UNDERSTANDING GROWTH PATTERNS IN US HEALTH CARE EXPENDITURES

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Abstract. We study the steady upward trend of Health Care Expenditures (HCE) over GDP for a sample of OECD countries between 1970 and 2007. While the US is clearly an outlier, almost all of the additional increase in US HCE happened during the 1978-1990 period. We perform two growth accounting exercises to explore sources of variability of HCE over GDP across countries. In the first growth accounting exercise based on value added we find that factor accumulation is unable to replicate the observed growth patterns. We also show that the additional increase in markups in the US corporate medical sector mimics well the ratio of HCE over GDP in the US. This suggests that differences in the relative price of health care – rather than technology, product quality, and factor accumulation – could explain the divergent growth patterns of HCE over GDP across these countries. In the second growth accounting exercise, we filter out prices from HCE over GDP, and confirm that there is very little variability for the product quality residual to explain the variation in HCE across countries.

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1 Introduction

One of the most noteworthy stylized facts for the US economy is the pronounced upward trend in the share of health care expenditures (HCE). Indeed, according to OECD data HCE accounted for about 7 percent of nominal GDP in 1970, while it is now about 18 percent. Mounting US medical expenditures have become an issue of national concern and a continuing challenge for policy makers (e.g., the Clinton Health Care Plan of 1993; the Bush Medicare Prescription Drug, Improvement, and Modernization Act of 2003; and more recently the 2010 Obama Affordable Care Act).

We use a comparison group of ten other OECD countries with high quality data: Australia, Canada, Denmark, Finland, France, Germany, Ireland, Japan, Spain, and the United Kingdom. Our quantitative analysis aims to assess deviations of US medical expenditures from common trends over the sample period 1970-2007. We shall focus on the *US medical care expenditure gap*, which we define as the US share of HCE in nominal GDP over the average share of HCE in nominal GDP of the other OECD countries. Figure 1.1 below illustrates the evolution of the US medical care expenditure gap for the sample period. The US was among the top health care spenders in 1970 but still far from being an outlier. The US medical care expenditure gap displays a pronounced upward trend over the 1980s. The gap remains flat during the eight-year period of the Clinton presidency, and it goes up slightly at the beginning of the 2000s. Hence, this figure suggests the existence of three well differentiated periods: (*i*) *The* 1970-1977 *period*: The US medical care expenditure gap hovered around 1.25; (*ii*) *The* 1978-1990 *period*: The US medical care expenditure gap increased steadily from 1.23 to 1.68; and (*iii*) *The* 1991-2007 *period*: The US medical care expenditure gap roughly stabilized around 1.70. Of course, the 1978-1990 transition episode is certainly puzzling. Indeed, it does not seem plausible to explain the sharp increase in HCE over such a limited time span by some aggregate variables with smooth long-term trends such as GDP, life expectancy, the size of the elderly population, defensive medicine, the prevalence of some modern health habits and trends (e.g., fast food and obesity), and new medical treatments.

The widespread use of better, more advanced technologies and product quality has been blamed for the high share of HCE in GDP in the US. The evidence supports the idea that new technologies may diffuse quickly among countries with commensurate income levels. Besides, the increase in the US medical expenditure gap occurred just over a decade, and such pattern of growth will be hard to replicate by simple models of technology diffusion. Regarding higher product quality in the US health care sector, the US typically trails behind in OECD rankings on various health care outcomes and indicators. This is still compatible with the widespread use of more sophisticated and less cost-efficient technologies in the US. However, our study shows that inflation in the US medical sector is driven by large markups, and price increases do not come along with extra expenditures of resources. Indeed, in our first growth accounting exercise below we show that the US medical care expenditure gap implied by factor accumulation runs in the opposite direction.

[Figure 1.1: The US Medical Care Expenditure Gap 1970-2007]

One major difficulty in uncovering US HCE growth patterns is the high degree of uniformity in the categories of sources and uses of funds. Figure 1.2(a) 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 1.2(b) breaks down HCE into various categories by use. A substantial increase in the categories of other personal health care and prescription drugs is observed, as well as a slight decline in physician and clinical services, and hospital care.[1] Again, these changes are just small departures from overall trends in HCE. Thus, for the matter in question, we would need to identify a group of variables that jointly drive all the expenditure categories. Two distinct candidates are prices and technology.

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

To gain a further understanding of the macroeconomic factors generating the divergent patterns of the US medical care expenditure gap, we perform a growth accounting exercise based on value added. Three main methodological issues motivate this exercise. First, we shall be concerned with *growth in factor quantities* and this is compatible with cross-country differences in price and quality levels. Second, as observed in Figure 1.1 above, most of the incremental growth in US medical expenditures occurred during the 1978-1990 transition period, just over a decade. As discussed below, it is unlikely that a large component of growth in HCE could be attributable to a sharp break in non-observable factors such as technological progress and product quality during such a short period of time. Further, this relatively short transition period is characterized by large increases in nominal and financial variables in the health care sector such as product markups. And third, our main analysis relies solely upon factor accumulation over quantities of inputs; hence, we need not take a stand on pricing policies, monopolistic behavior, the size of the government sector, and many other forms of market intervention and regulation at the aggregate level. We later address product quality and price effects as well as some rather complex measurements issues. In our sample period, capital displays higher growth in the US while labor displays higher growth in the OECD. From our growth accounting exercise we conclude that there should not be much difference in the evolution of the actual shares of HCE in nominal GDP for both economies. That is, the different growth patterns of US health care expenditures cannot be explained by aggregate factor accumulation.

The sizable wedge between the contribution of value added and HCE in the US motivates various supporting exercises. We first look at the evolution of markups, gross profits, and stock returns over a sample of US companies in the health care sector. Excessive levels of profitability and of stock market returns usually happen at times of high growth in HCE, which lends credibility to the idea of existence of monopoly power and other market frictions in the US health care sector not generally observed in the other countries. Moreover, an extensive literature claims that the US trails behind comparable OECD countries in terms of health outcomes and related health care indicators.

[1] As discussed below, changes in relative prices and public policies can account for some of these expenditure patterns.

Therefore, the different patterns of growth in HCE in the US cannot be backed by corresponding changes in product quality.

We should remark that we analyze variations of HCE over a group of countries with commensurate technological development and data quality, and we consider expenditure shares to condition by cross-country income levels. Several authors have pointed out that early diffusion of new technologies is frequently linked to similar GDP levels [Comin and Hobijn (2004 and 2010), Smith *et al.* (2009)]. In addition, when we adjust for prices we observe that US *real* HCE does not grow much faster than US *real* Total Consumption. In fact, the evolution of US real HCE is fairly well matched by value added from factor accumulation, as well as by similar indicators of health care quantities in the other OECD countries. Hence, our main analysis does not depend on prices, but our basic findings do not change when we filter out prices and common quality trends. To understand the stability of real HCE we explore potential drivers of US medical care prices such as hospital and professional services, and pharmaceutical products. Physicians' services, however, do not appear to be a major source of the continued inflation in the medical sector. Price markups attest that medical prices are disconnected from average variable costs.

Anderson *et al.* (2003) link the high HCE share in the US to prices. However, their period of analysis is 1990-2000 in which the US health care expenditure gap remained flat. Hall and Jones (2007) propose a model in which the HCE share goes up with income and technology growth with the end result of increasing life expectancy. As is well known, there has been some leveling of income by European countries. Moreover, US life expectancy has always been slightly below the OECD average. Hence, life expectancy could be instrumental in explaining global increasing trends in HCE, but other factors appear more adequate to replicate the observed differences at the cross-country level over shorter time spans. 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. Our analysis focuses on medical spending growth rates – rather than levels – within a selected group of OECD countries. In lieu of efficiency, we shall be concerned with the large wedge between the contribution of value added and HCE.[2]

Our paper suggests that monopoly power by the private sector appears to increase medical care prices, but it is not clear that public intervention might limit public health care expenditure while reducing costs as a result of monopsony power since public policies could also lead to over consumption by some parts of the population because of expansionary health care insurance programs. Indeed, the spread of health care insurance has been claimed as an explanatory variable for the growth in US medical expenditures. Finkelstein (2007) estimated that between 1965 and 1970 the

[2]As documented in Cutler and Ly (2011), three major factors may account for the high level of HCE in the US: (*i*) Higher cost of production factors, (*ii*) Greater share of administrative expenses, and (*iii*) More generous provision of medical services. As our main goal is to assess the evolution of the US medical care expenditure gap, we shall be concerned with all sources of factor accumulation in the health care sector, and so we focus on growth in value added rather than on actual levels of all these economic variables.

introduction of Medicare produced an increase in hospital spending six times larger than a private insurance program would have produced. At roughly the same time, however, many OECD countries did undergo notable expansions of their universal health care systems (e.g., Japan in 1961, Denmark in 1973, and Spain in 1986). Thus, we are led to conclude that expansionary trends in insurance markets cannot account for observed differences in HCE between the US and the rest of the OECD countries. Some international medical reforms will be echoed in our quantitative studies.

Ample literature has linked the rapid increase in HCE in the US to technological change.[3] For example, Di Matteo (2005) finds that technological change accounts for two thirds of health care spending growth over the 1975-2000 period. An excellent review of this literature is presented in Chernew and Newhouse (2012). Again, in our study, we control for the impact of technological change by conditioning on a sample of developed countries with comparable technologies.

Chandra and Skinner (2012) claim that simply attaching the label of "technological growth" as the major cause of increases in health care expenditure is not a meaningful way to address the problem. Our macro-level difference-in-difference approach should be of interest for the health micro literature that has tried to answer the same question of excessive HCE in the US but typically uses more fragmented evidence and does not focus on the 1978-1990 transition period. Chandra and Skinner (2012) follow Hall and Jones (2007) and propose a model with three types of health care goods that differ in cost-efficiency. They suggest that growth in US HCE is mostly driven by the widespread use of the least cost-efficient medical treatments embedded in new technologies. In their view, the adoption of these new technologies comes from the financing of health care costs through the insurance industry. Other health care systems with central budgeting or quantity constraints are not likely to experience rapid growth in these technologies. Garber and Skinner (2008) review some micro studies and claim that both cost and allocation efficiency between health care consumption and other consumption is difficult to answer. They also claim that other countries have shared the enormously valuable improvement in health – enjoyed by Americans in recent decades – at a much lower cost. Our study shows that an increasing US medical care expenditure gap does not stem from an extended use of capital and labor in the US. Thus, it appears that new technologies (more prevalent in the US) are typically associated with higher price markups. Hence, large product markups support the idea that market power – rather than the extra cost to generate higher product quality – might be an important determinant of US health care prices. Hospital and Related Services appears to be a driver of inflation in the US health care sector over the 1978-1990 transition period. Health insurance premiums underwent steep increases – considerably higher than the consumer price index (CPI) and the CPI-Medical Care (CPIMC) index.

The paper is organized as follows. In Section 2 we highlight some stylized facts about the evolution of labor and capital in the health care sector, and propose a basic growth accounting

[3]The economics literature usually estimates technological change from price data. According to the Boskin Commission Report (1996) the US consumer price index does not take into account a 3 percent yearly increase in the quality of health care goods. Unfortunately, we were not able to find data on consumption quality for the other OECD countries.

exercise based on value added. The implied US medical care expenditure gap remains fairly constant over the various time periods. In Section 3 we support this growth accounting exercise by looking at various indicators of health care quality. After filtering out price effects we confirm the stability of US real medical consumption over total consumption. In fact, adjusting for common quality trends and medical care inflation does not change our basic empirical findings about the implied evolution of the US medical care expenditure gap. In Section 4, we reexamine various independent measures of prices and sources of US health care inflation. We conclude in Section 5.

2 A Basic Growth Accounting Exercise for the US Health Care Sector

In our first pass to the data, we present a growth accounting exercise using the evolution of labor and capital for a restricted sample of countries. Moreover, for comparison purposes and to circumvent certain issues with some missing data, we also conduct a parallel growth accounting exercise for the US economy only. We find that labor and capital accumulation have no impact on the differential increase of the US medical care expenditure gap. Actually, the predicted gap from factor accumulation runs in favor of the other countries. Over the sample period 1970-2007, employment in the health care sector relative to total employment in the economy increased by 45 percent in the US and by 88 percent in the OECD, whereas average investment in the health care sector relative to total investment in the economy is about 3.7 percent in the US and 2.1 percent in the OECD. Labor income in the health care sector for the US is about 9 percent of total labor income, and labor income in the health care sector for the OECD countries is about 8 percent of total labor income. Therefore, the contribution of value added from factor accumulation to HCE in the US is relatively small since the share of HCE in GDP is about 18 percent.

