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The drivers of public health spending: Integrating policies and institutions

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THE DRIVERS OF PUBLIC HEALTH SPENDING: INTEGRATING POLICIES AND INSTITUTIONS

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Abstract/ Résumé

The drivers of public health spending: Integrating policies and institutions

This paper investigates the impact of policies and institutions on health expenditures for a large panel of OECD countries for the period 2000-10. We use a set of 20 policy and institutional indicators developed by the OECD characterising the main supply-side, demand-side, and public management, coordination and financing features of health systems. The impact of these indicators is tested alongside control variables related to demographic (dependency ratio) and non-demographic (income, prices and technology) drivers of health expenditures per capita. Overall, there is a reasonably good fit between the expected signs of the coefficients for the institutional indicators and the actual estimates. By integrating the role of policies and institutions, together with the other primary determinants, our analysis is able to explain most of the cross-country variation in public health expenditures.

Keywords: public health expenditures, health policies and institutions, demographic and non-demographic effects, linear and non-linear estimates, cross-country variation

JEL Classification: C1; H51; I12; I13; I18; J11

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Les déterminants des dépenses publiques de santé : Le rôle des politiques et des institutions.

Ce papier analyse l'impact des politiques et des institutions sur les dépenses de santé pour un large ensemble de pays de l'OCDE durant la période 2000-10. Nous utilisons un groupe de 20 indicateurs politiques et institutionnels développés par l'OCDE et qui caractérisent principalement l'offre, la demande, la gestion publique, la coordination et le financement des systèmes de santé. L'incidence de ces indicateurs est évaluée conjointement avec des variables de contrôle en lien avec les déterminants démographiques (taux de dépendance) et non démographiques (revenu, prix et technologie) des dépenses de santé par tête. Globalement, il existe une adéquation satisfaisante entre les signes attendus des coefficients des indicateurs institutionnels et les estimations. En intégrant le rôle des politiques et des institutions avec les autres déterminants principaux, notre analyse réussit à expliquer la majorité de la variation entre pays des dépenses publiques de santé.

Mots clés : dépenses publiques de santé, politiques et institutions de santé, effets démographiques et non démographiques, estimations linéaires et non linéaires, variation entre pays

Classification JEL: C1; H51; I12; I13; I18; J11

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THE DRIVERS OF PUBLIC HEALTH SPENDING: INTEGRATING POLICIES AND INSTITUTIONS

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1. Introduction

Most OECD countries have been facing substantial cost pressures to their health systems in recent years. Health expenditures in the OECD area represent on average 9.1% of the GDP (2012 data), reaching between 11-12% in countries like Canada, France, Germany, the Netherlands and Switzerland, and around 17% in the United States. From the early 2000s onwards, OECD countries have experienced sustained growth in health expenditure at rates that many countries find worrying for public finances, the major source of funding for health expenditures in the area. The biggest concern stems from the fact that the sustained increase in health expenditures has normally occurred beyond rates of economic growth, a panorama that has led all governments of OECD countries to implement various health system reforms.

The drivers of public health expenditure may be demographic and non-demographic. Demographic drivers relate broadly to the age structure of the population and the evolution of its health status, while non-demographic drivers include income growth, technology adoption, changes in relative prices, and health policies and institutions. The importance of each of these drivers for the growth in public health expenditures has been assessed by a few empirical studies.

Population ageing and other demographic factors, including improvements in population health status, account for only a relatively small share of health spending growth. The effect of ageing may introduce spending pressures in the future, but its effect has been weak in the past (see Culyer, 1990; Gerdtham *et al.*,1992; Hitiris and Posnett, 1992; Zweifel *et al.*,1999; Richardson and Roberston, 1999; Moise and Jacobzone, 2003; Jönsson and Eckerlund, 2003). Recently, de la Maisonneuve and Oliveira Martins (2013) estimate that the age effect accounted for just above one-tenth of the increase in government health expenditure per capita between 1995 and 2009. For France, Dormont et al. (2006)

1. The authors would like to thank Marion Devaux, Isabelle Joumard and Valérie Paris for very valuable comments and for sharing the institutional data used in this paper. This paper has benefited from helpful comments by Albert Okunade, Tom Getzen and participants of seminar sessions at iHEA Milan 2015 and University Paris-Dauphine. We also would like to thank Francesca Colombo, Andres Fuentes, Chris James and Mauro Pisu for useful comments on previous versions of the paper and Celia Rutkoski for excellent assistance in preparing the document. All errors are our own. OECD Working Papers should not be reported as representing the official views of the OECD or of its member countries. The opinions expressed and arguments employed are those of the author(s).

found that the shock due to changes in the age structure of the population only accounts for a 3:4% increase in on health expenditures between 1992 and 2000. Orszag (2007) also suggests a limited impact, albeit somewhat higher, of ageing accounting for less than 20% of federal spending on Medicare and Medicaid by 2050 in the United States.

In contrast, most studies have found that non-demographic drivers represent by far the most important determinant of the growth in health expenditures, estimated to reach on average around 4% per annum between 1995 and 2009 for the OECD (de la Maisonneuve and Oliveira Martins, 2013). The effect of real income growth on health expenditures has been widely debated in the literature (Getzen, 2000). The most recent estimates point to an income elasticity of health expenditures around or below one (see Dreiger and Reimers, 2005; Acemoglu et al., 2009; Baltagi and Moscone, 2010; Dormont et al., 2011; Holly et al., 2011). Thus, while the real income is an important driver, it is unlikely to explain the increase in the ratio of health expenditures to GDP.

The fact that health spending has been typically growing faster than income is often referred to as "excess cost growth" (Orszag, 2007; White, 2007). Relative prices, technological progress and the underlying health policies and institutions are candidates for explaining this expenditure residual. A large body of literature has focused on advances in medical treatment and health-care technologies (see Fuchs, 1972; Mushkin and Landefeld, 1979; Newhouse, 1992; Dormont et al., 2006; Medeiros and Schwierz, 2015), as well as improvements in lifestyle (Sheehan, 2002; Cutler, 2001). The impact of technical progress expenditures depends on the price elasticity of the demand for health care adjusted for quality effects. When this adjusted price elasticity is above one, a given decrease in health prices may induce a more than proportionate increase in demand volumes, thus increasing expenditures.

National policies and institutional arrangements in the health sector have been speculated to represent between one-third and two-thirds of health spending growth in the OECD, as well as in individual countries such as France and the United States (Dormont et al., 2006; Chernew and May, 2011). Despite the seemingly crucial importance of policy and institutional aspects to explain national health expenditure patterns, systematic cross-country analyses of their effects on health spending have not been able to disentangle them from other non-demographic drivers.

This paper seeks to contribute to this debate by investigating the relationship between a comprehensive set of policy and institutional factors on health expenditures for a large panel of OECD countries during the period 2000-10. Our empirical specification is derived from a social planner maximisation of a utility function with consumption and health spending as parameters, subject to the resource constraint and the production function of health. We use a set of 20 institutional indicators constructed by the OECD characterising the main features of health care systems, including supply-side, demand-side, public management, coordination, and financing aspects. Unfortunately, these indicators are only available for one point in time, thus limiting our analysis of institutions to cross-sectional aspects. These indicators are integrated into an econometric framework alongside usual control variables related to demographic (dependency ratio) and non-demographic (income, prices and technology) drivers of health expenditures per capita. The fundamental aim of this paper is to offer a more complete assessment of the determinants of health expenditures, enabling us to provide econometric estimation, supported by economic theory, of the role of institutions and policies on cross-country levels of public health expenditures.

Overall, we found a reasonably good fit between expected signs of coefficients for the institutional indicators and actual estimates: The models including policies and institutions can explain most of cross-country dispersion in health expenditures. Policies and institutions matter for differences in health care spending. Supply (e.g. competition, tighter regulation of service prices) and demand (e.g. more explicit definition of the publicly funded benefit package) appear to matter the most for cost-containment.

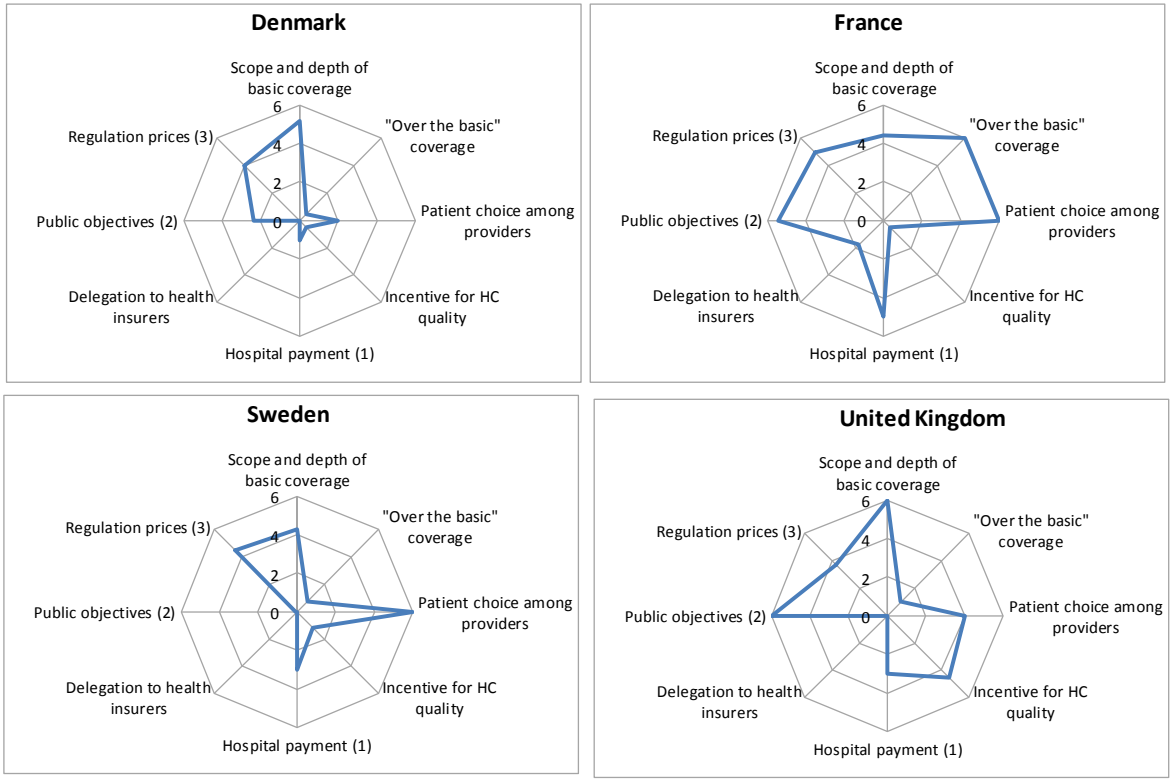
This paper is organised as follows. The next section discusses the expected health spending effects of various health policy and institutional arrangements commonly found in OECD countries, as well as the available empirical evidence on the matter. Section 3 describes the data and our theory-driven econometric specifications. The estimation results for our main models and associated robustness checks are presented in section 4. Section 5 uses the estimated model to explain the cross-country differences in health expenditures, focusing on the roles of policies and institutions. Section 6 concludes.

2. Health system institutional characteristics: Expected spending impacts and OECD evidence

The institutional set-up of health systems in OECD is rather varied across countries. Boundaries between different groups of health policies and institutions are rarely clear-cut, with no obvious best model (see OECD, 2010). Figure 1 provides an illustration of some of the institutional contrasts between four countries with very different health systems (Denmark, France, Sweden, United Kingdom), based on a subset of the data we use in our empirical work. The dataset on health policies and institutions used in this paper, further described below, was derived from official questionnaires sent to governments by the OECD. This qualitative information (269 variables) was transformed into quantitative indicators for 20 policy variables, using a standard scoring system. For example, to account for the competition among providers, an indicator on the *choice among providers* was created by adding the scores for choice among primary care physicians, specialists and hospitals. If the choice is free, a score of 2 is allocated to each answer, adding up to a maximum total score of 6. Other intermediate situations (financial incentives and limited choice) were allocated lower scores, with a minimum of zero. In this way, each policy variable by country ranges from 0 to 6.

Among the countries compared in Figure 1, France displays one of the most generous universal insurance systems and fully allows, as Sweden, for free choice among health providers, unlike Denmark. Provider payment incentives for higher quality of care are much stronger in the United Kingdom. Hospitals have strong financial incentives to increase their volume of services in France and very little incentives to do so in Denmark. Unlike other countries such as Switzerland, these four countries do not delegate much of the health system's administration to private insurers. Finally, public health objectives are reported to be more well-defined and closely monitored in France and the United Kingdom.

