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by

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Abstract This paper differs in two ways from previous comparative health system research. First, it focuses on the impact of pharmaceutical expenditures on total health expenditures as trends in pharmaceutical expenditures have been blamed of being a major driver of national health expenditures. In addition to pharmaceutical expenditures, other variables of interest are income, public financing, public delivery, ageing and urbanization. Second, the analysis includes a thorough sensitivity analysis on the proposed model using four samples (with and without the US, and imputed and not imputed data) to address the issue of robustness. Based on a typology of health care systems, trends of relevant explanatory variables are described using OECD Health Data 2003 data. Unlike any other of the variables, pharmaceutical expenditures show contradicting trends when measured as per capita pharmaceutical expenditures and pharmaceutical share of total health expenditures. Next, a regression analysis is performed on data from 1970 2000 for 19 OECD countries. Regression diagnostics indicated the absence of multicollinearity but the presence of heteroscedasticity and autocorrelation. Based on the Hausman test, a fixed effect model was chosen. As in all previous empirical research, per capita GDP turned out to be the most influential explanatory variable. While public financing of health care was always three out of four samples significantly inversely related to health expenditures, public delivery as a NHS dummy was always significantly positively related to the dependent variable. Unlike previous research, ageing is consistently and significantly related to higher total health expenditures and, so is urbanization. Finally, all samples show a highly negative relationship between share of pharmaceutical expenditures and health expenditures, suggesting support for the substitution theory.

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Is Taking a Pill a Day Good for Health Expenditures? Evidence from a Cross Section Time Series Analysis of 19 OECD Countries from 1970 – 2000.

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Abstract.

This paper differs in two ways from previous comparative health system research. First, it focuses on the impact of pharmaceutical expenditures on total health expenditures as trends in pharmaceutical expenditures have been blamed of being a major driver of national health expenditures. In addition to pharmaceutical expenditures, other variables of interest are income, public financing, public delivery, ageing and urbanization. Second, the analysis includes a thorough sensitivity analysis on the proposed model using four samples (with and without the US, and imputed and not imputed data) to address the issue of robustness.

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Keywords: health care expenditure, health care system, health economics, health policy, comparative.

Introduction.

The body of quantitative comparative health system literature has mainly focused on the impact of income and to a lesser degree the source of financing on total per capita health expenditures. This does not come as a surprise since both variables and especially income explain most of the variance of total per capita health expenditures.

This paper has two purposes. On the one hand, besides demographic control variables, attention is given to two explanatory variables that have not often been included in empirical models. A first explanatory variable is the share of total health expenditures spent on pharmaceuticals. The reason for including this variable in the model is the pattern it shows over the last thirty years as described in the next session as well as the its blameworthiness for the ever increasing total national health expenditures. A proxy variable representing the public delivery of medical care is also introduced in the model to complement the variable that measures the publicness of health care financing (figure 1). On the other hand, the proposed model's robustness is tested with four different samples. One sample is based on imputed date and the other sample is based on non-imputed data. For both samples, the analysis is done with and without the United States. The reason is that the United States' health care system can be considered to be so different than any other health care system vis-à-vis its total per capita health expenditures.

Trends in Pharmaceutical Expenditures.

Pharmaceutical expenditures as a percent of total health expenditure show a decreasing trend from 1970 to the mid-eighties after which they started to increase again (Figure 2). The United States' share of pharmaceutical expenditures is lower than the other two types of health care systems. In the United States, while experiencing a steady decrease of pharmaceutical share of total health expenditures from 12.4 % in 1970 to 8.6% in 1994, a steep increase took place from 1995 to 8.9% to 11.9% of total health expenditures.

Per capita spending on per capita pharmaceutical expenditures ($ PPP) increased steadily from 1970 to 2000 for all types of health care systems (Figure 3). In 1970, compared to the United States with $ 159 per capita pharmaceutical expenditures, countries without a NHS spent $ 119.4 per capita, while NHS countries spent the lowest per capita on pharmaceuticals with $ 18.5 per capita. Ten years later in 1980, per capita spending on health expenditures has doubled. This doubling trend has continued for the eighties and the nineties (Table 1).

Literature Review.

Total health expenditures and income.

Simple regression analysis on cross sectional as well as pooled time series has shown that GDP per capita explains a substantial percent of variation of total per capita health expenditures independent of whether exchange rates or purchasing power parities (PPPs) are used. (Newhouse, 1977; OECD, 1987; Parkin, et.al., 1987; Parkin, et.al., 1989; Hitiris & Posnett, 1992; O'Connel, 1996).

Similar results with respect to GDP have been obtained in multivariate cross section and time series analyses. Kleiman's (1974) seminal cross sectional multivariate analysis established that GDP in terms of exchange rates was significantly and positively related to total health expenditures in all models tested. This was confirmed by later cross sectional analysis using exchange rates (OECD, 1985; Leu, 1986, Getzen, 1992; Gerdtham & Jönsson, 1991) and PPPs (OECD, 1985; Pfaff, 1990; Gerdtham & Jönsson, 1991; Gerdtham et. al., 1992, Getzen 1992; Murillo et.al., 1993).

Multivariate time series analysis has yielded less stable results. Pfaff (1990) using data for three countries confirmed the positive relationship between GDP and total per capita health expenditures for Canada and the United States but not for Germany where the relationship became negative but not significant. Kanavos and Yfantopoulos (1999) found that GDP had no significant explanatory power in 7 of the 14 countries of the European Union independent of measurement in terms of exchange rates, PPPs or national currencies.

