HEALTH CARE SPENDING IN CROATIA AND SELECTED EU COUNTRIES – A PANEL UNIT ROOT ANALYSIS

Ivo Družić, Šime Smolić and Marija Penava
Faculty of Economics, University of Zagreb, Croatia

ABSTRACT

In the past four decades, a sharp increase in total health care spending, especially in developed countries, can be observed. The rise in share of the health care expenditures in GDP is driven mostly by the ageing population, the medical technology progress and the expectations of the population, namely the patients. In this paper health care spending and the outcomes of the health care system in Croatia and 11 selected countries of the European Union (EU) will be analyzed. The link between per capita health care expenditures and GDP per capita will be investigated, using panel data unit root tests. The outcomes use of the health care resources and the effectiveness of the health care systems will be observed through the data on infant mortality, the life expectancy and standardized death rates.

INTRODUCTION

The relationship between health care expenditures and its drivers has been examined in large number of studies and papers in past decades. As medical care spending continues to escalate in some countries, the search for alternatives to slow its growth has focused on the supply side. According to Getzen (2006), studies of health care costs on the national level clearly show that cost rises with an increase in per capita income, but the linkage between income and expenditures is often not found in studies of individual health care costs. This was explained through disparity between national and individual cost variations. Furthermore, Henderson (2007) highlights that demand for medical care is derived from the individual’s desire for good health. Individual patient factors (health status, demographic characteristics) play a key role in determining the demand for medical care. Policymakers are more interested in economic factors that affect demand since the individual incomes, the level of out-of-pocket spending, and the availability of medical insurance are more easily manipulated. Dreger and Reimers (2005) presented the cointegration relationship among health care expenditures, GDP, both real and in per capita levels, and medical progress. They also found that the income elasticity in the panel models is not different from unity, implying that health care expenditures are not a luxury good. In that study, the income is not the only determinant of health care expenditures but rather a medical progress. Blomqvist and Carter (1997) investigated health care-income relationship by testing for presence of an independent time trend in the health expenditure series. Their conclusion was that the demand for health is also predominantly affected by technological progress in medicine. Technological progress would shift out the demand curve for health services so that total spending could increase, no matter price elasticity being less than one. They also estimated income elasticity around one considering institutional differences among the countries in the sample, otherwise the result was a much higher elasticity estimate.
In this paper a different set of countries, primarily Transition countries are observed. Like in chosen developed countries of the EU, health care systems in Transition countries are passing through a numerous reforms in adapting to new conditions. First there is a pressure for higher private expenditure due to the rising costs of health care services, especially for pharmaceuticals. For the long period of time GDP growth rates in selected countries were lower than the growth rates of health expenditures, increasing total health expenditure share in GDP. That disparity can definitely be confirmed in some health care systems where the countries, such as Croatia, are struggling to reduce the fiscal pressure. The reasons for the cost-containment policy in Croatia are maybe different of those in Slovakia or Hungary, or even in Sweden, but they all have the same denominators – increasing share of elderly in total population, new and sophisticated medical equipment, high pharmaceutical expenditures and rising expectations of patients. Many countries have introduced or increased co-payments over time, especially for inpatient care and pharmaceuticals, in attempt to control the growth rate of public health care expenditures. Recent results of cost-containment policies suggest on mixed successes.

HEALTH EXPENDITURES

According to OECD (2007) expenditure on health care measures the final consumption of health goods and services (current health expenditure) plus capital investment in health care infrastructure. This includes spending by both public and private sources, public health and prevention programmes and administration. It is common that health spending to GDP ratio and health spending per capita should be considered together. Countries having a relatively high health spending to GDP ratio might have relatively low health expenditure per capita and conversely. Due to data availability, our analysis includes Croatia and set of eleven countries of European Union, namely Austria, Czech Republic, France, Germany, Hungary, Poland, Slovenia, Slovakia, Spain, Sweden and UK over the 1990 - 2005 period.

On Figure 1 a positive correlation between GDP per capita at purchasing power parity, and health spending to GDP ratio can be viewed. Richer countries typically spend a greater share of their GDP for health while some of them like Germany and France spent on health care in 2005 more than it is expected according to their GDP per capita. These two countries are the greatest outliers too. One possible reason for high health expenditures, primary per capita public health expenditures, is the population ageing effect. It was weak in the past, however it is very strong today in developed countries and in a quite large number of Transition

©Copyright 2009 by the Global Business and Technology Association
economies.\textsuperscript{1} This assessment is based on the combined effect of the projected increase in the share of older people (65 and over) and the tendency of health expenditures per capita to increase with age. Another driver of health expenditures is certainly income growth. According to Oliveira and de la Maisonneuve (2006) study, between 1981 and 2002, public health spending grew by 3.6\% per year in OECD countries, of which 2.3 percentage points by income effects. The factors underlying the residual expenditure growth are technology, pure demographic effects and relative prices of health care services. It is proven that the relationship between income and health is strong, but the nature of that relationship is far from clear.

