health care consumption goods  $m_s$ . Let  $a_t$  denote the technology level at time  $t$ . Let  $[0, \sigma(a_t)]$  be the mass of available technologies. Preferences are represented by a CES utility function. Health care varieties  $m_s$  for  $s \in [0, \sigma(a_t)]$  enter symmetrically into a utility aggregator  $M(t) = \left[ \int_0^{\sigma(a_t)} m_s^\gamma ds \right]^{\frac{1}{\gamma}}$ .

The representative agent solves the following budget-constrained maximization problem:

$$\max_{c, h, m_s} \sum_{t=0}^{\infty} \beta^t \left[ \lambda c_t^\rho + (1 - \lambda) \left( \phi(a_t)^{\frac{1}{\rho}} \left[ \int_0^{\sigma(a_t)} m_{ts}^\gamma ds \right]^{\frac{1}{\gamma}} \right)^\rho \right]^{\frac{1}{\rho}} \quad (1)$$

subject to

$$c_t + q_t h_t = y_t \quad (2)$$

$$\int_0^{\sigma(a_t)} m_{ts} ds = a_t h_t \quad (3)$$

$$0 < \beta < 1, 0 < \lambda < 1, 0 < \gamma < 1, -\infty < \rho < 1. \quad (4)$$

Parameter  $\lambda$  is called the share parameter. Parameter  $\rho$  determines the degree of substitution between the composite consumption good  $c$  and the health care utility aggregator  $M_t = \left[ \int_0^{\sigma(a_t)} m_{ts}^\gamma ds \right]^{\frac{1}{\gamma}}$ . Parameter  $\gamma$  determines the degree of substitution of the health care varieties  $m_s$ . Function  $\phi(a_t)$  is introduced to allow for shifts in the expenditure share as a result of technological change. Note that  $q_t h_t$  represents nominal health care expenditures, and  $h_t$  represents real expenditures.



An increase in the technology level  $a_t$  may change the composition of expenditures through the following three channels: (i) *The Price Effect*: An increase in  $a_t$  lowers the relative price of health care varieties  $q_t/a_t$  in terms of the numeraire good. This effect is present in economic growth models of embodied technological change [e.g., Greenwood, Hercowitz and Krusell (1997)]. (ii) *The Productivity Effect*: An increase in  $a_t$  results in higher productivity because it expands the mass of available technologies  $[0, \sigma(a_t)]$  to allow for a more efficient production of health care utility  $M(t) = \left[ \int_0^{\sigma(a_t)} m_{ts}^\gamma ds \right]^{\frac{1}{\gamma}}$ . That is, for  $0 < \gamma < 1$ , the same utility level  $M_t$  can now be obtained under lower spending. This effect is present in economic growth models with a continuum of product varieties [cf., Romer (1990)]. And (iii) *The Expenditure Effect*: An increase in  $a_t$  may shift the consumption expenditure share because technological change may expand the domain of application of health care varieties. This effect is reflected in function  $\phi(a_t)$ , and allows for an increase in the health expenditure share under a unitary income elasticity<sup>6</sup> as documented in many health economic studies [Chernew and Newhouse (2012)]. Note that for an inelastic demand (i.e.,  $\rho < 0$ ) both the price and productivity effects (i) – (ii) may lead to a decrease in the health care expenditure share under an increase in  $a$ . Hence, function  $\phi(a)$  builds in some further flexibility to model the effects of a change in  $a_t$  on health care expenditures  $q_t h_t$ . There are some other well-known models in which technological change may generate non-linear Engel curves [e.g., Becker, Philipson and Soares (2005) and Hall and Jones (2007)].

While this rich form for the utility function contemplates various channels for the influence of technological change, we should stress that in our growth accounting exercise all these effects will be pulled together as a quantity residual.

### 3.2 Optimality conditions

The representative agent assumes that the relative price  $q_t$  and the level of technological change  $a_t$  are exogenously given. In an optimal solution, consumption must be constant across medical varieties, i.e.,  $m_{ts} = m_t$  for all  $s$ . Then, from the first-order conditions of the consumers' optimization problem we obtain the optimal ratio of health care consumption to the composite consumption of all other goods:

$$\frac{m_t}{c_t} = \left( \frac{1}{q_t} \right)^{\frac{1}{1-\rho}} \left( \frac{1-\lambda}{\lambda} \right)^{\frac{1}{1-\rho}} \left( a_t \phi(a_t) \sigma(a_t)^{\frac{\rho-\gamma}{\gamma}} \right)^{\frac{1}{1-\rho}} \quad (5)$$

Now, multiplying both terms by relative price  $q_t$ , we can express the ratio of health care expenditures over total expenditures in non-health care goods as follows:

$$\frac{q_t h_t}{c_t} = \left( \frac{1}{q_t} \right)^{\frac{-\rho}{1-\rho}} \left( \frac{1-\lambda}{\lambda} \right)^{\frac{1}{1-\rho}} a_t^{\frac{\rho}{1-\rho}} \phi(a_t)^{\frac{1}{1-\rho}} \sigma(a_t)^{\frac{\rho(1-\gamma)}{\gamma(1-\rho)}} \quad (6)$$

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<sup>6</sup>Extensive cross-country empirical evidence [e.g., Gerdtham and Johnson (2000)] suggests income elasticities about one.

Equation (2) provides an expression for the evolution of health care expenditures relative to non-health care expenditures as a function of the relative price between the two goods and a residual term  $A_t$  driven by the level of technological progress  $a_t$ :

$$A_t = \left( \frac{1-\lambda}{\lambda} \right)^{\frac{1}{1-\rho}} a_t^{\frac{\rho}{1-\rho}} \phi(a_t)^{\frac{1}{1-\rho}} \sigma(a_t)^{\frac{\rho(1-\gamma)}{\gamma(1-\rho)}} \quad (7)$$

We allow this residual term to be different for each country  $i$ .

### 3.3 A cross-country analysis of the technology residual $A_t$

We now perform our growth accounting exercise. The objective is to filter out the price effect from the expenditure ratio  $qh/c$ . We are then left with the technology residual  $A_t^i$  for each country  $i$  at all times  $t$ .

More precisely, combining equations (6)-(7) we obtain:

$$\frac{q_t h_t}{c_t} = \left( \frac{1}{q_t} \right)^{\frac{-\rho}{1-\rho}} A_t \quad (8)$$

Therefore, for each country the residual  $A_t$  can be computed as:

$$A_t = \frac{q_t h_t}{c_t} \left( \frac{1}{q_t} \right)^{\frac{\rho}{1-\rho}} \quad (9)$$

Ringel *et al.* (2000) report estimates for the elasticity of demand for health care around -0.17. This makes  $\rho = -5$ . Hence, we shall compute the residual  $A_t$  under  $\rho = -5$ , which leads to a price-elasticity of health care expenditures of 1/6. We have also performed computations of the residual  $A_t$  under  $\rho = -4$ , and  $\rho = -3$ , with no substantial change in our results.

In order to map the model into the data, note that  $qh$  is health care expenditures (HCE),  $c$  is total consumption (TC), and  $q$  is the ratio of the consumer price index–medical care (CPIMC) over the consumption price index (CPI). Using equation (9), we then generate the residual  $A_t^i$  for each country  $i$ .

[Figure 3.1: A Growth Accounting Exercise: The Technology Residual  $A$  for a Sample of OECD Countries 1970-2007]

Figure 3.1 displays the evolution of the residual over our sample of countries for the period 1970-2007. We actually consider two group of countries. The first group comprises all countries but France and Spain. These latter countries are left apart because of sharp changes in the technology residuals upon enactments of some health care laws.

Observe from these figures that the US displays a technology residual  $A_t^{US}$  fairly close to the average of the other OECD countries. Hence, in this exercise technology does not appear to be a differential source of growth for US health care expenditures. The evolution of the US

technology residual seems in accordance with the stability of health care expenditure per capita documented in the previous section. Therefore, increasing trends in defensive medicine and in the intensity of medical technologies are not echoed in our analysis.

The French National Health Care System initial program was created in 1928 but was not comprehensive (Rodwin and Sandier, 1993). France expanded its public health insurance programs at various stages, and it became universal for all its citizens and residents in 2000 (Rodwin 2003). Spain shows steep increases in 1986 and 2003 corresponding to two medical reforms. The General Health Law of 1986 recognized the right to health care services to all citizens and foreign residents in Spain, and the Law of Cohesion and Quality of 2003 modernized and broadened the scope of the previous law.

### 3.4 A calibration exercise

In our second quantitative exercise we ask the following question: What is the predicted path of US medical expenditures under our model? We address this question under our baseline calibration for  $\rho = -5$ . In this predictive exercise, we make the identifying assumption that the US technology residual  $A_t^{US}$  is equal to the OECD average,  $A_t^{OECD}$ , excluding the US.

More formally, let us rewrite our demand equation:

$$\frac{q_t h_t}{c_t} = \left( \frac{1}{q_t} \right)^{\frac{-\rho}{1-\rho}} A_t \quad (10)$$

As already explained,  $q$  is the relative price of medical care in the US. Now, the technology residual  $A$  is equated to the OECD average  $A_t^{OECD}$  without the US. As a matter of fact, to isolate from the effects of some important health care laws in France and Spain, we also consider an average of  $A_t$  without the US, France, and Spain. In a third scenario ( $A_t^{OECD}$  regulated), we contemplate an average of  $A$  for the 10 other OECD countries in which the technology residuals for France and Spain have been filtered out within five-year windows of their main health care reforms.

As shown in Figure 3.2, the model is able to replicate the evolution of the observed US ratio of health care expenditures to total consumption over all the three scenarios. Therefore, excess acute inflation in the health care sector over the transition period 1978-1990 appears to be the main driving force behind the steep increase in health care expenditures over total consumption.

[Figure 3.2: A Predictive Exercise: US Health Care Expenditures vs. Simulated Data 1970-2007]

Of course, our results hinge on the choice of parameter  $\rho = -5$ . The same simulation exercise has been replicated for nearby values for  $\rho$  without substantial changes. As a matter of

fact, in Table 3.1 we report the Root Mean Square Error (RMSE) between actual US medical expenditures and the simulated data for  $\rho = -4$  and  $\rho = -3$ . As one can see, only minor variations in the goodness of fit occur over these parameter values.

[Table 3.1: Root Mean Square Errors]

## 4 Health Care Prices

Our analysis attests that the US medical care price gap – along with some developments in insurance markets – can replicate quite well the US medical care expenditure gap over the three sub-periods. We now offer some supplementary evidence to support our findings.

In the preceding sections, we have used the CPI–medical care (CPIMC) published by the US Bureau of Labor Statistics (BLS) since 1935. Another major health care price index is the personal consumption expenditures (PCE)–health care published by the US Bureau of Economic Analysis (BEA) since 1994. There are certain important differences between these two price measures, but their evolution is quite similar. As discussed in the appendix, the highest increases in the CPIMC are observed in Hospital and Related Services followed by Prescription Drugs, whereas Physicians’ Services trails the average. Within the PCE–health care, the highest increase is again observed in Hospital Services, whereas Pharmaceutical Products and Physicians’ Services trail the average.

### 4.1 A time-series analysis of US health care expenditures

Our growth accounting exercise demonstrates that the US technology residual  $A$  has evolved quite smoothly over time. Hence, we may then ignore global trends and simply focus on a time-series analysis of HCE in the US. The ratio of nominal HCE over GDP has not increased at the same pace throughout the last 40 years. As presently shown, underlying these medical expenditure patterns there are changes in the relative price of medical care and real GDP growth.