For more than a decade, pooled cross section time series multivariate analysis is the predominant way to analyze the determinants of health expenditures. Gerdtham (1992) using five pooling methods on a static equilibrium model as well as a dynamic error correction model for 22 countries covering 16 years (1972 – 1987) found that for both types of models GDP per capita PPP and per capita health expenditures were positively and significantly related. In a follow up study of 22 countries from 1971 through 1991 (Gerdtham et al. 1994, 1998; Gerdtham, 2003) the effects of GDP on total health expenditures were confirmed. Roberts (1999) using data of a selection of 20 OECD countries from 1966 to 1993 also obtained a significant positive estimate for per capita GDP.

In other words, studies investigating the determinants of total health expenditures have found a significant and positive relationship between per capita GDP and total per capita health expenditures, independent of the measurement of GDP, the functional form of the empirical model, the type of data (cross-sectional or pooled) and whether using simple or multivariate analyses.

Pharmaceutical share and total health expenditures.

With respect to pharmaceutical expenditures, two theories with support of empirical findings on a less aggregate exist. On the one hand, the argument is that pharmaceutical expenditures are becoming an increasingly important part of total health expenditures due to increased prices of pharmaceutical products and increased volume of consumption, together with growth in insurance coverage of prescription drugs and increased direct-to-consumer advertisement. (Du Bois et al., 2000; Berndt, 2001; Reinhardt, 2001; Danzon & Pauly, 2002). Therefore, pharmaceutical expenditures are related to increased health expenditures.

On the other hand, an alternative view suggests that in the end many pharmaceuticals are more cost-effective than other medical interventions such as surgery. In other words, drugs and especially newer more costly drugs cause pharmacoeconomic benefits that offset other medical costs. (Goldberg, 1993; Kleinke, 2000; Neumann et al. 2000; Soumerai, 2004).

Given the limited availibility of emperical results at an aggregate level, no direction is predicted with respect to the relationship between share of pharmaceutical expenditures and total health expenditures. As such the goal is to verify which – if any – of the above mentioned theories are supported at an aggregate level.

The public nature of a health care system.

First, public expenditures as a share of total health expenditures have been introduced in several multivariate analyses. In the OECD (1985) cross sectional models covering 20 countries in three separate years (1970, 1976 and 1980) public financing is never significant but is consistently inversely related to total per capita health expenditures regardless of functional form or whether expenditures are measured in terms of exchange rates or percent of GDP spent on health.

In the same OECD study, public financing becomes significant and has a negative sign when the three samples are pooled. Similar results the OECD study were obtained by Gerdtham et al. (1992) with 1987 data for 19 countries and. When using pooled data for 22 countries from 1972 through 1992 (Gerdtham, 1992), the sign was always negative but significance depended on the statistical method used. O'Connell (1996) also found a significant and inverse relationship between public share of total per capita health expenditures for a different sample of 21 countries from 1975 through 1990. In Roberts' (1999) analysis using a sample of 20 countries from 1960 through 1993, significance of the public share estimates were always positive but significance depended upon the statistical method used. Finally, in Gerdtham et al. (1994) negative but insignificant estimates were obtained for public share in a sample of 24 countries from 1970 to 1991. Later, a follow up study by Gerdtham et al. (1998; 2000) using four different samples only resulted in negative and significant public share estimates for sample containing data on 17 countries from 1970 to 1991. For the same sample from 1981 to 1991 and a sample of 22 countries from 1981 to 1991 estimates were positive but not significant.

In other words, unlike per capita GDP, the public share of total health expenditures has produced less consistent results. Both direction and significance depend on the sample. In addition, different statistical methods also produce different estimates in terms of sign and significance.

Public delivery and health expenditures.

Leu (1984) found that countries with a public integrated health care system (National Health Service) have significantly lower health expenditures than those who had not. Later on, Gerdtham et al. (1992) could not replicate these results. When included in the model with public share of total health expenditures the parameter estimate for public integrated health care system became insignificant and, when entered in the model with public hospitals and public financing share, the sign of public integrated health care system switches directions. While significantly affecting total health expenditures inversely in the follow up study (Gerdtham et al. 1994), this result became insignificant in later studies (Gerdtham et al. 1998, 2003).

The health system effect is measured through a dummy variable for whether or not a country has a National Health Service that is characterized by predominant public financing as well as public provision. As such, this variable also measures the predominant nature of the provision of health services in addition to the source of financing measured by public share of total health expenditure.

As far as this variable actually captures the public provision, the public choice argument in the tradition of Buchanan (1969) and Niskanen (1971, 1983) as Leu suggests may hold strong. The major reason why government can fail is the absence of a link between the costs of producing and the revenues generated for the production of the good. The inability of linking both will encourage inefficiencies and may result in

misallocation, overuse of sources or overproduction. A second reason why government is likely to fail is embedded in the organizational nature of a nonmarket entity. It refers to internal management problems that have to be overcome on a daily basis. The last economical reason why government can fail is the creation of derived externalities. These unwanted effects come into being through policy measures. (Stevens, 1993; Wolf, 1992; Horn, 1995, Miller, 1995)

Therefore, we expect countries with an NHS to be more expensive than countries without an NHS. The NHS dummy variable was coded as unity for country and year in which a NHS system was in place similar to Gerdtham et al. (1994, 1998, 2003).

Demographics and total health expenditures.