2.1 Evolution of labor and capital in the health care sector

Table 2.1 reports various dimensions of the evolution of labor and capital in the health care sector for some selected dates. 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*)].[4] Row (*iii*) shows the evolution of the average compensation of a non-physician health care worker with respect to a physician. This ratio remains relatively flat over the sample period.

Of course, HCE growth has expanded the labor force in the sector. In the 1970-2000 period, the number of active US physicians increased from 3.46 per 1,000 workers to 4.80 per 1,000 workers

[4] 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). These NIPA tables are available at http://www.bea.gov/iTable.

[row (*iv*)], while the number of active OECD physicians increased from 3.05 per 1,000 workers in 1970 to 5.36 per 1,000 workers in 2000 [row (*v*)]. The ratio of physician to non-physician health care workers and their income shares have been quite stable in our sample of countries for the periods in which data is available. With the introduction of Medicare and the subsequent expansion of the health care sector there was a considerable increase in the number of non-physician workers in the US health care industry in the late 1960s. For the other OECD countries, we have data for non-physician health care workers only after 1985. OECD and US data show that the ratio of physician to non-physician health care workers remained almost constant for the period 1985-2007. From our own computations from other US data sources, between 1970 and 1980 this ratio decreased from 13 percent to 8.5 percent, and between 1980 and 2007 it slowly decreased from 8.5 percent to 7.3 percent. In our growth accounting exercise we assume that the ratio of physician health care workers to non-physician health care workers remains flat in both the US and the OECD countries.

[Table 2.1: Labor and Capital Statistics]

When it comes to physical capital in the health care sector,[5] growth runs in favor of the US. Rows (*vi*) and (*vii*) report the average investment share in the health care sector in each decade between 1970 and 2000, whereas rows (*viii*) and (*ix*) report the average share of aggregate investment. Both the US and OECD show a decreasing investment pattern in the health care sector, but the US share has always been above – albeit the difference has been diminishing over time.

Therefore, labor in the health care sector has grown faster in the OECD while the corresponding physical capital investment share is greater in the US. We now lay down a growth accounting exercise based on factor accumulation to assess the observed growth patterns in the US medical care expenditure gap.

2.2 Growth accounting based on value added

Growth accounting based on value added circumvents the use of aggregate prices which may be picking up quality effects for the provision of goods and services. Because of data availability, in this section we only use seven countries in our sample: Australia, Canada, Germany, Japan, Spain, the United Kingdom, and the United States.

2.2.1 Growth accounting using capital and labor data for the US and the OECD

Let us assume that production in the overall economy and in the health care sector evolve according to the following Cobb-Douglas production functions:

$$Y = AK^{\alpha}L^{1-\alpha}$$

[5] Health care investment as percentage of HCE data are available from OECD Health Care Statistics (http://stats.oecd.org/). This item comprises gross capital formation of domestic health care provider institutions (excluding retail sale and other providers of medical goods). Health care investment could be privately or publicly financed.

$$Y_H = A_H K_H^{\alpha_H} L_H^{1-\alpha_H}$$

where A is the technology residual or total factor productivity (TFP) in the economy, K is the aggregate capital stock, L is total employment, and $0 < \alpha < 1$ is the capital income share. Similarly, A_H is TFP in the health care sector, K_H and L_H are capital and labor devoted to health care goods, and $0 < \alpha_H < 1$ is the capital income share in the health care sector. Then, the evolution of the US medical care expenditure gap depicted in Figure 1.1 is given by the ratio

$$\frac{\left(\frac{p_H^{US} \times Y_H^{US}}{p^{US} \times Y^{US}}\right)}{\left(\frac{p_H^{OECD} \times Y_H^{OECD}}{p^{OECD} \times Y^{OECD}}\right)} \tag{1}$$

where p_H^{US} and $p_H^{OECD}$are the prices in the health care sector and p^{US} and $p^{OECD}$are the prices in the rest of the economy in the US and OECD, respectively.

Growth accounting focuses on the contribution of *observable production factors*. Here, we want to assess the contribution of capital and labor to the US medical care expenditure gap as well as the size of the residual over our sample of countries. We start this exercise with the following identifying assumption over the growth rates of the unobservable factors:

$$(g_{A,H}^{US} - g_A^{US}) = (g_{A,H}^{OECD} - g_A^{OECD}) \tag{2}$$

Additionally, when we analyze the US medical care expenditure gap in this section we will be assuming that

$$(g_{p,H}^{US} - g_p^{US}) = (g_{p,H}^{OECD} - g_p^{OECD}) \tag{3}$$

If both assumptions hold, differential factor accumulation should suffice to explain the US medical care expenditure gap. The rest of the paper provides direct and indirect evidence that the main driver of the observed he US medical care expenditure gap is a violation of the equal growth rates for relative prices in equation (3). More precisely, our analysis implies that $(g_{p,H}^{US} - g_p^{US}) > (g_{p,H}^{OECD} - g_p^{OECD})$.

Under assumption (3), the US medical care expenditure gap is simply defined as $\frac{Y_H^{US}/Y^{US}}{Y_H^{OECD}/Y^{OECD}}$, which depends only on the accumulation of inputs in each economy and the technology residuals. The equal growth rate in the residuals [assumption (2)] states that the differential increase in technological change in the health care sector between the US and the OECD is the same as the differential increase in technological change for the aggregate economy between the US and the OECD. We will later check if this is a good approximation for US data. Now, taking logarithms, differentiating with respect to time, and assuming equal shares in the US and the OECD, we obtain the following expression for growth in the US medical care expenditure gap from the observable factors:

$$\alpha_H(g_{K,H}^{US} - g_{K,H}^{OECD}) + (1-\alpha_H)(g_{L,H}^{US} - g_{L,H}^{OECD}) - \alpha(g_K^{US} - g_K^{OECD}) - (1-\alpha)(g_L^{US} - g_L^{OECD}) \quad (4)$$

Calibration

Using OECD data we get a capital to GDP ratio K/Y between 2.0 and 2.5 for a subset of countries with available data. The observed investment to GDP ratio is around 0.20, which together with K/Y=2.5 yields an annual depreciation rate (δ) of 0.08 in the steady state. After letting K/Y=2.5 in 1970, we calculate the evolution of K for each country according to the standard law of motion $K_{t+1} = I_t + (1-\delta)K_t$.

The initial K_H is calculated differently since the share of investment in the health care sector is lower than the observed average share in the economy. We first estimate the average investment in health care over HCE (I_H/Y_H) and call this variable φ. Then, we calculate the initial capital in the health care sector as $K_{H,1970} = (\varphi/\delta)Y_{H,1970}$. Once this is estimated, we again apply the standard equation for the capital's law of motion to calculate $K_{H,t}$ for all dates t.

Finally, the last parameter we need to calibrate is the capital share α. The real return to capital in the US has been around 8 percent.[6] Letting K/Y=2.5 and a net capital return of 8 percent yields $\alpha = 0.4$. In our sensitivity analysis we let α range between 0.25 and 0.40. In our benchmark calculation we set $\alpha = \alpha_H = 0.25$. Arguably, the health care sector has a lower K/Y ratio which would lead to a lower capital share than the rest of the economy. Some authors, however, have stressed the externality effects of equipment investment [e.g., De Long and Summers (1992)]. Hence, the social rate of return may be higher than the private rate of return. Therefore, a higher value for α_H could be justified by invoking some plausible externality effects and intangible investments.

Results

We now simulate equation (4) under our benchmark calibration for the estimated capital stocks and OECD data on health care employment as a proxy for L_H and total employment as a proxy for L. Figure 2.1 below shows the US medical care expenditure gap implied by the model together with its empirical counterpart. We also report the pace of the US medical care capital gap ($\frac{K_H^{US}/K^{US}}{K_H^{OECD}/K^{OECD}}$) and the US medical care labor gap ($\frac{L_H^{US}/L^{US}}{L_H^{OECD}/L^{OECD}}$). The figure shows a relative increase in the stock of capital in the US and a relative increase in employment in the OECD.

[Figure 2.1: A Basic Growth Accounting Exercise Using Labor and Capital Data for the US and OECD]

Observe that the simulated US medical care expenditure gap remains quite flat during the entire period with a slightly declining trend. The gap goes down by 15 percent for our simulation of equation (4) while it goes up by 30 percent in the data. Further, during the 1978-1990 transition

[6] Between 1970 and 2007, for the value-weighted portfolio of all the publicly traded companies in the US (excluding ADRs and REITs), the yearly gross return was 11.2 percent, which translates into a yearly rate of return of approximately 8 percent after adjusting for inflation (data available from the Center for Research in Security Prices).

period the gap goes down by 5 percent for our simulation while it goes up by 32 percent in the data.

Sensitivity analysis

We also consider changes in these baseline values. We let the capital share α range between 0.4 and 0.25, and we let α_H differ from α. We let annual depreciation δ range between 0.06 and 0.08. Table 2.2 shows the percentage change in the simulated US medical care gap for the entire period in panel (a) and for the 1978-1990 transition period in panel (b). For the 1970-2007 period, under all pairs (δ, α), we observe a decrease in the simulated US medical care expenditure gap between 10 and 15 percent, as opposed to an increase of 30 percent in the data. Similar results are observed during the 1978-1990 transition period in panel (b). Therefore, the present growth accounting exercise based on value added determines that the US medical care expenditure gap should have decreased during the period 1970-2007 as well as during the 1978-1990 transition period.[7]

[Table 2.2: Sensitivity Analysis]

Implied medical expenditure gaps by country

To get a better understanding of the underlying forces driving the US medical expenditure gap over our sample of countries, we also report the relative contribution of factor accumulation to the medical sector for each country i as compared to the US. More formally, Figure 2.2 plots the evolution of the medical expenditure gap as defined by the following equation

$$\alpha_H(g^i_{K,H} - g^{US}_{K,H}) + (1-\alpha_H)(g^i_{L,H} - g^{US}_{L,H}) - \alpha(g^i_K - g^{US}_K) - (1-\alpha)(g^i_L - g^{US}_L) \tag{5}$$

where i stands for every other country in our restricted sample.

[Figure 2.2: A Basic Growth Accounting Exercise – Implied Medical Expenditure Gaps by Country]

First, the figure shows that most individual medical care expenditure gaps have remained relatively flat as we condition by US value added in the health care sector. The sharp decrease observed for Germany corresponds to the unification of the country after the fall of the Berlin Wall because of a break in the data. Note that this decrease has been tapering off over time. Second, there are two outliers: Canada and Spain. The share of HCE in Canada has been slightly above the OECD average but the contribution of value added appears remarkably low. The Canadian medical system has been widely criticized for being comparatively expensive, having long waiting periods for services, and having limited access to physicians and medical technology, which may justify the low contribution of health care value added in our exercise. At the other extreme, a high contribution of

[7] In unreported simulations available upon request, we estimate α_H for each country in our sample using the World Input-Output Database tables (http://http://www.wiod.org) for the year 2000. We found that the capital income share α_H in the health care sector for Canada, Germany, Japan and the US are quite similar (0.23, 0.21, 0.26 and 0.23 respectively), while those of Australia, Spain and the United Kingdom are significantly lower (0.12, 0.16 and 0.10 respectively). Allowing α_H to vary across countries does not change our qualitative results. If anything, it strengthens our conclusion that factor accumulation cannot account for the evolution of the US medical care expenditure gap.

value added in the Spanish medical sector is observed at the beginning of our sample period. Spain presents the highest percentage increase in the share of HCE moving from 3.5 percent of GDP in 1970 to 8.4 percent in 2007. Spain underwent various reforms towards higher health care quality and universal insurance for all citizens and residents, as well as an impressive GDP growth at these early dates.

2.2.2 Growth accounting using capital and labor data for the US only

As labor and capital data could be of lesser quality in our sample of OECD countries, we can simulate a variant of equation (4) for US data only. That is, we analyze the relative contribution of value added in the US health care sector over overall value added, and we condition for the growth of the share of HCE in the OECD countries. Formally, we consider the evolution of the US medical care expenditure gap (US only) under the following growth components:

$$\alpha_H g_{K,H}^{US} + (1-\alpha_H) g_{L,H}^{US} - \alpha g_K^{US} - (1-\alpha) g_L^{US} - g_{Y,H}^{OECD} + g_Y^{OECD} \tag{6}$$

The US values for K, K_H, α, α_H and δ come from the preceding exercise. Also, L and L_H are taken from employment data. For the other OECD countries, we consider the growth in the overall share of HCE. Medical prices face particularly difficult measurement problems, and according to the Boskin Commission Report (1996) the US consumer price index does not take into account a 3 percent yearly increase in the quality of health care goods, whereas this quality bias was less than 1 percent for the general index. On these grounds, we may consider that technological progress may have been more pronounced in the medical sector. Hence, our implicit identifying assumption $g_{A,H}^{US} = g_A^{US}$ underlying this exercise may not be supported by the data.

