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Health care financing and health outcomes in Pacific Island countries

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This paper provides empirical evidence on the relationship between per capita public health expenditure and three measures of health outcomes (infant and under-five mortality rates and crude death rates) using cross-country data from seven Pacific Island countries for selected years between 1990 and 2002. The results of the fixed-effects estimation procedure, correcting for AR(1) errors, provide strong evidence that per capita health expenditure is an important factor in determining health outcomes. The elasticity of the infant mortality rate with respect to per capita health expenditure is −0.66. Based on this elasticity, a 10% increase in per capita health expenditure means that a country such as Papua New Guinea, with a high infant mortality rate, would see a reduction of 3.6 infant deaths per 1000 live births, with an average reduction of 2.0 infant deaths per 1000 live births for the Pacific Island countries. The empirical results also provide strong evidence that per capita incomes and immunization are additional core factors that determine health outcomes. Some policy implications are drawn.

Keywords Pacific Island countries, health expenditure, infant mortality

KEY MESSAGES

- The study provides strong evidence that per capita health expenditure is important in determining health outcomes, with per capita incomes and immunization also featuring strongly.
- The results suggest that a 10% increase in per capita health expenditure would lead to an approximate 6.6% reduction in infant mortality rate, equating to an average reduction of 2.0 infant deaths per 1000 live births for the Pacific Island countries.
- Pacific Island governments should keep in mind the relationship between health expenditures and health outcomes over the long term when deciding on policy and budgetary allocations.

Introduction

While case studies of large developing countries have provided evidence of public health care spending improving health outcomes such as under-five mortality rates (for example, Bokhari *et al*. 2007 and Bhalotra 2007), little research has been conducted on health care financing and health outcomes in the Pacific Island countries (PICs). The purpose of the study reported here is to examine whether public expenditure allocations to the health sector improve health outcomes in the PICs. Analysis of the relationship between per capita health expenditure and health outcome indicators is important in order to decide on appropriate policy interventions to ensure improvements are made in outcomes such as infant and under-five mortality rates.

The PIC context

Like developing countries elsewhere, the PICs are poor, falling in the low and lower-middle income categories. On the human development index, they fall in the low and medium human development categories. A number of countries rank poorly in terms of their population's health status. For example, many countries have a high incidence of infant and under-five mortality and a high prevalence of preventable diseases. At the

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country level, infant mortality rates in 2005 ranged from 15.7 per 1000 live births in Fiji to 55.2 per 1000 live births in Papua New Guinea (PNG) (Figure 1). In the same year, under-five mortality rates ranged from 18.0 to 74.4 per 1000 live births in Fiji and in PNG, respectively (Figure 2). Neonatal causes are the main contributor to deaths among children under five in most PICs; other notable causes include diarrhoeal diseases, pneumonia and measles (Table 1).

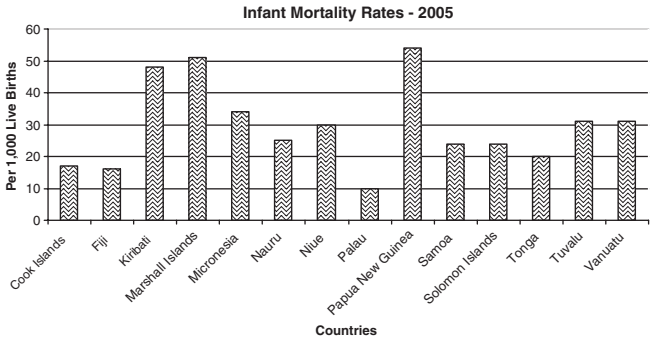

Figure 1 Infant mortality rates for Pacific Island countries, 2005
Source: World Health Organizaton (2006).

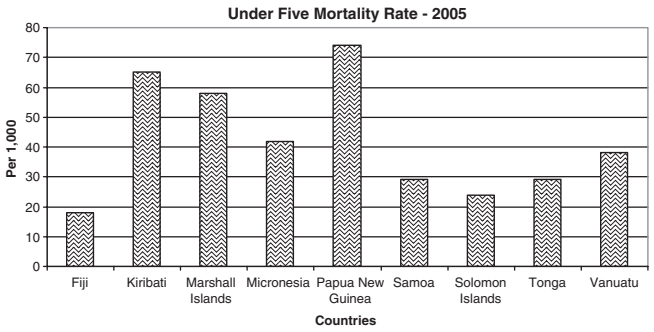

Figure 2 Under-five mortality rates for Pacific Island countries, 2005
Source: World Bank (2006a).

Neonatal causes of death accounted for nearly all under-five deaths (96.1%) in the Cook Islands in 2000 (Table 1). One possible explanation for this, other than the strong emphasis on primary health care, relates to the strength of family influence in the Cook Islands and to Cook Islanders being New Zealand citizens. Migrant Cook Islanders in New Zealand play an influential role in terms of financing their family's primary health care and the dissemination of important health care knowledge from New Zealand. Nauru has the highest incidence of under-five deaths from diarrhoeal diseases and pneumonia as a result of poor primary health care services.

This study focuses on seven PICs: Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu. It utilizes cross-country data for selected years between 1990 and 2002 for public spending on health, together with selected control variables that determine health outcomes. A fixed-effects estimation procedure, correcting for AR(1) errors, is used to investigate the relationship between per capita health expenditure and health outcomes. Public health expenditure in this study is defined as including recurrent and capital spending from local and central government budgets, internal borrowings and grants as well as donations from international agencies and non-governmental organizations.

The next section presents a brief summary of the international debate on public health expenditure and health outcomes. A description of the patterns of public expenditure on health in the PICs follows. The analytical model is then outlined, before a discussion of the empirical findings. The limitations of this study are then addressed, followed by a discussion of policy issues raised and conclusions.