International comparisons most commonly use the share of population age 65 and older as measure for an ageing population. One cross-sectional analysis of the OECD (1985) found that the percent population age 65 and older had no significant impact on total per capita health expenditures and that that there was an inverse relationship except for the years 1970 and 1976 where the sign was positive. When using change in per capita health expenditure over periods of 5 years, age was inversely related with the dependent variable. Getzen (1992) found a negative but insignificant relationship between ageing and total health expenditures.

Using pooled time series, positive and significant estimates for the percentage of population 65 and older were only obtained by Hitiris & Posnett (1992) and O'Connell (1996) while in the OECD study (1985) the only significant parameter estimates were negative. Similar to the OECD results, Barros (1998) for four 10-year time periods and Roberts (1999) for a 33 year time span never obtained positive or significant estimates. Finally, Okunade (2004) attained no significant relationship between health care expenditure growth in $ PPP and ageing on the short run but did a find positive and significant relationship on the long run.

Intuitively one may think that aging causes health expenditures to increase in two ways. First, the proportion of population of individuals age 65 and older grows. Second, life expectancy is increasing (Fuchs, 1990). In other words, more people are age 65 or older and this group of society is living longer causing health expenditures to increase because of increased demand for health services (Cassel. et al., 1992; Jacobzone, 2000; Lubitz, J. et al., 2001; Alemayehu, et al., 2004). This demographic change combined with the uneven spread of health care cost in a life cycle is expected to have an expenditure lifting effect. Therefore, we expect that an ageing population has an expenditure increasing effect.

Urbanization has been entered in empirical models on a regular basis. There are several reasons why the level of urbanization may have an increasing effect of health expenditure. From a public health perspective, contagious diseases may spread faster in urban arias because of the high density of cities. This on its turn can increase the use of medical services. Second, compared to rural areas, urban areas have more crime and traffic related injuries leading to a higher use of high cost trauma centers. Finally, availability and access is likely to be higher in urban areas. Therefore, the level of urbanization is expected to increase health expenditures (Crémieux, et al., 1999). This was confirmed by Leu's analysis (1984) in which positive estimates for the impact of urbanization on total health expenditures were obtained. However, urbanization was always significant. In Gerdtham's (1992) replication of Leu's model, urbanization had a negative sign and was never significant. When introduced in his own model, urbanization was significant and inversely related to total health expenditures.

Model Specification.

Based on the literature review, total per capita health expenditures can be written as the following function

$$THXP = \int (GDP + Publicshare + NHS + Pharmashare + Age65 + Urban)$$

Where

THXP are total per capita health expenditures in $ PPP
GDP is per capita Gross Domestic Product in $ PPP
Publicshare is the percent of total health expenditures that is financed publicly
NHS is a dummy for National Health Service systems
Pharmashare is the percent of total health expenditures that is spent on pharmaceuticals
Age65 is the percent of the population age 65 and older
Urbanization is the percent of total population living in an urban area as defined by the countries themselves.

Data and Methods.

Data.

The data used for the analysis come from the OECD health data set 2003 for all variables except urbanization, which was retrieved from the Worldbank's World Development Indicators data set 2003. The OECD data set contains information on 30 countries over a time span of more than forty years. One variable (level of urbanization) comes from the Worldbanks' WDI 2003 dataset.

For this study 19 countries were withheld for the analysis: Australia, Austria, Canada, Denmark, Finland, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States. Some countries were not included either because their comparability with the included countries: the Czech Republic, Hungary, Korea, Luxembourg, Mexico, Poland, the Slovak Republic and Turkey or, because of lack of data for the variables on which the multivariate analysis is based: Belgium, France, Switzerland.

Data have been transformed into their logs. Previous research (Parkin et.al., 1987, Gerdtham, 1992) has indicated that a double log functional form was preferable above any other functional form. More recently, this finding was confirmed by Gerdtham et al. (1994, 1998).

Methods.

While pooling has advantages, it also has disadvantages when using multivariate regression analysis. The combination of cross-sectional and time series data easily violates the OLS assumptions. Besides possible model misspecification, pooled data tend to be suffering from autocorrelation and heteroscedasticity (Stimson, 1985; Beck et. al., 1993; Beck & Katz, 1995; Hicks, 1996; O'Connel, 1996). In order to test

whether or not the variance of the error term is constant for all observations the χ^2 based White (1980) test is used. With respect to the possibility that in time series the current observation of the error term is a function of the previous one, the first order autocorrelation Breush-Godfrey test is used (Breush, 1978; Godfrey, 1978). In order to determine presence of multi-collinearity variance inflation and tolerance levels are calculated (Table 2).

Although no multi-colinearity has been detected (Table 3), the presence of heteroscedasticity (White test) and autocorrelation (Godfrey test) indicate that there are unmodeled country and time specific effects (Table 4). In order to solve this problem, time and country dummies can be introduced. Country dummies control for country specific differences that are not included in the model and, time specific dummies control for time related effects not captured by the model.

The next step is to determine whether these country and time specific effects are random or fixed. Random effect models are used when the effect are the result of a random selection of units of analysis from a population about which inferences are made while fixed effect models are used when inferences are made about the units of analysis included in the data only (Jones, 2000). Here, the selected countries do not come from regular random sample but are selected based on the availability of data and the comparability of countries. Therefore, a fixed effect model is the most appropriate statistical method. In addition, previous research (Gerdtham, 1992) has tested different statistical approaches on a previous version of the OECD data and, the two way fixed effect models yielded the most robust results. In order to confirm the appropriateness of this technique, a Hausman test (1978) for fixed effects was performed on all models resulting in significant values meaning that a fixed effect is an appropriate method to analyze the models. The results indicate that a fixed effect model is preferred (Table 3).

Results and Discussion.

