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Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

WORKING PAPER

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Andree Ehlert, Dirk Oberschachtsiek,

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University of Lüneburg
Working Paper Series in Economics

No. 284

October 2013

www.leuphana.de/institute/ivwl/publikationen/working-papers.html

ISSN 1860 - 5508

Cost Containment and Managed Care: Evidence from German Macro Data

Andree Ehlert · Dirk Oberschachtsiek · Stefan Prawda

Leuphana University of Lueneburg
Institute of Economics
Scharnhorststr. 1
21335 Lueneburg, Germany
ehlert@leuphana.de · oberschachtsiek@leuphana.de · prawda@leuphana.de

August 29, 2013

Abstract

The major German health care reforms undertaken since the late 1990s resulted in the adoption of selective contracting mechanisms in a formerly sectorally separated health care system. These reforms marked the launch of managed care in Germany that is expected to yield both a higher quality of care and cost containment. We investigate if managed care had an influence on the structure of health care expenditure in Germany during the start-up phase of managed care from 2004 to 2008. We focus on pharmaceutical spending by statutory sickness funds (i.e. German law-enforced health insurance). We followed a macroeconomic evaluation approach based on a regional panel data set in contrast to previous research and were thus able to control for a comprehensive set of regional and demographic variables. We discuss alternative model specifications and include a range of sensitivity analyses. Our results suggest that in contrast to public perception the share of managed care contracts has a positive impact on pharmaceutical spending.

Keywords Managed care · Health care expenditure · Pharmaceutical expenditure · Panel data · German health care reform
JEL Classification I11 · I18 · L14 · O52

1 Introduction

The continuing rise of public health care expenditure, both in absolute and percentage terms, has been a dominant political debate in most Organisation for Economic Co-operation and Development (OECD) countries in recent decades. Empirically, drug spending can be identified as a major spending block within health sectors where, for example, 15.9% of German health expenditure in 2012

related to pharmaceuticals (www.bmg.bund.de). The aging population and induced demand are discussed as potential cost drivers [26]. Both price regulation and copayments have been proposed as methods of breaking the trend of rising expenses, and managed care has been proposed as having considerable cost containment potential. The avoidance of double medication, improved communication among care providers and the impact of managed care on patient patterns of demand have been previously discussed [38, 39]. Earlier research on the driving forces of drug spending and, in particular, their cost containment potential, has focused on cross-country studies and identified income, demographic structure or physician density impacts [1, 2]. This study contributes to existing literature by asking whether managed care is a factor associated with changing patterns of pharmaceutical spending.

In general, managed care can be defined as a collection of measures that promote the integration of patients and service providers, see [41] for details. The German concept of managed care can be seen as a special case where the correction of the strict sectoral fragmentation between general physicians, specialists, care providers and the inpatient sector is emphasized.[1] For example, existing integrated care plans in Germany tend to focus on physician networks, the use of treatment guidelines and quality monitoring.[2]

The literature on the cost containment potential of managed care programs for numerous countries is limited to a micro-perspective [5].[3] In contrast, our study follows a macroeconomic evaluation approach. A main advantage of this method is the possibility to control for (favorable and/or adverse) spillover effects such as learning curves by physicians that have an impact also on the treatment of patients that are not enrolled in the program. To be precise, we ask whether managed care is an effective cost containment measure in the short run with respect to pharmaceutical expenditure. Hence, our key question is whether institutional reforms in the course of managed care have the potential to reduce costs at the market level of the German health care system. Note that in this study we are not able to evaluate the impact of managed care on total health care expenditure as reliable numbers of the latter are not available at the regional level. Consequently, cost shifting within the entire statutory health care system cannot be controlled for. However, empirical evidence on our research question is particularly relevant in view of recent policies at the national level aimed at cost containment with respect to the pharmaceutical industry (e.g. copayments and limited pharmaceutical budgets). Concerning this matter we study whether managed care is an adequate instrument. In line with existing literature (cf. Section 2) we do not address efficiency issues except for

[1] Throughout the paper managed care will be used as a generic term with respect to integrated care as well as disease management programs. The latter two terms are statutorily defined under German law whereas managed care is not. See Section 3.2 for details.

[2] Most health plans in the United States (US) in contrast concentrate on financing, i.e. they can be regarded as insurers with affiliated physician networks. Typically, they make use of their bargaining power to put downward pressure on prices. This method has been criticized for specializing in cost management rather than disease management [34, 23].

[3] Note that [30] include the proportion of health maintenance organizations and family doctor models as an explanatory variable for regional health care expenditure in Switzerland.

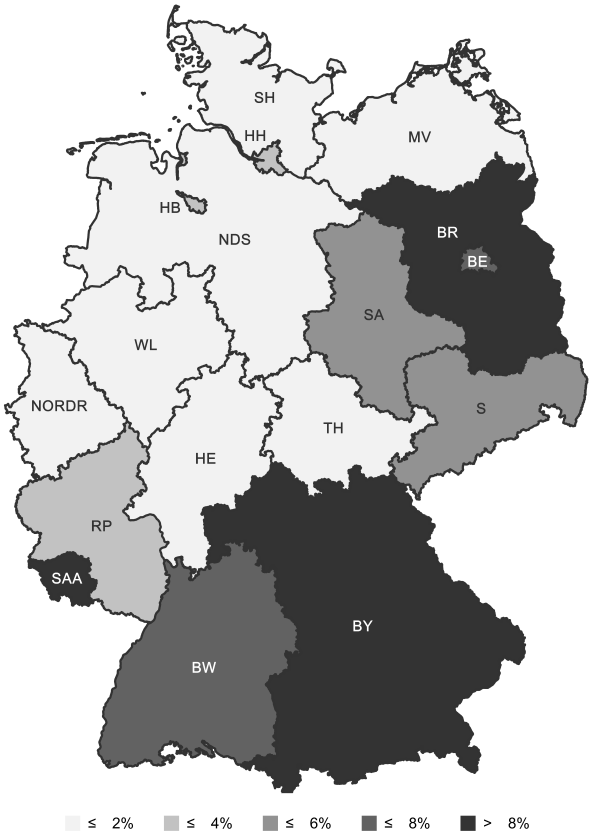

Figure 1: Share of statutory health insured population with integrated care contracts by region in 2008 as reported by statutory sickness funds, cf. [15]

including rough indicators such as the number of hospitalizations.