The effect of health expenditure on health outcomes

Of the 11 million children dying annually worldwide, 90% are under five (Bokhari *et al*. 2007). In poor countries, 30% of all deaths are of children, compared with less than 1% in rich

Table 1 Causes of death among children under 5 years of age in Pacific Island countries, 2000 (percentages)

Country	Causes of death (%)						
	Neonatal	HIV/AIDS	Diarrhoeal diseases	Measles	Malaria	Pneumonia	Other causes
Cook Islands	96.1	0.0	0.7	0.5	0.0	1.1	1.6
Fiji	41.2	0.2	10.6	0.0	0.0	9.2	38.8
Kiribati	22.1	0.0	21.9	2.6	0.7	11.5	41.2
Marshall Is.	37.1	0.3	14.1	0.5	0.0	13.5	34.5
Micronesia	49.2	0.3	8.0	1.5	0.0	11.3	29.7
Nauru	7.0	0.0	37.8	5.5	0.0	30.3	19.4
Palau	47.0	0.3	9.7	0.7	0.0	12.4	29.9
PNG	35.4	0.3	15.3	2.1	0.8	18.5	27.6
Samoa	49.2	0.3	9.7	0.1	0.1	10.2	30.4
Solomon Is.	49.5	0.3	8.8	0.5	0.1	9.5	31.3
Tonga	57.2	0.0	10.0	1.8	1.3	7.3	22.4
Tuvalu	40.0	0.3	13.2	1.2	0.0	13.5	31.8
Vanuatu	42.3	0.3	11.5	0.3	0.6	13.0	32.0

Source: World Health Organization (2006).

countries (Cutler *et al*. 2006). At least 10 million children under the age of five die each year, mainly from preventable (or curable) conditions that seldom kill children in rich countries (Jones *et al*. 2003). Such statistics provide clear evidence that poor health is concentrated amongst poor people in poor countries (see also Bhalotra 2007).

While relevant interventions (immunization and oral rehydration therapy) are low cost (Deaton 2006) and aid in minimizing deaths among children, the incidence of under-five mortality in the developing world in general, as well as in the PICs specifically, raises the question of whether national budgetary allocations to these forms of health care services are adequate and effective in terms of their impact on infant or under-five mortality. Available evidence from high-income countries strongly supports that the main contributors to mortality decline in children were improved nutrition and progress in medical technology (Cutler and Miller 2005; Cutler *et al*. 2006). While improved immunization, improved water and sanitation, and education also play a role, public health expenditure is considered to be an important factor in influencing health outcomes in developing countries, particularly in terms of reducing the incidence of infant and child mortality. For example, in their study on government health expenditure and health outcomes, Bokhari *et al*. (2007) found government spending on public health to be an important contributor to health outcomes. Similar effects were also noted by Bhalotra (2007) in her study on state health expenditure and infant mortality in India. Using lagged effects and controlling for trended unobservables and restricting the sample to rural households in India, Bhalotra (2007) found significant effects of health expenditure on infant mortality rates.

The examination of health care expenditure and health outcomes has been a subject of ongoing inquiry (Newhouse 1992; Hitris 1997; Di Matteo and Di Matteo 1998; Gerdtham and Jonsson 2000; Hitris and Nixon 2001; Gianonni and Hitris 2002; Bokhari *et al*. 2007; Costa-Font and Pons-Novell 2007). It is clear from a number of these studies that fiscal policy and the composition of public spending are important ingredients for improving health outcomes. The emphasis on increasing public spending on primary health care is generally justified on the basis that such spending ameliorates the impact of disease on the productive life years of the population (Gupta *et al*. 1999). It has also been shown that expenditure allocations in favour of health can boost economic growth while reducing poverty (for example, Barro 1991 and Temple 1999).

Public spending for health care is important for health outcomes of the poor as they are more likely to obtain health care from publicly provided facilities (Gwatkin 2000). Studies show that the poor are significantly less healthy than the rich (Gwatkin 2000; Wagstaff 2000) and that the rich are more likely to obtain medical care when sick (Makinen *et al*. 2000). Hence, health care financing can help to bridge the gap in health status between the poor and the rich.

A number of studies on health care financing and health status have shown that public expenditure on health care reduces the poor–rich differences in health outcomes. In a study involving 70 developing and transition economies, Gupta *et al*. (2001) found that the poor are more strongly affected by health care in comparison with the non-poor, and that the difference in the impact of spending between the poor and non-poor could be substantial. In a study by Gakidou and King (2000), health expenditure per capita, among other variables, was found to be negatively correlated with health inequality.

Health expenditure and mortality rates

The effect of public spending on health is usually measured by health outcome variables such as infant or child mortality rates and life expectancy. The effect of government health expenditure on infant and under-five mortality has been investigated by several researchers. While some studies do not find any support for public health expenditure reducing mortality rates, others show that health care spending has beneficial outcomes in terms of reducing infant and under-five mortality. For example, using cross-sectional data for 22 developing countries in 1985, Anand and Ravallion (1993) found that health expenditure raised life expectancy. In a study of the Philippines, the World Bank (1995) reported that public expenditure on health contributed to the reduction in infant mortality rates in poorer regions, but not in richer regions. In their study involving 50 developing countries, Gupta *et al*. (1999) found empirical evidence to support the claim that greater public spending decreased infant and child mortality rates. In a further study by these authors (Gupta *et al*. 2001) relating to public spending on health care for a larger sample (70 developing countries), the authors found some evidence that health expenditure reduced childhood mortality. In a study involving Central American and Caribbean countries, Hojman (1996) showed that public health spending had a statistically significant effect on health status. A study by Bidani and Ravallion (1997) also found that public spending had a beneficial impact on the health of the poor.

By contrast, however, other studies find little or statistically insignificant support for the notion that public health expenditure reduces mortality rates. Kim and Moody (1992) and Musgrove (1996) found that the effect of public spending on health status, as measured by the health outcome variables infant and child mortality rates, was statistically insignificant. Le Grand (1987) found a weak and negative correlation between health inequality and share of public spending in health care. Filmer *et al*. (1998) attempted to address the issue of allocations within the health sector by including a measure of government spending on primary health care in their cross-section analysis of the causal factors of infant mortality, and failed to find a statistically significant impact of primary health care spending on infant mortality rates. Filmer and Pritchetts's further study on the impact of government health expenditure on infant and under-five mortality in 98 developing countries revealed a statistically insignificant effect (Filmer and Pritchett 1999). Using a state panel for 1980–99, Deolalikar (2005) found no effect of current health expenditure on mortality rates in India.

