Output and Productivity Growth in the Healthcare Sector: A Study of Four European Countries

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Abstract

This paper attempts to measure output and productivity growth in the health care sector for four European countries, Germany, Hungary, Spain and the UK. It derives comparable costs weighted activity indexes for hospital outputs, shows the impact of quality adjustments using in-hospital mortality rates and derives output indices for some non-hospital output. Overall output growth is highest in the UK followed by Germany. Measures of labour input and labour productivity are present, with the latter showing similar growth in Germany, the UK and Hungary but slightly negative growth in Spain. This measurement exercise illustrates the difficulties in deriving comparable measures of productivity across countries whose healthcare systems vary enormously.

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Introduction

Measuring performance for those industries where much of their output is produced by the public sector, loosely termed 'non-market services' is notoriously difficult and underlies why, up to recently, many countries used inputs to measure outputs, both in terms of values and volumes. In recent years many countries have started the process of incorporating volume measures of outputs into national accounts that are based on activities carried out by public administration, education and health services (see OECD, 2010, for a summary). However in a recent overview of measures for the healthcare sector, Mas and Schreyer (2013) question the international comparability of many of the measures adopted. An exercise that attempts to directly compare output and productivity for a number of countries, using similar data, is likely to be useful in understanding these comparability issues.

This paper compares output and productivity across healthcare sectors in four European countries, Germany, Hungary, Spain and the United Kingdom. Systems of health care provision vary across the countries. In the UK and Spain most health care relies largely on public funding and public provision, although the prevalence of private hospitals is greater in Spain. The German system is one of universal insurance coverage with a mix of public and private providers. Following the collapse of the Communist regime, Hungary has moved from a wholly state controlled system to one that is close to the German approach. Through measuring both hospital and non-hospital outputs, and comparing with inputs used, the research can highlight aspects of cross country variation in terms of who is treated, types of treatments and resources employed.

The next section briefly discusses the methodology employed – more detail is provided in earlier companion papers, Hüttl et al. (2011). We then discuss data availability and some of the issues that arose in trying to populate the database. This is followed by a discussion of the results and some conclusions on the feasibility of carrying out international comparisons of performance in healthcare sectors.

Methodology

The general approach taken in this project to measure healthcare output and productivity is that outlined in the OECD Handbook on the measurement of the volume output of education and health services (OECD 2010), the Atkinson Review of the measurement of Government activity (Atkinson, 2005) and work carried out for the UK Department of Health by the University of York and the National Institute of Economic and Social Research, London (Dawson et al. 2005). Although health systems vary, the basic form in which data are available is similar across the four countries, consisting of data on the volume of activities carried out by health care providers and associated unit costs. This allows the estimation of aggregate output growth as the growth in activities weighted by unit costs. This project employed the most commonly used approach, estimating a Laspeyres index expressed by the following formula:

$$I = \sum_{j=1}^{J} \frac{x_{jt+1} c_{jt}}{x_{jt} c_{jt}}$$

where x_{jt} is the volume of output j in period t, and c_{jt} is the unit cost of output j in period t. In what follows this index is referred to as the cost weighted activity index (CWAI).

In the absence of prices, the use of unit costs is recommended by Eurostat for aggregation across activities (Eurostat, 2001), although it is acknowledged that this approach has many limitations. In particular it requires that expenditures are optimally allocated across procedures which may not be the case for health care services. Related to this is a substitution bias that may occur if the cost of a treatment falls as a result of greater efficiency, for example if some treatments move from inpatient to day clinics. A cost weighted activity index may show a fall in weighted output, if substitution between procedures is not optimal, whereas an index that incorporates the value to the patient might show a rise.

The reports mentioned above highlight the importance of adjusting an activity based index for the quality of the services provided. A detailed stratification of activities can to some extent capture quality change, since we are then closer to comparing like with like in each basic unit of activity (see the discussion in OECD 2010). If we assume that higher unit cost treatments are a good proxy for the complexity of procedures and better outcomes for patients then analysis by detailed treatment allows some quality change to be captured relative to a simple sum across activities. However it is important to ensure that the disaggregation across types of activity does not go too far in treating procedures that yield the same outcome but with different unit costs as different activities (see further discussion on this below).

Stratification of activities cannot on its own capture all quality change. There are a number of dimensions to quality, both in terms of the long-term outcome of treatment for the patient's welfare and also other aspects to the service provided such as waiting times, courtesy of health service staff and, in hospitals, quality of food and cleanliness. An overall adjustment for quality needs to both identify how these have changed and to take account of the relative importance of each. Dawson et al (2005) recommended using data on outcomes to adjust for

quality change. In doing so it is important that the outcome that is used is that which is attributable to the activities of the healthcare sector. There are a range of factors other than health services, such as lifestyles, that affect outcomes and dealing with this attribution problem is a particularly tricky issue. Data on general health outcomes are not currently routinely available[1] but each country produces data on in-hospital mortality rates which can be employed as a crude measure of quality change. This adjustment can be expressed by the following formula:

$$I^* = \frac{\sum_j x_{jt+1}\left(\frac{a_{jt+1}}{a_{jt}}\right)c_{jt}}{\sum_j x_{jt}c_{jt}}$$

where *a* is the survival rate. We refer to I* as a cost weighted output index (CWOI).

Measuring productivity additionally requires estimates of inputs used to produce the medical services. Conventional growth accounting analysis divides inputs in three broad categories: Labour, Capital and Intermediate purchases. Labour includes doctors, nurses, other professionals and auxiliary healthcare workers as well as a range of occupations that provide support services such as cleaners. Ideally, labour input should be adjusted for characteristics of workers, especially their levels of qualification. In healthcare a division by occupation might capture most of the relevant characteristics. Capital should also distinguish different types of assets, ideally separating high technology equipment from other types of investments. In healthcare, intermediate input includes drugs and clinical supplies and other purchases for current use. Again ideally we should try to separate drugs, which have been subject to rapid technological change, from other inputs.

[1] Some data on outcomes for particular health conditions are available, for example, following the development of Patient Reported Outcomes Measures (PROMs) in the UK. For further discussion of available indicators of health outcomes see O'Mahony and Stokes (2011).

Data

This section outlines data availability and highlights some practical issues that arose during the data gathering process. For three of the four countries the sample period was 2003-09 but data problems restricted the German estimates to the period 2004-08.

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Output

The research compares the growth in aggregate activity across the four countries. The most complete data are available for hospital inpatients so we begin with a discussion of that component of the healthcare services. Hospital output consists of both inpatient and outpatient care. In this report we define inpatient care as treatment consisting of some procedure administered to the patient such as an operation or drug treatment that requires monitoring of the patient in hospital. This can include minor operations that are carried out as day cases without the need for an overnight stay in hospital. Outpatient appointments are generally specialist consultations, pre-procedure and follow up appointments with the consultant or a member of their team who meets the patient but does not engage in any procedures. This definition best fits the UK data but as we will see below such a distinction is more problematic for other countries.

Hospital inpatient output

In terms of inpatient care each country produces data on activity, measured by the number of episodes, and unit costs by Diagnosis Related Group (DRG) for the hospital sector. The list

of DRGs varies across the countries so it is not feasible to directly match these. However aggregate activity and activity by broad diagnosis groups can be compared. In-hospital mortality rates are also available by DRG.

In order to calculate cost weighted activity indexes it is important to match DRGs over time within each country. The list of DRGs showed significant changes across time in all four countries. The types of changes are illustrated in Table 1 using a hypothetical example. The first two columns illustrate a common occurrence – an aggregate group in year t is broken down into a number of groups in year t+1. The way we dealt with this change was to aggregate A07A-E in year t+1 to give one overall group that could be compared with A07A in year t. In subsequent years the more detailed breakdown was used. The more complex problem is illustrated in the final two columns which is based on a real example from the German DRG system. A group of procedures in year t, A09C, are reclassified in year t+1 with some involving a breakdown into finer classifications (A09C-A09G) but some also migrating to other DRGs such as B36A. Simple aggregations do not help in dealing with this change.

For the UK the episode data were available on a consistent DRG[2] basis throughout our sample period but some aggregation was necessary for calculating unit costs. Similar issues arose for Hungary (see Hüttl and Nagy, 2012 for details). The number of changes was small for Spain and easily dealt with by aggregation. However it turned out that the complex problem was a major issue for Germany where migrations across DRG groups were very common and significant. In this case the original microdata were employed to achieve a

[2] These are referred to as Healthcare Resource Groups (HRGs) in the UK.

consistent matching through time (see Schulz, 2012 for details) – this restricted the number of years included in the sample.

Table 1. DRG changes through time

DRG t	DRG t+1	DRG t	DRG t+1
A07A	A07A	A09C	A09C
A07A	A07B	A09C	A09E
A07A	A07C	A09C	A09F
A07A	A07D	A09C	A09G
A07A	A07E	A09C	B36A
		A09C	F36A
		A09C	G36Z
		A09C	R36Z

In addition to changes through time, there are also some DRGs where unit costs are not available. In these cases we generally imputed a unit cost based on the median for related activities. Missing unit costs were only a problem in practice for the UK as the number of patients affected was small for other countries.

Non-hospital activity such as primary care, mental health and various screening and diagnostic activities can also be compared across the four countries only to a limited extent as issues of comparability were more difficult to deal with for these activities. In terms of inputs, each country has good quality data on labour input which distinguishes numbers employed and hours worked by occupation (doctors, nurses, auxiliaries etc.) and their relative earnings. Data on capital and intermediate input use are more sparse and proved difficult to

match with the output data presented below. Therefore in this paper we confine attention to labour productivity growth.

Results

Preliminary results covering the period 2003 to 2009 suggest that there is some variation in the growth rate of hospital output across countries measured by the cost weighted activity indexes, ranging from about 4% per annum growth in the UK compared to a slight decline in Hungary, but with large variation by year, especially for Hungary. This is illustrated in Charts 1a-d which show the growth in total inpatient activity and the cost weighted activity index for selected years. In all countries, cost weighted activity growth is higher than the growth in total activities suggesting greater concentration of services in relatively high cost procedures. Note the large negative entries for Hungary between 2005 and 2007 are due to reorganisation of the hospital sector. In Hungary the number of inpatient activities used to be very high (in 2004 over 2.5 million cases compared to about 10 million inhabitants so a major restructuring was undertaken in 2005-2006 with many patients taken out of the hospital sector and reallocated to other types of care (see further discussion below)).

