What Happens when Public Expenditure is Scaled Up?
An Enquiry into the Costs and Cost-effectiveness of Expenditure in Phases of Expansion

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Acronyms

BCG	Bacillus Calmette-Guérin
CIS	Commonwealth of Independent States
DEA	Data Envelope Analysis
DFR	Department of Feeder Roads (Ghana)
DPT3	Diphtheria, Pertussis, Tetanus (3 injections)
DUR	Department of Urban Roads (Ghana)
EdStats	Education Statistics (UNESCO/World Bank data source)
EPI	Expanded Programme of Immunisation
EP1	Lower Primary schools (Mozambique)
FCUBE	Free, Compulsory, Universal, Basic Education (Ghana)
FDH	Free Disposal Hull
GAVI	Global Alliance for Vaccines and Immunisation
GDP	Gross Domestic Product
GER	Gross Enrolment Rate
GHA	Ghana Highways Agency
GNI	Gross National Income
HiB	Haemophilus influenza B
HIPC	Highly Indebted Poor Countries
IDA	International Development Association
JICA	Japan International Cooperation Agency
MDG	Millennium Development Goal
OECD	Organisation for Economic Cooperation and Development
OED	Operations Evaluation Department (World Bank)
NHS	National Health Service (UK)
NIP	National Immunisation Programme
NRB	National Roads Board (Zambia)
PAF	Poverty Action Fund (Uganda)
PORALG	Presidential Office for Regional and Local Government (Tanzania)
PRSP	Poverty Reduction Strategy Paper
TANROADS	Tanzania Roads Agency
WHO	World Health Organisation
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund

US   United States (of America)
USAID   United States Agency for International Development
WDI   World Development Indicators (World Bank data source)

Currencies

B	Boliviano	Bolivia
TSh	Shilling	Tanzania
UM	Ouguiya	Mauritania
USh	Shilling	Uganda
VND	Dong	Vietnam
ZK	Kwacha	Zambia

Executive Summary

This paper asks whether the costs of providing public services in low-income developing countries tend to rise when expenditure on these services increases - as has been found to be the case in developed countries. It offers elements of an answer to this question by reference to evidence from country case studies relating to episodes of expenditure growth, mainly in the 1990s, in the fields of primary education, road maintenance and child immunisation.

The hypothesis is enunciated, based on the standard microeconomics of the firm, and assuming cost-curve convexity, that average (unit) costs are likely to rise in the long run for logistical reasons: even when services are produced and delivered efficiently, the resources required to provide services to remote locations and inaccessible clients are greater than those needed to reach more accessible areas and clients. Moreover, as short-run marginal costs are likely to be in excess of long-run marginal costs, because of immediate supply rigidities and unresolved technical inefficiencies, average costs may rise steeply when expenditures grow rapidly. If programmes require an initial phase of physical capacity construction before services can be expanded, the impression of rising average costs in episodes of programme expansion may be accentuated.

Much of the readily available evidence from OECD countries on costs in programmes on which public expenditure is raised relates to education. Here, there is well-attested evidence of stepped-up expenditure being translated primarily into higher costs per pupil, without an attendant increase in enrolments or educational attainments. However, recent analysis of the productivity of public expenditure in the UK since public expenditure started to rise in 2000, following a period of expenditure restraint, shows a pattern of falling productivity in several sectors which enjoyed rising expenditure allocations.

These considerations suggest a methodology for empirical enquiry into the experience of low-income developing countries which first quantifies the unit and incremental costs of service provision, and then seeks to explain developments observed in terms of: initial conditions, cost structures, labour rates and input prices, and changes in technical efficiency, i.e. the ratio of output produced to inputs used. Measured unit costs tend to vary from year to year, partly due to lumpiness in periodic (capital) expenditures and partly because of measurement and recording errors. However, if the incremental cost over a period of time exceeds the range of annual unit costs, programme costs can unambiguously be said to be rising - and vice versa. If the incremental cost approximates to the average of unit costs, the inference is that costs are broadly constant.

To conduct the analysis, some measure of the output of each service examined is required. Services were chosen for the analysis because relatively homogeneous output measures for them are available on which data are usually recorded. In education, the measure adopted is the number of children enrolled in primary schools. For road maintenance, the denominator used is kilometres of road receiving routine and periodic maintenance. For immunisation, the true measure to use is the cost per fully immunised child; however, for practical reasons, the number of children receiving a full course of DPT3 injections is used as a proxy for the number of fully immunised children.

Country-level data are more abundant and readily available in the case of education than for road maintenance. Eight countries' experiences of education costs are examined; historic evidence on road maintenance and immunisation is considered for only three and two countries respectively.

In education, six out of the eight countries exhibit rising costs in phases of expansion, in which the prime causal factor is rising real teachers' salaries, the predominant cost component. The reason for salary increases, however, has not in fact been a short-run inelasticity in the supply of teaching staff. Government pay-structure rigidities in most countries mean that the market for government jobs clears through quantities rather than via wage rates. The reason is rather that the qualifications, quality and motivations of teachers had previously been allowed to decline during years of fiscal austerity and inflation, and that it is necessary to raise salaries in order to raise teaching standards, without which enrolments would not grow to the intended extent. There have been concomitant but, in the absolute much smaller, increases in the costs per pupil of school facilities, learning materials and teacher training. One-off productivity increases are possible in education, and have to an extent been applied, but these are insufficient to counterbalance the effect on total costs of increased staff costs.

In road maintenance, the predominant cost element is the costs associated with the use of vehicles and equipment. Labour and materials are individually of lesser importance. In the three (African) cases examined expenditure increases have been occasioned by the establishment of 'road funds', and institutional reform has occurred with the outsourcing of maintenance works to contractors. Unit costs have been constant or have declined in episodes of expenditure growth because input and labour supply has been elastic, and because dynamic efficiency gains arising from contracting out, increasing competition between contractors and contractual innovations have counterbalanced cost increases caused by the growing inaccessibility of sites.

In immunisation, few countries have kept expenditure records, though output records are abundant. Of the two low-income countries with sufficient time series information to analyse, one - Bangladesh - reveals a broad constancy in unit costs over the years, while in the other - Nepal - the picture is inconclusive. Real prices of inputs used in the delivery of vaccines against the six diseases targeted in the Expanded Programme of Immunisation - representing nearly half of programme-specific costs - have fallen. Delivery has become more efficient as most vaccination now takes place at fixed locations, without the use of mobile clinics. These cost-saving factors have counterbalanced any higher costs associated with delivery to remote areas and arising from real staff cost increases. New vaccines and new routines whose use has now begun are increasing costs sharply.

The paper reaches the conclusion that, contrary to the hypothesis, there is no general evidence for rising costs in expanding public expenditure programmes in low-income countries. There is, however, a strong presumption of rising costs in education where staff costs are predominant, when achieving output and outcome targets requires continuing expenditure on raising teaching standards and staff incentives. In other sectors, there is greater scope for continuing efficiency gains sufficient in many cases to counterbalance the rising costs associated with extending outreach. When shortages in domestic inputs, including labour, occur, supply prices are unlikely to rise where the government has a high degree of monopsony. Quantity adjustment is likely to happen instead, with potentially adverse effects on the rate of feasible programme expansion.

For public expenditure planning purposes, however, there can be no rule-of-thumb substitute for case-by-case analysis of the factors affecting cost, and of the scope and outlook for variations in prices, wages and factor productivity. At the same time, there could be useful cross-country research, as has been done for education in richer countries, to establish how far cost characteristics at the sector level are generic, and how far a function of local circumstances.

Chapter 1: Introduction

Since 2000, with the proclamation of the Millennium Development Goals (MDGs), public expenditure has become the fulcrum and chosen instrument of development initiatives for poverty reduction. In the preceding years, when the emphasis in development policy was on macroeconomic stabilisation and incentives for the private sector, public expenditure was sometimes regarded more as a necessary evil and source of destabilisation than as the fount of sustainable economic development and poverty reduction. Now that many developing countries follow policies inspired by the Washington Consensus, there is mounting concern about the persistence and in a few cases the deepening of their poverty. Priorities have changed. Triggered by the Highly Indebted Poor Country (HIPC) initiative and the requirement laid on beneficiary countries to draft Poverty Reduction Strategy Papers (PRSPs), a new and powerful consensus has emerged about the importance of poverty reduction in a longer-term development perspective, and thus about the need to provide more and better public services to poor people.

The new consensus holds that, in the now at least partly liberalised economic policy environment to be found in most poor countries, the best strategy for sustainably reducing poverty is to make poor people more productive by means of better health and nutrition, better education and work-related training, and better access to transport and other infrastructural services. The expansion of these services had been restrained in the years of macroeconomic adjustment. More generous debt relief through the HIPC initiative provided an assurance of some additional resources to finance new programmes of expanded provision. Donors' pledges at the UN's Monterrey Financing for Development conference in 2002 created an expectation that higher levels of external financing would be forthcoming. The UN's 2005 Millennium Project, with its recommendation that poor countries should accelerate their public development plans, thus placing them on trajectories high enough to enable them to achieve the Millennium Development Goals (MDGs) by 2015, is likely to give further impetus to the aid-financed expansion of MDG-related public services, with costs borne to a large extent by recipient governments' budgets.

Since Monterrey, international development fora have resounded to calls for major increases in official development assistance, without which it is widely believed that many poor countries will be unable to achieve the MDGs. To make this possible, unconventional financing mechanisms such as the International Financing Facility promoted by the UK have been mooted. A pilot-scale precursor of the Facility to support a continuation of immunisation programmes received commitments of donor support at the 2005 G8 Summit. New special-purpose multilateral channels of assistance have been created for injecting higher levels of funding, notably for the expansion of primary education and disease control. The main generic purpose of these initiatives, however, as also of the intended higher future levels of conventional bilateral and multilateral assistance, is to support increases in pro-poor public development expenditure in low-income countries at risk of not achieving the MDGs. If the aid increases pledged at Monterrey materialise, and *a fortiori* if aid begins to flow at the needed level as assessed by the Millennium Project, these expenditure programmes will experience a major 'scaling-up' within the medium-term future.