[Figure 2.3: A Basic Growth Accounting Exercise Using Labor and Capital Data for the US only]

Figure 2.3 displays the newly simulated US medical care expenditure gap under equation (6) together with the previously simulated gap under equation (4). The figure illustrates that for the benchmark calibration, there is almost no difference between the present and previous growth accounting exercises. This confirms that the US medical expenditure gap also declines when the contribution of value added is restricted to the US economy. We should note, however, that for some other combination of parameter values used in the sensitivity analysis of Table 3.2, the simulated US medical care expenditure gap (US only) is significantly below that obtained from equation (4). Hence, some of these computations suggest that TFP in the US health care sector may have grown faster than in the aggregate economy. Accordingly, the underlying identifying assumption $g_{A,H}^{US} = g_A^{US}$ may not be a good approximation of the evolution of TFP in the health care sector. Our general formulation in (4) appears to be more adequate as it conditions for both general TFP trends in the aggregate economy and the health care sector.

Finally, using the above values for the growth of labor and capital we compute the growth rate of value added in the health care sector over value added in the economy. Formally, for every date we compute $\alpha_H g^{US}_{K,H} + (1-\alpha_H) g^{US}_{L,H} - \alpha g^{US}_K - (1-\alpha) g^{US}_L$. Under our baseline parameters, for the period 1970-2007 the share of HCE grows by 45 percent in our simulation exercise, while it grows by 130 percent in the data. For the 1978-1990 transition period the simulated share of HCE grows by 17 percent, while it grows by 47 percent in the data. Therefore, it appears that value added cannot account for the patterns of growth in the share of HCE in the US, and would require implausible growth in TFP in the health care sector.

2.3 Returns, yields, and markups of publicly traded companies in the health care sector

The previous growth accounting exercise attests that factor accumulation cannot explain the increase in the US medical care expenditure gap. It follows that our identifying assumptions [equations (2)-(3)] may fail. That is, the pace of technological change and incremental inflation rates in the medical sector may be greater in the US than in the average OECD country. Comin and Hobijn (2004 and 2010) document that technology spreads relatively quickly across countries with similar levels of development. They argue that the diffusion of new technology became increasingly fast after the Second World War. While considering financial data we conclude that increasing prices in the US health care sector cannot be associated with additional expenditures in resources. Moreover, Section 3 below builds on a vast literature claiming that higher medical prices are not associated with better health outcomes either. Therefore, the sharp break in the US medical care expenditure gap observed during the 1978-1990 period appears to be difficult to justify on the grounds of slow diffusion of technology and increasing costs originating from better product quality in the US.

Several micro studies analyze the degree of competition and efficiency in 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 in survival rates or quality of life for the elderly population. Koijen *et al.* (2016) call attention to a "medical innovation premium" of 4-6 percent annually for equity returns of firms in the health care sector, and interpret this premium as compensating investors for government-induced profit risk.

As discussed in the introductory section, we do not primarily address these efficiency issues from a micro perspective. Our main goal here is to focus on the large wedge between value added and HCE documented in our previous growth accounting exercise. As already pointed out, physicians did not particularly benefit from the observed HCE growth. But private companies may have been able to take advantage of monopoly power and existing frictions and regulations in the health care market. We consider stock returns, yields, and markups generated by publicly traded companies in the health care sector as compared to those in the aggregate economy. We find that the health care sector is associated with abnormal profits and markups. These financial measures of profitability grow much faster over the 1978-1990 transition period.

We retrieve company level data on Total Revenues, and Total Variable Costs from COMPUSTAT, i.e. entries REVT and COGS in COMPUSTAT, for the period between January 1970 and December 2007. We retrieve data on returns, prices, and shares outstanding on publicly traded firms in the US from the Center for Research in Security Prices (CRSP), i.e. entries RET, PRC and SHROUT in CRSP. We select our health care companies from the Standard Industrial Classification (SIC) codes as in Kenneth French's webpage within the set of industrial portfolios.[8] This is arguably the most used portfolio database in the finance literature. To have an idea of the relevance of our sample, we calculate the ratio of total yearly sales for the health care companies in our portfolio over HCE. This ratio increases from 20 percent in 1970 to 30 percent in 2007; hence, our sample appears to be fairly representative.

Stock market return

At every date, the health care portfolio return is calculated as an average of each company's return (including dividends) weighted by its relative market capitalization in the health care portfolio.[9] We also use a market weighted portfolio that includes almost all publicly available companies in the CRSP database.[10] Average returns in the health care sector portfolio have soared since the late 1970s. The weighted average yearly return for the 1970-2007 period for this portfolio is about 20.17 percent while that of the market portfolio is about 12.34 percent. In the finance literature it is customary to consider the metric *excess return adjusted by its standard deviation*. This metric is known as the *Sharpe Ratio* and provides a measure of the reward-to-risk. The risk-free rate (the one-month T-bill in our case) is subtracted from the portfolio return to compute the excess return. Under certain regularity conditions, all well diversified portfolios should have the same Sharpe Ratio. For our health portfolio, the Sharpe Ratio is 0.65 for the period 1970-2007 while it is 0.43 for the market portfolio. Interestingly, the Sharpe Ratio of the health care portfolio is 1.05 for the 1978-1990 period, while it is 0.04 and 0.72 for the 1970-1977 period and the 1991-2007 period, respectively.

Yield

We define the yield of a company as the company's gross profit divided by its market capitalization value at a certain date. Gross profit is the difference between total revenue and total variable cost. We focus on gross profit because this is usually considered a clean accounting measure of profitability [cf. Novy-Marx (2013)]. The aggregate yield is then obtained as a weighted average of individual yields, where the weights are company total revenues over the aggregate sum of total revenues. For our sample period, we get an average aggregate yield of about 36 percent for the com-

[8] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_49_ind_port.html. The list of companies used to construct the health care portfolio and SIC codes is also available from the authors upon request.

[9] A firm's market capitalization is the total number of shares outstanding times the price.

[10] The return of the market weighted portfolio also comes from Kenneth French database. See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html.

panies in the health care sector, and 70 percent for all other companies. A lower average yield may mean that companies in the health sector face lower risk and higher expectations of profit growth. In some research in progress, we have documented that lower yields are supported by sizable and stable product markups.

Price markup

We define the price markup of a company as the ratio between total revenue and total variable cost. The aggregate price markup is then obtained as a weighted average of company markups where the weights are company total revenues over aggregate total revenues. For our sample period 1970-2007, we get an average aggregate price markup in the health care sector around 193 percent, whereas we get an aggregate price markup for all the other companies around 55 percent.

The average yearly growth rate of HCE over nominal GDP was 3.2 percent during the 1978-1990 period, while it was 2.4 percent in the 1970-1977 period, and 1.6 percent in the 1991-2007 period. Table 2.3 compares this incremental growth rate against the following aggregate measures: (i) Annual incremental return of the health care sector portfolio as compared to the remaining market portfolio, (ii) Annual incremental growth rate of the yield of the health care sector portfolio as compared to the remaining market portfolio, (iii) Annual incremental growth rate of the aggregate markup of the health care sector portfolio as compared to the remaining market portfolio, and (iv) Annual incremental growth rate of value added in the health care sector as compared to the aggregate economy.

Remarkably, for the 1978-1990 and 1991-2007 periods the incremental annual markup growth rate in the health care sector is roughly the same as the incremental annual growth in the share of HCE, whereas there is much less variability in incremental growth of value added. Along these same lines, the incremental yield growth in the health care sector gets much higher during the 1978-1990 transition period. Hence, episodes of high growth of HCE in the US are associated with higher markups and higher growth rates of profitability. Excess returns also get much higher during the transition period, and stay relatively high afterwards even though there is a substantial decrease in the excess growth rate of the yield. This slow adjustment of stock market values typically occurs when high profits are initially perceived as temporary or non-sustainable.

[Table 2.3: Returns, Yields, and Markups of Publicly Traded Companies in the Health Care Sector Relative to the Rest of the Economy]

To have a better sense for these trends, Figure 2.4 depicts the evolution of Health Care Sector Markup over Economy Markup, Health Care Sector Gross Profit over Economy Gross Profit, Health Care Sector Value Added over Economy Value Added, and HCE over GDP between January 1970 and December 2007. Panel (a) displays variables in levels, and Panel (b) displays 5-year moving averages of corresponding growth rates. For convenience, all levels values are normalized to 100 at the start of the transition period in 1978, and the two vertical bars bracket the 1978-1990 transition period. The following facts are worth noticing from these figures. First, Health Care Sector Markup over Economy Markup mimics HCE over GDP whereas the incremental value added presents milder growth rates. Fluctuations in Health Care Sector Markup over Economy Markup slightly lead but are fairly contemporaneous with those of HCE over GDP. Increases in these two aggregate measures stimulate factor accumulation but this response is not very pronounced. Second, fluctuations in the growth rate of Health Care Sector Gross Profit over Economy Gross Profit move in tandem with that of Health Care Sector Markup over Economy Markup, but tend to have smaller values. In fact, after 1994, relative markups have an upward trend, while relative gross profits remain relatively flat. This suggests some kind of cost-containment as discussed in footnote 14 below. Overall, the present figure is consistent with the notion that growth in Health Care Sector Markup over Economy Markup is strongly linked to growth in HCE over GDP; markups seem a major driver of HCE.

[Figure 2.4: Health Care Sector Markup over Economy Markup, Health Care Sector Gross Profit over Economy Gross Profit, Health Care Sector Value Added over Economy Value Added, and HCE over GDP]

Finally, Figure 2.5 shows the evolution of the Herfindahl-Hirschman Index (HHI) that measures industry concentration; i.e., a higher value of the index implies higher industry concentration for the publicly traded companies in the health care sector. Besides this index, Panel (a) shows the number of publicly traded companies in the health care sector, whereas Panel (b) shows Health Care Sector Markup over Economy Markup. From Panel (a) we can observe that even though the number of publicly traded companies was steadily going up since the beginning of the 1978-1990 transition period, the HHI continues to increase until reaching its maximum value in the year 1989. (As discussed in Figure 2.4, increases in markups may stimulate further economic activity which in this case may translate into entry of firms in the medical sector.) Panel (b) shows that both the HHI and Health Care Sector Markup over Economy Markup went up during the transition period, but afterwards these two measures diverge. Hence, industry concentration can only offer a partial account for the evolution of markups. Further research may be necessary (possibly at the micro level) to understand the nature of market frictions that determine the evolution of product markups. Usually, markups are tied down to changes in demand elasticities and in the regulatory environment.

[Figure 2.5: Herfindahl-Hirschman Index for the Health Care Sector]

In summary, strong positive growth in the ratio of HCE over GDP can be fully backed up by corresponding growth in gross profits and markups. The connection between value added and financial variables appears to be much more tenuous, especially over the 1978-1990 transition period. For a realistic pace of technology diffusion, abnormal profits and markups help us understand that prices in the medical sector may not reflect the extra costs associated with high product quality.

3 Quality and Price Effects

To evaluate the wedge between value added and HCE, we now take a different approach and adjust HCE by aggregate prices. Of course, prices may be picking up quality effects but our previous evidence on the evolution of markups and gross profits shows a price disconnect from average costs. We first document some indicators of US health care quality within the OECD countries. After filtering out price effects, we also show that US real health care consumption moves *in tandem* with real GDP, as well as with real health care consumption in the other OECD countries. We then simulate a product quality residual over our sample of OECD countries. This approach does not change our basic findings in the previous section, but it is subject to new measurement issues as it is usually hard to disentangle price and quality effects.

3.1 Quality

Our growth accounting exercises rest on a certain identifying assumption for non-observable TFP growth; see equation (2). This assumption appears to be adequate for the 1978-1990 transition period. As already discussed, it is unlikely that TFP changes can have such a sizable differential impact across economic sectors and countries over such a limited time span. We next provide some supporting evidence for our identifying assumption by studying the evolution of product quality at the aggregate level. Various international institutions such as the OECD and the World Health Organization periodically report cross-country rankings on various dimensions of health status, heath care activities, quality of care, and access to care. Generally, the US lags behind many other OECD countries. In fact, when conditioning for income and health care expenditures the US appears mostly as an outlier.

