

# **The fiscal consequences of health and investments in healthcare: A quantitative “government perspective” analytic framework**

Nikolaos Kotsopoulos (1, 2), Mark P. Connolly (1, 2), Maarten J. Postma (1)

1. Unit of PharmacoEpidemiology & PharmacoEconomics, Department of Pharmacy, University of Groningen, The Netherlands
2. Global Market Access Solutions, St Prex, Switzerland

## **Abstract**

We describe a methodological framework for assessing the impact of health conditions on government tax revenue. Traditional approaches for evaluating health programs focus on health service and societal perspectives. These frameworks are limited because they fail to consider broader impacts of how changes in health status change productivity and consequently future government tax revenue tied to productive labour output. To present our framework we explore the case of paediatric conditions which result in cognitive defects that, in turn, impact educational attainment. Educational attainment is considered an explanatory variable of earnings whereas government tax revenue is dependent on earnings. The framework links differences in educational attainment to education-specific wages, and in this respect education also influences future government tax revenue. The method originates from human capital economics and generational accounting used by governments to investigate intertemporal budget constraints. Direct and indirect tax rates are linked to differences in lifetime education-specific earnings to quantify the tax revenue associated with individuals with and without paediatric conditions with potential cognitive impairments. The proposed framework allows the inclusion of government transfer payments to enable quantification of the net tax revenue linked to these conditions. Cohort models can then be constructed to assess, for single and multiple cohorts, the fiscal burden. The framework can be used to assess the rate of return from investments in interventions targeting at the condition and influence education and future productive labour. The presented framework may inform policy analysis with respect to resource allocation and funding and provides a tool for cross-sectoral comparisons. This framework integrates program analysis with fiscal accounting to estimate how investments in healthcare influence future government tax revenue and thus, it is relevant to tax-financed health systems concerned about sustainability of public finances.

**Keywords:** Economics, health investment, government perspective, paediatric diseases

## **Background**

Economic evaluations of health care technologies, traditionally quantify the cost-effectiveness or cost-utility of a new technology against a comparable intervention (Drummond et al. 1997). The rationale behind conducting economic evaluations is to aid decision making with the goal of maximizing health benefits from a given budget (Gold et al. 1996). Brouwer and Koopmanschap in their work on the foundations of economic evaluation reported that from the welfarists' point of view, a consistent method for conducting an evaluation is by using willingness to pay (WTP) and cost-benefit analysis (CBA). When the more pragmatic decision maker's approach (DMA) is used, one may consider economic evaluation as an imperfect aid to decision making (Brouwer and Koopmanschap 2000). As such, the authors noted that economic evaluations aim at informing decision making by being factored into a multi-criteria decision making process rather than indicating to the budget holder an optimal allocation of resources. The majority of recent economic evaluations attempt to address the issue of efficient use of health care resources mainly from the perspective of the health service. Furthermore, several economic studies assess the broader societal impact of diseases by quantifying not only quality adjusted life years (QALYs) or disability adjusted life years (DALYs) but also factors such as productivity losses attributed to mortality and/or morbidity.

It is increasingly recognised that diseases resulting in individuals withdrawing from the work force, working inefficiently (i.e. presenteeism), retiring or dying prematurely can also impact governments (WHO 2009). Specifically, tax revenue loss associated with ill-health, poses a considerable burden on central and regional governmental budgets suggesting a cross-sectoral negative impact of disease. A report commissioned by the UK government, describing the impact of ill health in working aged adults, suggested that health care costs of illness represented only 8-15% of total government costs. The findings of the report suggest that applying a health service or societal perspective analytic framework to evaluate health, in working-age adults, would not take into account approximately 90% of costs that fall on the UK government (Dame Carol Black 2008). Hence, economic assessments focusing solely on the health service cost may underestimate the economic impact of disease to governments. It should be feasible to quantify the tax revenue loss associated with the mortality and morbidity of diseases and subsequently provide governments with an additional criterion in the health care resource allocation decision making process.

In non-working age individuals, such as paediatric patients, the estimation of the lifetime economic consequences of disease, irrespective of analytical perspective, is difficult as it

requires long-term projections. Nevertheless, several paediatric conditions are deemed as having an independent relationship with diminished school achievement (Karande and Kulkarni 2005). Studies of school achievement found that children with asthma performed as well as their healthy peers however, the evidence on labour market performance showed an indication that individuals with asthma during childhood experienced disadvantage in later employment (Milton et al. 2004). School attendance was reported to be diminished among children with asthma from deprived areas as well as for minority ethnic children (Milton, Whitehead, Holland, & Hamilton 2004). A review by Milton and colleagues (Milton et al. 2006) reported that people with childhood-onset diabetes might experience disadvantage in employment, and had a lower income in adulthood, although diabetic complications appeared to be the most important determinant of social consequences in later life. Numerous studies have also described the impact that ADHD can have on educational outcomes. Children with ADHD are regularly found to have lower educational attainment, increased likelihood of dropping out of school and grade retention compared to children without ADHD (Biederman and Faraone 2006; Bussing et al. 2010; Matza et al. 2005; Sobanski et al. 2007). In the area of infectious diseases, malaria appears to have life-long effects on cognitive development and the education levels attained resulting from malaria-induced anaemia and the subsequent time lost to illness in the classroom (Barofsky et al. 2011; Kere et al. 1993).