Chart 1a. Hospital inpatient activity and cost weighted activity growth, Germany, 2004-08

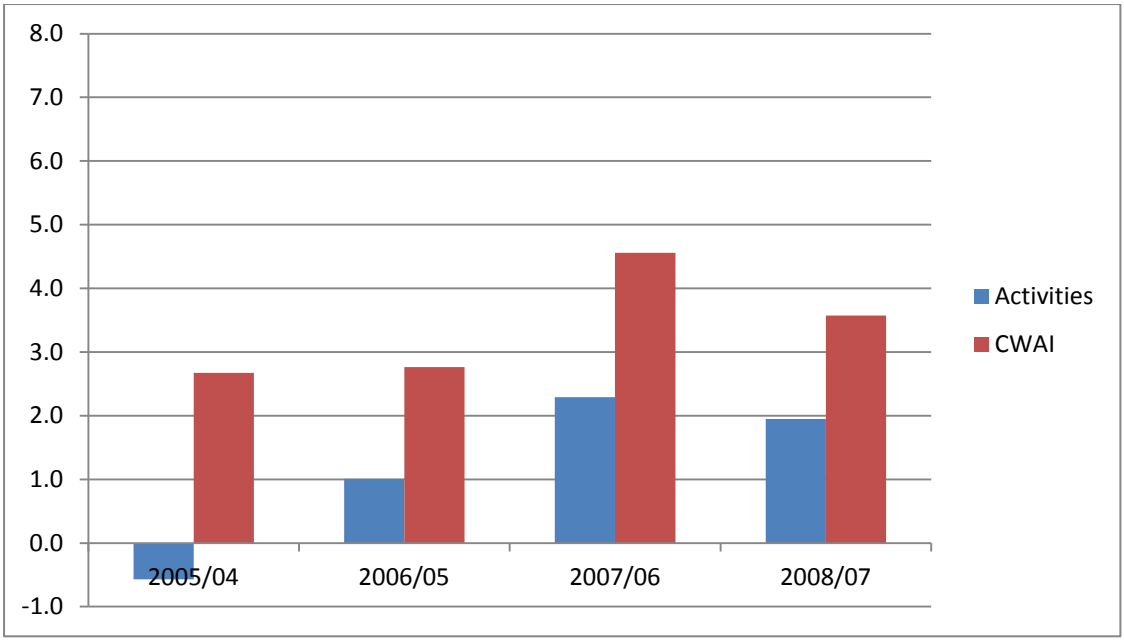


Chart 1b. Hospital inpatient activity and cost weighted activity growth, UK, 2003-09

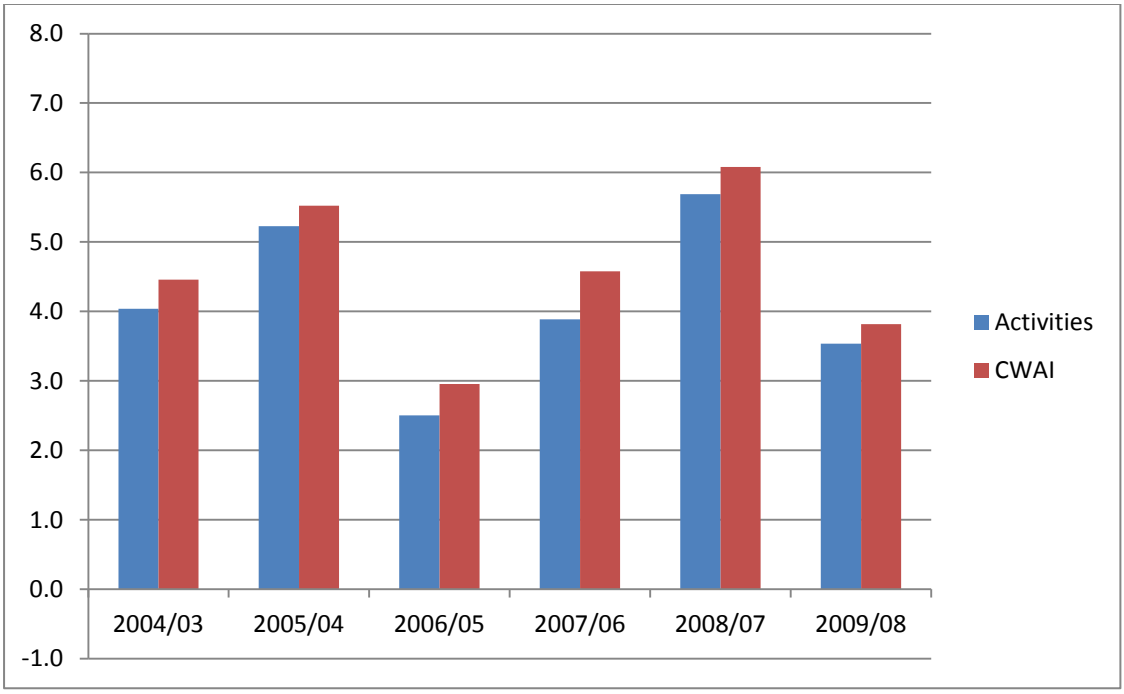


Chart 1c. Hospital inpatient activity and costs weight activity growth, Spain, 2003-09

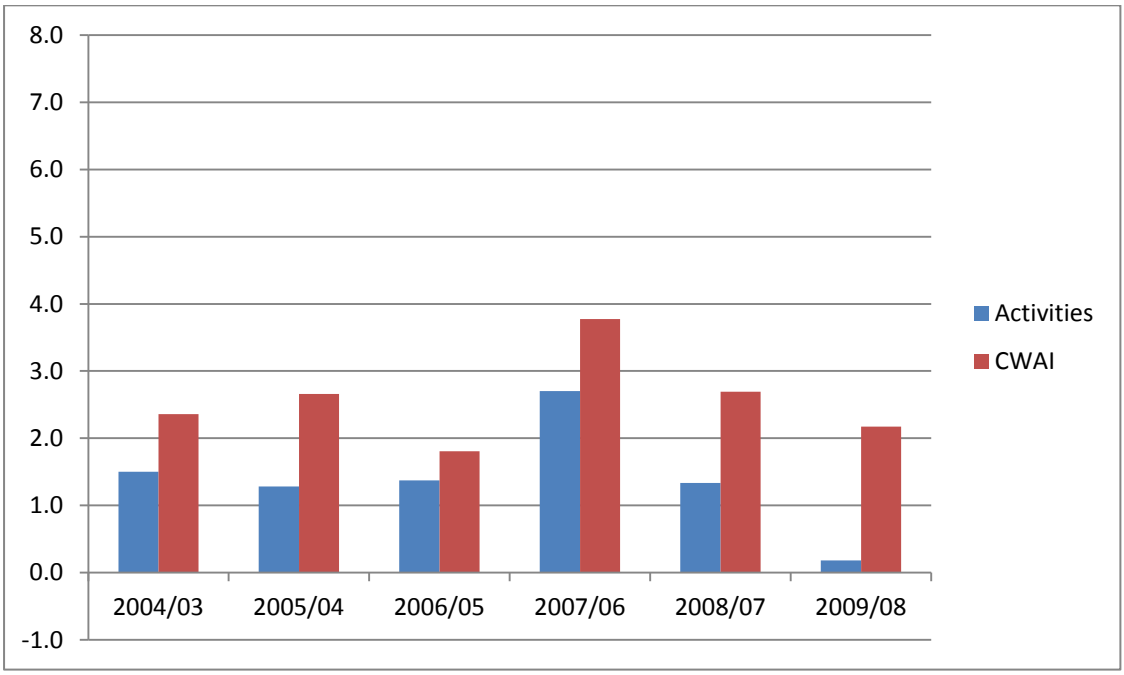
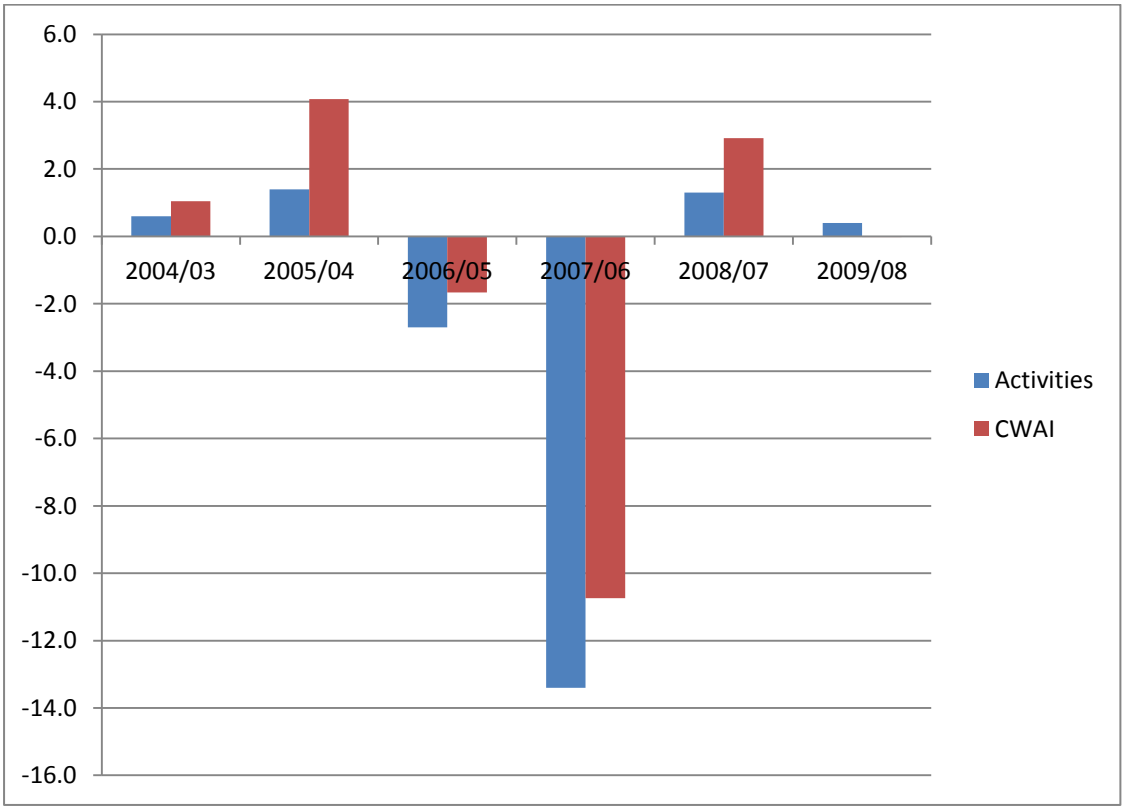