Figure 3.1 shows the evolution of some of these quality proxies for health status, which will be expressed as gaps: the corresponding US value over the average value of our sample of OECD countries (excluding the US), letting 100 be the initial value for our starting year, 1970. We consider the US gap for infant mortality, neonatal mortality, perinatal mortality, and life expectancy at birth.[11] We can observe that while the life expectancy gap has remained quite stable, the gap of every other variable has increased – meaning that in fact the quality gap has evolved against the US. These outcomes may partially be explained by other measures of health care activities and access to care such as the relatively large size of the uninsured population in the US: Around 12 percent of the population has permanently been uninsured over the last three decades.

[Figure 3.1: Quality Indicators over Time]

For narrower quality indicators we have not been able to gather data over the whole sample period. Table 3.1 reports on the following quality measures for the year 2003: Life expectancy, breast

[11]Infant mortality is the yearly number of deaths of children under 1 year of age per 1,000 live births. Neonatal mortality is the yearly number of deaths of children under 28 days of age per 1,000 live births. Perinatal mortality is the yearly number of deaths of children within 1 week of birth (early neonatal deaths) plus foetal deaths of minimum gestation period of 28 weeks or minimum foetal weight of 1,000 grams per 1,000 births (source: http://stats.oecd.org/).

cancer five-year observed and relative survival rates for females, cervical cancer five-year observed and relative survival rates for females, and colorectal cancer five-year observed survival rates for males and females.[12] For each of these indicators the coefficient of variation (i.e., the standard deviation over the mean) is usually very small – attesting that there is very little variability in all the quality proxies across the OECD countries.[13] The US has the lowest life expectancy, the maximum survival rates for breast cancer, and is below the maximum for cervical and colorectal cancers. Overall, the assumption of similar health care quality across OECD countries seems to be supported by the data.

[Table 3.1: Quality Measures in 2003]

Certainly, all the above evidence should be merely considered as informative of the health care quality level across countries. Besides, life expectancy can be affected by genetic differences and dietary habits. Similarly, survival rates are not necessarily a good proxy for the quality of life after a surgical procedure. Some indicators may proxy longevity rather than quality. Drösler *et al.* (2009) report findings on various new quality indicators regarding patient safety across OECD countries. Again, the US always ranks about average in every category.

3.2 The US medical care price gap and the stability of real HCE over Total Consumption in the US

Besides product quality, health care prices could be driving the US medical expenditure gap. A measure of the consumer price index–medical care (CPIMC) is available for all countries in our sample. These prices along with their data sources are formally explained in the Appendix. Measurement issues concerning the CPIMC will be deferred to the next section.

We define the US medical care price gap as the US ratio CPIMC/CPI over the average ratio CPIMC/CPI of the other OECD countries in our sample. Figure 3.2 plots the US medical care expenditure gap against the price gap; both ratios are normalized to 1 in 1977. Observe that the US medical care price gap mimics quite well the US medical care expenditure gap for the 1978-1990 period in which both increased by about 35 percent. Then, there is a mild disconnect: The relative

[12] Except for life expectancy, the set of countries used to construct the quality estimates in Table 3.1 is different from the eleven countries in the original comparison group. Since we could not find data for some of the countries in our original sample, we decided to use all the OECD countries with available data. Five-year observed survival rates are defined as the number of people diagnosed with cancer (age 15-99) within a certain period surviving five years after diagnosis, over the number of people diagnosed with the same cancer (age 15-99) within a certain period. Five-year relative survival rates are defined as the observed rate of people diagnosed with cancer (age 15-99) surviving five years after diagnosis, over an expected survival rate of a comparable group from the general population (see http://stats.oecd.org/).

[13] While the value of the standard deviation over the mean for life expectancy is 0.024 for our sample of OECD countries, this same ratio for all countries in the world in 2003 is about 0.145, around six times larger (data available at http://data.un.org/). There is no general data about survival rates for different types of cancer across countries. The American Cancer Society (2008) publishes some statistics for a few developing countries, and there is much more variability in survival rates than in the OECD. For example, the breast cancer 5-year relative survival rates in 2008 for China, India, Thailand and Uganda are 0.82, 0.52, 0.63 and 0.46, respectively. For the sample of 18 countries reported in Table 3.1 the minimum is 0.79 and the maximum is 0.89.

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.[14] 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 GDP will go down in the US as compared with the other OECD countries. As a matter of fact, the 1990s witnessed a shift to *managed care* leading to a relative decline of hospital care [Figure 1.2(b)], and to a decrease of indemnity health insurance plans in favor of HMOs, PPOs and POSs. Cutler *et al.* (2000) suggest that for certain treatments and procedures *managed care* organizations like HMOs may have lowered costs by about 30 to 40 percent as a result of price declines of medical services and treatment intensities.

[Figure 3.2: The US Medical Care Expenditure Gap vs. the Price Gap 1970-2007]

To go further into the evolution of real consumption in health care in the US, in Figure 3.3 we adjust HCE under various price measures. For the 1970-2007 sample period, HCE per capita at constant consumption prices in the US has increased by 300 percent. For the same time period, HCE per capita at constant medical care prices (real HCE) in the US has increased less than 100 percent. Moreover, there is no significant growth when real HCE per capita is adjusted by real Total Consumption (TC), but we observe some slight growth in the share of value added. Hence, Figure 3.3 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*) US value added in the health care sector over total value added in the economy.

[Figure 3.3: The Evolution of US Health Care Expenditures 1970-2007]

3.3 A cross-country analysis of the US health care expenditure gap as implied by aggregate prices

We now present a more systematic analysis of real health care consumption across countries. In a separate Appendix we detail a simple model for health care demand embedding several sources of technological progress and health care quality. The main purpose of our exercise is to filter out price effects and common trends in technology and product quality under the simplifying assumption of a constant elasticity of substitution between the health care good and the remaining aggregate good in the economy.

More precisely, let us assume that qh is health care expenditures (HCE), c is total consumption (TC), q is the relative price of medical care, and $\widehat{A}$ is a residual term picking up product quality. Then, let

[14] This is in line with our analysis of financial variables in Section 2.3, where after the 1978-1990 transition period we observe that relative markups between the US health care sector and the rest of the economy have an upward trend while relative gross profits remain quite flat. Thus, the evidence suggests that in relative terms, real medical consumption may have declined in the US because of cost containment while prices in the health care sector were still outpacing those of the rest of the economy.

$$\frac{\partial ln\,(h_t/c_t)}{\partial ln\,(q_t)} = \frac{1}{\rho - 1} \tag{7}$$

where $-\infty < \rho < 1$. After appending the residual term, we get: $ln\,(q_t h_t/c_t) = ln(\widehat{A}_t) + \left(\frac{\rho}{\rho-1}\right) ln\,(q_t)$. This is therefore our basic equation to track the evolution of the US medical expenditure gap:

$$q_t h_t/c_t = \widehat{A}_t q_t^{\frac{\rho}{\rho-1}} \tag{8}$$

In our data analysis, qh/c corresponds to the share of health care expenditures in total consumption for the US and OECD countries, whereas q picks the evolution of the ratio of the medical care price index CPIMC over the CPI for each country. Under the identifying assumption of equal growth rates for the residuals,

$$g_{\widehat{A}}^{US} = g_{\widehat{A}}^{OECD} \tag{9}$$

we have the following expression for growth in the US medical care expenditure gap based on incremental inflation in the medical sector:

$$\left(\frac{\rho}{\rho - 1}\right)(g_q^{US} - g_q^{OECD}). \tag{10}$$

Ringel *et al.* (2000) report estimates for the price-elasticity of demand for health care consumption of around -0.17. Since the health care good is a relatively small fraction of total consumption, we then get that ρ is approximately equal to -5. Studies consistently find inelastic demands when the share paid by the consumers is relatively low. These point estimates for the elasticity are around our calibrated value (*cf.*, *op. cit.*). It is worth noticing that fractional payment policies for medical expenses (e.g., some types of coinsurance and out-of-pocket expenditures) will not affect the elasticity of demand. For comparison purposes, we also report computations for $\rho = -3$ and for $\rho = -1$, which imply elasticities of demand for health care consumption of around -0.25 and -0.50, respectively.

Figure 3.4 reproduces these computations for the US medical care expenditure gap as implied by (10) as well as the empirical counterpart or actual gap. Observe that for $\rho = -5$ the simulated US medical care expenditure gap would account for about 107 percent of the actual gap. That is, over the sample period the implied US health care expenditure gap goes from 1.14 to 1.64 whereas in the data it goes from 1.14 to 1.53. For $\rho = -3$ the simulated residual would account for about 103 percent of the actual one, and for $\rho = -1$ the simulated residual would account for about 92 percent of the actual one. Because of the evolution of the medical expenditure gap in the last part of the sample, the breaking point is $\rho = -2$, where the simulated residual growth between 1970 and 2007 is almost the same as the actual one. This is consistent with a price elasticity of demand approximately equal to -0.33. For more inelastic demands, the observable growth in relative prices will overestimate the US medical expenditure gap.

[Figure 3.4: The US Health Care Expenditure Gap as Implied by the Relative Price]

3.4 Medical expenditure gaps by country

To have a better sense of these computations, we now replicate the US medical care expenditure gap for every single country i using $\rho = -2$. In fact, to adjust directly for actual growth in each individual gap, we consider the evolution of the following growth components for each country i:

$$\left(\frac{\rho}{\rho - 1}\right)(g_q^{US} - g_q^i) - g_{HC}^{US} + g_{HC}^i \tag{11}$$

where g_{HC}^i is the is the growth rate of HCE over Total Consumption for country i.

We can interpret expression (11) as the actual evolution of the ratios between the residuals $\widehat{A}_t^i$ and $\widehat{A}_t^{US}$. Figure 3.5 shows the evolution of these ratios for the residuals for each country i in the sample. Except for France and Spain, all these ratios for the individual residuals are fairly stable. Hence, the US displays a residual $\widehat{A}_t^{US}$ quite in line with the corresponding average of the other OECD countries. Roughly speaking, there are not noticeable differences in the US residual $\widehat{A}_t^{US}$ between the 1978-1990 transition period and the rest of the sample. For reasons already discussed, the US residual declines after 1992, which suggests either a relative loss in US real health care consumption or an upward bias in the US price index.

[Figure 3.5: Evolution of the Residuals by Country as Compared to the US]

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 sharp trend breaks in 1986 and 2003 corresponding to two major medical reforms. The General Health Law of 1986 recognized the right to health care services for 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.

In conclusion, three important facts emerge from this study: (i) The US residual $\widehat{A}_t^{US}$ behaves quite similarly throughout all three time sub-periods considered in our sample. This seems to be in accord with the aforementioned stability of *real* health care expenditures over *real* GDP observed in the US economy and the growth patterns of labor and capital in the health care sector. (ii) The pace of the US residual $\widehat{A}_t^{US}$ does not differ much from the average pace of the OECD residual $\widehat{A}_t^{OECD}$. And (iii) sharp breaks in the residuals are usually associated with medical reforms and regulations. Therefore, this growth accounting study appears to indicate that unobservables affecting the residuals like technology and product quality change would not be a major driving force for the pronounced increase in the US medical care expenditures gap over the 1978-1990 transition period.

4 Discussion of US Medical Care Prices

As shown in Figure 3.2, aggregate prices seem to track well the evolution of the US medical expenditure gap. In this section, we discuss some of the limitations of aggregate health care prices. We also compare the evolution of our US health care price index with independent measures of cost and sources of inflation in the medical sector. When we perform international comparisons, health care prices in the US are around 60 to 80 percent higher than in other OECD countries. These differences seem quite commensurate with the size of the US medical care expenditure gap.

The CPI-medical care (CPIMC) is published by the US Bureau of Labor Statistics (BLS) since 1935. The PCE-health care (PCEHC) is another major price index with data from 1929 and published since 1994 by the US Bureau of Economic Analysis (BEA). The evolution of these two measures is quite similar over the 1978-1990 transition period. As stated in Fixler and Jaditz (2002), there are three main differences between the BLS's CPIMC and the BEA's PCEHC: "First, the two indexes use different formulas. The CPI is a Laspeyres index, while the BEA product is a Fisher Ideal index. Second, the two indexes 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."