Although, several socio-demographic variables are deemed as potential determinants of a child's future earnings, in human capital economics, the most explored causal relationship is between earnings and quantity and/or level of education attained (Mincer 1974; Psacharopoulos 1981; Psacharopoulos and Layard 1979). Reduced school performance has some immediate societal cost implications but more importantly, reduced school achievement may reduce lifetime opportunities because of education-linked wage effects that will persist over the course of life (Becker 1964; OECD 2007). The relationship between earnings and tax revenue is intuitive especially in progressive tax systems. Thus, preventing or reducing the paediatric conditions that negatively impact school achievement may translate into tangible and quantifiable, long-term fiscal benefits for the government.

We hereby present a methodological quantitative analytic framework for assessing the fiscal impact of paediatric conditions or diseases which are responsible for cognitive defects and result in reduced school achievement. Moreover, we present two applications of the method. The first case study applies the framework to estimate the burden of type 1 diabetes for the UK government for a single birth cohort over lifetime. The second case study assesses, for a

single birth cohort, the government benefits from introducing a hypothetical vaccination programme against malaria in a developing African country (Ghana). The proposed framework combines methods from human capital economics theory and generational accounting. The framework's outputs consist of measures commonly used in financial economics and cost-benefit project appraisals.

### **Quantitative analytic framework**

The generational accounting theory was developed by Auerbach, Gokhale, and Kotlikoff as an intergenerational framework to evaluate the fiscal consequences of government policy decisions (Auerbach et al. 1994). As applied in the generational accounting modelling framework, finance sustainability is influenced by two opposing population forces that influence government expenditure and tax revenues. As populations age, the opposing forces include economic growth influenced by labour market participation, and age-related expenditure (European Commission 2009). By viewing opposing fiscal forces over the life course, it is possible to see how changes in population health status can influence the government balance sheet by increased transfer payments and reduced tax receipts. Over the course of life, individuals at different stages of life can be recipients of government transfer payments, as well as transferring wealth to government in the form of various taxes. By understanding the fiscal transfers between individuals and government, it is possible to derive a net fiscal position of an individual at any stage of life by deducting age-specific gross transfer payments from age-specific gross taxes (equation 1).

$$NPV_{fiscal_i} = \sum_{t=0}^{Le} \frac{Tax_{it} - Cost_{it}}{(1+r)^t} \quad (1)$$

Where Le: Life expectancy; i: disease status; and in year t

$$Tax_t = Direct\ tax_t + Indirect\ tax_t + National\ insurance_t \quad (2)$$

$$Cost_t = Education_t + Health_t + Other\ Transfer\ Payments_t + Pension_t \quad (3)$$

Hence for individuals with and without a paediatric disease, a fiscal NPV can be quantified indicating the lifetime fiscal burden of the condition. Similarly, a fiscal NPV corresponding to a diseased individual receiving treatment can be calculated by taking into account the cost and efficacy of treatment. The cost of the intervention would add up to health costs while efficacy can be reflected either as increase in survival or reduction in morbidity. By taking into account the costs of treatment and the benefits in terms of increased tax revenue, the rate of

investment (ROI) for the government from investing in the treatment of a paediatric disease can be calculated.

In order to quantify the lifetime tax of an individual modelling the future labour market is required. In particular, a projection of education-specific lifetime earnings is needed. Differences in educational attainment between individuals with and without the disease and between individuals receiving treatment are expected to produce different lifetime earnings. Several national statistical agencies report aggregate, age and education specific earnings. In addition, household surveys often report panel micro-data for constructing the fiscal life course. Recently, observational studies have attempted to explore the relationship between diseases, school achievement and lifetime earnings (Biederman et al. 2008; Biederman & Faraone 2006). Data from all these sources may be used to either interpolate or econometrically project the lifetime earnings curves of different groups of individuals.