**Effectiveness and efficiency**

Getzen (2007) emphasized that wealthier countries are also healthier, and they spend more on medical care. But more spending does not necessarily buy a better health. Many other factors associated with higher incomes, such as education, nutrition, and sanitation, are also known to improve health. Furthermore, the life expectancy has increased highly in many poor countries over past decades, even when the availability of doctors and GDP per capita declined.\textsuperscript{8} There is a strong relationship between mortality and income, although it is difficult to demonstrate crucially that medical care has an independent effect on average life expectancy as it is mentioned before. The infant mortality rates are among the most commonly cited international comparisons of health status. These rates measure much more than differences in health care across countries, and are affected by the socioeconomic factors as well. Filmer and Pritchett (1999) find that the impact of public spending on child health (under-5 infant mortality) is quite small, while other factors, such as income per capita, inequality in income distributions and female education are more influential determinants.

![Figure 2: Health Spending to GDP (%) in Selected Countries](chart.png)

When compared to countries at a similar level of income, Croatia has performed well in terms of health outcomes. Croatia’s standardized death rate of 886 per 100,000 (2005) is very close to the average EU rate of 678. Infant mortality rate of 5.7‰ (2005) is also low, lower than in Poland, Hungary and Slovakia, but still above the average of 4.7‰ in the European Union. The costs of achieving health outcomes in Croatia come at a moderate price in terms of per capita spending. However Croatia spent 8.1 per cent of GDP on health in 2005 and 8.4 percent in 2007, which is far above 6.9 percent of GDP in new member states and close to 8.8 percent spent on average by the EU15 (World Bank 2008). We can state that Croatia is one of the top spenders on health when compared to the EU member states, close to spending in Spain, UK and Sweden. Figure 2 depicts rising trend in health care spending in all the countries, except in Croatia where this trend was negative. One interesting notice from Figure 2 is stable convergence in health spending in Transition countries to that spending in

©Copyright 2009 by the Global Business and Technology Association
developed EU countries. This figure can be explained in higher GDP growth rates in Transition countries which lead to larger increase in total health expenditures, and higher private health spending, especially for pharmaceuticals (Czech Republic, Slovakia and Poland). The exception is health spending in Croatia which fell in observed period around 2.5 percentage points. High health expenditures at the beginning of 1990s in Croatia can be justified by increased health demand due to Homeland war (1991-1995).

Further increase in national and personal income, life expectancy, population ageing and dependency ratios, may lead to unsustainable growth in demand for health services and over-proportional growth in health spending. Incentives will have to be changed to address the problem, in particular to eliminate demand which does not lead to increase in health output.

**Panel Data Unit Root Analysis**

**Literature review**

Testing for unit roots in time series studies has recently become a common practice among applied researches. Many panel unit root tests are developed for time series studies – Levin Lin Chu test (LLC), Im-Pesaran-Shin (IPS) test, Breitung test, Residual-Based LM test, Augmented Dickey-Fuller (ADF) test, Maddala-Wu (MW) test. It is known that for the panel data analysis, the data consists of \( i = 1, ..., N \) cross sections, and several points of time series for each group \( t = 1, ..., T \), or a cross section of \( N \) time series each of length \( T(i) \).

Considering \( y_{it} = \rho y_{i,t-1} + \varepsilon_{it} \), \( i = 1, 2, ..., N \) for \( N \) countries the test for a unit root for country “A” is based on

\[
H_0: \rho_1 = 1 \\
H_1: \rho_1 < 1
\]

(1)

It is argued that this test has low power. In LLC’s test, null hypothesis is that each individual time series has unit root against the alternative that each time series is stationary. LLC suggested using their panel unit root test for panels of moderate size with \( N \) between 10 and 250 and \( T \) between 25 and 250. The null hypothesis in IPS test is that each series in the panel contains a unit root, i.e. \( H_0: \rho_i = 0 \) for all \( i \) and the alternative hypothesis is that each series in the panel allows for some (but not all) of the individual series to have unit roots. This test was applied for testing unit root for per capita national health expenditures (HE) and gross domestic product (GDP) for a panel of 20 OECD countries by McCoskey and Selden. They rejected the null hypothesis that these two series contain unit roots (Baltagi, 2005). IPS propose test where \( H_0: \beta_i = 0 \) and \( H_1: \beta_i < 0 \), this test is called \( t \)-bar statistic and is defined as the average of the individual Dickey-Fuller (DF) or augmented Dickey-Fuller (ADF) (Aslan, 2009).