The action programmes in PRSPs give prominent place to the expansion of (mostly) publicly financed pro-poor service provision. In some countries, such as Uganda, pro-poor expenditure programmes have been ring-fenced to protect them from the in-year

expenditure cuts characteristic of 'cash budgeting'.[1] The Needs Assessments conducted in eight pilot countries as part of the Millennium Project propose the priority expansion of these programmes.

This renewed interest in public development expenditure has naturally stimulated heightened attention, in developing countries and among donors, to budget- and public expenditure-management, and to accountability. A growing number of HIPC countries have developed medium-term fiscal frameworks within which their Poverty Reduction Strategy programmes fit, and which increase the likelihood of the adequacy of their financing. Some have undertaken expenditure-tracking studies with the purpose of seeing if funds voted actually give rise to the intended expenditures. A larger number have undertaken Country Financial Accountability Assessments which review the adequacy of their financial control, reporting and accountability procedures.

One issue which has received only limited attention in the current endeavours to improve developing countries' budget management and accountability is unit costs in public service provision. Some early Interim PRSPs and full PRSPs were criticised by the staffs of the International Monetary Fund and the World Bank which jointly assess them, on the grounds that their programmes were not properly costed, in other words that they did not present credible evidence-based assessments of the resources required to produce intended outputs, but instead were based on rule-of-thumb increments on past expenditure levels. Programmes are now better costed: estimated resource requirements are starting to be calculated at least on the basis of the priced inputs needed to reach targeted activity levels. Where outputs are reasonably homogeneous, input-output technical coefficients and recently observed unit costs (adjusted for inflation and wage increases) are used as a basis for estimating financing requirements. The validity of this procedure is the theme of this paper: it makes strong assumptions about the adequacy of past funding and the medium-term stability of prices and productivity.

Historical costings are likely to become increasingly unreliable as time goes on. Programme designs change, in the interest of either cost saving or improvement of service quality. Learning-by-doing effects and technological and institutional innovations may increase the technical efficiency and reduce the staffing levels of current programmes, thus lowering costs. On the other hand, unit input prices and staff salaries may rise, thus increasing the unit costs of outputs. Raising the standards of public service quality may also be cost-increasing. Thus, the unit costs of public service outputs are not stable through time. They are especially prone to rise in times of rapid programme expansion when technical inefficiencies and increases in input unit costs are most likely to occur.

The purpose of this paper is to look at the historic experience of the scaling-up of development expenditure in low-income developing countries with a view to achieving supply-driven increases in the quantity and/or quality of public service provision. The paper will focus on the effective execution of expanded expenditure programmes, and at their incremental unit costs. It will relate observed results in terms of rates of execution and actual cost to planned rates of expansion, political commitment, efforts at preparation and programme planning, and other institutional factors.

The paper will concentrate as far as possible on the consequences of public expenditure and associated initiatives which are measurable and attributable. It will therefore look at

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[1] In the late 1990s, Uganda created a Poverty Action Fund (PAF) within its budget which covered all expenditures in programmes deemed of priority in poverty reduction. At the time Uganda was, for the purpose of maintaining macroeconomic stability and fiscal discipline, practising 'cash budgeting' whereby cash releases – per month or per quarter – were not allowed to exceed exchequer receipts in the same period. PAF programmes received their full budgeted entitlements.

'outputs', i.e. measures of what service providers directly produce, rather than at the social and economic policy objectives or 'outcomes', which are furthered by programme outputs, but not exclusively caused by them. Moreover, it will concentrate on outputs generated by programmes where there are few 'joint products'. It will not look at programmes which produce multiple outputs.

The paper considers evidence on costs in primary/basic education, road maintenance and childhood immunisation, which are programmes with relatively simple, widely and easily quantified inputs and outputs, and where outputs are largely attributable to clearly identifiable expenditure programmes. Health care, on the other hand, will not be considered because of the lack in this sector of a simple one-to-one relationship between expenditures and outputs – or even activities – and because output records, for example on the number of patient episodes, are not kept in most countries.

Chapter 2 is a brief summary of relevant sections of the microeconomic theory of supply and of the determinants of production costs. It finds a close analogy between the production of public services and the theory of the production of private goods and services by the firm. This provides a basis for the paper's initial hypothesis that costs rise as expenditure programmes expand, and that they rise more steeply when activity is increased rapidly. Chapter 3 summarises some evidence from OECD and other countries – including some recent relevant evidence from the UK – which indicates a pattern of rising public service production costs.

Chapter 4 presents both the empirical methodology used in the case studies of public service costs in low-income countries during episodes of programme expansion, and a summary of the results obtained. The actual country case studies in the primary education, road maintenance and childhood immunisation sectors are presented in Annexes 1, 2 and 3 respectively. Chapter 5 draws conclusions from the case studies about why unit costs rise in some cases but not in others, and suggests some implications for resource planning, budgeting and management.

The case studies find a common pattern of rising costs in public programmes during expansion episodes in education, but not (albeit on the basis of very small samples) in road maintenance and immunisation. The explanation offered is in terms of differences in cost structures, in public service pay and complementing policies, in wage rate and input price trends, and in the scope for improvements in technical efficiency. It transpires that in education it is relatively harder than in the other sectors to meet quantitative output targets without incurring rising costs, even after taking credit for productivity gains.

Chapter 2: Microfoundations: Costs in Public Expenditure Programmes

2.1 Short- and long-run costs

The cost structures of many public service programmes can, within reason, be compared with those of the classical (Marshallian) firm, with the main exception that public providers will not choose production to equate marginal cost and revenue, so production may be located at any value of output. As programmes become established and grow, and as staff gain in experience and confidence, they may initially experience economies of scale and scope which help to reduce their average administrative and other overhead costs per unit of output. After further growth, however, programmes may encounter rising costs as they reach the limits of their current organisational capacity, and as the marginal (incremental) costs of resources required to reach ever less accessible programme beneficiaries rise ever more steeply. At this point, further programme expansion requires investment in new facilities and higher expenditure on overheads.

A programme for road maintenance, for example, which starts with a complement of staff and equipment, is likely to see its average (unit) costs per km of road fall as it overcomes organisational problems and reduces down-time by deploying its resources over easily accessible portions of the road network. Thereafter, as the programme continues to expand, and as distances from the central depôt increase, limitations in staff and equipment capacity will be experienced, and satellite depôts may have to be constructed, causing (annualised) average costs to cease falling and perhaps to rise. The rise will be more pronounced as the programme is extended to remote areas of difficult access where the productivity of staff and machinery is low. Any attempt to expand this programme rapidly is likely to incur more severe unit cost increases – because inexperienced staff are hired, temporary shortages of materials may occur, thus raising their prices, there is no time to construct satellite depôts, thus necessitating longer movements of personnel and equipment, and existing staff are paid overtime.

These propositions are illustrated in Fig. 2.1 which makes the analogy with the theory of the firm. It shows long-run average costs falling to the point at which current capacity is reached (where the volume of output is 25 units), whereafter they rise as expansion requires expenditure on additional capacity. The marginal cost curve, as in the theory of the firm, crosses the average cost curve at this point, signalling that unit costs are starting to rise. [2]

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[2] In formal terms, if the output of expenditure programme j is Q_j, and its total cost of production in each time period is C_j, the average (unit) cost in this time period is $\frac{C_j}{Q_j}$, and the marginal cost of increasing output is $\frac{\partial C_j}{\partial Q_j}$. Total cost in each time period is the sum of the costs of the (i) individual inputs used in production: $\sum_i a_{ij} p_i q_{ij} = C_j$, where a_{ij} are the shares of the cost of each input i in the production of j. Marginal costs may fall, be constant or rise, as a function of economies or diseconomies of scale, scope or intensity of production. Quantities of input required may vary more than, or less than, or be equi-proportionate to output: $\frac{\partial q_{ij}}{\partial Q_j} \leq 1, \geq 1$. Input prices may be raised when the demand for input rises, or they may remain constant, or even fall: $\frac{\partial p_{ij}}{\partial Q_j} \leq 0, \geq 0$. Marginal costs may be measured over one time period, or over a selected succession of time periods. When measured over a succession of time periods they are referred to as average incremental costs. Technical efficiency improvements reduce input quantities per unit of output, and alter input proportions, with effects on both average and marginal costs.

The short-run marginal cost curve, which describes the effect on costs of expanding operations without increasing capacity, rises much more steeply. It shows that expanding the rate of activity rapidly on the basis of existing capacity is expensive and inefficient – both because the unit costs of staff and inputs are higher than when expansion is at a more measured pace, and because the output/input ratio (productivity) falls.

This cost-function narrative is broadly characteristic of an array of typical pro-poor expenditure programmes, including those concerned with primary education, maternal and child health, and water and sanitation. However, the existing *modus operandi* may be a long way from the attainable 'efficiency frontier' – because of waste, misappropriation, dysfunctional incentives and inefficient procurement practices.[3] Governments can, and often do, take action to alter the height and shape of the long-run cost curves that they face through public expenditure management reforms (cf. section 2.4). Once cost-saving reforms have been implemented and have bedded down, cost curves will have been reconfigured, but their basic shape and behaviour is will probably still be as represented in Fig. 2.1.