While the above review provides evidence of support from some studies for health expenditure reducing mortality rates, no such research has been documented for the PICs. The effect of health care financing on health outcomes in the PICs deserves examination in light of the prevalence of preventable diseases, high levels of infant and under-five mortality rates, and low levels of budgetary allocations to the health sector.

In the next section, I therefore present a summary of the basic statistics on central government expenditures for key functional areas, together with an overview of the long-term trends in health care financing across the PICs. The intention is to provide an assessment of the trends, and not to review the causes of progress or stagnation.

Health care financing in the PICs

Government expenditure in the PICs as a share of total expenditure by functional category is summarized in Table 2. Not all the countries listed in Table 1 appear in Table 2 due to incomplete or absence of published data. Health expenditure statistics for each country are shown relative to government expenditure in other key areas, with the year of statistics indicated in parentheses. However, it is important to note that areas such as defence, housing and social security are not included here.

It is obvious from the table that, for all countries, health expenditure does not represent a major share of total government expenditure. With the exception of Kiribati and Tonga, health receives the smallest percentage of government expenditure of the key areas presented. In all countries except Tonga, health expenditure is less than education expenditure. While educational spending receives priority over both health and economic services in Fiji and Kiribati, spending on economic services has priority over health and education in the remaining countries.

Figure 3 depicts trends in health expenditure as a share of GDP for 1990–2001 for seven PICs. Except for Kiribati, health expenditure remained below 5% of GDP between 1990 and 1996. While it rose slightly after 1997 for Fiji, PNG, Samoa, Solomon Islands and Tonga, it declined in the case of Vanuatu. In Kiribati it also declined, considerably, but remained above the other six countries. It is quite difficult to offer much more than a basic description of trends across each country. Potential explanations for the observed trends involve governments' budgetary allocations, where other areas such as public services, economic services and education are given priority. Such prioritization relates to national policies of economic growth and public sector reform, and to demand for health care services.

Figure 4 depicts per capita health expenditure for seven PICs. Using 2003 as the cut-off year, per capita health expenditure ranged from a low of US$8 in PNG to a high of US$104 in Fiji. Between 1990 and 1994, per capita health expenditure remained below US$50 for all countries except Fiji. Per capita spending in Kiribati, Samoa and Tonga rose in the post-1995 period, while for the Solomon Islands, spending remained stagnant between 1990–2002. Surprisingly, PNG's per capita health expenditure has been in decline, falling gradually but steadily since 1997. Significant improvements in per capita spending are noted for Kiribati between 2001 and 2005.

The statistics presented here suggest that the Pacific Island governments have accorded low priority to improving the health conditions of their populations. Every country has a ministerial portfolio for health, the Ministry of Health, but it receives a small share of the budget allocation. Many countries have regarded expenditure on economic services as increasingly important for investment, as opposed to investments in health care services that may have a direct effect on public health.

There are a number of factors within the context of the PICs' economic setting that can possibly explain the long-term stagnant or falling trends in health expenditure. These include

Table 2 Government expenditure by function (percentage of total expenditure)

Country	Government expenditure (%)			
	General public services	Education	Health	Economic services
Cook Islands (2005)	20.8	13.9	11.3	38.9
Fiji (2002)	26.1	29.4	14.3	18.3
Kiribati (2005)	5.0	14.0	9.3	8.7
PNG (2002)	11.3	10.0	5.7	12.1
Samoa (2005)	26.5	22.1	16.7	24.6
Tonga (2002)	40.8	12.9	13.9	18.8
Vanuatu (2005)	15.3	22.7	11.1	43.4

Source: Asian Development Bank (2007).

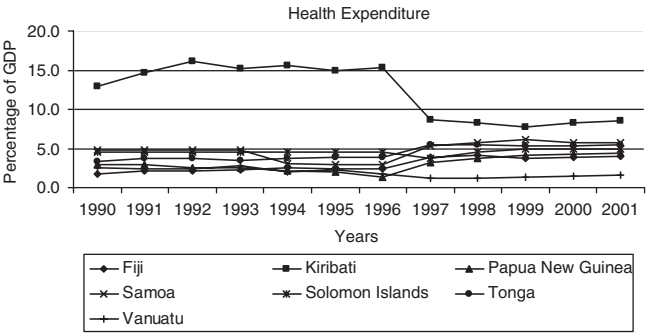

Figure 3 Health care expenditure as a percentage of GDP in seven Pacific Island countries
Source: Asian Development Bank (2007).

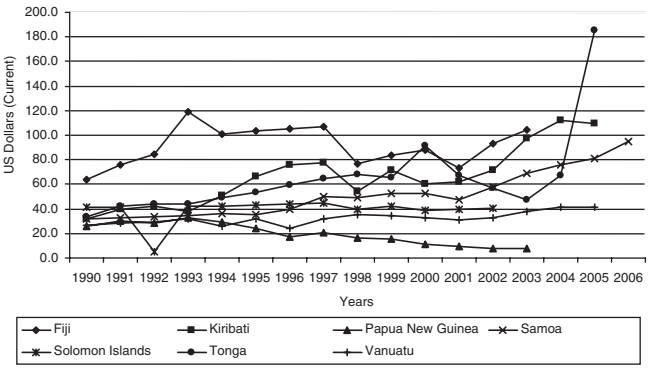

Figure 4 Per capita health expenditure in seven Pacific Island countries, 1990–2006
Source: Author's calculation based on data extracted from Asian Development Bank (2007). Data are government expenditure (recurrent and capital spending from government budgets as well as donations from international agencies and non-governmental organizations).

poor economic growth, small and under-developed private sectors, poor institutional structures and foreign aid.

