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Happiness and Government: The Role of Public Spending and Public Governance"

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Abstract

We use the quadratic form in the key spending variables in a statistical model to explain total life satisfaction using two waves of World Value Survey data covering 78 countries.. This allows us to estimate optimal government spending. We found that the average of total public spending for countries of good public governance is almost identical to the average of estimates of optimal total public spending, which stands at 36.5% of GDP and which is estimated at the average values in the sample for per capita GDP, median population age, and public governance quality indicator. However, significant over-spending or under-spending is found for individual countries. Optimal spending on both healthcare and that for education increase with population aging. Spending on education is found to reduce optimal healthcare spending. Per capita GDP increases optimal healthcare spending but reduces optimal education spending as a percentage of GDP. An alternative, "iterative" approach to estimating optimal government spending found similar optimal spending levels, lending credibility to the results. Using this iterative method, we found that for countries with poor public governance, people are happier with smaller public spending, with the highest subjective wellbeing found for those spending the least, at around 18% of the GDP.

1. **Introduction:**

Governments affect people's lives. But do they enhance or undermine people's lives? Countering arguments that governments usually interfere with free markets and create inefficiency, political scientist Benjamin Radcliff (2013) argues and presents evidence that bigger governments, particularly those that offer generous social safety nets, allow people to be free from anxiety and make them happier. Ott (2015), who reviewed his book, found his statistical evidence convincing. This is in line with earlier results by economists Blanchflower and Oswald (2007), who found that in the United States, the well-being of successive birth-cohorts had gradually fallen through time, whereas in Europe, where the social safety net is far more comprehensive and where tuition fees at colleges are mostly non-existent, newer birth-cohorts were happier. Blanchflower and Oswald noted that the coefficients about the cohort effects were not only statistically significant, but also big quantitatively.

But Radcliff studied only 21 traditional member states of the OECD. All of these countries have relatively high government quality, as indicated by the World Bank's public governance indicators. Radcliff's positive results need not apply to countries with lower quality governments. The quality of government and the type of government spending may well have a far greater impact on citizen welfare than the quantity of spending. In particular, governments with good governance are more likely to direct their spending to benefit their citizens. If so, governments with better governance should produce happier citizens, and controlling for the quality of government will allow us to better identify the impact of government spending. In this paper, we will test this hypothesis, along with trying to be more specific about how specific spending, in particular that on healthcare and on education, may affect welfare.

Ott (2010) extended the work of Helliwell and Huang (2008) and found that for his dataset for 127 countries, "technical quality" of governments, which is based on Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption, correlates with happiness in both rich and poor nations, while "democratic quality," which is based on "Voice and Accountability" and "Political Stability", only correlates with happiness in richer nations.[2] This is similar to what Helliwell *et al.* (2014) found in a more recent study. Helliwell *et.al.*, using Gallup World Poll data on 157 countries from 2005-2015, shows that changes in the technical quality of government[3], but not "democratic quality", are significantly and positively correlated with changes in well-being. Like Ott, they also found that democratic quality does

[2] These are sub-indices of the World Bank's Worldwide Governance Indicator. See http://info.worldbank.org/governance/wgi/index.aspx#home

[3] The authors renamed technical quality "delivery quality of government services."

have a positive and significant effect on life evaluations for rich countries. For poor countries the effect of democratic quality is not noticeable.

Kim and Kim (2012) found that small and good quality government is the most preferred form of government. Next preferred is "good and big government," followed by "bad and small government," while the worst is "big and bad government." We find evidence that these conclusions are about right: a government can be too big, even for one that is of high quality. But we will try to be more precise in showing the optimal size for different qualities of government, and to identify the relationship between levels of spending and total life satisfaction after controlling for the quality of government.[4]

While some authors (e.g., Bjornskov et al., 2007) point to the disadvantage of government consumption, Ng (2000) emphasizes the inefficiencies of private consumption due to relative competition, materialistic bias, and environmental disruption of most production and consumption (cf. Frank 2008, Wendner & Goulder 2008). In principle, even if government spending brings benefits, it must be funded and therefore involves costs. Based on diminishing returns of spending and increasing marginal cost of revenue, one would expect that after controlling for the quality of government an optimal spending level would exist. Moreover, it would seem intuitive that optimal government spending may vary from country to country, depending on things such as demography, stage of development, etc. We will, in this paper, try to identify how optimal government spending varies with such and other factors.[5]

In order to correctly identify the effects of government spending on welfare, we will need to build a statistical model that controls for the quality of government, as well as a host of other factors, such as relative incomes (income deciles) and demographics.[6] Moreover, given that total life satisfaction could be affected by non-material factors such as regularity of physical exercise, expressing gratitude, undertaking mindfulness training or the opportunities to help others in society, all of which relate to the "mental quality" of respondents, we will explicitly test the effects of such "mental quality" through introducing "mental capital" variables, to be elaborated below.

Mental capital refers to people's psychological disposition, which is the joint result of genetic, cultural and educational influences, in particular mental habits formed over the years.[7] Our

[4] This is again suggested by an anonymous referee.
[5] This point was raised by John Helliwell in a communication.
[6] Easterlin(2001) shows that material goods enhance subjective well-being at least partly through perceptions of relative well-being formed by "social comparison."(p.480) Our empirical results consistently show that indeed income deciles have significant effects on subjective well-being.(Easterlin, 1973, 1974).
[7] For a discussion of mental habits in psychology, please see this article and the references thereof in Psychology Today: https://www.psychologytoday.com/blog/the-mindful-self-express/201509/6-mental-habits-will-wear-you-down

results confirm that controlling for mental quality does improve the quality of our statistical results, both in terms of more reasonable signs of coefficients and in terms of statistical significance. This is in line with the view that there are "intrinsic" and "extrinsic" factors that determine a person's subjective well-being (Ho, 2014). Since the cultural factors of different countries are different and will have different effects on people's dispositions, by controlling for mental quality we may drop country dummies, since country fixed effects have already been captured by these mental capital variables.

Section 2 outlines the theory and methodology of the estimation. Section 3 describes the dataset that we use. Section 4 presents the results of the estimation. Section 5 presents the Monte Carlo simulation results that offer estimates of the confidence intervals of our estimates. Finally, Section 6 offers further discussions and conclusions.

2. The Theory and the Methodology

Most empirical studies on the determination of subjective wellbeing take happiness as dependent on uncontrollable circumstances and other uncontrollable factors such as genetics (Blanchflower and Oswald, 2007; Blanchflower and Oswald, 2011, Kim and Kim, 2012, Minkov & Bond, 2016). However, researchers are generally aware of the effects of voluntary factors on happiness. Martin Seligman, for example, proposed his now well-known formula for happiness: H=S+C+V, where H, the "Enduring level of Happiness", depends on S, the "Set range", which defines the range within which a person's happiness generally rises or falls and which is largely inherited; C, which represents life Circumstances; and V, which represents factors under Voluntary control. But notwithstanding a number of books telling people how life satisfaction can be enhanced by kicking bad habits and developing good ones (Duhigg, 2014, Jast, 2016), Voluntary factors are seldom incorporated into empirical studies.

Ho (2014) argued that this habit formation, which shapes the "mindset" of a person, is like the accumulation of capital that will allow the person to procure "mental goods" such as self-esteem, self-efficacy, optimism, confidence, and love through household activities that economists call "household production." Thus he amended Seligman's formula to read:

$$H = S(G, V) + C(t, V)$$

where G represents genetic factors and t situational factors beyond the choice of the individual, and V represents voluntary factors including in particular good habit formation. Recent development in epigenetics has given support to the proposition that the "set range" of happiness is not set in stone, but is subject to change, provided that the individual has spent

enough time forming the new habits.[8] This formation of good mental habits can be termed the formation of mental capital. A well-known UK study (Government Office for Science, UK, 2008), defines mental capital as "the totality of an individual's cognitive and emotional resources." "It includes their cognitive ability, how flexible and efficient they are at learning, and their 'emotional intelligence', such as their social skills and resilience in the face of stress. It therefore conditions how well an individual is able to contribute effectively to society, and also to experience a high personal quality of life."[9] By implication, this will affect a person's happiness. Habit formation is evidently linked to cultures, as people from the same culture often follow similar ways of life and share many similar habits. Recent studies have also confirmed that personality traits can change.[10] Mental health is crucial for "experiencing utility", i.e. for the degree to which people can actually enjoy what they experience (Carter and McBride, 2013). Mental health thus constitutes the basis of the ability to be happy, and raises the question of why not just focus on nurturing this ability instead of focusing on optimal government spending. A government keen on enhancing the happiness of its citizens would, however, do both. It should certainly not ignore the possibility that government spending can be excessive, and should attempt to avoid spending too little and spending too much. Thus the search for what constitutes optimal government spending remains meaningful notwithstanding the role of mental health and culture in determining happiness.