[Figure 4.1: Health Care Expenditures over GDP, Real GDP Growth, and the Relative Health Care Price]

Figure 4.1 [Panel (a)] portrays the actual evolution of (nominal) HCE over GDP in the US. To recast our previous analysis, Panel (b) of this figure plots the rates of real GDP growth and differential inflation in the health care sector. According to some researchers [cf. Smith, Newhouse and Freeland (2009)], there could be lags in the response of these variables that may go up to five years. That is, the short-run price elasticity may be smaller than the long-run price elasticity. The same may hold for GDP elasticities. Hence, these lags may lead to non-linear dynamics for the ratio HCE over GDP.

As in section 2, let us break down the analysis into the following sub-periods: (i) *The 1970-1978 period* in which the medical care expenditure gap hovered around 1.1. From Figure 4.1 [Panel (b)] this time episode presents moderate excess inflation in the health care sector and high real GDP growth. (ii) *The 1978-1990 period* in which the gap increased steadily to 1.55. From Figure 4.1 [Panel (b)] this time episode presents the highest excess inflation in the health care sector and low real GDP growth. (iii) *The 1990-2007 period* in which the gap has roughly settled down to 1.5. This time episode presents the lowest excess inflation in the health care sector and moderate real GDP growth.

In the 1993-2000 period of Clinton's Presidency, real GDP growth clearly dominates excess inflation in the health care sector. Therefore, one should expect the ratio real HCE over GDP to remain flat. As already discussed, the 1990s also witnessed a shift to "managed care" leading to a relative decline of hospital care (Figure 1.2), and to a decrease of indemnity health insurance plans in favor of HMOs, PPOs and PSOs (Figure 2.6). These changes might have affected the evolution of US prices in the health care sector during the 1990s. Cutler *et al.* (2000) suggest that for certain treatments and procedures "managed care" organizations like HMOs may have cut down costs by about 30 or 40 percent as a result of declines in prices of medical services and treatment intensities. Note from Figure 4.1 [Panel (b)] that in spite of all these changes "managed care" did not seem to affect substantially the composition of public and private expenditures. Indeed, Figure 4.2 confirms that the distribution of the insured and uninsured population and those publicly insured remains quite stable over the sample period.

[Figure 4.2: Distribution of the Population by Health Care Insurance]

## 4.2 Comparisons of international health care prices

Several studies and international institutions have reported marked cross-country differences in health care prices. For instance, Figure 4.3 presents costs of several health care items in five OECD countries as compared to the US for the year 2011. Switzerland exhibits the second highest costs: Around 65 percent of US dollar costs. For the remaining countries in the sample, the unitary prices observed are around one fifth of US costs.

[Figure 4.3: Country Health Care Prices over US Health Care Prices 2011]

In addition, there is a large international market for prescription drugs. The cross-country variability in wholesale drug prices is all well known. An early study by Jacoby and Hefner (1971) reported prices for twenty drugs in nine countries. The study confirms a great variation from country to country for a single product by the same manufacturer. Some on-patent drugs were even three times cheaper than in the US.

Later research has expanded the range of sample products to provide accurate price measures. Danzon and Furukawa (2003) consider a sample of 249 leading US molecules for nine

representative countries including the US. The sample represents 30 to 60 percent of sales in these countries. Manufacturer prices in the eight countries are usually between 20 to 40 percent lower than in the US. While on-patent brands may be almost 50 percent cheaper in some of these countries, generic drugs are usually more expensive. A related study by the US Department of Commerce (2004) on patented prescription drugs reports price indices that could be 50 percent lower than their US counterparts (*op. cit.*, p. 38). Several factors have been advanced to justify the high prices of prescription drugs in the US:

(i) *Products Liability*: Manning (1995) argues that both the litigation experience of specific pharmaceutical products and measures of substantial risk may have significant effects on the ratio of US to Canadian prices. Manning (1995) estimates that the observed distribution of price differences between the two countries has a mean of 69 percent higher in the US and a median of 43. Adjusting for the effects of products liability reduces the predicted mean and median to 36 and 33 percent respectively. The virtual effect of the liability is to eliminate the upper tail of the distribution of price differences for risky and highly advanced prescription drugs.

(ii) *Market Interventions*: According to the above study of the US Department of Commerce (2004) the pharmaceutical sector in the US follows guidelines which are closest to the free market. Most OECD countries engage in various forms of market intervention: Price controls, price reductions through monopolistic pricing and reimbursement policies, reference pricing (international or therapeutic reference pricing), volume limitations, profit controls, price floors to support local generic products, approval delays, and procedural barriers. The study argues that those restrictions influence drug prescription prices, the number of launches of new active substances, and drug availability.

(iii) *Income per Capital Levels*: Income levels could be reflected in higher quality requirements, higher prices for non-tradable goods (the Balassa-Samuelson effect) and lower elasticities for the pricing of international goods. From cross-country evidence [Summers and Heston (1991)], a cross-country difference of ten percent in income per capita may lead to a 3 percent increase in the relative price of non-tradable goods.

### 4.3 Who benefits from high prices?

#### 4.3.1 Physicians' compensation, relative productivity, and labor supply

Table 4.1 contains several data on physicians' compensation, productivity, and labor supply between 1970 and 2000. In row (i) we observe that total physicians' compensation over HCE has decreased from almost 15 percent in 1982 to 13.1 percent in 2000. Physicians' compensation over the average worker compensation in the economy increased between 1980 and 1990 but ended at a similar ratio in 2000 [row (ii)] while physicians' productivity has outpaced average

worker productivity [row (iii)].<sup>7</sup> Row (iv) of the table shows the evolution of the average compensation of a non-physician health care worker with respect to a physician. This ratio does not vary over the sample period.

[Table 4.1: Physicians' Compensation, Relative Productivity, and Labor Supply]

HCE growth has expanded the labor force in the sector. In the 1970-2000 period, the number of active physicians increased from 15 per 10,000 people to 26 per 10,000 people [row (v)]. The composition of the health care labor force has also changed. Row (vi) shows that the quantity of physicians over total health care workers has decreased from almost 11.7 percent in 1970 to 7.2 percent in 2000. With the introduction of Medicare and the subsequent expansion of the health care sector we observe a considerable increase in the number of non-physician workers in the health care industry [row (vii)]: The ratio of health care workers over the total number of workers in the economy has more than doubled between 1970 to 2000.

Is the increase in the quantity of health care workers driving the increase in health care costs? To answer this question we estimate the relative income share of health care workers. This is total compensation for workers in the health services industry divided by HCE. As seen in row (viii), the labor income share increases between 1970 and 1980 and then remains almost constant at around 30 percent. There is a steep increment between 1966 and 1974, right after the introduction of the Medicare program in 1965. We conclude that the labor share in the health care sector does not account for the observed increase in the ratio of HCE over GDP, especially during the 1980s.

### 4.3.2 Profitability of publicly traded companies in the health care industry

Several studies analyze the degree of competition of the US medical care sector. For instance, Dunn and Shapiro (2011) claim that physicians' market power may bias medical care prices and the quantity of health care services provided. Skinner *et al.* (2005) argue that Medicare spending appears to be highly inefficient: About 20 percent of Medicare expenditures do not provide any increase on survival rates or quality of life for the elderly population.

As already discussed, physicians did not particularly benefit from the observed HCE growth. Are private companies able to take advantage of existing frictions and regulations in the health care market? And do abnormal returns occur in periods of high or low HCE growth? It seems natural to approach these questions from the empirical asset pricing literature. Abnormal returns may be linked to market inefficiencies, distorting regulations, or entry barriers in the health care industry.

Let us first compare returns obtained by private companies in the health care sector with those of other competitive markets. Large differences can be interpreted as abnormal returns

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<sup>7</sup>We calculate average worker compensation as the ratio of *compensation of employees* (NIPA table 2.1) over *full-time and part-time employees* (NIPA table 6.4). NIPA tables are available at <http://www.bea.gov/iTable>.

directly linked to the possibility of arbitrage opportunities. It is well known that competition leads to an equilibrium in which the law of one price holds.

We use data on publicly traded firms in the US between January 1979 and December 2009 from the Center for Research in Security Prices (CRSP). Based on the Standard Industrial Classification (SIC) code, we select *SIC 80* and *SIC 632* as industries comprising health care companies.<sup>8</sup> We retrieve monthly observations to construct annual data. We delete firms with missing information: A firm must have data on returns (including dividends), end of the month closing price, and total number of shares outstanding.<sup>9</sup>

Now, let us move to the first question. We compute abnormal returns as the difference between the observed market returns and the returns predicted by an equilibrium model. Several models have been proposed to estimate equilibrium expected returns. The Capital Asset Pricing Model (CAPM) is a well known example in which the expected return is given by the amount of non-diversifiable risk (also called systematic risk). An abnormal return is a statistically significant difference between the expected return predicted by the model and the realized return observed in the market. The source of systematic risk in the CAPM is the market portfolio, which is the value-weighted portfolio of all the valuable assets in an economy. The following econometric version of the model has been widely tested:

$$r_i - r_f = \alpha_i + \beta_i(r_m - r_f) + \varepsilon_i \quad (11)$$

where  $r_i$  is the vector of returns of the assets under study (in our case  $i = SIC80, SIC632$ ),  $r_f$  is the risk free rate,  $r_m$  is the vector of returns of the proxy used for the market portfolio, and  $\varepsilon_i$  is the vector of asset specific returns or non-systematic risk. If asset  $i$  is properly priced given its quantity of systematic risk ( $\beta_i$ ), then  $\alpha_i$  should be statistically not different from zero, which implies the absence of abnormal returns.

In addition to the CAPM, we use two other popular models in the empirical asset pricing literature: The Fama-French (FF) three-factor model, and the FF model augmented with the momentum factor – known as the Carhart model. These models have been proposed to control

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<sup>8</sup>*SIC 80*: Establishments primarily engaged in furnishing medical, surgical, and other health services to persons. Establishments of associations or groups, such as Health Maintenance Organizations (HMOs), primarily engaged in providing medical or other health services to members are included, but those which limit their services to the provision of insurance against hospitalization or medical costs are classified as Insurance, Major Group 63. Hospices are also included in this major group and are classified according to the primary service provided.

*SIC 632*: Establishments primarily engaged in underwriting accident and health insurance. This industry includes establishments which provide health insurance protection for disability income losses and medical expense coverage on an indemnity basis. These establishments are operated by enterprises that may be owned by shareholders, policy holders, or other carriers. Establishments primarily engaged in providing hospital, medical and other health services on a service basis or a combination of service and indemnity are classified under Industry 6324.

Definitions available at <http://www.osha.gov/pls/imis/sicsearch.html> are from the US Department of Labor.

<sup>9</sup>The list of companies used to construct each SIC portfolio is available from the authors upon request.



for sources of systematic risk that the CAPM might be missing. Using standard OLS techniques, we test the following econometric versions of the FF and Carhart models:

$$r_i - r_f = \alpha_i + \beta_{i1}(r_m - r_f) + \beta_{i2}SMB + \beta_{i3}HML + \varepsilon_i \quad (12)$$

$$r_i - r_f = \alpha_i + \beta_{i1}(r_m - r_f) + \beta_{i2}SMB + \beta_{i3}HML + \beta_{i4}MOM + \varepsilon_i \quad (13)$$

where *SMB* captures size, *HML* captures book to market value, and *MOM* captures momentum profits.<sup>10</sup>

Table 4.2 reports coefficient estimates for equations (11)-(13) for sectors SIC 80 and 632. We report p-values in parenthesis, and  $R^2$  for each regression. The abnormal return  $\alpha$  is positive and significant for both health care industry portfolios across all three models. For the *SIC 80* portfolio, the p-value for  $\alpha$  is always less than 0.001. For the *SIC 632*, the p-value for  $\alpha$  is always less than 0.025. Besides, the  $\alpha$ -coefficients are quite sizable. For example, for the Carhart model, the monthly  $\alpha$  for *SIC 80* portfolio is equal to 1.11 percent. This translates into a yearly cumulative abnormal return of about 14.16 percent. Therefore, the results in Table 4.2 provide solid evidence of abnormal returns for publicly traded firms in the health care industry over the last 30 years.

