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Does a National Health Insurance System Enhance Quality of Care and Contain Cost?-An Empirical Investigation of the National Health Insurance System in Taiwan

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Abstract: The main purpose of this study is to examine: (1) The dynamic changes in cost containment and quality that have occurred under the National Health Insurance (NHI) program in Taiwan; (2) The trade-off effect relationship between cost and quality. This paper uses an empirical model to look at data from hospitals in Taipei between 1989 and 2004. The findings indicate that the NHI has led to poor cost containment and unimproved quality of care. In addition, it is to found that, after the NHI, there has been no trade-off between cost containment and quality. This suggests that a lack of market competition and an ineffective monitoring system have led to poor cost containment and quality. However, the negative relationship between cost and quality shows that the payment system should be link between cost and quality.

JEL Classifications: I14, I18, C23, H51
Keywords: National Health Insurance, Cost containment, Quality

1. Introduction

A National Health Insurance (NHI) program with its Fee-for-service (FFS) system was implemented in Taiwan in March 1995 (Chiang, 1997; Chang et al., 2008). The changes introduced by the NHI to the healthcare industry include: (1) the establishment of the Bureau of National Health Insurance (BNHI) to monitor costs and quality; and (2) the opening up of the hospital market to various providers to increase competition. Due to pressure from the sole monitoring system (BNHI) and from market competition, hospitals have been encouraged to both pursue cost containment and maintain quality of care.

This BNHI monitoring system is aimed at reducing fraudulent and unnecessary claims as well as at containing healthcare costs (Lu et al., 2003). The contractual FFS payment system acted as an incentive to hospitals to increase patient services resulting in an increase in healthcare spending. These factors have had two different types of impact on cost containment (Hung et al., 2008). After the NHI, the competitive environment has encouraged hospitals to improve quality of care so as to attract patients. On the other hand, physicians have received financial incentives to see more patients which has led to an overload of patients and longer waiting times causing a deterioration in the quality of patient care (Chang et al., 2005). These two motivators have impacted quality in different ways.

The trade-off between cost containment and quality is an important issue in healthcare reform. Cost containment and quality are affected by socio-demographic changes, as well as economic and financial factors (Chang et al., 2004). As shown in Figure 1, financial pressures can damage the system, leading to an increase in the trends for the Bureau of National Health Insurance (BNHI) to incur financial deficits.

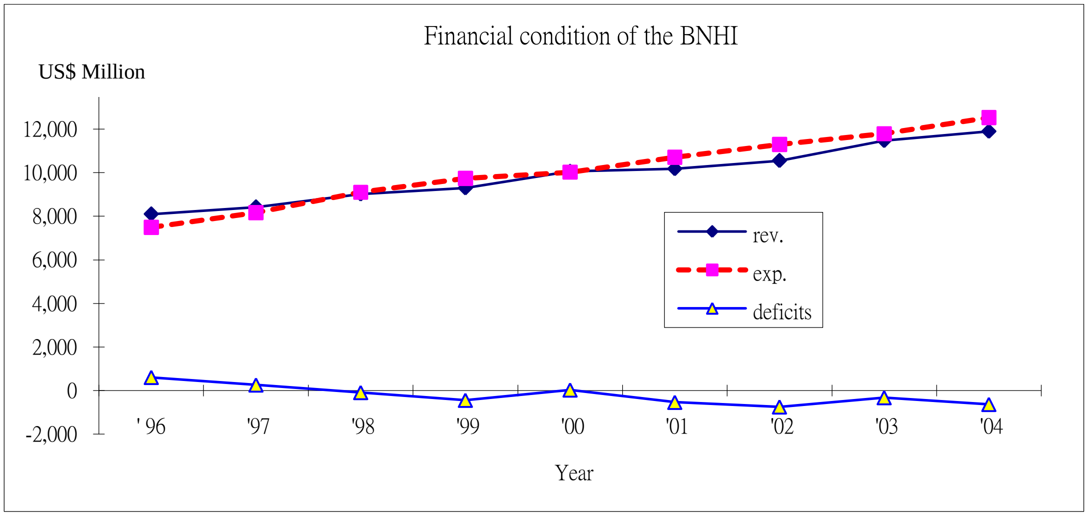

Figure 1: Financial deficits of BNHI in Taiwan: 1996-2004
(**Source:** The National Health Insurance Annual Statistics Information in 2005)

Most studies have found that in developed countries there is a relationship between cost containment and quality (Leatherman, et al., 2003; Siegrist et al., 2003; Younis et al., 2005), but there has been little discussion of this issue in developing countries. In addition, few studies have evaluated cost containment and quality on the basis of data derived from individual hospitals on the heels of regulatory intervention (Lee et al., 2004). Moreover, researchers have infrequently used panel data analysis as opposed to a single cross-section to investigate this issue (Lin, 2006).