Figure 1. Some characteristics of health systems in four OECD countries

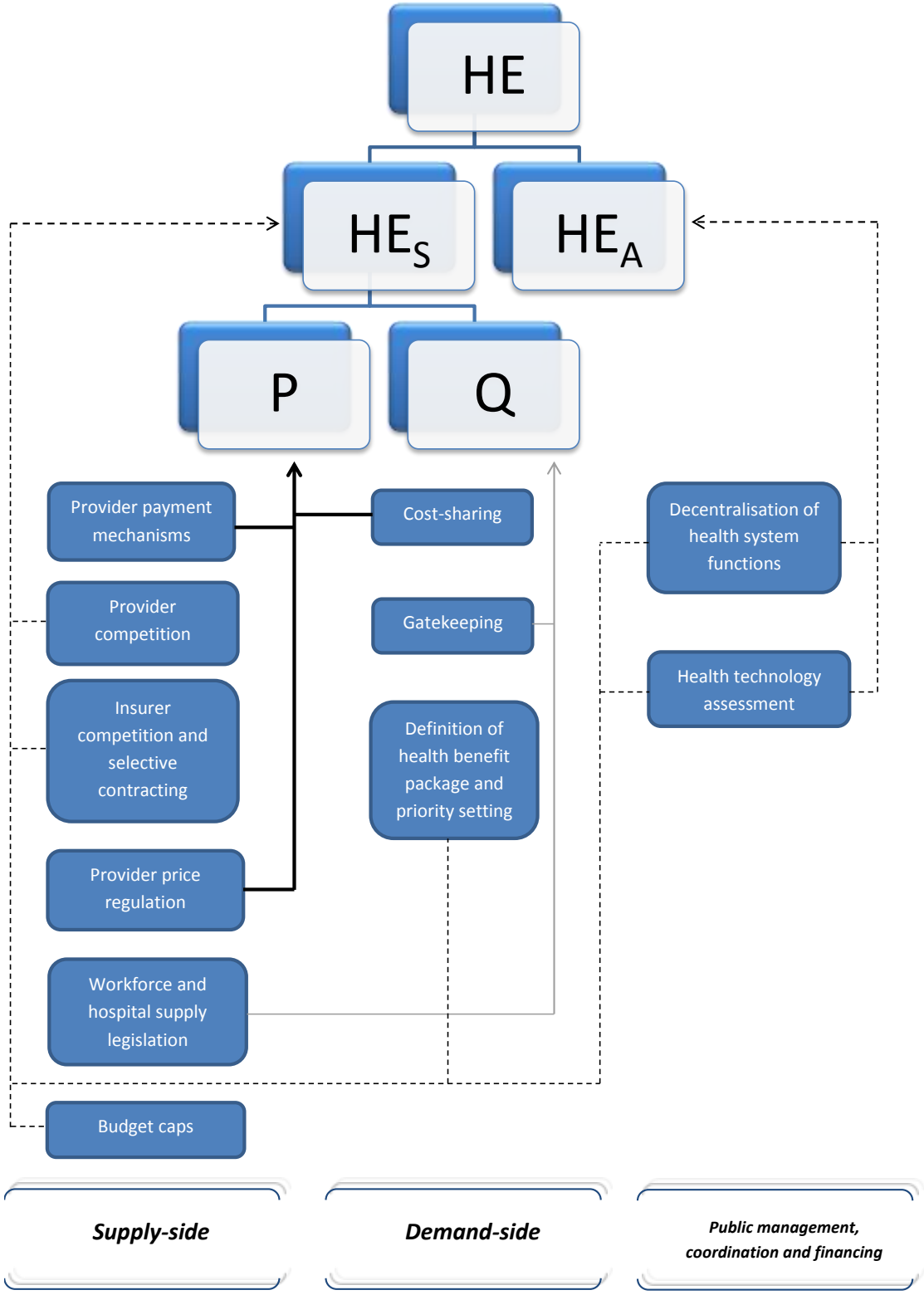


1. Volume incentives embedded in hospitals payment schemes.
2. Definition and monitoring of public health objectives.
3. Regulation of prices/fees paid by third-party payers.
Source: Authors' calculations based on Paris et al. (2010).

Although generalisations are risky in such a diverse environment, the channels through which many of these and other health policy and institutional characteristics may affect the behaviour of providers and consumers are outlined in Figure 2.[2] They may directly influence prices (black lines) or quantities (grey lines) of goods and services provided. Institutional aspects may also impact health spending by indirectly stimulating administrative units, providers and consumers to adjust prices and/or quantities (dotted lines). All these factors may therefore affect the resulting spending on health goods and services (HE_S) and/or administration of the health system (HE_A), and ultimately total health expenditures (HE). From a broad economic perspective, these institutional characteristics can be grouped into three categories (identified at the bottom of Figure 2), depending on whether they influence primarily (*i*) the *supply-side*, (*ii*) the *demand-side*, or (*iii*) the *public management, coordination and financing* aspects of the health system.

2. The framework to analyze the policy determinants of health spending, as well as the subsequent discussion of the empirical evidence coming from OECD countries, draws heavily on Moreno-Serra (2014). The institutional characteristics depicted in Figure 2 are likely to exhibit interactions between them, which of course may have implications for their "net" health spending effects. These potential interactions are not presented in the Figure for the sake of simplicity but are discussed throughout the paper.

Figure 2. Stylised framework for the policy and institutional determinants of health spending



For the purposes of our empirical analysis, the investigation of the influence of policies and institutions on health spending is based on 20 indicators for 26 OECD countries (Annex, Table A1). These were derived from an OECD qualitative questionnaire, which comprises 81 questions for each country (see Paris et al., 2010). These indicators are only available one point in time (around 2008-09, depending on the country) and thus cannot account for policy changes. This concerns in particular, the recent reforms in hospital payments and the use of Health Technology Assessment (HTA). The next sub-sections discuss how we could expect the policies and institutions examined here – grouped according to the categories in Figure 2 – to affect health spending. Hereafter, the labels for the 20 indicators used in our empirical analysis are denoted in italics in the text.

2.1. Supply-side aspects

2.1.1 Provider payment

Physicians act as agents of the patients and have often some authority to determine the need for specialist or hospital care. Historically, physician payment methods (variable *physician payment*) have taken the form of salary arrangements, capitation or fee-for-service, for all or (more frequently) different combinations of services (Ellis and Miller, 2008). Empirical studies have generally supported the theoretical predictions in that salary and fee-for-service (FFS) schemes do not provide physicians with incentives to contain expenditures, while FFS may even exacerbate supplier-induced demand (Gerdtham and Jönsson, 2000; Ellis and Miller, 2008). Overall, salary and FFS mechanisms may create upward pressure on the volume of expenditures. In order to control spending, some OECD countries have favoured pre-defined capitation-based budgets for physicians and other services needed by the patients in recent years, with apparent success regarding reduction of service volume and spending in the hospital sector, for example, in the United Kingdom (Dusheiko et al., 2006). Other countries have maintained FFS arrangements in place but within the context of a hard budget, or reduced fees for some services in a bid to attenuate cost pressures, although there is evidence from the United States that the latter may have led to some compensatory increases in the volume of services provided (Nguyen 1996).

Payment mechanisms to hospitals (*hospital payment*) – the biggest source of spending in a health system – can be based on characteristics of providers (e.g. line-item budgets), services (in which providers are usually remunerated according to the volume of procedures e.g. FFS), bundle of services or patients (e.g. variants of diagnosis-related groups, DRGs). Economic theory and empirical studies have suggested that, all else equal, payment schemes based on provider or patient characteristics generally give hospitals stronger incentives to contain volumes or be more efficient than payment based on service characteristics (Ellis and Miller 2008). Specifically in the OECD area, quantitative studies (Louis et al., 1999; Gerdtham et al., 1999; Dismuke and Guimaraes, 2002; Kwon, 2003; Moreno-Serra and Wagstaff, 2010) indicate that hospitals have indeed responded to the incentives embedded in DRG-based payment, which has been accompanied by the development of improved clinical guidelines and protocols in some contexts (*incentives for quality*), by cutting overprovision of services and reducing expenditures with no general reductions in care quality.[3]

2.1.2 Provider competition

Promoting competition between healthcare providers (*choice among providers*) in principle encourage providers to seek efficiency gains, which may generate savings in the sector. However,

3. Noteworthy, results are context-dependent and the effect on the volume of care produced may vary. Where DRG replaced per diem payment there is no incentives to increase prices, but where they replaced global budgets they may exist.

economic theory indicates that much depend on the specific features of the competitive environment, including the extent to which providers can compete for patients. Theoretical predictions suggest that a regulatory framework where patients can choose among hospitals that are allowed to compete only through the quality of their services is more conducive to efficiency, and care quality improvements, than systems where hospitals compete both on service quality and prices (Gaynor et al., 2013). The available empirical evidence from different settings such as the United States and United Kingdom tends to confirm these theoretical predictions (Volpp et al., 2003; Gaynor et al., 2013).

2.1.3 Insurer competition

The existence of purchaser competition and the degree to which payers can contract selectively with providers is often argued to likely affect costs and efficiency in the health system. Prominent examples are the implementation of managed care organisations in the United States and managed insurer competition in the Netherlands, which were hoped to promote cost-savings by encouraging competing insurers to negotiate reimbursement fees with competing hospitals (mainly through prospective payment mechanisms) and pharmaceutical companies (Zwanziger et al., 2000). There is now accumulated evidence that purchaser competition (*user choice of insurer*) coupled with selective contracting (*lever*) and payment-for-performance in the Dutch and American contexts have contributed to reduce hospital costs (with spillover cost reductions for non-price regulated providers who have to compete for patients) and bring down generic drug prices and insurance premia (Dranove et al., 1993; Zwanziger et al., 1994, 2000; Baker, 1999; Schut and van de Ven, 2011).

2.1.4 Workforce and hospital supply legislation

Some OECD countries have introduced direct or indirect controls over the total wage bill in the health sector, including workforce supply controls (*regulation of physician supply*), tighter entry or licensure legislation for physicians being a prime example, and hospital supply controls (*regulation of capital investment*; e.g. restrictions on the number of beds and purchasing of high-cost equipment). Related legislation has been enacted in Denmark, France, Spain and Sweden, among others, mainly as a response to perceived inflationary pressures from workforce and hospital costs (Mossialos and Le Grand, 1999). The consequences of such measures for the total level of spending in physician and hospital markets have been subject to debate. Standard economic theory suggests that, under a regime of flexible prices, the net spending effect of restrictions such as physician supply caps will depend on the elasticity of patient demand vis-à-vis higher prices for physician services. In practice, while the evidence regarding hospital supply controls is scant, physician entry barriers have apparently resulted in further inflationary pressures on the total wage bill or service prices in Canada and the United States due to reduced provider competition and higher prices charged by protected professionals (Anderson et al., 2000; Bärnighausen and Bloom, 2010).

2.1.5 Provider price regulation

In order to stimulate price competition and cost savings, governments have also imposed direct price controls in the health sector through, among others, reduced flexibility of fee setting for physician (*regulation of price for physician services*) and hospital services (*regulation of price for hospital services*), as well as caps on medicine prices and determination of reference reimbursement prices for all drugs (*regulation of pharmaceutical price*) with similar therapeutic effects in a particular cluster. Governments have also regulated prices or fees paid to providers by third-party players (*regulation of prices charged to third-party*). In theory, these regulatory instruments may indeed result in lower prices for health services, but the net effect on overall expenditures will depend on the extent to which price regulation encourages further supply and demand for health services. In OECD countries, empirical studies have found that direct price regulation in areas such as hospital care and pharmaceuticals can lead to lower prices and net cost

savings for the public sector (Andersson et al., 2006; Danzon and Ketcham, 2004; Sood, 2009; Danzon, 2011; Gaynor et al., 2013).

2.1.6 Budget caps

1. Ceilings on health expenditures have been applied in different ways, referring to a given sector (e.g. spending or volumes in inpatient care) and/or overall government health expenditure, sometimes within broader programmes of fiscal consolidation (Docteur and Oxley, 2003; Schneider, 2007). It seems plausible to expect that expenditure targets (*stringency of budget constraint*) and volume (*control of volume*) will be more effective for cost-containment in healthcare if set budgets are stringent and providers or managers are held accountable for exceeding targets (for instance, through administrative or financial sanctions on providers). One theoretical disadvantage of sector budgets compared to global budgets for spending control is that the former may stimulate cost-shifting and raise expenditure in sectors not subject to explicit budget ceilings. But perhaps the main problem with sector budgets is that they may not encourage ta shift towards more cost-efficient services (e.g. from impatient to ambulatory care). Despite some evidence of cost-shifting in Germany, budget caps in primary care and ambulatory physician services seem to have resulted in net overall savings in the German health sector (Schöffski and von der Schulenburg, 1997). There is quantitative evidence of net savings also in the English health sector due to fundholding practices (Dusheiko et al., 2006), as well as generally positive anecdotal evidence from other OECD countries (Mossialos and Le Grand, 1999; Docteur and Oxley, 2003).

2.2. Demand-side aspects

2.2.1 Gatekeeping

Gatekeeping arrangements (*gatekeeping*) are expected to help control outpatient and inpatient costs by requiring primary care physicians to pre-authorise service use by patients, screening out unnecessary services (Docteur and Oxley, 2003). Despite its adoption in many OECD countries, there has been wide variation in the stringency of gatekeeping regulations and incentives across countries, and the evidence on the system-wide cost impacts of gatekeeping implementation in individual countries is still methodologically limited (Forrest, 2003; Moreno-Serra, 2013).