The model has been tested with different samples and table 3 shows that regardless of the sample, all models are highly significant with at least an R^2 of .9912. While this R^2 may be considered alarmingly high, it can be explained by the fact that GDP is responsible in all equations for at least 90% of the variation in the dependent variable. When comparing the unimputed data with on average 21.8% missing values, all estimates of the explanatory variables of the model have the similar size, identical signs and are statistically significant with the exception of public share of total health expenditures, which is not significant when the United States is included in the sample. Results are very similar in the sample with the linearly imputed data, with the exception of the public share that is significant whether or not the United States is included. The results indicate that the model tested is robust and that the United Sates is to a certain degree is an outlier but at the same token, it must be mentioned that it is not really an influential outlier.

With respect to income as measured in terms of per capita GDP, all samples yield positive estimates of the same magnitude. Unlike most previous aggregate research results and more in the line of the results of meso and micro studies, the results of this analysis show an elasticity lower than unity meaning that health car is not a luxury good.

The wide spectrum of results with respect to the nature of health care as a good is caused by two reasons. First, the wide variety of results can be explained the different statistical analysis used to determine the elasticity of health care. (Kanavos & Mossialos, 1999) A second reason is related to the level of analysis. (Kavanos &

Mossialos, 1999; Getzen, 2000) In contrast to aggregate studies, household surveys show that health care is a necessity good. The reason for these rather contradictory results is twofold. On the one hand, micro studies investigate the behavior of individuals and make inferences about the average individual while the macro studies concentrate on the average behavior of a pool of individuals. On the other hand, at the different levels of analysis, the income effect is experienced in a different way because of the level where the budget restrictions take place. At the micro level, the average individuals are much more sensitive to changes in income and therefore the spending effect on health. At the macro level, spending restrictions are set through a budget process for which individuals are not directly sensitive. Because of those reasons, different results may be obtained at different levels of analysis.

However, the simple fact that that an elasticity does or does not exceed unity only means that as income increases, the increase in health care spending will be relatively higher than the increase in income. As such, a legitimate role in the financing of health care cannot be based on whether a good is considered a luxury good or not in the economic sense.

The empirical results from this study do indicate that an increase of 10 percent of government share of total health expenditures is likely to decrease total health expenditures between 1.4 and 3.3 percent.

From the analysis, all estimates are negatively and except for one significantly related to the dependent variable is thought provoking. One possible reason why publicly financed health care may reduce expenditures is lower administrative costs. All countries that have statutory health insurance also have standardized levels of covered care for almost the whole population. The financial resources are generated directly through taxes and/or contributions from employers and/or employees and, are then pooled on one account. From that account, government either pays providers directly as is the case in single payer systems or, transfers the money to social insurances in third payer systems that are responsible for reimbursing covered health services.

Public and private insurance schemes have administrative costs caused by processing claims. Commercial health insurances are more likely to have higher administrative costs that are caused by rating systems and premium structures that have to be developed and sometimes tailored to the purchasers' preferences. There are sales and marketing costs to sell the insurance in a competitive market as well. Finally, there are the costs of complying with government regulation. (Pauly et al., 1991, 1999, 2001; Thorpe, 1992)

Indeed, comparisons between countries show that in the United States administrative costs of health insurance are higher than in any other country (Himmelstein & Woolhandler, 2003; Reinhardt et al., 2004; Woolhandler et al., 2003; Woolhandler & Himmelstein, 2002). In addition, a study on voluntary private insurance in the European Union showed that administrative costs of private insurance schemes are higher than their public counterparts (Colombo & Tapay, 2004; Mossialos & Thomson, 2002).

If there is a legitimate role for government in financing health care, the next question then, is whether the private sector has a role to play in a health care system. The results from this analysis support a role for private entities. The health system variable that is indicative of public predominance in a health care system is assumed to capture also the public provision of health services. The results show that the presence of an NHS is an expenditure increasing institutional arrangement in the health care system if the assumption mentioned above holds strong. This supports the public choice theory that states that public providers show monopolistic behavior causing inefficiencies, which is supported by results from research in two areas on the efficiency of health care providers.

First, waiting times is one manifestation of the inefficiency of public providers. Several studies have looked at differences between countries for referral time lags (Fleming et al., 1992) and waiting times for different surgical procedures. (Blendon et al. 2002; Carroll et al., 1995; Siciliani & Hurst, 2004) Results show that in countries with public provision of medical care referral and waiting times are longer.

Second, empirical studies on hospitals have found that in NHS health systems hospitals behave as bureaucracies. This resulted in budget maximizing behavior as well as misallocation of resources that on its turn resulted in overutilization of supplies and overinvestment in equipment leading to excess capacity. (Rodriguez et al., 2004; Spicer, 1982)

With respect to pharmaceutical expenditures, the results support the substitution theory that argues that drugs can have an expenditure lowering effect because it has the potential to prevent more costly medical care later on. An increase of 10 percent in pharmaceutical expenditure can reduce health expenditures between .8 and 1.5 percent.

Over the years, empirical research predominantly focusing on elderly and welfare recipients has found evidence for this substitution theory (Poisal et al., 1999; Thomas et al., 2001). Studies in the United States show that limiting reimbursable medication has increased institutionalization among elderly covered by Medicaid (Soumerai et al., 1991). Similarly, HMO enrollees who were subject to pharmaceutical capitation had higher total health costs than those not subjected to capitation (Popovian et al., 1999). In addition, pharmaceutical cost increases for the treatment of schizophrenia was lower than cost increases of other medical services for treating the disease. Finally, Lichtenberg (1996) found that hospitalization and surgical procedures was inversely related to number of prescribed drugs and that newer drugs were able to reduce-non pharmaceutical expenditures (Lichtenberg, 2000).