In our econometric specification we explicitely model regional variation in pharmaceutical expenditure by the volume of managed care interventions (in addition to a comprehensive set of further control variables). We use a panel data set to combine time and cross regional variation to control for regional specific (individual) effects. Figure 1 provides an overview of the statutory health insured population with integrated care contracts.

Section 2 of this paper discusses previous research. We study some German health care system fundamentals and the institutional background of managed care in Section 3. We also discuss extant literature on possible ways for managed care to contain pharmaceutical expenditure. Our panel dataset and the econometric setting is introduced in Section 4. A discussion of our empirical results and a sensitivity analysis are provided in Section 5. Finally, Section 6

concludes and gives directions for future research.

2 Review of the Literature

Cost containment has been mooted as a major argument in favor of managed care. Although selected population-based programs showed some small savings relative to traditional indemnity insurance [5], the overall financial expectations of sickness funds with respect to managed care could not be met [31, 32].

Studies evaluating managed care contracts expenditure are primarily designed in terms of population-based microeconometric analyses with or without control group [29]. The avoidance of double medication, improved communication among care providers as well as the impact of managed care on patients patterns of demand have been discussed [38, 39].

An increasing body of literature underlines the impact of managed care on the nature and extent of prescription drug usage [38, 39]. See also [1, 2] for results on the determinants of the demand for pharmaceuticals at the market level. In particular, potential methods of short-term pharmaceutical cost containment include changing incentives through risk taking by physicians, treatment guidelines or conduct rules for health care providers.

A potential limitation of the microeconometric setting is that spillover effects may not be accounted for. For example, patients in statutory health insurance may benefit from an overall change in treatment schemes introduced by managed care routines [6]. Furthermore, a tendency to concentrate on successful programs and/or regional centers entails a potential selection bias. The fact that most evaluations focus on flagship projects instead of on a nationwide coverage has also been criticized [32].

On a regional level, research on the outcome of program interventions or organizational changes is limited [6, 19]. However, in relation to the regional dimensions of health expenditure, spatial characteristics have been identified as highly relevant. For example, international level approaches include [13, 17] showing that both income levels and the structure of health care financing are relevant health expenditure variables. Similar results have also been discussed at a regional health care expenditure level [8, 20, 28, 30, 22, 7, 11].

3 Managed Care in the German Health Care System

3.1 Institutional Background

German health insurance is strictly regulated. For example, new service provider settlements and the introduction of new drugs or therapies are only permitted by ordinance. When making international comparisons, the following points can be highlighted as characteristic of the German health care system:

- almost full health care insurance population coverage

- strong statuary health care insurance (88%) and low (11%) private insurances (as of 2007)
- moderate cost sharing (e.g. a quarterly practice fee between 2004 and 2012 in addition to drug copayments of 5 to 10 EUR)
- free choice of service provider
- provider reimbursements are composed of fee-for-service and per-capita flat rates
- upper budget constraints for each service provider

Another major aspect of the German health care system is the importance of collective contracting. In particular, reimbursement and contract design are mainly negotiated between a provider monopoly formed by the national association of statutory health insurance physicians (Kassenärztliche Bundesvereinigung, KBV) and the statutory sickness funds. As a result, until the late 1990s the German health care system failed to exhibit organizational or structural innovation. The resulting inefficiencies in terms of lack of communication and information exchange across sectors, disciplines and providers, and hence the oversupply and misallocation of medical services are largely considered responsible for increasing financial pressure in the German health care system. For example, Germany holds the fifth-highest position in the 2010 OECD expenditure ranking for pharmaceutical expenditure per capita [25]. In the same year, total spending on health care was about 11.6% of gross domestic product, i.e. the fourth-highest value among OECD member states, and life expectancy was 80.5 years which is below the OECD average [25]. Consequently, structural reforms of the German health care system have long been called for.

3.2 The Implementation of Managed Care in Germany

As a step towards cost containment policies in health care first components of managed care similar to other OECD-countries were initially introduced in Germany in the late 1990s [36]. The main objective was to allow for direct contracts between care providers and statutory sickness funds to take advantage of efficiency enhancing institutional innovations such as practice communities and networks, practice management companies, buying associations, and to increase competition. Consequently, the reforms of 2000 and 2004 (in particular § 140a–d SGB V, social insurance code, book five) broke the existing bilateral monopoly of collective contracting in the German health care system.[4]

[4] To stimulate initial investment in integrated care programs (e.g. contract design, tendering procedures, internal evaluation etc.) a start-up financing scheme of up to 1% of overall statutory outpatient and inpatient services was provided from 2004 to 2008, amounting to EUR 1.7 billion in total. The initial financing was considered necessary as the legal requirement for stable contribution rates (§ 71 SGB V) did not allow statutory sickness funds to cover their costs by a (temporary) increase in premiums. Note that reliable budgetary adjustment routines have still not been implemented (as of 2013), cf. [32].

