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The effects of health aid on child health promotion in developing countries: cross-country evidence

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Although epidemiological knowledge in relation to child health has improved in the last few decades, around 3 million children die each year in developing countries from preventable diseases. The international development community views increased immunization coverage for children as an important step in eliminating or reducing these deaths. Many developing countries have very limited resources to tackle major health problems and have to rely on external finance. This article examines the impact of foreign aid devoted to the health sector on child health promotion in developing countries. Two proxies for child health promotion are used: (a) immunization against measles and (b) immunization against Diphtheria–Pertussis–Tetanus (DPT). A range of model specifications and panel data econometric techniques are applied to data covering the period 1990 to 2005. This article finds a positive and statistically significant link between health aid and the measures of child health promotion.

Keywords: foreign aid; child health; immunization; developing countries

JEL Classification: F35; I12; C23

I. Introduction

Child health is one of the most fundamental determinants of a country's long-term development prospects. Despite recent improvements in epidemiological knowledge in relation to child health, many children continue to die in developing countries. Approximately 11 million young children die each year and the majority of these deaths are from preventable illnesses such as diarrhoea, measles, malaria or tetanus (UNICEF, 2008). Lawn *et al.* (2005) estimate that every year around 4 million babies die in the first 4 weeks of life, with 99% of these neonatal deaths occurring in developing countries. It is also estimated that around 150 million children suffer from neurodevelopmental disability and most them live in low and middle income countries (Maulik and Darmstadt, 2007).

With the recent emphasis on the Millennium Development Goals (MDGs), which include health-related goals, there is a worldwide call, under the leadership of the World Health Organization (WHO),

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United Nations Children's Fund (UNICEF) and the World Bank to tackle child mortality and morbidity, development and neonatal survival.[1] For this purpose, multilateral and bilateral donors are scaling up their aid programs. Indeed, Official Development Assistance (ODA) has increased from US$69.1 billion in 2003 to a record high of almost USD $120 billion in 2008. ODA is expected to increase further to US$130 billion by 2010 (Organization for Economic Co-operation and Development (OECD), 2006). After stagnating in the 1980s and 1990s, foreign aid devoted to health has risen in recent years. In 2006, aid to the health sector amounted to USD 12.6 billion and over the period 1980 to 2006 it increased at an average rate of 9%. Further, the rate accelerated to 15% annually between 2000 and 2006 (OECD, 2008a).

The existing literature on the effectiveness of aid has centred on its impact on the rates of per capita income growth in recipient countries using cross-country data.[2] This article departs from these previous studies by examining the relationship between health aid and child health promotion in developing countries, proxied by rates of immunization.[3] It examines the impact of international assistance on an input into health care (immunization) rather than on health outputs such as infant mortality or life expectancy. This is justified on the following grounds. First, there is strong evidence that immunization (an input into health care) has an important impact on the rates of child and infant mortality (health outputs). Second, data on health outputs, such as child and infant mortality, are typically only available for every 5 years restricting sample size. Third, isolating the direct impact of health aid on child or infant mortality is very difficult empirically. There are numerous determinants of health outputs such as mortality rates including income, household size and composition, parental education, the gender of the child, the location of their household, access to water and sanitation, access to health services, the fate of a previous child as well as rates of immunization (Charmarbagwala *et al*., 2004). While the MDGs represent a number of important outputs, they can be criticized for not applying enough attention to the inputs that are required for their achievement.

The six immunizable diseases incorporated in the WHO's expended program on immunization (measles, pertusis, poliomyelitis, diphtheria, tetanus and tuberculosis) have been estimated to kill more than 3 million children annually (UNICEF, 2008). Morley *et al*. (1963), McGregor (1964) and Walsh (1986) have documented that measles is a major cause of mortality and morbidity in developing countries.[4] Moreover, measles is often associated with diarrheal diseases, which in turn have a great impact on child health and development (Motarjemi *et al*., 1993).[5] Another child-related disease, which may rival measles in importance and severity, is pertusis (whooping cough), a highly infectious disease.