In Choi (2001) LLC, IPS and augmented Dickey-Fuller (ADF) tests are analyzed. LLC test has gained much popularity in applications and has often been used in international finance and macroeconomics. This test assumes that all groups (countries, firms etc.) have the same AR (autoregressive) coefficient under both the null and alternative hypothesis which is common in panel data analysis. IPS and ADF tests are based on more general assumptions than LLC’s test and seem to outperform LLC’s test in finite samples. Several common features are shared by these tests. First there is a requirement of the infinite number of groups \( N \), implying that it should be infinite for the asymptotic normality results to hold and, at the same time, small enough relative to the number of time series. This mean that the tests may not keep nominal size well either when \( N \) is small or when \( N \) is large relative to \( T \). When \( N \) is infinite, the number of groups which do not have a unit root should grow at the same rate as \( N \) for the tests to be consistent. When \( N \) is finite, tests are consistent against the alternative that at least one group does not have a unit root.

McCoskey and Selden (1998) explained why it is necessary to check for unit roots in each of the time series used to estimate a model. Having two nonstationary series, i.e. containing a trend which can be of two types – deterministic and stochastic; they will tend to drift away from their starting points. Regressing one on other will give the appearance of a significant positive or negative relationship depending on drift direction of series. Moreover, when only one of the two series has a unit root non accurate specification can also arise. When
the non stationary series can be transformed to the stationary series by differencing once, the series is integrated of order one – denoted I(1). A series which is I(1) is also said to have a ‘unit root’. If the series needs to be differenced \( k \) times in order to achieve stationarity then the series is said to be I(\( k \)). A series which is I(\( k \)) is also said to have \( k \) unit roots.

In their research Augmented Dickey-Fuller (ADF) test is employed including time trend

\[
\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{j=1}^{p-1} \phi_j \Delta y_{t-j} + \epsilon_t
\]  

(2)

where \( \Delta y_t \equiv y_t - y_{t-1} \) and \( t \) indicates time. The null hypothesis is that \( \gamma = 0 \). While the \( t \)-statistic for \( \hat{\gamma} \) does not have the familiar mean-zero \( t \)-distribution under the null hypothesis, tables of critical values have been developed (Monte Carlo methods). Baltagi (2005) states that IPS \( t \)-bar statistic is defined as the average of the individual ADF statistic as

\[
\bar{t} = \frac{1}{N} \sum_{i=1}^{N} t_{\rho_i}^i
\]  

(3)

where \( t_{\rho_i} \) is the individual \( t \)-statistic for testing \( H_0: \rho_i = 0 \) for all \( i = 1, 2, ..., N_i \). In case the lag order is always zero \( (p_i = 0 \) for all \( i \)), IPS provide simulated critical values for \( \bar{t} \) for different number of cross-sections \( N \), series length \( T \) and Dickey-Fuller regressions containing intercepts only or intercepts and linear trends. In the general case where the lag order \( p_i \) may be nonzero for some cross-sections, IPS shows that a properly standardized \( \bar{t} \) has an asymptotic \( N (0, 1) \) distribution. The advantage of IPS method is that it allows the data generating processes to vary across countries with respect to ADF coefficients and error structures. The lag length can also vary across countries rather than imposing a uniform lag length. The Fisher ADF test essentially combines the \( p \)-values of the test statistic for a unit root in each residual cross-sectional unit. The test is non-parametric and maybe computed for any arbitrary choice of a test for the unit root. The test has a chi-square distribution with \( 2N \) (where \( N \) is the cross section) degrees of freedom. An important advantage of this test is that it can be used regardless of whether the null is one of integration or stationary (Narayan, 2007).

**DATA AND RESULTS**

We use data for health care expenditure as percentage of GDP and log-levels of per capita GDP for 12 selected countries (Austria, Croatia, Czech Republic, France, Germany, Hungary, Poland, Slovakia, Slovenia, Spain, Sweden and United Kingdom) from WHO Health for All Database spanning the years 1990 to 2005. We also employed log-level data for life expectancy measured in years, and the percentage of people aged 65 and more in overall population which sometimes are used as proxies for the medical progress. All series enter in logs, except the share of elderly in overall population and health care expenditures.

The results from the LLC, Breitung, IPS and Fisher-ADF tests for the four series are reported in Table 1. In great number of series, a unit root is detected for the level variables, while the first differences appear to be stationary. Only for the variable population 65 and over the result is less reliable. Our main finding from the LLC, Breitung, IPS and Fisher-ADF tests is that for the two series – health care expenditures and life expectancy, for each of the twelve countries – we are unable to reject the unit root null hypothesis, and for the series of per capita GDP and population 65 and over we rejected null hypothesis. However, when we conduct the unit root tests by taking the first difference of the series GDP and population over 65, we are able to reject the unit root null hypothesis. This leads us to conclude that series GDP and population 65 and over are integrated of order one.
### Table 1: Results of the Panel Unit Root Tests