It is essential to consider that both disease management programs (DMP, § 137f SGB V) and programs of integrated care (IC, § 140a SGB V) played a critical role within the German managed care system in the 2000s. The term disease management applies to a fixed set of diagnosis groups only, and aims to reach the growing number of chronically ill patients in these groups (bronchial asthma, breast cancer, chronic obstructive pulmonary disease, type 1 and type 2 diabetes mellitus and coronary heart disease). Programs of this type must be approved by the federal social insurance authority (Bundesversicherungsamt) and must be evaluated independently on a regular basis. Programs of integrated care, in contrast, do not require formal evaluation and allow for a considerably greater cross-sector cooperation of health care providers.[5] Additional forms of managed care such as structural contracts (§ 73a SGB V), pilot projects (§§ 63–65 SGB V), family doctor-centered health care (§ 73b SGB V) and special outpatient physician care (§ 73c SGB V) appear to be less significant.

According to the rather open definition in § 140a SGB V integrated care is an intersectoral and/or interdisciplinary provision of health care based on individual contracts between statutory health insurers and care providers. In contracts of integrated care, participation of the insured is voluntary. Potential contractual partners are listed exhaustively in § 140b SGB V, including physicians, hospitals and group practices. In 2007, the list was extended to include intermediary management companies. Provider reimbursement is arranged individually by contracting partners, where providers may assume budgetary responsibilities.[6]

To give a rough overview of the empirical structure of partners in integrated care, we note that the share of hospitals as sole contractual partners of sickness funds decreased from 23% to 16% from 2004 to 2008, while the share of direct contracts between physicians and sickness funds increased from 15% to 30% in the same period [15]. The German system of managed care also has a strong focus on certain diagnosis groups. In particular, integrated care schemes rarely provide population-based full coverage (2% of all integrated care contracts in 2007/08) but concentrate on the treatment of widespread disease, e.g. palliative care (26%), skeleto-muscular and connective tissue disorders, or cardiovascular disease (8%) [15]. Direct financial incentives appear to be limited both on the parts of the patient and the providers.

3.3 The Potential Influence of Managed Care on Pharmaceutical Expenditure

We argued above that both organizational and behavioral changes have the potential to contain pharmaceutical expenditure within managed care in comparison to standard care. Most research on this subject, however, focuses on the US perception of managed care, i.e. health maintenance organizations [16, 21].

[5] Consequently, disease management programs may be considered a subset of integrated care in the German context [32].

[6] It is characteristic of the German integrated care system that even regular statutory care is still accessible for managed care patients after referral by a physician (§ 140c SGB V).

An exception is the study by [18] using German data. In the following, we review potential cost containment mechanisms in managed care environments.

There is evidence for both cost increases and cost containment in pharmaceutical expenditure with respect to enrolment for managed care, cf. e.g. [23] and [38]. It is vital to carefully analyze the intervention timeframe. In general, a typical causal chain reflecting the financial impacts of managed care can begin with an increased number of medical consultations within managed care patients. This clearly tends to increase pharmaceutical spending when we model a physician visit to coincide with a certain probability for a prescription [35, 39]. This observation is reinforced by the fact that patients appear to show higher levels of compliance and closer agency relationships with their doctors in managed care. In economic terms, this corresponds to a decrease in their price elasticity with respect to pharmaceuticals.[7] Within managed care contracts, however, patients may not need to supply co-payment. Standard economic theory suggests that the demand effect of this price reduction may be attenuated by the lower price elasticity compared with standard care [38]. Taken together, the net demand side impact of managed care on pharmaceutical expenditure remains unclear.

With respect to the supply side, we can expect an increasing physician price elasticity because of the higher risk taking by contractual arrangements as well as binding treatment guidelines, provider education and monitoring by the managed care organization [10, 38]. These influences appear to be opposed to the increasing demand for physician visits on the part of the patients and may lead the doctor to prescribe more appropriate and lower priced drugs. Furthermore, better drug monitoring within the programs may lead to an avoidance of double medication through improved intersectoral cooperation.

An ongoing discussion focusses on the question of whether managed care companies take a long-term or a short-term financial target perspective. The former can be considered a cost shifting strategy. It implies a willingness to accept a higher drug spend in the short term that is expected to pay off in the medium to long term through lower treatment costs. This assumption is supported by [35, 21]. However, the stronger bargaining power of managed care companies vis-à-vis pharmaceutical industries allows them to negotiate discounts and to switch to generic drugs [39].

When applied to the German managed care market the above findings should be qualified by two facts that are not central to the health care systems of other countries. First, relatively tight budget constraints for individual physicians as a form of risk bearing are already in place in standard statutory health care. Second, large sickness funds have signed discount agreements with pharmaceutical manufacturers within standard care so the potential for small managed care companies to further reduce purchase prices is limited. The same appears to be true for the use of generic drugs, in contrast to the situation in the US [39]. However, with the legal establishment of a managed care environment (§ 140a–d

[7] Note that co-payments for medication in standard German statutory health care remained at a constant low level of between 5 and 10 EUR from the beginning of our study period (2004) until today.

SGB V) Germany has implemented additional reforms allowing for an increased level of market activities within the health care system. This may have further extended risk bearing for physicians, discount agreements in the drug market within German health care, and efficiency-enhancing practices such as more adequate use of pharmaceuticals. For the remainder of the paper our question is therefore whether the institutional reforms associated with German managed care have led to measurable short-term pharmaceutical cost reductions.