We first regress subjective well-being, as measured by total life satisfaction, against three categories of variables: (a) mental capital variables, (b) socio-economic and demographic variables, and finally (c) government quality and government spending variables (total government spending, government healthcare spending, and government education spending). Optimal government spending is determined by maximizing total life satisfaction with respect to government spending using the estimated quadratic equation (the "derivative approach"). An alternative, "iterative approach," offers a check for the robustness of the results and will be described and reported in the Appendix. The iterative approach generates estimates of how much total life satisfaction will decline with a deviation from the optimal level of spending. Our results show that including the mental capital variables noticeably improves the statistical results and allows us to derive more meaningful and sensible conclusions.

Under the derivative approach, we include the share of government spending in the GDP, and the square of this share. If the share term carries a positive coefficient, and the square of the share term carries a negative coefficient, then we can obtain the optimal government spending share by equating the first derivative (with respect to the share of government spending in the

[8] A good reference is: http://energeticsinstitute.com.au/epigenetics-of-human-happiness/

[9] *Foresight Report: Mental Capital and Well-being*, Government Office for Science UK, Executive Summary, 2008, p.10.

[10] Srivastava, et.al.(2003) found that personality traits normally will change as a person grows up.

GDP) to zero, since the second-order condition for a maximum will be satisfied.[11] We will consider the share of healthcare public spending, that of education public spending, and the share of overall public spending in turn. It is not possible to obtain meaningful results if all these three "share" variables are included in one equation.

In order to gauge the effects of population aging, developmental stage, and quality of governance on optimal government spending, we add three interactive variables: *mage.share*; *gdppc.share*, and *WGI.share*, where *mage* is the median age of the population; *share* is the share of public spending in the GDP, which could be total government spending share (*govt*), public spending on health (*health*), or public spending on education (*edu*). *WGI* is the Worldwide Governance Index, an aggregate governance indicator from World Bank based on six dimensions of public governance. We wanted to test if public education spending (*edu*) might reduce optimal healthcare spending given that better educated people may be better able to protect their health (Cheng, *et.al*. 2014). So for the equation involving healthcare spending (*health*) we add an interactive term *health.edu.*

Let government spending be denoted "*share*," (which could be *govt*, *health*, or *edu*)[12] expressed as a percentage of the GDP, median age *mage*, and GDP per capita as *gdppc*. The equation with subjective well-being *H* ("total life satisfaction") can be estimated as a function of *share* and $share^2$, along with *share.mage*, *share.WGI*, and *share.gdppc*:

$$H = a + b\ share + c\ share^2 + d\ share.mage + e\ share.gdppc + f\ share.WGI + g\ \mathbf{X} + u \quad [1]$$

where **X** is a vector of control variables including the mental capital variables and the circumstantial variables other than government spending, and *u* is a random error.

To maximize H, the first-order condition is that the first derivative of equation [1] with respect to share has to be equal to zero. The second-order condition is that the second derivative is negative. This means b should be positive and c should be negative if optimal spending exists. Thus, assuming the second-order condition is already satisfied, from the first-order condition:

b + 2c *share* + d *mage* + e *gdppc* + f *WGI* = 0

This implies 2c *share* = -b - d *mage* - e *gdppc* - f *WGI*. We can derive optimal share as:

[11] We thank Avinash Dixit for suggesting this method. Altunc, O.Faruk and Celil Aydin (2013) also used this method, but the dependent variable was GDP growth and not subjective well-being.

[12] We use public spending and government spending interchangeably, even though some jurisdictions differentiate the two. Public spending is just spending of revenues raised through the government's authority.

-b/2c – (d/2c) *mage* – (e/2c)*gdppc* –(f/2c)*WGI*.

We generally would expect optimal health (public) spending (as a % of GDP) to rise with aging because older people will need more healthcare. Optimal healthcare spending is also expected to rise with per capita GDP if health is a "superior good" so that people are prepared to spend more on health when their incomes rise. Public governance is expected to have a positive effect on healthcare spending because an accountable government attracts more trust and makes an increase in spending politically feasible. If d, e, and f are positive, then optimal spending will increase with aging, with economic development, and with improvement in public governance. As mentioned above, we add the interactive variable *health.edu* to test the effect of public education spending (*edu*) on optimal healthcare spending. We expect the interactive coefficient to be negative.

As with many empirical studies, there may be a worry about the endogeneity problem, i.e., whether the optimal government spending that we estimate may be biased because happiness may also affect government spending. We would argue that this problem does not really apply to our study. First of all, while governments may be concerned about how they can raise happiness, an exogenous rise in happiness should not change government decisions. There are also great variations in the key Total Life Satisfaction measure among the subjects in each country, each of whom takes government spending as exogenous. Moreover, the spending shares often owe their origins to historical reasons and political reasons which probably relate more to distribution of power and influence than to overall happiness.[13] For example, Hong Kong's financial secretaries have inherited a rule of spending no more than 20% of the GDP. Gilens and Page (2014) found the American government more responsive to the rich and the elite than to the man in the street.

3. **The Data**

In this paper we use data from the 5th and 6th waves of the World Value Survey (2005-2009, 2010-2014). We use the individually reported life satisfaction score (scale 1 to 10) in WVS as the dependent variable.

To capture the effects of a person's mental disposition on happiness, we select mental quality variables that correspond to Love, Insight, Fortitude, and Engagement, which have been shown to correlate strongly with subjective well-being in previous studies (Ho, 2012, 2014). Because

[13] Meltzer and Richard (1981) showed how politics may work to determine aggregate government spending.

the WVS is not custom-designed for our study, we select variables that correspond nearest to these concepts.

Spending ratios to be tested include public healthcare spending, education spending by government, and total public spending, all expressed as percentage of GDP. If out of the three years before the survey, only data for two years is available, we take the average for those two years. If data for only one year is available, then data for that year will be used without averaging. If spending data within the three years before the survey is not available, then the data for the year nearest to the year of the survey will be used.

The World Bank provides a summary Worldwide Governance Index (WGI) which covers six domains of governance including control of corruption, government effectiveness, political stability and absence of violence/terrorism, regulatory quality, rule of law, and accountability. The data is available from 1996 to 2013. We treat all public spending as government spending, and this is expressed as a percentage of GDP. Data on total government spending are from the IMF. Data on healthcare and education spending, unless otherwise noted, are from World Bank. (See **Table 7** for details about variable definitions relating to the World Value Survey and **Table 8** for other variable definitions from other data sources, both tables in **Appendix 1**.)

In addition, among explanatory variables, we include age (and the square of age, to capture non-linear effects of age), sex, education attainment, whether or not religious, marital status (married, divorced, separated, or widowed, against the benchmark of being single), employment status (full time employed, part time employed, self-employed, retired, housewife, or student, against the benchmark of being unemployed), income decile, subjective and financial satisfaction.

4. Results:

We first included country dummies along with all the other control variables, but we discovered that including country dummy variables could confound the effects of key explanatory variables, and the sign requirements for the key variables in order to identify optimal spending may be violated. In the end we dropped all country dummies, which is justified under the consideration that mental quality variables that relate to cultural are included. Given that within each country mental quality variables may still vary from person to person, we argue that including the mental quality variables is actually superior to using country dummies. Our regression results support this conjecture.

Table 1 presents the key coefficients for calculating optimal spending under the derivative approach. The coefficients are estimated in an ordered probit model with a 10-point scale

total life satisfaction as the dependent variable. We use the ordered probit model following the well-known work by Blanchflower and Oswald (2007).[14] The coefficients on the interactive variables indicate that healthcare spending should be higher (even as a % of GDP) for countries with better public governance, higher GDP per capita, and higher median age. Education spending is found to reduce optimal healthcare spending. It is notable that including the mental quality variables allows us to obtain more significant and more sensible coefficients. In particular, the interactive variable between (government) healthcare spending (*health*) and the median age(*mage*) is much more significant and positive when mental quality variables are included than when they are excluded. If mental quality variables are excluded, optimal government spending on education (*edu*) cannot even be identified because the z-score for *edu* is insignificant.