[Table 4.2: Tests of Abnormal Returns 1979-2009]

Let us next move to the second question: Are abnormal returns driven by HCE growth? In Figure 4.4, we plot yearly abnormal returns from each SIC portfolio against the growth rate in HCE. The yearly abnormal returns are computed under the CAPM.<sup>11</sup> Since financial variables are much more volatile than macro variables we consider a 5-year moving average to smooth out the estimates. The figure plots the 5-year moving average of the abnormal returns and growth rates of HCE. All these variables display similar trends – suggesting a link between abnormal returns observed in the health care industry and HCE growth.

[Figure 4.4: Abnormal Returns and Health Care Expenditures 1979-2009]

Finally, we report concentration ratios for each SIC code under the Herfindahl–Hirschman Index (HHI). [Similar results are available for the four-firm concentration index (FFCI).] Figure 4.5 plots the HHI for both SICs. Larger concentration ratios are observed during the transition period up to 1990. In fact, for the *SIC 632* the HHI index remains above 1500 during the entire transition period, which can be considered moderate market concentration. For that same

<sup>10</sup>SMB, HML and MOM are generally considered as sources of non-diversifiable risk; see Fama and French (1993) and Carhart (1997). Data are downloaded from Kenneth French website.

<sup>11</sup>The data in this figure uses a constant beta estimated over the entire sample. We also produced a figure with rolling betas estimated based on 60 consecutive monthly returns and collapsing the alpha to zero whenever it is not significant. Results are qualitatively the same and are available from the authors upon request.

SIC, the FFCI is over 60 percent during the transition period. Then, all these concentration measures decline to reach minimum values in 1993. Afterwards, concentration ratios increase again.

[Figure 4.5: Industry Concentration Ratios]

To sum up, we find evidence of abnormal returns in the health care sector. This evidence signals existence of market frictions that private companies should be able to exploit. Abnormal returns happen at times of high HCE growth. Further, relatively high concentration ratios are observed during the transition period in which HCE growth was quite remarkable.

#### 4.4 Malpractice and out-of-pocket expenditures

In section 2 we discussed some trends of malpractice, out-of-pocket expenditures, and real health care consumption. We now provide a simple quantitative analysis of these trends. For real health care expenditures we consider the US residual  $A_t$  of section 3. The malpractice insurance-premium measure and out-of-pocket expenditures are defined in the appendix below. For medical care prices we consider the overall CPI–medical care and its three main components: Hospital and Related Services, Prescription Drugs, and Physicians’ Services.

Table 4.3 shows several contemporaneous correlation coefficients. Growth rates of price related variables are not contemporaneously correlated with the growth rate of out-of-pocket expenditures over HCE (except for the price index of Hospital and Related Services), and are not contemporaneously correlated with the growth rate of the malpractice insurance-premium measure (except for prescription drugs). These growth rates in prices, however, present a negative contemporaneous correlation with the growth rate in the US residual  $A_t$ . The growth rate of out-of-pocket expenditures over HCE is negatively correlated with the growth rate in the US residual  $A_t$ . Surprisingly, the growth rate of the malpractice measure appears to be negatively correlated with the growth rate of the US residual  $A_t$ . Therefore, while prices and out-of-pocket expenditures seem to influence the US residual  $A_t$  in the right direction, the malpractice insurance-premium measure does not.

[Table 4.3: Contemporaneous Correlation Coefficients]

## 5 Concluding Remarks

In this paper we are concerned with the evolution of US health care expenditures. This is a topic of national concern, and a tall order for balanced economic growth. Since 1980, the US has presented the highest health care expenditure share of the OECD. As the baby-boom generation is approaching retirement, it is feared that the US medical care expenditure gap may be increasing.

To guide this discussion, we consider a sample of 11 OECD countries over the time period 1970-2007. We distinguish three sub-periods for the health care expenditure gap: (i) *The 1970-1977 period*: The US medical care expenditure gap hovered around 1.1 (over the OECD average), (ii) *The 1978-1990 period*: The US medical care expenditure gap increased steadily from 1.1 to 1.55, and (iii) *The 1991-2007 period*: The US medical care expenditure gap stabilized around 1.5. Therefore, the 1978-1990 period stands up as a transitional episode with a sharp change in the US medical care expenditure gap.

One major difficulty to uncover these growth patterns appears to be the high degree of uniformity presented by US medical expenditures in the various categories by source and use. These regular trends are even preserved in the transitional period 1978-1990. Indeed, when adjusting for inflation in the medical sector we get that the ratio of real health care expenditures over real GDP is quite flat over the sample period. The stability of US real health care expenditures over real GDP is quite striking.

After a review of some basic empirical facts, we consider that there is a group of economic variables that cannot account for these growth patterns of the US medical care expenditure gap. This group includes GDP growth, life expectancy, trends in elderly population, defensive medicine, and physicians' compensation. In simple words, these variables do not present enough variability in the data to account for the transitional period 1978-1990. US GDP growth has been lower than average OECD growth, and US life expectancy has simply been trailing the OECD average. Also, real Medicare cost per enrollee has been growing at similar rates than real health care expenditures per capita, and the distribution of the population over the categories of uninsured, privately and publicly insured remains quite stable over the sample period. Upward trends in defensive medicine should be reflected in increasing real medical expenditures per capita, whereas we observe a slight decline in real medical expenditures per capita by the end of the 1990s with the widespread use of "managed care." Lastly, the ratio of total physicians' compensation over health care expenditures has trended downwards; in fact, the labor income share in the health care sector has remained flat over the sample period.

On the other hand, there is another group of variables which cannot be discarded as possible explanatory variables on a first pass. This group of variables include the advent and intensive use of new technologies, the relative price of medical care, malpractice insurance costs, out-of-pocket expenditures, and health care reforms. There are several microeconomic studies on the cost effects of various technologies [e.g., Chandra and Skinner (2012)]. Our cross-country macroeconomic approach is intended to assess the differential effects of technology in the US as compared with the average technology residual for all the other OECD countries. It turns out that the pace of the US technology residual does not differ much from that of the average OECD technology residual. Then, after filtering out the average OECD residual, growth patterns of US health care expenditures can be pretty much accounted for by the relative price of medical care under a price elasticity of demand around -0.17. Within our OECD sample, the US is the leading country to undergo an excess acute inflation in medical care consumption. Inflation in

US medical care is not higher than in many other countries: What it seems high is the change in the US *relative* price of medical care.

The “crisis” of medical malpractice happened in the transitional period of the 1980s along with marked increases in the US health care expenditure and price gaps. Hence, malpractice insurance costs could be blamed for both increasing real medical care consumption and prices in the transitional period. We nevertheless find that malpractice insurance costs are not strongly correlated with either medical care prices or real quantities (the US technology residual) over the whole sample period. Rather weak correlations for both medical care prices and medical consumption are also found for out-of-pocket health care expenditures.

Some health care programs become noticeable because of some trend breaks in the data. In the US, the introduction of Medicare and Medicaid as well as some other medical reforms have expanded the demand for health care. Increases in health care expenditures as a result of medical reforms, however, seem to be more pronounced in many other OECD countries such as France and Spain that have implemented systems of universal insurance.

Besides the aforementioned transitional period 1978-1990, health care prices seem to account for some other important episodes in the recent US health care history. For instance, during the Clinton Presidency 1993-2000, the ratios of both private and public health care expenditures over GDP remained quite flat. This was actually a period of low excess inflation in the health care sector and high GDP growth rates.

Therefore, the issue boils down to the following basic questions: (i) Are US health care prices higher than in other OECD countries? And if so, (ii) Which are the explanatory factors behind the higher US prices? Section 4 above provides further evidence in support of higher US prices concerning some medical treatments and prescription drugs. The health economics literature has identified various factors to account for the higher US prices for prescription drugs. These factors may also extend to the observed high prices of hospital and other medical services. Certain regulations in overseas health care markets appear to be quite effective to support lower prices. Finally, when considering production factors in the health care sector, we observe that medical care prices appear to be strongly correlated with corporate profits and stock market returns, but weakly correlated with salaries and labor income shares. Technological innovation and market power may thus be important determinants of health care prices. Physicians’ compensation seems unrelated to medical price increases. The observed growth in US health care expenditures has been accommodated via employment rather than via salaries.

## 6 Appendix

### 6.1 Definitions and data sources

*Total Consumption* (OECD data): The sum of government final consumption expenditure and private final consumption expenditure (private refers to household and non-profit institutions

serving households. See <http://stats.oecd.org/glossary/>).

*Health Care Expenditures* (OECD data): “The expenditure on activities that – through application of medical, paramedical, and nursing knowledge and technology – has the goals of: Promoting health and preventing disease; Curing illness and reducing premature mortality; Caring for persons affected by chronic illness who require nursing care; Caring for persons with health-related impairments, disability, and handicaps who require nursing care; Assisting patients to die with dignity; Providing and administering public health; Providing and administering health programmes, health insurance and other funding arrangements.

With this boundary, general public safety measures such as technical standards monitoring and road safety are not considered as part of expenditure on health. Activities such as food and hygiene control and health research and development are considered health-related, but are not included in total health expenditure. Expenditures on those items are reported separately in the chapter on health-related functions.” (OECD Health Data 2012 Definitions, Sources and Methods; available at <http://stats.oecd.org>)

*Medical Care Prices:*

Medical care prices from 1970 to 1977 for the 11 OECD countries in the sample are from Gillion *et al.* (1985). Remaining data come from the following sources:

*Australia:* Data from 1989 to 2007 corresponds to the health component of the CPI (available from the Australian Bureau of Statistics at <http://www.abs.gov.au>). Data from 1978 to 1988 corresponds to the health price index published by the OECD (available at <http://stats.oecd.org/>).

*Canada:* Data corresponds to the health and personal care price index component of the CPI (available from Statistics Canada at <http://www76.statcan.gc.ca>).

*Denmark:* Data from 1996 to 2007 corresponds to the CPI–health price, available at the FRED database (Federal Reserve Bank of St. Louis). Data from 1978 to 1995 corresponds to the health price index published by the OECD (available at <http://stats.oecd.org/>).

*Finland:* Data from 1996 to 2007 corresponds to the CPI–health price, available at the FRED database (Federal Reserve Bank of St. Louis). Data from 1978 to 1995 corresponds to the health price index published by the OECD (available at <http://stats.oecd.org/>).

*France:* The CPI–medical care is the union of the following three price indices: (i) The health services up to year 1992 (and then discontinued), (ii) The medical services and health care expenditures up to year 1998 (and then discontinued), and (iii) The health services from 1998 to 2007 (available from the French National Institute for Statistics and Economic Studies at <http://www.bdm.insee.fr>).

*Germany:* Data up to 1983 is from Gillion *et al.* (1985). Data from 1991 until 2007 corresponds to the health component of the CPI (available from the German Federal Statistics Office at <https://www.destatis.de/>). Data for the missing period 1984–1990 has been interpolated using data from Schieber *et al.* (1994).

*Ireland:* Data corresponds to the health subcategory of the CPI, which is available from the Irish Central Statistics Office at <http://www.cso.ie/>.

*Japan:* Data corresponds to the medical care item of the CPI [available from the Japanese Statistics Bureau, Director-General for Policy Planning (Statistical Standards) and Statistical Research and Training Institute at <http://www.stat.go.jp/>].