The long-term economic growth of the PICs has been poor, with some countries experiencing extended periods of sluggish growth, as noted in a recent World Bank report (World Bank 2006b). Sluggish long-term economic growth is likely to have adverse human effects; for example, a direct effect on national resource allocation, with cuts in government expenditure on health and in other areas, thus exacerbating ill-health and lowering the well-being of the population. Poor economic growth has also contributed to high levels of unemployment, with a large proportion of the working-age population in several countries having no income-earning capacity, which has a direct negative bearing on household wealth and welfare. Further, developments in the PICs' external economic environment have had a negative influence on their economic growth. Easterly and Kraay (2000) note that: 'Per capita GDP growth rates are more volatile in small states, due to their much greater exposure to international trade and fluctuations in their terms of trade'.

Closely connected to PICs' economic growth is the size of their private sector and overall business environment. It is generally assumed that a large and expanding private sector and a favourable business environment aid economic growth, which in turn raises the quality of life through increases in income. While it is difficult to gauge the extent of the private sector in each country, available indicators show that in several PICs it is very small (Table 3). A more appropriate indicator of the private sector is privatization proceeds as a share of GDP. The statistics for this indicator do not exist for a number of countries. However, several countries' trade statistics indicate that the value of their imports is many times more than that of their exports, again indicating the small size of private production. The small size of the private sector itself constrains government revenues through taxes as well as lowering per capita incomes for the population. A poor business environment is also an impediment to the rapid growth of the private sector in a number of PICs. For example, it takes many days for businesses to start up from the time of registration (Table 3).

Efforts to maintain strong institutions and achieve continued improvements in institutional quality (law and order, regulatory barriers, property rights, government effectiveness and control of corruption) have also affected private initiatives in the PICs. This issue is currently a core area of discussion and policy focus for several PICs. In a study on good governance, Saldanha (2004) has argued that 'governance problems in the Pacific find their roots deeply embedded in political and social issues such as the structures of government, the quality of leadership, and the capacity of civil society to hold government accountable.' Corruption and mismanagement of public funds are common in several PICs and have had a regressive effect on the delivery of public goods and services, including health care. In addition, political developments have affected national progress in some countries. In recent times, Fiji, the Solomon Islands, Tonga and, to some extent, PNG have been politically unstable. In their study, Duncan and Chand (2002) argued that 'in common with all the PICs, four of the Melanesian countries have experienced difficulties in generating better living standards for their people and political instability has made economic development even more difficult.'

Table 3 The business environment in seven Pacific Island countries

Countries	Domestic credit to private sector (% of GDP)		Time required to start a business (days) in 2006
	1990	2005	
Fiji	34.2	42.2	46
Kiribati	n.a.	n.a.	21
Papua New Guinea	28.6	13.9	56
Samoa	22.7	40.2	35
Solomon Islands	18.8	22.8	57
Tonga	37.7	61.4	32
Vanuatu	37.7	46.4	39

Source: World Bank (2007).
n.a. = data not available.

PICs have continued to receive foreign aid. Aid as a percentage of gross national income and aid per capita are above average for the lower-middle income group of countries and are highest in the world on a per capita basis (Hughes 2003; Gani 2005). Although large aid flows to the PICs have been chiefly within the context of economic growth, foreign aid was also extended to fund government expenditures as some countries have been unable to generate sufficient funds to meet their functional expenditure requirements (World Bank 2006b). While data are inadequate in terms of the proportion of aid allocated to the health sector, it is likely that several countries' health sector budgets have been supplemented by foreign aid. Given the ongoing constraints on foreign reserves, many countries will continue to require external help in the form of aid. Therefore, well-targeted aid, particularly to the health sector, should remain a priority for donors.

Methods

The study utilizes cross-country data on public spending on health from Fiji, Kiribati, PNG, Samoa, Solomon Islands, Tonga and Vanuatu for selected years between 1990 and 2002, together with selected control variables that determine health outcomes. The relationship between per capita health expenditure and health outcomes is explored using a fixed-effects estimation procedure, correcting for AR(1) errors.

Links between health expenditure and health outcomes in the PICs can be examined through an empirical framework where the key issue relating to health outcomes and per capita health expenditure is unfolded. Thus, the structural equation to examine the impact of public spending on health care in the PICs takes the following general form:

$$Y_{it} = f(H_{it}, X_{it}) \quad (1)$$

where Y is a health outcome indicator reflecting health status of country i, H is per capita public spending on health care, X is a vector of socio-economic control variables, and t is the time.

Infant mortality, under-five mortality and crude death rates are considered to be good indicators of the health status of a population (Sen 1998). Changes in national health policies that directly affect investment in health capital, in particular in budgetary allocations to the health sector, are likely to show

Table 4 Variable definitions and data sources

Variable	Definition	Source of data
Infant mortality rate	The number of infants dying before reaching 1 year of age per 1000 live births in a given year	World Health Organization
Under-five mortality rate	The probability that a newborn baby will die before reaching age 5 expressed as a rate per 1000 children under age 5	World Bank
Crude death rate	The number of deaths occurring during the year per 1000 population estimated at mid-year	World Bank
Per capita income	The gross national income per capita (adjusted for purchasing power parity) in US dollars	World Bank
Per capita public health expenditure	The per capita public health expenditure (recurrent and capital spending from government budgets including donations from international agencies and non-governmental organizations) in US dollars	Asian Development Bank
Immunization	The percentage of children aged 12–23 months who received one dose of vaccine against measles before 12 months	World Bank
Urbanization	The estimated urban population as a percentage of total population	World Bank and Asian Development Bank
Calorie intake	The average daily per capita total calorie supply in grams	World Health Organization and Asian Development Bank

quicker effects in terms of health status of the population than other policy changes. It has been noted that long-term improvements in the health status of populations are best reflected in infant mortality and life expectancy rates (see, for example, Gupta and Mitre 2004).