Clearly, immunization is fundamental for child health. Yet in developing countries, many children still do not have access to vaccines, despite the fact that most evidence suggests that immunization is one of the most cost-effective public health policies (Lu *et al*., 2006). Indeed, the role of immunization in preventing death among children has been substantiated in the medical field as well as social science studies. For example, Koenig *et al*. (1991), Aaby (1995) and Kristensen *et al*. (2000), among others, have shown that measles vaccination campaigns in developing countries significantly reduce child deaths as well as overall mortality. The greatest burden of vaccine preventable disease is in sub-Saharan Africa, which accounts for more than half of global measles deaths, 41% of tetanus deaths and 58% of pertussis (whopping cough) deaths. Seven largely populated countries, which include Bangladesh, DR Congo, Ethiopia, India, Indonesia, Nigeria and Pakistan, contribute to the 33 million unimmunized children around the world (Keegan and Bilous, 2004).[6]

Hence, increased immunization coverage for children in the developing world is an immediate priority not only for their national interest, but also for the international development community in its

[1] MDG 4 focuses on child survival and the target is to reduce by two-thirds under five mortality rates by the year 2015.
[2] See, for example, Burnside and Dollar (2000), Hansen and Tarp (2000, 2001), Easterly *et al*. (2004), Rajan and Subramanian (2005) and Ouattara and Strobl (2008). See McGillivray *et al*. (2006) for a review of this literature and Roodman (2004) for a critique. Islam (1992), Mbaku (1993) and Gounder (2001) are examples of studies using time-series data for individual countries.
[3] Masud and Yontcheva (2005) and Mishra and Newhouse (2007) are two other recent studies to examine the impact of aid on health outcomes in general. Ideally, aid devoted to child health would be used although accurate and reliable data at this level do not exist.
[4] Recent estimates show that more than 95% of measles deaths occur in low-income countries.
[5] It is estimated that up to 26% of diarrheal-associated deaths can be prevented by measles vaccination (Feachem and Koblinsky, 1983). Pneumonia, malnutrition and shigella dysentery are other complications associated with measles.
[6] While in industrialized countries immunization coverage are over 80%, in the poorest countries they are less than 50% (WHO, 2003).

commitment to achieving the MDGs. Immunization also has a wider impact. For example, when children are healthy they are more likely to attend school, thus helping to improve the human capital of the country. Immunization coverage can also help a country's health system by reducing the health burden, and therefore the cost of diseases.

Note that recipient governments will often have discretion over how health aid funding is spent. Fungibility arises if some part of health aid is used for other (nonhealth) purposes. Even if just a small portion of health aid is diverted to other purposes, a positive association between health aid and rates of immunization is by no means guaranteed. First, health aid consists of different types of aid and is not always provided explicitly for immunization programs. Second, even when donors fund vaccinations programs, increasing their supply, this does not necessarily imply that demand exists or that the resources allocated for this purpose are used effectively. Moreover, undertaking an empirical examination of health aid and immunization rates can reveal the magnitude of any relationship between the two and help identify the most effective health inputs that international donors can support.

The remainder of this article is structured as follows. Section II discusses the data and outlines the methodology. The results and their interpretation are provided in Section III. Finally, the article concludes in Section IV.

II. Data and Methodology

This article adopts an empirical approach to evaluate the impact of health aid on child health through immunizations. Data are collected for 109 countries covering the period 1990 to 2005. Data relating to child immunizations are obtained from the World Bank (2008). The measure of aid used is the amount of net ODA disbursed by donors to support the health sector of the recipient country, expressed as a ratio of recipient country Gross Domestic Product (GDP). ODA is the most widely used measure of foreign aid and data are obtained from the OECD (2008b). Table A1 in the Appendix provides further detail of data sources and definitions.

The following empirical model is specified:

$$Chealth_{it} = \beta_0 + \beta_1 Govrev_{it} + \beta_2 Aid_{it} + \beta_3 y_{it} + \theta' z_{it} + \varepsilon_{it} \quad (1)$$

where *Chealth* represents child health and is proxied using two variables: (i) immunization against measles and (ii) immunization against Diphtheria–Pertussis–Tetanus (DPT). *Govrev* represents government tax revenue. It is included to provide an indication of the resources that recipient country governments have to devote to improving health status. Government health expenditures are not included since a large part of health aid will fund health expenditures, leading to well-known problems of collinearity and double counting. The variable y represents income per capita since richer countries can be expected to have higher levels of child health and immunization coverage.