4 Data and Methods

4.1 Data Base and Variable Definitions

We use a panel dataset covering 17 regions that mirror the spatial structure of German statutory health insurance. Except for North Rhine-Westphalia (which is sub-divided into Westphalia-Lippe and Nordrhein), the regions correspond to German federal states. Our panel covers the period from 2004 to 2008 for contracts on integrated care where data were made available through an official reporting system [15]. Providers with programs of integrated care under public support (start-up funding) were asked to submit detailed information on their contracts. The reporting was discontinued after 2008. To date, this panel provides the only comprehensive publicly available data source on integrated care in Germany. In total, we thus have $5 \cdot 17 = 85$ observations on integrated care.[8] For data on disease management programs, we used statistics reported by the federal social insurance authority for the period 2005 to 2011, and hence have $7 \cdot 17 = 119$ observations.

We focus on pharmaceutical expenditure (PE) as the dependent variable. Deflation is recognized by conversion into real expenditure as of 2005 (consumer price index for pharmaceutical products, CC0611, see `https://www-genesis.destatis.de/genesis/online/`). Similar to [13, 12, 28, 26, 8, 20, 30], we control for a set of standard factors that determine health care expenditure such as household income (HHI), unemployment (UN), physician density (PHYS), age structure (P65, population share aged 65 and over) and technological progress over time. Note, however, that although our set of control variables mostly agrees with the abovementioned literature we particularly focus on managed care variables, i.e. data on integrated care (IC) and disease management programs (DMP). The respective variable descriptions and data sources are summarized in Table 1. Note that DMP values for 2004 are not reported in official statistics, and were not available despite best efforts. Hence, data for 2004 were estimated by subtracting the average of the moving differences across time from the 2005 values.

With respect to total health care expenditure positive income elasticities around unity have been reported for HHI using both international [13] and

[8] Although the observation period is limited by data availability, this data frame constitutes an order of magnitude similar to that used in the literature on health care expenditure at the market level [24, 13, 8].

Table 1: Variables and data sources

Variable	Description	Source
PE	Total net expenditure (i.e. adjusted for rebates and co-payments) by public sickness funds on pharmaceuticals per insured patient (inflation-adjusted, base year = 2005)	www.gkv-gamsi.de
HHI	Per capita household income (inflation-adjusted, base year = 2005)	www.regionalstatistik.de
UN	Unemployment rate	www.statistik.arbeitsagentur.de
PHYS	Density of physicians (within statutory health insurance)	www.destatis.de & www.kbv.de
P65	Share of population aged 65 and over	www.destatis.de
IC	Share of persons with statutory health insurance registered for IC	www.bmg.bund.de
DMP	Share of persons with statutory health insurance registered for DMP	www.bva.de
CASE	Number of outpatient cases per person with statutory health insurance (based on quarterly data)	www.kbv.de
HOSP	Number of hospital cases per 100,000 persons	www.destatis.de
HOSPINT	Hospital treatments of patients with life threatening conditions per 100,000 persons	www.destatis.de
GEN	Share of generic drug prescriptions in the total drug market (inflation-adjusted, base year = 2005)	www.gkv-gamsi.de
POP	Population density	www.destatis.de

regional [7] data. Hence, we also expect a positive effect of income on pharmaceutical expenditure. We convert HHI into real income as of 2005 (CC99, see `https://www-genesis.destatis.de/genesis/online/`). We include UN to capture shifts in demand for pharmaceuticals associated with behavioral changes for people losing their job or facing the risk of unemployment. The literature generally reports insignificant results [12]. The hypothesis as to demand inducement by physicians is still under discussion. The variable PHYS is therefore intended to cover the impact of incomplete patient information regarding the prescription behavior of providers. We hypothesize the effect to be positive for German data, see [41] for a discussion. The variable P65 reflects the fact that an aging population is likely to increase demand for pharmaceuticals because of a changing morbidity structure. Finally, we include a time trend to capture technological change.

In addition to the above set of standard explanatory variables discussed in the international literature on health care expenditure we challenge the model with the inclusion of further candidate right hand side variables in Section 5.2. As a rough proxy for a health outcome variable we will consider both the share of hospital cases (HOSP) as well as the share of acute hospital cases (HOSPINT). We include the number of outpatient cases (CASE) in order to control for demand effects, and also as a rough indicator of total health care expenditure, i.e. cost shifting with respect to pharmaceuticals. We are aware of the potential endogeneity at this point and the adequacy of the number of outpatient cases as an instrumental variable may be questioned critically.[9] Furthermore, the share of generic drug spending (GEN) will be considered to capture changes in pharmaceutical expenditure that are attributable to patent issues. A dummy on eastern German regions (EW) as well as a population density variable (POP) are examined to reflect (enduring) regional differences.

The pooled data set including basic summary statistics for each of the variables is reported in Table 2. It shows that regional variation is substantial with respect to income, unemployment and the share of integrated care, see also Figure 1. Summary annual statistics are given in Table 3. This reflects the stable increasing expenditure on pharmaceuticals trend (in real terms). As anticipated, it also reveals a rising share of generic drugs.

4.2 Econometric Specification

Although extant literature provides a thorough discussion of medical demand functions at the individual level (cf. e.g. [14, 37, 41]), the problem of aggregation for market level demand functions questions their application in our setting, see [13, 27] for a comprehensive discussion. Hence, we start our analysis from a parsimonious model, i.e. the Cobb-Douglas functional form proposed for market level health expenditure regressions in previous research [13, 1, 12, 8, 7]. Although far from fully flexible [26], it provides a reasonable reflection of input substitutability with decreasing marginal rates of technical substitution.

[9] A general 2SLS procedure could not be performed due to limited data availability at the regional level.