Health outcomes are presumed to be primarily a function of per capita health expenditure as well as several other variables. The variables tested here are predominantly the main conventional variables that are used in many cross-country studies. The control variables include per capita income, immunization rates, urbanization rates and calorie intake. In the regression analysis, equation (1) is expressed in three sets of reduced forms as follows:

$$\ln IMR_{it} = \alpha_0 + \alpha_1 \ln Y_{it} + \alpha_2 \ln PCH_{it} + \alpha_3 \ln IMU_{it} + \alpha_4 \ln URB_{it} + \ln \alpha_5 CI_{it} + \nu_{it} \quad (2)$$

$$\ln U5M_{it} = \beta_0 + \beta_1 \ln Y_{it} + \beta_2 \ln PCH_{it} + \beta_3 \ln IMU_{it} + \beta_4 \ln URB_{it} + \ln \beta_5 CI_{it} + \nu_{it} \quad (3)$$

$$\ln CDR_{it} = \chi_0 + \chi_1 \ln Y_{it} + \chi_2 \ln PCH_{it} + \chi_3 \ln IMU_{it} + \chi_4 \ln URB_{it} + \ln \chi_5 CI_{it} + \nu_{it} \quad (4)$$

where, *IMR* = infant mortality rate; *U5M* = under-five mortality rate; *CDR* = crude death rate; *Y* = per capita income; *PCH* = per capita health expenditure; *IMU* = immunization (against measles); *URB* = urbanization; *CI* = calorie intake; *ln* = logs; *i* = country; *t* = time.

The error term in the above equation is ν_{it} with the assumption that $\nu_{it} \approx iid\ (0, \sigma^2)$. The expected effects are: *Y (-)*; *PCH (-)*; *IMU (-)*; *URB (-)*; and *CI (-)*.

Details on all variables are presented in Table 4. The sample years for the health outcome indicator 'infant mortality rate' were 1990, 1995, 1998, 2000 and 2002. For under-five mortality rates, sample years were 1990, 1995, 2000 and 2002, and for crude death rate, they were 1990, 1992, 1995, 1997, 2000 and 2002. All data were extracted from a number of sources, as indicated in Table 4.

Equation (2) includes seven countries and five time periods; equation (3) includes seven countries and four time periods; and equation (4) includes seven countries and six time periods. While equations (2) to (4) can be estimated with ordinary least squares, the result is likely to be biased if the error terms are correlated within each time series unit and are heteroscedastic across each cross-sectional unit given that the data utilized here are cross-country. Combining these assumptions means estimating a cross-sectionally heteroscedastic and time-wise autoregressive model. This procedure of estimation is also equivalent to the generalized least squares (GLS) estimation.

It should be noted that the GLS equivalent estimation does not take into account the country-specific factors. While the sample of countries falls within the same geographical latitudes and similar socio-economic structures, the health outcomes differ from one country to another. To take into account country-specific differences, a fixed-effects estimation procedure including country-specific dummy variables is adopted. In total there are seven dummies, D1 to D7, for each of the equations (2) to (4) (see Table 6). The no-constant option is adopted in the estimation procedure so as to avoid the commonly known dummy variable trap. Given the nature of the data, the possibility of AR(1) errors is likely and so the fixed-effects estimation procedure corrected for AR(1) errors is adopted.

Results

The results of the GLS estimation procedure are presented in Table 5. The results of the fixed-effects estimation procedure corrected for AR(1) errors are reported in Table 6 and are considered to be robust as the statistical significance and R-square improved significantly compared with the GLS estimation in Table 5. Discussion of the results of the right-hand-side variables of equations (2) to (4) follows.

Per capita public health expenditure

The coefficient for per capita public health expenditure is, as expected, negative for infant and under-five mortality rates (Tables 5 and 6). The coefficient PCH for infant mortality rate is

Table 5 Empirical results based on generalized least squares estimation

	Infant mortality rate, *ln IMR*	Under-5 mortality rate, *ln U5M*	Crude death rate, *ln CDR*
Constant	−0.705	0.518	0.331
	(0.199)	(0.169)	(0.109)
per capita income *ln Y*	−0.483	−0.154	−0.105
	(7.922)*	(3.005)*	(1.632)***
per capita health expenditure *ln PCH*	−0.611	−0.005	0.036
	(6.185)*	(0.092)	(0.615)
immunization *ln IMU*	−0.490	−0.478	−0.506
	(2.077)**	(3.183)*	(3.244)*
urbanization *ln URB*	0.068	−0.110	−0.125
	(0.434)	(0.841)	(1.058)
calorie intake *ln CI*	1.562	0.656	0.644
	(3.090)*	(1.538)	(1.528)
Number of observations	35	28	42
R-square	0.88	0.49	0.46
Durbin Watson statistic	1.80	1.75	1.81

Notes: t-statistics are in parentheses.

*, **, and *** indicate significance at 1%, 5% and 10% levels, respectively.

Table 6 Empirical results of fixed-effects estimation corrected for AR (1) errors

Variables	Infant mortality rate, *ln IMR*	Under-5 mortality rate, *ln U5M*	Crude death rate, *ln CDR*
per capita income *ln Y*	−0.409	−0.416	−0.047
	(8.416)*	(2.425)**	(0.753)
per capita health expenditure *ln PCH*	−0.655	−0.069	0.123
	(9.897)*	(1.089)	(1.969)**
immunization *ln IMU*	−0.884	−0.446	−0.643
	(5.888)*	(2.216)**	(3.863)*
urbanization *ln URB*	0.139	−0.098	−0.163
	(0.979)	(0.716)	(1.319)
calorie intake *ln CI*	1.983	0.793	0.855
	(4.390)*	(1.619)***	(1.784)***
D1	−2.850	−0.474	−1.049
	(0.905)	(0.133)	(0.308)
D2	−2.863	−0.558	−1.137
	(0.905)	(0.156)	(0.333)
D3	−2.989	−0.488	−1.125
	(0.945)	(0.136)	(0.328)
D4	−2.826	−0.540	−1.184
	(0.902)	(0.150)	(0.346)
D5	−2.898	−0.614	−1.244
	(0.917)	(0.171)	(0.363)
D6	−2.902	−0.585	−1.217
	(0.917)	(0.163)	(0.355)
D7	−3.280	−0.692	−1.337
	(1.033)	(0.193)	(0.389)
Number of observations	35	28	42
R-square	0.94	0.54	0.51

Notes: t–statistics are in parentheses.