*Spain:* The CPI–medical care is constructed as the union of several price indices. From 1977 to 1992 we used the CPI–medicine (IPC–medicina). For the period 1993–2001 we used the average change in five subcategories of the CPI: medical, dental and non-hospital paramedical services (servicios médicos, dentales y paramédicos no hospitalarios), drugs and other pharmaceutical products (medicamentos y otros productos farmacéuticos), machines, therapeutic material and its repairs (aparatos y material terapéutico y sus reparaciones), hospital care (cuidados en hospitales y similares), and medical insurance (seguros médicos). From 2002 to 2007 we used the average change in the three available subcategories: Drugs, pharmaceutical products and therapeutic material (medicamentos, otros productos farmacéuticos y material terapéutico), medical, dental and non-hospital paramedical services (servicios médicos, dentales y paramédicos no hospitalarios), and hospital services (servicios hospitalarios). Available from the Instituto Nacional de Estadística at <http://www.ine.es/>.

*United Kingdom:* Data up to 1983 is taken from Gillion *et al.* (1985). Data from 1988 until 2007 corresponds to the health component of the CPI (available from the Office for National Statistics at <http://www.ons.gov.uk/>). Data from the missing period 1984–1987 has been interpolated using data from Schieber *et al.* (1994).

*United States:* Data corresponds to the CPI–medical care (available from the Bureau of Labor Statistics at <http://www.bls.gov/>).

#### *Malpractice Indices:*

*Incurred Losses:* The insurer’s expected costs for claims reported in that year and adjustments to the expected costs for claims reported in earlier years [GAO (2003) report].

*Paid Losses:* Cash payments that insurers make in a given period, such as a calendar year, on claims reported during both the current and previous years [GAO (2003) report].

*Insurance-Premium:* The average change in the cost of malpractice insurance for three physicians’ specialties: General Medicine, General Surgery, and Obstetrics/Gynecology. Data from 1976 to 1986 are from Danzon (1991). Data from 1987 to 1990 are from Harrington *et al.* (2008). Data from 1991 to 2007 are from authors’ computations from insurance costs for the three specialties (Medical Liability Monitor Reports) over 51 US states.

*Out-of-Pocket Expenditures:* “Out-of-pocket spending for health care consists of direct spending by consumers for health care goods and services. Included in this estimate is the amount paid out-of-pocket for services not covered by insurance and the amount of coinsurance or deductibles required by private health insurance and public programs such as Medicare and

Medicaid (not paid by some other third party), as well as payments covered by Health Savings Accounts.” See <http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/downloads/dsm-10.pdf>.

Insurance premia for private health insurance and Medicare are not included with this funding category since the enrollee pays to a third-party insurer (private health insurance or Medicare) that is classified in the NHEA as a separate source of funds. Similarly, coinsurance and deductible amounts paid by supplementary Medicare policies on behalf of enrolled Medicare beneficiaries are also excluded from the out-of-pocket source of funds category, and are counted as private health insurance.

## 6.2 Consumer Price Index–Medical Care vs. Personal Consumption Expenditures–Health Care Index

The CPI–medical care of the BLS is the index used in the paper, with the caveat that for 1970–1978 we use data from Gillion *et al.* (1985). Then, the BEA initiated the PCE–health care in 1994. As stated in Fixler and Jaditz (2002), there are three main differences between the CPI–medical care and the PCE–health care: “First, the two indices use different formulas. The CPI is a Laspeyres index, while the BEA product is a Fisher Ideal index. Second, the two indices have different underlying concepts. The BLS product measures the prices paid by (urban) consumers, while the BEA product measures the prices of final consumption goods, wherever they are purchased. Finally, differences in how the detailed components are implemented lead to differences in how prices are measured and the weights attached to specific series.”

As of December 2004, the medical care category as a whole had a weight of 6.1 percent in the CPI while health care had a weight of 20.3 percent in the PCE. Both indices grow at similar rates until 1997 (Figure A.1). Then, the CPI grows at a faster pace than the PCE.

[Figure A.1: CPI–Medical Care vs. PCE–Health Care Index]

As illustrated in Figure A.2, the CPI–medical care comprises two broad categories: Medical Care Services (with a weight of 2/3 in the overall basket) and Medical Care Commodities. Within Medical Care Services the items Hospital and Related Services and Professional Services are the main subcategories accounting for almost 45 percent of the CPI–medical care. Within Medical Care Commodities, the main category is Prescription Drugs accounting for almost 20 percent of the overall index. Similar subcategories can be found in the PCE–health care. In this later index, Hospital Services carries a weight of 36 percent, Physicians Services carries a weight of 20 percent, and Pharmaceutical Products carries a weight of 16 percent.

[Figure A.2: The CPI–Medical Care Basket]

In Figure A.3 we plot the evolution of the CPI–medical care [Panel (a)] and the PCE–health care [Panel (b)] for the three main subcategories already mentioned. We observe that Hospital

and Related Services has experienced the highest increase for both indices. Note that after 1994 this CPI category grows faster than the PCE category. Professional Services has the lowest growth. Prescription Drugs has increased slightly more than the overall index for the CPI and Pharmaceutical Products less than the overall index for the PCE. Therefore, in both cases Professional Services appreciated at a slower pace than the overall index while Hospital Services appreciated at a much faster pace.

[Figure A.3: The Evolution of the CPI–Medical Care and PCE–Health Care]

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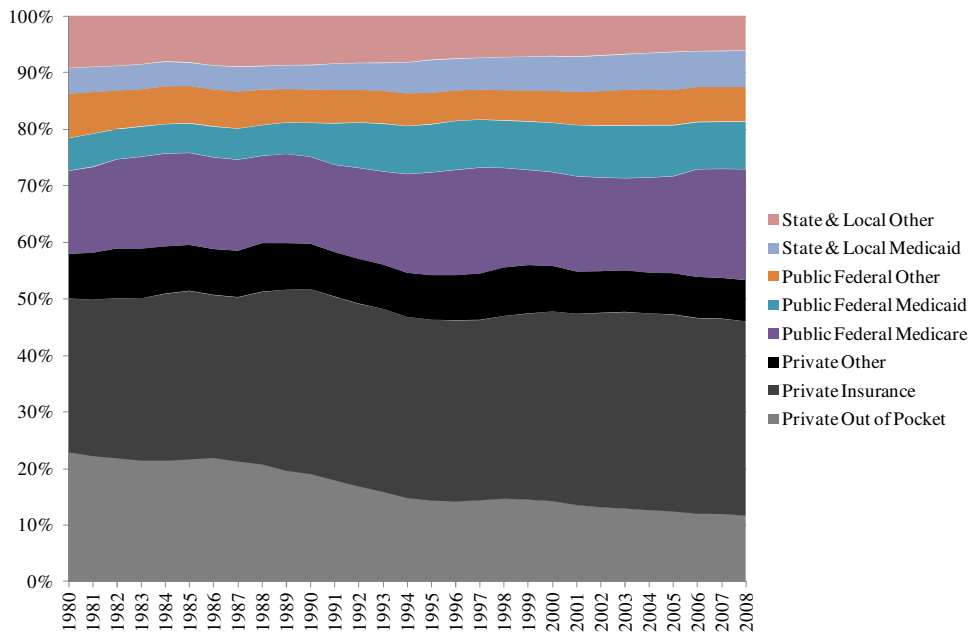
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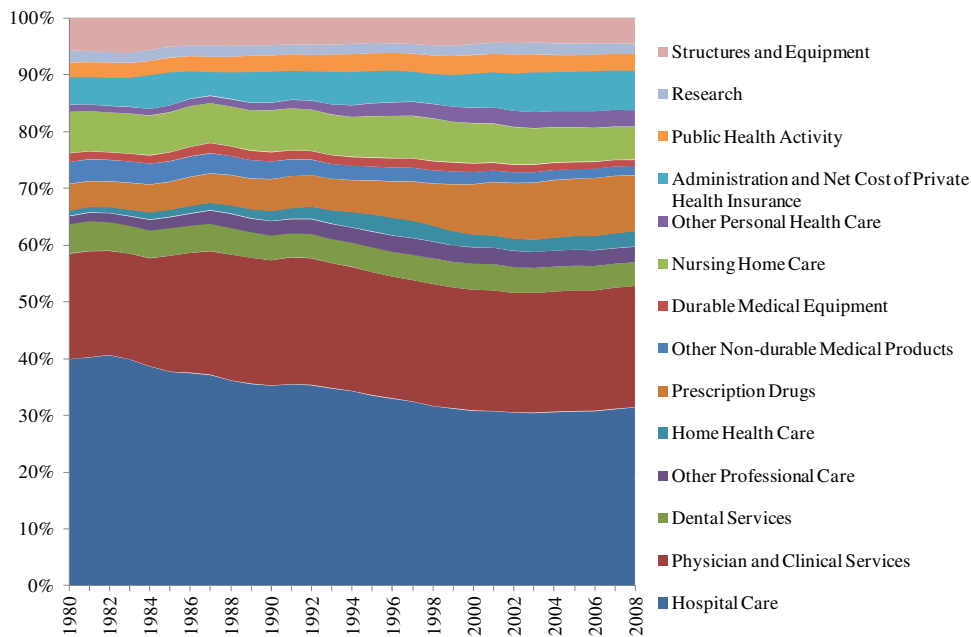
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**Figure 1.1: The Evolution of US Health Care Expenditures by Source 1980-2007**



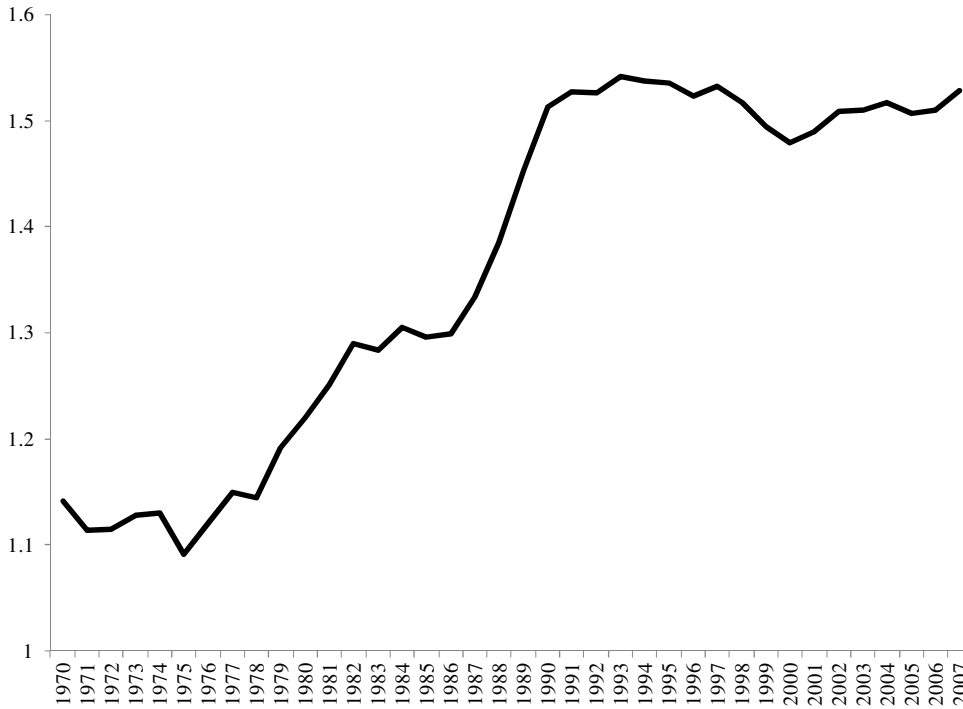
Source: US Department of Health and Human Services - Centers for Medicare and Medicaid Services.