z_{it} represents a vector of control variables, and θ' their associated slope coefficients. Variables in z include population, population density and the level of urbanization. These variables are included in the model since it is postulated that widespread immunization programs can be carried out more effectively in small, densely populated countries with larger proportions of the population living in cities. The vector z also includes female illiteracy, governance, institutional quality and the number of TV sets per 1000 people. Female illiteracy is included since higher levels of illiteracy might be associated with poor levels of child health. Moreover, it is anticipated that higher levels of governance and institutional quality are associated with higher levels of child health. The number of TV sets is included to capture mediatization. If people have access to information about immunization, they are more likely to become involved in these programmes. In some developing countries the government uses the media to inform people of immunization programmes and encourage them to participate. Table A2 in the Appendix provides summary statistics of the variables used in this study.

Subscript i and t are, respectively, country and year identifiers. The explanatory variables are not available for all countries in the sample. A number of alternative model specifications were therefore estimated in order to identify the most important drivers of child health and to test the robustness of results. In addition to Ordinary Least Squares (OLS) and Fixed-Effects estimations, the System-Generalized Method of Moments (GMM) estimator (GMM-SYS) and Two-Stage Least Squares (2SLS) estimators are adopted to exploit the panel nature of the data and control for the potential endogeneity of the aid variable.

III. Results and Interpretation

Results from the estimation of the empirical model are provided in Tables 1–3. Table 1 provides OLS and fixed-effects estimation results from the estimation of the model with immunization against DPT used as

Table 1. The impact of health aid on child health (DPT immunization)

	OLS			Fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax revenue (% GDP)	0.455***	0.452***	0.808***	0.201**	0.222***	0.163
	(0.13)	(0.14)	(0.11)	(0.081)	(0.072)	(0.20)
Health aid (% GDP)	3.780***	2.604**	1.916*	1.959***	1.947***	2.019**
	(1.17)	(1.14)	(1.09)	(0.71)	(0.65)	(0.78)
log(income per capita)	0.129***	0.109***	0.00969	0.0221	0.0566***	0.0571**
	(0.0082)	(0.012)	(0.014)	(0.030)	(0.017)	(0.027)
log(population)		–1.934***	–1.020***		–2.033**	–0.840
		(0.34)	(0.38)		(0.86)	(1.09)
log(population density)		2.164***	3.044***		3.006***	3.817***
		(0.47)	(0.48)		(1.15)	(1.24)
Proportion of urban population		0.0595	0.0964**		0.135*	0.0196
		(0.037)	(0.042)		(0.074)	(0.083)
Female illiteracy			–0.494***			–0.726***
			(0.033)			(0.085)
Governance			2.412***			0.101
			(0.48)			(0.61)
Institutional quality			0.303***			0.311***
			(0.040)			(0.048)
TV set per 1000 people			0.0162**			0.0634***
			(0.0083)			(0.014)
Constant	–77.49***	–9.263	51.90***	96.56***	–14.59	109.5***
	(7.81)	(9.71)	(11.8)	(25.0)	(15.5)	(25.9)
Observations	991	989	575	991	989	575
R^2	0.57	0.59	0.71	0.67	0.66	–
$F(\zeta = 0)$	132.65***	50.57***	52.36***	44.79***	46.23***	32.49***

Notes: Robust SEs in parentheses. $F(\zeta = 0)$ is F-test of joint significance of all explanatory variables. Time dummies included. ***, ** and * denote significance at 1, 5 and 10% levels, respectively.

the dependent variable. The results in column (1), which portray the baseline model, show that health aid is positively associated with child health proxied by DPT immunization (at the 1% level). In column (2) additional control variables (population, population density and proportion of urban population) are included to ensure that results are not driven by specification. There is still a statistically significant association between health aid and immunization DPT (at the 5% level). In column (3) further control variables (female illiteracy, governance, institutional quality and the number of TV sets per 1000 people) are added. Again, the reported results substantiate the finding that health aid bears a positive and significant association with child health (at the 10% level). The coefficients on all variables have their expected signs and are statistically significant with the exception of the coefficient on the per capita income variable which is not statistically significant.