2.2.2 Cost-sharing

Some degree of patient cost-sharing has been advocated and introduced in OECD health systems and elsewhere as a lever to contain possible overconsumption of specific services and reduce pressure on national health budgets (Schokkaert and van de Voorde, 2011). *A priori*, user payments for certain health services and prescription drugs, in the form of co-payments (fixed amount), co-insurance rates (share of costs) and/or deductibles (patient reimbursement only above a given minimum threshold cost) can be expected to reduce service utilisation by effectively raising the price of healthcare at the point of use (*depth of basic insurance*). There is indeed a body of empirical research pointing to lower service use and reduced public health spending in the shorter term due to higher reliance on cost-sharing (Manning et al., 1987; Rubin and Mendelson, 1996; Zweifel and Manning, 2000; Goldman et al., 2007; Schokkaert and van de Voorde, 2011; Kenneally and Walshe, 2012). The longer term effects of higher cost-sharing on health expenditures remain controversial, however, as higher cost-sharing has been found to lead to lower use of needed medical care especially among low-income and high-risk populations, with adverse consequences for health status and potentially higher spending on more expensive care in the future (Manning et al., 1987; Gruber, 2006; Haviland et al., 2011; Rubin and Mendelson, 1996; Lundberg et al., 1998; Robinson, 2002; Jemiai et al., 2004; Kim et al., 2005).

2.2.3 Definition of the health benefit package and priority setting

Many governments and other payers use positive and negative lists of therapies to define a basket of benefits covered partially or fully by pooled health funds (*definition of benefit basket*) (Mossialos and Le Grand, 1999). Often this institutional lever is intended to affect primarily the behaviour of patients by imposing restrictions on the bundle of services funded by healthcare insurance, ultimately affecting also the supply patterns of medical care and pharmaceuticals, according to evidence-based clinical guidelines or protocols (*public health objectives*). In principle, a more generous package of benefits subsidised by the healthcare payer can be expected to result in higher medical expenditures, although much will depend on the type of services included in the package. For instance, encouraging effective preventive and health promotion services through explicit priority setting in public health may lead to lower hospital admission rates and reduced use of expensive therapies in the longer term (Kenkel and Sindelar, 2011). Moreover, judicious use of health technology assessment (see below) to determine the benefits package – favouring only the most cost-effective therapies for a given condition – could contribute to savings in the health sector without detrimental impacts on care quality. In the pharmaceutical sector, for instance, the use of formularies or preferred drug lists in the benefit package definition has been found to have led to lower expenditure on pharmaceuticals by the public sector and managed care organisations in the United States and Canada (Elzinga and Mills, 1997; Kibicho and Pinkerton, 2012; Morgan et al., 2004).

2.3. Public management, coordination and financing aspects

2.3.1 Health technology assessment

The creation and use of national agencies to assess new technologies (*use of health technology assessment, HTA*) in countries like Australia, France, Finland, Sweden and the United Kingdom has been expected to promote value-for-money in public health spending through evaluation of the benefits and costs of new (generally more expensive) treatments, also reducing waste by directly restricting demand for "old" interventions whose benefits are not worth the costs (Mossialos and Le Grand, 1999). Although there is scarce empirical evidence on its cost-containment impacts in the health sector, health technology assessment may be expected to generate overall efficiency gains primarily through its use for an evidence-based definition of the package of interventions publicly funded (and their specific reimbursement levels) within the health system. In other words, *HTA* may not reduce directly expenditures, but rather improve the quality of health services and, in this way, reduce pressures to future spending. On the other hand, the creation and operation of a health technology assessment body adds another layer of administrative costs to the health sector.

2.3.2 Degree of decentralisation of health system functions

It has been argued that decentralisation of health system functions (including planning, management, financing and delivery of services) to sub-national levels of government (*degree of decentralisation*) can contribute to cost-efficiency and control by aligning resource allocation with local preferences and cost structure, thus encouraging many OECD countries to take steps in such direction (Saltman et al., 2006). However, it has also been argued that decentralised health systems may hinder cost-containment efforts by weakening coordination and encouraging duplication of services (Magnussen et al., 2006). From a practical standpoint, transfer of decision-making concerning planning and service delivery to sub-national levels in the OECD area – largely with centralised funding in most cases – seems to have translated into reduced expenditures at the health system level in some contexts but not others, depending crucially on how hard sub-national budgets really are (Giannoni and Hitiris, 2002; Costa-Font and Pons-Novell, 2007; Magnussen et al., 2007; Mosca, 2007; Costa-Font and Moscone, 2008, Braendle and Colombier, 2015).

To sum-up, Table 1 provides the expected health spending effects of each of the institutional characteristics described above, based on the stylised framework presented in Figure 1. Anticipating our empirical results, these *a priori* signs are compared in the two last right-hand columns with the coefficients estimated through the econometric models presented in the next sections. As mentioned previously, these institutional aspects are likely to interact with each other and with other demographic and non-demographic characteristics. This has implications for their net impacts on health spending. Accordingly, the next section provides a more formal and complete treatment of the economic relationships between health expenditures and its demographic and non-demographic determinants.

Overall, there is a reasonable good fit between the *a priori* signs and the estimated coefficients. Out of the 20 policy *cum* institutional indicators, 11 of the estimated coefficients are coherent with the priors. There are only four cases where the econometric models provide an opposite sign to the expected one: *physician payment*, *control of volume, gatekeeping* and *health technology assessment*. In five other cases, there is no significantly estimated coefficient.

Table 1. Overview of institutional effects on health spending

Category	Institutional aspect	Variable name	Short definition and interpretation	Effect on health spending		
				Expected	Estimated Linear model	Estimated non-Linear model
Supply-side	Provider payment	*Physician payment*	Incentives for higher volume in physician payment mechanisms (primary care, outpatient and inpatient specialists): predominant mechanism(s) from salary, capitation, FFS (higher score = stronger incentive to generate volume)	Positive	**Negative**	**Negative**
Supply-side	Provider payment	*Hospital payment*	Incentives for higher volume in hospital payment mechanisms: line-item or prospective global budgets, per case/DRG, per procedure/diem, retrospective funding, and their combinations (higher score = stronger incentive to generate volume)	Positive	No effect	No effect
Supply-side	Provider payment	*Incentives for quality*	Incentives for health care quality (patient outcomes and satisfaction): guidelines/protocol adherence incentives (including financial) and sanctions for physicians and/or specialists and/or hospitals (higher score = stronger incentives)	Ambiguous	**Positive**	**Positive**
Supply-side	Provider competition	*Choice among providers*	Degree of patient choice of physician, specialist and hospital (higher score = more choice)	Negative	No effect	No effect
Supply-side	Insurer competition	*User choice of insurer*	Single or multiple insurers; degree of patient choice of insurer for basic coverage and their market shares (higher score = more choice)	Ambiguous	**Positive**	**Positive**
Supply-side	Insurer competition	*Lever*	Existence of levers for competition in insurance markets: whether insurers have some control on benefit package, level of coverage and premia, and whether they can selectively contract with providers (including pharmaceutical companies); existence of risk-equalisation/risk-adjustment schemes; availability of consumer information on premia/coverage (higher score = more levers for competition)	Negative	No effect	**Negative**

Table 1. Overview of institutional effects on health spending *(cont.)*

Category	Institutional aspect	Variable name	Short definition and interpretation	Effect on health spending		
				Expected	Estimated Linear model	Estimated non-Linear model
Supply-side	Workforce supply legislation	*Regulation of physician supply*	Existence of quotas for medical students, specialties and location; policies for shortage/redistribution (higher score = stronger regulation)	Ambiguous	**Positive**	**Negative**
Supply-side	Hospital supply legislation	*Regulation of capital investment*	Regulation of hospitals (opening, bed supply, services, high-cost equipment): quotas, authorisation at local and/or central level (higher score = stronger regulation)	Negative	**Negative**	**Negative**
Supply-side	Provider price regulation	*Regulation of price for physician services*	Regulation of prices/fees for physician services: degree of flexibility for charges (higher score = less flexibility, stronger regulation)	Negative	**Negative**	No effect
Supply-side	Provider price regulation	*Regulation of price for hospital services*	Regulation of prices for hospital services: degree of flexibility for setting charges (higher score = less flexibility, stronger regulation)	Negative	**Negative**	**Negative**
Supply-side	Provider price regulation	*Regulation of pharmaceutical price*	Regulation of pharmaceutical prices: degree of flexibility that companies have to set their prices (higher score = less flexibility, stronger regulation)	Negative	No effect	No effect
Supply-side	Provider price regulation	*Regulation of prices charged to third-party*	Regulation of prices/fees paid to providers by third-party payers	Negative	No effect	No effect
Supply-side	Budget caps	*Stringency of budget constraint*	Expenditure targets or strict health budget and their allocation levels; consequences of budget constraint, including waiting times and compensation from providers to NHS/SHI (higher score = stronger presence and effects of budgets)	Negative	No effect	No effect
Supply-side	Budget caps	*Control of volume*	Monitoring, regulations and controls on volumes of care: activity volume, monitoring of guideline adherence, drugs advertising to consumers, physician payment reduced according to exceeded volume targets (higher score = stronger controls)	Negative	**Positive**	**Positive**

Table 1. Overview of institutional effects on health spending *(cont.)*

Category	Institutional aspect	Variable name	Short definition and interpretation	Effect on health spending		
				Expected	Estimated Linear model	Estimated non-Linear model
Demand-side	Gatekeeping	*Gatekeeping*	Requirement/incentives to register with primary care physician and/or referral to secondary care (higher score = more stringent gatekeeping)	Negative	No effect	**Positive**
Demand-side	Cost-sharing	*Depth of basic insurance*	Basic primary services coverage with or without co-payments for 10 care functions (higher score = wider scope and more depth of coverage)	Ambiguous	**Positive**	**Positive**
Demand-side	Definition of health benefit package and priority setting	*Definition of benefit basket*	Whether and how the benefit basket is defined for medical procedures and pharmaceuticals: negative/positive lists by providers and/or SHI funds and/or central level (higher score = more centralised and positive definition)	Ambiguous	**Negative**	**Negative**
Demand-side	Definition of health benefit package and priority setting	*Public health objectives*	Definition and monitoring of public health objectives (including process, outcomes and inequalities): number of objectives, monitoring institutions, degree of stakeholders' accountability (higher score = more effective priority setting and monitoring)	Ambiguous	**Positive**	**Positive**
Public management, coordination and financing	Health technology assessment	*Use of health technology assessment*	Existence and use of health technology assessment in determining benefit coverage, reimbursement levels/prices and clinical guidelines (higher score = higher reliance)	Negative	No effect	**Positive**
Public management, coordination and financing	Decentralisation of health system functions	*Degree of decentralisation*	Degree of decentralisation of decision-making across levels of government (higher score = higher participation of sub-national levels)	Ambiguous	No effect	**Negative**

Note: Positive and negative stands statistically significant estimated coefficients. The estimated coefficients that are coherent with the expected signs are noted in bold. "No effect" stands for the coefficients that are not statistically significant.

3. Empirical Framework

3.1. The data

In addition to the institutional indicators described above, which are time-invariant, our empirical analysis relies on data extracted from the OECD health database (http://www.oecd.org/els/health-systems/health-statistics.htm). They consist on health expenditure (public, private and total), GDP per capita, demographic variables (old-age dependency ratio), relative prices of health, and an innovation index in health technologies (to capture the quality aspects). The unbalanced panel covers 25 OECD countries for which the institutional data are available. It covers the period 2000-10, with an average of 9.6 years per country.

Following de la Maisonneuve and Oliveira Martins (2013), this paper uses the value-added deflator in the health and social work sectors,[4] taken from the OECD STAN database (http://www.oecd.org/sti/ind/stanstructuralanalysisdatabase.htm), as a proxy for health prices. Despite the coverage of the aggregate deflator being broader than the health sector alone, the latter represents the lion's share of the total; moreover, prices in both sectors usually follow the same path.[5] The health price deflator is expressed as a ratio to the GDP deflator, to generate the relative price index for health services used to deflate health care expenditures. With low price elasticity and a steady increase of health prices, this could explain the upward drift of expenditure to GDP.

To proxy the changes in the (technology-induced) quality of health care services, we constructed an innovation index based on a combination of patents and R&D statistics, which are commonly used to measure innovation. The indicator is based on the assumption that the OECD frontier of health care services tends to increase in line with the share of OECD health patents in total patents. However, as suggested by Okunade and Murthy (2002), the actual increases in quality depend on the total R&D spending of each individual country, reflecting both diffusion and absorption capacity of technological innovation.[6]

Table 2 provides the average total, public and private health expenditure GDP shares for the period 2000-11 across OECD countries, as well as key drivers. Countries differ substantially in terms of total health expenditures. France, Germany, New Zealand and Switzerland display shares of health spending in GDP larger than 10%.[7] The bulk of health expenditure is mostly done by the public sector, on average private health expenditures only account for slightly above 2% of GDP. Dependency ratios (ratio of population aged 65-84 to population 15-64) differ markedly across countries, reaching above one-quarter of the working age population in the oldest European countries and Japan. Relative health prices did not display large variations during the period 2000-11 and in many countries they actually declined. The latter suggests that relative health prices may not be the main drivers of the increase in health

4. The value-added deflator for the health sector alone is not available for all countries.

5. These data are available upon request.

6. More specifically the indicator is computed for a given country i as:
$$Q_i = \frac{R\&D_i}{GDP_i} \cdot \frac{\text{Total OECD Patents in the Health sector}}{\text{Total OECD patents}}.$$

7. Note that the US is the country with the largest share of health spending to GDP in the OECD. Unfortunately, since data on policies and institutions were not available, it could not be included in our empirical work.

expenditures. Finally, the health care innovation index shows significant differences across countries (driven by the ratio of R&D to GDP in each country).