The purpose of this study is to explore the impact of the NHI program in Taiwan on cost of healthcare and quality of care. In particular, it seeks to uncover the relationship between the cost containment and quality before and after the advent of the NHI. The rest of this paper is organized as follows: section 2 describes the methodology, section 3 reports the empirical results and lastly some conclusions are offered.

2. Methodology

In this study, we follow the methodologies of Smith et al. (1981), as well as Tennyson et al. (2000), who used cost and quality to measure hospital performance, to compare the performance before and after the advent of the NHI.

Public hospitals and not-for-profit hospitals are the norm in Taiwan (Chang et al., 2004). Taipei is the capital as well as political and economic center of Taiwan. Understanding the behavior of hospitals in Taipei would set a benchmark for evaluating hospitals in other areas. Accordingly, the sample used in the empirical analysis consists of data from public and not-for-profit hospitals in city of Taipei.

The sample data are collected from the National Health Insurance Annual Statistics Information database and from the Health Information Indices database for 2005. These databases include market, operational, and financial information for a 16-year period (1989–2004). Information from a total of 21 hospitals (12 of which are public and 9 not-for-profit hospitals) are included in the sample, specifically, Renai, Yangming, Zhong Xiao, Heping, Wanfang, Zhongxing, Women's and Children's, Guan Du, Chronic Diseases, Songde, Traditional Medicine, Venereal Diseases Control, Central Clinic, Country, Chang Gung, Cathay, Kang Ning, Sun Yat Sen Cancer Center, Shin Kong, Mackay, Taiwan Adventist hospitals. Overall, this sample consists of a panel of 336 hospital-years.

Empirical analysis is used to evaluate cost containment and quality pre- and post- NHI. First, in Model 1, we examine whether or not the NHI has improved quality of care and contained cost. In Model 2, we investigate the relationship between cost containment and quality before and after. Definition of the variables is presented in Table 1.

Table 1. Definition of variables

Variable List	**Definition and measure**
Model 1:	
Dependent variables:	
REV(Hospital revenues)[1]	Cost containment index: log of patient service revenues to patients
MR (Mortality rate)[2]	Quality index: risk adjusted mortality rate within 30 days (mortality rates adjusted by age, sex and illness)
IR (Infection rate)[2]	Quality index: risk adjusted infection rate within 30 days (infection rates adjusted by age, sex and illness)
Independent variable:	
YR89	Dummy variable (year 1989 =1; other years =0)
YR90	Dummy variable (year 1990 =1; other years =0)
YR91	Dummy variable (year 1991 =1; other years =0)
YR92	Dummy variable (year 1992 =1; other years =0)
YR93	Dummy variable (year 1993 =1; other years =0)
YR94	Dummy variable (year 1994 =1; other years =0)
YR95	Dummy variable (year 1995 =1; other years =0)
YR96	Dummy variable (year 1996 =1; other years =0)
YR97	Dummy variable (year 1997 =1; other years =0)
YR98	Dummy variable (year 1998 =1; other years =0)
YR99	Dummy variable (year 1999 =1; other years =0)
YR00	Dummy variable (year 2000 =1; other years =0)
YR01	Dummy variable (year 2001 =1; other years =0)
YR02	Dummy variable (year 2002 =1; other years =0)
YR03	Dummy variable (year 2003 =1; other years =0)
YR04	Dummy variable (year 2004 =1; other years =0)
Control variable:	
HHI (Competition)	Herfindahl-Hirschman Index, index of competition, ($H = \sum_{i=1}^{N} s_i^2$ where s_i is the market share of the *i*th hospital in one district, and N is the number of hospitals (a small value of HHI indicates higher market competition)
AP (Aging population)	Percentage of the population aged 65 and over to the total population
LOS (Length of stay)	Average length of stay, index of efficiency (log of the total number of inpatient days to the total number of admissions)
IS (Illness severity)	Severity of illness, illness severity index (the number of occupied intensive-care patient bed days divided by the total number of occupied patient bed days)