After adjusting for aggregate inflation in the economy, Hospital and Related Services has experienced the highest overall growth rate (3.76 percent annually for the CPIMC over CPI since 1978). Prescription Drugs shows the lowest growth rate before the transition period starts, and it grows at 3 percent annually for the CPIMC over CPI after 1978. Professional Services appreciates at a slower pace (1.35 percent annually for the CPIMC over CPI) since 1978. After 1992, for all these categories the PCEHC grows at a slower pace than the CPIMC. In summary, the highest increases relative to average inflation are observed in Hospital and Related Services and within the 1978-1990 transition period.

4.1 Measurement issues

Inflation in the health care sector has been greater than average inflation in the economy in almost every year. As explained in the Boskin Commission Report (1996), the CPIMC and its various subcategories had an estimated annual upward bias of 3 percent between 1970 and 1995 when adjusting for quality. During the same time period, the overall CPI has an estimated annual upward bias of 0.6 percent, leading to an estimated yearly bias in the growth rate of the CPIMC over CPI of 2.4 percent. Technology may impact HCE in various ways. To control for the effects of technological progress our macro-level difference-in-difference approach conditions upon a group of OECD countries with similar health care quality and comparable methodologies in data collection.

For many countries public provision of health care is the norm. Accordingly, medical care expenditures are estimated as in any other public good – including the cost of intermediate inputs and labor but not capital rents. Medical care prices in some countries do not depart much from the overall consumer price index. We should also point out that average inflation in the OECD was much greater than in the US in the 1970s, but inflation has been much lower and more stable in the remaining part of the sample for all these countries. In fact, for both the US and the OECD countries the CPIMC over the CPI did not grow at all in the 1970s. The US relative price of medical care started to grow in the 1978-1990 transition period. Therefore, the US medical care price gap is not influenced by unequal cross-country inflation trends; when inflation trends diverge between the US and the OECD, there are no deviations in the relative price of medical care.

A major component of the CPIMC is Hospital and Related Services. There is evidence that this component is upward biased because list prices are affected by discounts. Indeed, this bias has been the norm under the expansion of HMOs and PPOs since managed care organizations are able to bargain on hospital's list prices (Dranove *et al*. 2008). This possible upward bias may have been rather small during the 1978-1990 transition period since HMOs and PPOs just became important in the late 1980s. In 1997 the BLS started to implement corrective measures to the CPIMC-hospital and related services to remove this sampling error (Cardenas, 1996). In a recent study, Koechlin *et al*. (2010) circumvent this upward bias by comparing what they call hospital quasi-prices over several OECD countries. These quasi-prices are defined as negotiated or administrative prices or tariffs on various hospital services items. Still, these authors find that US hospital services are 60 percent above the average cost of these other countries.

Berndt *et al*. (2000) discuss another source of overstatement of the CPIMC-hospital and related services component: The switch from inpatient procedures to outpatient procedures – mainly because of the cost-containment efforts supported by managed care organizations. The switch from inpatient to outpatient treatments may have increased the average complexity and cost of medical procedures for both types. Indeed, very complex procedures were still left as inpatient care, and those shifted to outpatient care were more complex than the average procedure of this category. Since outpatient and inpatient procedures enter separately and with fixed weights in the index calculation, the possible cost reduction of the shift to outpatient care may have not been reflected in the CPIMC-hospital and related services. This upward bias may have been exacerbated after 1987 with the expansion of managed care organizations. The BLS did not take corrective measures until 1998 (Berndt *et al*. 2000). Again, this bias should be rather small for the 1978-1990 transition period.

A pioneering work by Griliches and Cockburn (1994) found that US pharmaceutical price indexes were upward biased because of a shift from branded to generic drugs. Danzon and Chao (2000) found that the large differences between US prices and those of other countries reported in many studies might be smaller than previously thought. After 1995, the BLS implemented corrective measures for the construction of its pharmaceutical price indexes, including generic drugs (Berndt *et al*. 2000). It seems that neglecting generic drugs in the price index should have a very limited impact during the 1978-1990 transition period. The market for generic drugs expanded after the Waxman-Hatch Act of 1984 (Berndt and Aitken, 2010). The generic drugs' share of total dispensed prescription drugs in the US retail market represented just 18 percent in 1984. It increased to 36 percent by 1994, then 56 percent by 2004, and 74 percent by 2009. At the same time, the revenue share of generic drugs has been relatively small. For example, in 2004 generic drugs were 56 percent of dispensed drugs but its revenue share was only 17 percent. The revenue share of generic drugs rose to 24 percent by 2009 (Berndt and Aitken, 2010). Hence, during the 1978-1990 transition period the upward bias would seem rather limited. Of course, generic drugs are also dispensed in every OECD country. Danzon and Furukawa (2011) found that generic drugs are more expensive in the US than in most of the OECD countries right after the branded drug's patent expires (around 75 percent of the branded drug price). Three years after patent expiration, prices of generic drugs decline more sharply in the US, and after eight years of patent expiration generic drugs are cheaper in the US than in all other OECD countries except the UK. Again, these patterns may further reduce the possible upward CPIMC bias in the 1978-1990 transition period.

4.2 US medical prices, markups, and health insurance premiums

We now study the evolution of *independent* price measures beyond the CPI and other sources of inflation supporting high prices in the US medical care sector. Price increases for medical products and services have come along with hikes in markups and health insurance premiums. Table 4.1 reports the evolution of several cost measures in the health care sector:

(*i*) *Aggregate Markup in the Health Care Sector over Aggregate Markup in the Economy:* A weighted average of Total Revenues over Total Variable Cost of publicly traded companies in the health care sector relative to the remaining publicly traded companies in the US stock market. (Construction of this variable is explained in Section 2.3; source: COMPUSTAT.)

(*ii*) *Average Physician Compensation over CPI*: A measure of the evolution of the average physician's salary in the US (sources: The American Medical Association for the years 1978-2000 and the Medical Group Management Association for the years 1994-2005).

(*iii*) *Cost per Inpatient Day over CPI*: An independent measure of health care inflation reported by the American Hospital Association (sources: Goldman and McGlynn (2005), and the BLS).

(*iv*) *Insurance-Premium Malpractice Index over CPI*: A measure of malpractice insurance costs for the providers of medical services. It is 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 specialties (Medical Liability Monitor Reports) over fifty-one states.

(*v*) *Private Health Insurance Premium per Enrollee over CPI*: The cost of health insurance for a privately insured person (sources: Cohen *et al*. (2009), the US Department of Health and Human Services – Centers for Medicare and Medicaid Services, and the BLS).

(*vi*) *Cost of Medicare per Enrollee over CPI*: Government's expenses per publicly insured elderly person (sources: The US Department of Health and Human Services – Centers for Medicare and Medicaid Services, and the BLS).

(*vii*) *HCE per Capita over CPI*: Real HCE per US inhabitant (sources: US Department of Health and Human Services – Centers for Medicare and Medicaid Services, and the BLS).

(*viii*) *CPIMC over CPI*: A measure of excess inflation in the US medical care sector with respect to the average inflation in the US economy (source: The BLS).

[Table 4.1: Independent Price Measures beyond the CPI and Other Sources of Inflation in the US Medical Sector]

Observe from this table that Health Care Sector Markup over Economy Markup moves remarkably close to the CPIMC over CPI. The CPIMC displays a modest growth in comparison with other measures of medical costs, except for Average Physician Compensation which grows much less.

These price measures grow much faster over the 1980-1990 period. The Cost per Inpatient Day over the CPI shows a steep cumulative increase of about 70 percent over the 1978-1990 transition period, whereas the CPIMC over CPI presents a cumulative increase of around 35 percent over the same period. Malpractice insurance premiums almost triple during the 1978-1990 transition period. The health economics literature [e.g., Harrington *et al.* (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. A main argument against using malpractice as an explanatory variable is that these costs are rather low: About 1.25 percent of HCE expenditures.[15]

Private Health Insurance per Enrollee has grown faster than HCE per Capita over the entire sample period. This increment came along with decreasing out-of-pocket expenditures – albeit out-of-pocket expenditures have still grown faster than nominal income per capita. Private Health Insurance per Enrollee over CPI more than doubles over the 1978-1990 transition period. Changes in Private Health Insurance per Enrollee over CPI are contemporaneously correlated with changes in CPIMC over CPI (a correlation coefficient of 0.43).

The Cost of Medicare per Enrollee and HCE per Capita have moved together over the sample period. Hence, costs in the private and public sectors may be driven by the same set of common factors. Since the distribution of the population over the categories of uninsured, privately and publicly insured remained quite stable over the last three decades, it appears that aging and the size of the elderly population cannot possibly account for the observed increase in the US medical care expenditure gap over our sample period.

To sum up, except for aggregate markups and average physician compensation, related measures of medical care costs show much steeper increases than the CPIMC over both the entire sample period and the 1978-1990 transition period. On these grounds, the CPIMC seems a conservative measure of health care costs. We should remark that these measures of medical care costs have been

[15] Kessler (2011) argues that although the indemnity payments and administrative expenses of the malpractice system amount to less than 1 percent of health care spending, the costs of defensive medicine are likely to be far greater because neither patients nor physicians bear most of the marginal costs.

obtained from unrelated data sources.

4.3 Microeconomic evidence of international health care prices

Several studies and international institutions have reported marked cross-country differences in health care prices. Figure 4.1 presents costs of several health care items in five OECD countries as of year 2011. These costs are reported as fractions of the corresponding US cost. 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 4.1: International Health Care Prices over US Health Care Prices 2011]

In these comparative studies it becomes quite difficult to control for quality across countries. There is, however, a large international market for prescription drugs, and the cross-country variability in wholesale drug prices has been well documented. 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 outside the US. Using 121 drugs to compare US prices with those of Canada and seventy-six drugs to compare with the UK, two GAO reports (GAO 1992, 1994) found that manufacturers prices in the US were on average 32 percent higher than in Canada and 60 percent higher than in the UK.

Later research has expanded the range of sample products to provide accurate price measures. Danzon and Furukawa (2003) find that manufacturer drug prices in eight representative 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 cheaper right after patent expiration, but later on they become relatively more expensive than in the US (Danzon and Furukawa, 2011). A related study by the US Department of Commerce (2004) on patented prescription drugs reports price indexes that could be 50 percent lower than their US counterparts (*op. cit.*, p. 38). Hence, even for tradable products of a given quality, medical prices in the US are much higher.

5 Concluding Remarks

In this paper we present a macro-level difference-in-difference approach to study the evolution of US health care expenditures. Since 1980 the US features the highest health care expenditure share of all the OECD countries. With the approaching retirement of the baby-boom generation, it is feared that the US medical care expenditure gap may take up a new expansionary turn. Thus, managing health care expenditure growth has become a topic of national concern, and a tall order for balanced economic growth.

To guide this discussion, we examine a sample of eleven OECD countries with similar income and quality data over the sample period 1970-2007. We define the US medical care expenditure gap as the US medical expenditure share in nominal GDP over the average share of the other OECD countries. We distinguish the following time periods: (*i*) *The* 1970-1977 *period*: The US medical care expenditure gap hovered around 1.25, (*ii*) *The* 1978-1990 *period*: The US medical care expenditure gap increased steadily from 1.23 to 1.68, and (*iii*) *The* 1991-2007 *period*: The US medical care expenditure gap stabilized around 1.70. Hence, the 1978-1990 period stands out as a transition episode with the sharpest increase in the US medical care expenditure gap.

One major difficulty in uncovering these growth patterns for US medical expenditures appears to be the high degree of uniformity in the various National Health Expenditure Accounts' categories by source and use of funds. These regular trends prevail over the 1978-1990 transition period. When adjusting for inflation in the medical sector, we obtain that the ratio of real health care expenditures over real GDP is quite flat over the *entire* sample period, but we observe some slight growth in the share of US value added.

We first perform a growth accounting exercise based on value added to asses the contribution of observable production factors. This exercise focuses on the supply side of the economy, and hence it has the advantage of circumventing obvious issues related to price and quality data as well as the various degrees and forms of government intervention across countries. As is well known, growth accounting methods become most powerful under a stable influence of technological progress across economies, and a similar composition and productivity of labor and capital over time. The ratio of physician to non-physician health care workers has been quite stable in our sample of countries for the periods in which data is available. Also, the US capital and labor income shares appear quite stable over time, both in the medical sector and in the economy. For the 1970-2007 sample period, labor in the health care sector has grown faster in the OECD, while capital in the health care sector has grown faster in the US. Overall, our growth accounting exercise based on value added indicates that the US medical care expenditure gap should have gone down in the period 1970-2007, while it went up by about 30 percent in the data. Therefore, the divergent patterns of growth of health care expenditures between the US and the OECD cannot be explained by factor accumulation.