Table 1: Estimating Optimal Government Spending on Health and on Education, Based on Full Dataset

	Coefficients for Key Variables under the Derivative Approach (Mental Variable Included)		**Optimal Spending, Algebraic Expression**	**Optimal at Average *WGI*, *gdppc*, and *mage***
Health	*health.WGI*: 1.393958	z: 7.07	0.0066**WGI*+0.000000197* *gdppc* + 0.000814**mage*-0.361278**edu*+0.0288	0.0433 Or 4.3%
	health.gdppc: 0.0000418	z: 4.09		
	health.mage: 0.1728409	z: 11.48		
	health.edu: -76.75174	z: -10.87		
	health: 6.116038	z: 6.34		
	health2: -106.2225	z: -11.86		
Education	*edu.WGI*: 1.511276	z: 9.62	0.0036**WGI*+ 0**gdppc* + 0.000494**mage*+0.0252	0.04178 Or 4.2%
	edu.gdppc: -0.0000169	z: -1.82		
	edu.mage: 0.209314	z: 15.83		
	edu: 10.68168	z: 6.79		
	edu2: -211.9357	z: -12.72		
	Coefficients for Key Variables under the Derivative Approach (Mental Variable Excluded)		**Optimal Spending, Algebraic Expression**	**Optimal at Average *WGI*, *gdppc*, and *mage***
Health	*health.WGI*: 2.264965	z: 13.40	0.0083**WGI*+0.000000205* *gdppc* +0.00003* *mage* - 0.267387**edu* + 0.0485	0.04267 Or 4.3%
	health.gdppc: 0.0000558	z: 6.11		
	health.mage: 0.008106	z: 0.59		

[14] The ordered probit framework will ensure that the predicted values of total life satisfaction will fall within the 1 to 10 scale.

	health.edu: -72.77231	z: -11.10		
	health: 13.20933	z: 14.96		
	health2: -136.0805	z: -17.04		
Education	*edu.WGI*: 1.874867	z: 13.41	0.0134**WGI*+0**gdppc*+ 0.000448**mage*+0	0.01716 Or 1.7%
	edu.gdppc: 5.27e-06	z: 0.61		
	edu.mage: 0.0628038	z: 5.19		
	edu: 1.284353	z: 0.87		
	edu2: -70.09287	z: -4.52		

Note: The average of WGI, GDP per capita, median age and education spending are respectively 0.208678, 17703.16, 32.06881 and 0.0456(i.e., 4.56%)

All the coefficients carry the expected signs. While spending on education should be higher with better governed countries, richer countries should spend LESS out of the GDP on education because 1% of a rich country's GDP allows a lot more spending per capita than 1% of a poor country's GDP does. It may be thought that countries with a higher median age in the population need to spend less on education because there may be fewer school age children. But with a smaller labour force these countries may need to spend more in order to boost productivity. The effect of aging on optimal education spending is an empirical question, and it turns out that population aging actually INCREASES optimal education spending.

The ordered probit regression equations for the estimation of optimal health spending and optimal education spending by the government, which are based on over 105,000 observations from the two waves of WVS, are presented in **Table 2** and **Table 3**.

Table 2: Ordered Probit Regression on Total Life Satisfaction to Identify Optimal Public Spending on Healthcare (Full sample)

		Coefficient	**z**	**P>|z|**	**Statistical Diagnostics**	
Mental Capital Variables Of Each Individual	L_FamImp	0.03535	12.04	0.000	Log likelihood	-187120
	L_FriImp	-0.00159	-1.13	0.259	Number of obs	99,091
	L_HelpOthers	0.00475	2.86	0.004	LR chi2(30)	42090.98
	I_Autonomous	-0.00072	-0.67	0.505	Prob > chi2	0.0000
	I_EnvirImp	0.02139	14.88	0.000	Pseudo R2	0.1011
	F_HardWork	0.00415	3.80	0.000		
	E_Creative	0.00453	3.46	0.001		
	E_FreeChoice	0.11187	76.34	0.000		

Social-economic Variables Of Each Individual	healthstatus	0.08164	61.27	0.000		
	age	-0.01228	-9.31	0.000		
	agesq	0.00014	10.25	0.000		
	female	0.04835	6.73	0.000		
	edu	-0.00841	-5.40	0.000		
	religious	0.05884	7.80	0.000		
	married	0.12974	13.06	0.000		
	DSorW	-0.01073	-0.77	0.439		
	partself	-0.01479	-1.58	0.114		
	retired	-0.01273	-0.91	0.365		
	housewife	0.09261	7.83	0.000		
	student	0.03544	2.36	0.018		
	unemployed	-0.05437	-4.30	0.000		
	finsat	0.19014	116.74	0.000		
	incomedecile	0.01426	8.06	0.000		
Public Spending and Interactive Variables	health	6.11604	6.34	0.000		
	health2	-106.22250	-11.86	0.000		
	health.WGI	1.39396	7.07	0.000		
	health.gpdppc	0.00004	4.09	0.000		
	health.mage	0.17284	11.48	0.000		
	health.edu	-76.75174	-10.87	0.000		
Wave 5 Dummy	Wave5	-0.11341	-15.79	0.000		

Note: Coefficients for cut1 to cut 9 in the ordered probit equation are not reported to save space.

Table 3: Ordered Probit Regression on Total Life Satisfaction to Identify Optimal Public Spending on Education (Full sample)

		Coefficient	**z**	**P>|z|**	**Statistical Diagnostics**	
Mental Capital Variables Of Each Individual	L_FamImp	0.03567	12.22	0.000	Log likelihood	-190108
	L_FriImp	-0.00186	-1.33	0.184	Number of obs	100,591
	L_HelpOthers	0.00435	2.65	0.008	LR chi2(29)	42823.96
	I_Autonomous	-0.00037	-0.34	0.733	Prob > chi2	0.0000
	I_EnvirImp	0.02234	15.77	0.000	Pseudo R2	0.1012
	HardWork	0.00446	4.11	0.000		
	E_Creative	0.00544	4.18	0.000		
	E.FreeChoice	0.11235	77.39	0.000		
	healthstatus	0.08102	61.34	0.000		

Social-economic Variables Of Each Individual	age	-0.01245	-9.51	0.000		
	agesq	0.00015	10.37	0.000		
	female	0.04663	6.54	0.000		
	edu	-0.00907	-5.81	0.000		
	religious	0.05966	7.97	0.000		
	married	0.12119	12.32	0.000		
	DSorW	-0.01580	-1.15	0.250		
	partself	-0.01264	-1.36	0.173		
	retired	-0.01066	-0.76	0.446		
	housewife	0.09996	8.49	0.000		
	student	0.03820	2.56	0.011		
	unemployed	-0.05649	-4.56	0.000		
	finsat	0.19011	117.63	0.000		
	incomedecile	0.01615	9.16	0.000		
Public Spending and Interactive Variables	eduratio	10.68168	6.79	0.000		
	eduratio2	-211.93570	-12.72	0.000		
	edu.WGI	1.51128	9.62	0.000		
	edu.gdppc	-0.00002	-1.82	0.069		
	edu.mage	0.20931	15.83	0.000		
Wave 5 Dummy	wave5	-0.11071	-15.49	0.000		

Note: Coefficients for cut1 to cut 9 in the ordered probit equation are not reported to save space.

Most of the coefficients carry expected signs. Among the mental quality variables, *L_FamImp*, indicating the respondent takes family as very important, *E_FreeChoice*, indicating the respondents has a sense of free choice and control over one's destiny, carry very significant and positive coefficients. *I_Autonomous*, which indicates the degree to which the respondent sees himself as an autonomous individual, carries a negative coefficient. The variable actually tends to take on a positive coefficient in good governance countries and a negative coefficient in poor governance countries, suggesting that those who aspire for autonomy and who live in poor governance countries could be frustrated and become unhappy. In the complete sample the negative effect appears to dominate. Interestingly, *I_EnvirImp*, or taking the environment as important, always carries a very significant positive coefficient, suggesting that people who has a longer view and is concerned about sustainability have a better sense of balance, may be less ego-centric, and are happier.

Using the full sample, it will not be possible to identify the optimal total government spending because the first and second-order conditions for optimality are violated. However, if we divide the sample into jurisdictions with WGI higher than median and jurisdictions with WGI

lower than median, we can identify optimal government spending for the former sample (see **Table 4**) but not for the latter.

Table 4: **Ordered Probit Regression on Total Life Satisfaction to Identify Optimal Total Government Spending (Above Median WGI Countries Only)**

	Key Variables		**Optimal Spending, Algebraic Expression**	**Optimal at Average *WGI*, *gdppc*, and *mage***
Total Public Spending	*govt.WGI*: 0.4937716	z: 11.20	0.0396**WGI*+0**gdppc*+0.01666**mage*+0.2633	0.36523 or 36.5%
	govt.gdppc: 6.53e-08	z: 0.05		
	govt.mage: 0.02078	z: 5.75		
	govt: 3.284948	z: 9.51		
	govt2: -6.237423	z: -11.92		

Interestingly, for countries with below median WGI it is not possible to identify optimal total government spending using the derivative approach because the first and second-order conditions for optimality are violated. Using the iterative approach we discover that optimal total government spending for these countries seems to be "as low as possible."