Model 2:	
Dependent variables:	
REV (Hospital revenues)[1]	Cost containment index: log of patient service revenues to patients
Independent variable:	
MR (Mortality rate)[2]	Quality index: risk adjusted mortality rate within 30 days (mortality rates adjusted by age, sex and illness)
IR (Infection rate)[2]	Quality index: risk adjusted infection rate within 30 days (infection rates adjusted by age, sex and illness)
Control variable:	
HHI (Competition)	Herfindahl-Hirschman Index, index of competition, ($H = \sum_{i=1}^{N} s_i^2$ where s_i is the market share of the *i*th hospital in one district, and N is the number of hospitals (a small value of HHI indicates higher market competition)
AP (Aging population)	Percentage of the population aged 65 and over to the total population
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IS (Illness severity)	Severity of illness, illness severity index (the number of occupied intensive-care patient bed days divided by the total number of occupied patient bed days).

Notes: 1. From the BNHI's point of view, hospital revenues are the BHNI's costs, because most hospital will claim their sales to the BNHI. Therefore, cost containment will focus on hospital revenues; 2. In 1999, the Department of Health (DOH) in Taiwan launched Taiwan quality indicators projects. Mortality rates and infection rates are included in Taiwan quality indicators.

Model 1 - Cost containment and quality consist of two equations. Equation (1) tests for the effects of NHI on cost, the second on quality.

$$REV_{i,t} = a_0 + a_1YR89_{i,t} + a_2YR90_{i,t} + a_3YR91_{i,t} + a_4YR92_{i,t} + a_5YR93_{i,t} + a_6YR94_{i,t} + \alpha_7YR95_{i,t} + a_8YR96_{i,t} + a_9YR97_{i,t} + a_{10}YR98_{i,t} + a_{11}YR99_{i,t} + a_{12}YR00_{i,t} + a_{13}YR01_{i,t} + a_{14}YR02_{i,t} + a_{15}YR03_{i,t} + a_{16}YR04_{i,t} + a_{17}HHI_{i,t} + a_{18}AP_{i,t} + a_{19}LOS_{i,t} + a_{20}LS_{i,t} + \upsilon_{i,t} \quad \textbf{(1-1)}$$

$$MR_{i,t} = b_0 + b_1YR89_{i,t} + b_2YR90_{i,t} + b_3YR91_{i,t} + b_4YR92_{i,t} + b_5YR93_{i,t} + b_6YR94_{i,t} + b_7YR95_{i,t} + b_8YR96_{i,t} + b_9YR97_{i,t} + b_{10}YR98_{i,t} + b_{11}YR99_{i,t} + b_{12}YR00_{i,t} + b_{13}YR01_{i,t} + b_{14}YR02_{i,t} + b_{15}YR03_{i,t} + b_{16}YR04_{i,t} + b_{17}HHI_{i,t} + b_{18}AP_{i,t} + b_{19}LOS_{i,t} + b_{20}LS_{i,t} + \mu_{i,t} \quad \textbf{(1-2)}$$

$$IR_{i,t} = c_0 + c_1YR89_{i,t} + c_2YR90_{i,t} + c_3YR91_{i,t} + c_4YR92_{i,t} + c_5YR93_{i,t} + c_6YR94_{i,t} + c_7YR95_{i,t} + c_8YR96_{i,t} + c_9YR97_{i,t} + c_{10}YR98_{i,t} + c_{11}YR99_{i,t} + c_{12}YR00_{i,t} + c_{13}YR01_{i,t} + c_{14}YR02_{i,t} + c_{15}YR03_{i,t} + c_{16}YR04_{i,t} + c_{17}HHI_{i,t} + c_{18}AP_{i,t} + c_{19}LOS_{i,t} + c_{20}LS_{i,t} + \xi_{i,t} \quad \textbf{(1-3)}$$

Dependant variables*:* *REV* = cost containment index (log of patient service revenues to patients). From the BNHI's point of view, hospital revenues are the BHNI's costs, because most hospitals will claim payment for their sales to the BNHI. Therefore, cost containment will focus on hospital revenues. *MR* = quality index (mortality rates); *IR* = quality index (infection rates); ***Independent variables****:* *YR* = dummy variable (assigned year = 1; other years = 0); ***Control variables:*** *HHI* = market factor (competition, HHI); *LOS* = operational factor (average length of stay); *AP* = aging population; *IS* = severity of illness.