*, **, and *** indicate significant at 1%, 5% and 10% levels, respectively.

statistically significant at the 1% level. The best point estimates for the coefficients of PCH for infant and under-five mortality are −0.66 and −0.07, respectively (Table 6). The large difference between these estimated coefficients suggests that government health care funding impacts the infant mortality rate more strongly than the under-five mortality rate. This is consistent with the pattern of governmental budgetary allocation to health care in the PICs which is largely targeted for basic primary health care services such as immunization, control of diarrhoea, nutritional training programmes for mothers and some ante-natal care. Based on the elasticity of the infant mortality rate, a 10% increase in per capita health expenditure would mean a reduction in infant mortality rate by approximately 6.6%. For a country such as PNG with a high infant mortality rate, this means a reduction of approximately 3.6 infant deaths per 1000 live births, and for the PICs an average reduction of 2.0 infant deaths per 1000 live births. The coefficient for the crude death rate is positive and statistically insignificant and indicates that health care expenditure is of little consequence here.

Per capita income

The sign on the coefficient of income is, as expected, negative for infant and under-five mortality rates and for death rates. Elasticity with respect to per capita income is −0.41 for infant and under-five mortality rates and −0.05 for crude death rate (Table 6). The income coefficient is statistically significant at the 1% level for both infant and under-five mortality rates. There are large differences between the estimated coefficients for per capita income for infant and under-five mortality rates and crude death rates. This outcome suggests again that governmental expenditure is targeted towards primary health care. The elasticity of the under-five mortality rate of −0.41 is very close to that obtained by Bokhari *et al*. (2007) in a study involving several large developing countries where the elasticity of income was −0.40. The results obtained for the income variable provide strong support that the level of income matters strongly for infant and under-five mortality rates and for crude death rates: rising income means falling mortality rates. On the basis of elasticities obtained for infant and under-five mortality rates, it can be argued that a 10% increase in per capita incomes implies a reduction of approximately 3.0 under-five deaths per 1000 live births in PNG, and an average reduction of approximately 1.7 under-five deaths per 1000 live births for the PICs.

Immunization

The coefficient immunization has the expected negative sign for infant and under-five mortality rates and crude death rates (Table 6). In all these three health indicator outcomes the coefficients of immunization are statistically significant, at the 1% level for infant mortality and crude death rates, and at the 5% level for under-five mortality rate. The elasticity of infant and under-five mortality rates is −0.88 and −0.45, respectively. The elasticities obtained indicate that a 10% increase in immunization rates would reduce infant and

under-five mortality rates by 8.8 and 4.5%, respectively. On the basis of the elasticity of the infant mortality rate, a 10% increase in immunization rates implies a reduction of approximately 4.8 infant deaths per 1000 live births in PNG and an average reduction of approximately 2.6 infant deaths per 1000 live births for the PICs. These are large effects for countries such as Kiribati, the Marshall Islands, Micronesia and PNG as they have high infant and under-five mortality rates. The results obtained for the immunization variable provide strong evidence that immunization programmes are vital and certainly contribute towards reducing mortality rates. Comparing the size of the elasticities of per capita health expenditure, per capita income and immunization, it is clear that immunization has a much stronger impact in reducing mortality rates.

Urbanization and calorie intake

The model here also controls for urbanization and calorie intake. Of all the health outcome indicators, the coefficient of urbanization is the only one statistically insignificant. For under-five mortality rates and crude death rates, the sign on the coefficient is, as expected, negative. However, for infant mortality rate it is positive and contrary to prior expectations. Similarly, calorie intake has a positive sign on its coefficient, contrary to expectations.

Study limitations

This study has limitations, some of which should be highlighted. The major limitation surrounds the choice of variables and data. Published data were not available on some of the key variables of interest, largely to do with socio-economic characteristics that may affect health outcomes. For example, a potential limitation lies in the fact that the study does not control for private health expenditure. Past studies have indicated that private health expenditure and private health insurance play a role in supplementing public health care (Costa-Font and Garcia 2003). In some PICs, private health care is available through private hospitals or private health practitioners. Data on these forms of private health care services are not available. Hence, the models tested here do not include private health care expenditure.

Another variable that is not controlled for is education level or literacy rates. Past studies have shown that literacy, particularly of females, impacts on the health status of infants and children (Shultz 1961; Deolalikar 2005). Previous studies analysing the effect of health expenditure on health outcomes have controlled for literacy or education levels (Gupta *et al*. 1999; Bokhari *et al*. 2007). The models here do not include any measures of adult female literacy or education. While data on level of education are available for some PICs, in others this is missing. Given the nature of cross-country estimations, a consistent set of data was needed for the specified time periods, thus with data missing for some countries it was impossible to control for this variable. It is worth noting that while infant mortality is expected to be lowered by improvements in education, in a recent study by Bhalotra (2007), which tested a model with a very large sample from India and controlled for state education expenditure, the expected reduction in infant mortality was statistically insignificant.

The empirical analysis here does not compare health care outcomes between the rich and the poor. It can be argued strongly that the rich may be able to access better health care services than the poor when governmental budgetary allocations to health care are squeezed. However, the poor may access health care services in times of budgetary cuts through foreign aid or forms of in-kind transfers from family and friends and charity groups. The data utilized here are national aggregates that do not differentiate between rich and poor. Hence, such data limitations constrain further analysis on this issue.

Several PICs comprise small scattered islands, many kilometres away from main urban centres, where health care is difficult to access as a result of poor infrastructure (lack of transportation services to hospitals or nearest health clinics and lack of accommodation facilities for remote families visiting hospitals or health care clinics). Where accommodation is available, this is expensive, and where transportation services are available, they are expensive or irregular; hence the cost of seeking health care becomes a major constraint. The burden of cost is further compounded by health care fees levied by most government-run hospitals and health care clinics. Future research should consider the family burden of the cost of seeking public health care services.