Chart 1d. Hospital inpatient activity and costs weight activity growth, Hungary, 2003-09

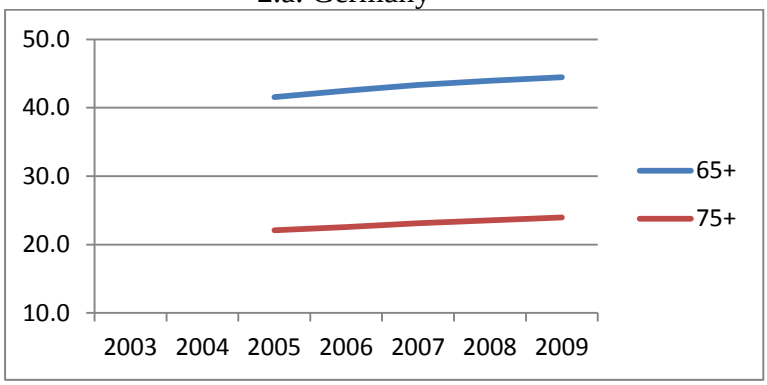


The underlying data suggests that the difference between the unweighted and cost weighted activity indexes are likely due to the increases in treatments for the elderly, especially those aged 75 or over, and increases in treatments for complex conditions with co-morbidities. Charts 2a-2d illustrate this trend towards hospitals treating more older inpatients through time. Although the years for which data are available and the age categories vary across country and so are not directly comparable, all four show upward trends, and this is especially strong in Spain for patients aged 75 and over.

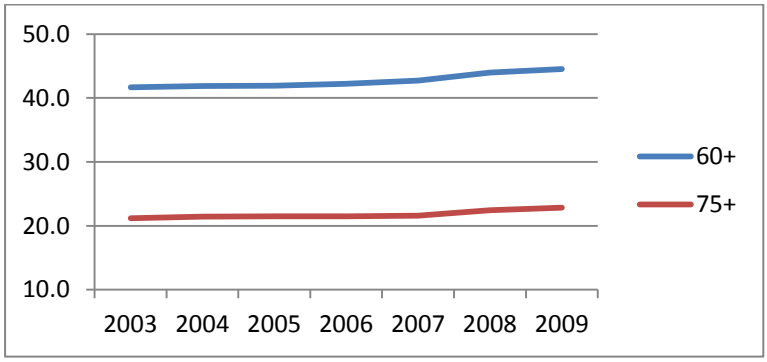
Unit costs are not available for DRGs by age for the four countries in this paper so it is not possible to calculate separate CWAI by age group. Schulz (2012) presents estimates of the CWAI for DRGs that are specifically dedicated to those aged over 65 for Germany. This found extremely high growth for these procedures, of the order of 15% per annum from 2004-2006 and over 10% per annum between 2006 and 2008. Chart 1 shows about 3% average growth in the overall CWAI over the 2004-2008 time period. However these elderly specific DRGs represent only a small percent of overall procedures (3.4% of inpatients in 2008). An alternative calculation that chose DRGs where more than 80% of patients were aged over 65 yielded CWAI growth rates over 7% between 2006 and 2008, but slightly above the aggregate in the period 2004 to 2006. In both calculations the CWAI growth was significantly higher than activity growth suggesting that even within DRG procedures that are concentrated on older people, there is a trend towards greater use of relatively high cost procedures.

Chart 2. Share of older age groups in total number of hospital inpatients

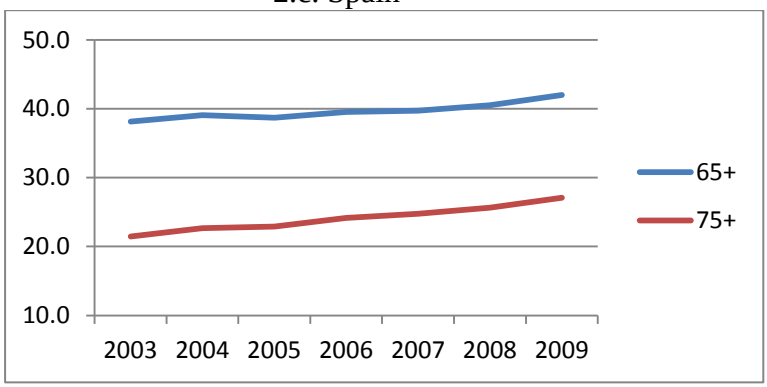
2.a. Germany



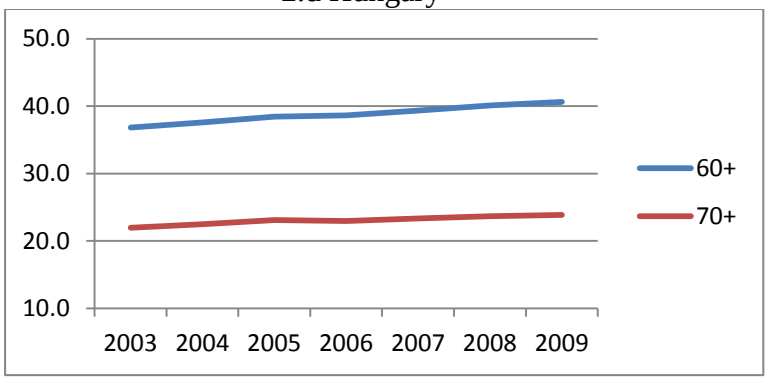
2.b. UK



2.c. Spain

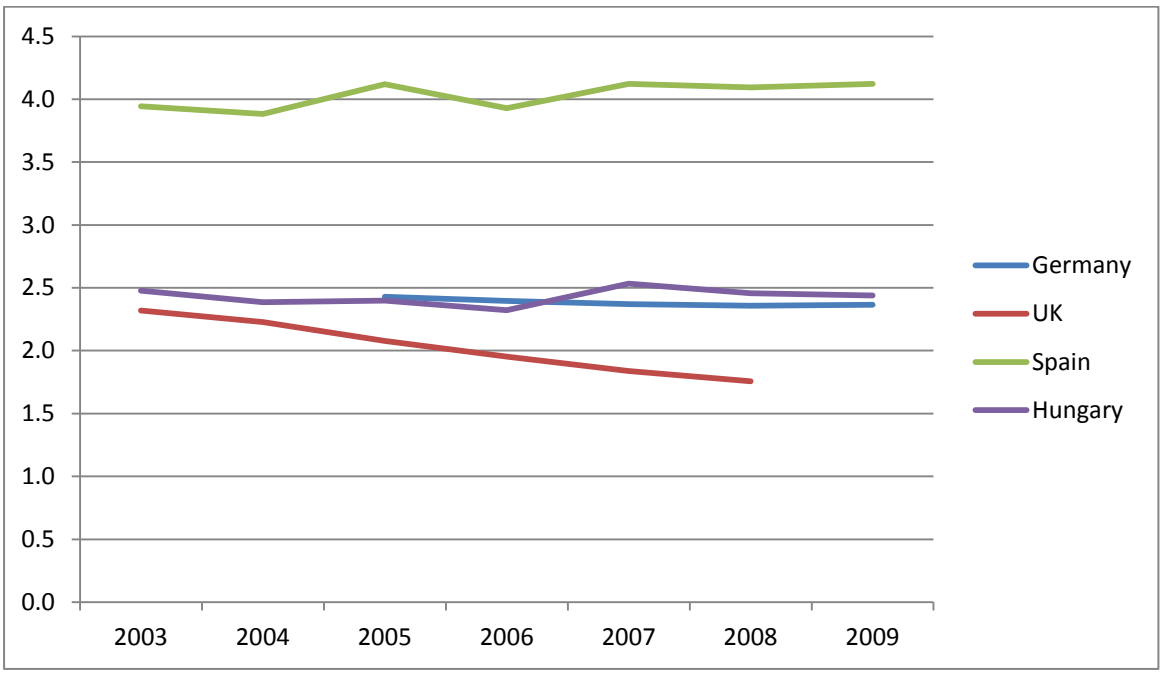


2.d Hungary



We next consider the impact of including adjustments for survival rates as a measure of quality. Chart 3 presents the trends in in-hospital mortality in the four countries over our sample period. Caution should be exercised in comparing these directly across countries because of definitional issues. Broadly, on aggregate, in-hospital mortality has remained fairly stable over this period in Spain and Hungary, with slight falls in Germany and the UK. The impact on the output index will however be particularly driven by how mortality has changed for both high volume and high cost activities.