Model 2 – The trade-off test between cost and quality can be formulated as follows:

$$REV_{i,t} = r_0 + r_1MR_{i,t} + r_2 HHI_{i,t} + r_3 LOS_{i,t} + r_4 IS_{i,t} + \varepsilon_{i,t} \quad \textbf{(2-1)}$$

$$REV_{i,t} = \pi_0 + \pi_{i,1}IR_{i,t} + \pi_2 HHI_{i,t} + \pi_3 LOS_{i,t} + \pi_4 IS_{i,t} + \upsilon_{i,t} \quad \textbf{(2-2)}$$

Dependant variables*:* *REV* = cost containment index (log of patient service revenues to patients); ***Independent variables****:* *MR* = quality index (mortality rates); *IR* = quality index (infection rates);

Control variables: *HHI* = market factor (competition, HHI); *AP* = aging population; *LOS* = operational factor (average length of stay); *IS* = severity of illness.

The estimations are provided for each equation: Model 1-1, Model 1-2, Model 1-3, Model 2-1 and Model 2-2. The results are reported below.

3. Data and Empirical Results

Table 2 provides descriptive statistics of the performance levels for hospitals in Taipei before and after the NHI. The evidence shows the following trends: First, there was a significant increase in the ratios of patient service revenues to number of patients after the NHI. Second, mortality rates and infection rates have decreased but the results on t/z values were statistically insignificant. Third, competition is decreased (increased HHI) and average length of stay (LOS) increased, which did not meet with the NHI's expectation. The results suggest that lack of competition may have induced hospitals to extend the LOS in this period. In addition, there was an insignificant increase in the severity of illness.

Ordinary Least Squares (OLS) regression was used to examine changes in cost and quality in the pre and post the NHI periods. It can be seen in Panel A of Table 3 that most coefficients of YR were significantly positive after the year 1995 in all equations. This implies that costs significantly increased after the NHI. As reported in Panels B and C of Table 3, the coefficients of YR are all negative and insignificant, indicating that quality remained statistically unchanged between the pre- and post-NHI periods (quality has not improved after the NHI). Overall, the evidence shows that costs have escalated; but quality has not improved.

Table 2. Univariate analysis - sample descriptive statistics (before and after the NHI)

Variables	(1) **After the NHI** (n = 189) from 1996 to 2004[4]					(2) **Before the NHI** (n = 129) from 1989 to 1994[4]					(3)=(1)-(2) Difference[3]
	Mean	Median	S.D.	Min.	Max.	Mean	Median	S.D.	Min.	Max.	t/z value[3]
Dependent variable:											
1.*REV*[1]	3.2771	3.3750	0.3016	2.6000	3.8900	2.7558	2.7900	0.2450	2.2000	3.0800	**9.3909*****[2]
2.*MR*[1]	0.0241	0.0215	0.0214	0.0100	0.0900	0.0253	0.0250	0.0199	0.0100	0.0700	**-1.5345**
3.*IR*[1]	0.0285	0.0302	0.0219	0.0028	0.0700	0.0297	0.0330	0.0199	0.0034	0.0900	**-1.8761**
Independent variables: Market factors											
4. *HHI*	0.3967	0.4173	0.0930	0.1600	0.4800	0.3387	0.3426	0.1032	0.0900	0.4200	**1.3241***[2]
5. *AP*	0.0987	0.0989	0.0123	0.0390	0.1000	0.0741	0.0764	0.0126	0.0600	0.1120	**9.4321*****[2]
Operational factors											
6. *LOS*	1.1411	1.0500	0.3634	0.6600	2.0900	1.1230	0.9900	0.3010	0.7200	1.8600	**0.3382**
7. *IS*	0.0189	0.0190	0.0750	0.0061	0.0221	0.0164	0.0150	0.0516	0.0051	0.0216	**0.0025**

Notes: 1. Hospital revenues (REV) represent the cost containment index; mortality (MR) and infection rates (IR) represent the quality index; HHI represents competition; AP represents the elderly; LOS represents average length of stay; IS represents illness severity; 2. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level; 3. Difference (3) = (after (1) – before (2)). If the variables passed the Komogorov-Smirnov test, then the t-test was used; if variables did not pass the K-S test, then the nonparametric Wilcoxon signed rank z-test was adopted; 4. After the NHI (from 1996 to 2004); before the NHI (from 1989 to 1994).