Unlike most comparative multivariate analyses, this analysis has rather robust estimates in the expected direction with respect to the impact of an ageing population on total health expenditure. Urbanization is also positively related to total health care expenditures.

Conclusion.

Important conclusions can be drawn from this study. From an institutional perspective, the role of government with respect to financing of the health care system confirms most of the previous research. An increased involvement of government in financing medical care can reduce total health expenditures because economies of scale. However, the delivery of medical care may not be ideal when provided by a public provider. In other words and based on the robust findings of this study, a publicly financed health care system with privately provided medical care seems to be preferable over any other arrangement of provision and delivery of medical care. Next, unlike most previous studies that attempted to identify the impact of demographic changes and their effects on national health expenditures, the results of this study confirms the even intuitively increasing effects of an ageing population on total health expenditures. Finally yet importantly, the impact of pharmaceutical proportional expenditure on total health expenditure may have expenditure saving effects on health expenditures. This study confirms at an aggregate level the substitution theory that is empirically supported by some meso and micro research. Given these findings, further research should focus on the respective role of the public and private sector with respect to the delivery and financing of medical care as well as

the impact of pharmaceutical expenditures on total health expenditures within the context of an ageing population.

While the robustness of model across different samples is rather strong, endogeneity may be an issue and should be the focus of attention in further research.

References.

Alemayehu, B. & Warner, K.E. (2004), The Lifetime Distribution of Health Care Costs. In Health Services Research., 39: 627 – 642.

Barros, P.P. (1998) The Black Box of Health Care Expenditure Growth Determinants. In Health Economics, 7: 533 – 544.

Beck, N. & Katz, J. N., (1995), What to do (and not to do) with time series cross-section data., In American Political Science Review, 89: 634-647.

Blendon, R. J. Schoen, C. DesRoches, C. Osborn, R. Zapert, K. (2003) Common Concerns Amid Diverse Systems: Health Care Experiences In Five Countries. In Health Affairs. 22: 106-121.

Berndt, E. R., (2001), Pharmaceutical Industry: Why Major Growth in Times of Cost Containment., In Health Affairs., 20: 100 – 114.

Breush, T.S. (1978) Testing for Autocorrelation in Dynamic Linear Models., In Australian Economic Papers., 17: 334 – 355.

Buchanan, J.M. (1969), Cost and Choice: An Inquiry in Economic Theory. Chicago: Markham.

Cassel, C.K., Rudberg, M.A.. & Olshansky, S.J., (1992), The Price of Success: Health Care in an Ageing Society. In Health Affairs, 87 – 99.

Carroll, R.J. et al. (1995) International Comparison of Waiting Times for Selected Cardiovascular Procedures, Journal of the American College of Cardiology, 1: 557 – 563.

Colombo, F. & Tapay, N. (2004) Private Health Insurance in Ireland. A Case Study. Paris: OECD Health Working Papers.

Crémieux, P-Y., Meilleur, M-C., Ouelette, P., Petit, P., Zelder, M. & Potvin, K. (2005) Public and Private Pharmaceutical Spending as Determinants of Health Outcomes in Canada., In Health Economics., 14: 107 – 116.

Danzon, P.M, & Pauly, M.V., (2002), Health Insurance and the Growth in Pharmaceutical Expenditures., In The Journal of Law and Economics., 65: 587 – 613.

Du Bois, R. W., Chawla, A., Neslusan, C.A., Smith, M.W. & Wade, S., (2000), Explaining Drug Spending Trends: Does Perception Match Reality. In Health Affairs., 19: 231 – 239.

Flemming, D. M., et al. (1992) The European Study of Referrals from Primary to Secondary Care, In Royal College of General Practitioners. London, Occasional Paper No. 56.

Fuchs, V., (1990), The Health Sector's Share of the Gross National Product. In Science., 247: 534 – 538.

Gerdtham, U. & Jönsson, B., (2000), "International Comparisons of Health Expenditure: Theory, data and econometric analysis." In Cuyler, A. & Newhouse, J. (eds.) Handbook of Health Economics. Volume I. Amsterdam: Elsevier Science.

Gerdtham, U., (1992), Pooling International Health Care Data. In Health Economics., 1: 217 – 231.

Gerdtham, U., Jönsson, J, McFarlan, M. & Oxley, H., (1994), Factors Affecting Health Spending: A Cross-Country econometric analysis. In OECD: New Directions in Health Care Policies: improving Cost Control and Effectiveness. Annex. Paris: OECD.