Table 2: Summary statistics by region (sample averages 2004–2008)

	PE	*HHI*	*UN*	*PHYS*	*P*65	*IC*	*DMP*	*CASE*	*HOSP*	*GEN*	*POP*
Berlin	379	15,630	0.167	192	0.178	0.061	0.045	7.684	20,716	0.617	3,821
Brandenburg	314	15,248	0.163	122	0.205	0.095	0.062	5.966	20,319	0.619	86
Baden-Württemb.	319	19,161	0.057	143	0.186	0.042	0.025	6.503	18,065	0.567	300
Bayern	294	19,359	0.062	157	0.187	0.138	0.039	6.499	20,774	0.589	177
Bremen	331	17,407	0.138	194	0.207	0.011	0.040	9.372	29,262	0.654	1,640
Hessen	313	18,193	0.082	148	0.191	0.014	0.032	6.732	19,559	0.623	288
Hamburg	371	19,540	0.098	185	0.184	0.014	0.026	9.020	22,745	0.642	2,324
Mecklenburg-Vorp.	396	14,580	0.181	141	0.204	0.006	0.060	6.856	22,723	0.613	73
Niedersachsen	314	16,578	0.096	133	0.198	0.011	0.029	6.494	18,676	0.618	168
Nordrhein	322	17,669	0.107	142	0.196	0.018	0.045	6.553	22,040	0.625	774
Rheinland-Pfalz	326	18,186	0.073	138	0.199	0.018	0.044	6.285	20,521	0.608	204
Sachsen	388	15,315	0.161	138	0.229	0.020	0.061	6.674	21,598	0.590	231
Sachsen-Anhalt	380	14,467	0.177	131	0.223	0.167	0.062	6.280	23,272	0.592	119
Saarland	379	16,757	0.091	149	0.214	0.113	0.044	6.757	24,450	0.598	406
Schleswig-Holst.	296	17,707	0.095	145	0.203	0.009	0.031	6.388	19,162	0.609	179
Thüringen	380	14,914	0.147	138	0.214	0.006	0.052	6.771	22,972	0.586	143
Westfalen-Lippe	308	17,669	0.098	133	0.195	0.021	0.043	6.370	22,040	0.623	379

Table 3: Summary statistics by year (mean and standard deviation (below), total Germany, * $\sim$ estimated)

	PE	HHI	UN	$PHYS$	$P65$	IC	DMP	$CASE$	$HOSP$	GEN	POP
2004	285	16,853	0.125	147	0.190	0.020	0.015*	6.764	21,286	0.559	664
	28	1,602	0.050	21	0.012	0.050	0.008*	0.956	2,622	0.024	1,007
2005	341	16,965	0.137	148	0.197	0.045	0.027	6.851	21,450	0.578	664
	35	1,707	0.045	21	0.013	0.061	0.009	0.935	2,612	0.024	1,010
2006	350	17,096	0.126	149	0.202	0.052	0.041	6.878	21,454	0.613	665
	40	1,742	0.042	21	0.014	0.062	0.012	0.955	2,582	0.024	1,015
2007	362	16,944	0.106	150	0.206	0.056	0.057	6.944	21,935	0.622	667
	39	1,732	0.039	22	0.015	0.062	0.017	0.948	2,670	0.022	1,020
2008	371	16,959	0.093	151	0.210	0.051	0.077	7.034	22,373	0.678	667
	43	1,702	0.034	22	0.016	0.049	0.020	0.972	2,667	0.027	1,023
2009	382	16,925	0.095	152	0.212	–	0.092	7.520	22,804	0.697	667
	45	1,552	0.031	21	0.017	–	0.022	1.100	2,639	0.019	1,026
2010	388	17,225	0.090	152	0.212	–	0.097	7.498	23,182	0.706	666
	44	1,644	0.029	20	0.017	–	0.022	1.105	2,795	0.017	1,032
2011	383	17,363	0.084	153	0.212	–	0.103	7.638	23,532	0.722	669
	45	1,732	0.029	20	0.017	–	0.024	1.099	2,712	0.016	1,039

Consequently, for our base model we assume that

$$\begin{aligned} PE_{it} =& HHI_{it}^{\beta_1} UN_{it}^{\beta_2} PHYS_{it}^{\beta_3} \\ & P65_{it}^{\beta_4} IC_{it}^{\beta_5} DMP_{it}^{\beta_6}, \end{aligned} \tag{1}$$

where $i = 1, \ldots, 17$ indicates the study regions, and $t = 2004, \ldots, 2008$ the years of the panel on integrated care (and $t = 2005, \ldots, 2011$ for disease management programs). Despite the two dimensional index, note that the above equation is still set up as a quasi pooling framework because the indices i and t are not identifiable in a regression. In particular, unobserved or omitted components that influence pharmaceutical expenditure simultaneously with our set of observables are not considered. Latent variables such as the working of institutions or historically based regional differences are still expected to vary systematically between federal states. This is particularly important given that the German managed care market reflects substantial regional heterogeneity, cf. Figure 1. Standard econometric theory indicates that this sort of unobserved effects may cause serious problems rendering a pooled ordinary least squares (OLS) procedure inapplicable. In particular, it cannot control for the unobserved effects, meaning that the resulting partial effects of the observable explanatories may be biased.

However, in view of the two-dimensional panel structure of our data, we include time constant unobserved components. Time stability is a strong but plausible assumption in light of the regional focus of the unobservable variables as well as the relatively short study period. Furthermore, we include a linear time component to capture the remaining general trends. It is intuitive to consider the estimable representation of Eq. (1) in its logarithmic error form, i.e.

$$\begin{aligned} \log PE_{it} = & \beta_1 \log HHI_{it} + \beta_2 \log UN_{it} + \\ & \beta_3 \log PHYS_{it} + \beta_4 \log P65_{it} + \\ & \beta_5 \log IC_{it} + \beta_6 \log DMP_{it} + \\ & \beta_7 t + \alpha_i + u_{it} \end{aligned} \tag{2}$$

where u_{it} represents the idiosyncratic error terms, and the unobserved regional effects are captured by α_i. Note that the coefficients $\beta_1, \ldots, \beta_6$ reflect output elasticities whereas β_7 gives the annual percentage change of pharmaceutical expenditure.