Table 3. Ordinary Least Squares (OLS) regression analysis - cost control and quality (before and after the NHI)

Model 1-1: $REV_{i,t} = a_0 + a_1YR89_{i,t} + a_2YR90_{i,t} + a_3YR91_{i,t} + a_4YR92_{i,t} + a_5YR93_{i,t} + a_6YR94_{i,t} + \alpha_7YR95_{i,t} + a_8YR96_{i,t} + a_9YR97_{i,t} + a_{10}YR98_{i,t} + a_{11}YR99_{i,t} + a_{12}YR00_{i,t} + a_{13}YR01_{i,t} + a_{14}YR02_{i,t} + a_{15}YR03_{i,t} + a_{16}YR04_{i,t} + a_{17}HHI_{i,t} + a_{18}AP_{i,t} + a_{19}LOS_{i,t} + a_{20}LS_{i,t} + \upsilon_{i,t}$

Model 1-2: $MR_{i,t} = b_0 + b_1YR89_{i,t} + b_2YR90_{i,t} + b_3YR91_{i,t} + b_4YR92_{i,t} + b_5YR93_{i,t} + b_6YR94_{i,t} + b_7YR95_{i,t} + b_8YR96_{i,t} + b_9YR97_{i,t} + b_{10}YR98_{i,t} + b_{11}YR99_{i,t} + b_{12}YR00_{i,t} + b_{13}YR01_{i,t} + b_{14}YR02_{i,t} + b_{15}YR03_{i,t} + b_{16}YR04_{i,t} + b_{17}HHI_{i,t} + b_{18}AP_{i,t} + b_{19}LOS_{i,t} + b_{20}LS_{i,t} + \mu_{i,t}$

Model 1-3: $IR_{i,t} = c_0 + c_1YR89_{i,t} + c_2YR90_{i,t} + c_3YR91_{i,t} + c_4YR92_{i,t} + c_5YR93_{i,t} + c_6YR94_{i,t} + c_7YR95_{i,t} + c_8YR96_{i,t} + c_9YR97_{i,t} + c_{10}YR98_{i,t} + c_{11}YR99_{i,t} + c_{12}YR00_{i,t} + c_{13}YR01_{i,t} + c_{14}YR02_{i,t} + c_{15}YR03_{i,t} + c_{16}YR04_{i,t} + c_{17}HHI_{i,t} + c_{18}AP_{i,t} + c_{19}LOS_{i,t} + c_{20}LS_{i,t} + \xi_{i,t}$

Panel A: Model 1-1

Dependent Var.:	*REV* – Hospital Revenues					
Independent Var.:	(1)		(2)		(3)	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	4.0744***	5.2000	3.2047***	3.6200	4.1866***	4.6300
YR89	-0.1831	-1.3900	-0.2215	-1.5600	-0.2064	-1.5700
YR90	0.0795	1.4800	0.1056	0.9500	0.0957	1.3800
YR91	0.0564	1.0500	0.0732	0.6600	0.0686	1.2800
YR92	-0.0496	-0.9200	-0.0522	-0.4700	-0.0562	-1.0500
YR93	0.0308	0.5700	0.0382	0.4100	0.0411	0.4500
YR94	0.0541	1.0000	0.0665	0.6000	0.0617	1.1600
YR95	**0.0991***	**1.8900**	**0.0574**	**0.5300**	**0.1128****	**2.1500**
YR96	**0.3009*****	**5.7200**	**0.2722****	**2.4900**	**0.3194*****	**6.0400**
YR97	**0.2769*****	**5.2700**	**0.2591****	**2.3500**	**0.2995*****	**5.6200**
YR98	**0.1766*****	**3.4500**	**0.1783***	**1.7500**	**0.2015*****	**3.8500**
YR99	**0.0840***	**1.7400**	**0.1024***	**1.9400**	**0.1126****	**2.1300**
YR00	**0.2278*****	**4.5400**	**0.2339****	**2.1700**	**0.2584*****	**4.9400**
YR01	**0.1363*****	**2.5600**	**0.1079****	**2.1700**	**0.1145****	**2.2400**
YR02	**0.2817*****	**5.3500**	**0.2448*****	**4.7000**	**0.2583*****	**5.1500**
YR03	0.0937	1.5800	0.0411	0.4500	0.0304	0.5600
YR04	0.1543	1.4800	0.0986	1.0700	0.0796	1.5200
HHI (Competition)	2.1309*	1.8100			2.1103*	1.8900
AP (Aging population)			2.8458*	1.6700	1.5261*	1.8500
LOS (Length of stay)	0.4698***	13.8800	0.2580***	4.0100	0.4715***	14.110
IS (Illness severity)	0.2391	1.2111	0.3874*	1.7621	0.2570	1.3237
F-statistics	38.4306***		7.7452***		36.2507***	
Adjusted R^2	0.8445		0.5224		0.8501	
N	336		336		336	