Table 2. Health expenditures and their primary determinants, OECD countries 2000-10

Country	Real total health expenditure (in % of GDP)	Real public health expenditure (in % of GDP)	Real private health expenditure (in % of GDP)	Dependency ratio	Relative prices	Quality
Australia	6.5	4.4	2.1	17.1	1.014	15.5
Austria	9.9	7.5	2.3	21.7	1.002	18.6
Belgium	8.6	6.4	2.1	23.1	1.017	16.7
Canada	8.5	5.9	2.6	17.1	0.990	16.5
Czech Republic	6.6	5.7	0.8	19.1	1.100	10.6
Denmark	9.5	8.0	1.5	20.8	1.000	20.6
Finland	8.4	6.1	2.2	21.9	1.008	28.6
France	10.4	8.1	2.3	22.1	0.991	19.0
Germany	10.6	8.3	2.3	25.5	0.981	21.5
Greece	9.4	5.9	3.5	25.0	0.947	5.0
Hungary	7.7	5.2	2.4	21.2	0.986	7.5
Iceland	9.9	8.0	1.8	15.7	0.957	22.4
Italy	8.3	6.5	1.8	26.0	0.996	9.5
Korea	5.5	3.1	2.4	12.3	0.991	22.7
Luxembourg	5.4	4.5	0.9	18.6	0.969	14.4
Mexico	4.7	2.1	2.7	7.7	0.970	3.1
Netherlands	9.5	7.2	2.3	19.3	1.000	16.8
New Zealand	10.2	8.1	2.1	16.6	0.947	9.9
Norway	6.8	5.7	1.1	19.5	1.011	14.1
Poland	5.9	4.1	1.8	17.2	1.012	5.3
Portugal	9.2	6.4	2.8	23.6	0.956	7.0
Slovak Republic	6.6	5.2	1.4	15.6	1.002	5.6
Spain	7.1	5.1	2.0	21.7	0.998	8.9
Sweden	7.9	6.5	1.4	23.3	0.983	32.3
Switzerland	10.6	6.3	4.4	20.7	0.986	23.7
United Kingdom	6.7			21.3	0.977	15.4
Unweighted average	*8.1*	*6.0*	*2.1*	*19.8*	*1.0*	*15.0*

Source: OECD Health data and authors' calculations.

3.2. The econometric model

The specification of our econometric model follows naturally from a theoretical framework derived in the Annex. Taking logs on both sides of the equation (A7) yields the following expression (omitting time and country indices):

$$\log H^{*} = \frac{1}{1-\rho\beta}\cdot\log(\beta) + \frac{1}{1-\rho\beta}\cdot\log\left(\frac{\lambda}{1-\lambda}\right) + \frac{\rho}{1-\rho\beta}\cdot\log(Q) - \frac{1}{1-\rho\beta}\cdot\log(r) + \frac{1-\rho}{1-\rho\beta}\cdot\log(y) \quad (1)$$

While this equation cannot be directly estimated, it suggests a log-linear reduced form where the optimal health spending per capita (H^{*}) is explained by health policies and institutions through the elasticity of the health production function (β), the preferences towards health (λ, ρ), health care relative prices (r) and innovation/quality (Q), and real income (y). We further assume that the share of health spending in the utility term λ is affected by demographic factors proxied by the ratio of people aged 65-84 to working-age population (the dependency ratio) *dep*,[8] as follows:

8. Note that it is not possible to identify the effect of time-constant policies passing through log β as other time-constant factors may be channeled through λ.

$$\log\frac{\lambda}{1-\lambda} = \phi \cdot dep \quad with \quad \phi \geq 0 \tag{2}$$

We first estimate a log-linear model where all country-specific factors, including policies and institutions, are only captured by country fixed-effects e_i. To control for idiosyncratic common time shocks we also add a set of time dummies f_t. The error term captures all possible random components including those associated with the approximation used above. All the variables are assumed to have contemporaneous effects on health expenditures, except the innovation index that was lagged by 4 periods to account for the significant delay between innovations and their adoption (see also robustness checks below). The econometric model of health spending per capita suggested by equation (1) can then be written as:

$$\log(H_{i,t}) = \alpha + \mu_1 \cdot \log(y_{i,t}) + \mu_2 \cdot dep_{i,t} + \mu_3 \cdot \log(r_{i,t}) + \mu_4 \cdot \log(Q_{i,t-4}) + e_i + f_t + u_{i,t} \tag{3}$$

Equation (3) is estimated using a linear fixed-effects estimator. We then compare the results from this model with those from a specification where the country fixed-effects are replaced by the *k* time-invariant policy and institutional variables (*P*), estimated using pooled OLS:[9]

$$\log(H_{i,t}) = \alpha + \mu_1 \cdot \log(y_{i,t}) + \mu_2 \cdot dep_{i,t} + \mu_3 \cdot \log(r_{i,t}) + \mu_4 \cdot \log(Q_{i,t-4}) + \sum_k \delta^k P_i^k + f_t + u_{i,t} \tag{4}$$

Finally, we also estimate a non-linear model where the vector of policies and institutions is interacted with all other explanatory variables:

$$\log(H_{i,t}) = (1 + \sum_k \delta^k P_i^k) \cdot \left[\alpha + \mu_1 \cdot \log(y_{i,t}) + \mu_2 \cdot dep_{i,t} + \mu_3 \cdot \log(r_{i,t}) + \mu_4 \cdot \log(Q_{i,t-4}) + f_t\right] + u_{i,t} \tag{5}$$

The coefficients *a*, *b* and *d* are expected to be positive and *c* negative in all models above.

As can be seen from equation (A7) in the Annex, the economic intuition underlying the non-linear specification (5) is straightforward. On the one hand, there are fundamental factors driving the core amount of health spending: income, demographic factors, the price and the quality of health services. On the other hand, the core amount of health spending can be magnified by some health policies and institutions, or on the contrary be reduced by efficient regulations and practices. For that reason, policies and institutions intervene in a multiplicative way in the model and affect all fundamental factors in a similar way. Equation (5) is estimated via a non-linear least-square method.

4. Main Results

4.1. Primary determinants of health spending

As most policy and institutional indicators considered in our analysis pertain to the public health sector, we concentrate here on public health spending. Estimates for total and private health expenditures are presented as robustness tests in the Appendix.

As a first step we consider only the main traditional determinants of health spending per capita that have been used in the literature, together with the country fixed-effects (equation 3). The first column of Table 3 reports the results.[10] The elasticity of public health spending with respect to income per capita is

9. Note that country fixed-effects cannot be estimated together with the time-invariant policy and institutional indicators.

10. All models in this paper are estimated with standard errors robust to heteroskedasticity.

found to be lower than but close to unity. As expected, a higher old-age dependency ratio is positively related to health spending, but in this specification the estimated coefficient is not significant. The price elasticity coefficient has the expected sign and is just lower than the one in absolute terms. The innovation/quality index is not statistically significant at conventional levels.

Table 3. Public health expenditure and all health policies and institutions (Baseline)

Dependent variable: log of real Public Health Expenditures per capita	(1) Linear FE	(2) Pooled OLS with Institutions	(3) Non-Linear with Institutions
Log of GDP per capita	**0.922*** **	**1.277*** **	**1.343*** **
	(0.223)	**(0.070)**	**(0.057)**
Dependency ratio	0.026	**0.023*** **	**0.027*** **
	(0.020)	**(0.005)**	**(0.004)**
Log relative Health prices	**-0.865*** **	**-1.016*** **	**-1.067*** **
	(0.192)	**(0.090)**	**(0.087)**
Quality effect	-0.003	**0.015*** **	**0.015*** **
	(0.006)	**(0.002)**	**(0.002)**
Physician payment		**-0.094*** **	**-0.039*** **
		(0.019)	**(0.006)**
Hospital payment		-0.013	0.004
		(0.021)	(0.007)
Incentives for quality		**0.146*** **	**0.056*** **
		(0.031)	**(0.009)**
Choice among providers		0.008	0.006
		(0.026)	(0.011)
User choice of insurer		**0.119***	**0.064*** **
		(0.062)	**(0.016)**
Lever		-0.096	**-0.053*** **
		(0.059)	**(0.014)**
Regulation of physician supply		**0.049*** **	**-0.012***
		(0.015)	**(0.007)**
Regulation of capital investment		**-0.050*** **	**-0.019*** **
		(0.015)	**(0.007)**
Regulation of price for physician services		**-0.068*** **	-0.012
		(0.021)	(0.008)
Regulation of price for hospital services		**-0.064*** **	**-0.027*** **
		(0.020)	**(0.008)**
Regulation of pharmaceutical price		-0.002	0.005
		(0.018)	(0.004)
Regulation of prices charged to third-party		0.043	0.006
		(0.037)	(0.009)
Stringency of budget constraint		-0.063	-0.019
		(0.039)	(0.015)
Control of volume		**0.049*** **	**0.023*** **
		(0.012)	**(0.004)**
Gatekeeping		0.004	**0.015** **
		(0.022)	**(0.007)**
Depth of basic insurance		**0.153*** **	**0.064*** **
		(0.019)	**(0.006)**
Definition of benefit basket		**-0.065*** **	**-0.024*** **
		(0.018)	**(0.007)**
Public health objectives		**0.076** **	**0.020** **
		(0.030)	**(0.008)**
Use of health technology assessment		0.020	**0.026** **
		(0.044)	**(0.012)**
Degree of decentralisation		-0.037	**-0.025*** **
		(0.027)	**(0.007)**
Constant	-7.204***	-10.961***	-11.703***
	(2.446)	(0.644)	(0.511)
Country Fixed Effects	Yes	No	No
Year Fixed Effects	Yes	Yes	Yes
Number obs	240	240	240
R2	0.594	0.981	0.999

Note: Robust standard errors in parentheses.
***, **, * indicate significant at the 1%, 5% and 10% level respectively.

4.2. The policy and institutional determinants of health spending

We now examine the effects of our policy and institutional variables (equations 4 and 5), displayed in the second and third columns of Table 3. The estimate of the income elasticity of public health expenditures becomes larger than one in both cases. The price elasticity coefficient still has the expected sign and is slightly higher than unity. The innovation/quality index has a positive sign, as expected, and becomes statistically significant.

As for the policy and institutional variables, a positive (negative) sign on a coefficient indicates an increase (decrease) in public health spending associated with higher values of that particular indicator. The introduction of these variables substantially increases the explanatory power of our models, with most of the variance explained by the included covariates. Among the 20 institutional variables considered in the analysis, there are only four cases where the estimated coefficients display a sign that contradicts our priors (see Table 1).

Statistically significant and in line with our expectations, stronger *regulation of capital investment, regulation of prices for hospital services* are associated with lower public health expenditures. The estimated coefficients on the existence of levers for competition in insurance markets (*lever*) and *regulation of price for physician services* are negative but only statistically significant in the one of the models.

Contrary to our expectations, incentives for higher volume of *physician payment* are associated with lower public health spending. Similarly, the *control of volume*, *gatekeeping* and *health technology assessment* were expected to dampen expenditures, but according to the estimates they appear to increase public health spending. These latter results may be due to reverse causality, as countries with high expenditures may have introduced institutional changes precisely to reduce such spending, such as more monitoring on volumes of care and more frequent use of health technology assessment tools to guide reimbursement decisions.

Among the institutional indicators with an ambiguous expected sign, stronger *incentives for quality* for providers, broader *user choice of insurer*, more *depth of basic insurance* mechanisms, and priority setting through definition and monitoring of *public health objectives* are all associated with higher spending in both specifications. The centralized *definition of a benefit basket* through positive/negative lists, and the *degree of decentralisation* of health decision-making all appear to influence spending negatively. Finally, more stringent *regulation of physician supply* produces opposite signs in each of the models, so the estimated effect does not seem robust.

To sum, seven policies were estimated to have a reducing impact on expenditures, seven policies are associated with higher expenditures and one for which the two models produce contradictory results. For the remaining five policy and institutional variables the corresponding coefficient are not statistically significant at conventional levels. If we take the linear model (equation 4 and Table 3, col. 2), for each policy variable having a significant negative coefficient (*physician payment, regulation of capital investment, regulation of price for physician and hospital services* and *definition of benefit basket*), an increase of its policy indicator by one unit is associated with a decrease of real health expenditures per capita ranging from 5% to 9%.