Fig. 2.1 Short- and long-run marginal costs
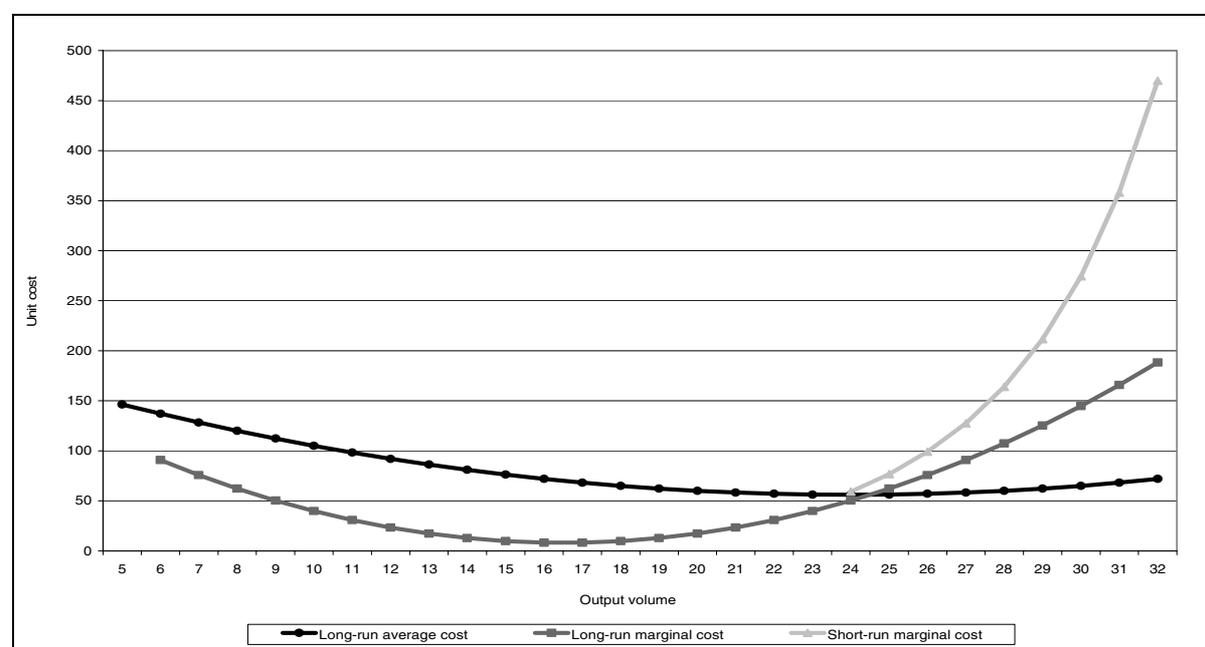
2.2 Relative price effect

There are productivity-based reasons, not subsumed in cost curves, why the costs of public service provision are likely to rise in the longer run relative to the general level of prices in the economy, even allowing for the cost-saving benefits of public sector reforms. Total factor productivity tends to grow more slowly in public service provision than on average in the rest of the economy, particularly in sectors producing traded goods and services. This is because of the labour-intensive character of many public services and the relatively limited competitive incentive in them to process and product innovation. Process innovations in public services, such as the computerisation of communications and record-keeping and outsourcing, are slow to implement, and produce once-for-all rather than continuous cost

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[3] Examples of efficiency frontier analysis in health and education respectively can be found in WHO (2000), Chapter 2 and in Roberts (2003), Chapter 2.

savings. Some public services, particularly education, are inherently labour-intensive, and it is very difficult to increase technical efficiency without incurring political cost.

As economies grow and incomes rise, public service wages and salaries rise, causing – in the absence of significant offsetting efficiency gains – a rise in the costs of public service provision relative to costs and prices elsewhere in the economy. This relative price effect is commonly observed in developed OECD countries. It is one of the factors lying behind the narrowing of the gap between the Purchasing Power Parity and conventional calculations of the national incomes of developing countries as their per capita incomes increase.

2.3 Expenditure profiles with lumpy investments

In (the common) cases where public service provision can only be expanded after a period in which human, institutional and physical capacity-building takes place, there may be the appearance of a fall in the efficiency of expenditure programmes when expenditure increases, even if in reality capacity development and operational expenditure are deployed cost-effectively. This is because of the waiting period or time lag before development expenditure produces higher capacity.

The point is simply illustrated in Fig. 2.2 which presents the case of a single project to enlarge the current scale of service provision permanently. Expenditure on the service to be expanded is divided into recurrent outlays for operation and maintenance and development expenditure which covers all non-recurrent outlays associated with the expansion programme.

Fig. 2.2 Service expansion expenditure profile
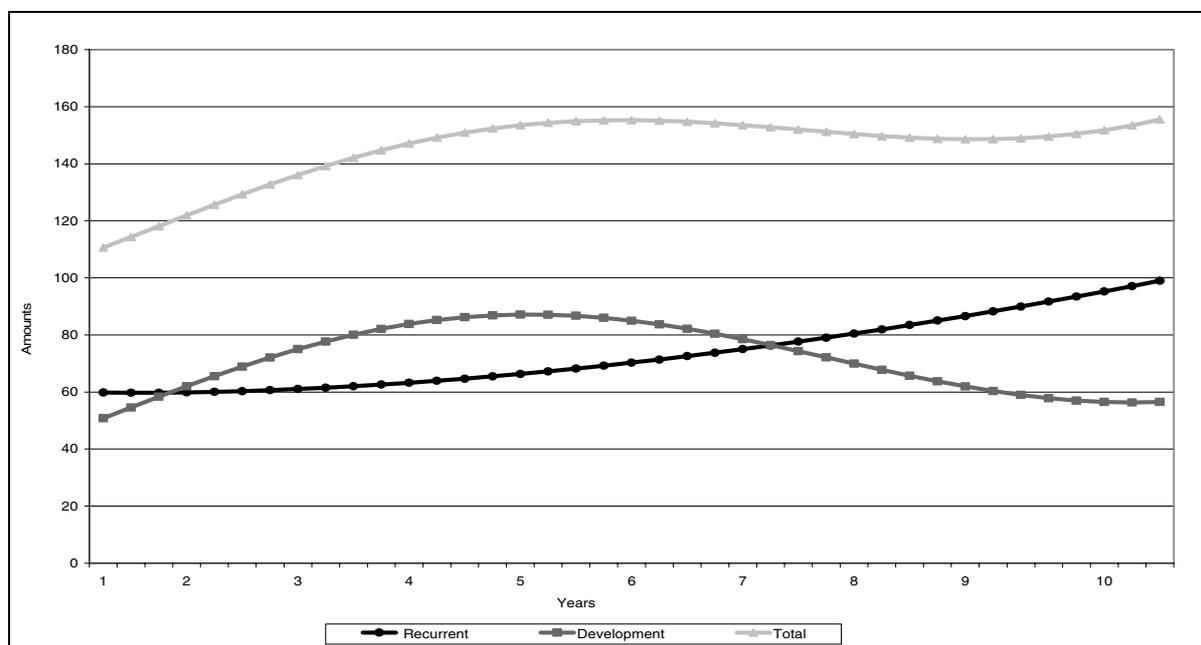
Assuming cost-effectiveness achieved by exerting control over factors causing marginal costs to rise, the time profile of recurrent expenditure can be taken to reflect the effective delivery of services. In the diagram service delivery, thus represented, only begins to expand in the course of year 3, and it is not until the latter part of year 7 that it has increased by one-third over its original year 1 level. By the end of year 2 total programme expenditure is running at a monthly rate 25% higher than at the beginning of year 1 but, assuming that

services expand proportionately to recurrent outlays, programme output remains unchanged. A casual observer might draw the inference that efficiency was falling sharply. The example shows unit costs rising by 25% above their original level in years 4 and 5 when development expenditure is at its apogee (Fig. 2.3). However, they decline thereafter to 15% below their original level when the main development phase is over in year 10, indicating the possibility of a reasonable financial return on investment. (In real life there would only be a decline in unit costs if scale economies were still available causing long-run marginal costs to fall).

Fig. 2.3 Unit cost profile
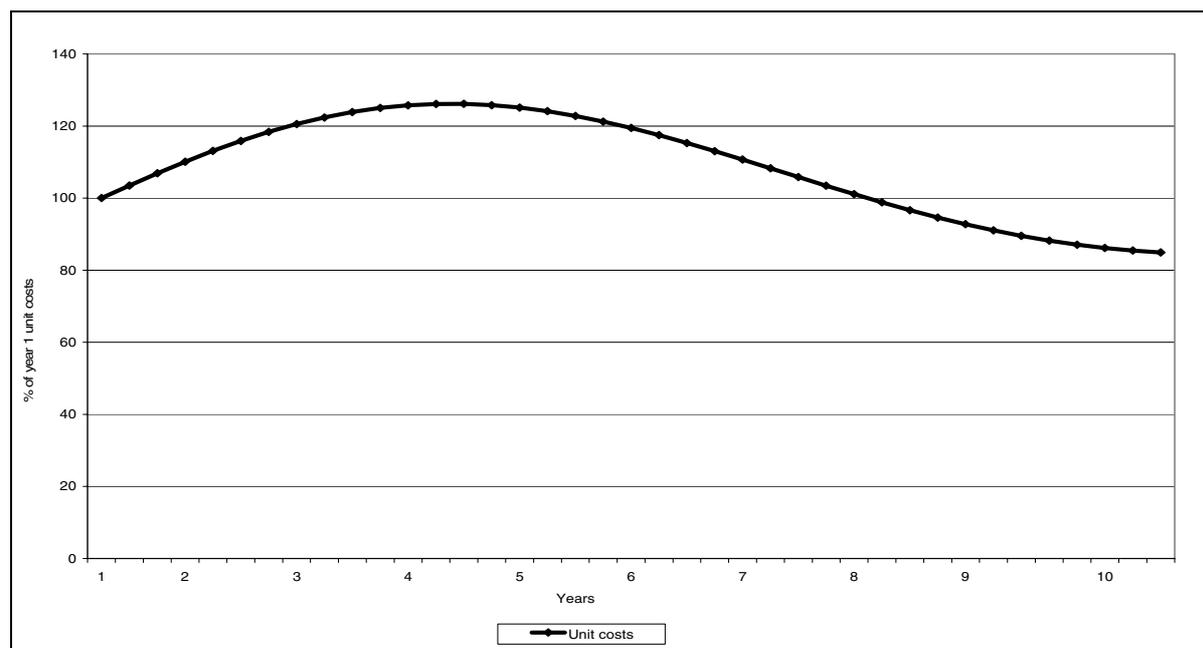
Turning to the more true-to-life dynamic case where capacity is continuously expanded, the lumpiness of the time profile of expenditure is to an extent suppressed. If capacity expansion occurs at a steady rate, measured unit costs should remain constant (assuming constant long-run marginal costs) because total capacity-development expenditures should rise *pari passu* with recurrent expenditures and with the production of outputs. However, if there is an upward inflexion in the rate of capacity expansion, the first rising then falling unit cost time profile characteristic of the single project case is likely to reappear. It becomes more pronounced the faster the rate of expenditure acceleration, because the ratio of development to recurrent expenditure rises more – before declining later when the new desired level of capacity is attained. In other words, the initial rise in unit costs will be the greater, and the waiting period before the results of development activity are fully realised the longer, the greater the rise in the development/recurrent expenditure ratio.