We then provide some supporting evidence to account for the wedge between growth in value added and US health care expenditures. Various international institutions such as the OECD and the World Health Organization periodically report cross-country rankings on various dimensions of health status, health care activities, quality of care, and access to care. In many of these rankings the US lags behind many other OECD countries. Hence, the assumption of similar growth in technology and product quality across countries seems quite plausible at the aggregate level. Moreover, it is unclear that technology could account for the sharp break in the trend of the US medical gap over the 1978-1990 transition period – just spanning over a single decade. Indeed, US medical care expenditures are characterized by large corporate markups, gross profits, and stock market returns. Periods of strong positive growth in the ratio of HCE over GDP are backed by contemporaneous and commensurate changes in gross profits and markups. When we filter out price effects we find that the growth of the product quality residual in the US falls into the OECD average.

Whereas medical prices in some OECD countries followed the general pace of inflation, US medical inflation has considerably outpaced general inflation. The health economics literature has identified various factors that account for the higher prices of prescription drugs in the US, which may also extend to the observed high prices of hospital and other medical services. Health insurance premiums present much higher price increases than the CPI-medical care. Increasing charges in hospital and related services appear to be a main driving force in the US health care sector over the 1978-1990 transition period.

Finally, our methods impose severe limitations on the form of the health care production function. A statistical-based approach could also identify main drivers of health care expenditure patterns. In fact, in our supporting exercises we have reported several estimates of price elasticities for health care demand, and one would need to check whether or not these elasticities are statistically significant across countries. In unreported results available upon request, we have run panel data regressions for the US medical care expenditure gap with respect to each individual country as the dependent variable and the corresponding *US gaps* for the following four independent variables: The medical care price, GDP per capita, population 65 years old and over, and life expectancy. In this strongly balanced panel with ten cross-sectional observations and thirty-eight time-series observations, we find that only the US medical care price gap and the US GDP per capita gap are statistically significant. For our sample period, however, the US GDP per capita gap went down by about 10 percent, and hence it works in the opposite direction. As discussed above when considering gaps by country, this income gap may pick up a catching-up effect as a result of converging GDP per capita trends in the OECD.

6 Appendix

6.1 A simple model of health care expenditures

Let us just consider an endowment economy with a representative agent. The economy can also be reinterpreted as a social planning problem for the optimal allocation between a variety of medical services and all the other goods. A key parameter in the model is the price elasticity for health care demand. We should note that even if the health care good is subsidized the price elasticity of demand will not be changed when the representative agent has to pay a constant fraction of medical expenditures.

At every time $t = 0, 1, \cdots$, 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 for $s \in [0, \sigma(a_t)]$, where a_t denotes the technology level at time t and $[0, \sigma(a_t)]$ is the mass of available varieties. Preferences are represented by a CES utility function. All health care varieties m_{ts} at time t enter symmetrically into a utility aggregator $M(t) = \left[\int_0^{\sigma(a_t)} m_{ts}^{\gamma} ds\right]^{\frac{1}{\gamma}}$.

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

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

subject to:

$$c_t + q_t h_t = y_t$$

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

$$0 < \beta < 1, 0 < \lambda < 1, 0 < \gamma < 1, -\infty < \rho < 1$$

where $q_t h_t$ represents nominal health care expenditures, q_t is the relative price, and h_t represents real expenditures.
Parameter λ is called the consumption share parameter. Parameter ρ determines the degree of substitution between the composite consumption good c and the health care utility aggregator $M_t = [\int_0^{\sigma(a_t)} m_{ts}^{\gamma} ds]^{\frac{1}{\gamma}}$. Parameter γ determines the degree of substitution of the health care varieties m_s. Function $\phi(a_t)$ allows for shifts in the expenditure share as a result of technological change.

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 varieties $[0, \sigma(a_t)]$ 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 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 as documented in several 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 *et al.* (2005) and Hall and

Jones (2007)].

While this rich form for the utility function contemplates various channels for the influence of technological change, we will again collect all of these effects as part of the non-observable residual.

Optimality conditions

The representative agent assumes that the relative price q_t and the level of technological change a_t are exogenously given. Over the 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 agent's optimization problem we obtain the optimal ratio of average consumption of health care varieties m_t over the composite consumption of all other goods c_t:

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

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:

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

These equation 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 $\widehat{A}_t$ collecting the underlying quality effects:

$$\widehat{A}_t = \left(\frac{1-\lambda}{\lambda}\right)^{\frac{1}{1-\rho}} a_t^{\frac{\rho}{1-\rho}} \phi(a_t)^{\frac{1}{1-\rho}} \sigma(a_t)^{\frac{\rho(1-\gamma)}{\gamma(1-\rho)}}$$

6.2 Main Definitions Data Sources

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 programs, 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 not included in total health expenditure." (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 eleven 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 indexes: (*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 indexes. 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/).

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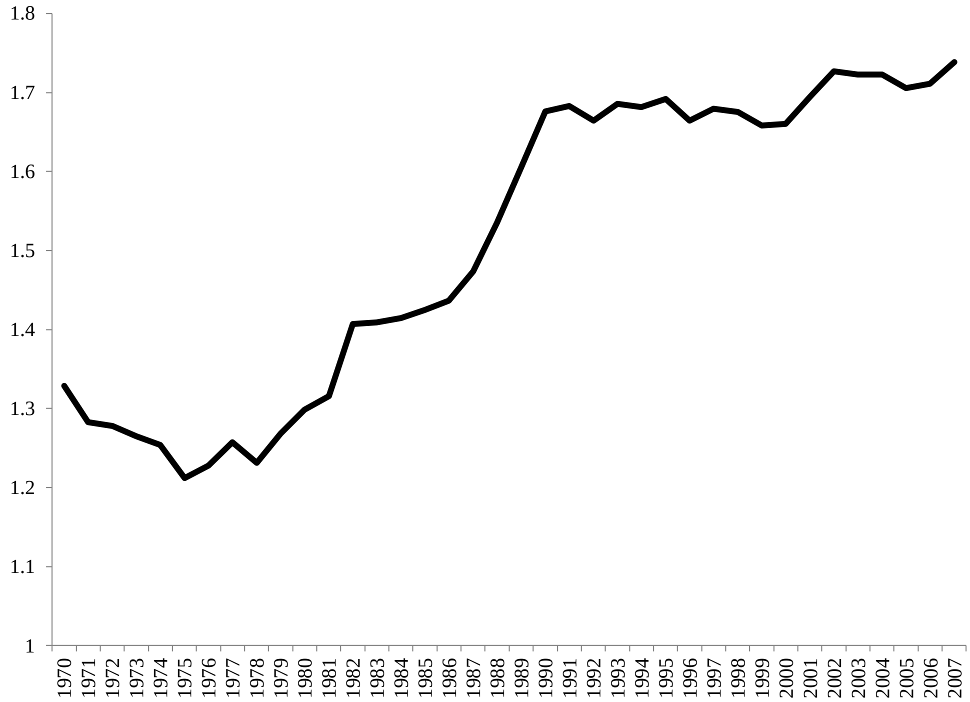
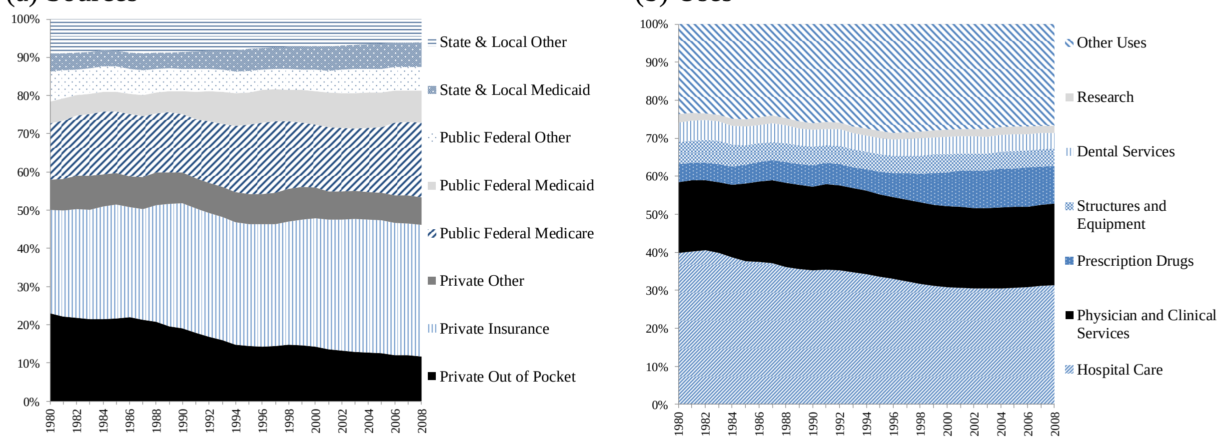
Figure 1.1: The US Medical Care Expenditure Gap 1970-2007



Source: OECD Health Data (June 2014).

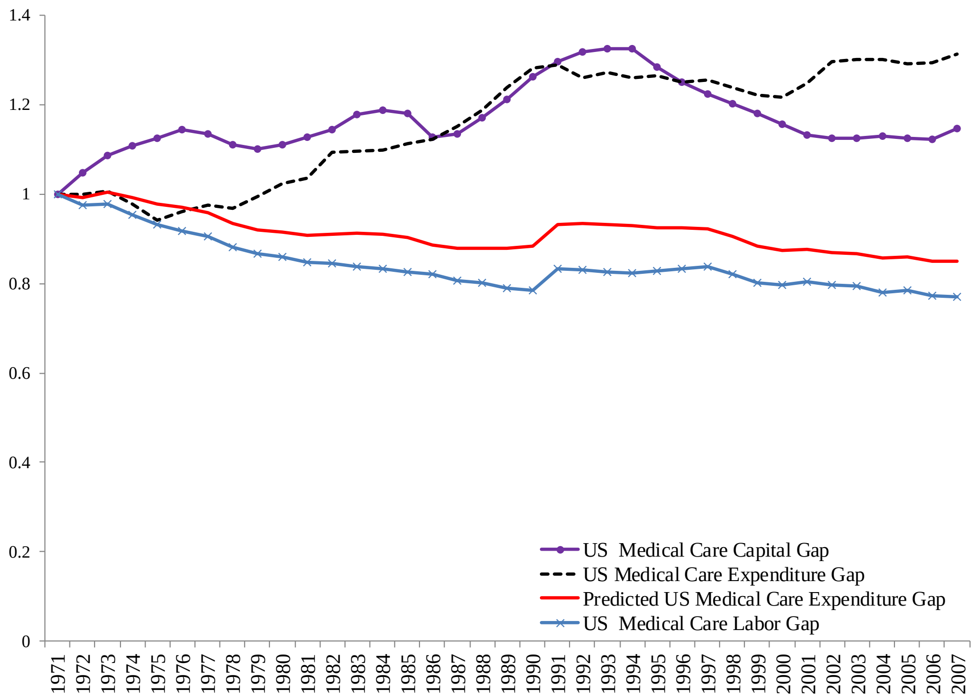
Figure 1.2(a): The Evolution of US Health Care Expenditures by Sources and Uses 1980-2007

(a) Sources (b) Uses



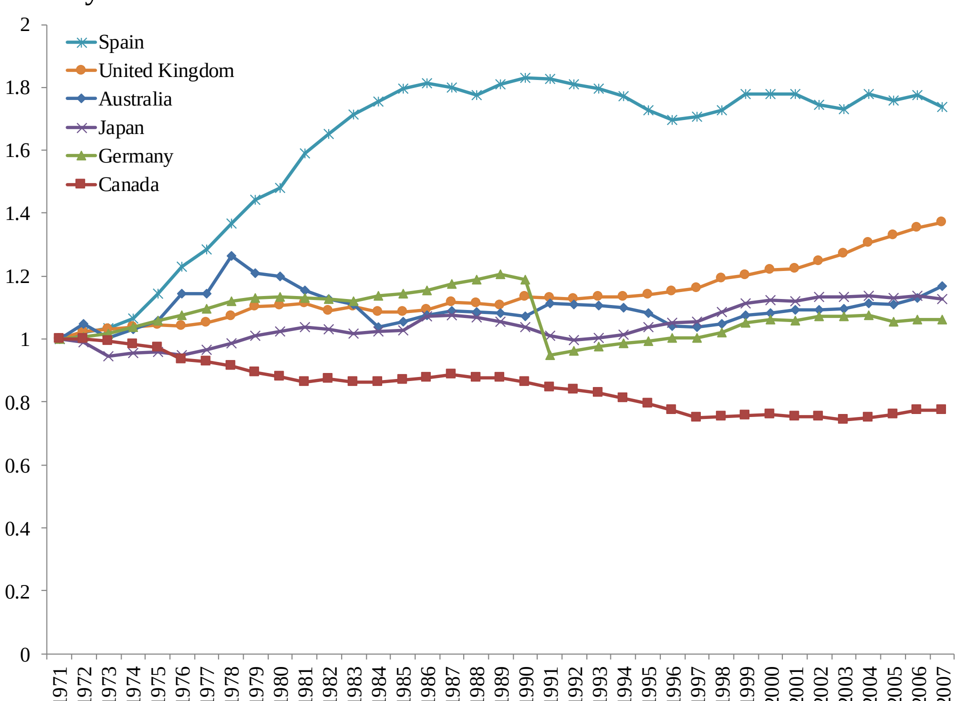
Source: US Department of Health and Human Services - Centers for Medicare and Medicaid Services.