4.3. Robustness analysis

We examined the robustness of our results by running regressions on total and private health expenditures, as well as estimating the policy and institutional variables one-by-one. Appendix Table A2 reports the results for total (column 1) and private (column 2) health expenditures. Both models are

estimated using our more flexible non-linear specification given in equation (5). For all policy and institutional variables but one (*regulation of capital investment*), the estimated coefficients for total expenditures have the same signs as for public expenditures. For private expenditures, in four cases the sign is the opposite compared to public spending. For the variable *user choice of insurer* this seems intuitively right: it seems plausible for increased competition among providers to put a downward pressure on private expenditures. For regulation of capital investment, this is associated with reduced public spending but could in principle induce insurers and/or providers to increase their investment levels on services currently unregulated. Finally, although decentralisation was found to be linked to lower public spending in the baseline estimations, it could in some contexts induce a substitution effect and increase private expenditures.

We further examine the robustness of our results by testing the impact of our institutional variables individually (Appendix Table A3).[11] In seven instances the results are in line with those of the full model (*user choice of insurer, depth of basic insurance, definition of benefit basket, Gatekeeping, public health objectives, use of health technology assessment* and *degree of decentralisation*). In only three cases the coefficients have opposite signs to the baseline estimates and are statistically significant (*lever, regulation of physician supply and regulation of prices for hospital services*). In two other cases the individual estimates show significant coefficients which are in line with expected effects, while in the full model they were not significant (*choice among provider* and *regulation of prices charged to third party*).

We also tested for the sensitivity of the results to the introduction of one lag in the control variables (GDP per capita, dependency rates and prices). The coefficient values are very close and only one of the standard errors improves the significance of the variables (for the indicator on the stringency of the budget constraint).

5. Explaining cross-country differences in health expenditures

Finally, it is possible to use the estimates presented in Table 3 to explain the cross-country differences in health expenditures by the cross-country differences in economic, demographic and institutional factors. For that purpose, the non-linear model displayed in equation (5) and presented in Table 3 Column (3) is used as a benchmark. As the latter model is non-linear, cross-country differences in health expenditures are not equal to the sum of cross-country differences in the various economic and institutional factors, as some interaction terms are involved. To disentangle the influence of economic and demographic factors on one side and institutional effects on the other, an Oaxaca-Blinder decomposition is proposed. It writes the difference in health expenditures relative to the sample average over the period as the sum of two terms, the contribution of institutional cross-country differences and the contribution of cross-country differences in economic and demographic factors.[12] The first term is composed of an interaction with a mix of country and averaged economic factors, while the second term is made of an interaction with a mix of country and averaged institutions:

11. While the latter estimations may be prone to omitted variable bias, the non-negligible degree of pairwise correlation between some of our policy and institutional variables (Appendix Table A4) may also generate multi-collinearity issues in the baseline full model.

12. Several preliminary verifications are needed to check the validity of this calculation. First, there is a 0.99 correlation between observed annual spending and the annual spending predicted by the model. Second, there is a 0.99 correlation between predicted spending averaged over the period and predicted spending based on explanatory variables averaged over the period. Therefore, the decomposition based on sample averages appears to be fully consistent with estimates derived from annual variables.

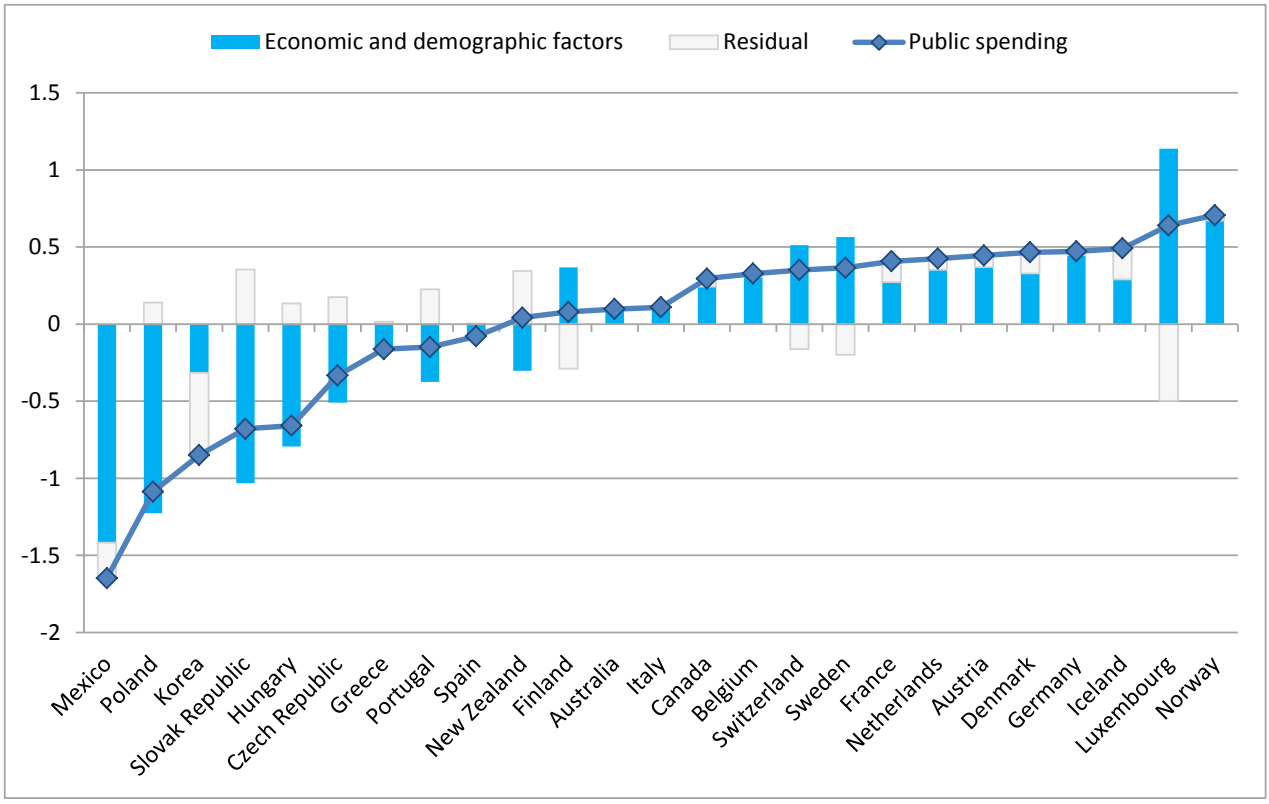
$$\log(H_i - \overline{H}) = \underbrace{\left[\sum_k \delta^k \left(P_i^k - \overline{P}^k\right)\right] \cdot \left[0.5\sum_k \mu^k F_i^k + 0.5\sum_k \mu^k \overline{F}^k\right]}_{institutions} + \underbrace{\left[\sum_k \mu^k \left(F_i^k - \overline{F}^k\right)\right] \cdot \left[1 + 0.5\sum_k \delta^k P_i^k + 0.5\sum_k \delta^k \overline{P}^k\right]}_{demographic\ and\ economic\ factors} \quad (6)$$

where $\overline{H}$ is the sample average of expenditures; $\overline{P}_k$ the sample average of each institution; F_i represents the country economic or demographic factors (dependency ratio, real income, relative health prices and innovation) and $\overline{F}^k$ their sample average for each factor.

To start, Figure 3 presents the contributions of demographic and economic variables to explain the cross-country differences to the OECD average. Lower income countries, such as Mexico or Poland, spend less than one third of the sample average and high-income countries like Iceland, Luxembourg and Norway spending above 60% the sample average.[13] The primary drivers of cross-country differences in spending are the economic and demographic factors (on average 71%), but in some case a substantial residual remains unexplained. This is the case of Korea, Slovak Republic and New Zealand where this residual is above 40%.

13. Note that these percentages are obtained by taking the exponential of the log differences between country averages and OECD sample average shown in the chart.

Figure 3. Contribution of demographic and economic factors to cross-country differences in health expenditures[1]



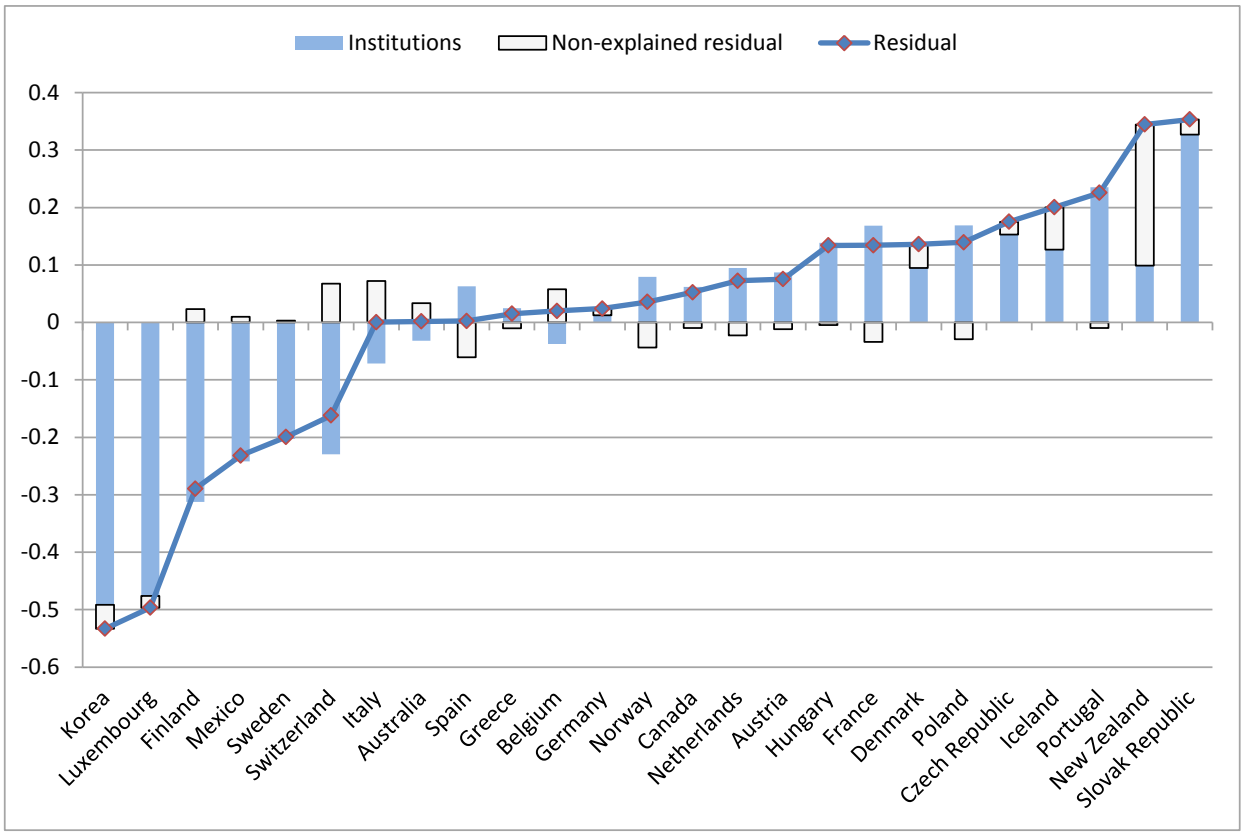
1. Log differences between country averages and OECD sample average.

Residual: Part of health expenditures that is not explained by demographic and economic factors.

Source: Authors' calculations.

One step further, we now apply the same method to compute by how much of the residual can be explained by institutional factors (Figure 4). It can be seen that in most countries policies and institutions explain the bulk of the residual, the only notable exception being New Zealand. In this way, our analysis provides an almost complete explanation for the deviations country by country of public health expenditures to the OECD sample mean.

Figure 4. Contribution of policies and institutions to cross-country differences in the residual of health expenditure[1]



1. Log differences between country averages and OECD sample average.

Non-explained Residual: Part of health expenditures that is not explained by demographic, economic factors, and policies and institutions.

Source: Authors' calculations.

6. Conclusions

This paper investigates the impact of policies and institutions on health expenditures for a large panel of OECD countries for the period 2000-10. We propose a theoretical framework where a social planner maximises utility over health spending and consumption subject to a budget constraint and the health production function. The theoretical model provides guidance for the selection of our data and econometric specifications. We estimate linear and non-linear specifications to examine the relationship between public health expenditures and a large set of 20 institutional indicators pertaining to the supply-side, demand-side, and public management, coordination and financing aspects of health systems, while controlling for other demographic and non-demographic drivers of health expenditures.

Overall, there is a reasonably good fit between the expected signs of the coefficients for the institutional indicators and the actual estimates. From a supply-side perspective, we find evidence that in countries where there is real scope for competition between payers – beyond the simple existence of more than one insurer in the market – tend to exhibit lower health spending. This corroborates evidence from some national contexts (e.g. Netherlands) in that payer competition can push hospital and drug costs down provided effective selective contracting mechanisms are in place (Dranove et al., 1993; Zwanziger et al., 1994, 2000; Baker, 1999; Schut and van de Ven, 2011). Our results also highlight the importance of well-designed regulatory measures as far as the supply of health services is concerned. The estimates provide

support to the idea that tighter regulation of prices of hospital and physician services as well as capital investment is linked to lower inflationary pressures from wages and service costs. These are likely to be useful tools for health policy in order to counterbalance the seemingly higher overall spending induced by policies aimed at raising care quality, as in the case of the monitoring costs and financial incentives related to clinical guidelines and protocols adherence.