**Figure 1.2: The Evolution of US Health Care Expenditures by Use 1980-2007**



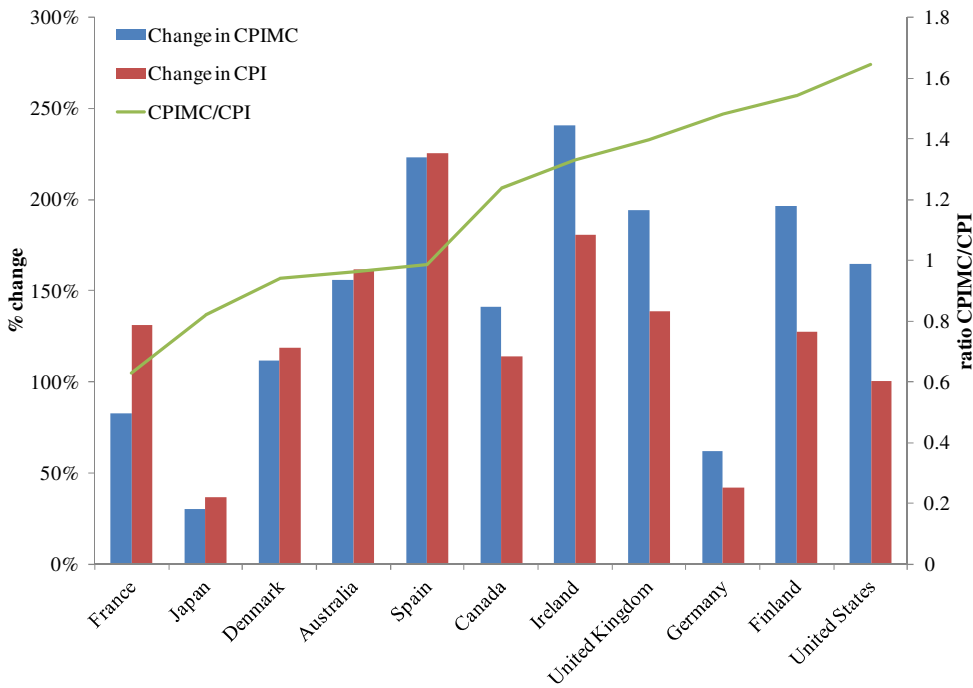
Source: US Department of Health and Human Services - Centers for Medicare and Medicaid Services.

**Figure 2.1:** The US Medical Care Expenditure Gap 1970-2007



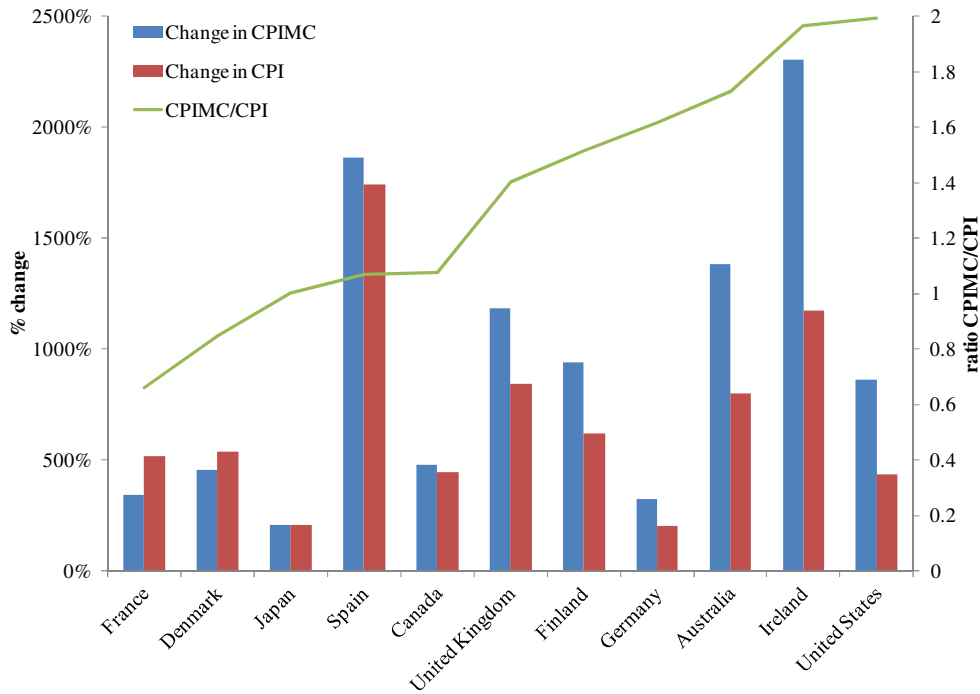
Source: OECD Health Data (June 2012)

**Figure 2.2:** The Medical Care Price Gap 1978-1990



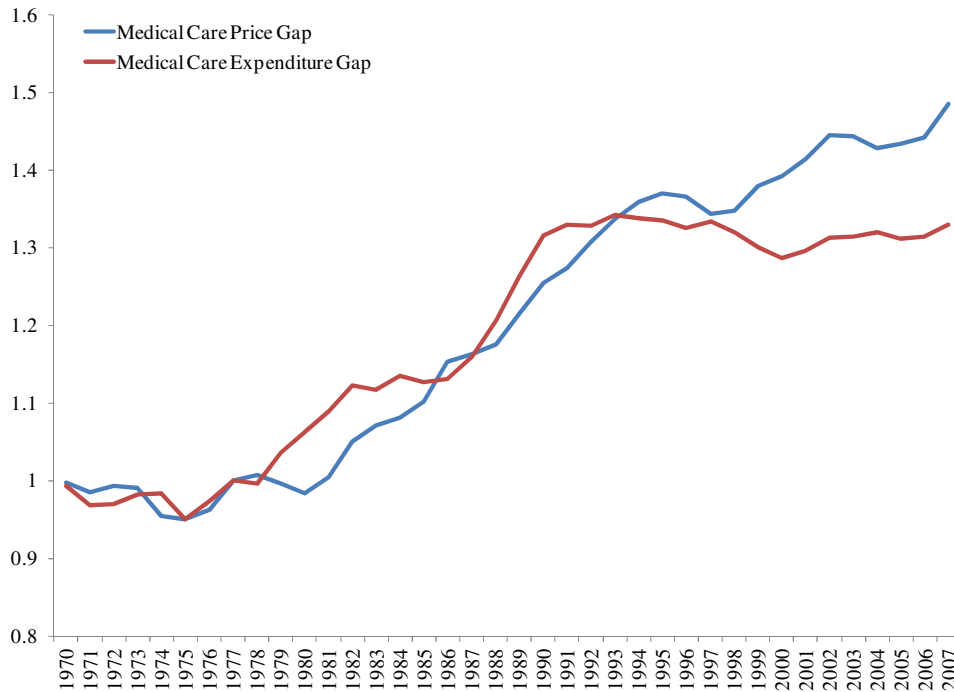
Source: Official statistics of each country and authors' computations.

**Figure 2.3: The Medical Care Price Gap 1970-2007**



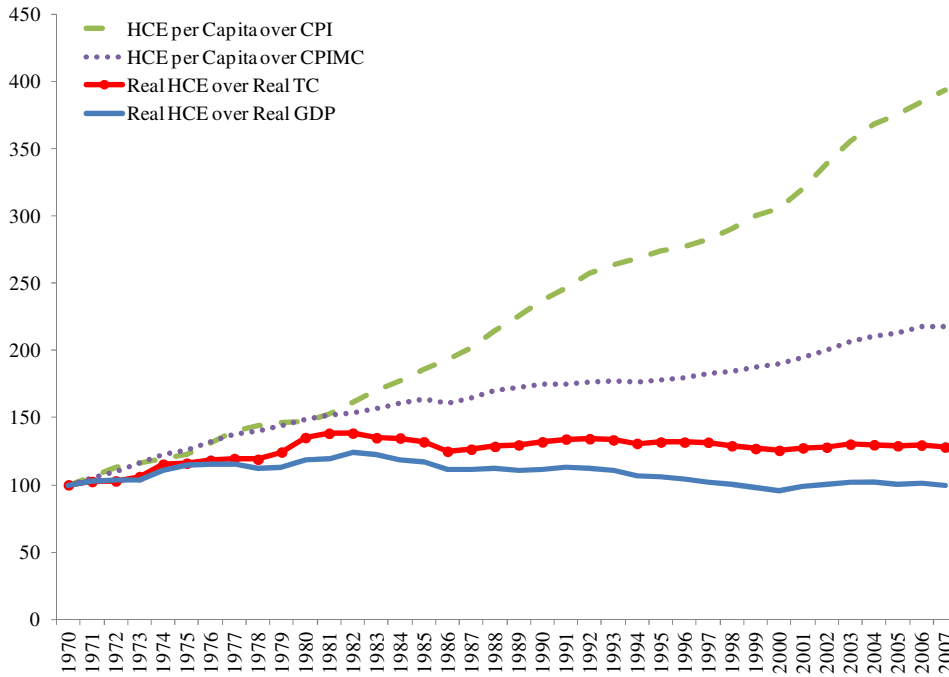
Source: Official statistics of each country and authors' computations.

**Figure 2.4: The US Medical Care Expenditure Gap vs. the Price Gap 1970-2007**



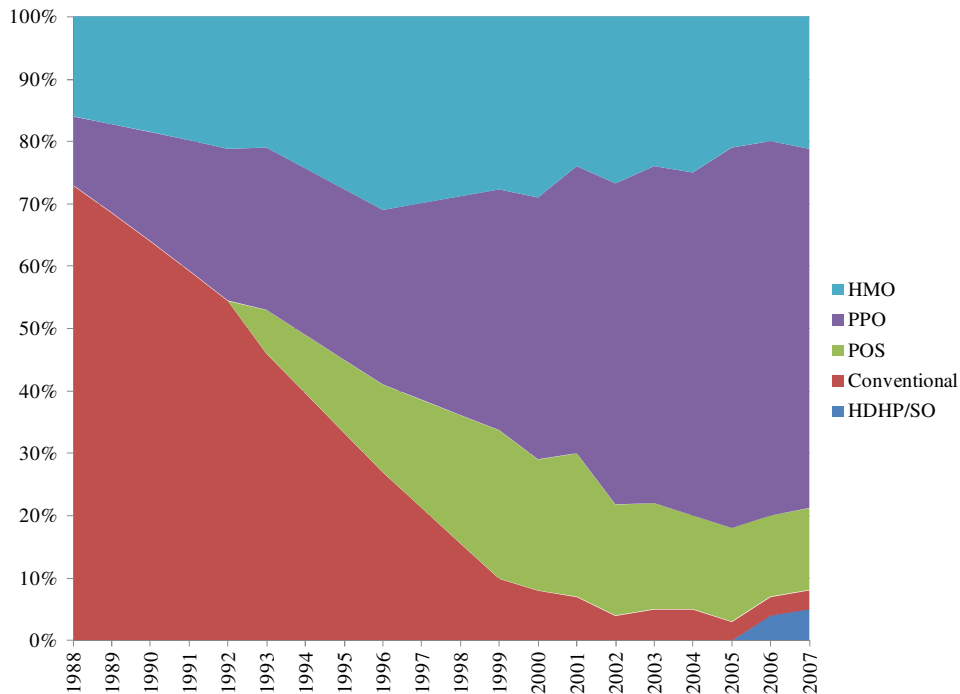
Source: Health Care Expenditures are from the OECD Health Data (June 2012). Health Care Price data are taken from each country's official statistics and authors' computations.