Panel B: Model 1-2

Dependent Var.:	*MR* – Mortality rates					
Independent Var.:	(1)		(2)		(3)	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	-0.0816^{***}	-4.8000	0.0282^{**}	2.01000	-0.0608^{***}	-3.1000
YR89	-0.0008	-0.0900	-0.0062	-0.68000	-0.0004	-0.0400
YR90	0.0015	0.1800	0.0031	0.32000	0.0028	0.3300
YR91	-0.0030	-0.3500	-0.0006	-0.07000	-0.0010	-0.1200
YR92	-0.0026	-0.3000	-0.0008	0.08000	-0.0004	0.0500
YR93	0.0012	0.1400	0.0067	0.66000	0.0053	0.6200
YR94	-0.0053	-0.6200	-0.0021	0.20000	-0.0002	0.0300
YR95	-0.0051	-0.6000	-0.0038	0.36000	-0.0013	0.1400
YR96	-0.0001	-0.0100	-0.0096	0.91000	-0.0071	0.7800
YR97	-0.0022	-0.2600	-0.0082	0.76000	-0.0057	0.6200
YR98	-0.0040	-0.4800	-0.0060	0.56000	-0.0043	0.4700
YR99	-0.0031	-0.3800	-0.0068	0.62000	-0.0058	0.6300
YR00	0.0002	0.0300	0.0120	1.11000	-0.0096	1.0400
YR01	-0.0056	-0.6300	-0.0033	-0.3800	-0.0026	-0.3100
YR02	-0.0012	-0.1400	-0.0004	-0.0600	-0.0002	-0.0300
YR03	-0.0071	-0.8200	-0.0065	-0.7500	-0.0042	-0.4900
YR04	-0.0065	-0.7500	-0.0069	-0.8000	-0.0060	-0.5500
HHI (Competition)	-0.1643^{*}	1.9700			-0.1587	1.3500
AP (Aging population)			0.3472^{**}	2.2300	0.2713^{**}	2.0300
LOS (Length of stay)	0.0061^{*}	1.8100	0.0213^{***}	3.7200	0.0071^{*}	1.9300
IS (Illness severity)	0.1761^{*}	1.8800	0.1052	1.0600	0.1627^{*}	1.7700
F-statistics	4.1682^{***}		4.4658^{***}		4.3827^{***}	
Adjusted R^2	0.4858		0.5027		0.5143	
N	336		336		336	

Panel C: Model 1-3

Dependent Var.:	*IR* – Infection rates					
Independent Var.:	(1)		(2)		(3)	
	coefficient	t-value	coefficient	t value	coefficient	t-value
Constant	0.0463^{***}	4.9000	0.0281^{***}	3.9800	0.0529^{***}	4.7800
YR89	-0.0005	-0.0100	-0.0007	-0.1500	-0.0013	-0.2700
YR90	-0.0017	-0.3500	-0.0014	-0.2800	-0.0013	-0.2700
YR91	-0.0019	-0.4100	-0.0014	-0.2900	-0.0013	-0.2800
YR92	-0.0027	-0.5700	-0.0019	-0.3800	-0.0018	-0.3700
YR93	-0.0031	-0.6500	-0.0022	-0.4300	-0.0018	-0.3700
YR94	0.0000	0.0000	0.0012	0.2300	0.0017	0.3500