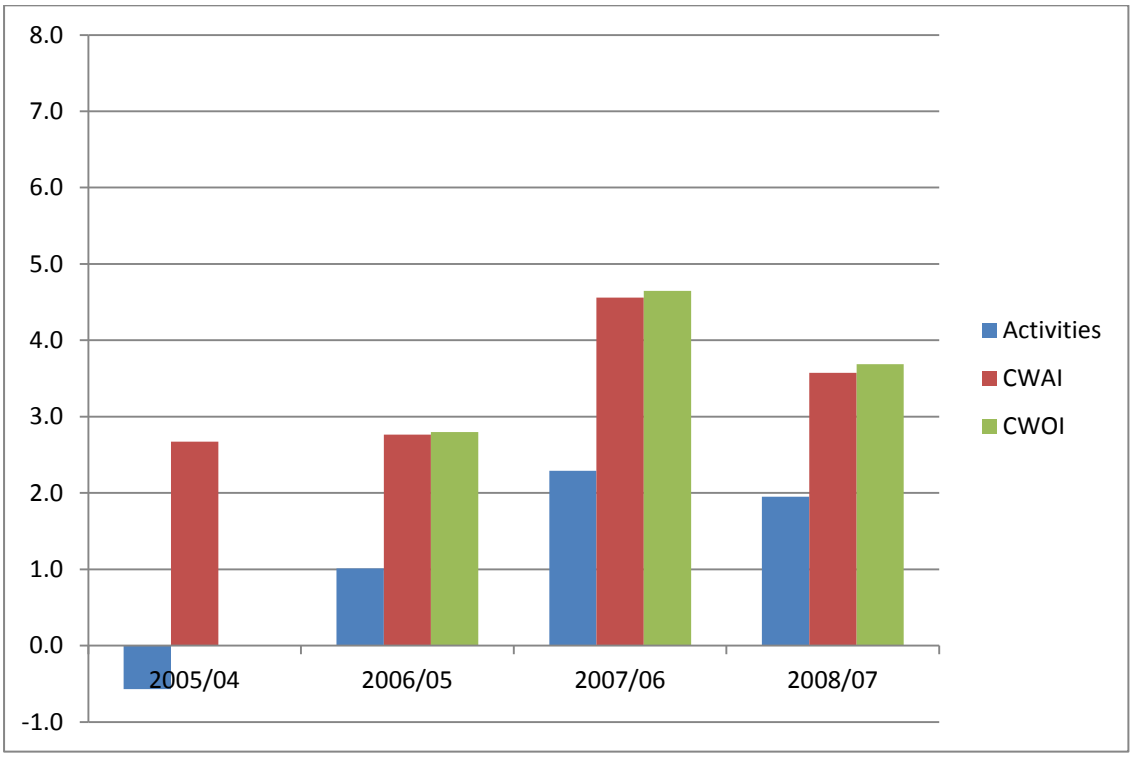
Chart 3. In-hospital mortality rates



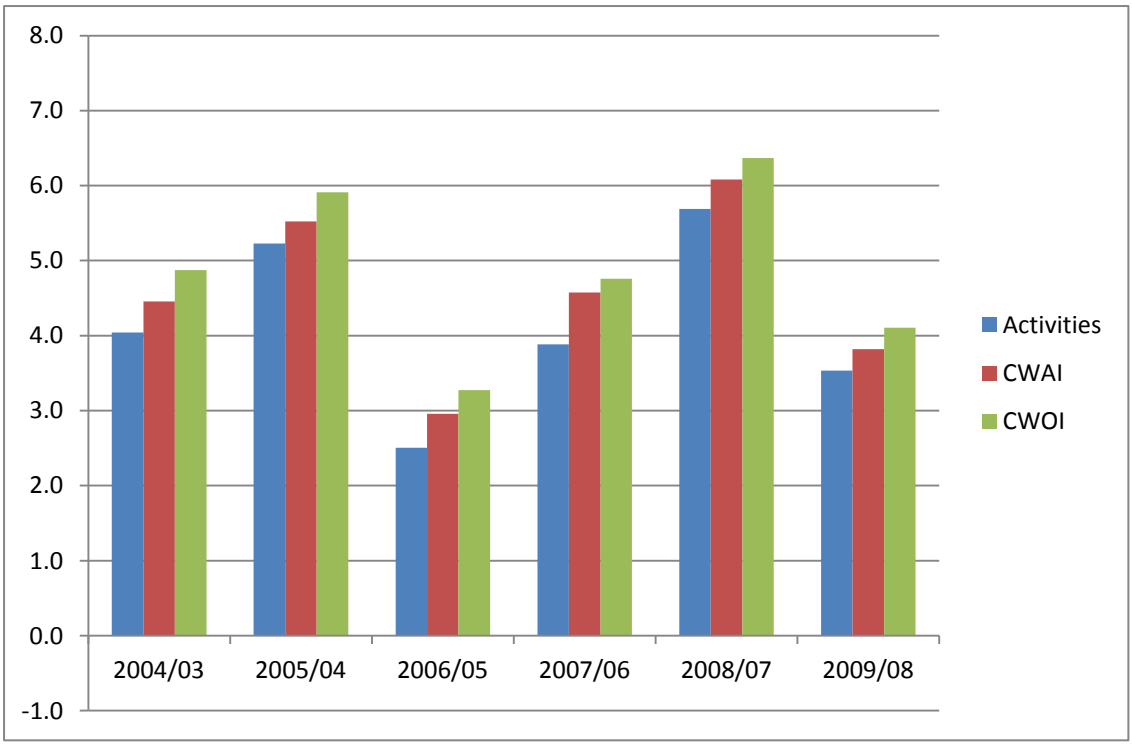
Charts 4a-d illustrate the impact of including the survival adjustment, which we call a cost weighted output index (CWOI). This shows an increase for all countries and most time periods but the adjustments are relatively minor. This is in line with the impact of adjustments found in earlier work for the UK (e.g. Dawson et al., 2005; Castelli et al., 2008).

Chart 4. Activities, cost weighted activities and cost weighted output (adjusting for survival)