With accrual accounting in public expenditure budgeting – which is becoming the norm in OECD countries but which remains very rare in low-income countries – fixed capital costs are measured by their annual user charge (depreciation and interest) spread over the life of the assets, and do not just enter the expenditure accounts on acquisition. This smoothes the lumpiness otherwise apparent in the time profile of expenditures on capital-intensive programmes.

These considerations add a further dimension to the interpretation of the empirical evidence on unit costs. Observed unit costs do not increase simply because of rising short- or long-run marginal unit costs but also because of the lumpiness of investment activity.

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2.4 Budget reform and cost management

2.4.1 Evidence of waste and inefficiency

In the absence of powerful and effective instruments of accountability and control, there is an intrinsic tendency for public funds to be used wastefully and corruptly. Without the pressure of competition in the market, administrative sanctions and other moral and material incentives for accountable behaviour, public expenditure managers can best maximise their personal welfare by corrupt procurement practices, or by diverting funds to their personal gain or to the benefit of interest groups to which they belong or are beholden. Without similar incentives and/or sanctions, whether or not formalised in contracts, service providers (as agents) have little motive to deliver in full the services for which they are paid by the state (their principal).

Expenditure tracking surveys, pioneered in Uganda following research which uncovered the leakage of most funds allocated to meet non-salary education expenses (Reinikka and Svenson, 2001) but now replicated in a growing number of other developing countries, have identified many egregious cases of waste and the diversion of funds from their intended purposes. Tracking surveys fulfil monitoring and evaluation functions which should rightly be performed by national audit institutions, whose job it is to verify that public funds have been spent as and where intended, and to identify instances of waste and inefficiency. However, audit institutions tend to be understaffed and to lack the political authority to question established public expenditure management practices.

In the absence of effective performance management designed to minimise waste and inefficiency, there can arise large differences in output unit costs between different providers of identical or similar services within the same country - and *a fortiori* between providers in different countries. Technical inefficiency and malpractice are major reasons for the observed large shortfalls below their efficiency frontiers of expenditure programmes in many countries which are key to poverty reduction.[4] In-country differences are due mainly to differing levels of technical efficiency from one service-providing entity (e.g. school, clinic) to another. They arise more rarely from local differences in input unit costs. These cost differences provide the basis for (comparative) performance assessment.

In order to raise efficiency levels among the least efficient providers, sector programme managers monitor providers' costs, establish benchmarks and set targets for performance improvements. Among the techniques used in making performance comparisons and establishing norms of best practice are 'data envelope analysis' (DEA) and the 'free disposal hull' (FDH) techniques. Both of these use actual performance data to identify production functions describing feasible output levels corresponding to level of inputs. The former, which is used in the construction of efficiency frontiers, makes the assumption that linear combinations of observed most efficient practice are all feasible, producing a smooth efficiency frontier; the latter assumes more conservatively that only observed efficient output-input combinations are feasible, giving rise to a stepwise representation of the efficiency frontier.

2.4.2 Reform agenda

Public expenditure and programme management reforms are topics to which much detailed attention has been devoted but which lie outside the scope of this paper. The

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[4] Cf. footnote 2

upshot of reforms, however, is to contain or reduce quality-adjusted unit costs and to make possible the provision of services to wider spectra of beneficiaries.

Specific reforms produce cost-reduction benefits including:
- reduced overheads, through staff reductions in administration and in service delivery (eliminating ghost workers from the payroll, reviewing complements, trimming allowances etc.), and by vacating redundant premises;
- decreased waste and the misapplication of voted funds, through better public expenditure management practice, including competitive procurement, implementing integrated financial management systems requiring timely and consistent recording and reporting of expenditures, and expenditure and efficiency audits;
- reduced input unit costs, from efficiently planned procurement practices and wider tendering;
- reduced staff unit costs, by regrading posts and altering staff qualifications and status;
- improved technical efficiency – the physical output/input ratio – through incentives to staff for better performance, and through procedural reforms which reduce delays and raise the activity rates of staff and facilities;
- lower average public expenditure costs across a range of output levels, from the outsourcing of service provision to executing agencies or private sector service providers, whose contractual performance is closely monitored, and which are given incentives to achieve lower production costs through efficient procurement and a continuous quest for improvements in technical efficiency.

In terms of the simple analytical framework presented in Fig. 2.1, the effect of reforms such as these is to lower the total and average cost curves in the relevant range, altering the height and perhaps the shape of the short-run marginal and long-run incremental cost curves. If service expansion takes place at the same time as cost-saving reforms are being implemented, it may be difficult to disentangle the simultaneous effects of the reforms which lower cost schedules and of the economies or diseconomies of scale associated with increases in the level of activity. Thus, falling costs, caused by the one-off effect of reforms, may falsely be ascribed to falling average and marginal cost schedules.

2.5 Summary

There are five main reasons why observed unit costs of public service provision may rise:

- expansion programmes may incur higher input unit prices because of supply inelasticities for sufficiently skilled labour, especially in the short term; this is likely to be a constraint in Africa rather than elsewhere, especially for rural areas;
- expansion may cause technical efficiency (the output/input ratio) to decline at the margin, especially in the short run, because of individual and institutional inexperience, poor planning and physical capacity limitations;
- public services to be expanded may lie in that range of the long-run cost curve where incremental costs are rising, for example because of the greater needs and relative inaccessibility of intended beneficiaries;
- the relative price effect: unit costs may rise faster than the general level of inflation because the rates of resource-saving technical progress are lower in the public services than in the rest of the economy, and
- the accelerated capacity expansion effect: measured annual unit costs rise because the ratio of development to recurrent expenditure rises to increase the rate of capacity-building.

The remainder of the paper will look at evidence of the costs of public service provision with particular reference to phases of increased capacity expansion, with a view to identifying which of these explanations seem best to explain observed increases in unit costs.

Chapter 3: Evidence from OECD countries

The public expenditure economics literature contains a number of case studies and econometric analyses which bear out the propositions in section 2.5, notably in the education and health sectors.

3.1 Education in the US

3.1.2 Rise in expenditure

In the 1960s, public expenditure per student in attendance at US public schools rose rapidly: by 1970 it was 53% higher than in 1960 in real (1983 prices) terms. In the following decade it increased by a further 23%. Enrolments rose by only 22% in the 1960s, and then fell by 10% in the 1970s. Test scores were at their highest in the early 1960s, and then began a steady decline which was arrested only after 1980.

One ostensible reason for the rise in expenditure in the 1960s was a real increase of 33% in teachers' salaries. Another was the fall in the pupil/teacher ratio which started in the 1960s and continued in the 1970s. A survey of econometric studies of school performance data for this period, however, identifies no robust explanatory function relating expenditure to outcomes which satisfactorily explains the observed deterioration of performance (Hanushek, 1986). One interpretation of the evidence is that unit costs were allowed to rise because there were no institutional incentives to contain them (Hanushek, 1994). This is a plausible explanation of longer-run unit cost increases, but not of the short- to medium-term increases occurring in phases of rapid expenditure growth. Another is that increases in education spending were directed toward activities which do not get reflected in better test scores, which is basically any subject other than maths and English. Spending on special education is one example which will have been important in developed countries.

3.1.3 Scale economies

Econometric estimates of the importance of factors determining per student costs in Utah reveal clear evidence of economies of scale. Unit operating costs fall as the number of students per school district rises (with an elasticity of -0.25 to -0.3) (Chakraborty et al., 2000). This is likely to arise from the use of shared support and logistical facilities. The scale-economy effect would be stronger still if fixed costs were taken into account. Other studies identify scale economies in the size of schools, which are reversed when schools expand beyond an optimum enrolment level.3.2 Other evidence in education

3.2.1 Institutional factors

A large-scale cross-country study based on data for 260,000 secondary school students in 39 countries has found that about two-thirds of the variance in test scores is attributable to a basket of institutional and management factors. Independently of these factors school funding has either no significant effect on outcomes or even a negative effect (Wößman, 2003).

3.2.2 Long-term productivity decline

Productivity studies on time series data of eleven OECD countries (Gundlach et al., 2001) and six East Asian countries[5] (Gundlach and Wößman, 2001) find that there have been trend increases in the unit costs of 'producing' school outcomes, as measured by standardised test scores, in many of these countries. Governments, as in the US, have increased the volume and quality of inputs, thus increasing costs, without achieving any commensurate improvement in schooling outcomes. Part of the explanation of the results achieved in these studies is the relative price effect: outlays have been deflated by GDP or service sector deflators, rather than by education-sector-specific deflators, which has accentuated the apparent increase in the 'price' of education. For the rest, the studies reveal a tendency for the elasticity of educational outcome supply with respect to inputs to fall in the longer run, at least in countries which have already attained high levels of educational attainment.

3.3 UK public expenditure 1995-2001

Recent research by the UK Office of National Statistics shows that government output, measured by the volume of goods and services provided without (full) charge to users, has risen by less than the volume of inputs used in its production, implying a fall in 'productivity' – i.e. technical efficiency (Pritchard, 2003). The fall has been most pronounced in the years after 1998 when public expenditure began to expand after several years of stability (Fig.3.1). Inputs and outputs are indices representing physical goods and services consumed and produced, weighted by base year (1995) prices.