5. Searching for Confidence Intervals

Using the Derivative Method, we obtain estimates of optimal spending based on an equation with coefficients which are not independently estimated. It is therefore not possible to derive analytic approximations of the variance of these estimated optimal spending figures calculated from the regression results. Numerical methods have to be used.

Stata generates the means vector *m* and the covariance matrix *sigma* of coefficients for each ordered probit equation that we estimated. We then use Matlab to generate a large number (1 million) of random vectors chosen from the multivariate normal distribution with mean *m* and covariance matrix *sigma*. Then a 1,000,000 by 5 matrix (or 1,000,000 by 6 for the equation to identify optimal healthcare expenditures) containing the random numbers is created. For each of the 1,000,000 trials we calculate the optimal public spending according to the formula, and thus derive 1 million possible optimal values. A histogram is drawn and the distribution of these simulated values is found to be close to normal. We then calculate mean, variance, standard deviation, t statistics, and derive the confidence intervals.

Table 5 presents the simulation results and the confidence intervals. The results suggest that the estimates are statistically significant and that the confidence intervals are sufficiently narrow for them to be meaningful.

Table 5: Results of Monte Carlo Simulation
To Identify Confidence Intervals for Estimates of Optimal Spending

(The following is based on estimates as per Table 1)						
	Mean	**Variance**	**Standard Deviation**	**t**	**Confidence Interval**	
Healthcare Spending (Mental Variable Included)	0.04328	1.55E-06	0.001244	34.79	0.04084	0.04571
Education Spending (Mental Variable Included)	0.04105	5.21E-07	0.000722	56.86	0.03963	0.04246
Healthcare Spending (Mental Variable Excluded)	0.04267	7.84E-07	0.000886	48.18	0.04093	0.04440
Education Spending (Mental Variable Excluded)	0.02592	3.48E-05	0.005903	4.39	0.01435	0.03749
(The following is based on estimates as per Table 4)						
	Mean	**Variance**	**Standard Deviation**	**t**	**Confidence Interval**	
Total Public Spending	0.36567	3.87E-05	0.006219	58.797	0.35348	0.37786

6. Discussions and Conclusions

Our investigation of optimal healthcare spending, education spending, and total spending in the public sector has produced interesting results. We discover that while estimates of "optimal government spending" for countries with good governance are meaningful those for countries with poor governance can be misleading. For example, using the iterative approach presented in Appendix 2, we found optimal government spending in poor governance countries

to be "as low as possible." But this does not mean raising government spending will necessarily reduce the wellbeing of society. The reason why we got the result "the lower the better" is people do not trust the government will spend the money in the right places. If there is more transparency and more accountability for the funds spent, the estimated optimal government spending will go up.

The use of interactive variables appears to be particularly illuminating in a number of ways. First it confirms that optimal spending rises with the quality of public governance. Optimal healthcare spending is found to rise with population aging. Higher GDP per capita would raise the optimal healthcare spending but has negligible impact on optimal education spending. Education spending is found to reduce the need for higher healthcare spending. This may appear puzzling but can be easily explained. First there is a need to enhance the productivity of a shrinking labour force in the face of a rise in the elderly dependency ratio. On the other hand, if a longer lifespan increases the length of productive life, educational investment will become more rewarding as the higher productivity applies for a longer period. Moreover, since education may also make better informed consumers and thus increase the utility of consumption, when people live longer the rewards to education through higher consumption-utility will also be higher.

Our results show that actual public spending on healthcare appears to be on average somewhat less than optimal (4.13, <4.33), while actual public spending on education spending appears to be somewhat more than optimal(4.55, >4.17).[15] A possible factor to consider is the relative competition effect—competition for relative standing. As shown by Wilkinson (1997), relative-income effects are very important in determining health outcomes. This has probably to do with the psychosocial effects of social position. Thus, even with higher absolute incomes and better healthcare, the relatively poor persons in an advanced country are typically less healthy than the relatively rich persons in a poor country. Thus relative economic position affects not only general well-being, but also health outcomes. This may require somewhat more health spending to deal with the impaired health outcomes arising from inequality. In education, the importance of relative competition is even much more important, to the extent that much education spending is explicitly aimed at improving relative positions. A number of factors are involved. Admission to good educational institutions typically depends on relative educational outcomes. The top university gets the best (relatively) high school graduates. Employers also select employees at least partly based on relative education outcomes. Thus, relative education outcome will affect one's income-earning capacity. Moreover, relative education outcomes are also valued as such over and above the earnings implication. As a result, families, and also governments in response to popular demand,

[15] In favour of space considerations, these estimates are not provided here but are available from the authors upon request.

invest a lot, in money, time, and effort to secure higher educational outcomes. However, investment in education to improve relative standing at the individual level may be socially wasteful as, on average, relative position cannot be improved at the social level, no matter how much effort and resources are spent. Thus, if education inputs increase, and even if effectively in pushing up the relative positions of some people, the net results on the welfare of the people have to be discounted much more by the mutually offsetting effects of relative competition. This is unlikely to be fully appreciated at the family level. In addition, people may be caught in a prisoner-dilemma situation. This may partly explain the result of excessive spending on education at the social level. On the other hand, health spending is rarely aimed at improving relative position per se. If health is improved, people are likely made better off. Inadequate spending on healthcare could be partly due to the inadequate appreciation of the benefits due to the long-term nature and uncertainty in results, and partly due to the squeeze from excessive spending on education.

The inclusion of mental quality variables in a well-being regression on government spending and other control variables is novel. **Table 1** compares the key coefficients including versus excluding the mental variables. It can be seen that without including the mental variables the coefficient on "*edu*" becomes insignificant, making an estimate of optimal education spending unreliable. Secondly, the coefficient on the interactive term *health.mage* (government healthcare spending * median age of population) carries a much bigger (almost 3 times as big) and much more significant positive coefficient. The optimal spending estimates are all much bigger with the mental variables included than when they are not included.

In the split sample regressions based on median WGI, some interesting results are obtained. For good governance countries, we found, through the iterative approach, that optimal healthcare spending is 7.52%, much higher than the 3.14% figure for poor governance countries. These results are consistent with the optimal spending of 4.3% estimated at average *WGI*, *gdppc*, and mage under the derivative method. Generally, good governance countries also tend to have higher GDP per capita, and more advanced aging. The combination of these considerations means that optimal healthcare public spending should be considerably higher than 4.3%. The converse is true for poor governance countries.

It is interesting to observe that all the mental quality variables carry the expected positive coefficients in above median *WGI* countries, while in below median *WGI* countries those who think of themselves as autonomous individuals and those who think being creative and doing things in one's own way is important are less happy. Good governance tends to reward creative people and protect personal freedoms better. In addition, good governance generates greater trust in the government so that optimal government spending is higher.

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Appendix 1:

Table 6: Variables from the World Value Surveys			
Question in Survey(Wave number), Variable Used in Paper	**Question in Survey**	**Role of the Variable in the Model**	**Scale**
V4(5, 6) *L_FamImp**	Would you say Family is: very important, rather important, not very important, or not at all important	To reflect if the respondent loves his or her family.	Scale: 1 to 4. 4 being most important. Note ordering reversed from the original.
V5(5, 6), *L_FriImp**	Would you say Friends are: very important, rather important, not very important, or not at all important	To reflect if the respondent cares for his or her friends.	Scale: 1 to 4. 4 being most important. Note ordering reversed from the original.
V84(5) V74B(6) *L_HelpOthers**	It is important to this person to help the people nearby; to care for their well-being.	To reflect if the person is a caring, loving person.	Scale 1 to 6. Note ordering reversed from the original.
V214(5) V216(6) I_Autonomous*	I see myself as an autonomous individual.	To reflect the wisdom of seeing self-actualization as more important than pleasing others,	Scale of 4, original ordering reversed. 4 most affirmative.
V88(5) V78(6) *I_EnvirImp**	Looking after the environment is important to this person; to care for nature (and save life resources. Wave 6 only)	To reflect the wisdom of caring for nature and having a sense of balance and longer view.	Scale of 6; original ordering reversed. 6 most affirmative.
V120.(5) V100(6) *F_HardWork**	In the long run, hard work usually brings a better life versus hard work doesn't	To reflect Engagement in the form of hard work as a purposive activity.	Scale of 10. 10 means: hard work usually brings good results. Original