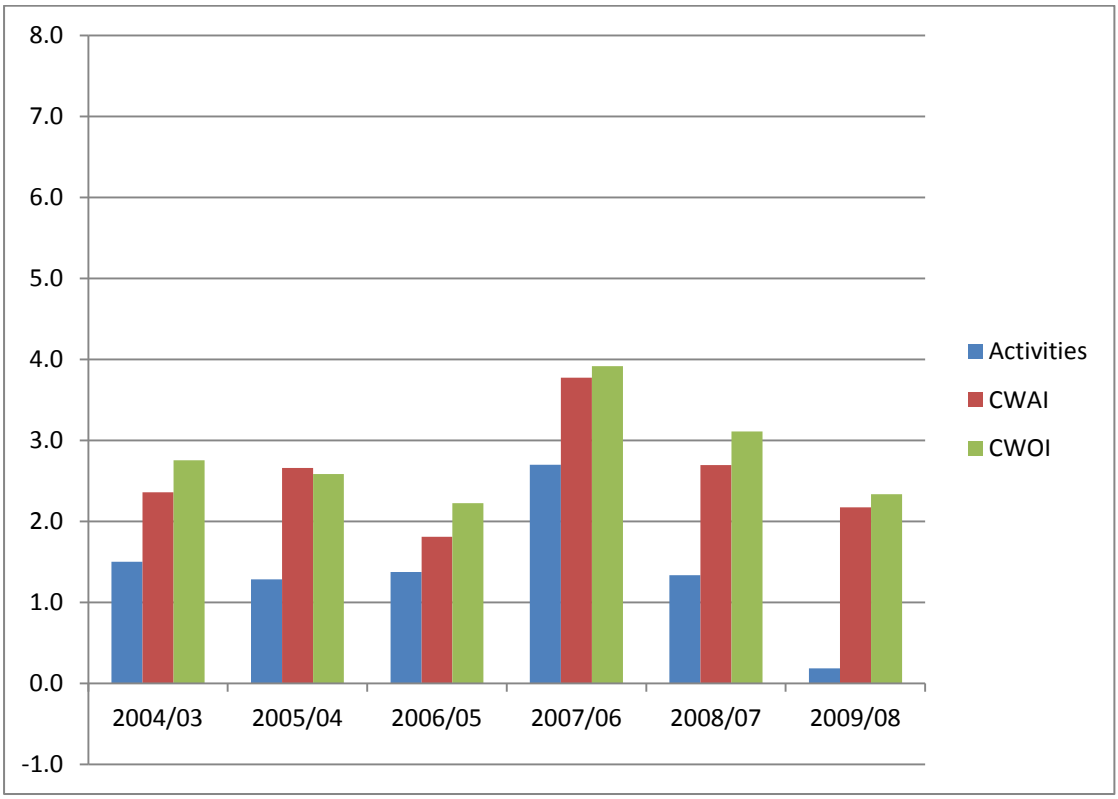
4.a. Germany



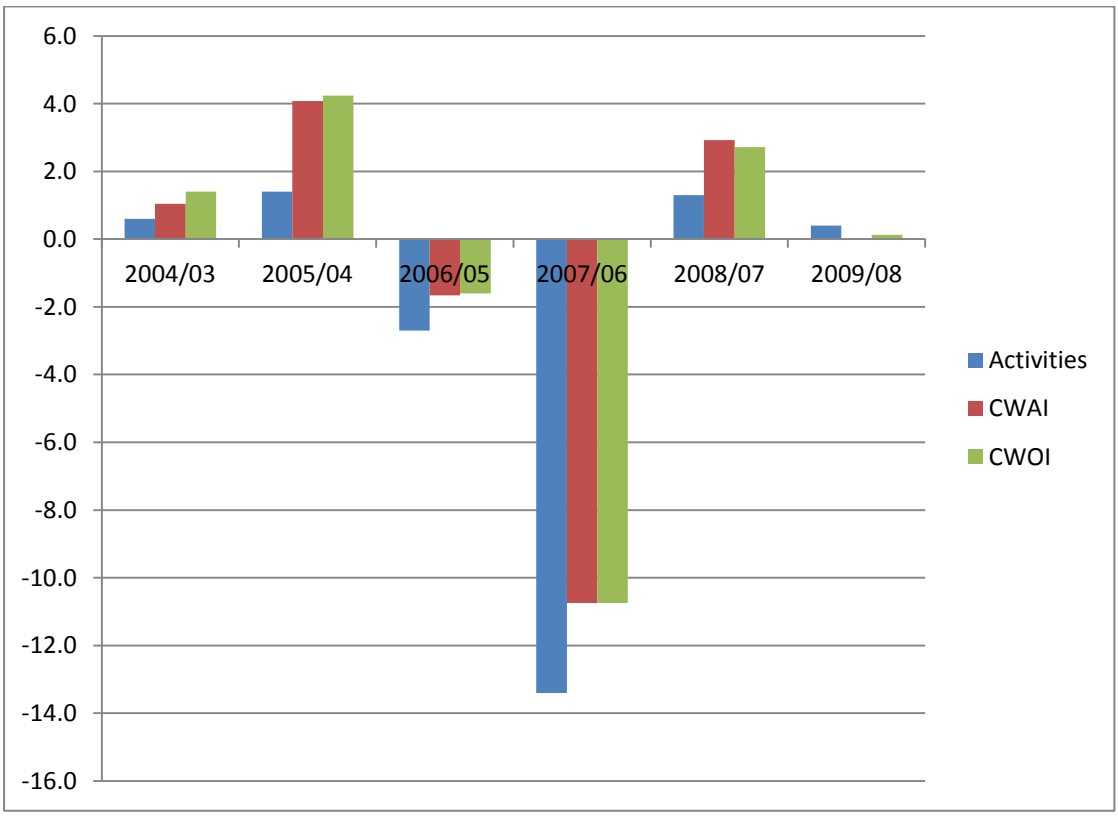
4.b. UK



4.c. Spain

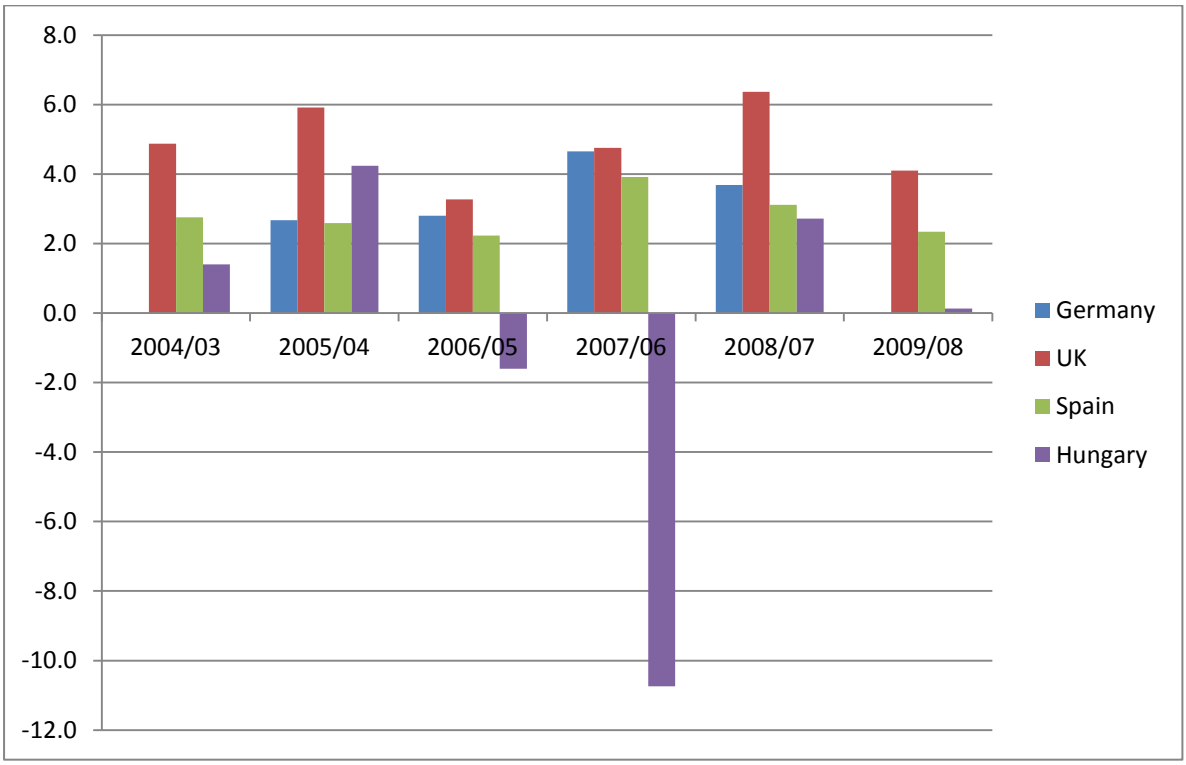


4.d. Hungary



It is useful to summarise the growth rates of CWOI across the four countries, shown in Chart 5. This shows clearly higher growth rates in the UK than the other three, coinciding with policy initiatives that significantly increased government expenditures on health services.

Chart 5. Comparative CWOI growth in four countries



Note: Data for Germany are only available for the period 2005/4 to 2008/7, with data on survival only available for 2006/5 onwards (the chart presents the CWAI for Germany for 2005/04).

Before examining other hospital activity it is useful to try to compare output growth across the four countries by major treatment group. Although DRGs cannot be matched, some broad disease categories are roughly comparable. First comparing the UK and Germany, Chart 6 shows the growth in CWAI and CWOI for the broad categories listed in Table 2. In almost all categories the UK outperforms German growth and the UK adjustments for survival are generally much greater. This is especially true for diseases of the respiratory system (group D) where the mean age of patients tends to be very high (67 years in the UK in 2008). However there are also large UK relative gains in output in groups such as H

(Musculoskeletal system) and K (Endocrine and metabolic system) where the mean age is less than 60. Hence the better performance of the UK on this measure is observed across a range of conditions and not just confined to a few.

Chart 6. Growth in CWAI and CWOI, Germany and the UK, average 2005-2008

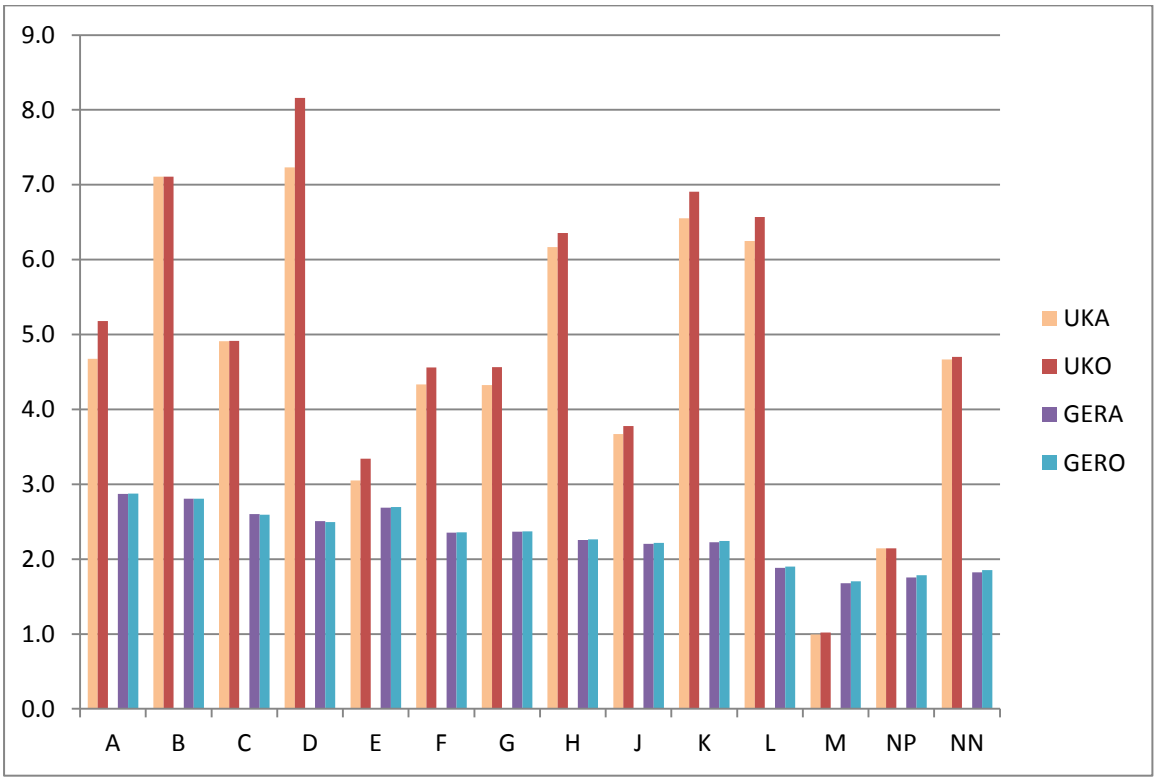
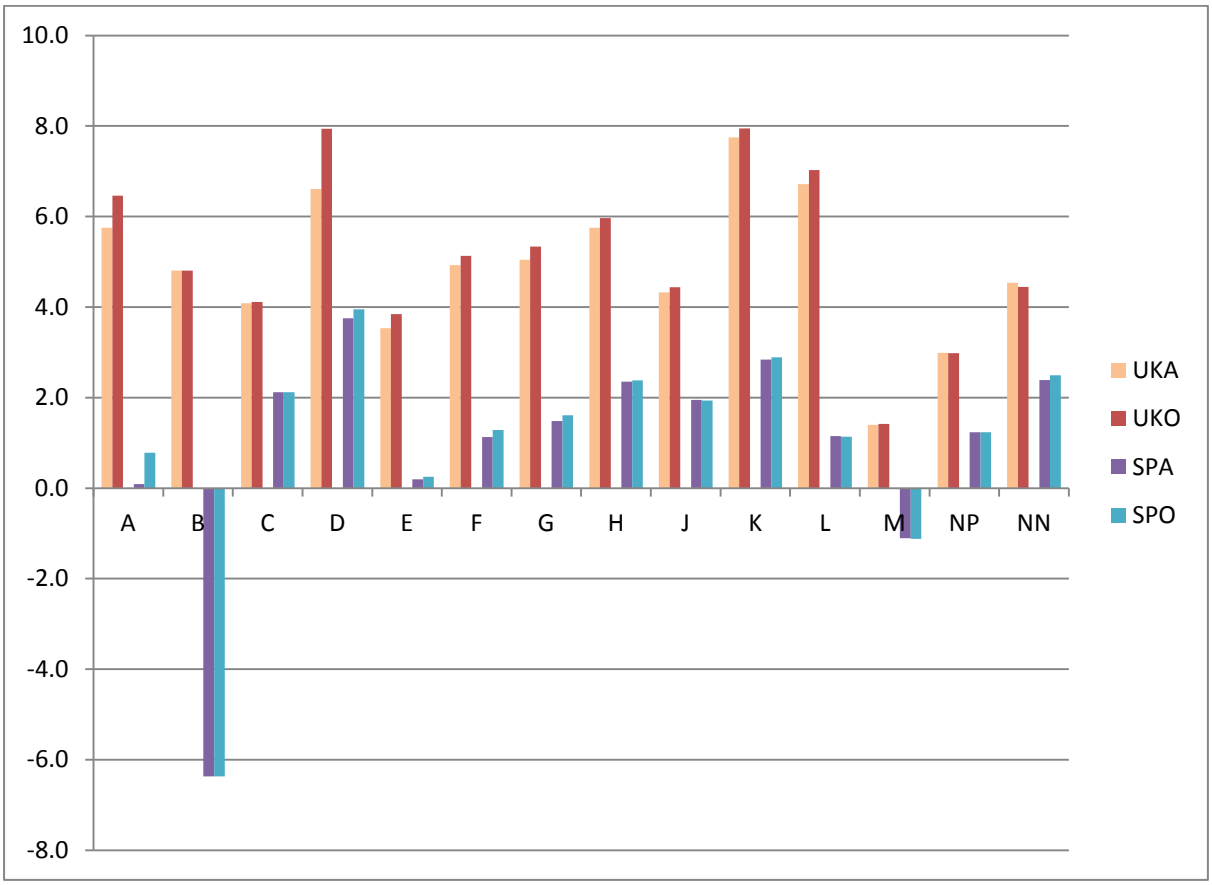