Gerdtham, U., Jönsson, J, McFarlan, M. & Oxley, H., (1998), The Determinants of Health Expenditures in OECD Countries: A pooled Data Analysis. In Zweifel, P., (ed.) Health, the Medical Profession, and Regulation. Dordrecht: Kluwer Academic Publishers.
Gerdtham, U., Jönsson, J, McFarlan, M. & Oxley, H., (2003), Factors Affecting Health Spending: A Cross-Country econometric analysis. In OECD: Health Care Systems: Lessons from the Reform Experience. Paris: OECD.
Gerdtham, U., Sögaard, J., Andersson, F. & Jønsson, B., (1992), An Econometric Analysis of Health Care Expenditure: A Cross-Section Study of the OECD Countries. In Journal of Health Economics, 11, 63 – 84.
Gertdham, U. & Jönsson, B., (1991), Conversion Factor Instability in International Comparisons of Health Care Expenditures. In Journal of Health Economics, 10: 227 – 234.
Getzen, T.E., (1992), Population Ageing and the Growth of Health Expenditures. In Journal of Gerontology, 47: 98 – 104.
Getzen, T.E. (2000) Health Care is an Individual Necessity and a National Luxury Good: Applying Multilevel Decision Models to the Analysis of Health Expenditures. In Journal of Health Economics, 19: 259 – 270.
Godfrey, L.G. (1978) Testing Against General Autoregressive and Moving Average Error Models When the Regressors Include Lagged Dependent Variables., In Econometrica, 46: 1293 – 1302.
Goldberg, R., (1993), Pharmaceutical Price Controls: Saving Money Today or Lives Tomorrow?, Institute for Policy Innovation Policy Report No. 123.
Hausman, J.A. (1978) Specification Tests in Econometrics. In Econometrica. 46: 1251 – 1271.
Himmelstein, D.H. & Woolhandler, S. (2003) National Health Insurance or Incrimental Reform: Aim High, or at Our Feet? In American Journal of Public Health. 93: 102 – 105.
Himmelstein, D.H. & Woolhandler, S. (2002) Taking Care of Business: HMOs hat Spend More on Administration Deliver Lower-Quality Care. In International Journal of Health Services. 4: 657 – 667.
Hitiris, T. & Posnett, J., (1992), The Determinants and Effects of Health Expenditure in Developed Countries. In Journal of Health Economics., 11: 173-182.
Horn, M., (1995), The Political Economy of Public Administration. Institutional Choice in the Public Sector. Cambridge: Cambridge University Press.
Jacobzone, S., (2000), Coping with Ageing: International Challenges. In Health Affairs. 19: 213 – 225.
Jarque, C. M. & Bera, A.K. (1980) Efficient Tests for Normality, Heteroscedasticity, and Serial Independence of Regression Results. In Economics Letters, 6: 255 – 259.
Jones, A. M. (2000) Health econometrics, In Handbook of Health Economics (Eds.) A. J. Culyer and J. P. Newhouse, Elsevier, Amsterdam.
Kanavos & Yfantopoulos, 1999, Cost Containment and Health Expenditures in the EU: A Macro Economic Perspective. In Mossialos, E. & Le Grand, J. (Eds.) Health Care and Cost Containment in the European Union. Ashgate Publishing: Aldershot.
Kleiman, E., (1974), The Determinants of National Outlay on Health. In The Economics of Medical Care., Perlman, M. (Ed.) New York: John Wiley & Sons.
Kleinke, J.D., (2000), Just What the HMO Ordered: The Paradox of Increasing Drug Costs., In Health Affairs., 19, 78 – 91.
Leu, R. E., (1986), The Public-Private Mix and International Health Care Costs. In Cuyler, A.J. & Jonsson, B. (eds.) Public and Private Health Services. Oxford: Basil Blackwell.
Lichtenberg, F.R., (1996) The Effect of Pharmaceutical Utilization and Innovation on Hospitalization and Mortality., NBER Working Paper 5418, Cambridge: National

Bureau of Economic Research.
Lichtenberg, F.R., (1996) Do (More and Better) Drugs Keep People out of the Hospital. In The American Economic Review. 86: 384 – 388.
Lubitz, J., Greenberg, L.G., Gorina, Y, Wartzman, L. & Gibson, D. (2001), Three Decades of Health Care Use by the Elderly, 1965 – 1998. In Health Affairs. 20: 19 – 32.
Miller, G.J. (1995) Managerial Dilemmas. The Political Economy of Hierarchy. Cambridge: Cambridge University Press.
Mossialos, E. & Thomson S.M.S. (2002) Voluntary Health Insurance in the European Union. In Mossialos, E., Dixon, A., Figueras, J. & Kutzin, J. (eds.) Funding Health Care for Europe. Buckingham/Philadelphia. Open University Press.
Murillo, C., Piatecki, C. & Saez, M., (1993), Health Expenditure and Income in Europe., In Health Economics, 2: 127 – 138.
Neumann, P.J., Sandberg, E.A., Bell, C.M., Stone, P.W. & Chapman, R.H., (2000), Are Pharmaceuticals Cost-Effective? A Review of the Evidence. In Health Affairs., 19: 92 – 109.
Newhouse, J.P., (1977), Medical Care Expenditure: A Cross-National Survey.In The Journal of Human Resources., 1: 115-125.
Niskanen, W.A. (1971), Bureaucracy and Representative Government. Chicago: Aldine Atherton.
Niskanen, W.A. (1983) Bureaucrats between Self-Interest and Public Interest. In Hanusch, H. (Ed.) Anatomy of Government Deficiencies, Berlin: Springer-Verlag.
O'Connell, J.M., (1996), The Relationship Between Health Expenditure and the Age Structure of the Population in OECD Countries., Health Economics, 5: 573 – 578.
OECD, (1985), Measuring Health Care 1960 – 1983., Paris: OECD.
OECD, (1987), Financing and Delivering Health Care. A Comparative Analysis of OECD Countries. Paris: OECD.
OECD, (2003), Health Data 2003. A Comparative Analysis of 30 Countries., Paris: OECD.
Okunade, A., Karakus, M. C. & Okeke, C., (2004), Determinants of Health Expenditure Growth of the OECD Countries: Jackknife Resampling Plan Estimates. In Health Care Management Science, 7: 173 – 183.
Parkin, D.W., McGuire, A.J. & Yuke, B.F., (1987), Aggregate Health Expenditures
Parkin, D.W., McGuire, A.J. & Yuke, B.F., (1989), What Do International Comparisons of Health care Expenditures really show?, In Community Medicine, 11: 116 – 123.
Pauly, M. & Damon, P., Feldstein, P. & Hoff, J. (1991) A Plan for Responsible National Health Insurance". In Health Affairs. Spring: 5 – 25.
Pauly, M., Percy, A. & Herring, B. (1999) Individual versus Job-Based Health Insurance: Weighing the Pros and Cons. In Health Affairs. 18: 28 – 44.
Pauly, M. & Herring, B. (2001) Expanding Coverage via Tax Credits: Trade-Offs and Outcomes. In Health Affairs. 20:9-26.
Pfaff, M., (1990), Differences in Health Care Spending across Countries: Statistical Evidence. In Journal of Health Politics, Policy and Law, 15: 1 – 24.
Popovian, R., Johnson, K.A., Nichol, M.B. & Liu, G. (1999) The Impact of Pharmaceutical Capitation to Primary Medical Groups on the Health Expenditures of Medicare HMO Enrollees., In Journal of Managed Care Pharmacy., 5: 414 – 419.
Reinhardt, U. E., (2001), Perspectives on the Pharmaceutical Industry. In Health Affairs, 20: 136 – 149.
Reinhardt, U.E. (2004) U.S. Health Care Spending in an International Context. In Health Affairs. 23: 10 – 25.
Roberts, J., (1999), Sensitivity of Elasticity Estimates for OECD Health Care Spending: Analysis of a Dynamic Heterogeneous Data Field. In Health Economics.