Fig. 3.1 Government expenditure efficiency in the UK 1985-2001
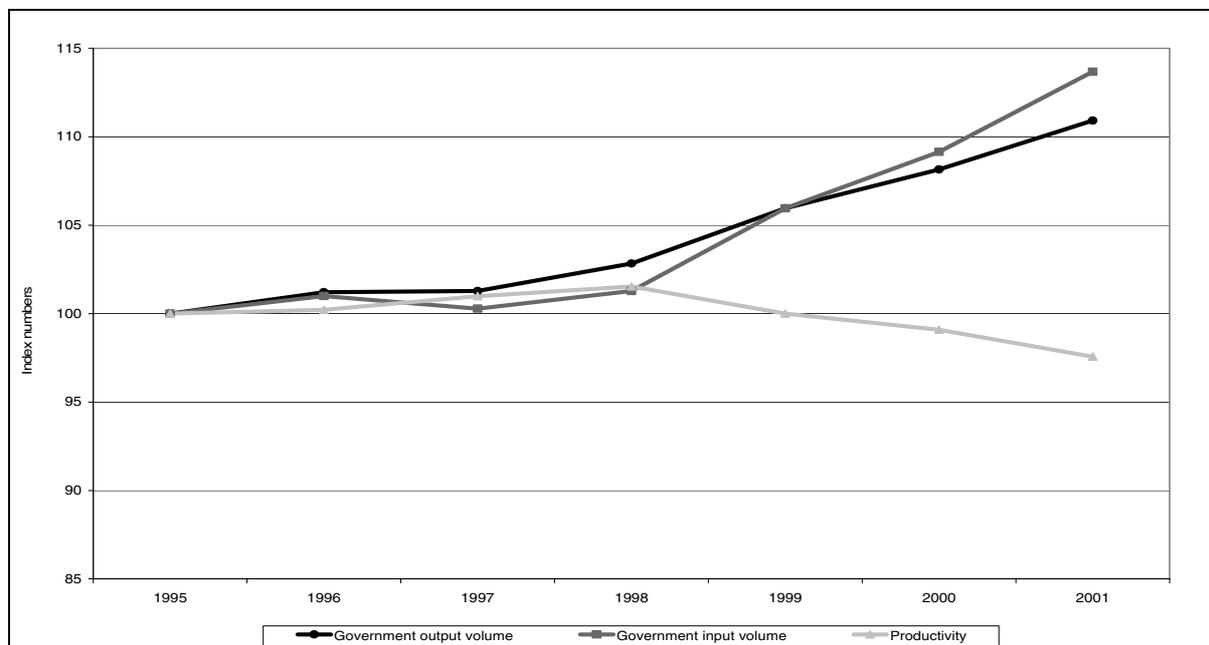
Source: Pritchard (2003)

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[5] Hong Kong, Japan, S. Korea, Singapore, Thailand, Philippines.

The calculations underlying this analysis are open to criticism. First, at the time, there were relatively few indicators of output which had to proxy for the results of a very disparate array of public service activities. The indicator set has subsequently been enriched. Second, some indicators, such as the number of patient episodes in the National Health Service (NHS), may be perverse: more patient episodes may be a symptom of falling standards of diagnosis and treatment rather than genuinely higher productivity. Third, the indicators yield no direct information on customer convenience and satisfaction, and more generally on the quality of service provided.

These deficiencies have been corrected in some degree in the health sector, using a more disaggregated approach to costs and price deflation, incorporating evidence on improvements in health outcomes and new information on the quality of service (Lee, 2004). The effect has been to reduce the apparent extent of decline in technical efficiency in the NHS, but not to show an increase.

3.4 Interpretation

In terms of the potential causes of unit cost increase listed in section 2.5, the following factors seem *prima facie* to have been most influential in the cases introduced above:

- *Education in the US.* Unit output costs seem to have risen because of combinations, varying through time, of: (i) higher unit input prices in the 1960s, when teachers' salaries were increased; (ii) falling technical efficiency, with declining pupil/teacher ratios and an absence in the public education system of incentives for, and reforms leading to, higher total factor productivity; and (iii) a relative price effect affecting public services in general, raising their costs relative to those in the competitive private sector where productivity was rising faster.

- *Education in the OECD and Asia.* The relative price effect and falling technical efficiency (diminishing pupil/teacher ratios) worked simultaneously to increase the unit costs of educational outputs in the countries covered by the surveys. In some countries, falling school-age population cohorts may have pushed education systems backwards towards the declining sections of their average cost curves where scale economies are being lost as school rolls fall in the absence of reforms to reduce overheads.

- *Public expenditure in the UK.* The expansion of expenditure on public services in the UK starting in 2000 involved both an increase in the development/recurrent expenditure ratio, as facilities were expanded, re-equipped or refurbished, and higher input unit costs, as professional staff remunerations were raised. Thus, part of the perceived fall in public service productivity arises from the lag in benefits from lumpy expenditure on capacity development. Part may also be due to the rapidity of the expenditure increase, which may have caused some costs to rise along short-run marginal cost curves which were higher than they would have been if the pace of expansion had been more measured. Whatever the case, public service provision in education and health has been in a rising segment of its average cost curve, with incremental costs clearly in excess of average costs. Service delivery capacity is being expanded (and service quality improved) by outsourcing to private sector contractors at prices which imply unit output costs higher than historic costs in the public sector – though they are believed to be lower than incremental unit costs in the public sector.

These explanations are illustrative and intuitive. They are not based on a rigorous analysis of the data. They serve, however, to show how observed unit cost developments may reflect the simultaneous impact of multiple and sometimes contradictory influences. They also show

that, unless there is some prior analytical understanding of these factors - the nature of the expenditure, the rate of its increase, the quality of its planning and execution, underlying average and incremental cost curves, and a variety of supply-side and demand-side variables – increasing public expenditure may produce unexpected and unintended outcomes. These factors deserve attention in the design and execution of programmes of service expansion.

Chapter 4: Evidence from Case Studies in Low-income Countries

4.1 Approach, methodology and sources

Areas of public expenditure - primary (or basic) education, road maintenance and childhood immunisation - were selected for cost analysis where, *a priori,* expenditure data on clearly defined programmes should be readily available, where output measurement should be routine and where there should be continuous and accessible records of programme achievements. Programmes were also chosen for examination because they were representative of the main areas of public expenditure on social and economic services.

The output measures used are: for education, gross enrolments; for road maintenance, kilometres of road maintained; and for immunisation, the number of children immunised.

The delivery of these services requires a high proportion of recurrent expenditure - on wages, salaries, materials and other operating costs - and involves relatively low expenditure on lumpy capital goods, though an important exception is the expansion in school building programmes. The bulk of outlays on these services therefore feature in the recurrent budget. Thus, this study avoids the problem of trying to relate episodic and uneven flows of capital expenditure - some of which, if directly financed by donors, are not even fully accounted for in the state budget - to programme outputs.

The analytical approach adopted was simply to:

i.   identify from historic data episodes when public expenditure on these services was deliberately increased,
ii. identify the increases in physical programme output achieved during these episodes,
iii. calculate unit costs and incremental costs during the episodes - or parts thereof,
iv. explain changes in total programme cost in terms of changes in input unit costs (wages, salaries, prices) and in the technical efficiency with which physical inputs have been converted into programme outputs.

Conclusions and inferences are drawn by comparing unit and incremental costs. If incremental costs, econometrically calculated from simple regressions of total costs on outputs, are found to have been above unit (average) costs throughout the episodes under examination, it is concluded that costs were unambiguously rising. In the opposite case costs were unambiguously falling. If annual unit costs are found to have fluctuated above and below calculated incremental costs, the conclusion is ambiguous.

The calculated trends in unit and incremental costs are interpreted in the light of information on countries' circumstances, strategies and policies, as far as possible identifying the roles played by the factors listed in sections 2.4 and 2.5 in either raising or lowering programme costs. These interpretations are then used to segregate those influences which were context-specific and one-off from those which may be considered generic, and thus characteristic of public expenditure generally in the sectors concerned. Some general conclusions are thus drawn, based on differences in cost structure, input price formation and the scope for continuous improvements in efficiency.

The analysis relies on country case studies. The possibility of conducting cross-country econometric analysis was originally envisaged, but then abandoned. The two reasons for

this were, first, that the data available were in some cases hard to find, often of poor quality and frequently discontinuous, and, second, that it became apparent from the country case studies that costs have evolved differently in countries which have embarked on programme expansion from different starting points and different initial conditions. To be successful, econometric modelling would require a comparative statistical representation of the array of initial conditions present at the start of each expansion episode, including service quality, salary rates relative to recruitment and skill requirements and the extent of maintenance backlogs. This would be no easy task. Even if statistically satisfactory econometric results were be found, they would represent only an average of countries' cost responses, and would thus have illustrative rather than parametric value in practical resource planning.

The primary sources of information used are government records which are published and/or communicated to international data bases such as EdStats - jointly maintained by UNESCO and the World Bank as a source of standardised statistical information on educational performance and expenditure. These sources have been supplemented by otherwise unpublished information contained in programme evaluation, public expenditure and project reports by donor agencies, principally the World Bank.

4.2 Basic education

Eight country cases have been examined, most of them low-income countries and all of them covered by the Education Fast Track Initiative, or under consideration for inclusion in this programme. The countries are Bolivia, Ethiopia, Ghana, Mauritania, Mozambique, Uganda, Vietnam and Yemen. The episodes of expenditure growth examined mostly occurred in the 1990s, though in Ghana and Mauritania the period extends back into the 1980s.

The circumstances of these countries and analysis of their educational costs at the primary or basic levels are set out in detail in Annex 1. All of these countries embarked on programmes of radical improvement in their primary education performance, following - in the cases of Uganda, Vietnam, Ethiopia, Mozambique and Yemen - periods of civil conflict and disruption, and in all cases periods of economic decline or stagnation in the course of which public services were underfunded. The main relevant features of these countries are briefly summarised below.

Bolivia

In 1992, the government initiated a programme to improve the quality and accessibility of education, especially in the rural areas, involving the construction of schools and the recruitment of more teachers. Expenditure on education rose from 2.4% of GDP in 1990 to 5.6% of GDP in 2001. Pupils enrolled in primary and secondary schools rose by 60%, with most of the increase occurring in secondary schools, but expenditure per pupil increased by 76% in real terms. The incremental cost far exceeded average costs. Most of the increase in outlays was accounted for by real increases in teachers' salaries.

Ethiopia

The government launched a programme of education expansion in 1994 with the ultimate objective of universal primary education. Primary enrolments rose by 300% between 1992 and 2002, but expenditure increased by only 39%. After an initial rise when the programme was launched, expenditure per pupil fell. Most of the increase in public expenditure on

primary education was devoted to school building. Major economies were realised by reducing teachers' salaries in real terms.

Ghana

Ghana embarked on a major educational reform programme in 1985 designed to focus public expenditure on basic education. Further improvements were introduced in 1996 with a view to making basic education free, compulsory and universal. Enrolments rose from 1.4 million in 1980 to 1.9 million in 1990, and to 2.5 million in 2000, with the most rapid increases occurring in the 1985-95 period. Expenditure in real terms rose more rapidly, almost exclusively due to rising real salaries, causing per-pupil expenditure to rise by 74% between 1990 and 2000. The incremental cost of increasing enrolment was significantly in excess of the top end of the range of average costs.