	generally bring success—it's more a matter of luck and connections		scale reversed.
V80(5) V70(6) *E_Creative**	It is important to this person to think up new ideas and be creative; to do things one's own way.	To reflect Engagement as being creative and assertive.	Scale of 6, original ordering reversed. 6 most affirmative.
V46(5) V55(6) *E_FreeChoice**	How much freedom of choice and control you feel you have over the way your life turns out.	To reflect a person's sense of Engagement.	Scale 1 to 10. 10 means having a great deal of choice.
V11(5, 6) *healthstatus**	All in all, how would you describe your state of health these days? Would you say it is: Very good, good, fair, or poor	To reflect subjective assessment of health status.	Scale: 1 to 4, 4 being most healthy. Original scale was reversed.
V22(5) V23(6) *Sat** Or total life satisfaction	All things considered, how satisfied are you with your life as a whole these days? Using this card on which 1 means you are "completely dissatisfied" and 10 means you are "completely satisfied" where would you put your satisfaction with your life as a whole?	This is the key subjective well-being question the answer to which becomes our dependent variable.	Scale 1 to 10, 10 being most satisfied.
wave5	Dummy for Wave 5	To reflect the influence of being in wave 5	Dummy variable, 1 =wave 5, 0=wave 6

V237(5) V242(6) *age*	Interviewees' age	To reflect the influence of age	Scale 15 to 99
agesq	Age squared	To reflect non-linearity	
V235(5) V240(6) *female*	Code respondent's sex by observation	To reflect the influence of gender	Dummy variable, 1 =female and 0=male
V238(5) V248(6) *edu*	What is the highest educational level that you have attained?	To reflect the influence of education level	1-9, 1=no formal education, 9=University-level
V187(5) V147(6) *religious***	Independently of whether you attend religious services or not, would you say you are?	To reflect the influence of being religious	Dummy variable, 1=a religious person, 2=not a religious person
V55(5) V57(6) *married****	Are you currently….. married?	To reflect the influence of being married	Dummy variable, 1=married or living together, 2=otherwise
V55(5) V57(6) *DSorW****	Are you currently…. Divorced, separated or widowed?	To reflect the influence of being divorced, separated or widowed	Dummy variable, 1=divorced, separated or widowed, 0=otherwise
V241(5) V229(6) *partself*****	Are you employed now or not? If yes, about how many hours a week? If more than one job: only for the main job	To reflect the influence of being a part time employee or self-employed	Dummy variable, 1=part time employee or self-employed, 0=otherwise
V241(5) V229(6) *retired*****	Are you employed now or not? If yes, about how many hours a week? If more than one job: only for the main job	To reflect the influence of being retired	Dummy variable, 1=retired/pensioned, 0=otherwise
V241(5)	Are you employed	To reflect the	Dummy variable,

V229(6) *housewife*****	now or not? If yes, about how many hours a week? If more than one job: only for the main job	influence of being a housewife	1=housewife, 0=otherwise
V241(5) V229(6) *student*****	Are you employed now or not? If yes, about how many hours a week? If more than one job: only for the main job	To reflect the influence of being a student	Dummy variable, 1=student, 0=otherwise
V241(5) V229(6) *unemployed*****	Are you employed now or not? If yes, about how many hours a week? If more than one job: only for the main job	To reflect the influence of being unemployed	Dummy variable, 1=unemployed, 0=otherwise
V68(5) V59(6) *finsat*	How satisfied are you with the financial situation of your household?	To reflect subjective assessment of financial status.	Scale 1 to 10, 10 most satisfied
V253(5) V239(6) *incomedecile*	We would like to know in what group your household is. Please, specify the appropriate number, counting all wages, salaries, pensions and other incomes that come in.	To reflect income level	Scale 1 to 10, 10 being highest group

* These variables are rescaled to 0 to 10 in the regressions in order to facilitate comparison of the magnitudes of their influences.

**The original options are: 1=A religious person, 2=Not a religious person, 3=An atheist.

***The original options are: 1=Married, 2=Living together as married, 3=Divorced, 4=Separated, 5=Widowed, 6=Single.

****The original options are: 1=Full time employee, 2=Part time employee, 3=Self employed, 4=Retired/pensioned, 5=Housewife not otherwise employed, 6=Student, 7=Unemployed, 8=Other.

Table 7: Other Variables			
Variable Used in Paper	**Definition**	**Expected Effect on subjective well-being**	**Source**
R	The initial spending ratio used in the iteration procedure testing for optimality.	Not applicable	Calculated as average of actual spending ratio.
r	Actual spending ratio for each country, used in flow chart only.	Not applicable	Relevant spending ratios from World Bank, IMF, or official statistical office of relevant government.
WGI	Aggregate governance indicators for 215 countries and territories for six dimensions of governance.	Positive	www.govindicators.org
gdppc	Gross domestic product based on purchasing-power-parity (PPP) per capita GDP (Current US dollar)	Not used stand alone in the ordered probit regression	http://knoema.com/IMFWEO2013Oct/imf-world-economic-outlook-october-2013
mage	Median age of population in 2010	Not used stand alone in the ordered probit regression	https://en.wikipedia.org/wiki/List_of_countries_by_median_age#cite_note-3
health	Public sector health expenditure as % of GDP	Positive	http://data.worldbank.org/
health2	health squared	Negative	By calculation
health.WGI	*health*WGI*	Positive	By calculation
health.mage	*health**median age	Positive	By calculation
health.gdppc	*health**GDP per capita	To be determined	By calculation
health.edu	health*edu	Negative	By calculation
edu	Education expenditure by the government as % of GDP	Positive	http://data.worldbank.org/
edu2	edu squared	Negative	By calculation
edu.WGI	edu*WGI	Positive	By calculation

edu.mage	edu*median age	To be determined	By calculation
edu.gdppc	edu*GDP per capita	To be determined	By calculation
govt	Total government expenditure as % of GDP	Positive	https://datamarket.com/data/set/1h79/general-government-total-expenditure-percent-of-gdp#!ds=1h79!1ewr=1x&display=table
govt2	govt squared	Negative	By calculation
govt.WGI	govt*WGI	Positive	By calculation
govt.mage	govt*median age	To be determined	By calculation
govt.gdppc	govt*GDP per capita	To be determined	By calculation
devhealth	Absolute deviation of actual public sector health spending from the share tested for optimality	Negative if R is indeed optimal since deviating from optimal reduces well-being	By calculation using formula |r-R|. r is actual public sector health spending. R is the level of public sector health spending being tested for optimality.
devedu	Absolute deviation of actual public sector education spending from the share tested for optimality	Negative if R is indeed optimal since deviating from optimal reduces well-being	By calculation using formula |r-R|. r is actual public sector education spending. R is the level of public sector education spending being tested for optimality.
devgovt	Absolute deviation of actual total government spending from the share tested for optimality	Negative if R is indeed optimal since deviating from optimal reduces well-being	By calculation using formula |r-R|. r is actual total government spending. R is the level of total public sector spending being tested for optimality.

Note: The public sector health spending of Hong Kong is from Hong Kong Medical Journal: http://www.hkmj.org/system/files/2013-S7.pdf . The public sector health spending of Taiwan is from Ministry of Health and Welfare, Taiwan. The public sector education spending of China is from cohort of Statistics of the People's Republic of China: http://www.stats.gov.cn/english/statisticaldata/AnnualData/. The public sector education spending of Taiwan is from Republic of China (Taiwan): http://www.stat.gov.tw/ .