Data quality is another issue to consider. The public health expenditure data used here include donations from international agencies and non-governmental organizations. It is difficult to separate the percentage contributions other than government tax revenues because of the absence of published data. In addition, there are possibilities of double accounting by the Bureau of Statistics in respective countries. Some countries have taken initiatives to improve their national data collection and recording, and data quality is likely to improve in future as a result.

Once data become available, future research should examine the effects of some of the core control variables mentioned here, such as the effect of literacy rates and private per capita health expenditure. In addition, it would be useful to examine the effects of health care funding on the rich and poor segments of the population. Household survey data would be more useful for this kind of inquiry and the collection of such data is highly encouraged. Further, more country-specific studies are encouraged so as to account more strongly for the in-country variations in the socio-economic structures that determine health status.

Conclusions and policy implications

The central focus of this study was to examine whether public expenditure allocations to the health sector improve health outcomes in the PICs (the countries studied being Fiji, Kiribati, PNG, Samoa, Solomon Islands, Tonga and Vanuatu). The study used cross-country data on per capita public spending on health for selected years between 1990 and 2002, together with selected control variables that determine health outcomes. Three indicators of health outcomes—infant mortality rate, under-five mortality rate and crude death rate—were chosen for empirical analysis.

The regression results of the fixed-effects model correcting for AR(1) errors provide strong confirmation that per capita health

expenditure matters for health outcomes in the PICs. Based on the elasticity of the infant mortality rate, it is argued that a 10% increase in per capita health expenditure would mean an approximate 6.6% reduction in infant mortality rate. For a country such as PNG with high infant mortality, this means a reduction of approximately 3.6 infant deaths per 1000 live births, and for the PICs, an average reduction of 2.0 infant deaths per 1000 live births. The regression results also provide strong evidence that other than per capita health expenditure, per capita incomes and immunization rates are two core factors that determine health outcomes in the PICs. Based on the elasticities obtained, I suggest that a 10% increase in per capita incomes would mean a reduction of approximately 3.0 under-five deaths per 1000 live births in PNG, and an average reduction of approximately 1.7 deaths per 1000 live births for the PICs. In terms of the elasticities obtained for immunization, it is argued that a 10% increase in immunization rates would mean a reduction of approximately 4.8 infant deaths per 1000 live births in PNG, and an average reduction of approximately 2.6 infant deaths per 1000 live births for the PICs.

While the limitations of this study are acknowledged and the results should be interpreted with caution, the empirical findings nevertheless strongly indicate policy measures that need to be put in place. These are discussed below.

PIC governments need to safeguard budgetary allocations to the health sector and in particular to primary health care services. Like elsewhere, Pacific Island governments are always pressed to balance their limited budget and to raise productivity. In this process, government budgetary allocations may be cut without sufficient thought to outcomes in the health sector. Human health is a major determinant for national human capital formation. Like several areas of government spending, the budgetary allocation to the health sector needs to be boosted and at the same time protected against expected national revenue shortfalls and unexpected downward revisions of budgets. Pacific Island governments would do well to keep in mind the relationship between health expenditures and health outcomes over the long term. This should be of concern for policy makers and finance ministers. While Pacific Island governments' annual budgets are usually intended to ensure the macro-economic sustainability of total government expenditures, measuring outcomes is a serious problem and budgets do not take these into consideration. There is an urgent need to take health expenditures and health outcomes into account in the budgetary formulation process, and to formulate budgetary allocations to the health sector accordingly.

Improved immunization, among other factors, has been found to be an important variable that can influence health outcomes, particularly in terms of reducing infant and child mortality rates in developing countries. This study also confirms immunization as a significant determinant. PICs' health statistics have also indicated measles as a contributor to infant and child death (Table 1). Thus, it is important that PICs engage in boosting their immunization coverage from its current low levels. Particular attention should be given to rural and remote communities who are unable to access adequate primary health care services. Pacific Island governments can have little excuse for not enhancing immunization coverage given that this is both cost-effective and saves lives.

Strong economic growth is essential. Economic growth raises incomes and this can lead to rapid improvements in the provision of health care services through greater financial and human capital allocations to the health sector, as well as better education and general improvements in physical infrastructure—all important for improving human capital. Thus, there is a continuing need for the PICs to devote more resources to health care so as to achieve a higher quality of health and health-related services. Better quality of health care translates into lower mortality and higher life expectancies. PICs should also look into other areas that affect growth such as investments in physical and human capital (schooling), financial development and international trade.

The role of donors is important. Targeting of budgetary aid can have useful effects. Donors can ensure that part of their aid that goes to the health sector is allocated to primary health care services like immunization, neonatal care and maternal education. While aid has continued to flow, achievements in good governance have been disappointing. Some donors are now attempting to assist in improving governance in key sectors through direct aid allocation or linking project aid to improvements in governance. The example of the PICs should indicate to donors that good governance matters for aid allocation. Budgetary aid should be conditional upon PICs improving governance and in particular reducing the public financial mismanagement in the health sector as well as in other governmental areas.

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References

Anand S, Ravallion M. 1993. Human development in poor countries: on the role of private incomes and public services. *Journal of Economic Perspectives* **7**: 133–50.

Asian Development Bank. 2007. *Key Indicators 2007*. Manila.

Barro RJ. 1991. Economic growth in a cross-section of countries. *Quarterly Journal of Economics* **106**: 407–44.

Bhalotra S. 2007. Spending to save? State health expenditure and infant mortality in India. *Health Economics* **16**: 911–28.

Bidani B, Ravallion M. 1997. Decomposing social indicators using distributional data. *Journal of Econometrics* **77**: 125–39.

Bokhari FAS, Gai Y, Gottret P. 2007. Government health expenditures and health outcomes. *Health Economics* **16**: 257–73.