**Figure 2.5:** The Evolution of US Health Care Expenditures 1970-2007



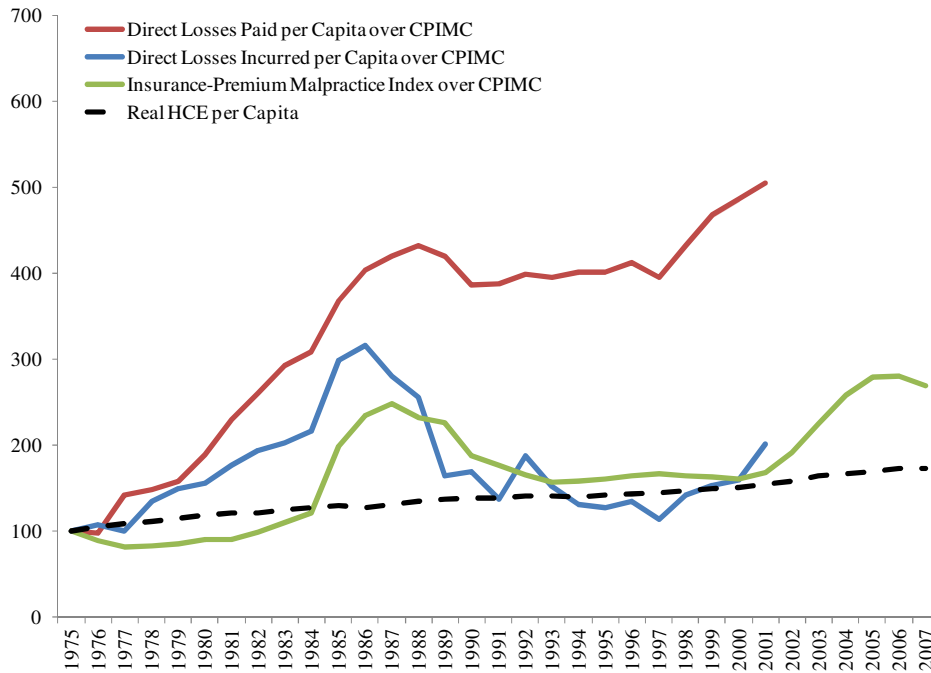
Source: US Department of Health and Human Services -- Centers for Medicare and Medicaid Services and the Bureau of Labor Statistics.

**Figure 2.6:** The Structure of the Insurance Market



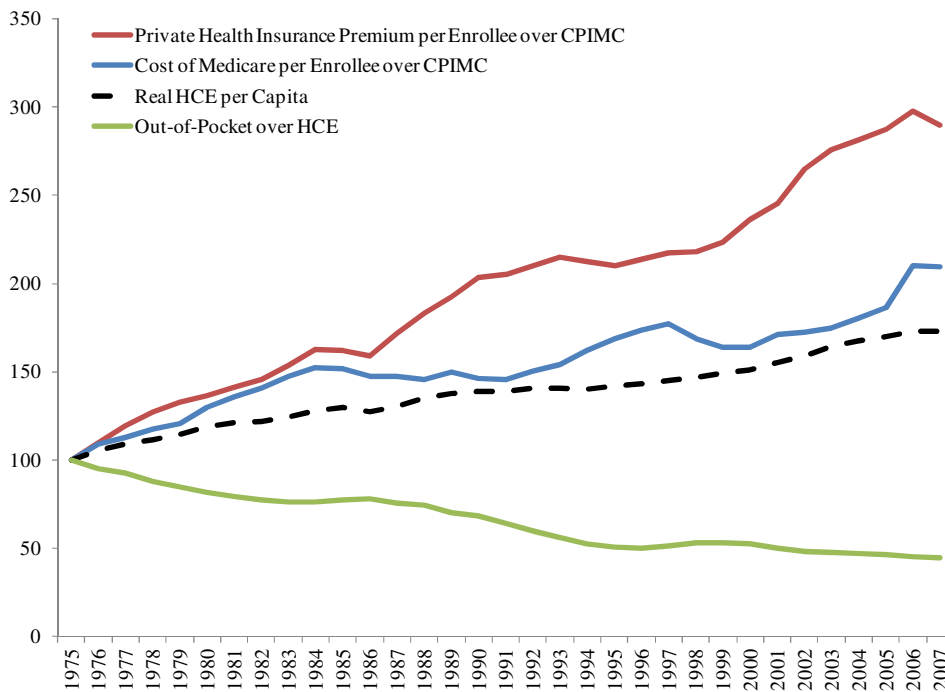
Source: Kaiser Family Foundation

**Figure 2.7:** US Medical Malpractice Insurance Premiums and Real Health Care Expenditures per Capita



Source: The 2003 GAO Report on Medical Malpractice Insurance, and the Bureau of Labor Statistics.

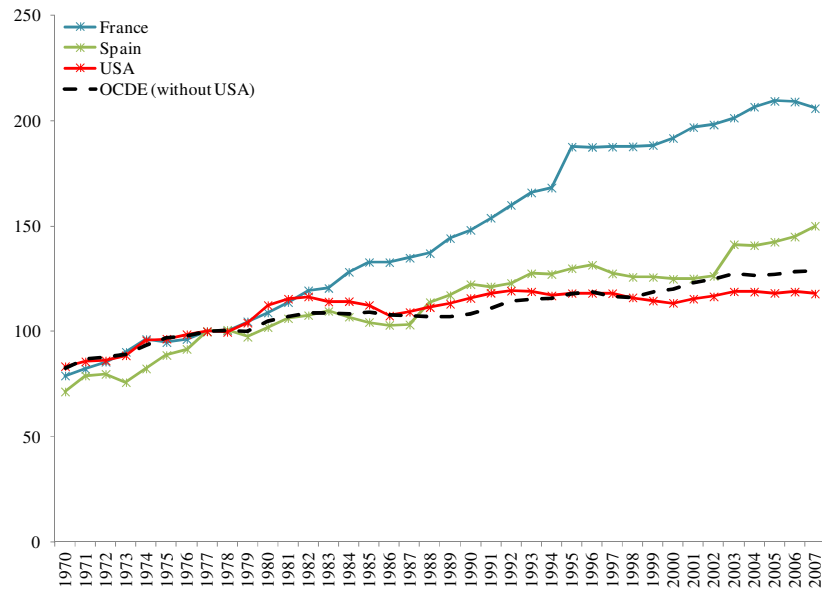
**Figure 2.8:** US Health Care Insurance Premiums and Real Health Care Expenditures per Capita



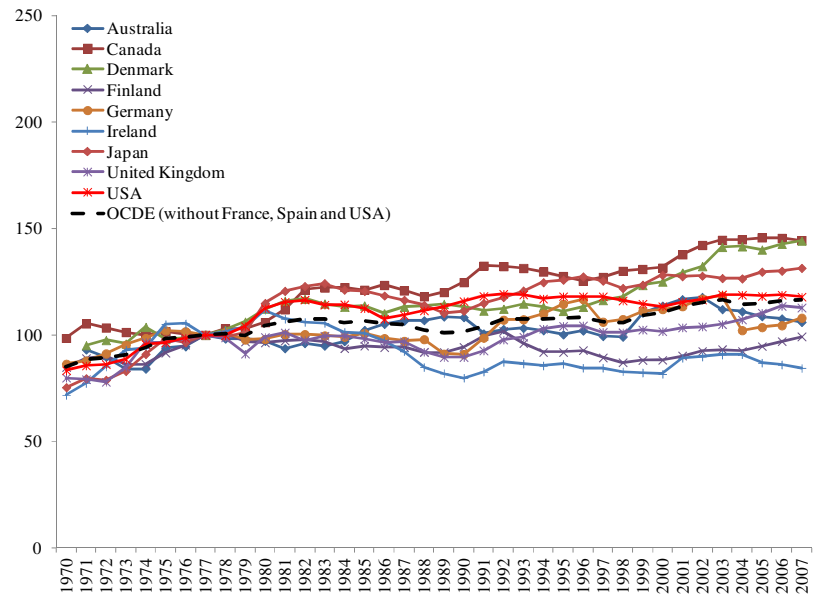
Source: Cohen et al. (2009), US Department of Health and Human Services - Centers for Medicare and Medicaid Services, and the Bureau of Labor Statistics.

**Figure 3.1:** A Growth Accounting Exercise: The Technology Residual  $A$  for a Sample of OECD Countries

(a) France and Spain



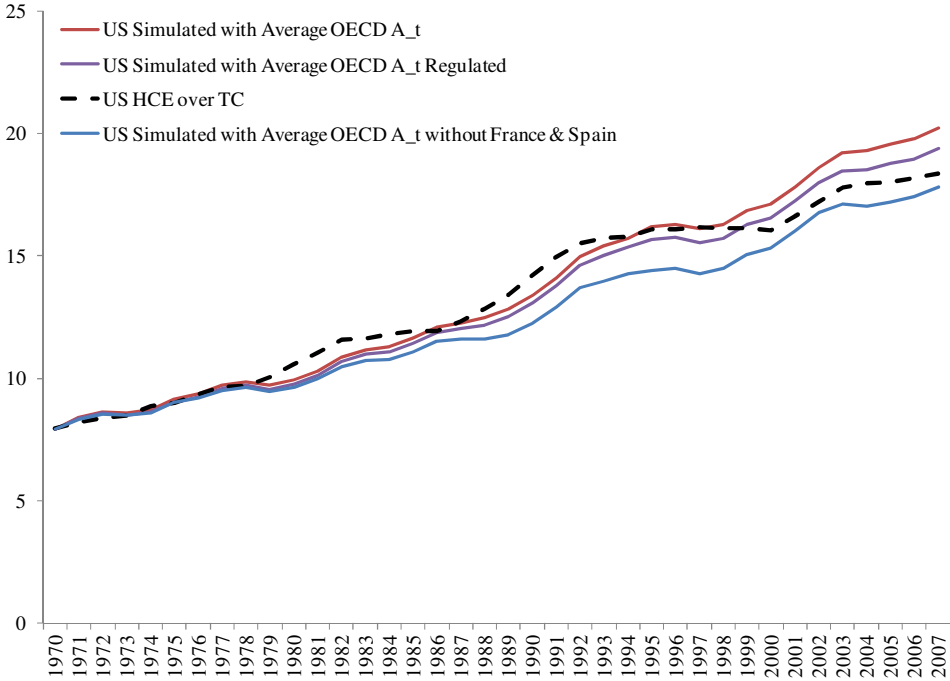
(b) OECD sample without France and Spain



Source: Health Care Expenditures are from the OECD Health Data (June 2012). Health Care Price data are taken from each country's official statistics and authors' computations.



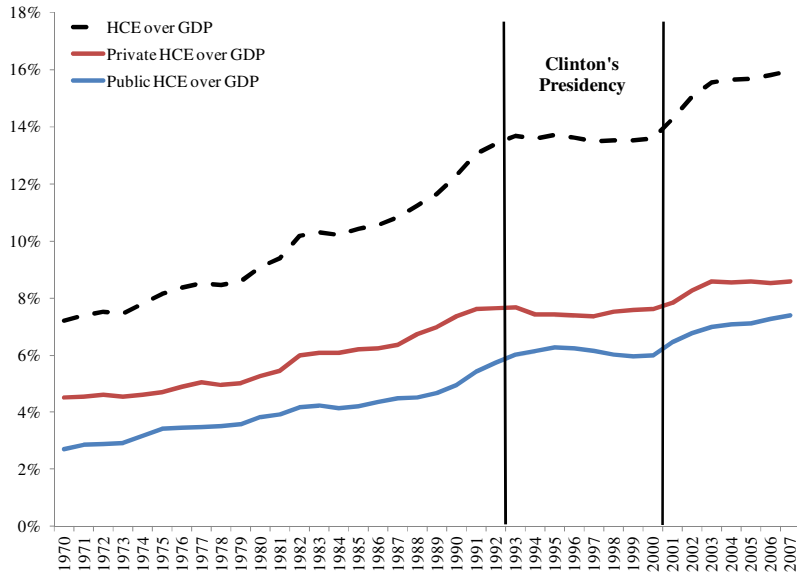
**Figure 3.2:** A Predictive Exercise: US Health Care Expenditures vs. Simulated Data



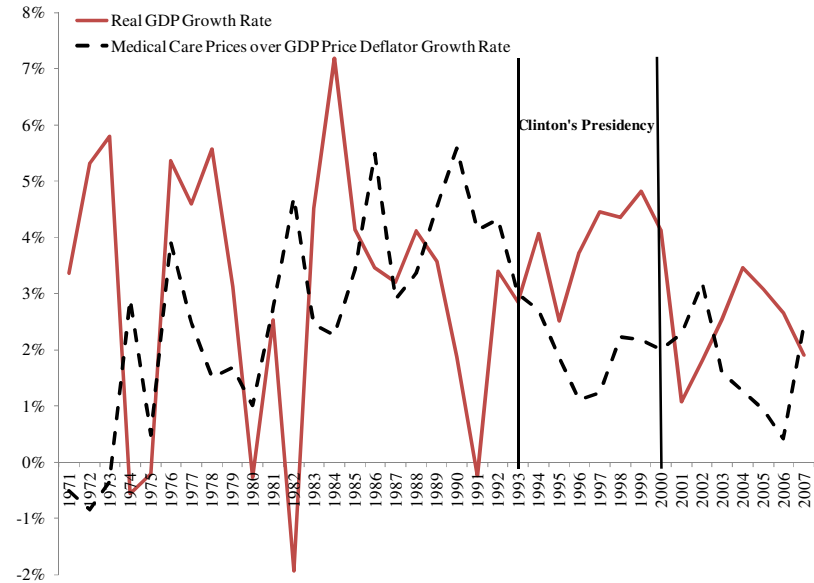
Source: Health Care Expenditures are from the OECD Health Data (June 2012). Health Care Price data are taken from each country’s official statistics and authors’ computations.