The three models are re-estimated using a fixed-effects approach and results are presented in columns (4)–(6). Results are remarkably consistent with those from OLS estimation. Importantly, the coefficient on the health aid variable is consistently positive and statistically significant (at the 1% and 5% levels).

There might be legitimate concerns regarding these results due to the problem of endogeneity of the health aid variable. We attempt to address this issue by estimating the variants of our model using instrumental variable techniques namely the 2SLS and the GMM-SYS estimators.[7] Columns (1), (2) and (3) of Table 2 report the 2SLS estimation results whilst columns (4), (5) and (6) show the GMM-SYS results. Once again, we find that health aid increases immunization DPT (at the 1% and 5% levels). Overall, the evidence that health aid impacts positively and significantly (in statistical terms) on immunization DPT remains robust across a number of specifications.

This article now turns to the second proxy for child health: immunization against measles. Results are provided in Tables 3 and 4. In Table 3, OLS results,

[7] Both the GMM-SYS and the 2SLS techniques use internal instruments (Blundell and Bond, 1998; Baum *et al*., 2007 for a detailed discussion). Results from all GMM specifications pass the Hansen test for over-identifying restrictions and the Arellano–Bond (1991) test for second-order autocorrelation.

Table 2. The impact of health aid on child health (DPT immunization)-instrumental variable approach

	2SLS			GMM-SYS		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax revenue (% GDP)	0.607**	0.869***	0.736***	0.535**	0.230***	0.756***
	(0.27)	(0.29)	(0.25)	(0.24)	(0.064)	(0.060)
Health aid (% GDP)	1.872**	1.245**	1.088**	2.447**	0.305**	1.586***
	(0.80)	(0.39)	(0.31)	(1.02)	(0.13)	(0.55)
log(income per capita)	0.181***	0.129***	0.0610*	0.112***	0.0959***	0.0463***
	(0.021)	(0.033)	(0.033)	(0.022)	(0.012)	(0.0078)
log(population)		–0.346	–0.464		–5.700***	–1.187
		(1.24)	(0.80)		(0.64)	(0.89)
log(population density)		3.814***	3.063***		3.047***	1.949*
		(1.41)	(0.83)		(0.80)	(1.14)
Proportion of urban population		0.198*	0.0782		0.0452	0.0953
		(0.10)	(0.092)		(0.057)	(0.15)
Female illiteracy			-0.559***			–0.423***
			(0.066)			(0.090)
Governance			1.878			0.631**
			(1.16)			(0.24)
Institutional quality			0.447***			
			(0.077)			
TV set per 1000 people			0.0487**			0.0990***
			(0.021)			(0.0100)
Constant	–88.74***	–70.81***	78.49***	–17.80	42.72***	91.38***
	(16.6)	(25.4)	(26.7)	(18.5)	(9.37)	(14.7)
Observations	716	714	448	991	989	784
R^2	0.29	0.32	0.68	n.a.	n.a.	n.a.
$F(\zeta = 0)$	3.28**	1.87*	3.62***			
AR(2) *p*-value	n.a.	n.a.	n.a.	0.47	0.11	0.62
Hansen/Sargan test *p*-value	0.10	0.12	0.10	0.29	0.54	0.36

Notes: Robust SEs in parentheses. $F(\zeta = 0)$ is *F*-test of joint significance of all explanatory variables. Time dummies included. ***, ** and * denote significance at 1, 5 and 10% levels, respectively.

provided in columns (1), (2) and (3), clearly show that health aid is positively correlated to child health in all three of the specifications. The estimated coefficient of health aid is statistically significant in all the regressions (at the 1% level). The fixed-effects results, provided in columns (4), (5) and (6), also show that health aid increases immunization against measles (at the 1% level). Table 4 presents results from the instrumental variable approaches and demonstrates that the positive association between health aid and child health remains robust. Indeed, results from 2SLS in columns (1)–(3), and from GMM-SYS provided in columns (4)–(6) show that the estimated coefficient of health aid is positive and statistically significant (at 1% and 5% levels).