Our cross-country data do not, however, support findings from case studies indicating a relationship between regulation of pharmaceutical prices and health spending (Danzon and Ketcham, 2004; Danzon, 2011). Furthermore, we also find ambiguous effects of the regulation of physician supply through mechanisms such as quotas for medical students on expenditures, despite the findings on a positive relationship from the Canadian and American settings (Anderson et al., 2000; Bärnighausen and Bloom, 2010).

The results for demand-side policies and institutions are closely aligned with our expectations as well. The data support claims in the literature about higher overall expenditures in the longer run in countries that rely more heavily on user co-payments to fund primary care, possibly by the financial barriers imposed for access to preventive care and early stage treatment (see, among others, Gruber, 2006; Haviland et al., 2011). On the other hand, the data do provide support to claims that priority setting, or a more explicit definition of the publicly funded benefit package through mechanisms such as negative/positive lists and pharmaceutical formularies, should favour more effective cost-containment efforts in the health system (Kenkel and Sindelar, 2011; Morgan et al., 2004). Finally, concerning the public management dimensions, we found that decentralisation of health system functions is associated with lower levels of spending.

Our analysis also enabled to disentangle the relative weight of the different drivers in the explanation of the cross-country differences of public health expenditures. As expected, we found that a large share of these differences (around 71%) can be explained by demographic and economic factors, notably real income. The policy and institutional variables explain most of the remaining differences (23%), thus appearing to have a significant influence. Further investigation on the role of policies and institutions in the growth of health expenditures will require data on the evolution of these variables over time. More generally, more comparable health data over time will be critical to improve our knowledge in this field.

REFERENCES

Acemoglu, D., Finkelstein, A. and M. Notowidigdo (2013), "Income and health spending: evidence from oil price shocks", *The Review of Economics and Statistics*, vol. 95(4), pp.1079-1095.

Anderson, G., D. Halcoussis, L. Johnston and A. Lowenberg (2000), "Regulatory barriers to entry in the healthcare industry: the case of alternative medicine", *The Quarterly Review of Economics and Finance*, Vol. 40, No. 4, pp.485-502.

Andersson, K., M. Petzold, C. Sonesson, K. Lonnroth and A. Carlsten (2006), "Do policy changes in the pharmaceutical reimbursement schedule affect drug expenditures? Interrupted time series analysis of cost, volume and cost per volume trends in Sweden 1986-2002", *Health Policy*, Vol. 79, No. 2-3, pp.231-243.

Baker, L. (1999), "Association of managed care market share and health expenditures for fee-for-service Medicare patients", *JAMA: the Journal of the American Medical Association*, Vol. 281, No. 5, pp.432-437.

Baltagi B.H. and F. Moscone (2010), "Health Care Expenditure and Income in the OECD Reconsidered: Evidence from Panel Data", *Economic Modelling*, Vol. 27(4), pp. 804-811.

Bärnighausen, T. and D. Bloom (2011), "The Global Health Workforce", in Glied, S. and P. Smith (eds.), *The Oxford Handbook of Health Economics*, Oxford University Press, Oxford.

Braendle T and Colombier C (2015) , « What Drives Public Health Care Expenditure Growth? Evidence from Swiss Cantons, 1970-2012", Center of Business and Economics (WWZ), University of Basel, Working Paper 2015/12.

Chernew, M. and D. May (2011), "Health Care Cost Growth", in Glied, S. and P. Smith (eds.), The Oxford Handbook of Health Economics, Oxford University Press, Oxford.

Costa-Font, J. and F. Moscone (2008), "The impact of decentralization and inter-territorial interactions on Spanish health expenditure", *Empirical Economics*, Vol. 34, No. 1, pp.167-184.

Costa-Font, J. and J. Pons-Novell (2007), "Public health expenditure and spatial interactions in a decentralized national health system", *Health Economics*, Vol. 16, No. 3, pp.291-306.

Culyer, A.J. (1990), "Cost Containment in Europe", *Health Care Systems in Transition*, OECD, Paris.

Cutler, D. (2001), "The Reduction in Disability among the Elderly", *Proceedings of the National Academy of Science*, Vol. 98, No. 12, June.

Danzon, P. (2011), "The Economics of the Biopharmaceutical Industry", in Glied, S. and P. Smith (eds.), *The Oxford Handbook of Health Economics*, Oxford University Press, Oxford.

Danzon, P. and J. Ketcham (2004), "Reference Pricing of Pharmaceuticals for Medicare: Evidence from Germany, the Netherlands, and New Zealand", in Cutler, D. and A. Garber (eds.), *Frontiers in Health Policy Research*, Vol. 7, NBER and MIT Press, Cambridge, MA.

de la Maisonneuve, C. and J. Oliveira Martins (2013), "A Projection Method for Public Health and Long-Term Care Expenditures", *OECD Economics Department Working Papers*, No. 1048, OECD Publishing.
http://dx.doi.org/10.1787/5k44v53w5w47-en

Dismuke, C. and P. Guimarães (2002), "Has the caveat of case-mix based payment influenced the quality of inpatient hospital care in Portugal?", *Applied Economics*, Vol. 34, No. 10, pp.1301-07.

Docteur, E. and H. Oxley (2003), *Health-Care Systems: Lessons from the Reform Experience*, OECD Economics Department Working Papers No. 374, Paris.

Dormont, B., M. Grignon and H. Huber (2006), "Health Expenditure Growth: Reassessing the Threat of Ageing", *Health Economics*, 15 (9), pp. 947-63.

Dormont, B. *et al.* (2011), "Health Expenditures, Longevity and Growth", in *Ageing, Health and Productivity*, Oxford University Press.

Dranove, D., M. Shanley and W. White (1993), "Price and concentration in hospital markets: the switch from patient-driven to payer-driven competition", *Journal of Law & Economics*, Vol. 36, No. 2, pp.179-204.

Dreger, C. and H.-E. Reimers (2005), "Health Care Expenditures in OECD Countries: A panel Unit Root and Cointegration Analysis", *International Journal of Applied Econometrics and Quantitative Studies*, Vol. 2(2), pp. 5-20.

Dusheiko, M., H. Gravelle, R. Jacobs and P. Smith (2006), "The effect of financial incentives on gatekeeping doctors: evidence from a natural experiment", *Journal of Health Economics*, Vol. 25, No. 3, pp.449-478.

Dusheiko, M., H. Gravelle, N. Yu and S. Campbell (2007), "The impact of budgets for gatekeeping physicians on patient satisfaction: evidence from fundholding", *Journal of Health Economics*, Vol. 26, No. 4, pp.742-762.

Ellis, R. and M. Miller (2008), "Provider Payment Methods and Incentives", in Kris, H. (ed.), *International Encyclopaedia of Public Health*, Oxford Academic Press, Oxford.

Elzinga, K. and D. Mills (1997), "The distribution and pricing of prescription drugs", *International Journal of the Economics of Business*, Vol. 4, No. 3, pp. 287-99.

Forrest, C. (2003), "Primary care gatekeeping and referrals: effective filter or failed experiment?", *BMJ*, Vol. 326(7391), pp.692-695.

Fuchs, V. (1972), *Essays in the Economics of Health and Medical Care*, National Bureau of Economic Research, New York.

Gaynor M., R. Moreno-Serra and C. Propper (2013), "Death by market power: reform, competition, and patient outcomes in the National Health Service", *American Economic Journal: Economic Policy*, Vol. 5, pp.134-166.

Gerdtham, U., J. Sogaard., F. Anderson and B. Jonsson (1992), "An Econometric Analysis of Health Care Expenditure: A Cross-Section Study of the OECD Countries", *Journal of Health Economics*, Vol. 11, No. 1, pp. 63-84.

Gerdtham, U-G. and B. Jönsson (2000), "International Comparisons of Health Expenditure: Theory, Data and Econometric Analysis", in Culyer, A. and J. Newhouse (eds.), *Handbook of Health Economics*, Vol. 1, Elsevier, Amsterdam.

Gerdtham, U. G., C. Rehnberg and M. Tambour (1999), "The impact of internal markets on health care efficiency: evidence from health care reforms in Sweden", *Applied Economics*, Vol. 31(8), pp.935-945.

Giannoni, M. and T. Hitiris (2002), "The regional impact of health care expenditure: the case of Italy", *Applied Economics*, Vol. 34(14), pp.1829-1836.

Goldman, D., F. Joyce and Y. Zheng (2007), "Prescription drug cost sharing: associations with medication and medical utilization and spending and health", *JAMA: the Journal of the American Medical Association*, Vol. 298(1), pp.61-69.

Gruber, J. (2006), *The Role of Consumer Copayments for Health Care: Lessons from the RAND Health Insurance Experiment and Beyond*, Henry J. Kaiser Family Foundation, Menlo Park, California.

Hall, C. and R.E. Jones (2007), "The Value of Life and the Rise in Health Spending", *The Quarterly Journal of Economics*, Vol. 122(1), pp. 39-72.

Haviland, A., N. Sood, R. McDevitt and M. Marquis (2011), "How do consumer-directed health plans affect vulnerable populations?", *Forum for Health Economics & Policy*, Vol. 14(2), pp.1-23.

Hitiris, T. and J. Posnett (1992), "The Determinants and Effects of Health Expenditure in Developed Countries", *Journal of Health Economics*, Vol. 11(2), pp. 173-81.

Holly, A., X. Ke and P. Saksena (2011), "The Determinants of Health Expenditure: A Country-Level Panel Data Analysis", *World Health Organisation Working Paper*.

Jemiai, N., S. Thomson and E. Mossialos (2004), "An overview of cost sharing for health services in the European Union", *Euro Observer*, Vol. 6(3), pp.1-4.

Jönsson, B. and I. Eckerlund (2003), "Why do Different Countries Spend Different Amounts on Health Care?", *A Disease-based Comparison of Health Systems*, OECD, Paris.

Kenkel, D., and J. Sindelar (2011), "Economics of Health Behaviors and Addictions: Contemporary Issues and Policy Implications", in Glied, S. and P. Smith (eds.), *The Oxford Handbook of Health Economics*, Oxford University Press, Oxford.

Kenneally, M., and V. Walshe (2012), "Pharmaceutical cost-containment policies and sustainability: recent Irish experience", *Value in Health*, Vol. 15(2), pp.389-393.

Kibicho, J. and S. Pinkerton (2012), "Multiple drug cost containment policies in Michigan's Medicaid program saved money overall, although some increased costs", *Health Affairs*, Vol. 31(4), pp. 816-826.

Kim, J., S. Ko and B. Yang, (2005), "The effects of patient cost sharing on ambulatory utilization in South Korea", *Health Policy*, Vol. 72(3), pp. 293-300.

Kwon, S. (2003), "Payment system reform for health care providers in Korea", *Health Policy and Planning*, Vol. 18(1), pp.84-92.

Louis, D., E. Yuen, M. Braga, A. Cicchetti, C. Rabinowitz, C. Laine and J. Gonnella (1999), "Impact of a DRG-based hospital financing system on quality and outcomes of care in Italy", *Health Services Research*, Vol. 34(1) (Pt 2), pp. 405-15.

Lundberg, L., M. Johannesson, D. Isacson and L. Borgquist (1998), "Effects of user charges on the use of prescription medicines in different socio-economic groups", *Health Policy*, Vol. 44(2), pp. 123-134.

Magnussen, J., T. Hagen and O. Kaarboe (2007), "Centralized or decentralized? A case study of Norwegian hospital reform", *Social Science & Medicine*, Vol. 64(10), pp. 2129-2137.

Magnussen, J., F. Tediosi and P. Mihályi (2006), "Effects of Decentralization and Recentralization on Economic Dimensions of Health Systems", in Saltman, R., V. Bankauskaite and K. Vrangbaek (eds.), *Decentralization in Health Care*, Open University Press, Maidenhead.

Manning, W., J. Newhouse, N. Duan, E. Keeler, A. Leibowitz and M. Marquis (1987), "Health insurance and the demand for medical care - evidence from a randomized experiment", *American Economic Review*, Vol. 77(3), pp. 251-277.

Medeiros, J. and C. Schwierz (2015), Efficiency Estimates of Health Care Systems, *European Commission Economic Papers* 549, European Commission, Brussels.

Moise, P. and S. Jacobzone (2003), "Population Ageing, Health Expenditure and Treatment: an ARD Perspective", *A Disease-based Comparison of Health Systems*, OECD, Paris.

Moreno-Serra, R. (2014), The impact of cost-containment policies on health expenditure: evidence from recent OECD experiences, *OECD Journal on Budgeting* Vol.12, pp. 1-29.

Moreno-Serra, R. and A. Wagstaff (2010), "Systemwide impacts of hospital payment reforms: evidence from Central and Eastern Europe and Central Asia", *Journal of Health Economics*, Vol. 29(4), pp. 585-602.

Morgan, S., J. Agnew and M. Barer (2004), "Seniors' prescription drug cost inflation and cost containment: evidence from British Columbia", *Health Policy*, Vol. 68(3), pp. 299-307.

Mosca, I. (2007), "Decentralization as a determinant of health care expenditure: empirical analysis for OECD countries", *Applied Economics Letters*, Vol. 14(7-9), pp. 511-515.