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>LLC</th>
<th>Breitung</th>
<th>IPS</th>
<th>ADF - Fisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care expenditures</td>
<td>-3.39*</td>
<td>-0.17</td>
<td>-2.13*</td>
<td>-1.46*</td>
</tr>
<tr>
<td>GDP</td>
<td>0.41</td>
<td>2.77</td>
<td>-1.67</td>
<td>1.96</td>
</tr>
<tr>
<td>Life expectancy</td>
<td>-4.41*</td>
<td>-0.92</td>
<td>-2.81*</td>
<td>-2.51*</td>
</tr>
<tr>
<td>Population 65 and over</td>
<td>-0.46</td>
<td>0.92</td>
<td>2.26</td>
<td>2.18</td>
</tr>
</tbody>
</table>

**FIRST DIFFERENCES**

<table>
<thead>
<tr>
<th>LEVELS</th>
<th>LLC</th>
<th>Breitung</th>
<th>IPS</th>
<th>ADF - Fisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care expenditures</td>
<td>-6.42*</td>
<td>-2.41*</td>
<td>-4.83*</td>
<td>-4.88*</td>
</tr>
<tr>
<td>GDP</td>
<td>-6.83*</td>
<td>-2.58*</td>
<td>-3.21*</td>
<td>-3.57*</td>
</tr>
<tr>
<td>Life expectancy</td>
<td>-12.79*</td>
<td>-5.31*</td>
<td>-4.81*</td>
<td>-7.66*</td>
</tr>
<tr>
<td>Population 65 and over</td>
<td>-9.47*</td>
<td>-0.81</td>
<td>-3.92*</td>
<td>-4.79*</td>
</tr>
</tbody>
</table>

A * indicates rejection of the null hypothesis of nonstationarity at least on the 0.05 level of significance.

We also examined the relationship between per capita GDP in purchasing power parity, health spending to GDP, life expectancy and infant mortality. Both health spending to GDP and per capita GDP have a statistically significant and positive impact on infant mortality for the panel of 12 countries. The elasticity on per capita GDP and infant mortality is 0.26, implying that an increase of 1 per cent in per capita GDP (at PPS) leads to a decrease of 0.26 per cent in infant mortality rate, ceteris paribus. The effect of per capita GDP (at PPS) on life expectancy is moderate. Furthermore health spending to GDP generates a positive effect on infant mortality rate, and in this panel the elasticity on health spending to GDP and infant mortality is about 0.12, but there is a weak effect of health spending to GDP on life expectancy. This is showing us that health spending, as the share of GDP, is not a key determinant of longer life expectancy, both at birth and at the age of 65.

### Conclusion

There are several implications that can be found in this paper. First, we approved the findings of previous researchers about the existence of a unit root for the level variables and the first differences to be stationary. Second, we examined the relationship between health care spending to GDP and per capita GDP, infant mortality rate and life expectancy, both at birth and at the age of 65 for 11 EU countries and Croatia. The increase in health spending to GDP has a positive effect on infant mortality rate, but the effect on life expectancy is not very strong. Higher income per capita has greater positive impact on the infant mortality rate decrease. We cannot confirm that per capita GDP, both in purchasing parity and real terms, strongly influence the health spending in the countries observed in this analysis. Regarding the health outcomes in selected countries, those with lower per capita income and per capita health spending can obtain good health care system performance. It is shown that Croatia, with relatively lower per capita GDP and per capita health spending, achieves better health outcome than comparable countries of European Union. The gap between the effectiveness (outcomes) of health care systems observed in this analysis is relatively narrower than it can be observed from the data for GDP per capita and per capita health spending.

©Copyright 2009 by the Global Business and Technology Association
REFERENCES


World Bank (2008). *Croatia Restructuring Public Finance to Sustain Growth and Improve Public Services*. 

©Copyright 2009 by the Global Business and Technology Association
The share of elderly (65 years old and over) in total population was in 2005 16.26% in Austria, 16.84% in Croatia, 14.12% in Czech Republic, 16.3% in France, 18.8% in Germany, 15.7% in Hungary, 13.2% in Poland, 11.74% in Slovakia, 15.47% in Slovenia, 16.75% in Spain, 17.2% in Sweden and 16.3% in the United Kingdom.

The average life expectancy in some less developed European countries is higher than it is expected according to their national income, health care services etc. In 2004 Albania had average life expectancy at birth of 76.24, Azerbaijan 72.47, Tajikistan 73.34 years. Similar examples can also be found in some countries of Central and the Southern America (Costa Rica, Colombia and Cuba).

In 2006 total pharmaceutical expenditure as % of total health expenditure amounted 23.4% in Czech Republic, 27.2 in Poland, 31% in Hungary, and 31.9% in Slovakia (data for Slovakia is from 2005).