Figure 2.1: A Basic Growth Accounting Exercise Using Labor and Capital Data for the US and OECD



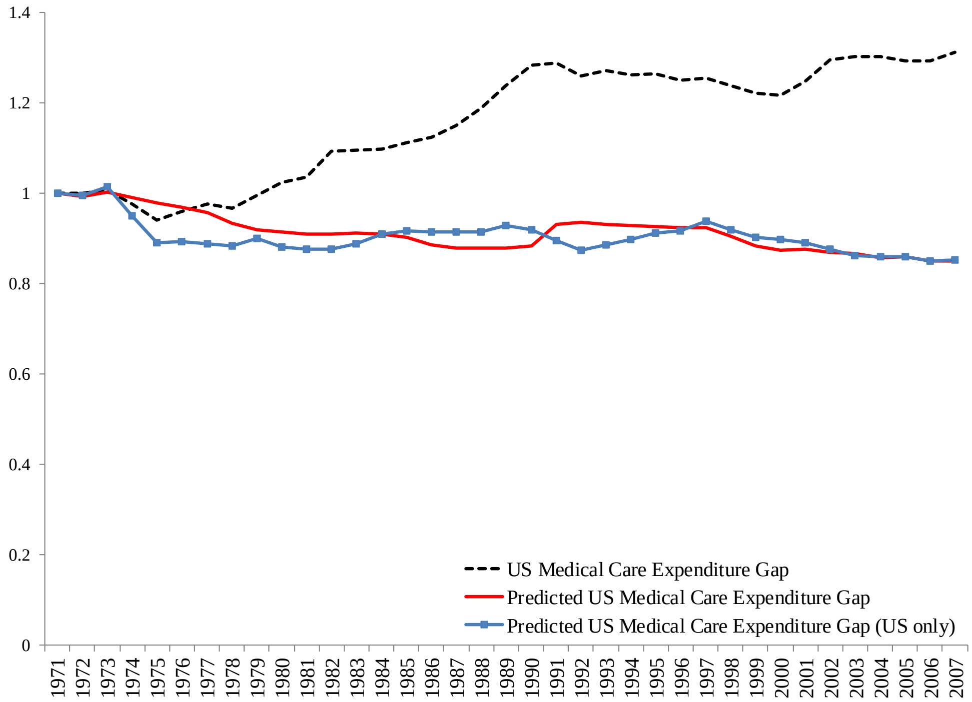
Source: OECD Health Data (June 2014) and authors' computations.

Figure 2.2: A Basic Growth Accounting Exercise – Implied Medical Expenditure Gaps by Country



Source: OECD Health Data (June 2014) and authors' computations.

Figure 2.3: A Basic Growth Accounting Exercise Using Labor and Capital Data for the US only

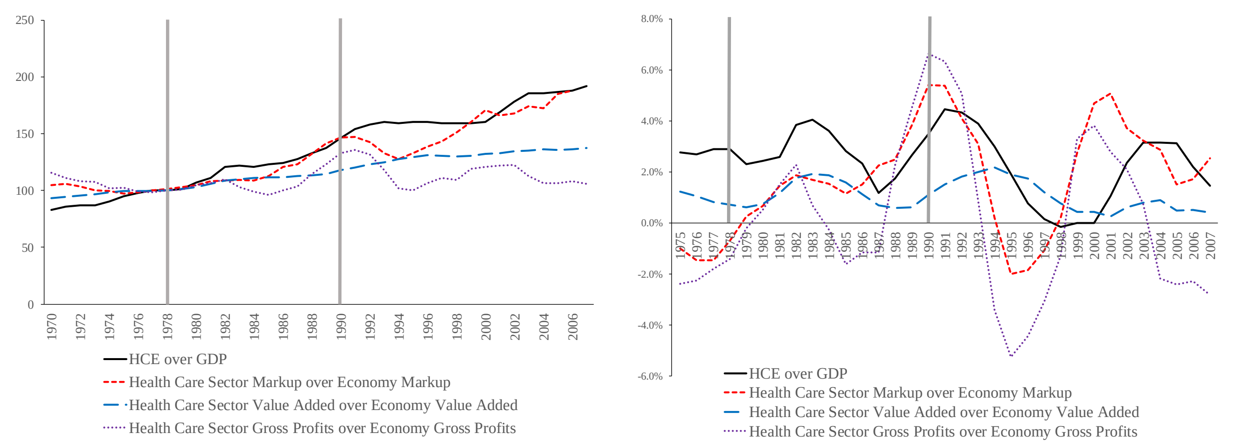


Source: OECD Health Data (June 2014) and authors' computations.

Figure 2.4: Health Care Sector Markup over Economy Markup, Health Care Sector Gross Profit over Economy Gross Profit, Health Care Sector Value Added over Economy Value Added, and HCE over GDP

(a) Levels

(b) Growth Rates (5-year moving average)



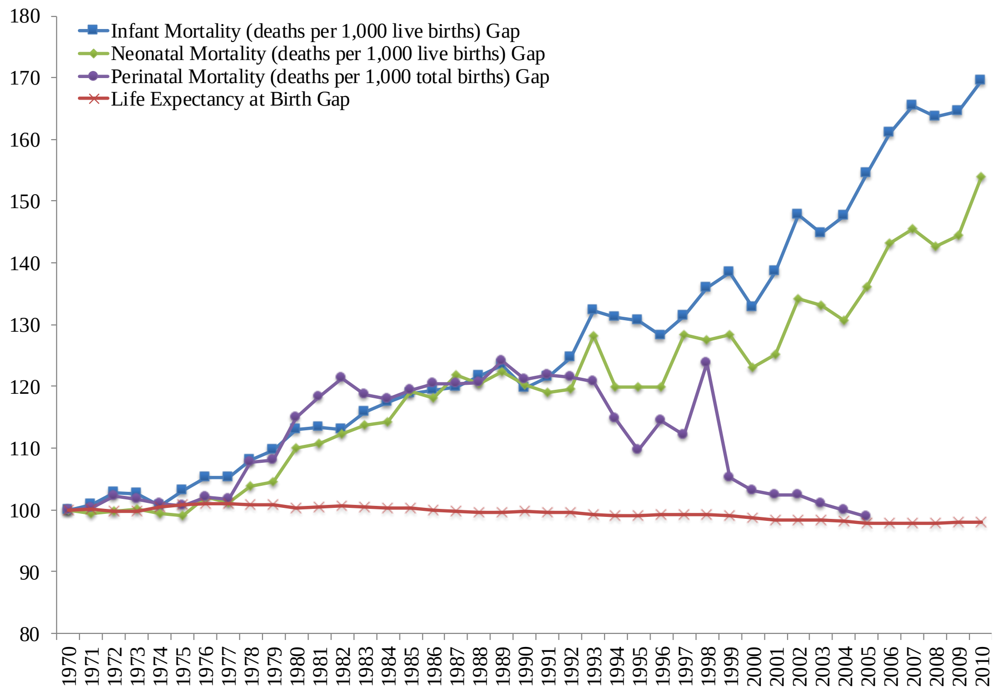
Source: CRSP, COMPUSTAT and authors' computations.

Figure 2.5: Herfindahl-Hirschman Index for the Health Care Sector

(a) HHI and Number of Firms (b) HHI and Markup

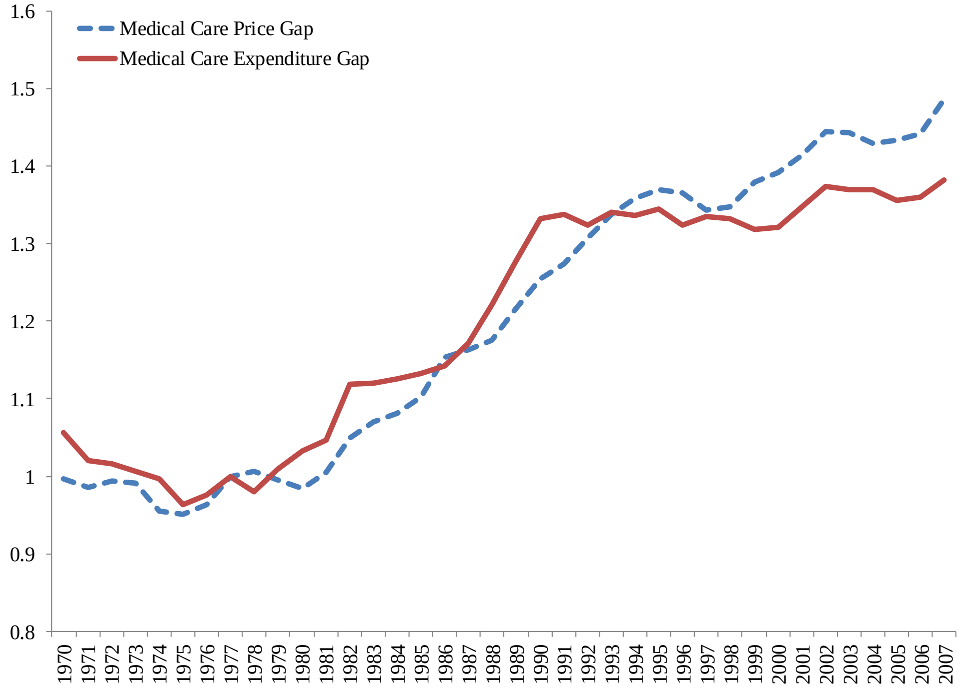
Source: CRSP, COMPUSTAT and authors' computations.

Figure 3.1: Quality Indicators over Time



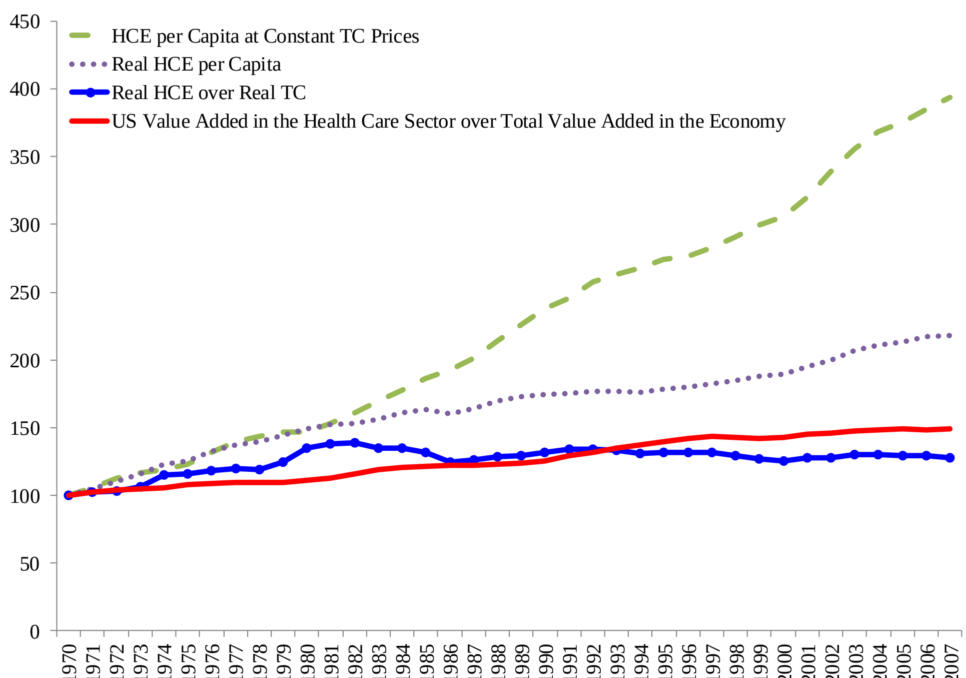
Source: OECD Health Data (June 2014).