Mauritania

Enrolments in primary education rose, from a low level, by 56% in 1980-5, and by 75% in the 1990-5 period, whereafter the pace of expansion declined. Real expenditure per pupil rose slightly in 1980-5, but then fell continuously until the mid-1990s. During the early 1990s period of rapid enrolment growth, the incremental cost of expansion was virtually nil. This was largely achieved by reducing real salary levels for teachers, though some cost saving was also realised by dint of an increase in the pupil/teacher ratio. These cost savings were bought at the expense of falling education quality. Unit costs have increased since the late 1990s as the government has sought to reverse the decline in quality by improving teachers' training and remuneration and increasing the supply of teaching materials. In this latter period, the incremental cost of enrolment has slightly exceeded per-pupil expenditure.

Mozambique

Primary enrolments and expenditure fell during the war years, then stagnated for a while after the peace agreement of 1992, before rising sharply in the later 1990s. The number of children enrolled increased from 1.2 million in the years 1991–3 to 2.8 million in 2003, when the gross enrolment rate reached 110%. Expenditure per pupil rose strongly after the mid-1990s when enrolments and total expenditure were both growing fast. Internal efficiency indicators – on repetition, completion and survival – improved somewhat but remained low by the standards of other African countries. The pupil/teacher ratio remained high. The incremental cost was above per-pupil costs in the 1990s. The government's current strategy is to spend more on qualitative improvements and to raise enrolment above 3 million, which implies further rises in unit costs.

Uganda

In Uganda, the government decided in 1996 to accelerate progress towards universal primary education by abolishing primary school fees. Enrolment growth far exceeded government expectations and financial provision. Enrolments rose by 120% from 3 million in 1996 to 6.6 million in 1998. Unit costs initially fell, as the pupil/teacher ratio and class sizes rose. From 1998 onwards, however, expenditure was rapidly expanded to build more schools, train more teachers and procure more teaching materials. Unit costs accordingly rose – to well in excess of historic levels in real terms. The incremental cost was below

average (unit) costs in the years prior to 1996 when enrolments were static; it exceeded unit costs thereafter when outlays were expanding to keep pace with rising enrolments.

Vietnam

In 1986, Vietnam introduced economic reforms (*doi moi*) which made primary education fee-paying. The net enrolment rate fell from 95% in 1980 to 87% in the mid-1990s, though gross enrolments continued to expand because of the presence of over-age children and high rates of repetition. Since the mid-1990s, gross enrolments have fallen – though the net enrolment rate has returned to its former high level - because the school-age cohort has started to shrink, over-age pupil numbers have fallen, and repetition rates have been much reduced. Public expenditure on primary schooling grew exceptionally fast (13.8% p.a.) in 1991-2002 as the government invested heavily in educational quality and in overcoming exclusion. This, combined with first slowly rising and then falling enrolments, resulted in a 16.3% p.a. rise in unit costs. The incremental cost of enrolment in the years of increasing rolls (1991-7) was well in excess of average costs.

Yemen

Enrolment in basic education began to expand rapidly in 1999, following some years of stagnation or decline, under the stimulus of public expenditure on schooling which started to increase after 1995. Unit costs, formerly falling (as teachers' salaries and education standards declined), began to rise, particularly with the implementation of new policy packages for basic education in 1998 and 2001, comprising incentive payments and training provision for teachers.

The relationship between average and incremental costs in these countries is summarised in Table A1.1 in Annex 1. In almost all countries, incremental costs unambiguously exceed average costs in the same time periods, indicating a clear pattern of rising unit costs. The main exceptions – Ethiopia and Mauritania prior to 1995 – are countries where teachers' salaries at the outset were high relative to the market rate, and where it proved temporarily possible to reduce real remunerations while simultaneously recruiting more teaching staff. The experience of Mauritania, however, shows that this policy can impair incentives and have negative consequences for educational standards if pursued too long. In both countries, episodes of falling unit costs have been followed by years during which unit costs have again increased.

The question thus arises of why the trend in unit costs in the majority of these countries is found to be rising. The main proximate cause is that real salary levels for teachers and administrative staff have increased. Salaries constitute at least 70% of the cost of delivering an education service, and rarely less than 80% of the recurrent cost of education provision. Real salary increases have been noted in Bolivia, Ghana, Mozambique, Vietnam and, latterly, Uganda and Yemen. They have been required to recruit more and higher quality staff and to incentivise them to undertake training and to work productively, often in remote rural areas previously underserved by the education service. Increasing staff salaries was a reaction to initial conditions in which the education system was failing many children because schools were inaccessible, or where staff were frequently absent and where the quality of education was poor and deemed of little worth by parents. Raising salaries was thus a *sine qua non* for improving educational performance. Real staff salaries have also increased because the general level of public service remunerations has risen. General public service real pay increases have occurred in Bolivia, Ghana and Vietnam, and latterly in Yemen.

Increases in staff numbers have been less important as a cause of rising unit costs. In most cases pupil/teacher ratios have either remained broadly constant or have risen in the course of episodes of expenditure increase. A rise in the pupil/teacher ratio which increases the technical efficiency with which inputs are converted into outputs in the education process goes some way to offset the increase in the unit costs of enrolment arising from higher input unit costs in the form of higher real salaries. The pupil/teacher ratio rose sharply in Uganda after the abolition of school fees in 1996. Vietnam is the only country in the sample where the pupil/teacher ratio was reduced. This was part of a deliberate policy of increasing expenditure on schooling in order to raise teaching standards and educational attainments, with a view to enhancing the global competitiveness of the Vietnamese economy.[6]

Increasing primary enrolments by improving the quality and accessibility of schools not only involves recruiting more staff and motivating them through higher pay, it also requires additional per-pupil expenditure on teacher training, school facilities and educational books and materials. These elements have been predictable components of education system reform and revitalisation programmes. In percentage terms, however, they have made only small contributions to overall cost increases - commonly in the range 10-20%.

One-off factor productivity improvements may be achievable in education. For instance, teacher absences may be reduced, and administrative and supervisory duties may be delegated to non-professional staff, making it possible to raise the pupil/teacher ratio without impairing the effectiveness of education programmes. However, once these reforms are accomplished continuous productivity increase has proved generically hard to achieve. Pupil/teacher ratios have increased in Uganda and in Bolivia. Uganda responded to overcrowding in schools following the abolition of fees by double-shifting. But these expedients have aroused fears that standards will fall. Yemen has resolved to reduce expenditure on (overstaffed) headquarters administration in order to increase funding for front-line services. If successful, this may reduce unit costs by making schooling more attractive to clients, and encouraging additional enrolment. However, none of these measures produce more than one-off efficiency increases; they offer no prospect of continuous productivity growth.

To summarise, education programme expansion often requires the payment of a higher price for the most costly input, namely, teaching staff. Input unit cost reductions achieved in school building and book procurement, as in Uganda, can do little to offset staff salary increases. Technical efficiency improvement options are available, but can be pursued only to a limited extent without impairing educational quality, which in turn risks undermining the objective of increasing enrolment. Some technical efficiency options are two-edged: higher pupil-teacher ratios may result in higher repetition and drop-out rates which are symptomatic of a waste of resources. Few countries in the sample demonstrate technical efficiency gains in the course of their episodes of expenditure expansion.

A post-script to this analysis is in order. The analysis has, for simplicity and because more data are available, used gross enrolment as an output measure and unit cost denominator. However, enrolments *per se* are not the objective of primary education, which is to give children basic cognitive tools. Completion rates and test scores are better indications of educational success. It is thus gratifying to note that higher expenditure on primary education has resulted in improvements in reported completion rates in Bolivia, Mauritania, Mozambique, Vietnam and, provisionally, Uganda. In Ghana, the EdStats data (which are based on official data based on the school census) suggest that quality has been impaired, but a recent survey by the World Bank (2004) found test scores to have improved

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[6] Within the next decade, Vietnam intends to make computers available in all schools (Socialist Republic of Vietnam, 2003).

since 1990. This discrepancy is indicative of the problems with data quality in developing countries.

4.3 Road maintenance

The costs of routine and periodic road maintenance in Ghana, Tanzania and Zambia have been analysed to test the hypothesis that intensification of activity leads to rising unit costs because of a combination of higher input prices and falling technical efficiency. The country case studies with background information on road maintenance costs and financing are in Annex 2.

The three countries are among the many developing countries which, following recommendation by the World Bank in the late 1980s and 1990s, established user charge-funded, earmarked, 'road funds', with a view to increasing the volume and predictability of road maintenance budgets. Real road maintenance budgets have risen unambiguously in Ghana and Tanzania, but in Zambia have fluctuated trendlessly. The institutional arrangements have not worked perfectly – with some earmarked receipts being diverted from road funds, some road fund resources being allocated to purposes other than maintenance, and some delays in meeting the cash flow needs of implementing agencies – but they have been a distinct improvement on previous practice.

The costs of road maintenance tend to be dominated by vehicle and equipment user costs – acquisition, fuel, spares, maintenance and repairs – which typically amount to half of total costs. Labour and construction material costs – amounting to 10-20% each – are usually of less importance. These are average indications. The structure of costs varies greatly according to the operations undertaken, with routine maintenance – cutting grass, clearing ditches and culverts, restoring road markings and filling potholes – being significantly more labour-intensive in developing countries than periodic maintenance, which includes using machinery for grading and resurfacing. Variations in average costs, therefore, depend on changes in the efficiency with which vehicles and construction equipment are used and labour deployed, and on the elasticity of the supply of labour.

One by-product of the establishment of road funds has been an institutional change from the use of direct labour for maintenance operations to the outsourcing of these operations to contractors. By the end of the 1990s almost all maintenance work was carried out by local contractors. Responsible government departments were becoming increasingly sophisticated in their contract management practices and, with a rapid increase in the number of available contractors, competitive bidding was becoming the norm. Contractors were proving to be more efficient than public works departments in their hiring and deployment of labour and machinery. This institutional change thus exerted downward pressure on unit costs.

The analysis of recent expenditure and output data for Ghana, Tanzania and Zambia yields evidence of falling unit costs, both for routine and periodic maintenance. There are considerable parallels in the policies and institutional arrangements adopted by the three countries. Tanzania has managed them more successfully than the other two. Ghana was the first to establish a road fund (in 1985), but was able to channel more resources into maintenance only after 1996.