Costa-Font J, Garcia J. 2003. Demand for private health insurance: how important is the quality gap? *Health Economics* **12**: 587–99.

Costa-Font J, Pons-Novell J. 2007. Public health expenditure and spatial interactions in a decentralised national health system. *Health Economics* **16**: 291–306.

Cutler D, Miller D. 2005. The role of public health improvements in health advances: the twentieth century United States. *Demography* **42**: 1–22.

Cutler D, Deaton A, Lleras-Muney A. 2006. The determinants of mortality. *Journal of Economic Perspectives* **20**: 97–120.

Deaton A. 2006. Global patterns of income and health: facts, interpretations and policies. WIDER Annual Lecture, September, Helsinki.

Deolalikar A. 2005. *Attaining the Millennium Development Goals in India: how likely and what will it take to reduce infant mortality, child malnutrition, gender disparities and hunger-poverty and to increase school enrolment and completion*. New Delhi: Oxford University Press.

Di Matteo L, Di Matteo R. 1998. Evidence on the determinants of Canadian provincial government health expenditure 1965–1991. *Journal of Health Economics* **17**: 211–28.

Duncan R, Chand S. 2002. Arc of instability. *Asian-Pacific Economic Literature* **16**: 1–11.

Easterly W, Kraay A. 2000. Small states, small problems? Income, growth and volatility in small states. *World Development* **28**: 2013–27.

Filmer D, Pritchett L. 1999. The impact of public spending on health: does money matter? *Social Science and Medicine* **49**: 1309–23.

Filmer D, Hammer J, Pritchett L. 1998. Health policy and poor countries: weak links in the chain. Policy Research Working Paper No. 1874. Washington, DC: World Bank.

Gakidou K, King G. 2000. An individual level approach to health inequality: child survival in 50 countries. Global Programme on Evidence for Health Policy Discussion Paper no. 18. Geneva: World Health Organisation. Available online at: http://www-nt.who.int/whosis/statistics/discussionpapers/pdf/paper18.pdf.

Gani A. 2005. Pacific Island countries high per capita foreign aid requirement. *Journal of International Development* **18**: 285–92.

Gerdtham UG, Jonsson B. 2000. International comparisons of health expenditure: theory, data and econometric analysis. In: Culyer AJ, Newhouse JP (eds). *Handbook of health economics*, Vol. 1. Amsterdam: Elsevier, pp. 11–53.

Gianonni M, Hitris T. 2002. The regional impact of health care expenditure: the case if Italy. *Applied Economics* **34**: 1829–36.

Gupta I, Mitra A. 2004. Economic growth, health and poverty: an exploratory study for India. *Development Policy Review* **22**: 193–206.

Gupta S, Verhoeven M, Tiongson E. 1999. Does government spending buy better results in education and health care? IMF Working Paper No. WP/99/21. Washington, DC: International Monetary Fund.

Gupta S, Verhoeven M, Tiongson E. 2001. Public spending on health care and the poor. IMF Working Paper No. WP/01/127. Washington, DC: International Monetary Fund.

Gwatkin DR. 2000. Health inequalities and the health for the poor: what do we know? What can we do? *Bulletin of the World Health Organisation* **78**: 3–18.

Hitris T. 1997. Health care expenditure and integration in the countries of the European Union. *Applied Economics* **29**: 1–6.

Hitris T, Nixon J. 2001. Convergence of health care expenditures in the EU countries. *Applied Economics Letters* **8**: 223–8.

Hojman DE. 1996. Economic and other determinants of infant and child mortality in small developing countries: the case of Central America and the Caribbean. *Applied Economics* **28**: 281–90.

Hughes H. 2003. Trade or aid? Which benefits developing countries most? *Economic Papers* **22**: 20–34.

Jones G, Steketee R, Bhutta Z, Morris S, the Bellagio Child Survival Study Group. 2003. How many child deaths can we prevent this year? *The Lancet* **362**: 65–71.

Kim K, Moody PM. 1992. More resources better health? A cross-national perspective. *Social Science and Medicine* **34**: 837–42.

Le Grand J. 1987. Inequalities in health: some international comparisons. *European Economic Review* **31**: 182–91.

Makinen M, Waters H, Rauch M *et al.* 2000. Inequalities in health care use and expenditures: empirical data from eight developing countries and countries in transition. *Bulletin of the World Health Organisation* **78**: 55–65.

Musgrove P. 1996. Public and private roles in health: theory and financing patterns. World Bank Discussion Paper No. 330. Washington, DC: World Bank.

Newhouse JP. 1992. Medical care costs: how much welfare loss? *Journal of Economic Perspectives* **6**: 3–21.

Saldanha C. 2004. Strategies for good governance in the Pacific. *Asian-Pacific Economic Literature* **18**: 30–43.

Schultz TW. 1961. Investment in human capital. *American Economic Review* **51**: 1–17.

Sen A. 1998. Mortality as an indicator of economic success and failure. *Economic Journal* **108**: 1–25.

Temple JRW. 1999. The new growth evidence. *Journal of Economic Literature* **37**: 112–56.

Wagstaff A. 2000. Socioeconomic inequalities in child mortality: comparisons across nine developing countries. *Bulletin of the World Health Organisation* **78**: 19–29.

World Bank. 1993. *World Development Report: Investing in Health*. New York: Oxford University Press for the World Bank.

World Bank. 1995. Philippines: public expenditure management for sustained and equitable growth. World Bank Report No. 14680-PH. Washington, DC: World Bank.

World Bank. 2006a. *World Development Indicators CD ROM 2006*. Washington, DC: World Bank.

World Bank. 2006b. The Pacific infrastructure challenge: a review of obstacles and opportunities for improving performance in Pacific Islands. Working Paper No. 36031. Washington, DC: World Bank.

World Bank. 2007. *World Development Indicators 2007*. Washington, DC: World Bank. Available online at: http://.www.worldbank.org/wdi.

World Health Organization. 2006. Regional databases. Manila: WHO Regional Office of the Western Pacific. Available online at: http:www.who.int/whosis/database/core/core_select