While the impact of health aid on child is the main focus of this article, the other variables in our specifications warrant some discussion. The results indicate that domestic revenue, in the form of tax revenues, exerts a positive and statistically significant effect on child health (with exception of just one regression). This appears to indicate that in addition to health aid, domestic resources play an important role in improving child health. However, while the coefficients on the tax revenue variable are statistically significant (across most specifications) they are far smaller than the coefficients on the aid health aid variable. This indicates that additional external support from donors in the form of health aid has a much greater impact on child health promotion than increases in internal government revenue from taxes. Child immunization rates are therefore more likely to increase with additional donor support than they are through additional tax revenues collected by recipient governments.[8]

There is also strong evidence to suggest that per capita income is positively associated with child health. Indeed, in higher income countries we would expect better child health. As expected, population density, governance and institutional quality exert a positive and statistically significant impact on child health. There is also some support for TV sets per 1000 people

[8] The authors are grateful to an anonymous referee for making this point.

Table 3. The impact of health aid on measles immunization (pooled-OLS and fixed-effects results)

	Pooled-OLS			Fixed effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax revenue (% GDP)	0.422**	0.480**	0.665**	0.340***	0.352**	0.252
	(0.19)	(0.22)	(0.27)	(0.12)	(0.17)	(0.17)
Health aid (% GDP)	3.977***	3.367***	3.390***	1.900***	4.540***	2.030***
	(1.02)	(1.12)	(1.13)	(0.59)	(1.00)	(0.70)
log(income per capita)	0.116***	0.0634**	0.00973	0.0823**	0.0988***	0.0665**
	(0.020)	(0.031)	(0.034)	(0.037)	(0.027)	(0.031)
log(population)		–1.183	–0.475		–3.270**	–1.709
		(0.90)	(0.83)		(1.29)	(1.09)
log(population density)		1.281	1.736*		10.30***	0.684
		(1.28)	(0.95)		(1.60)	(1.35)
Proportion of urban population		0.226**	0.257***		0.854***	0.0403
		(0.11)	(0.089)		(0.10)	(0.11)
Female Illiteracy			–0.342***			–0.248**
			(0.076)			(0.098)
Governance			1.697			0.820
			(1.11)			(0.68)
Institutional quality			0.247***			0.142***
			(0.079)			(0.047)
TV set per 1000 people			0.0167			0.0172
			(0.021)			(0.014)
Constant	–22.92	14.31	20.38	4.950	–12.7***	–2.288
	(17.4)	(27.4)	(26.5)	(30.6)	(2.14)	(27.0)
Observations	938	936	560	938	936	560
R^2	0.59	0.61	0.68	0.66	0.64	0.61
$F(\zeta = 0)$	17.49***	19.81***	26.39***	39.82***	42.56	26.43***

Notes: Robust SEs in parentheses. $F(\zeta = 0)$ is *F*-test of joint significance of all explanatory variables. Time dummies included. ***, ** and * denote significance at 1, 5 and 10% levels, respectively.

having the same relationship. Population and female illiteracy also appear to be associated with lower levels of child health. With respect to female illiteracy, low levels of literacy might imply a lack of awareness regarding the benefits or importance of immunization and thus a reluctance to attend immunization programs.

IV. Conclusion

This article evaluates the impact of health aid on child health in developing countries. Using two indicators of child health, namely immunization measles and immunization DPT, and a panel of aid recipient countries, it finds strong evidence that increases in health aid are associated with improvements in child health. The results also show that domestic resources in the form of government revenue, income per capita, mediatization (proxied by the number of TV sets per 1000 people), population density, good governance and institutional quality also play an important role in improving child health. In contrast, our results reveal that female illiteracy has a negative and statistically significant association with child health.

The main finding of this article suggests that international donors can substantially enhance child survival and child health in developing countries by scaling up health aid. Given the low subsidization of the health sector in developing countries, scaling up health aid would also help in the implementation of other important vaccines such as rotavirus vaccines, which have become an issue of high priority.[9] Our results also suggest a number of other channels through which policymakers could improve levels of child health. These channels include improving levels of governance and institutional quality, increasing

[9] Naghipour *et al.* (2008) estimate that the burden of rotavirus disease causes more than 110 million diarrhea episodes, 25 million clinical visits, 2 million hospitalization and more than half a million deaths, with almost 90% of these cases in developing countries. The authors argue that there is desperate need to extend rotavirus vaccines to developing countries in order to reduce rotavirus-associated deaths.