8, 459 – 479.
Rodriguez – Alvarez, A. & Knox – Lovell, C.A. (2003) Excess capacity and expense preference behaviour in National Health Systems: an application to the Spanish public hospitals. Health Economics. 13: 157 – 169.
Siciliani, L. & Hurst, J. (2004) Causes de la Disparité des Délais d'Attente en Chirurgie Non Urgente dans les Pays de L'OCDE. In Revue Economique de l'OCDE. 38: 107 – 137.
Soumerai, S.B. (2004) Benefits and Risks of Increasing Restrictions on Access to Costly Drugs in Medicaid. In Health Affairs, 23: 135 -146.
Soumerai, S.B., Ross-Degnan, D., Avron, J., McLaughlin, T.J. & Choodnovski, I. (1991) Effects of Medicaid Drug-Payments on Admission to Hospitals and Nursing Homes., In The New England Journal of Medicine., 325: 1072 – 1077.
Spicer, M.W. (1982) The Economics of Bureaucracy and the British National Health Services. In Milbank Memorial Fund Quarterly. 60: 657 – 672.
Stevens, J.B. (1993), The Economics of Collective Choice. Boulder: Westview Press.
Stimson, J. A., (1985) Regression in Space and Time: A statistical essay. American Journal of Political Science, 29: 914 - 944.
Thorpe, K.E. (1992) Inside the Black Box of Administrative Costs. In Health Affairs. 11: 41 – 55.
White, H. (1980) A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity. In Ecomometrica. 48: 817 – 838.
Wolf, C. (1992) Markets or Governments. Choosing between Imperfect Alternatives. Cambridge: The MIT Press.
Woolhandler, S. & Himmelstein, D.H. (2002) Paying for National Health Insurance – and Not Getting It. In Health Affairs. 21: 88 – 98.
Woolhandler, S. Campbell, T. & Himmelstein, D.H. (2003) Costs of Health Care Administration in the United States and Canada. In New England Journal of Medicine. 348: 768 – 775.

Financing

Delivery		Public	Private
	Public	NHS	
	Private	Non NHS	Entrepreneurial

Figure 1. *Typology of Health Care Systems*[1].

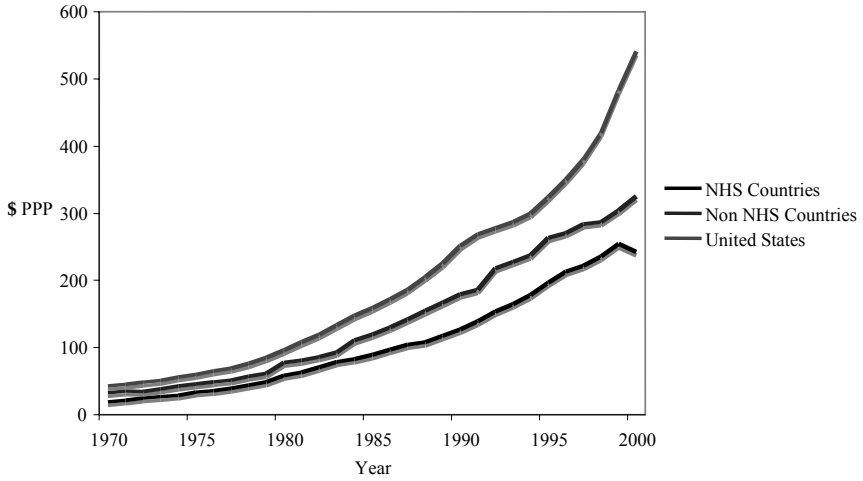

Figure 1. Per Capita Pharmaceutical Expenditures (1970 – 2000).

[1] The typology code is the same as in Gerdtham et al. (1994, 1998 and 2003). NHS countries are Denmark, Greece (since 1983), Iceland, Ireland, Italy (since 1979), New Zealand, Norway, Portugal (since 1978), Spain (since 1984), Sweden and the United Kingdom. Non NHS countries are Australia, Austria, Canada, Germany, Greece (before 1983), Italy (before 1979), Japan, the Netherlands, Portugal (before 1978), Spain (before 1984). The United States is the only entrepreneurial system.