In human capital economics the model proposed by Mincer (Mincer 1974) has been widely used to project an individual's lifetime earnings based on the level or the quantity of education. In its simplest form the Mincer model, predicts the logarithm of earnings as a function of schooling years, work experience and squared work experience. Other explanatory socio-demographic variables, such as ethnicity, economic status of parents, and distance from educational infrastructure may also be incorporated. The simplest form of the Mincer function is shown in equation 4.

$$\ln Y_{ti} = \alpha_{0i} + a_{1i}x_1 + a_{2i}x_2 + a_{3i}x_2^2 \quad (4)$$

Where  $Y_{ti}$  is the annual wage (or earnings) of an individual in year  $t$  with disease status  $i$  (i.e. diseased or disease-free),  $\alpha_{0i} - \alpha_{3i}$  regression coefficients and  $X_1, X_2$  correspond to schooling years and age, respectively. Hence, by estimating the coefficients of the Mincer model, one may project the lifetime earnings and thus, quantify a tax base where government revenue can be derived from. Alternatively, in the absence of micro-data, the estimate of a Mincer function for the general population could be used and education level or quantity may be varied to determine the lifetime earnings differential between diseased and disease-free individuals. Government tax revenue may subsequently be modelled as a function of age-specific earnings.

At each year, taxes represent a fixed percentage of an individual's total earnings. The types of tax that can be modelled are direct income tax and indirect taxes (e.g. VAT for the part of the disposable income that goes to consumption). Additionally, social insurance contributions

may be incorporated as they are typically linked with earnings. Other tax that may apply includes road tax and property tax. Consistently with the generational accounting methodology earnings should be inflated over time to reflect increases in future productivity (Auerbach, Gokhale, & Kotlikoff 1994). Furthermore, earnings should be adjusted for age-specific unemployment probability. In addition, age-specific transfer cost data can be obtained by national statistics and inflated to reflect future cost/price inflation. Finally, survival probabilities may also be derived from published life tables and/or epidemiologic mortality studies.

### **Case study I: Type-1 diabetes in the UK**

A simplified example shedding light to the differences between traditional economic analyses and the proposed analytic framework may be derived from type 1 diabetes in the UK. It should be noted that the case study presented here is illustrative and aims at presenting the method and its differences from traditional economic studies rather than providing precise estimates.

Diabetes is deemed as a costly disease in developed countries. A recent analysis estimated the direct and indirect costs associated with diabetes in the UK (Hex et al. 2012). The study reported considerably high indirect costs. According to the study, diabetes cost approximately £23.7bn in the UK in 2010/2011: £9.8bn in direct costs (£1bn for type 1 diabetes and £8.8bn for Type 2 diabetes) and £13.9bn in indirect costs (£0.9bn and £13bn). The authors estimated the productivity losses associated with sick days and presenteeism. Furthermore, the study included in its analysis a higher probability of unemployment for diabetes after the age of 45 years.

Based on our proposed framework, in order to quantify the government impact of type 1 diabetes in the UK, the first step is to estimate the tax revenue and government transfer payments. By deducting transfer payments from tax revenues that is, by applying equation (1) the fiscal NPV can be calculated for an average UK birth cohort. A similar cumulative fiscal NPV can be generated for an equally-sized cohort (n=1,000) of diagnosed with type 1 diabetes individuals. Type 1 diabetes individuals are expected to incur higher transfer costs due to increased lifetime health care costs. Furthermore, type 1 diabetes patients are expected to generate less total earnings due to increased mortality, and reduced earnings associated with lower school achievement. For simplicity, in the presented analysis we did not take into

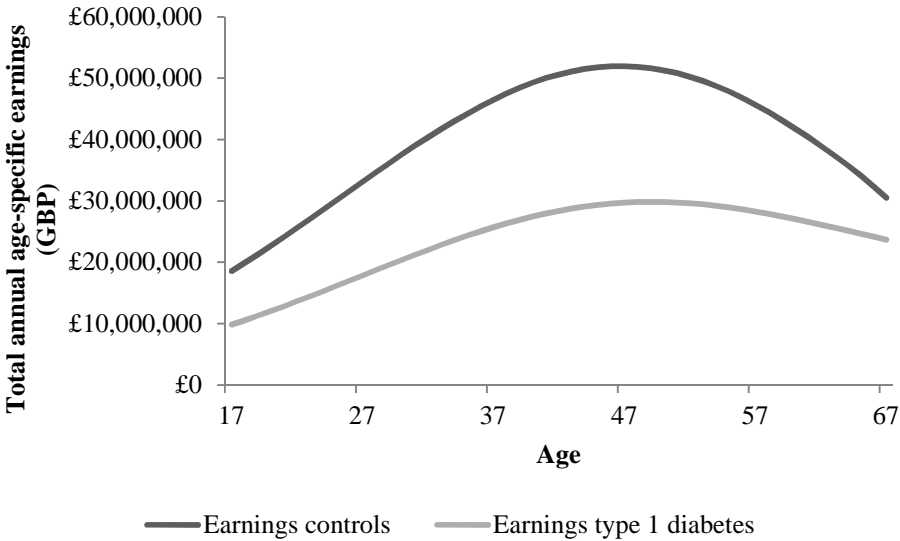
account the impact on government arising from increased unemployment, absenteeism and presentism.