For a proper evaluation of Eq. (2) we must account for two econometric challanges: the endogeneity of certain regressors, and the potential correlation between the regional effects and the explanatory variables. We will discuss the first issue in Section 5 and approach the second point using two standard techniques, fixed effects (FE) and random effects (RE) estimations. We briefly review their principal assumptions to facilitate the discussion of regression results in Section 5. In particular, the fixed effects estimator makes no assumptions as to $Cov(\alpha_i, \boldsymbol{X}_{it})$ (where we treat α_i as random, cf. [40]). Consequently, the

unobserved effects may be arbitrarily related with the observable explanatories $\boldsymbol{X}_{it}$. To achieve this robustness, the unobserved effect is eliminated by the so-called within-transformation. A time-demeaned equivalent of Eq. (2) is used and then estimated by pooled OLS of $\hat{\boldsymbol{y}}$ on $\hat{\boldsymbol{x}}$ where $\hat{\boldsymbol{x}}_{it} = \boldsymbol{x}_{it} - \bar{\boldsymbol{x}}_i$, for all i and t, and similarly for $\hat{\boldsymbol{y}}_{it}$. Note, however, that the elimination of α_i comes at the cost of ignoring the between variation in the data, i.e. level differences for the federal states. With respect to Table 3 the low within (i.e. over time) variation of some variables such as household income or physician density can be problematic in the context of fixed effects estimation. The resulting estimates may then expected to be imprecise.

The random effects estimator is more efficient when $Cov(\alpha_i, \boldsymbol{X}_{it}) = 0$ (see [40] for the precise assumptions). It applies a weighted average of the fixed effects and the pooled OLS specification that takes the between variation into account (i.e. information across regions as well as across periods). More precisely, pooled OLS is run on a quasi-demeaned version of Eq. (2), i.e. $\ddot{\boldsymbol{y}}$ on $\ddot{\boldsymbol{x}}$ where $\ddot{\boldsymbol{x}}_{it} = \boldsymbol{x}_{it} - \lambda\bar{\boldsymbol{x}}_i$ for certain weights $0 \leq \lambda \leq 1$, and similarly for $\ddot{\boldsymbol{y}}$. However, the assumption $Cov(\alpha_i, \boldsymbol{X}_{it}) = 0$ is made that must be addressed with caution. The random effects estimation is generally only applied if the Hausman test (see Section 5.1) does not reject the null hypothesis of the random effects assumptions.

In the following section, we discuss the empirical results corresponding to the fixed and random effects estimations. We also test the respective model assumptions.

5 Empirical Results

5.1 Does Managed Care Affect Expenditure on Medication?

The estimation of Eq. (2) was implemented using [9]. The corresponding results for the fixed effects and random effects methods are reported in Table 4. For both methods, we discuss three alternative models labeled FE I to FE III and RE I to RE III. The models differ in the number of explanatory variables included where we focus on DMP and on HHI. These two variables are the most debatable of those included in Eq. (2) because DMP contains an estimate for the year 2004 (official data are not available) and HHI includes a potential endogeneity problem that may be resolved by the instrument UN.

To distinguish between the fixed effects and the random effects framework, we performed the Hausman test on the null hypothesis of the random effects assumptions. The results including the respective degrees of freedom are reported in the last row of Table 4. We were not able to reject the null hypothesis in any case. Consequently, we tend to prefer the random effects models.

We tested for serial correlation in the idiosyncratic error terms for RE models [3, 4, 40]. We were not able to reject the null hypothesis of no serial correlation. In addition, we report results for heteroskedasticity-consistent standard

Table 4: Regression results for alternative models. The level of significance is indicated by *** ~ 0.001, ** ~ 0.01, * ~ 0.05, and . ~ 0.1. The adjusted determination coefficient is given in the third last row. Weights for the feasible generalized least squares (GLS) estimator are given by λ, see [40]. The χ^2 statistic for the Hausman test is reported in the bottom row.

Model	FE I	FE II	FE III	RE I	RE II	RE III	RE III (ROB)	RE DMP (ROB)
CONST				4.6716.	5.5914*	8.9163***	8.9163***	13.7451***
				2.6199	2.7457	1.2795	1.8338	2.2591
HHI	-0.0577	-0.1122		0.4054.	0.3328			-0.5424***
	0.4224	0.4353		0.2233	0.2325			0.1579
UN	0.3218***	0.3080***	0.3199***	0.2750***	0.2476***	0.2538***	0.2538***	0.0296
	0.0492	0.0550	0.0469	0.0414	0.0482	0.0396	0.0403	0.0268
PHYS	-0.6856	-0.6020	-0.6761	0.1817	0.2155	0.2552	0.2552	0.3164*
	0.6653	0.6847	0.6565	0.1649	0.1675	0.1693	0.2321	0.1589
P65	1.1687**	1.1315**	1.1668**	0.7003**	0.6646*	0.6092*	0.6092*	0.2435
	0.3507	0.3586	0.3477	0.2580	0.2597	0.2574	0.3013	0.2043
IC	0.0080	0.0082	0.0079	0.0114*	0.0114*	0.0138*	0.0138.	
	0.0056	0.0057	0.0056	0.0054	0.0054	0.0052	0.0083	
DMP		0.0121			0.0228			0.0354**
		0.0212			0.0206			0.0118
t	0.0582***	0.0521***	0.0580***	0.0576***	0.0462**	0.0567***	0.0567***	0.0126***
	0.0102	0.0148	0.0100	0.0089	0.0137	0.0091	0.0099	0.0030
N	85	85	85	85	85	85	85	119
adj. R^2	0.6574	0.6471	0.6679	0.7994	0.7910	0.8075	0.8075	0.7890
λ				0.8053	0.8054	0.8182	0.8182	0.8977
χ^2 (df)				2.8998 (6)	2.3225 (7)	10.038 (5)		3.4515 (6)

errors (ROB) for model RE III.