Mossialos, E. and J. Le Grand (1999), "Cost Containment in the EU: An Overview", in Mossialos, E. and J. Le Grand (eds.), *Health Care and Cost Containment in the European Union*, Ashgate, Aldershot.

Murphy, K. and R. Topel (2006), "The Value of Health and Longevity", *Journal of Political Economy*, Vol.114(5), pp. 871-904.

Mushkin, E.P. and J.S. Landefeld (1979), *Biomedical Research: Costs and Benefits*, Ballinger Publishing Company, Cambridge, Massachusetts.

Newhouse, J.P. (1992), "Medical Care Costs: How Much Welfare Loss?", *Journal of Economic Perspectives*, Vol. 6(3), pp. 3-21.

Nguyen, N. (1996), "Physician volume response to price controls", *Health Policy*, Vol. 35(2), pp. 189-204.

OECD (2010), *Health Care Systems: Efficiency and Policy Settings*, OECD Publishing.

Okunade, A., and V.N.R. Murthy (2002), "Technology as a Major Driver of Health Costs: A Cointegration Analysis of the Newhouse Conjecture", *Journal of Health Economics* 21, pp.147-159.

Orszag, P. (2007), The Long-Term Outlook for Health Care Spending, Congressional Budget Office, Congress of the United States, Washington D.C.

Paris, V., M. Devaux and L. Wei (2010), "Health Systems Institutional Characteristics: A Survey of 29 OECD countries", *OECD Health Working Papers* No. 50, OECD, Paris.

Richardson, J. and I. Robertson (1999), "Ageing and the Cost of Health Services", in *Policy Implications of the Ageing of Australia's Population*, Productivity Commission and Melbourne Institute, Canberra.

Robinson, R. (2002), "User Charges for Health Care", in Mossialos, E., A. Dixon, J. Figueras and J. Kutzin (eds.), *Funding Health Care: Options for Europe*, Open University Press, Buckingham.

Rubin, R. and D. Mendelson (1996), "A framework for cost-sharing policy analysis", *Pharmacoeconomics*, Vol. 10(2), pp. 56-67.

Saltman, R., V. Bankauskaite and K. Vrangbaek (eds.) (2006), *Decentralization in Health Care*, Open University Press, Maidenhead.

Schneider, P. (2007), *Provider Payment Reforms: Lessons from Europe and America for South Eastern Europe*, HNP Discussion Paper, October, The World Bank, Washington D.C.

Schöffski, O. and J. von der Schulenburg (1997), "Unintended effects of a cost-containment policy: results of a natural experiment in Germany", *Social Science & Medicine*, Vol. 45(10), pp. 1537-1539.

Schokkaert, E. and C. van de Voorde (2011), "User Charges", in Glied, S. and P. Smith (eds.), *The Oxford Handbook of Health Economics*, Oxford University Press, Oxford.

Schut, F., and W. van de Ven (2011), "Effects of purchaser competition in the Dutch health system: is the glass half full or half empty?", *Health Economics Policy and Law*, Vol. 6(1), pp. 109-123.

Sheehan, P. (2002), "Health Costs, Innovation and Ageing", *Pharmaceutical Industry Working Paper Series* No. 9, Centre for Strategic Economic Studies, Victoria University of Technology, Melbourne.

Sood, N., H. de Vries, I. Gutierrez, D. Lakdawalla and D. Goldman (2009), "The effect of regulation on pharmaceutical revenues: experience in nineteen countries", *Health Affairs*, Vol. 28(1), pp. w125-w137.

Volpp, K., S. William, J. Waldfogel, J. Silber, J. Schwartz and M. Pauly (2003),"Market reform in New Jersey and the effect on mortality from acute myocardial infarction", *Health Services Research*, Vol. 38, pp.515-533.

White, C. (2007), "Health care spending growth: how different is the United States from the rest of the OECD?", *Health Affairs*, Vol. 26(1), pp. 154-61.

Zwanziger, J., G. Melnick and A. Bamezai (2000), "The effect of selective contracting on hospital costs and revenues", *Health Services Research*, Vol. 35(4), pp. 849-867.

Zwanziger, J., G. Melnick, J. Mann and L. Simonson (1994), "How hospitals practice cost containment with selective contracting and the Medicare prospective payment system", *Medical Care*, Vol. 32(8), pp. 1153-62.

Zweifel P., S. Felder, and M. Meiers (1999), "Ageing Of Population And Health Care Expenditure: A Red Herring?", *Health Economics,* 8, pp. 485–496.

Zweifel, P. and W. Manning (2000), "Moral Hazard and Consumer Incentives in Health Care", in Culyer, A. and J. Newhouse (eds.), *Handbook of Health Economics*, Elsevier, Amsterdam.

ANNEX. THEORETICAL DERIVATION OF AN OPTIMAL HEALTH SPENDING EQUATION

We now develop a stylized micro-founded model of utility maximisation by a social planner subject to a budget constraint and a health production function. Let us consider a representative agent who maximises utility derived from individual consumption c expressed in real terms and health status denoted as x. For the sake of simplicity, we abstract from the heterogeneity associated with age and consider a unique life period.[14] Utility is given by the following CES function:

$$U(c,x) = \left(\lambda \cdot x^{\rho} + (1-\lambda) \cdot c^{\rho}\right)^{1/\rho}, \ \rho \leq 1 \tag{A1}$$

As a particular case, a Cobb-Douglas utility function is obtained for $\rho = 0$. In the above function, health status x is an unobserved, latent, health compound that includes both mortality risks (and life expectancy) and morbidity status. The representative agent maximises utility under a budget constraint:

$$c + r \cdot H = y \tag{A2}$$

where H is real health spending per capita, r relative health prices (i.e. health prices divided by a consumption/income deflator), and y real individual income proxied by real GDP per capita. There is no physical capital, no savings and no international trade in the economy.

An individual's health state x is determined by a simplified health production function that uses individual health spending with decreasing returns to scale and is augmented by an exogenous technological variable Q that captures the quality of health technologies:

$$x = Q \cdot H^{\beta}, \text{ with } 0 \leq \beta \leq 1 \tag{A3}$$

A social planner will maximise aggregate utility over consumption and health spending subject to the resource constraint and the production function of health. Denoting $h = H/y$ as the share of real health spending in real income, the optimal allocation solves:

$$\max_{c,h} \left[\lambda \cdot Q^{\rho} (h \cdot y)^{\beta\rho} + (1-\lambda) \cdot c^{\rho}\right]^{1/\rho} \quad s.t. \quad c = (1 - r \cdot h) \cdot y \tag{A4}$$

The optimal allocation of health spending and consumption satisfies the following first-order condition:

14. For a dynamic system of health investments throughout life allowing for age-specific mortality rates see Hall and Jones (2007).

$$h^* = \left(\frac{\beta\lambda}{1-\lambda}\right)^{1/(1-\rho\beta)} Q^{\rho/(1-\rho\beta)} r^{-1/(1-\rho\beta)} (1-rh^*)^{(1-\rho)/(1-\rho\beta)} y^{\frac{1-\rho}{1-\rho\beta}-1} \quad \text{(A5)}$$

The equation above links the optimal health spending share to the technological variable, relative health prices and real income. The optimal share h^* however appears on both sides of the equation in a non-linear way. To further simplify equation (A5), we can consider that health relative prices are on average close to one and the health spending share is on average around 8% of the GDP in a sample of high-income OECD countries (see Table 2 in the text). The expression $(1-\rho)/(1-\rho\beta)$ is the income elasticity of health spending *H*, which is likely to be smaller but close to one.[15] This yields the following approximation: $(1-rh^*)^{(1-\rho)/(1-\rho\beta)} \approx 1$. Under these conditions, the optimal health spending share in real income can be conveniently approximated by:

$$h^* \approx \left(\frac{\beta\lambda}{1-\lambda}\right)^{1/(1-\rho\beta)} Q^{\rho/(1-\rho\beta)} r^{-1/(1-\rho\beta)} y^{\frac{1-\rho}{1-\rho\beta}-1} \quad \text{(A6)}$$

And the optimal health spending per capita then is:

$$H^* = h^* y \approx \left(\frac{\beta\lambda}{1-\lambda}\right)^{1/(1-\rho\beta)} Q^{\rho/(1-\rho\beta)} r^{-1/(1-\rho\beta)} y^{\frac{1-\rho}{1-\rho\beta}} \quad \text{(A7)}$$

Health policies and institutions enter the formulation above as factors that influence the degree of cost-efficiency of health expenditures. In practice, policies and institutional factors determine the magnitude of the parameter β in the health production function, with cost-efficient policies raising parameter β and therefore the health level for a given amount of health spending.

It is interesting to note that the impact of institutions on health spending per capita H^* depends on the value of the elasticity of substitution $\sigma = 1/(1-\rho)$ in the utility function (equation 1). If $\sigma < 1$ (or $\rho < 0$), consumption and health status have low substitutability. An increase in parameter β would increase efficiency and lower health expenditures per capita, which is the desired outcome from a public policy perspective.

15. For example Acemoglu et al. (2013) derive a central estimate for the income elasticity of health spending around 0.72. For a literature review of the income elasticity of health spending, see de la Maisonneuve and Oliveira Martins (2013).

Table A1. Health policy and institutional indicators[1]

	Provider payment			Provider competition	Insurer competition		Workforce supply legislation	Hospital supply legislation	Provider price regulation				Budget caps		Gatekeeping	Cost-sharing	Definition of health benefit package and priority setting		Health technology assessment	Decentralisation of health system functions
	Physician payment	Hospital payment	Incentives for quality	Choice among providers	User choice of insurer	Lever	Regulation of physician supply	Regulation of capital investment	Regulation of price for physician services	Regulation of price for hospital services	Regulation of pharmaceutical price	Regulation of prices charged to third-party	Stringency of budget constraint	Control of volume	Gatekeeping	Depth of basic insurance	Definition of benefit basket	Public health objectives	Use of health technology assessment	Degree of decentralisation
Australia	4.5	1.0	1.5	5.3	0.0	0.0	3.6	6.0	5.0	3.0	5.0	3.9	2.0	3.0	2.0	5.1	5.0	6.0	6.0	2.8
Austria	4.0	4.0	0.0	2.7	2.0	0.5	3.6	6.0	3.0	4.0	5.0	4.2	0.0	5.0	0.0	5.4	2.5	0.1	3.7	3.6
Belgium	6.0	6.0	2.5	5.0	0.0	0.0	4.8	6.0	4.0	2.0	6.0	5.0	2.0	3.0	3.0	4.9	5.0	0.0	5.0	0.5
Canada	6.0	2.0	1.0	4.7	1.0	0.0	3.6	6.0	3.0	4.0	4.0	3.5	3.0	3.7	4.0	5.5	1.5	1.4	5.0	5.1
Czech Republic	3.3	2.0	1.5	6.0	4.0	2.4	2.4	0.5	4.0	5.0	5.0	4.1	2.0	5.0	0.0	5.3	5.0	0.9	0.0	1.2
Denmark	2.5	1.0	0.5	2.0	1.0	0.0	4.8	4.0	4.0	5.0	1.0	4.0	2.0	1.7	6.0	5.3	2.5	2.4	6.0	2.3
Finland	2.0	5.0	0.0	0.0	1.0	0.0	3.6	0.0	6.0	5.0	5.0	4.8	2.0	1.7	4.0	4.9	2.5	0.2	4.3	4.7
France	4.5	5.0	0.5	6.0	2.0	0.3	4.8	4.0	4.0	3.0	5.0	5.0	2.0	1.7	3.0	5.2	5.0	5.4	4.0	0.0
Germany	4.5	5.0	0.0	5.3	6.0	5.0	3.6	4.0	3.0	3.0	1.0	3.7	2.0	2.0	3.0	5.6	4.0	0.1	3.6	1.5
Greece	0.8	6.0	1.0	3.3	2.0	1.5	2.4	0.0	4.0	1.0	5.0	5.0	2.0	1.0	0.0	4.6	1.5	0.0	0.0	0.0
Hungary	1.0	5.0	0.0	6.0	0.0	0.0	4.8	4.8	5.0	1.0	5.0	5.9	5.0	3.3	5.0	5.1	2.5	1.8	4.3	1.1
Iceland	1.5	0.0	0.0	6.0	0.0	0.0	2.4	0.0	4.0	6.0	6.0	5.4	2.0	3.7	0.0	5.4	3.0	0.2	3.3	0.2
Italy	1.0	5.0	1.0	6.0	0.0	0.0	4.8	6.0	3.0	5.0	5.0	4.2	5.0	2.3	6.0	5.4	5.0	0.9	3.6	2.3
Korea	4.5	6.0	0.0	5.0	0.0	0.0	2.4	0.0	4.0	4.0	5.0	5.4	0.0	4.3	0.0	4.1	5.0	0.1	4.0	0.0
Luxembourg	6.0	0.0	0.4	6.0	0.0	0.0	0.0	3.5	4.0	5.0	5.0	3.6	1.0	1.7	0.0	5.4	5.0	0.0	0.0	0.0
Mexico	0.0	2.0	1.0	0.0	2.0	1.0	3.0	5.5	4.0	3.0	4.0	4.7	3.0	1.0	4.0	4.2	1.1	0.7	1.1	1.9
Netherlands	5.5	1.0	1.5	5.0	4.0	5.0	4.8	1.5	2.0	5.0	5.0	3.2	2.0	1.0	6.0	5.7	5.0	0.0	6.0	0.0
New Zealand	3.0	1.0	1.0	2.0	0.0	0.0	3.6	1.0	4.0	4.0	5.0	4.5	6.0	0.0	5.0	5.4	2.5	4.8	5.0	2.6
Norway	3.3	2.0	1.0	6.0	1.0	0.0	4.8	3.5	4.0	5.0	5.0	4.3	6.0	1.7	6.0	5.3	2.5	4.8	5.0	3.0
Poland	1.8	5.0	3.0	6.0	0.0	0.0	3.6	0.0	6.0	5.0	5.0	5.4	6.0	1.7	4.0	5.3	5.0	1.8	4.7	1.8
Portugal	0.0	0.0	2.5	0.7	0.0	0.0	3.6	4.5	4.0	6.0	5.0	5.4	6.0	2.7	6.0	5.1	2.5	1.8	4.7	1.1
Slovak Republic	1.0	5.0	1.5	6.0	3.0	0.7	3.6	0.8	6.0	1.0	5.0	3.5	2.0	3.7	6.0	4.8	5.5	4.8	0.0	0.8
Spain	0.5	0.0	1.0	0.7	1.0	0.0	3.6	4.0	4.0	5.0	5.0	4.5	2.0	3.0	6.0	5.4	5.0	0.1	4.7	5.5
Sweden	0.0	3.0	1.2	6.0	0.0	0.0	2.4	2.9	4.0	5.0	5.0	4.5	6.0	2.3	0.0	4.9	2.5	0.1	4.0	4.3
Switzerland	6.0	3.0	0.0	4.7	6.0	3.3	2.4	3.0	3.0	4.0	5.0	4.2	0.0	3.3	3.0	4.8	4.5	1.8	3.7	4.3
United Kingdom	2.0	3.0	4.5	4.0	0.0	0.0	3.6	1.0	4.0	5.0	2.0	3.7	6.0	2.3	5.0	5.6	4.0	6.0	4.0	3.0
Average	***2.9***	***3.0***	***1.1***	***4.2***	***1.4***	***0.8***	***3.5***	***3.0***	***4.0***	***4.0***	***4.6***	***4.4***	***3.0***	***2.5***	***3.3***	***5.2***	***3.7***	***1.8***	***3.7***	***2.1***