In order, to reflect mortality of individuals with type 1 diabetes we used UK reported age-specific (5-year) mortality data (NHS Information Center 2011). For illustrative purposes we hypothesized that type 1 diabetes individuals are expected to incur annual healthcare costs of £2,500 (Hex, Bartlett, Wright, Taylor, & Varley 2012). The latter cost reflects the per capita direct cost quantified by Hex and colleagues. We assumed that this was the cost premium associated with type 1 diabetes individuals and that healthy controls incur health care costs equal to the average UK individual's costs. In reality, the calculation of the UK average age-specific health care costs, used in this example had already included diabetic populations.

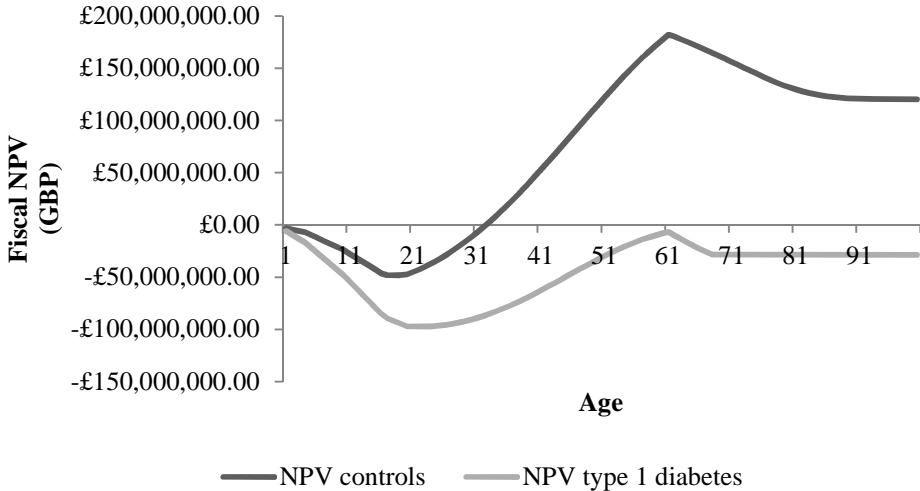
The results from the literature do not provide a definitive answer on the relationship between type 1 diabetes educational attainment and earnings and further investigations are needed. Nevertheless, the currently available evidence gives an indication about the potentially negative impact of type 1 diabetes on earnings. For the purposes of this paper we assumed that type 1 diabetes individuals attain one year of education less compared to healthy controls. Based on a previously estimated Mincer function in the UK, one-year less school achievement is expected to result in reduced earnings and subsequently reduced tax of 9.86% (Polacheck 2007).

Figure 1 represents the generated lifetime earnings curves for a birth cohort of 1,000 individuals with complicated type 1 diabetes against 1,000 healthy controls. The analysis showed that type 1 diabetes individuals are expected to generate less earnings compared to healthy controls. The largest proportion (60%) of the earnings difference originated from the educational effect, with the rest 40% being attributable to mortality (break down analysis not shown). Figure 2 illustrates, the resulting fiscal NPV for a cohort of 1,000 type 1 diabetes individuals, born in 2011 in the UK against the fiscal NPV of an equally-sized birth cohort of healthy controls. The fiscal NPV was calculated assuming a 3% discount rate and an equal cost and productivity annual inflation rate. The projected retirement age was set at 67 years of age. The analysis showed that type 1 diabetes individuals incur a substantially negative fiscal NPV over their lifetime thus, posing a high burden for the UK government. The results imply that any intervention towards the prevention of complicated type 1 diabetes consequences may result in considerable returns for the UK government in terms of increased future tax revenue.

**Figure 1 Total projected annual age-specific earnings of a birth cohort (n=1,000) with type 1 diabetes versus healthy controls**



**Figure 2 Cumulative fiscal NPV over time**



**Case study II: Prevention of Malaria in Ghana**

Malaria poses a substantial epidemiologic and economic burden to developing countries (Boel et al. 2012). We applied the proposed analytic framework to assess the impact that a malaria vaccination programme may have from the government perspective in Ghana.