Taken together, the estimated coefficients appear to be relatively stable throughout models FE I to RE III. Additionally, the value of λ being close to unity indicates that the fixed and random effects estimates are technically close. Note from our discussion in Section 4.2 that they would in fact be equal for $\lambda = 1$, see [40] for details. Both this and the Hausman test imply that the random effects assumptions are not overly critical.

There are two major exceptions to the stability of coefficients across models. Both HHI and PHYS change their sign from a negative to a positive (while being insignificant). This could be explained by the low within variation levels for both variables. The fixed effects estimator concentrates on this low kind of variation and may thus produce high standard errors. Making additional use of the between variation (cf. Table 2) the random effects estimator yields a reduction in standard errors as well as the expected positive sign for income. Both coefficients are insignificant for models RE I to RE III. This finding is not inconsistent with the literature, however, as there are examples of both positive and negative signs for income in health expenditure equations with a comparable set of additional covariates, see e.g. [17, 7] for a positive and significant relationship, [30] for a significantly negative sign and [8] for an insignificant relationship.

The highly significant positive coefficient on unemployment is somewhat surprising. The elasticity interpretation states that a doubling of the unemployment rate is associated with an increase in pharmaceutical spending by approx. 25% holding all other factors constant. However, our finding supports earlier research that reports negative associations of unemployment and individual health [33], i.e. a positive tendency for drug usage to increase with unemployment.

In contrast, the significant coefficient on P65 is in line with our expectations and the numbers reported in literature [17, 8, 28]. Its value of close to unity underlines the fact that the elderly affect pharmaceutical spending one-to-one.

The positive and (in case of the random effects framework) significant coefficient on integrated care is our primary finding. Holding all other factors constant a higher percentage of enrolment in contracts of integrated care appears to increase pharmaceutical expenditure during the period of investigation. This result challenges the prevailing view of decreasing pharmaceutical expenditure as part of integrated care, at least for a short-run relationship. Note that the small absolute size of the coefficient does not necessarily undermine its importance. Elasticity interpretation shows that a doubling of the number of patients registered for integrated care (e.g. from 5% to 10%, which is not an unrealistic scenario in view of the low base inscription level, cf. Table 3) appears to be associated with a 1% increase in pharmaceutical expenditure, a total value of the order of EUR 0.5 billion at the market level. The inclusion of the DMP variable does not change this result. Note also that DMP itself appears to be associated with an increase in pharmaceutical expenditure. As mentioned above, however, this result must be interpreted with caution because the data on DMP for 2004 were obtained by estimation. Consequently, to challenge the positive sign on DMP we included model RE DMP (ROB), i.e. random effects with ro-

bust standard errors, to concentrate on the somewhat larger period 2005–2011 with reliable numbers made available by the federal social insurance authority (`www.bva.de`). Because no official data on integrated care exists for later than 2008, we excluded this variable. We ran versions of the model for alternative sets of variables using fixed and random effects methods (not shown). We discuss only the preferred specification, i.e. model RE DMP (ROB) in Table 4. The striking result is that the DMP coefficient even becomes significant and increases in magnitude. Here, the supply induced demand hypothesis can also be discussed on the basis of the significantly positive PHYS coefficient.

5.2 Sensitivity Analysis

The coefficient estimates shown in Table 4 substantially depend on the particular model, the set of variables and/or sample selection. In this section, we discuss to what extent the relationship between expenditure on medication and the share of insurees registered for programs of integrated care and disease management programs is robust with respect to alternative samples and model specifications.

We challenge the results of Table 4 by applying further variations on the set of explanatory variables. To this end we concentrate on the main variables of interest, i.e. the coefficients of IC and DMP, only. We provide estimates for the coefficient on IC for the preferred random effects models RE 1 to RE III in Table 5 where the respective change on the set of explanatories is stated in the first column. Estimates for the DMP coefficient for model RE DMP (ROB) are included. The variable HOSPINT was included as a workaround for the potential endogeneity associated with HOSP, because we needed to consider a potential trade-off between the number of hospital cases and the expenditure on medication. We can assume the number of acute hospital cases (HOSPINT) not to be a function of spending on pharmaceuticals. For Table 5 note that the coefficients appear to be fairly stable against different sets of regressors and significance levels do not deteriorate. Consequently, we regard the RE models applied in Section 5.1 and, most importantly, the result on IC and DMP as generally robust.

The potential sample selection bias is compounded by the highly restricted availability of data on German programs of integrated care. In our sensitivity analysis we thus focus on regional rather than temporal variations of our sample. To assess the influence of the particular federal states included we re-estimate the preferred random effects model (RE III) leaving out two regions at a time. More precisely, we rerun parameter estimations for all possible subsets of our dataset containing only 15 out of 17 regions, i.e. a total of $\binom{17}{15} = 136$ subsets. The procedure also covers the effects of potential outliers. We graphically report the resulting parameter estimates for the coefficient on integrated care in Figure 2, where we also indicate significance for any particular estimate. Note that in neither case did the coefficient on IC become negative, nor can significance of the estimate be considered a marginal phenomenon as 111 out of the 136 subsets yield a significant coefficient (solid dots) on IC. This figure also shows results applied to the DMP coefficient for model RE DMP. Except for a different

Table 5: Sensitivity analysis for variations on the set of regressors (addition '+' and omission '-') based on models RE I to RE DMP (ROB) where only the coefficient on IC is displayed. For RE DMP (ROB) we give the coefficient on DMP (standard deviations below). Levels of significance are indicated as in Table 4.