Appendix 2: The Iterative Method of Estimating Optimal Government Spending

The iterative approach can be explained using a flow chart (Figure 1):

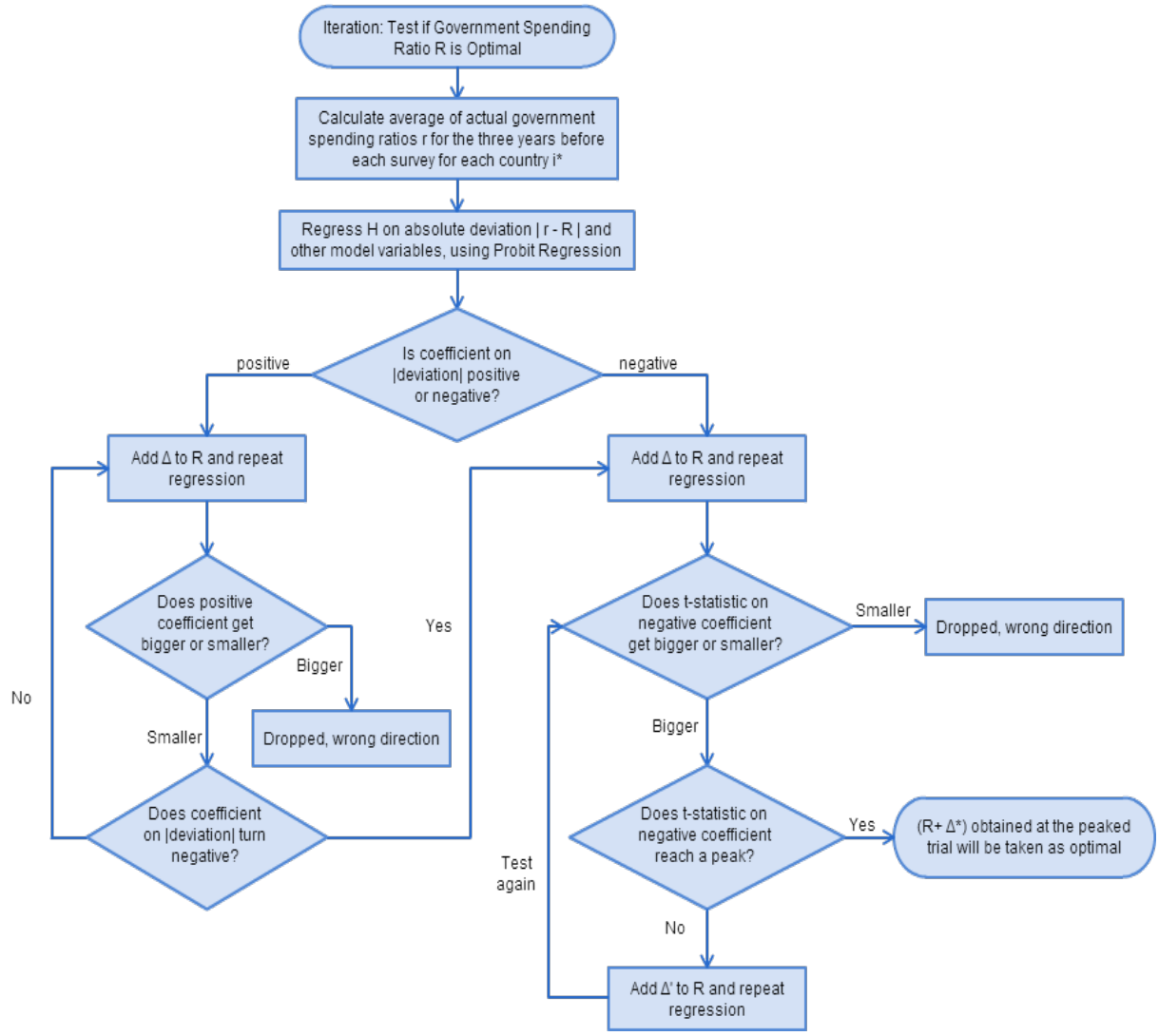


Figure 1: The Iterative Approach to Estimate Optimal Public Spending
(H in the flow chart is Total Life Satisfaction)

Estimation starts with assuming that the average of actual spending (expressed as % of GDP) is the optimal spending for the sample countries. This ratio to be tested, R, if indeed correct, would imply that any deviation from R, whether above or below, would reduce subjective well-being. So we calculate, for each country, the absolute value of the deviation of the actual spending from R. We expect that the deviation would carry a negative and significant coefficient in the ordered probit regression on subjective wellbeing with all the relevant variables.

We will then add an *increment* (0.1% or 1%, depending on whether we are seeking optimal categorical spending or total spending) to government spending, which may be positive or negative, and do a re-run of the regression. If the increment produces a negative coefficient with a bigger z-score, we know we are in the right direction, and continue to add a further increment, re-estimate the regression, and keep going on until the negative z-statistics peaks. The optimal spending should be R *plus* the increment tried that yielded the highest negative z-statistic.

The iterative method has the advantage that it could also offer more precise estimate of optimal spending because small increments in each direction are tested. In contrast, the derivative approach is subject to a particular functional form, namely the quadratic specification. Sometimes the second order conditions for optimality may not be satisfied. We discover that even when the derivative approach fails to yield an optimal spending the iterative method may still generate meaningful results.

Still, a limitation of the iterative approach is that we cannot use an interactive variable to estimate the marginal impact of governance or population aging on optimal spending. Still, since we expect that optimal government spending will rise with government quality, we can divide the sample of countries into two subsamples: those with above average government quality indicators, and those with below average government quality indicators. Results from the two subsamples do show that higher optimal government spending is associated with higher government quality.

As outlined in the flow chart above, we obtained the following iterations in the search for optimal total spending for above-median WGI countries:

Here total_X means the average total government spending (as share of GDP) MINUS X%. totalX means average total government spending (share of GDP) PLUS X%. The z score is the z statistic on the absolute deviation from the figure tested for optimality.

For the above median WGI countries, average total government spending is 36.45% of GDP. The iteration highlighted in **Table 8** shows a z that peaks, suggesting that 36.45% +3% or 39.45% is the optimal government spending. This is slightly higher than the average of optimal government spending estimates of 36.49% estimated using the derivative approach.

Table 8: Iterations and z Scores in Search of Optimal Total Government Spending for Above Median WGI Countries

Iteration	z
total_2	-11.3869
total_1	-12.5952
total_0	-13.917
total1	-15.2162
total2	-16.1099
total3	-16.2124
total4	-16.0232
total5	-15.8062
total6	-15.6537
total7	-15.5316
total8	-15.0767

The estimated ordered probit equation corresponding to total3 is presented in **Table 9**:

Table 9: Ordered Probit Regression on Total Life Satisfaction Corresponding to Iteration "total3" (Above Median WGI Countries)

	Coef.	z	P>|z|			
L_FamImp	0.03787	9.27	0.000		Log likelihood	-87481.5
L_FriImp	0.00972	4.61	0.000		Number of obs	48,569
L_HelpOthers	0.00887	3.71	0.000		LR chi2(29)	20378.48
I_Autonomous	0.01271	7.38	0.000		Prob > chi2	0.0000
I_EnvirImp	0.01405	6.68	0.000		Pseudo R2	0.1043
F_HardWork	0.00633	3.86	0.000			
E_Creative	0.01008	5.11	0.000			
E_FreeChoice	0.11130	49.58	0.000			
healthstatus	0.09140	46.89	0.000			
wave5	0.00154	0.16	0.872			
age	-0.01093	-5.88	0.000			
agesq	0.00013	6.49	0.000			
female	0.05091	5.10	0.000			
edu	-0.01602	-6.84	0.000			
religious	0.09842	9.63	0.000			
married	0.15452	10.85	0.000			
DSorW	-0.02990	-1.56	0.118			
partself	-0.03989	-2.87	0.004			

retired	0.03532	1.88	0.060			
housewife	0.08201	4.42	0.000			
student	0.06996	3.20	0.001			
unemployed	-0.03957	-2.07	0.038			
finsat	0.18303	75.91	0.000			
incomedecile	0.01277	4.96	0.000			
WGI	0.20442	21.00	0.000			
devgovt3	-1.26470	-16.21	0.000			