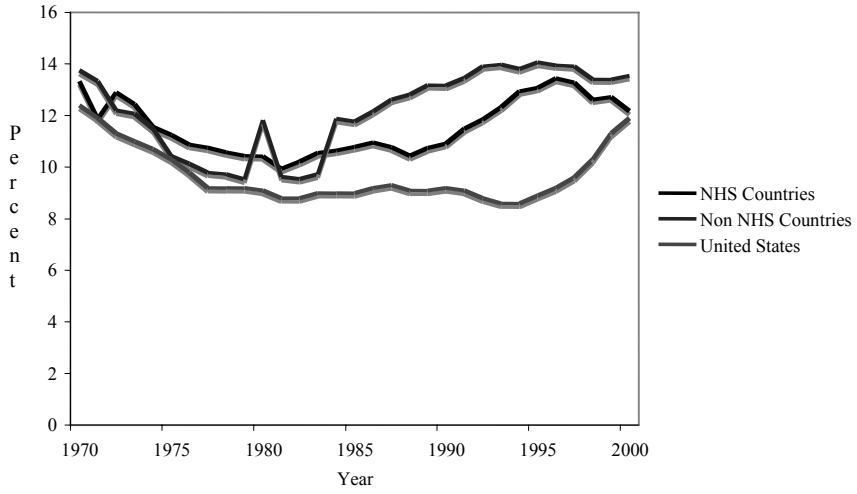

Figure 2. *Percent of Pharmaceutical Expenditures by Health Care System (1970 – 2000).*

Table 1. *Per Capita Expenditures ($ PPP) on Pharmaceuticals by Decade (1970 – 2000).*

	1970	1980	1990	2000
NHS System				
Denmark	-	50	109	208
Finland	20	54	122	264
Iceland	22	92	216	-
Ireland	22	49	88	191
New Zealand	-	54	129	-
Norway	10	55	98	-
Sweden	18	55	120	305
United Kingdom	21	57	132	-
Average	**18.8**	**58.3**	**126.8**	**242.0**
Non NHS System				
Australia	-	53	117	292
Austria	-	-	-	-
Canada	29	60	192	404
Germany	36	110	228	379
Japan	-	111	232	315
Netherlands	-	53	128	237
Average	**32.5**	**74.3**	**179.0**	**358.3**
Entrepreneurial System				
United States	43	96	251	541
Grand Average	**31.4**	**76.2**	**185.6**	**380.4**

Source: OECD 2003

Table 2. *Results for Multi-Collinearity Tests.*

		Unimputed	Unimputed No Us	Imputed	Imputed No US
GDP	tol	0.7	0.7	0.63	0.64
	vif	1.42	1.41	1.56	1.55
Public Share	tol	0.57	0.51	0.6	0.51
	vif	1.72	1.95	1.66	1.93
NHS	tol	0.6	0.62	0.66	0.69
	vif	1.66	1.59	1.5	1.43
Pharma Share	tol	0.89	0.82	0.93	0.86
	vif	1.11	1.2	1.07	1.16
Age 65+	tol	0.75	0.77	0.72	0.74
	vif	1.32	1.29	1.37	1.34
Urbanization	tol	0.59	0.51	0.63	0.54
	vif	1.67	1.93	1.57	1.85

Table 3. *Test Results for Heteroscedasticity, Serial Correlation and Fixed Effects.*

White Test	**76.54** [a]	**79.85** [a]	**92.92** [a]	**91.18** [a]
Godfrey's Test	**341.97** [a]	**309.86** [a]	**388.15** [a]	**357.56** [a]
Hausman Test	**15.98** [a]	**16.95** [a]	**16.43** [a]	**18.13** [a]

[a] ≤ .01; [b] ≤ .05; [c] ≤ .1

Table 4. *LSDV Estimates for the Different Samples.*

	Unimputed	**Unimputed No US**	**Imputed**	**Imputed No US**
Intercept	-0.18	-1.06	-0.41	**-1.22** [c]
t	*-0.26*	*-1.55*	*-0.6*	*-1.8*
GDP	**0.56** [a]	**0.63** [a]	**0.6** [a]	**0.67** [a]
t	*10.1*	*11.61*	*10.45*	*12.08*
Public Share	-0.06	**-0.26** [a]	**-0.14** [c]	**-0.33** [a]
t	*-0.77*	*-3*	*-1.7*	*-3.29*
NHS	**0.07** [b]	**0.08** [a]	**0.1** [c]	**0.09** [a]
t	*2.07*	*2.47*	*3.29*	*3.4*
Pharma Share	**-0.15** [a]	**-0.12** [a]	**-0.1** [a]	**-0.08** [a]
t	*-5.28*	*-4.41*	*-4.16*	*-3.4*
Age 65+	**0.18** [a]	**0.21** [a]	**0.14** [a]	**0.18** [a]
t	*3.35*	*3.93*	*2.6*	*3.45*
Urbanization	**0.63** [a]	**0.63** [a]	**0.66** [a]	**0.65** [a]
t	*9.06*	*9.54*	*5.99*	*9.29*
R-Square	**0.9912** [a]	**0.9916** [a]	**0.9911** [a]	**0.9934** [a]
Observation	464	433	485	454
N	589	558	589	558
Percent missing	21.22	22.40	17.66	18.64

[a] ≤ .01; [b] ≤ .05; [c] ≤ .1

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