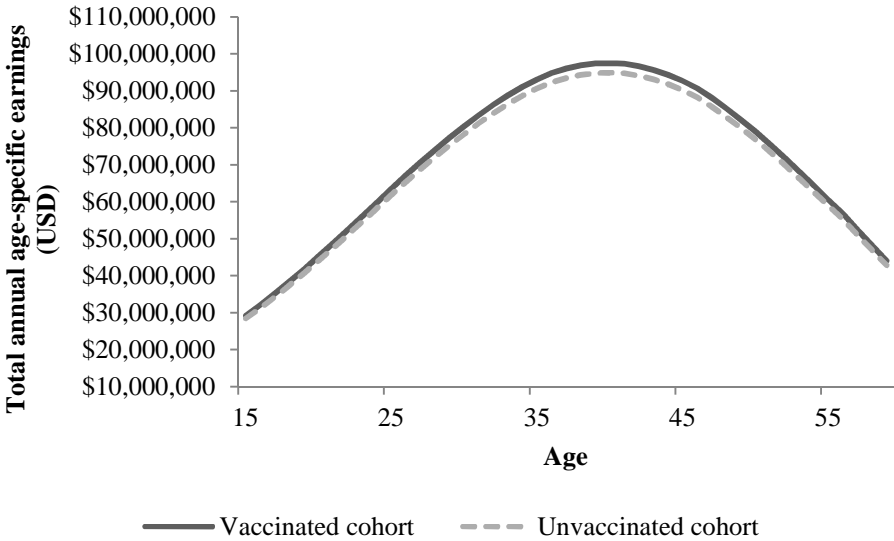
A government perspective decision analytic model was developed simulating the occurrence of uncomplicated and severe malaria as well as malaria with neurocognitive impact. The neurocognitive effect of malaria was simulated as having a negative long-term effect on school achievement. The analysis was conducted for annual birth cohorts of n=100,000 each.



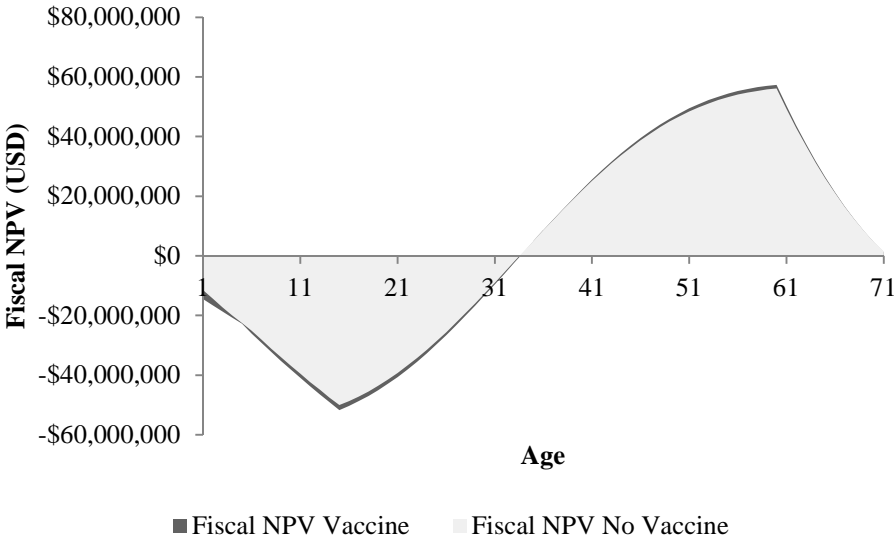
A life time simulation was conducted to assess the fiscal NPV for equally-sized vaccinated and unvaccinated cohorts. The average age of retirement in Ghana was set at 61 years of age. Life tables, age-specific health care and educational costs, government transfer payments and age-specific unemployment data were obtained from national statistics. Education participation data were also derived from national statistics (<http://www.statsghana.gov.gh/KeySocial.html>). Malaria epidemiology originated from published evidence (Oduro et al. 2007). Malaria costs were derived from the published literature (Asenso-Okyere and Dzator 1997) and inflated at 7% to reflect current prices. A vaccination programme with 100% coverage, 50% efficacy in preventing malaria and malaria-attributable mortality and a booster dose at the age of five years was hypothesized. A hypothetical cost per vaccine dose of \$50 (including programme costs, administration and cold chain cost) was also assumed. Following the Mincer model, age-specific earnings were modelled as a function of schooling years and age. A set of studies was identified showing that the eradication of malaria may result in almost one additional year of schooling (Barofsky, Chase, Anekwe, & Farzadfar 2011). Moreover, previous studies have also shown that one additional schooling year may result in 9.7% higher lifetime earnings (Rankin et al. 2006). A nominal discount rate of 10% was assumed with 7% annual cost inflation and a wage productivity growth of 3%.