The conclusions reached from the analysis of their performance are somewhat tentative because of the paucity of consistent time series data on expenditure and activity levels until recent years. Comparisons with costs incurred in years prior to the establishment of road funds and the accompanying institutional and contractual changes were found not to be

possible. Table 4.1 summarises the results, showing that incremental costs have been either within the range of, or lower than, average (unit) costs over the years in which road fund arrangements have become effective.

Table 4.1 Unit and incremental costs in road maintenance in three countries

	Currency unit (base year for price deflation)	Unit cost range (constant prices, '000s)	Incremental cost (constant prices, '000s)	Ratio incremental cost/ unit cost [a]
Ghana (1996-2004)	cedi (1995)			
- Routine, trunk roads		1,700 - 1,100	1,440	1.03
- Routine, feeder roads		1,200 - 400	320	0.40
Tanzania (1991/2-2004/5)	shilling (2000)			
- All maintenance, trunk roads		5,930 - 1,440	610	0.17
- All maintenance, feeder roads		2,640 - 690	520	0.31
Zambia (2000-5)	kwacha (2000)			
- Routine, paved roads		270 - 4,380	1,190	0.51
- Routine, unpaved roads		630 - 3,010	810	0.45

Source: Annex 2
Note: a = Denominator is the mid-point of the unit cost range.

This repeatedly observed trend of declining unit costs contradicts the intuitive hypothesis that costs would normally rise as activity levels increase, because input unit prices are likely to increase with rising demand, given the likelihood of short-run supply inelasticity and rising logistic costs, and because the technical efficiency of maintenance operations is likely to fall through managerial failure and practical difficulties in mobilisation. The most likely explanations for the counter-intuitive cost trends are that:

- The scaling-up of maintenance activities has been accompanied by institutional change in the form of contracting out maintenance works to local enterprises - some small-scale - which have been significantly more efficient in their deployment of resources of capital and labour than the public sector road agencies which had previously undertaken these operations directly. The gain in factor productivity was not once-for-all: local contractors, initially few in number, gained in experience, and had to face increasing competition from new entrants. Government road agencies, now acting as principals, simultaneously learned how to save costs through competitive bidding and to set contractual terms so as to stimulate innovation and rising efficiency. Where 'admeasure' contracts with negotiated unit costs for prescribed quantities of work are still common practice, monopsonistic road agencies, operating in a buyer's market, are able to negotiate advantageous rates. Where, as is starting to happen, contractors are given full responsibility for maintaining sections of road in an acceptable condition and a free hand in their choice of technique, they have an additional incentive to seek cost-saving technical solutions.

- Road maintenance inputs - labour, equipment and materials - are available to maintenance contractors in fairly elastic supply. The main domestic factors which might drive up these costs are exchange-rate depreciation and increases in interest rates. Road maintenance contractors are not subject, in their hiring of labour, to the rigidities of employment by a public service organisation. The supply of unskilled and semi-skilled labour is elastic at most times, wages paid are close to market rates and contract

durations tailored to employers' needs. The only type of input potentially subject to supply inelasticity is domestically sourced materials.

So long as these institutional and market conditions persist there are good reasons for expecting the trend of non-rising unit costs in road maintenance to persist. Technical efficiency improvements should continue at a rate broadly sufficient to offset logistical cost increases arising from the intensification of activity in increasingly remote locations.

4.4 Childhood immunisation

Successful programmes of immunisation, on which there are output data, have existed for a long time in many countries. Their continuance and extension are crucially important for making further progress towards the Millennium Development Goals for health, viz. the reduction of infant and child mortality.

The Expanded Programme of Immunisation (EPI) was launched in 1977. It has enjoyed extensive and persistent international support, orchestrated by the World Health Organisation (WHO) and UNICEF, but with significant contributions also from the International Development Association and various prominent bilateral donors. WHO has provided technical assistance and has monitored coverage. By the late 1980s, almost all developing countries were running programmes for increasing childhood immunisation coverage. By 1990, a coverage rate of 70-80% was achieved – up from an estimated 5% in the 1970s. Progress thereafter stalled, and in some countries coverage declined. There was a parallel decline in the 1990s in identifiable commitments of aid for health.

The EPI has provided protection against six diseases, diphtheria, pertussis, tetanus, polio, tuberculosis and measles, for which there were prescribed antigens, vaccination schedules and logistical and outreach techniques. In the late 1990s, the international community recognised that protection should, if affordable, be extended against other diseases, specifically Hepatitis B and Haemophilus influenza B (HiB). In 1999, a new international, public-private, funding initiative, the Global Alliance for Vaccines and Immunisations (GAVI), was launched with a view to further raising immunisation coverage and to promoting new vaccines providing protection against a wider spectrum of diseases.

The physical progress of immunisation has been carefully charted since the EPI was launched, using a combination of activity reports from countries' EPI personnel and sample surveys. Procedures were evolved for reconciling inconsistencies between estimates and for correcting biases. As a result, most developing countries have continuous and public records of the immunisation rates they have achieved.

The recording of corresponding expenditure data, on the other hand, has been patchy or non-existent. In low-income countries, the costs of vaccines, disposable supplies, specialist equipment and vehicles have in the main been financed by donors, while most staff costs have been met locally, from governments' health budgets, or in some cases, from user charges. Few countries have treated domestic budgetary expenditure on immunisation as a separate cost item, distinct from other primary health spending. The personnel, facilities and logistical costs of primary care and immunisation are to an extent shared, especially when immunisation is administered from fixed facilities, and not mobile clinics. Donors' contributions to the EPI are not readily distinguishable from the rest of aid for health in the available records.

The availability of data on costs and financing has recently improved. WHO is constructing a database on immunisation expenditures and achievements. GAVI has required its beneficiary countries to draw up Financial Sustainability Plans, showing how immunisation

programmes would be integrated into national health budgets when (if) GAVI financing comes to an end. However, these initiatives do not repair the lack of historical data on the years when the EPI's outreach and outlays were in full expansion.

Bangladesh, exceptionally, has published time series of expenditure data since 1986 covering the years when it was rapidly expanding its immunisation coverage. In Nepal, there are expenditure data over a run of years, starting in 1997; however, there were years when immunisation coverage was, if anything, falling. The cost analysis results for these two countries are presented in Table 4.2.

Table 4.2 Unit and incremental costs in immunisation programmes in two countries

	Currency unit	**Unit cost range**	**Incremental cost**	**Ratio incremental cost/ unit cost [a]**
Bangladesh 1986-98	Taka [b] ('000s)	58.3 - 355.7	194.1	0.94
Nepal 1997-2002	US$ [c]	4.2 - 6.8	6.7	1.22

Source: Annex 3
Notes: a = Denominator is the mid-point of the unit cost range; b = 1996 prices; c = current prices.

The two notable features of the Bangladesh case are (i) the wide year-to-year fluctuations in costs per child immunised, and (ii) the virtual identity through time of average unit and incremental costs. The high variance in unit costs is explained by the lumpiness of expenditures on equipment and vehicles needed for delivering the service, and by the erratic flow of external financing used in their procurement. The more interesting observation is that programme expansion and rising expenditures do not seem to have forced the incremental cost to rise above the annual average of unit costs. In other words, the immunisation programme was expanding to cover more remote areas and less accessible population groups in a long-run constant cost environment.

The evidence from Nepal is not so categorical on this point, as the calculated incremental cost exceeds the average of annual unit costs. However, the result is not statistically significant. Bangladesh's experience is almost certain to have been more typical of that of the majority of EPI countries.

The explanation for the long-run constancy of unit costs in Bangladesh lies in a combination of (a) the constant or falling real prices of the vaccines, other consumables and equipment traditionally used in delivering immunisation services, (b) productivity increases in the deployment of staff and facilities employed sufficient to offset any rises in real staff remunerations, and (c) reductions in wastage rates through the better handling and storage of vaccines and other perishable supplies. The technology used in the EPI has been essentially unchanged for 30 years. Competition among suppliers, including suppliers from developing countries, has borne down on prices. Some developing countries, for example in Latin America, have pooled their procurement of supplies, and have bargained for lower prices. Domestic factor productivity has increased, *inter alia*, with the delivery of an increasing proportion of immunisations from fixed facilities (e.g. health centres) instead of mobile clinics. Child immunisation has been mainstreamed into primary health provision, thus reducing administrative and logistical overheads. These factors have been sufficient to counterbalance the inevitably higher costs on staff time and transport of taking vaccination to less accessible population groups.

This putative historic constancy of unit costs is now changing. GAVI is introducing in the country programmes which it supports new vaccines which cover a wider spectrum of diseases, and which require fewer repeat doses for full coverage. A number of country-level

financial sustainability studies have been conducted, all showing that the use of the new, and much more expensive, vaccines is likely to cause unit costs of immunisation coverage to rise substantially. Table A3.2 in Annex 3 shows how the introduction of the new vaccines and of new procedures for their administration is now projected to raise unit costs substantially in six low-income countries, increasing the incremental cost of their programmes to well above their new, higher unit costs.

Chapter 5: Conclusions

5.1 Interpreting case-study evidence on costs

The evidence from a limited range of case studies cannot be conclusive. This study makes no claim to statistical validity. At best it can suggest some ways in which the hypotheses enunciated earlier in the paper about the likelihood of rising costs when expenditure programmes are expanding should be modified, and some of the reasons why unit costs appear in some cases to be containable.

Another limitation is that the analysis abstracts from the effect of varying levels of service quality, and from costs associated with improving standards. This was done in order to focus more intently on the cost consequences of scaling-up. The country case studies reveal awareness and use of the notion of unit costs for planning purposes, but warn that it is also important to bear quality considerations in mind in interpreting historical data. Observed rising (or falling) costs may reflect the shape of an underlying supply curve; or they may be the consequences of slow, but one-off, adjustments to correct for past under- or over-investment and inherited inefficiencies.

Chapter 2 identified two main drivers of variations in the unit costs of public service provision: the prices paid for inputs and labour, and the technical efficiency with which they are transformed into service outputs. The underlying hypothesis tested in the country case studies is that costs in public expenditure programmes are likely to rise as expenditures are stepped-up – at least in the short to medium term – because of rising input prices due to supply constraints, and because of technical inefficiencies arising from inexperience, deficient organisation, and mounting logistical costs.