Table 2 Broad disease categories

CODE	Description
A	Nervous system
B	Eyes and periorbita
C	Mouth, head, neck and ears
D	Respiratory system
E	Cardiac surgery and primary cardiac conditions
F	Digestive system
G	Hepatobiliary and pancreatic system
H	Musculoskeletal system
J	Skin, breast and burns
K	Endocrine and metabolic system
L	Urinary tract and male reproductive system
M	Female reproductive system
NP	Obstetrics
NN	Diseases of childhood and neonates

Chart 7 compares the UK and Spain growth rates of CWAI and CWOI, averaged over a longer time period, 2003-2009. This shows much more variability in Spain. Relative to the UK Spain performs worse in all categories and increases due to greater survival rates are again much lower than in the UK.

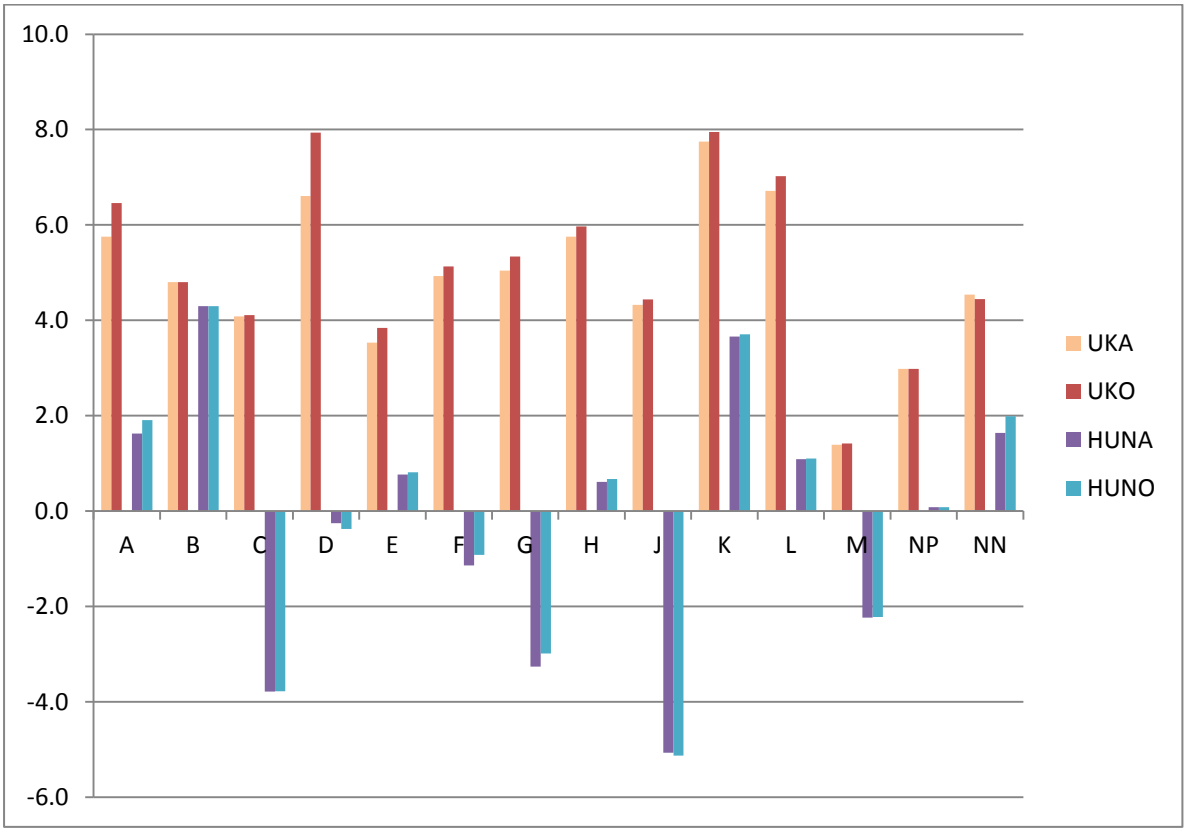
Chart 7. Growth in CWAI and CWOI, Spain and the UK, average 2003-2009



Finally in this section we compare the UK and Hungary, shown in Chart 8. As with Spain, growth in activity is very variable in Hungary with some conditions showing pronounced declines over the period. There is declining growth in some important life threatening illnesses such as respiratory conditions. Again the UK survival adjustments appear much higher than for Hungary. This to some extent reflects the fact that hospital death rates in

Hungary may be artificially high, as home care of dying persons is not organised and financed by the social security system.

Chart 8. Growth in CWAI and CWOI, Hungary and the UK, average 2003-2009



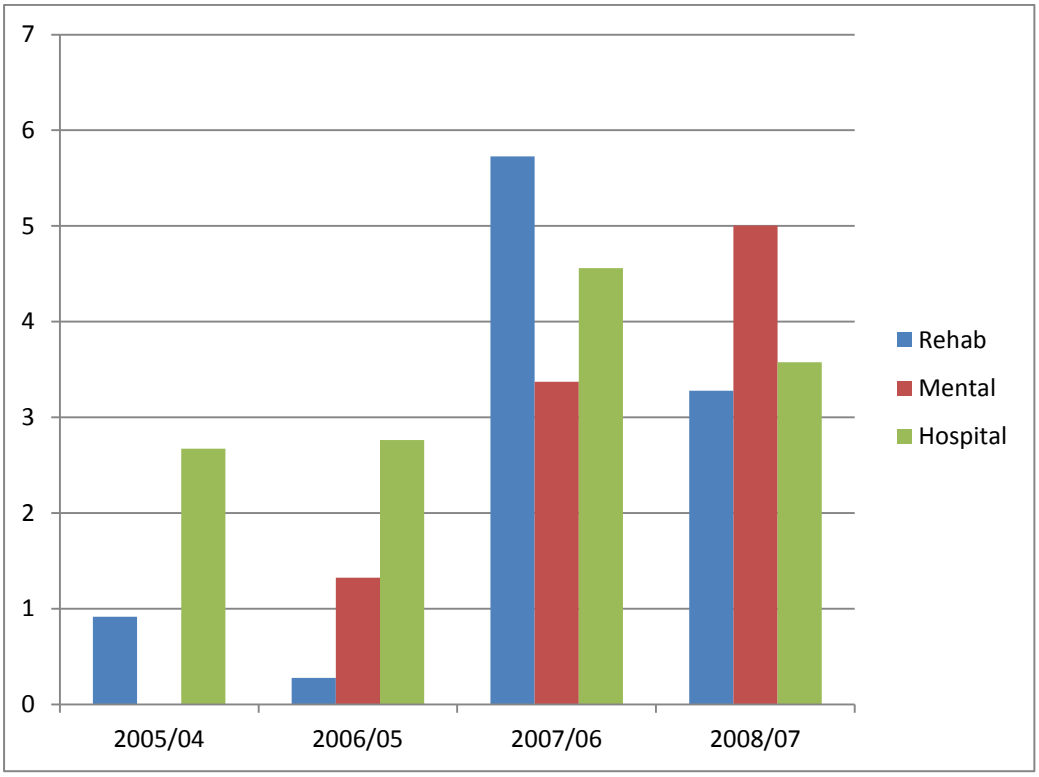
Other activity

Deriving internationally comparable data on activities other than inpatient care is very difficult. For Germany data on outpatient care was not available on the same basis as for inpatient activity. Outpatient services in hospitals are classified as treatments carried out by specialists as part of their ambulatory health care service. Practicing physicians as well as doctors employed at a hospital are allowed to treat patients on an outpatient basis in hospitals using the facilities of hospitals. They have to reimburse the hospital for the use of the devices and equipment. They are then reimbursed by the health insurance funds at a fee for service base. Data from the health insurers suggest that these activities have been growing at the rate

of about 11% per annum between 2004 and 2008 which is much higher in terms of inpatient growth. However, without unit costs it is not possible to add this component of output to the inpatient data shown in Chart 1a.

It was possible to estimate cost weighted activity indexes for both mental health activities carried out by non-DRG hospitals and for rehabilitation services. Chart 9 contrasts the growth in these two activities with the cost weighted output index for hospitals. The average across the short time considered here is similar in the three levels of activities, about three percent per annum, although the chart does show some differences year on year.