Figure 3 shows the generated earnings curves for the vaccinated and the unvaccinated cohorts, respectively. Figure 4 illustrates the cumulative Fiscal NPV over the lifetime of a vaccinated cohort versus an equally-sized, unvaccinated cohort. The results showed that a vaccinated cohort may result in marginally higher fiscal NPV. The Fiscal NPV at year 61 was positive and incrementally favourable for the vaccinated cohort despite the relatively high hypothetical cost of vaccination (2-fold the average per capita health care expenditure). In addition, the analysis showed that vaccination investment cost may be counterbalanced by the increase in earnings and the resulting higher tax revenue for the government. The incrementally higher fiscal NPV of the vaccinated cohort is attributed to the additional earnings and tax resulting from the increase in survival and from the reduction in the neurocognitive effect which, through a higher educational attainment yields higher earnings and tax revenue.

**Figure 3 Total projected annual age-specific earnings of vaccinated versus unvaccinated birth cohorts (n=100,000)**



**Figure 4 Cumulative fiscal NPV over time**



**Discussion**

In 2009 the World Health Organisation (WHO) released the WHO Guide to Identify the Economic Consequences of Disease and Injury (WHO 2009). Within the WHO guide the impact of population health on government was described. The report acknowledged that injury and illness can impact government fiscal accounts both in terms of lost tax revenue and increased transfers costs. The implications of this report suggest that preventing illness would likely have a positive impact for government as more people would be working and paying taxes. In the spirit of the WHO guide, we sought to understand how the treatment or

prevention of paediatric diseases might influence fiscal accounts using a “government perspective” accounting framework. The proposed framework can apply to changes in morbidity and mortality, both of which are directly applicable to a range of medical conditions. The basic principle of the “government perspective” approach is that economic beneficiaries of improved health are worth considering in the context of health investments. In most cases the individuals themselves and society as a whole will benefit from improved health. This is attributed to several factors including wage increases, and indirectly through improved educational opportunities influencing future earnings.

Government expenditure can also be influenced by population health, whereby poor health has the capacity to increase government expenditure in health care and social programs as well as reduce tax-receipts from fewer individuals working (WHO 2009). Conversely, the same would be true as economies expand because of improved population health, all things equal, governments will receive more tax revenue (Sancak et al. 2010). In this context a fiscal accounting approach can capture simultaneously the positive and negative impact of health and changes in health status linked to investments in healthcare to derive the net fiscal impact attributed with these investments.

The proposed framework is particularly relevant for immunizations which represent a high-cost investment that pays-off years or even decades after the actual immunization. Furthermore, because vaccination programs are often funded directly from finance departments, describing health gains in terms of net tax revenue for government is a language more familiar to finance departments. Previous applications have evaluated investments in rotavirus vaccination in Egypt (Connolly et al, 2012). In some countries the mortality and morbidity burden of rotavirus deaths are substantial, and the observation that indirect costs represent a significant proportion of costs suggested the fiscal effects will also be significant (Parashar et al. 2003;Standaert et al. 2008). In addition, the proposed framework has been utilised to demonstrate the fiscal value of government investments in assisted reproduction (i.e. in-vitro fertilisation) (Connolly et al. 2008).

Using our quantitative analytic “government perspective” framework, we showed that the prevention of malaria in children and the prevention of diabetic complication can impact government fiscal accounts when these children reach working ages. This is consistent with a recent UK policy analysis which highlighted that investments in evidence-based prevention, early intervention and treatment for mental disorders can have economic benefits that go far beyond the health sector (McDaid and Knapp 2010). The analysis suggested that, in light of

austerity measures, policy appraisals should go further than the cost-effectiveness and assess the cross-sectoral impact not only of treatments but also of preventive actions (McDaid & Knapp 2010).

In economic theory, higher educational attainment implies a higher potential for increased lifetime earnings (Barone and van de Werfhorst 2011;Card 2012;Mincer 1974;Psacharopoulos 1981;Psacharopoulos & Layard 1979) which, in turn, provide the basis for higher tax revenue. When considering the long-term economic prospects of a society, the populations' level of education is deemed as an important determinant of economic growth (Barro 2012). An analysis of cross-country data estimated that an additional year of schooling roughly raises the growth rate by 0.44% per year (Barro 2012). Hence, health care technologies aiming at reducing the effect of paediatric diseases on school achievement may have a considerable and quantifiable value for the governments.