**Figure 4.1:** US Health Care Expenditures over GDP, Real GDP Growth, and the Relative Medical Care Price

(a) Public, Private and Total Health Expenditures over GDP

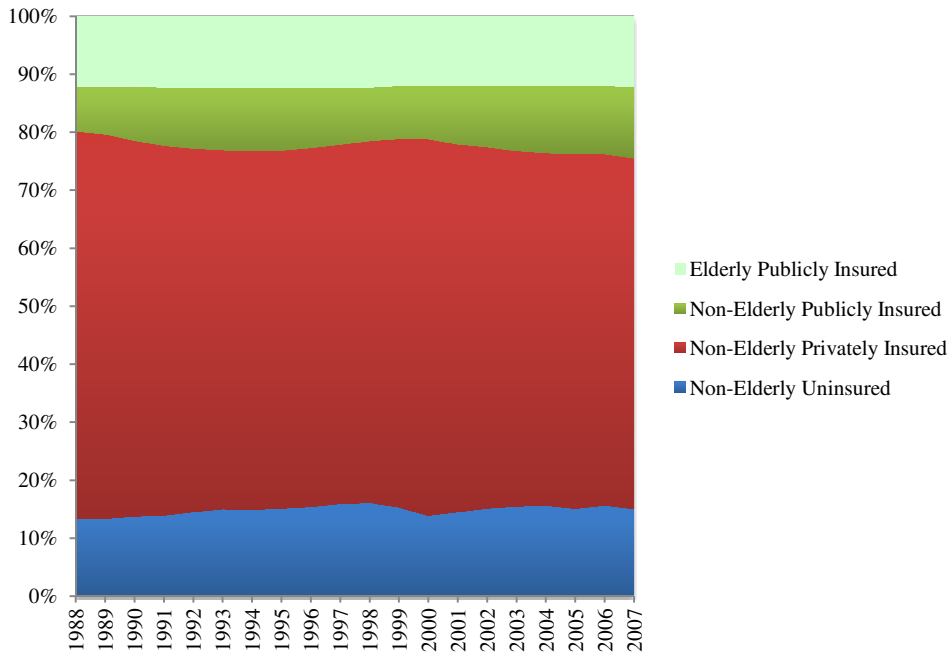


(b) Annual Real GDP Growth, and Excess Inflation in the Relative Medical Care Sector



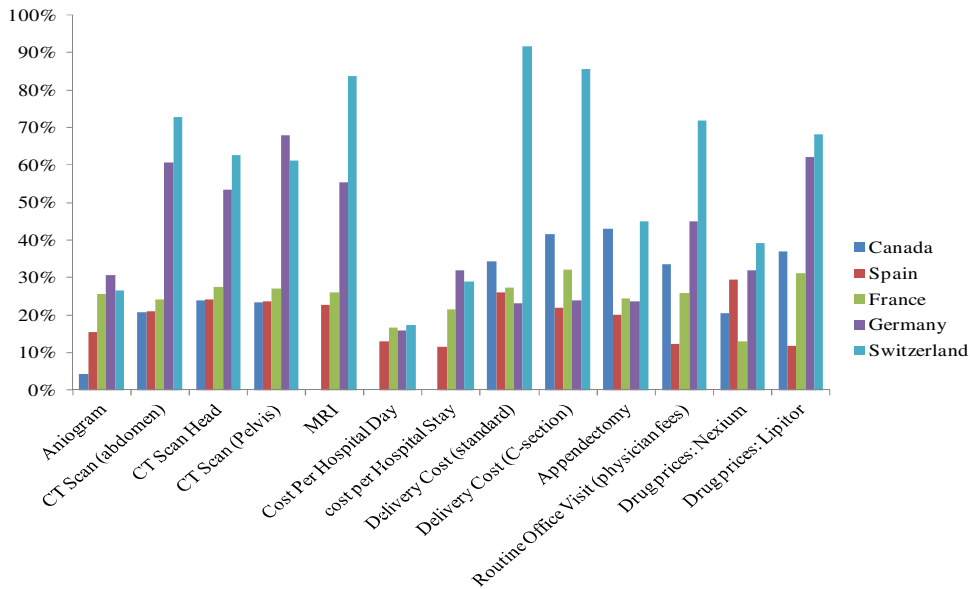
Source: US Census Bureau and US Department of Health & Human Services - CMS

**Figure 4.2:** Distribution of the Population by Health Care Insurance



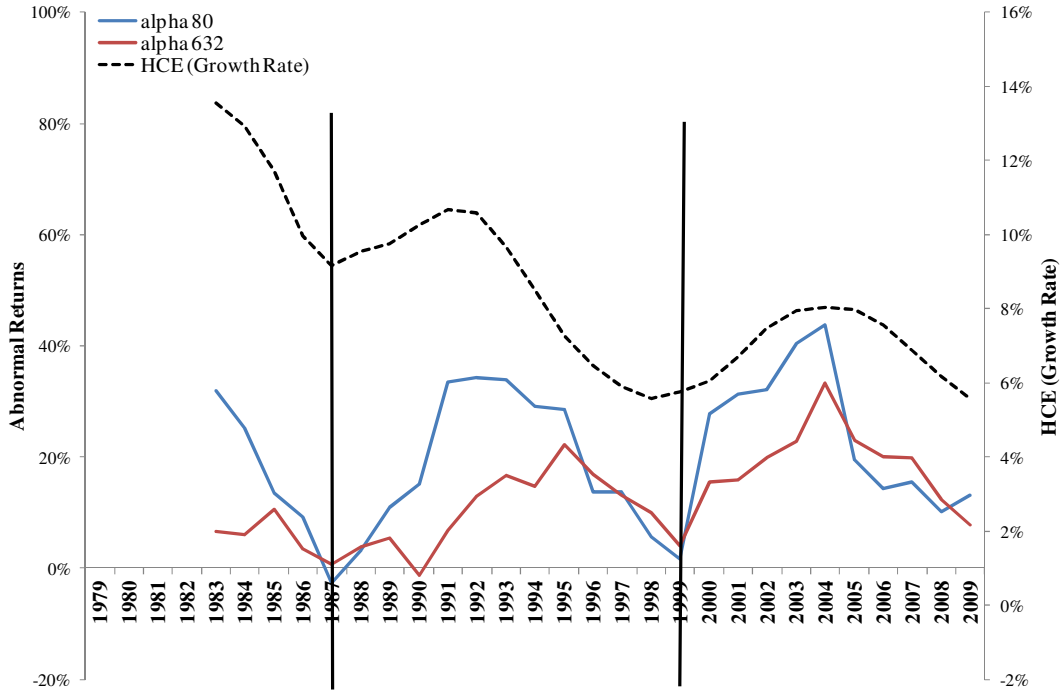
Source: Gruber & Levy (2009) and US Department of Health and Human Services -- Centers for Medicare and Medicaid Services

**Figure 4.3:** Country Health Care Prices over US Health Care Prices 2011



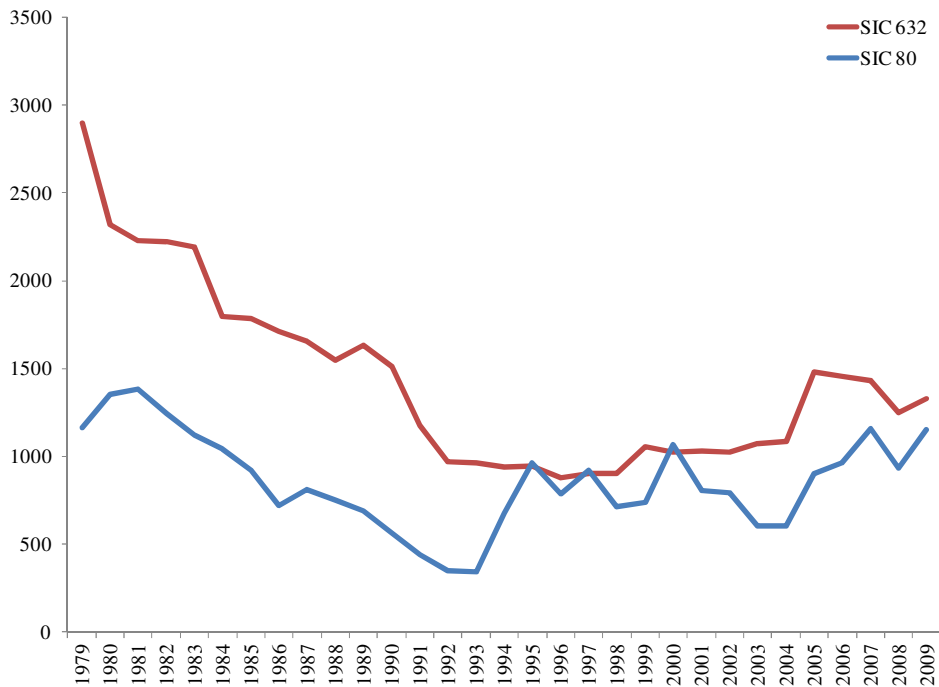
Source: International Federation of Health Plans. 2011 Comparative price report: medical and hospital fees by country. [http://ifhp.com/documents/IFHP\\_PriceReport2010ComparativePriceReport29112010.pdf](http://ifhp.com/documents/IFHP_PriceReport2010ComparativePriceReport29112010.pdf).