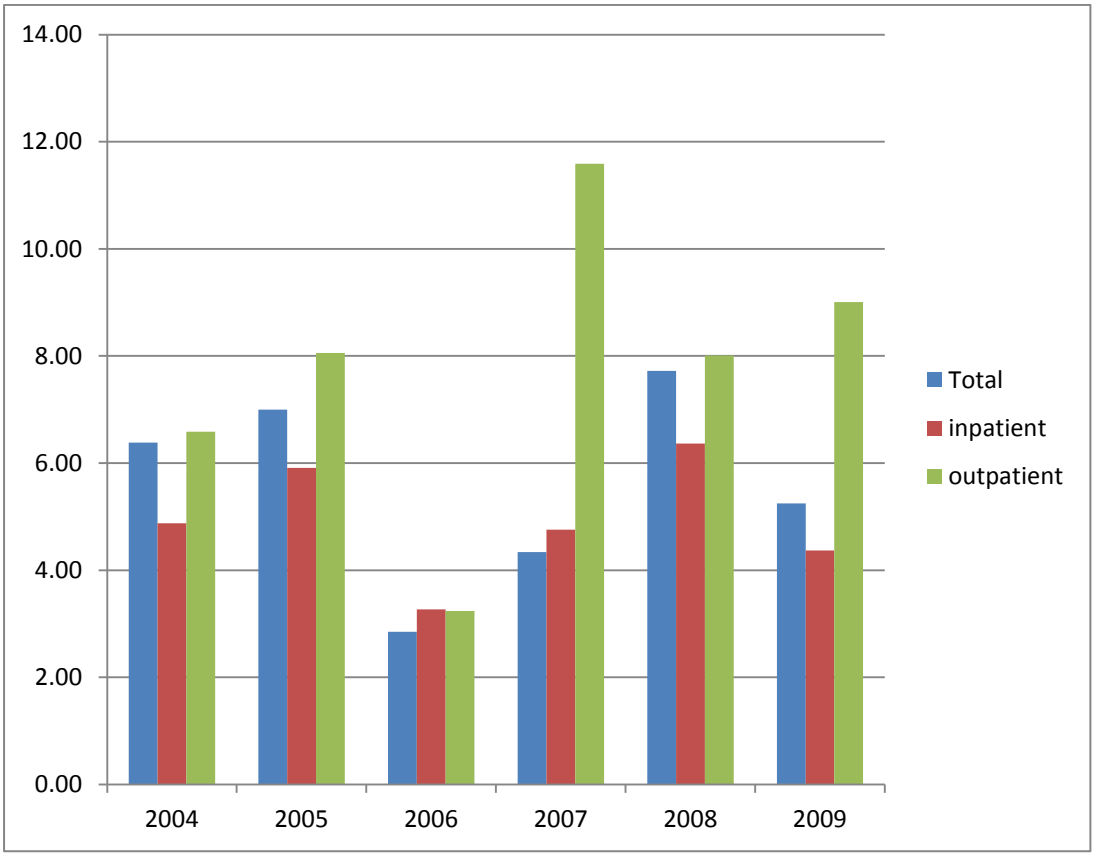
Chart 9. CWAI, rehabilitation, mental health and DRG hospitals, Germany



The UK has the most complete data by activity. The Department of Health has been providing data on many activities and unit costs since the late 1990s in their reference costs

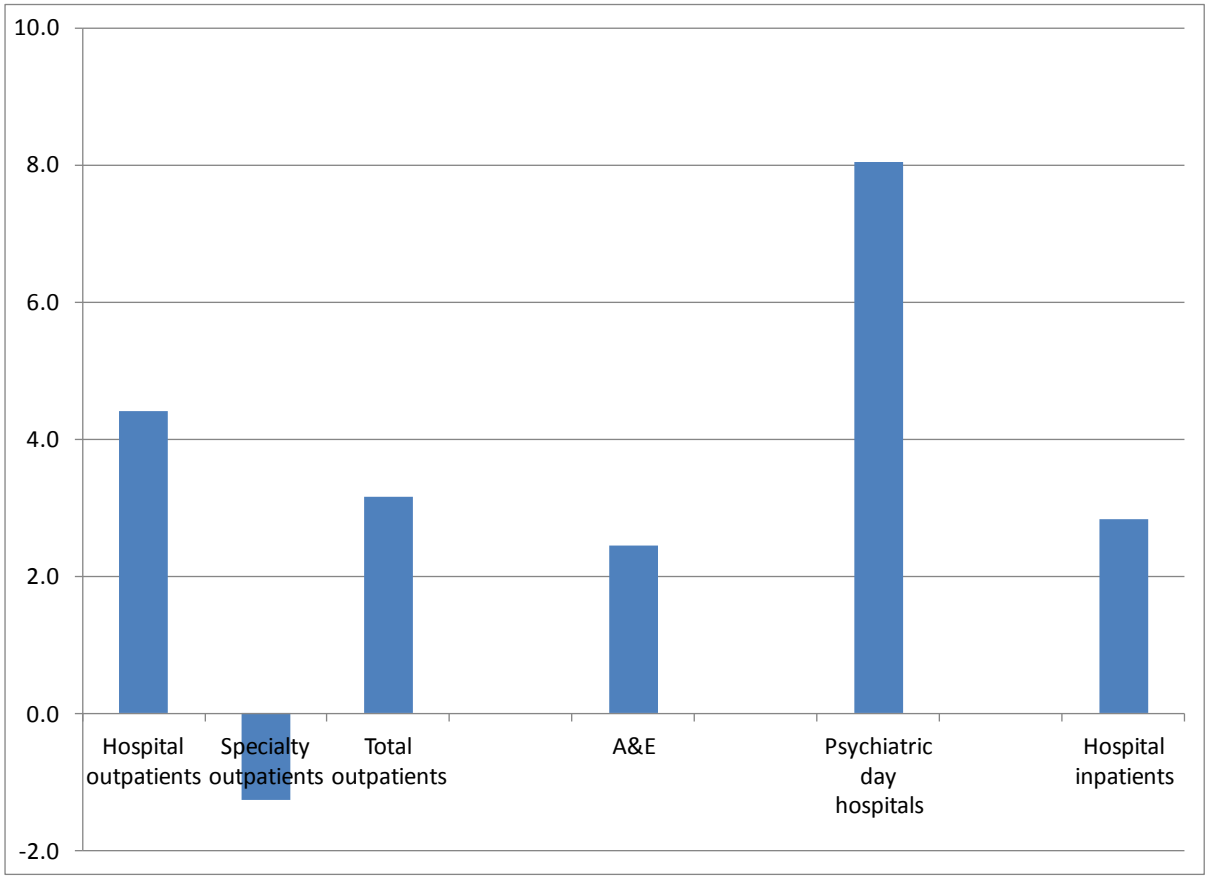
database with the extent of detail and coverage rising through time. Chart 10 presents CWAIs for outpatients and other activities where the coverage and types of treatment could be compared across time. The 'other activities' group includes accident and emergency, mental health, diagnostic tests, chemotherapy, radiotherapy, renal dialysis and treatment for cystic fibrosis. Outpatient activity has been growing much faster than inpatient activity, by on average about 3 percentage points per year – outpatients represented about 22% of expenditure across these three broad groups on average across this time period. Other activities grew at a similar rate to inpatient activities on average but were much more variable year on year – these represented about 18% of expenditures.

Chart 10. Inpatient, outpatient and other activity, UK.



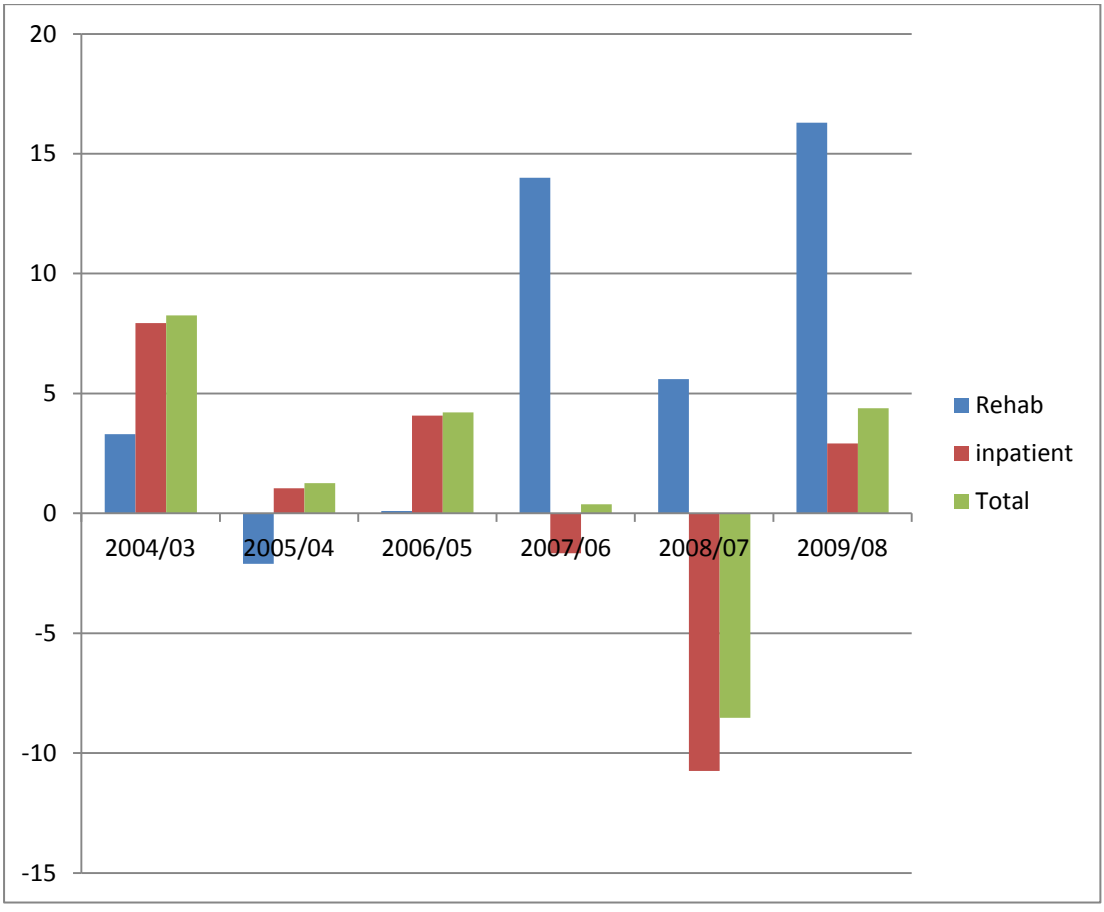
In the case of Spain there is very little information available outside the hospital sector. Although total volumes are available for a few activities, unit costs are not. Chart 11 shows average growth rates for the period 2003-09 for outpatients, accident and emergency and psychiatric day hospitals, contrasting with the growth of inpatient activity. Total outpatient growth was higher than inpatient growth, although not by as much as for the UK. This is dominated by hospital outpatients with negative growth over the period in specialty centres. Growth in psychiatric hospital activities was particularly strong. Without unit costs it is not possible to measure aggregate output. If we used UK relative shares for these activities then the overall output growth would be marginally higher, 3.2% per annum, than the 2.8% for inpatients alone.