YR95	-0.0014	-0.3100	-0.0001	-0.0200	-0.0006	0.1100
YR96	-0.0023	-0.4800	-0.0007	-0.1300	-0.0001	0.0000
YR97	-0.0025	-0.5300	-0.0007	-0.1300	-0.0004	-0.0100
YR98	-0.0072	-1.5600	-0.0051	-0.9500	-0.0046	-0.8900
YR99	-0.0072	-1.5600	-0.0046	-0.8600	-0.0044	-0.8400
YR00	-0.0041	-0.9200	-0.0018	-0.3400	-0.0012	-0.2300
YR01	-0.0006	-0.1200	-0.0004	-0.0800	-0.0004	-0.0100
YR02	-0.0010	-0.2100	-0.0071	-1.5100	-0.0004	-0.0800
YR03	-0.0079*	-1.7200	-0.0019	-0.4100	-0.0058	-1.0500
YR04	-0.0027	-0.6000	-0.0016	-0.3200	-0.0010	-0.1800
HHI (Competition)	-0.0425	-1.3200			-0.0442*	-1.7800
AP (Aging population)			0.0644**	2.2300	0.0855***	2.8200
LOS (Length of stay)	0.0050*	1.7200	0.0014	0.4800	0.0053*	1.7200
IS (Illness severity)	0.2011*	1.9600	0.1575	1.5300	0.2152*	1.9800
F-statistics	4.9882***		4.5427***		4.4492***	
Adjusted R^2	0.6021		0.5682		0.5537	
N	336		336		336	

Notes: 1. t-statistics are reported in parentheses;
2. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level;
3. There are three estimations: Model (1) including YR dummy, HHI and LOS variables; Model (2) including YR dummy, AP and LOS variables; and Model (3) including YR dummy, HHI, AP and LOS variables;
4. Taiwan implemented the NHI in 1995.

To take the analysis one step further, we also examine the trade-off effect between cost containment and quality, use panel data regression with the fixed effects model. In the estimation reported in Table 4, REV is a dependent variable and MR (IR) represents the equations as an independent variable. As shown in Table 4, REV during the period 1989-2004 (full sample) is insignificantly positively related to MR (IR). The coefficients of both MR and IR were insignificantly negative before the NHI. Interestingly, the relationship between REV and MR (IR) became significantly positive after the NHI. These findings suggest that there is no trade-off between cost containment and quality after the NHI. The findings imply that: (1) after the NHI, the FFS has not linked quality of service with payment; (2) the monitoring system of the BNHI is weak and inefficient (Fu et al., 2004); and (3) the lack of competition has led to the deterioration in the effect on quality of care.

Table 4. Panel data regression with fixed effects model analysis - cost control and quality (before and after the NHI)

$$Model\ 2\text{-}1:\ REV_{i,t} = r_0 + r_1 MR_{i,t} + r_2\ HHI_{i,t} + r_3\ LOS_{i,t} + r_4\ IS_{i,t} + \varepsilon_{i,t}$$

$$Model\ 2\text{-}2:\ REV_{i,t} = \pi_0 + \pi_{i,1} IR_{i,t} + \pi_2\ HHI_{i,t} + \pi_3\ LOS_{i,t} + \pi_4\ IS_{i,t} + \upsilon_{i,t}$$

Panel A (Model 2-1)

Dependent Var.: *REV* – Hospital Revenues						
Independent Var.:	(1)		(2)		(3)	
Period	1989-2004		1996-2004		1989-1994	
	Full sample		After the NHI		Before the NHI	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	0.1432	0.1100	12.3908***	4.1100	-5.4571**	-2.2400
MR (Mortality rates)	**3.0873**	**1.3500**	**12.6742*** **	**3.4000**	**-0.8825**	**-0.5400**
HHI (Competition)	2.6481*	1.7200	4.9686	1.5400	2.8939*	1.9100
AP (Aging population)	13.1993***	13.7200	2.3350	0.5300	8.4666***	2.9600
LOS (Length of stay)	0.1852*	1.7700	0.3087**	2.0100	0.2150	0.8100
IS (Illness severity)	1.9882*	1.9500	2.5333**	2.2700	2.3995**	2.1600
F-statistics	33.7023***		17.2837***		36.2832***	
Adjusted R^2	0.8327		0.6192		0.8942	
N	336		189		126	

Panel B (Model 2-2)