1. The indicators are scaled from 0-6. They correspond to the institutional setting of health policies surveyed by the OECD around 2008-09.

Source: Paris et al. (2010) and OECD (2010).

Table A2. Robustness analysis: Non-linear estimates for total and private health expenditures

Dependent variable: log of real Total or Private (or Public) Health Expenditures per capita	(1) TOTAL EXP	(2) PRIVATE EXP	(3) *Memo item: PUBLIC EXP*
Log of GDP per capita	**1.201*** **	**1.403*** **	**1.343*** **
	(0.047)	**(0.102)**	**(0.057)**
Dependency ratio	**0.016*** **	**-0.024*** **	**0.027*** **
	(0.002)	**(0.005)**	**(0.004)**
Log relative Health prices	**-0.774*** **	0.167	**-1.067*** **
	(0.077)	(0.309)	**(0.087)**
Quality effect	**0.004*** **	0.003	**0.015*** **
	(0.001)	(0.005)	**(0.002)**
Physician payment	**-0.037*** **	**-0.136*** **	**-0.039*** **
	(0.006)	**(0.021)**	**(0.006)**
Hospital payment	0.004	**0.199*** **	0.004
	(0.005)	**(0.017)**	(0.007)
Incentives for quality	**0.025*** **	**0.177*** **	**0.056*** **
	(0.006)	**(0.017)**	**(0.009)**
Choice among providers	0.011	**0.068*** **	0.006
	(0.008)	**(0.011)**	(0.011)
User choice of insurer	**0.074*** **	**-0.284*** **	**0.064*** **
	(0.011)	**(0.055)**	**(0.016)**
Lever	**-0.041*** **	**0.369*** **	**-0.053*** **
	(0.011)	**(0.048)**	**(0.014)**
Regulation of physician supply	**-0.018*** **	**-0.274*** **	**-0.012***
	(0.006)	**(0.030)**	**(0.007)**
Regulation of capital investment	**0.010** **	**0.116*** **	**-0.019*** **
	(0.005)	**(0.008)**	**(0.007)**
Regulation of price for physician services	**-0.010** **	**-0.090*** **	-0.012
	(0.004)	**(0.013)**	(0.008)
Regulation of price for hospital services	**-0.014** **	0.002	**-0.027*** **
	(0.006)	(0.016)	**(0.008)**
Regulation of pharmaceutical price	**0.017*** **	**0.029** **	0.005
	(0.002)	**(0.014)**	(0.004)
Regulation of prices charged to third-party	0.007	**0.257*** **	0.006
	(0.005)	**(0.032)**	(0.009)
Stringency of budget constraint	**-0.029** **	**-0.355*** **	-0.019
	(0.012)	**(0.023)**	(0.015)
Control of volume	**-0.004***	**-0.044*** **	**0.023*** **
	(0.003)	**(0.013)**	**(0.004)**
Gatekeeping	0.006	**0.239*** **	**0.015** **
	(0.005)	**(0.022)**	**(0.007)**
Depth of basic insurance	**0.020*** **	**0.067*** **	**0.064*** **
	(0.003)	**(0.014)**	**(0.006)**
Definition of benefit basket	**-0.030*** **	**-0.179*** **	**-0.024*** **
	(0.006)	**(0.010)**	**(0.007)**
Public health objectives	0.004	**0.197*** **	**0.020** **
	(0.003)	**(0.019)**	**(0.008)**
Use of health technology assessment	**0.053*** **	0.030	**0.026** **
	(0.008)	(0.040)	**(0.012)**
Degree of decentralisation	**-0.023*** **	**0.108*** **	**-0.025*** **
	(0.005)	**(0.029)**	**(0.007)**
Constant	**-9.601*** **	**-12.020*** **	**-11.703*** **
	(0.429)	**(0.911)**	**(0.511)**
Year Fixed-effects	Yes	Yes	Yes
N	248.000	240.000	240.000

Note: Robust standard errors in parentheses.
***, **, * indicate significant at the 1%, 5% and 10% level respectively.

Table A3. Robustness analysis: Non-linear estimates for public health expenditures

Dependent variable: log of real Public Health Expenditures per capita	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Log of GDP per capita	0.988***	0.999***	0.975***	0.970***	0.997***	0.993***	0.986***	0.982***	0.991***	0.990***	0.987***	1.005***	0.986***	0.981***	0.990***	1.011***	0.985***	0.992***	0.984***	0.972***
	(0.010)	(0.007)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.008)	(0.007)	(0.009)	(0.009)	(0.010)	(0.008)
Dependency ratio	0.048***	0.052***	0.047***	0.042***	0.048***	0.047***	0.041***	0.049***	0.047***	0.050***	0.047***	0.049***	0.048***	0.047***	0.045***	0.032***	0.047***	0.046***	0.046***	0.048***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Log relative Health prices	-0.782***	-0.783***	-0.712***	-0.791***	-0.797***	-0.776***	-0.852***	-0.746***	-0.755***	-0.791***	-0.767***	-0.824***	-0.763***	-0.780***	-0.796***	-0.883***	-0.725***	-0.873***	-0.809***	-0.690***
	(0.178)	(0.157)	(0.188)	(0.161)	(0.163)	(0.167)	(0.181)	(0.169)	(0.176)	(0.167)	(0.172)	(0.164)	(0.174)	(0.172)	(0.176)	(0.133)	(0.180)	(0.168)	(0.190)	(0.174)
Quality effect	0.011***	0.011***	0.011***	0.013***	0.011***	0.011***	0.014***	0.011***	0.010***	0.008***	0.012***	0.010***	0.012***	0.012***	0.013***	0.013***	0.012***	0.013***	0.011***	0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Physician payment	0.003																			
	(0.004)																			
Hospital payment		-0.023***																		
		(0.002)																		
Incentives for quality			-0.010*																	
			(0.005)																	
Choice among providers				0.012**																
				(0.005)																
User choice of insurer					0.010***															
					(0.003)															
Lever						0.008**														
						(0.003)														
Regulation of physician supply							0.013***													
							(0.003)													
Regulation of capital investment								-0.005												
								(0.004)												
Regulation of price for physician services									-0.016***											
									(0.003)											
Regulation of price for hospital services										0.014***										
										(0.003)										
Regulation of pharmaceutical price											-0.003									
											(0.004)									
Regulation of prices charged to third-party												-0.010***								
												(0.004)								
Stringency of budget constraint													-0.001							
													(0.004)							
Control of volume														0.004						
														(0.004)						
Gatekeeping															0.006*					
															(0.003)					
Depth of basic insurance																0.027***				
																(0.002)				
Definition of benefit basket																	-0.007*			
																	(0.004)			
Public health objectives																		0.016***		
																		(0.004)		
Use of health technology assessment																			0.009**	
																			(0.004)	
Degree of decentralisation																				-0.012***
																				(0.004)
Constant	-8.473***	-8.667***	-8.319***	-8.200***	-8.579***	-8.526***	-8.386***	-8.422***	-8.494***	-8.522***	-8.458***	-8.670***	-8.459***	-8.395***	-8.481***	-8.460***	-8.431***	-8.522***	-8.399***	-8.321***
	(0.159)	(0.151)	(0.169)	(0.157)	(0.155)	(0.156)	(0.166)	(0.143)	(0.161)	(0.159)	(0.154)	(0.161)	(0.168)	(0.138)	(0.151)	(0.131)	(0.166)	(0.146)	(0.160)	(0.138)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240

Note: Robust standard errors in parentheses. ***, **, * indicate significant at the 1%, 5% and 10% level respectively.

Table A4. Correlations among the policy and institutional indicators, 26 OECD countries

	Physician payment	Hospital payment	Incentives for quality	Choice among providers	User choice of insurer	Lever	Regulation of physician supply	Regulation of capital investment	Regulation of price for physician services	Regulation of price for hospital services	Regulation of pharmaceutical price	Regulation of prices charged to third-party	Stringency of budget constraint	Control of volume	Gatekeeping	Depth of basic insurance	Definition of benefit basket	Public health objectives	Use of health technology assessment	Degree of decentralisation
Physician payment	1.00																			
Hospital payment	0.09	1.00																		
Incentives for quality	-0.03	0.07	1.00																	
Choice among providers	0.36	0.21	0.09	1.00																
User choice of insurer	0.31	0.17	-0.23	0.03	1.00															
Lever	0.35	0.11	-0.09	0.11	0.89	1.00														
Regulation of physician supply	-0.10	0.06	0.06	-0.03	-0.07	-0.06	1.00													
Regulation of capital investment	0.15	-0.16	-0.12	-0.06	-0.10	-0.15	0.33	1.00												
Regulation of price for physician services	-0.39	0.20	0.15	-0.02	-0.38	-0.51	-0.07	-0.32	1.00											
Regulation of price for hospital services	0.00	-0.45	0.16	-0.16	-0.14	-0.05	-0.19	-0.17	-0.24	1.00										
Regulation of pharmaceutical price	0.01	-0.02	-0.04	0.21	-0.29	-0.27	-0.07	-0.08	0.18	-0.07	1.00									
Regulation of prices charged to third-party	-0.32	0.17	0.00	0.00	-0.46	-0.41	0.05	-0.09	0.40	-0.13	0.43	1.00								
Stringency of budget constraint	-0.54	-0.15	0.35	0.00	-0.46	-0.35	0.24	0.02	0.23	0.14	-0.07	0.18	1.00							
Control of volume	0.06	-0.05	-0.19	0.22	0.03	-0.11	0.12	0.13	-0.06	-0.06	0.23	0.03	-0.34	1.00						
Gatekeeping	-0.27	-0.11	0.12	-0.34	0.01	-0.02	0.53	0.17	0.05	0.05	-0.31	-0.25	0.47	-0.32	1.00					
Depth of basic insurance	0.19	-0.33	0.14	0.15	0.06	0.16	0.13	0.11	-0.28	0.40	-0.29	-0.39	0.26	-0.15	0.29	1.00				
Definition of benefit basket	0.37	0.21	0.24	0.43	0.20	0.23	-0.08	-0.16	0.03	0.09	0.13	-0.25	-0.31	0.13	0.01	0.15	1.00			
Public health objectives	0.01	-0.10	0.34	0.17	-0.17	-0.28	0.24	0.03	0.34	-0.16	-0.13	-0.07	0.38	-0.20	0.32	0.16	0.08	1.00		
Use of health technology assessment	0.21	0.00	0.13	-0.14	-0.17	-0.05	0.35	0.21	-0.14	0.34	-0.18	0.00	0.21	-0.27	0.42	0.36	0.06	0.17	1.00	
Degree of decentralisation	-0.08	-0.09	-0.03	-0.41	0.06	-0.12	0.02	0.20	-0.05	0.32	-0.19	-0.32	0.10	0.04	0.27	0.17	-0.18	-0.01	0.39	1.00

Note: For a description of the variables see Table 1.