Chart 11. Output growth in Spain, average 2003-09



Hüttl and Nagy (2012) present estimates of cost weighted activity for rehabilitation and long term care (Rehab). Chart 12 shows the results. In Hungary there has been a major restructuring of the health sector in the past decade with many patients who were previously treated in hospital being transferred to the rehabilitation and long term care sector. Overall combining inpatients and Rehab across the time period from 2002 to 2009 growth in output was about 2.5 percent per annum. Therefore although individually the two series on inpatients and rehabilitation show large swings, the overall output figure is less volatile. Data on outpatients by procedure were not available due to inconsistencies in measurement across time. Total outpatient appointments grew on average at 1.5% from 2004 to 2009, less than for the other outputs shown in Chart 12, with similar large swings from year to year as for inpatients.

Chart 12. Growth rates in inpatients and rehabilitation and total activity, Hungary



Labour input and labour productivity

Given the large differences in coverage of outputs across the four countries, the approach taken to measuring labour productivity was to try to match labour input to the activities covered. So for Germany we present estimates for hospital activity alone whereas the UK includes all non-primary care activities and Hungary includes both hospital inpatient and Rehab.

Table 3 shows growth rates over the period 2003 to 2009 and shares in 2009 of various categories of staff employed by German hospitals. This shows significant growth in medical services (mostly doctors) with some growth also in medical technicians and other professionals. There has been a decline overall in nursing staff (the largest individual category) and many other groups.

Table 3. Growth in numbers employed and shares of the workforce by category, German hospitals

	Growth (average 2003-09)	Share 2009 (%)
Medical services	2.33	16.2
Nursing services	-0.69	37.6
Medical technician services	0.55	15.9
Functional services*	1.30	11.2
Clinical domestic service staff	-7.46	1.5
Housekeeping and supply services	-4.91	5.5
Technical services	-1.71	2.2
Administrative services	0.11	7.2
Special services	-1.22	0.5
Other personnel	-0.79	2.2

* includes nursing staff for surgery service, anaesthesia, midwives, occupational therapists and ambulance service.

Using relative earnings to weight each group leads to an overall growth in labour input of 0.2% per annum over the period 2003-09 and 0.15% per annum from 2004 to 2008. As cost

weighted activity grew on average by about 3.4% in the latter period, this implies strong positive labour productivity growth.

Table 4 shows similar information for the UK NHS excluding primary care. Doctors are a lower share than for Germany but this is not surprising given that the activities covered are broader. Nurses have the highest individual shares followed by support services. As for Germany doctors show the highest overall growth followed by other professionals with growth in nursing staff relatively low.

Table 4. Growth in numbers employed and shares of the workforce by category, UK NHS

	Growth (average 2003-09)	Share 2009 (%)
Doctors and other medical staff	4.59	8.31
Qualified Nurses	1.32	29.21
Qualified scientific, therapeutic & technical staff	3.37	12.34
Qualified ambulance staff	1.94	1.48
Support to clinical staff	1.23	29.13
NHS infrastructure support	2.78	19.50
Other non-medical staff	-9.84	0.03

Aggregate labour input growth is estimated again using earnings shares, estimated at 2.4% per annum between 2003 and 2009. In the same period output grew at 5.6% per annum so labour productivity grew at 3.2% about equal to the rate in Germany.

Growth in staff numbers by category in Spain are shown in Table 5 for the acute care sector. Medical doctors represent a higher share and are growing faster than in the equivalent German sector. Overall growth in employment at 3.5% is significantly higher than the 2.8% growth in output over the same period suggesting negative labour productivity growth in Spain of about -0.7% average per annum. We do not have data on relative earnings but it is likely that an earnings weighted labour input would grow faster as the growth in relatively

expensive doctors is higher than less costly groups such as nurses. This would make the growth in labour productivity even more negative. Adding numbers employed in long term care and psychiatric hospitals implies only marginally smaller growth in labour at 3.4%. If we accept the crude estimate of 3.2% output growth when these additional activities are included, labour productivity growth would be only marginally negative at -0.2% per annum.

Table 5. Growth in numbers employed and shares of the workforce by category, Spain.

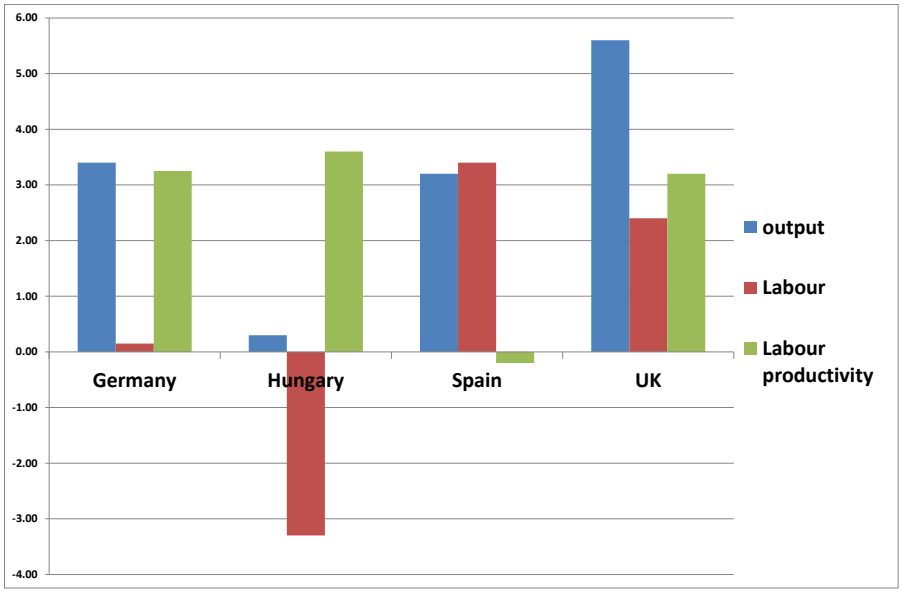
	Growth (average 2003-09)	Share 2009 (%)
Doctors	4.19	19.63
Nursing assistants	3.21	20.57
Qualified Nurses	3.77	26.96
Resident Physicians	4.37	3.65
Other Medical staff	7.28	4.22
Non-medical staff	2.44	24.98
Total	3.54	100.00

Hüttl and Nagy (2012) present estimates for Hungary for inpatients and rehabilitation and long term care combined. Their estimates suggest significant declines in labour input over the period, of the order of -3.3% per annum. This is derived as the wage weighted average of numbers employed in the three output areas, inpatients, mental health and long term care. Since aggregate output in these combined activities was growing at 0.3% per annum, this translates to labour productivity growth of 3.6%. This is slightly above the rates reported for Germany and the UK above.

Chart 13 summarises output, labour input and labour productivity growth for the four countries. It shows that in three of the four countries, similar labour productivity growth was achieved through different channels – significant output growth in Germany with no increase in labour input, very high output growth in the UK but also relatively high growth in labour

input, and low output growth in Hungary accompanied by a significant reduction in labour input. Output growth in Spain was similar to that in Germany but labour input growth was the highest in the four countries so that labour productivity growth was slightly negative.

Chart 13. Growth in Output, Labour Input and Labour Productivity, 2003-09*



*2004-08 for Germany

Conclusions

This paper attempted to compare output and productivity in healthcare production across four European countries. Leaving aside the data comparability issues for now, the picture that emerges is one of similar labour productivity growth rates in Germany, the UK and Hungary with Spain lagging considerably behind. Output growth is relatively steady in the more mature German hospital sector with the UK catching up through higher output growth. In both, the high growth rates are apparent across most major conditions. In Hungary the high growth in labour productivity is due almost entirely to declining labour input reflecting a transformation and restructuring of the sector in the past decade with low growth in output

overall. Output growth in Spain is a little lower than in Germany but this has not kept pace with the growth in labour input. Both Spain and Hungary show much greater variability across the main procedure groups than Germany or the UK.

These conclusions, however, need to be tempered by the many data comparability issues that arose when trying to compare the four countries. One important conclusion emerging is the need for much more information for activities other than inpatient treatment in hospitals in three of the four countries. An important insight that arose from attempts to measure and compare output and productivity growth was that the data required are intrinsically linked to the system of provision of the service. Therefore when systems differ international comparisons become very difficult. Counting number of patients by treatment carried out or disease category is made difficult as the same person may have multiple contact points which can cross producing units. For example in the UK a typical patient journey starts with a referral from primary care, outpatient attendances in hospitals, inpatient treatment, follow up outpatient appointments and possibly subsequent care in the community. UK data sources include measures for all these levels of service even though tracking of individual patients is not currently feasible. In Germany the journey is different and some parts of the treatment such as follow on care are reimbursed through the social security system so do not appear in hospital data. In general coverage of activities and treatments varied across the four countries - the UK had the most complete coverage as most health services are produced by the NHS but even here the small private sector is not covered. Ideally the output and labour productivity growth rates presented above should be evaluated relative to levels but the different coverage makes this a difficult task.

These problems could be overcome by using administrative data that tracks all treatments received by patients so the patient rather than the activity becomes the unit of output. To adequately take account of quality of treatment the main requirement is information on health status before and after treatment. There has been some progress in measuring impacts of treatment for a few conditions in the UK but to date there is no systematic international evidence. Finally there is very little available evidence on inputs other than labour so deriving multi-factor productivity estimates is not feasible at this stage.

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