Figure 3.2: The US Medical Care Expenditure Gap vs. the Price Gap 1970-2007



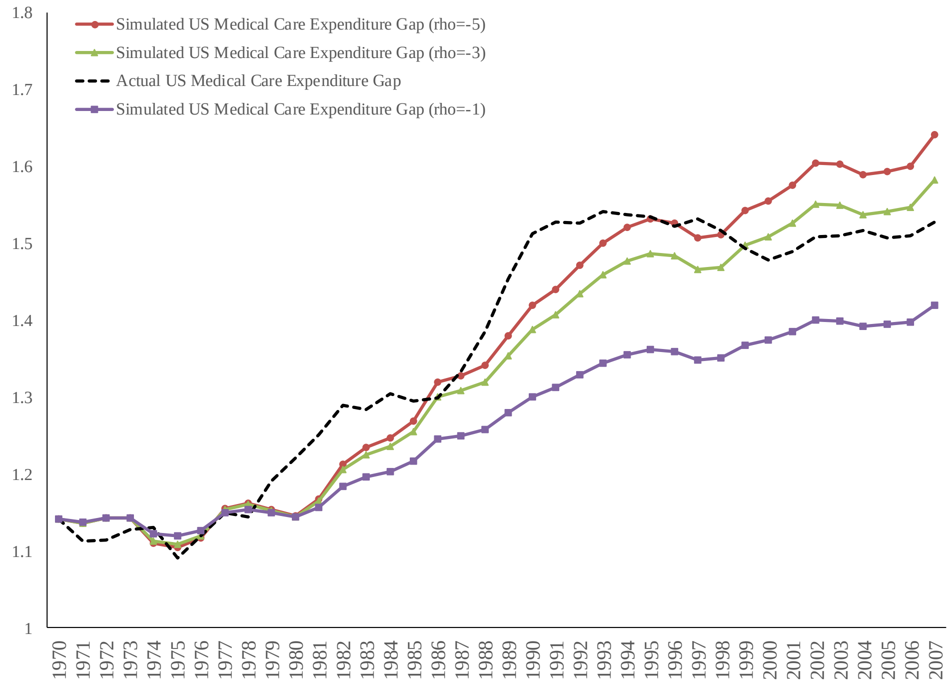
Source: Health Care Expenditures are from the OECD Health Data (June 2014). Health Care Price data are taken from each country's official statistics and authors' computations.

Figure 3.3: The Evolution of US Health Care Expenditures 1970-2007



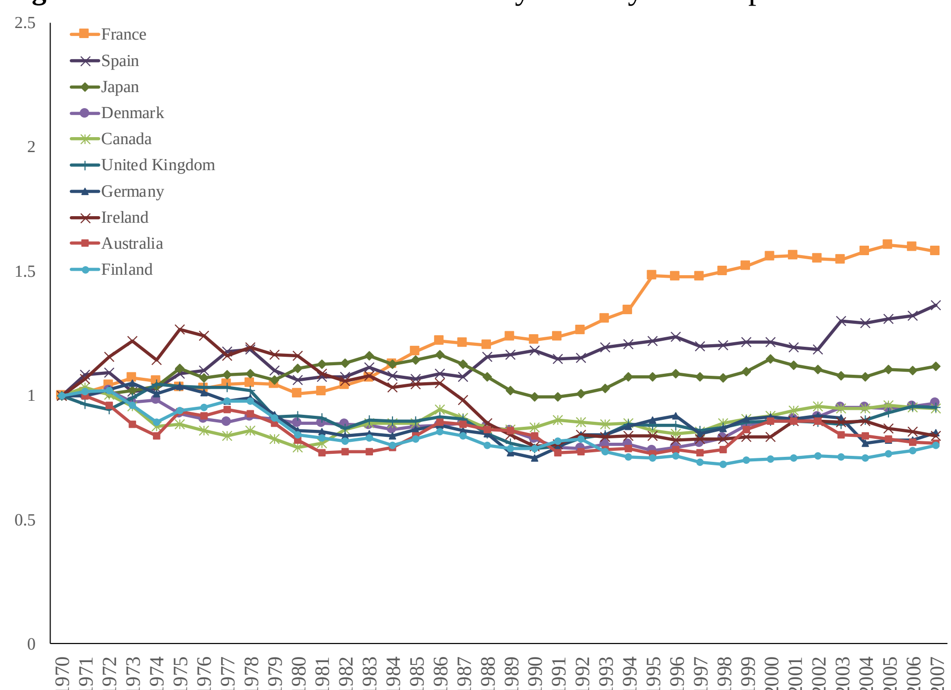
Source: US Department of Health and Human Services - Centers for Medicare and Medicaid Services and the Bureau of Labor Statistics.

Figure 3.4: The US Health Care Expenditure Gap as Implied by the Relative Price



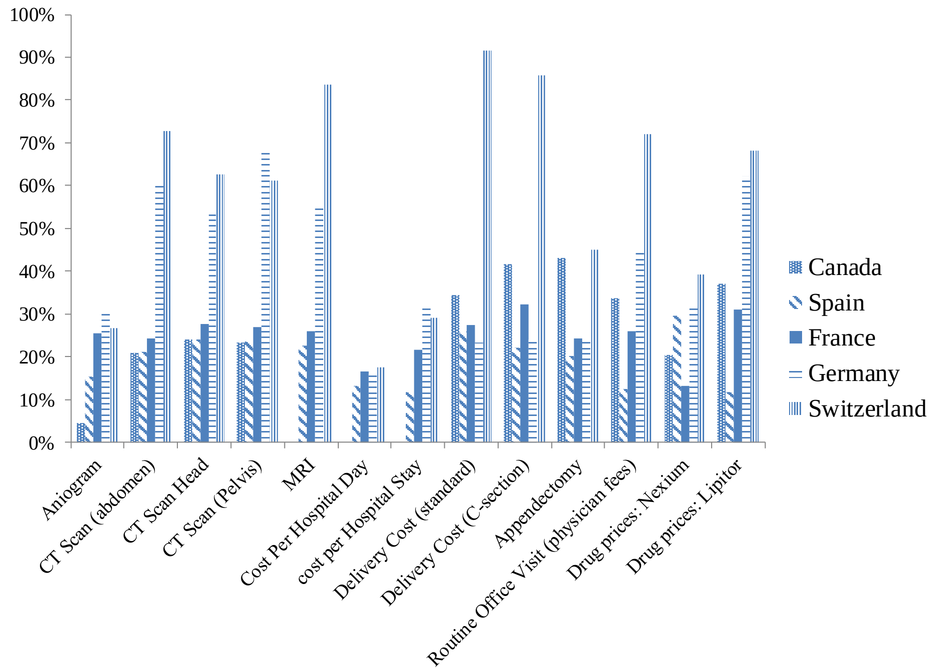
Source: Health Care Expenditures are from the OECD Health Data (June 2014). Health Care Price data are taken from each country's official statistics and authors' computations.

Figure 3.5: Evolution of the Residuals by Country as Compared to the US



Source: Health Care Expenditures are from the OECD Health Data (June 2014). Health Care Price data are taken from each country's official statistics and authors' computations.

Figure 4.1: International 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.

Table 2.1: Labor and Capital Statistics

a) Labor Productivity and Compensation in the US

	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) Average Non-Phys. Compensation over Average Physician Compensation	N/A	11.4%*	11.3%	12.0%

b) International Comparisons of Labor and Capital

	1970	1980	1990	2000
(iv) US Physicians per 1000 Workers	3.46	3.79	4.25	4.80
(v) OECD Physicians per 1000 Workers	3.05	4.03	4.96	5.36
(vi) US Health Care Investment over HCE§	7.04%	5.57%	4.85%	4.35%
(vii) OECD Health Care Investment over HCE§	5.52%	4.33%	4.25%	4.07%
(viii) US Aggregate Investment over GDP§	22.02%	22.97%	20.98%	21.76%
(ix) OECD Aggregate Investment over GDP§	26.46%	24.34%	23.15%	22.92%

* Data from year 1982.

§ Average over the subsequent 10 years

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

Table 2.2: Sensitivity Analysis

(a) 1970-2007 Period

Observed Change in US Medical Expenditure Gap: 30%			
δ	α	α_H	Predicted Change in Gap
0.08	0.25	0.25	-15.0%
0.06	0.25	0.25	-15.0%
0.08	0.4	0.25	-13.3%
0.06	0.4	0.25	-13.3%
0.08	0.4	0.4	-9.6%
0.06	0.4	0.4	-10.0%

(b) 1978-1990 Transition Period

Observed Change in US Medical Expenditure Gap: 32%			
δ	α	α_H	Predicted Change in Gap
0.08	0.25	0.25	-5.4%
0.06	0.25	0.25	5.9%
0.08	0.4	0.25	-4.7%
0.06	0.4	0.25	-5.2%
0.08	0.4	0.4	-17.0%
0.06	0.4	0.4	-2.5%

Source: OECD Health Data (June 2014) and authors' computations.

Table 2.3: Returns, Yields and Markups of Publicly Traded Companies in the Health Care Sector Relative to the Rest of the Economy

		Growth Rates			
	Health Care Sector Returns minus Economy Returns	Health Care Sector Markup over Economy Markup	Health Care Sector Yield over Economy Yield	Health Care Sector Value Added over Economy Value Added	HCE over GDP
Average 1970-1977 period	0.6%	-0.5%	1.7%	0.9%	2.4%
Average 1978-1990 period	10.7%	3.0%	9.5%	1.4%	3.2%
Average 1991-2007 period	9.1%	1.8%	2.7%	0.9%	1.6%

Source: CRSP, COMPUSTAT, Kenneth French website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/), and authors' computations.

Table 3.1: Quality Measures in 2003

	2003							
Variable	**Obs**	**Mean**	**US/Mean**	**US/Max**	**Std. Dev.**	**StdDev/Mean**	**Min**	**Max**
Life Expectancy	11	81.82	**0.97**	**0.93**	1.97	*0.024*	79.60	85.30
Breast Cancer Five-Year Observed Survival Rate (Female)	18	72.66	**1.07**	**1.00**	4.28	*0.059*	61.11	77.72
Breast Cancer Five-Year Relative Survival Rate (Female)	18	84.02	**1.06**	**1.00**	3.12	*0.037*	78.57	89.30
Cervical Cancer Five-Year Observed Survival Rate (Female)	19	61.81	**0.97**	**0.82**	5.34	*0.086*	50.92	73.35
Cervical Cancer Five-Year Relative Survival Rate (Female)	18	65.81	**0.98**	**0.84**	5.03	*0.077*	57.28	76.69
Colorectal Cancer Five-Year Observed Survival Rate (Male)	18	48.25	**1.11**	**0.89**	5.52	*0.114*	38.28	59.80
Colorectal Cancer Five-Year Observed Survival Rate (Female)	19	52.95	**1.06**	**0.96**	4.24	*0.080*	42.79	58.23

Source: OECD Health Data (June 2012).

Table 4.1: Independent Price Measures beyond the CPI and Other Sources of Inflation in the US Medical Sector

	1975	1980	1985	1990	1995	2000	2005
Markup in the Health Care Sector over Markup in the Economy	97	100	107	138	124	156	168
Average Physician Compensation over CPI	N/A	100	103	124	124	125	139
Cost per Inpatient Day over CPI	61	100	154	192	245	238	N/A
Insurance-Premium Malpractice Index over CPI	110	100	254	287	278	291	552
Private Health Insurance Premium per Enrollee over CPI	73	100	137	206	241	284	377
Cost of Medicare per Enrollee over CPI	77	100	136	156	204	208	258
HCE per Capita over CPI	84	100	127	162	187	208	256
CPIMC over CPI	99	100	115	137	155	162	178

Source: US Bureau of Labor Statistics, US Bureau of Economic Analysis, US Department of Health and Human Services -- Centers for Medicare and Medicaid Services, The 2003 GAO Report on Medical Malpractice Insurance, Goldman and McGlynn (2005), and Cohen et al. (2009). Physicians' compensation data come from authors' calculations using data from the American Medical Association and the Medical Group Management Association.