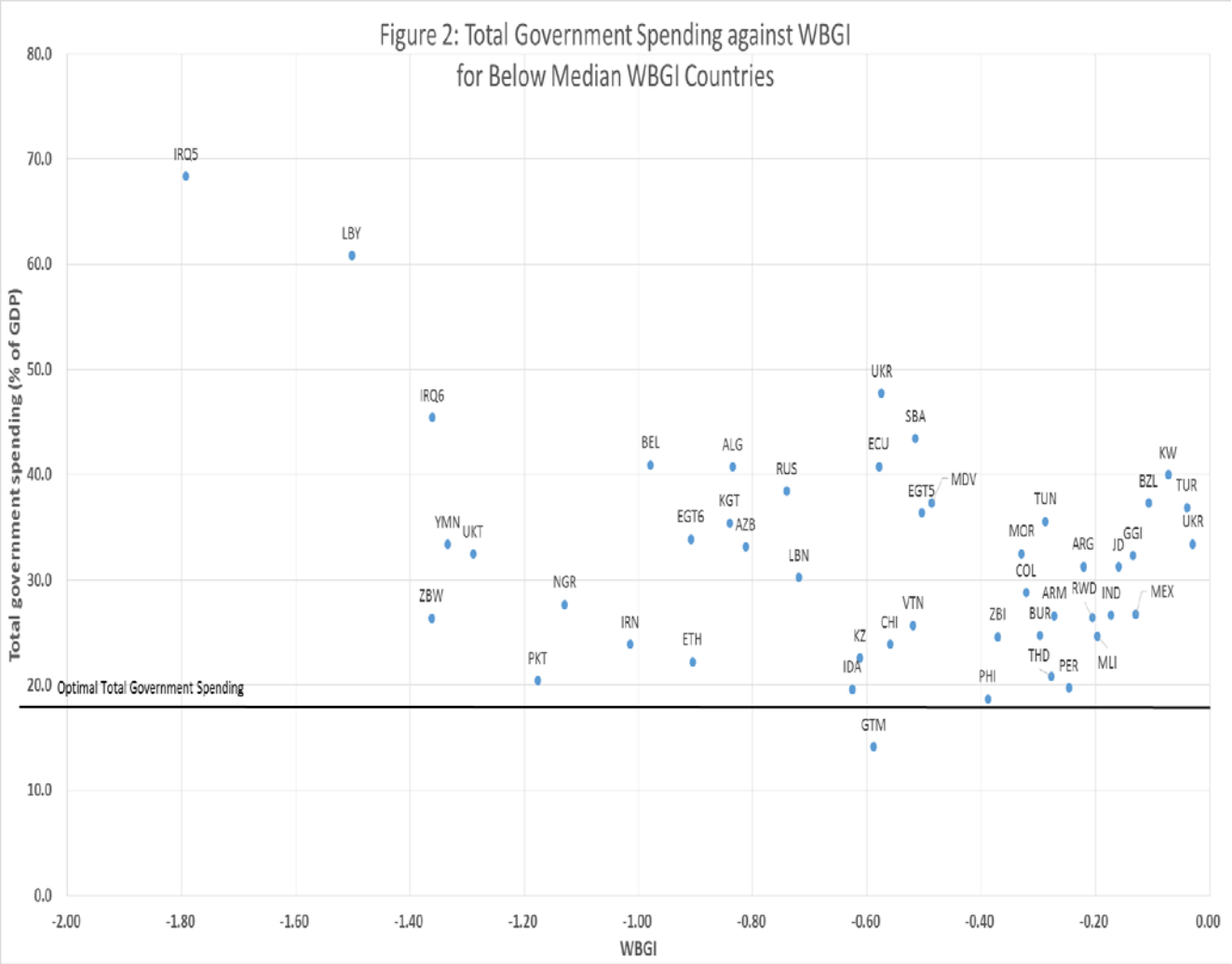
Note: coefficients on the "cuts" on the ordered probit regression are not reported to save space.

When we apply the iterative method to the sample of countries with below median WGI, we obtain, among others, the following iterations as listed in **Table 10**.

Table 10: Iterations and z Scores in Search of Optimal Total Government Spending for Below Median WGI Countries

Iteration	z
total_8	-0.49474
total_9	-1.6291
total_10	-2.87775
total_11	-3.56419
total_12	-3.96474
total_13	-4.13681
total_14	-4.13681

For this sample, the average of total government spending is 31.23%. Upon testing it is found that both the coefficient and the z statistic turn negative with a negative increment. With successive iterations subtracting a bigger and bigger number from 31.23% the negative z score peaks at -4.13681, implying that optimal government spending is 31.23%-13%. This corresponds to total government spending at 18.23% of GDP. The z score remains the same and is not unique with further negative increment trials, indicating that the optimal spending may be smaller than the observed total public spending among countries in the sample. This is confirmed with a scatter diagram. (**Figure 2**).



The ordered probit regression corresponding to the optimal iteration is presented in **Table 11**.

Table 11: Ordered Probit Regression on Total Life Satisfaction
For Below Median WGI Countries Corresponding to Iteration "total_13"

	Coef.	z	P>|z|			
L_FamImp	0.03395	8.28	0.000		Log likelihood	-114425
L_FriImp	-0.00566	-3.14	0.002		Number of obs	58,681
L_HelpOthers	0.00135	0.63	0.530		LR chi2(29)	24013.38
I_Autonomous	-0.01502	-11.67	0.000		Prob > chi2	0.0000
I_EnvirImp	0.02752	15.14	0.000		Pseudo R2	0.095
F_HardWork	0.00587	4.28	0.000			
E_Creative	-0.00707	-4.38	0.000			
E_FreeChoice	0.11120	61.48	0.000			

healthstatus	0.07399	44.02	0.000			
wave5	-0.18827	-19.56	0.000			
age	-0.01297	-7.15	0.000			
agesq	0.00018	8.75	0.000			
female	0.06649	6.83	0.000			
edu	0.00399	2.09	0.036			
religious	-0.04054	-3.94	0.000			
married	0.11030	8.49	0.000			
DSorW	-0.03251	-1.71	0.088			
partself	-0.03363	-2.85	0.004			
retired	-0.05171	-2.52	0.012			
housewife	0.10599	7.24	0.000			
student	-0.00185	-0.10	0.923			
unemployed	-0.07055	-4.50	0.000			
finsat	0.17992	88.54	0.000			
incomedecile	0.03430	14.91	0.000			
WGI	0.22056	19.09	0.000			
devgovt_13	-0.20929	-4.14	0.000			

Note: As before the coefficients for the cuts are not presented to save space. For the same reason we will not present other estimations using the iterative approach.

Appendix 3

Table 12: List of Countries/Jurisdictions Covered in the Study

Above Median WGI	Below Median WGI
Australia	Algeria
Bulgaria	Argentina
Canada	Armenia
Chile	Azerbaijan
Cyprus	Belarus
Estonia	Brazil
Finland	Burkina
France	China
Germany	Colombia
Ghana	Ecuador
Great Britain	Egypt
Hong Kong	Ethiopia
Hungary	Georgia
Italy	Guatemala
Japan	India
Jordan	Indonesia
Malaysia	Iraq
Netherland	Jordan
New Zealand	Kazakhstan
Norway	Kuwait
Poland	Kyrgyzstan
Qatar	Lebanon
Romania	Libya
Singapore	Mali
Slovenia	Mexico
South Africa	Moldova
South Korea	Morocco
Spain	Nigeria
Sweden	Pakistan
Switzerland	Peru
Taiwan	Philippines
Trinidad	Russia

United States	Rwanda
Uruguay	Serbia
	Thailand
	Tunisia
	Turkey
	Ukraine
	Uzbekistan
	Viet Nam
	Yemen
	Zambia
	Zimbabwe

Note: Above median countries were more often included in both Wave 5 and Wave 6. A country included in each wave was counted as a separate country. Otherwise the number of above median and below median countries should be equal. In principle the number of countries or jurisdictions above and below median WGI should be the same. They are not the same because countries that had been covered in both wave 5 and wave 6 are counted as separate entries in splitting the sample and more above median countries were covered in both waves. When repeated countries are eliminated, we have a somewhat longer list of below median countries.

Table 13: Actual and Optimal Total Public Spending for Good Governance Countries/Jurisdictions Based on the Derivative Method

Country	Wave	Actual Total Public Spending(% of GDP)	Optimal Total Public Spending (% of GDP)
Australia	Wave6	36.83	38.93
Australia	Wave5	34.87	38.81
Bulgaria	Wave5	35.86	34.21
Canada	Wave5	42.33	39.48
Chile	Wave6	23.95	36.33
Chile	Wave5	19.94	36.12
Cyprus	Wave6	46.14	36.3
Cyprus	Wave5	43.25	36.26
Estonia	Wave6	40.99	37.17
Finland	Wave5	50.31	40.81
France	Wave5	53.27	37.95
Germany	Wave5	46.44	39.62
Germany	Wave6	44.79	39.42
Ghana	Wave5	21.4	30.15
Ghana	Wave6	27.62	30.13
Great Britain	Wave5	39.5	38.58
Hong Kong	Wave5	17.67	39.23
Hungary	Wave5	50.44	36.03
Italy	Wave5	47.84	36.28
Japan	Wave6	38.21	38.6
Japan	Wave5	34.72	38.39
Jordan	Wave5	37.39	30.18
Malaysia	Wave5	26.89	32.02
Malaysia	Wave6	28.57	31.85
Netherland	Wave6	50.24	39.94
Netherland	Wave5	45.48	39.58
New Zealand	Wave5	33.2	39.87
New Zealand	Wave6	38.95	39.78
Norway	Wave5	40.56	39.51
Poland	Wave6	43.72	36.01
Poland	Wave5	43.58	34.8
Qatar	Wave6	28.62	34.26