Model	RE I	RE II	RE III	RE III (ROB)	RE DMP (ROB)
+HOSP +GEN +POP	0.0093.	0.0093.	0.0109*	0.0109	0.0458***
	0.0054	0.0053	0.0053	0.0087	0.0097
+CASE +GEN + POP	0.0095.	0.0096.	0.0119*	0.0119	0.0446***
	0.0055	0.0055	0.0053	0.0083	0.0107
+CASE	0.0115*	0.0116*	0.0138*	0.0138.	0.0363**
	0.0055	0.0055	0.0053	0.0083	0.0116
+HOSP	0.0111*	0.0112*	0.0129*	0.0129	0.0373**
	0.0054	0.0054	0.0052	0.0084	0.0118
+HOSPINT	0.0118*	0.0116*	0.0143**	0.0143.	0.0331**
	0.0055	0.0054	0.0053	0.0081	0.0114
+GEN	0.0097.	0.0098.	0.0124*	0.0124*	0.0491***
	0.0053	0.0053	0.0052	0.0052	0.0107
+POP	0.0112*	0.0113*	0.0133*	0.0133	0.0308*
	0.0054	0.0054	0.0052	0.0084	0.0121
+EW	0.0113*	0.0111*	0.0130*	0.0130	0.0358**
	0.0055	0.0054	0.0054	0.0085	0.0116
-PHYS	0.0109*	0.0109*	0.0139*	0.0139	0.0346**
	0.0053	0.0053	0.0053	0.0085	0.0131

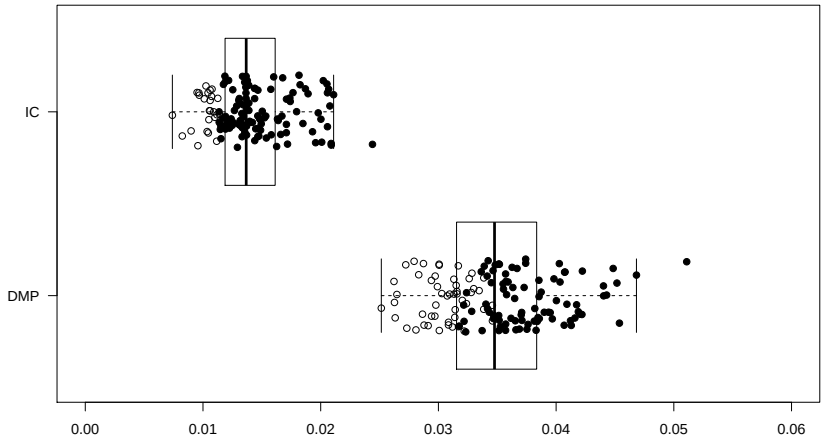

Figure 2: Variation of the coefficient on IC (model RE III) and DMP (model RE DMP) for all 136 possible subsets of 15 out of 17 regions. Box-plots and individual values shown. Solid dots indicate statistical significance at the 0.05 level.

coefficient level estimate, a similar result holds.

6 Conclusion

The main purpose of our analysis was to study the impact of managed care participation on pharmaceutical expenditure in Germany from a macroeconomic point of view. We challenge the hypothesis that the removal of inefficiencies among the central actors of the health system through the introduction of managed care programs leads to a reduction in drug spending.

Our findings show that the share of patients registered for managed care programs has a statistically significant and positive effect on pharmaceutical expenditure in the short run, i.e. the start-up phase of managed care in Germany from 2004 to 2008. More precisely, our results suggest that a doubling of the share of integrated care contracts in Germany (starting from a level as low as 5%) is associated with a 1% increase in pharmaceutical spending. Being a low number on an individual level note that this scenario corresponds to a considerable increase of approx. EUR 0.5 billion at the market level. Results for disease management programs are also statistically significant and positive, the coefficients being even of a larger order of magnitude. We control for an extensive set of covariables and find a plausible range of coefficient estimates in line with previous research on the determinants of regional health care expenditure. Further, our findings are robust to different model specifications and sensitivity

analyses.

Conceptually, the main contribution of our analysis with respect to earlier research on the outcome of managed care programs is our focus on a macroeconomic evaluation approach using regional data. Here, variance originates from cross sectional and temporal differences between regions. An advantage as compared to microeconomic evaluation approaches is that our method also allows to control for the effect that a program has for those who are not enrolled, i.e. we are able to control for spillover effects.

While our findings point to an increase in expenditure associated with managed care it is vital to note that this result may be only part of the picture. Our study does not take into account cost shifting nor changing patterns of required medication coming to light within the closer care environment of managed care programs, i.e. changes in the quality of care. In particular, data on total (statutory) health care expenditure need to be made available by sickness funds, provider organizations or federal offices at the regional level in order to control for cost-shifting tendencies. The example of other countries such as Switzerland [30] proves that similar data bases can be well realized at a regional level. If so, further research may benefit from longer observation periods such that long term (financial) effects of managed care programs in Germany may be studied, too.

Acknowledgements

The authors wish to thank Peter Zweifel for useful discussions and for his valuable comments that helped to improve earlier versions of this work.

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Leuphana Universität Lüneburg
Institut für Volkswirtschaftslehre
Postfach 2440
D-21314 Lüneburg
Tel.: ++49 4131 677 2321
email: brodt@leuphana.de

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