Table 4. The impact of health aid on measles immunization (instrumental variable results)

	2SLS			GMM-SYS		
	(1)	(2)	(3)	(4)	(5)	(6)
Tax revenue (% GDP)	1.872**	1.435***	1.065***	3.287***	1.948***	0.478***
	(0.80)	(0.55)	(0.24)	(0.65)	(0.18)	(0.070)
Health aid (% GDP)	0.607**	0.744***	0.969***	0.389**	0.333***	0.528***
	(0.27)	(0.24)	(0.20)	(0.18)	(0.10)	(0.097)
log(income per capita)	0.181***	0.0962***	0.0627**	0.112***	0.0631***	0.00112
	(0.021)	(0.033)	(0.025)	(0.020)	(0.018)	(0.011)
log(population)		–0.567	0.105		–2.995***	–3.068***
		(1.20)	(0.59)		(1.06)	(0.60)
log(population density)		3.850***	3.580***		1.399	0.0916
		(1.35)	(0.64)		(0.88)	(0.52)
Proportion of urban population		0.295***	0.103		0.199**	0.0784
		(0.094)	(0.078)		(0.076)	(0.061)
Female illiteracy			–0.550***			–0.180***
			(0.056)			(0.045)
Governance			1.492			3.921***
			(0.98)			(0.34)
Institutional quality			0.0481***			0.109***
			(0.018)			(0.028)
TV set per 1000 people			0.392***			
			(0.063)			
Constant	–88.74***	–44.02*	71.51***	–5.355	37.54**	73.21***
	(16.6)	(23.1)	(20.3)	(17.2)	(14.3)	(11.1)
Observations	716	586	448	938	936	734
R^2	0.29	0.38	0.67	n.a.	n.a.	n.a.
$F(\zeta = 0)$	45.58***	26.46***	56.88***			
AR(2) *p*-value	n.a.	n.a.	n.a.	0.38	0.23	0.23
Hansen/Sargan test *p*-value	0.28	0.27	0.10	0.51	0.57	0.48

Notes: Robust SEs in parentheses. $F(\zeta = 0)$ is *F*-test of joint significance of all explanatory variables. Time dummies included. ***, ** and * denote significance at 1, 5 and 10% levels, respectively.

rates of female literacy and improving health awareness through programs on television and other outlets.

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Appendix

Table A1. Data: sources and definitions

Variable	Definition	Source
Immunization DPT	Percentage of children aged 12–23 months immunized against DPT	World Bank (2008)
Immunization measles	Percentage of children aged 12–23 months immunized against measles	World Bank (2008)
Tax revenue	Revenue from direct and indirect taxes (% GDP)	World Bank (2008)
Health aid	ODA disbursements targeting the health sector (data expressed in % GDP)	OECD online statistics (2008b)
Income	Real income per capita	World Bank (2008)
Population	Mid year population (000s)	World Bank (2008)
Population density	People per sq km	World Bank (2008)
Urbanization	Share of the total population living in areas	World Bank (2008)
Female illiteracy	Percentage of female aged 15 and above who cannot read and write	World Bank (2003, 2008)
Governance	Civil liberties	Freedom House (2008)
Institutional quality	International Country Risk Guide (ICRG)	Knack and Keefer (1995)
TV sets	TV sets per 1000	World Bank (2008)

Table A2. Summary statistics

Variable	Mean	SD	Min	Max
Immunization DPT (percentage of children ages 12–23 months)	73.9	21.2	10	99
Immunization measles (percentage of children ages 12–23 months)	74.0	19.7	12	99
Tax revenue (% GDP)	16.4	7.5	2.0	54.4
Health aid (% GDP)	0.48	1.0		0.00002 16.7
Real income per capita	3791.9	3428.6	170.6	19567.4
Population (000s)	40 549	151 129.3	62.4	1 294 846
Population density	101	148.2	1.3	1089.5
Urbanization	42.8	21.3	5.4	96.5
Female illiteracy	39.0	26.2	0.21	94.9
Freedom house civil liberty	4.1	1.6	1	7
Institutional quality	45.8	14.9	4.2	89.8
TV set (per 1000)	98.52	107.22	0.053	536.95