Romania	Wave6	36.96	32.9
Romania	Wave5	32.1	32.71
Singapore	Wave6	14.13	39.17
Slovenia	Wave5	42.53	37.06
Slovenia	Wave6	46.77	37.04
South Africa	Wave5	27.19	32.16
South Korea	Wave6	22.14	35.66
South Korea	Wave5	20.73	35.65
Spain	Wave6	46.08	36.84
Spain	Wave5	38.65	36.63
Sweden	Wave6	52.92	40.49
Sweden	Wave5	53.58	39.94
Switzerland	Wave5	34.7	40.14
Taiwan	Wave6	20.72	36.33
Taiwan	Wave5	20.83	35.53
Trinidad	Wave6	37.92	32.34
Trinidad	Wave5	28.56	32.13
United States	Wave5	35.1	37.56
United States	Wave6	41.51	37.45
Uruguay	Wave6	33.49	35.21
Uruguay	Wave5	31.64	34.61
Average		**36.45**	**36.49**

**Wave5: 2004-2009; wave6: 2010-2014*

Note: For the above countries, optimal total government spending varies from 30.1 to 40.8% of the GDP. This compares with the optimal government spending estimated using the iterative method of 39.4%. For countries below median level of governance quality, optimal government size is 18.2% or less according to the iterative method and cannot be identified using the derivative approach.

Table 14: Actual and Optimal Spending for Health and for Education (Estimated from Full Sample)

Country or Jurisdiction	Wave*	Actual Healthcare Public Spending	Optimal Healthcare Public Spending	Actual Education Public Spending	Optimal Education Public Spending
Algeria	wave6	4.02	3.12	4.34	3.56
Argentina	wave5	4.4	.	4.15	3.94
Armenia	wave6	1.96	3.94	3.41	4
Australia	wave6	6.15	4.17	5.35	4.94
Australia	wave5	5.64	5.87	4.92	4.93
Azerbaijan	wave6	1.2	5.86	2.81	3.64
Belarus	wave6	3.89	3.85	4.92	4.09
Brazil	wave5	3.39	3.91	4.5	3.99
Bulgaria	wave5	4.53	3.84	3.58	4.66
Burkina Faso	wave5	4.3	5.32	4.5	3.24
Canada	wave5	6.92	2.45	4.93	5.1
Chile	wave6	3.47	6.21	4.16	4.51
Chile	wave5	2.58	5.07	3.25	4.49
China	wave6	2.87	5.30	3.57	4.06
China	wave5	1.9	4.26	2.43	4.07
Colombia	wave6	5.02	4.63	4.55	3.77
Colombia	wave5	4.43	3.48	4.13	3.69
Cyprus	wave6	3.23	3.42	7.61	4.6
Cyprus	wave5	2.71	4.17	6.88	4.6
Ecuador	wave6	2.68	4.41	4.41	3.56
Egypt	wave6	1.97	3.17	3.76	3.38
Egypt	wave5	2.12	3.01	3.82	3.53
Estonia	wave6	5	3.24	5.61	4.88
Ethiopia	wave5	2.51	5.21	5.57	3.03
Finland	wave5	6.06	1.66	6.38	5.25
France	wave5	8.51	5.81	5.7	4.93
Georgia	wave5	1.83	5.51	2.95	4.39
Germany	wave6	8.64	4.98	5.08	5.2
Germany	wave5	8.2	6.34	4.43	5.22

Ghana	wave6	3	6.47	6.84	3.59
Ghana	wave5	3.82	2.24	6.07	3.59
United Kingdom	wave5	6.47	2.50	5.28	5.02
Guatemala	wave5	2.26	5.82	2.98	3.28
Hong Kong	wave5	2.56	3.10	4.33	5.15
Hungary	wave5	5.08	6.47	5.17	4.81
India	wave5	0.94	5.20	3.17	3.74
Indonesia	wave5	0.88	3.78	2.81	3.67
Iran	wave5	2.33	3.79	5.09	3.52
Iraq	wave6	2.1	2.85	.	3.05
Iraq	wave5	2.92	.	.	2.9
Italy	wave5	6.54	.	4.56	4.94
Japan	wave6	7.55	5.81	3.61	5.16
Japan	wave5	6.52	6.67	3.58	5.14
Jordan	wave6	6.2	6.58	.	3.54
Jordan	wave5	4.75	.	.	3.62
Kazakhstan	wave6	2.48	.	3.06	3.78
Kuwait	wave6	2.09	4.06	3.76	3.8
Kyrgyzstan	wave6	3.73	4.41	6.28	3.44
Lebanon	wave6	2.85	2.11	1.92	3.72
Libya	wave6	3.02	4.42	.	3.18
Malaysia	wave6	2.18	.	5.53	3.88
Malaysia	wave5	1.9	3.48	5.2	3.9
Mali	wave5	3.2	3.54	4.15	3.25
Mexico	wave6	3.11	2.59	5.2	3.79
Mexico	wave5	2.63	3.39	4.93	3.8
Moldova	wave5	4.36	3.46	7.14	4.08
Morocco	wave6	2.07	2.88	5.38	3.71
Morocco	wave5	1.68	2.98	5.5	3.7
Netherlands	wave6	9.68	2.89	5.95	5.15
Netherlands	wave5	7.14	6.00	5.47	5.12
New Zealand	wave6	8.44	6.03	6.89	5
New Zealand	wave5	6.27	5.15	6.52	5
Nigeria	wave6	1.85	5.22	.	3.06
Norway	wave5	7.93	.	6.71	5.07
Pakistan	wave6	0.96	5.80	2.21	3.15
Peru	wave6	2.81	3.09	2.66	3.74

Peru	wave5	2.59	.	2.7	3.69
Philippines	wave6	1.65	4.11	2.65	3.5
Poland	wave6	4.85	3.95	5.17	4.7
Poland	wave5	4.31	3.60	5.41	4.6
Qatar	wave6	1.75	5.07	2.45	4.29
Romania	wave6	4.4	4.65	3.3	4.42
Romania	wave5	4.34	6.70	3.4	4.4
Russia	wave6	3.82	5.07	4.1	4.16
Russia	wave5	3.23	4.94	3.73	4.16
Rwanda	wave6	6.26	4.37	4.86	3.37
Rwanda	wave5	4.44	4.44	4.34	3.27
Serbia	wave5	6.06	2.53	4.67	4.37
Singapore	wave6	1.51	2.53	3.18	5.04
Slovenia	wave6	6.62	4.36	5.69	4.93
Slovenia	wave5	6.12	7.18	5.74	4.93
South Africa	wave5	3.35	5.41	5.29	3.89
Korea, South	wave6	3.92	5.31	4.93	4.66
Korea, South	wave5	2.83	3.45	4.29	4.66
Spain	wave6	7.04	5.26	5	4.89
Spain	wave5	5.99	5.36	4.28	4.87
Sweden	wave6	7.85	5.64	7.12	5.23
Sweden	wave5	7.34	5.86	6.91	5.18
Switzerland	wave5	6.21	5.67	5.27	5.18
Taiwan	wave6	3.76	5.58	4.38	4.69
Taiwan	wave5	3.7	6.31	4.25	4.62
Thailand	wave5	2.52	5.70	4.13	4.09
Trinidad and Tobago	wave6	2.83	5.42	3.16	4.18
Trinidad and Tobago	wave5	2.45	4.10	3.16	4.16
Tunisia	wave6	4.16	4.87	6.17	3.88
Turkey	wave6	4.87	4.81	2.86	4.02
Turkey	wave5	3.92	3.07	2.86	4.03
Ukraine	wave6	4.27	4.60	6.73	4.28
Ukraine	wave5	3.86	4.57	5.86	4.33
United States	wave6	8.4	3.44	5.33	4.79
United States	wave5	7.01	3.84	5.26	4.8
Uruguay	wave6	5.72	5.76	4.5	4.48
Uruguay	wave5	4.26	5.74	2.7	4.42

Uzbekistan	wave6	2.75	4.83	.	3.3
Vietnam	wave5	1.73	5.29	4.89	3.69
Yemen	wave6	1.51	.	5.15	2.85
Zambia	wave5	3.66	3.05	1.76	3.24
Zimbabwe	wave6		1.52	2.5	2.91
Average		**4.13**	**4.33**	**4.55**	**4.17**

**Wave5: 2004-2009; wave6: 2010-2014*

Note: Empty boxes indicate that the optimal spending shares cannot be estimated because of some missing variables. Optimal healthcare and optimal education spending under the iterative method are respectively 7.52% and 2.39% for above median governance countries and 2.14% and 4.48% for below median WGI countries.