Dependent Var.: *REV* – Hospital Revenues						
Independent Var.:	(1)		(2)		(3)	
Period	1989-2004		1996-2004		1989-1994	
	Full sample		After the NHI		Before the NHI	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	-0.1622	-0.1200	14.1720***	4.5300	-5.1246***	-2.5100
IR (infection rates)	**0.4107**	**0.1800**	**9.5414*** **	**2.8500**	**-3.6948**	**-1.5400**
HHI (Competition)	3.2134	1.4700	8.9048***	3.5500	2.6402*	1.8600
AP (Aging population)	13.2023***	13.4600	8.7182*	1.8200	7.5657***	3.1200
LOS (Length of stay)	0.1399*	1.8500	0.2899	1.5400	0.1961	0.8600
IS (Illness severity)	4.3621***	2.5500	1.4068*	1.7400	1.0719	0.6800
F-statistics	32.4958***		18.5827***		42.7216***	
Adjusted R^2	0.8192		0.6732		0.9017	
N	336		189		126	

Notes: 1. T-statistics are reported in parentheses; 2. * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level; 3. There are three estimations: Model (1) including samples from 1989 to 2004; Model (2) including samples from 1996 to 2004; Model (3) including samples from 1989 to 1994.

4. Discussion and Conclusions

The objective of the study is to answer two questions. Has healthcare reform achieved the expected goals - better cost containment and improved quality of healthcare? And secondly, has there been a trade-off between these two objects? The findings reported in the paper show that healthcare costs have actually escalated and the quality of care has not improved.

There are several possible explanations for the increased in health spending after the NHI. First, the ineffectiveness of the BNHI monitoring systems has led to a rise in healthcare costs without enhancing quality of care. This finding is consistent with Muth et al. (1998) study which shows that it is more difficult to coordinate larger groups and factions, because of increased group conflicts. After the NHI, the size of the BNHI has grown to become larger than that of the bureaus responsible for the old insurance schemes. Yet, the current medical-claim payment monitoring procedure of the BNHI (a single sampling audit and payment system) is limited by its sampling procedure and auditing bias (Fu et al., 2004). Moreover, the FFS pays providers the same fees regardless of the quality of their services (Cheng, 2003). The financial incentives to hospitals involved in the implementation of the FFS system have caused excessive and inadequate services, which have contributed to an increase in healthcare costs rather than improvement in quality (Culter, 1995). Moreover, weak market competition has not induced hospitals to manage costs or improve quality (Lu et al., 2003). The absence of a consultant outreach policy (a gatekeeper system) formulated by general medical practitioners or patient choice advisers (PCAs) may also be a factor leading to waste and loss of efficiency (Milne et al., 2003).

The findings do not show a trade-off effect with respect to the trade-off between cost containment and quality of care. The explanations above may account for these findings. Before the NHI, only about 50% of the total population was covered by medical insurance, and contractual hospitals comprised only 42% of the total number of hospitals. The majority of uninsured people had to pay health expenditures themselves. The more they paid; the better quality they got. This suggests that cost (REV) was positively (negatively) associated with quality (mortality or infection rate) before the NHI. After the NHI, the monitoring system of the BNHI and FFS proved ineffective (Fu et al., 2004). Weak competition meant that large hospitals could recover the cost of expenditures regardless of quality. Thus, after the NHI, cost (REV) is negatively (positively) related to quality (mortality rate).

The research findings have a number of implications. First, the FFS payment system seems to have encouraged the use of healthcare resources meaning an increase in the number of visits, overuse of rehabilitation services and drug treatment. Second, an effective monitoring system (by the BNHI) would help keep healthcare costs within a reasonable range. Thus, policymakers may need to rebuild the monitoring system by increasing financial incentives to monitoring staff of the BNHI[19]. Finally, policymakers should insist on information transparency which would lead to better cost containment and quality of care.

This paper is limited in terms of interpretation and generalization by the size and characteristics of the sample, due to the difficulty of obtaining data. Also, definition of quality of care is difficult (Chang et al., 2004). The mortality rate (infection rate) and patient satisfaction are the most often used quality indicators in Taiwan (Cheng, 2003). In this study, we use mortality rates (clinical quality) to define quality. In addition, the measurement of severity of illness is limited, because Taiwan did not adopt the diagnosis-related groups (DRG) system until 2010. In future study, we plan to extend the scope of this work to include more quality indicators.

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