**Figure 4.4:** Abnormal Returns and Health Care Expenditures 1979-2009



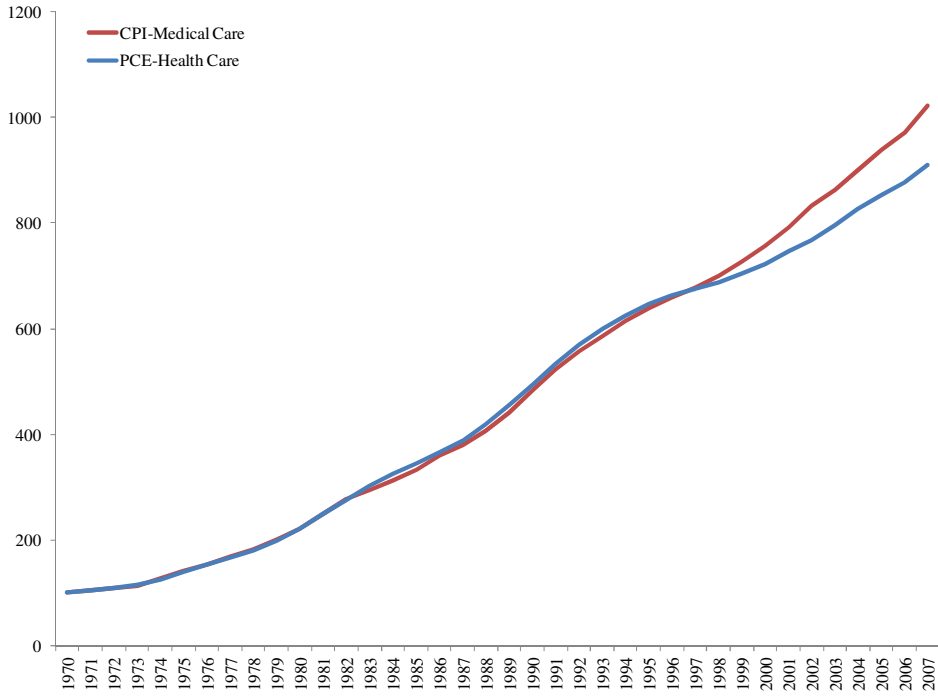
Source: CRSP, Bureau of Economic Analysis, US Department of Health & Human Services – CMS, and Kenneth French webpage.

**Figure 4.5:** Industry Concentration Ratios



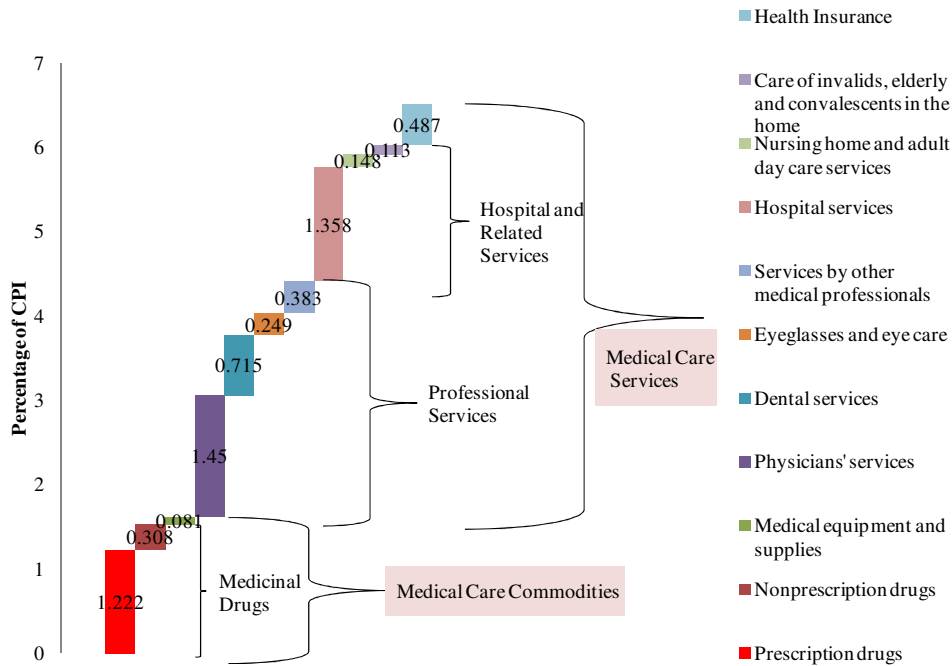
Source: CRSP and authors' computations.

**Figure A.1:** CPI--Medical Care vs. PCE--Health Care Index



Source: Bureau of Labor Statistics and Bureau of Economic Analysis

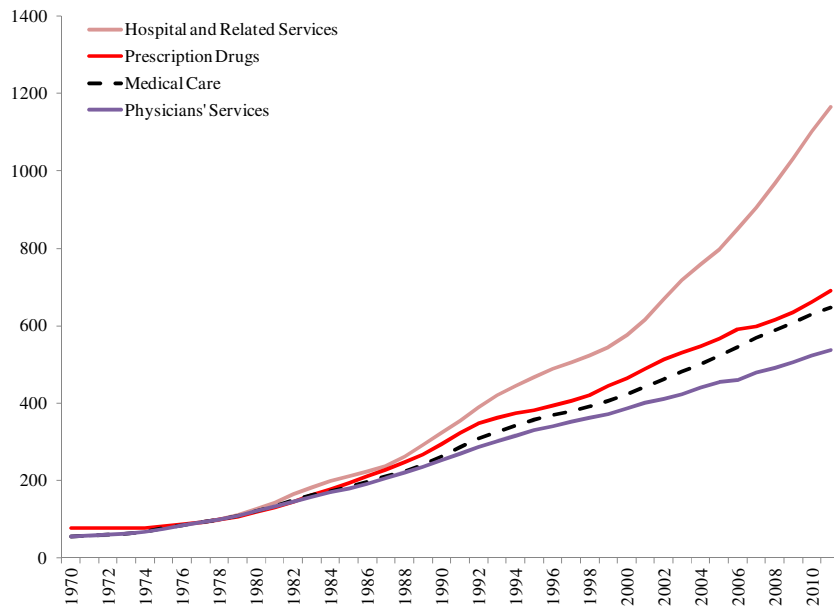
**Figure A.2: CPI--Medical Care Basket**



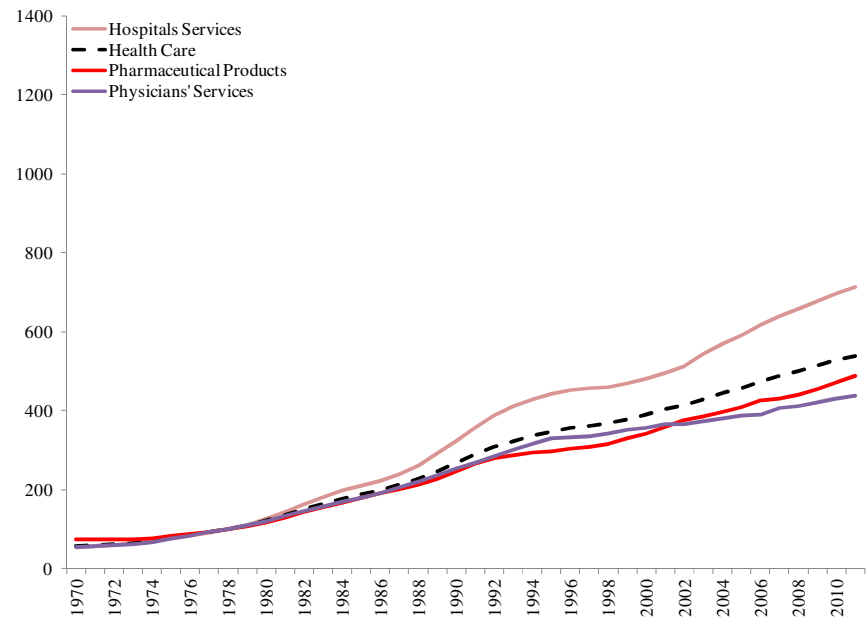
Source: Bureau of Labor Statistics

Figure A.3: CPI--Medical Care and PCE--Health Care

(a) Evolution of the CPI--Medical Care



(b) Evolution of the PCE--Health Care Index



Source: Bureau of Labor Statistics and Bureau of Economic Analysis

**Table 3.1:** Root Mean Square Errors

|                                       | $\rho = -3$ | $\rho = -4$ | $\rho = -5$ |
|---------------------------------------|-------------|-------------|-------------|
| $A_t^{OECD}$                          | 0.59        | 0.66        | 0.75        |
| $A_t^{OECD}$ <i>regulated</i>         | 0.68        | 0.62        | 0.61        |
| $A_t^{OECD}$ without France and Spain | 1.30        | 1.17        | 1.08        |

**Table 4.1:** Physicians' Compensation, Relative Productivity, and Labor Supply

|   | 1970  | 1980   | 1990  | 2000  |
|---|-------|--------|-------|-------|
| (i) Total Physicians Compensation over HCE                              | N/A   | 14.8%* | 14.1% | 13.1% |
| (ii) Average Physician Compensation over Average Worker Compensation    | N/A   | 4.95*  | 5.77  | 5.16  |
| (iii) Real HCE per Physician over Real GDP per Worker                   | N/A   | 20.5   | 23.8  | 22.1  |
| (iv) Average Non-Phys. Compensation over Average Physician Compensation | N/A   | 11.4%* | 11.3% | 12.0% |
| (v) Physicians over Total Population                                    | 0.15% | 0.19%  | 0.22% | 0.26% |
| (vi) Physicians over Total Health Care Workers                          | 11.7% | 8.2%   | 7.1%  | 7.2%  |
| (vii) Total Health Care Workers over Total Workers                      | 3.5%  | 5.5%   | 6.8%  | 7.4%  |
| (viii) Labor Income Share in the Health Care Industry                   | 24.3% | 32.6%  | 33.0% | 31.1% |

\* Data corresponds to the year 1982

Sources: AMA, AMGA, Bureau of Labor Statistics, and US Census Bureau

**Table 4.2:** Tests of Abnormal Returns 1979-2009

|           | SIC 632           |                    |                   | SIC 80            |                    |                   |
|-----------|-------------------|--------------------|-------------------|-------------------|--------------------|-------------------|
|           | CAPM              | FF                 | FF+Carhart        | CAPM              | FF                 | FF+Carhart        |
| $\alpha$  | 0.00772<br>(0.00) | 0.005394<br>(0.02) | 0.00609<br>(0.01) | 0.01306<br>(0.00) | 0.012237<br>(0.00) | 0.01111<br>(0.00) |
| $\beta_1$ | 0.8931<br>(0.00)  | 0.9921<br>(0.00)   | 0.9782<br>(0.00)  | 0.9408<br>(0.00)  | 0.9173<br>(0.00)   | 0.9397<br>(0.00)  |
| $\beta_2$ |                   | 0.0155<br>(0.84)   | 0.0027<br>(0.97)  |                   | 0.4282<br>(0.00)   | 0.4488<br>(0.00)  |
| $\beta_3$ |                   | 0.4183<br>(0.00)   | 0.3940<br>(0.00)  |                   | 0.1658<br>(0.08)   | 0.2052<br>(0.03)  |
| $\beta_4$ |                   |                    | -0.0744<br>(0.13) |                   |                    | 0.1207<br>(0.03)  |
| $R^2$     | 0.45              | 0.48               | 0.49              | 0.41              | 0.44               | 0.45              |

Source: CRSP, Kenneth French website and authors' computations.

**Table 4.3:** Contemporaneous Correlation Coefficients

|   | $\Delta$ Real CPI -<br>Hospital and related<br>services | $\Delta$ Real CPI -<br>Prescription Drugs | $\Delta$ Real CPI -<br>Physicians' services | $\Delta$ Real CPI -<br>Medical Care | $\Delta$ Insurance-Premium<br>Malpractice Index<br>over CPIMC | $\Delta$ Out-of-Pocket<br>over HCE | $\Delta A_t$ |
|---|---|---|---|-------------------------------------|---|------------------------------------|--------------|
| $\Delta$ Insurance-Premium<br>Malpractice Index over<br>CPIMC | -0.06   | 0.28                                      | 0.02  | 0.07                                | 1.00  |                                    |              |
| $\Delta$ Out-of-Pocket over HCE                               | -0.31   | 0.16                                      | 0.00  | 0.00                                | 0.40  | 1.00                               |              |
| $\Delta A_t$  | -0.19   | -0.47                                     | -0.46                                       | -0.51                               | -0.27   | -0.43                              | 1.00         |

Source: US Department of Health and Human Services - Centers for Medicare and Medicaid Services, the Bureau of Labor Statistics and authors' computations.