The proposed framework described here originates from the generational accounting framework which is a useful tool for evaluating the long-term intergenerational fiscal consequences of policy decisions. Rather than presenting a government's financial situation by budget deficit and public debt, the generational accounting methodology rationalises the intertemporal budgetary impact of policy decisions taking into consideration age cohorts who will pay for policies now and into the future. The underlying premise of fiscal policy is zero sums over the long-term, because government obligations must be met by current and future generations. The prevalence of diseases in the current and future generations that result in mortality and productivity losses, through morbidity and indirect consequences may be critical determinants of long-term public finance sustainability. In developing countries, health care investments may increase economic growth and therefore the income base which governments can tax. In turn, increased government revenues may result in more public investments which may trigger fiscal multiplier's effects and improve development

The proposed framework is based on several long-term projections of volatile economic figures which inevitably introduce uncertainty. Forecasting key analysis' inputs in the long-term, such as the cost and productivity inflation, age-specific unemployment rates, government transfer payments and health care costs is typically based on current data which may not accurately reflect the future situation. Predicting the future age and education specific earnings and tax paying capacity of an individual is dependent on several exogenous parameters which may not be included in the forecast models (e.g. technological change, educational policy changes, and tax system reforms). However, a modelling approach enables

the conduct of sensitivity analyses to address some of the uncertainties. The illustrated examples are based on single-cohort analyses. Multiple cohorts may also be modelled in order to quantify the cross-generational effect of investing in paediatric health care interventions. In the case of preventing transmittable diseases that would also require the inclusion of transmission dynamics into the simulation.

In contrast with traditional technology appraisals, our framework projects economic benefits associated with changes in population health status in relation to spending on discrete health programs. In this respect it is possible to view our approach as a budget impact model that assesses the effect of health changes across different government fiscal accounts, and accounts for any tax revenues that may arise through increased societal productivity. In this context, the analysis follows a discounted cash flow methodology widely used in financial analysis and may provide with an additional decision making criterion when evaluating new health care technologies.

## References

- Asenso-Okyere, W.K. & Dzator, J.A. 1997. Household cost of seeking malaria care. A retrospective study of two districts in Ghana. *Soc.Sci.Med.*, 45, (5) 659-667
- Auerbach, A.J., Gokhale, J., & Kotlikoff, L.I. 1994. Generational accounting: a meaningful way to evaluate fiscal policy". *The journal of economic perspectives* (1) 73-94
- Barofsky, J., Chase, C., Anekwe, T., & Farzadfar, F. The economic effects of malaria eradication: Evidence from an intervention in Uganda. <http://www.hsph.harvard.edu/pgda/working.htm> . 2011.  
Ref Type: Electronic Citation
- Barone, C. & van de Werfhorst, C. 2011. Education, cognitive skills and earnings in comparative perspective. *International Sociology*, 26, (4) 483-502
- Barro, R. Education and economic growth. [www.oecd.org/dataoecd/5/49/1825455.pdf](http://www.oecd.org/dataoecd/5/49/1825455.pdf) . 2012. 2-2-2012. Ref Type: Electronic Citation
- Becker, G.S. 1964. *Human Capital: A theoretical and Empirical Analysis, with Special Reference to Education* Chicago, University of Chicago Press .
- Biederman, J. & Faraone, S.V. 2006. The effects of attention-deficit/hyperactivity disorder on employment and household income. *MedGenMed.*, 18, 8-12
- Biederman, J., Petty, C.R., Fried, R., Kaiser, R., Dolan, C.R., Schoenfeld, S., Doyle, A.E., Seidman, L.J., & Faraone, S.V. 2008. Educational and occupational underattainment in adults with attention-deficit/hyperactivity disorder: a controlled study. *J.Clin.Psychiatry*, 69, (8) 1217-1222
- Boel, M.E., Rijken, M.J., Brabin, B.J., Nosten, F., & McGready, R. 2012. The epidemiology of postpartum malaria: a systematic review. *Malar.J.*, 11, (1) 114
- Brouwer, W.B. & Koopmanschap, M.A. 2000. On the economic foundations of CEA. Ladies and gentlemen, take your positions! *J.Health Econ.*, 19, (4) 439-459
- Bussing, R., Mason, D.M., Bell, L., Porter, P., & Garvan, C. 2010. Adolescent outcomes of childhood attention-deficit/hyperactivity disorder in a diverse community sample. *J.Am.Acad.Child Adolesc.Psychiatry*, 49, (6) 595-605
- Card, D. 2012, "The causal effect of education on earnings ," In *Handbook of Labor Economics*, vol. 3 D. Card & O. Ashenelter, eds., Elsevier Science B.V., pp. 1801-1863.
- Connolly MP, Topachevskiy O, Standaert B, Ortega O, Postma M. The impact of rotavirus vaccination on discounted net tax revenue in Egypt: A government perspective analysis. *Pharmacoeconomics* in press.
- Connolly, M.P., Pollard, M.S., Hoorens, S., Kaplan, B.R., Oskowitz, S.P., & Silber, S.J. 2008. Long-term economic benefits attributed to IVF-conceived children: a lifetime tax calculation. *Am.J.Manag.Care*, 14, (9) 598-604
- Dame Carol Black 2008, *Review of the health of Britain's working age population*, London: TSO.

- Drummond, M.F., O'Brien, B., Stoddart, G.L., & Torrance, G.W. 1997. *Methods for the Economic Evaluation of Health Care Programmes*, 2nd ed. Oxford, Oxford University Press .
- European Commission, D.-G. o. E. a. F. A. 2009, *Sustainability Report 2009*. European Economy, European Communities, 2009, Luxemburg, 9.
- Gold, M.R., Siegel, J.E., Russell, L.B., & Weinstein, M.C.E. 1996. 1996. *Cost-effectiveness in Health and Medicine*. Oxford Univ. Press, Oxford.
- Hex, N., Bartlett, C., Wright, D., Taylor, M., & Varley, D. 2012. Estimating the current and future costs of Type 1 and Type 2 diabetes in the UK, including direct health costs and indirect societal and productivity costs. *Diabet.Med.*
- Karande, S. & Kulkarni, M. 2005. Poor school performance. *Indian J.Pediatr.*, 72, (11) 961-967
- Kere, N.K., Keni, J., Kere, J.F., Bobogare, A., Webber, R.H., & Southgate, B.A. 1993. The economic impact of Plasmodium falciparum malaria on education investment: a Pacific Island case study. *Southeast Asian J.Trop.Med.Public Health*, 24, (4) 659-663
- Matza, L. S., Paramore, C., & Prasad, M. A review of the economic burden of ADHD. *Cost Effectiveness and Resource Allocation*. <http://www.resource-allocation.com/content/pdf/1478-7547-3-5.pdf> . 2005. 15-10-2011. Ref Type: Electronic Citation
- McDaid, D. & Knapp, M. 2010. Black-skies planning? Prioritising mental health services in times of austerity. *Br.J.Psychiatry*, 196, (6) 423-424
- Milton, B., Holland, P., & Whitehead, M. 2006. The social and economic consequences of childhood-onset Type 1 diabetes mellitus across the lifecourse: a systematic review. *Diabet.Med.*, 23, (8) 821-829
- Milton, B., Whitehead, M., Holland, P., & Hamilton, V. 2004. The social and economic consequences of childhood asthma across the lifecourse: a systematic review. *Child Care Health Dev.*, 30, (6) 711-728
- Mincer, J. 1974. *Schooling, Experience and Earnings* Columbia University Press .
- NHS Information Center 2011, *National Diabetes Audit Mortality Analysis 2007–2008*.
- Oduro, A.R., Koram, K.A., Rogers, W., Atuguba, F., Ansah, P., Anyorigiya, T., Ansah, A., Anto, F., Mensah, N., Hodgson, A., & Nkrumah, F. 2007. Severe falciparum malaria in young children of the Kassena-Nankana district of northern Ghana. *Malar.J.*, 6, 96
- OECD. *Lifelong Learnings and Human Capital* . <http://www.oecd.org/dataoecd/43/50/38982210.pdf> . 2007. 24-10-2011. Ref Type: Electronic Citation
- Parashar, U.D., Bresee, J.S., & Glass, R.I. 2003. The global burden of diarrhoeal disease in children. *Bull.World Health Organ*, 81, (4) 236

Polacheck, S. W. 2007, Earnings Over the Lifecycle: The Mincer Earnings Function and Its Applications, IZA Discussion Paper No. 3181 .

Psacharopoulos, G. 1981. Returns to education: an updated international comparison. *Comparative education* 321-341

Psacharopoulos, G. & Layard, R. 1979. Human capital and earnings: British evidence and critique. *Review of Economic Studies* 485-503

Rankin, N., Sandefur, J., & Teal, F. 2006, Learnings and Earnings in Africa: Evidence from Ghana

Sancak, C., Velloso, R., & Xing, J. 2010, Tax Revenue Response to the Business Cycle, IMF, Working Paper WP/10/71.

Sobanski, E., Bruggemann, D., Alm, B., Kern, S., Deschner, M., Schubert, T., Philipsen, A., & Rietschel, M. 2007. Psychiatric comorbidity and functional impairment in a clinically referred sample of adults with attention-deficit/hyperactivity disorder (ADHD). *Eur.Arch.Psychiatry Clin.Neurosci.*, 257, (7) 371-377

Standaert, B., Perez, N., Tehard, B., Colin, X., & Detournay, B. 2008. Cost-effectiveness analysis of vaccination against rotavirus with RIX4414 in France. *Appl.Health Econ.Health Policy*, 6, (4) 199-216

WHO 2009. WHO Guide to identifying the Economic Consequences of Disease and Injury Geneva , WHO PRESS.