The case studies in education appear, with some exceptions, to confirm this intuition. The case studies of road maintenance and immunisation appear to contradict it. There appears to be a dominant pattern of rising unit costs in primary/basic education during episodes of programme expansion, but constant, or even falling, costs in road maintenance and immunisation.

The following paragraphs offer explanations of why this might be. The observations are summarised in Table 5.1. In essence, there are differences in the cost structures of the three services, in the behaviour of their input prices during expansionary episodes, and in their respective scope for cost-saving technical progress and efficiency gains, which leave education much more exposed to rising costs than road maintenance and EPI activity.

Table 5.1 Summary of factors affecting programme unit costs

| | Cost structure | Input Prices | | Technical Efficiency |
		Labour	Other	
Education	Largely professional labour	Tendency to rise to ensure motivation and quality	Some, but limited, scope for reducing prices of buildings and materials	Significant one-off savings from increasing teacher/pupil contact and delegating supervision and administration, but little scope for dynamic productivity gains
Road maintenance	Mainly fuel and other vehicle/ equipment user costs	Unskilled and semi-skilled labour in elastic supply at stable real rates	Traded goods inputs in elastic supply at prices depending on exchange rates and international prices	Productivity can increase dynamically with incentives created by outsourcing
Immunisation	Programme-specific (non-shared) costs consist of equal shares of personnel and supplies/vaccine costs	Subject to trends in public service remunerations for professionals	Costs of basic EPI supplies and equipment stable or falling; new (pentavalent) vaccines are significantly more expensive to procure and deliver	Variable scope for one-off reductions in vaccine wastage rates, staff deployment and logistic requirements

5.1.1 Education

In education, the overwhelmingly preponderant cost element in service provision is personnel, mainly teachers. Wages and salaries account for up to 90% of recurrent costs. Changes in the real remunerations of teaching and administrative staff in the schooling system, net of productivity changes, are thus bound to be reflected in service unit costs. Some labour productivity improvements are possible, especially in education systems which have suffered from bad management where staff are ineffectually deployed. However, once management reforms have been applied which raise the effective teaching hours of professionals and which assign supervisory and administrative duties to less qualified personnel, the scope for further effective productivity enhancement becomes limited. Beyond a certain threshold (of around 40) further increases in the pupil/teacher ratio become self-defeating because they reduce the quality of the education dispensed, leading to lower pupil attainment, and thus to high drop-out and lower enrolment rates.

Countries' experiences of personnel costs have been various. The rule in most countries has been for these costs to rise during episodes of increased activity; however, in two exceptional cases – Ethiopia and Mauritania – they have fallen. The reasons for rising (and falling) costs have, contrary to the hypothesis, been less to do with short-run supply inelasticities in the market than with longer-term adjustments to initial conditions which

were out of kilter with the quantitative and qualitative needs of an expanding education service.

In Ethiopia and Mauritania, teachers' salaries were initially high relative to per capita GDP and to the reservation wage of qualified potential recruits for the education service. They could, at least for a time, be reduced by the monopsonistic state employer while increasing numbers of teachers were recruited, and without impairment to service quality. The studies of these two countries suggest that the process was taken too far and that remunerations have lately had to be improved in order to prevent service quality from declining.

In other countries – Ghana, Bolivia, Yemen, Mozambique and Vietnam, for example – years of austerity, inflation and in some cases conflict have eroded the purchasing power of teachers' salaries to a point where teaching staff were becoming demotivated, underqualified and often absentee. Raising enrolment in these countries involved investment in teacher training and a reversion to remuneration levels high enough to recruit, motivate and retain the services of growing numbers of trained and qualified staff.

In public education employment and procurement the state is less a price-taker than a price-maker. It can compress its costs by exercising its monopsonistic powers, at least in the short to medium term. It tends to have the illusion of supply-side elasticity. It usually does not know, and often does not seek to discover, the market price. But, when it presses suppliers too hard and for too long towards their average costs (or reservation wages) the quality and reliability of the supply deteriorates.

Thus, when expansion programmes are mooted, and severe qualitative shortcomings are diagnosed, the general rule is for countries to raise real remunerations in the interest of reviving the quality of schooling, and thus of encouraging higher enrolments and higher educational attainment.

5.1.2 Road maintenance

Road maintenance presents a contrasting case where labour costs are a much smaller element of total costs and where, with outsourcing, governments have successfully induced cost-reducing technical progress.

The inference from the road maintenance case studies is that most inputs, including unskilled and semi-skilled labour and imported equipment, fuel, materials and parts, are available in elastic supply, and that private contractors have become at least as efficient as public works departments in their procurement of these. Unit labour costs borne by independent public works contractors are likely to have been less than those incurred by public sector employers, even though real public sector remunerations in the three countries examined have been subject to erosion through inflation. Although in principle the supply of locally procured maintenance materials might be subject to rising marginal costs, this factor does not seem, in practice, to have played a noticeable role in the countries examined.

Improvements in technical efficiency, however, have been more important than unit input prices in holding down or even reducing the unit costs of the maintenance operations performed. Independent contractors have been more flexible and inventive in their deployment of inputs and labour than public works departments, leading to falling input/output ratios. Moreover, governmental roads agencies have improved their skills in negotiating advantageous contracts, with the result that the 'producer surplus' which

contractors might have exclusively appropriated has in practice been shared by the state. Public expenditure per km of road maintained has thus been contained, or has fallen.

Childhood immunisation

The very limited evidence uncovered on *childhood immunisation* costs is harder to interpret reliably. Immunisation requires a significant deployment of professionally trained staff and of (generally imported) vaccines, supplies and equipment. These two elements, in roughly equal proportions, dominate the programme-specific costs of delivery. Personnel costs bulk larger still if the costs of resources shared with other programmes are also included. However, to judge from the experience of Bangladesh, it appears not to have been necessary to raise remuneration rates significantly in order to recruit the growing number of staff needed to extend EPI coverage. Any upward drift in wage rates has been counteracted by technical economies in staff deployment (from delivery from fixed instead of mobile clinics) and vaccine wastage rates, and by lower input supply prices.

Moreover, as in education, EPI costs reflect a degree of monopsony in the position of the state in the local market for professionally trained labour. Though the state has to compete with the private sector as an employer of health workers, it is by far the largest single source of employment in the sector. Remunerations for public sector health workers tend to reflect trends in wages and salaries in the wider public sector. The market adjusts through quantity, rather than price. When, for reasons of public policy, there is pay restraint in the public sector, the recruitment of health sector workers may diminish and the migration of staff to the private sector may increase. The effect of this is to retard the expansion of health sector programmes, including immunisation. The impact of a rising supply price of professional labour on programme costs will thus be disguised, taking the form of staff shortages and possible shortfalls in planned levels of programme activity.

5.2 Implications for scaling-up public expenditure programmes

This paper covers insufficient empirical ground to permit any confident generalisation. However, it has unearthed enough evidence to question the opening hypothesis that increases in activity rates will raise unit costs – and will do so all the more when increases are rapid. It finds evidence that, whether intentionally or otherwise, countervailing forces are often present which push average costs down, even at times when rising activity rates are pressing them upward. Furthermore, there are rigidities in government procurement and employment practices which make it unlikely that sharp increases in public expenditure combined with short-run supply inelasticities will translate into abrupt cost increases.

The differential impact of expenditure increases on unit costs in different programmes cautions against any across-the-board assumptions about cost developments in public expenditure planning. It points strongly to the need for case-by-case analysis of the structure of costs incurred in each programme and of the factors which are likely to affect them in each time period.

The programme characteristics which deserve particular attention in this analysis are:

- the cost structure: the respective shares of skilled and unskilled labour, domestic and imported supplies, parts, equipment and services, and, with accrual accounting, the user cost of capital;

- the short- and medium-run elasticity of supply of labour and domestically produced inputs; how easily imports can and will be substituted for domestic inputs whose short-run supply is inelastic;

- rigidities in government employment practices determining whether there will be quantity or price adjustment to changing market circumstances;

- the political economy of public sector employment: the extent to which governments are likely to accede to pressures from employees and wider clientèles to raise wage and salary rates and to increase public employment; or, conversely, the amount of pressure governments are likely to be under to implement salary-cost-reducing reforms in public employment and remuneration practices;

- the short- and medium-run scope for technical efficiency gains - arising from reforms in working practices, institutional innovation or technical progress – which increase the output/input ratio or permit cost-saving changes in input mixes.

5.3 Implications for 'capacity-building'

The advocates of a rapid scaling-up of public expenditure programmes needed to meet the MDGs recognise that 'weak public administration' and shortages of professionally trained and experienced staff may frustrate this objective (Sachs, 2005: Chapters 2 and 3; also de Renzio, 2005). They interpret these constraints as limits on the pace of implementation, but without reference to implications for programme costs. The actions they propose for lifting the constraints comprise high-pressure, up-front, endeavours to train more staff at all levels and to build analytical and administrative capacity. However, as discussed in Chapter 2, these actions have implications for programme costs, which are bound to rise during the phase of accelerated capacity-building, without an immediate corresponding rise in programme outputs. They will also leave a legacy of permanently higher staff and other operating costs which may raise unit costs in service delivery unless these inputs are deployed with a care to efficiency, and thus cost-effectiveness.

It follows that important components of the analytical and administrative capacity to be built are the capabilities to monitor and evaluate the costs incurred in expenditure programmes, to assess the allocative and technical efficiency with which resources are mobilised and deployed, to identify procurement, institutional and technical options for cost control and cost reduction, and to have the necessary measures taken to ensure cost-effective programme delivery.

5.4 Implications for further research

Given the limited empirical evidence used, this paper's conclusions can only be provisional. They may serve as hypotheses for use in the practical planning of public expenditure in the sectors covered. But, as such, they imperatively need confirmation and quantification using local and locally relevant data and information. The empirical approach adopted could, and perhaps should, be extended to further case-study work in other sectors and in a much wider range of countries. In this paper, the regressions were used as a descriptive statistic to estimate incremental costs rather than the behavioural relationship between output and expenditure. Thus, the calculations do not account for potential spurious correlation in time-series data, which none of the series are in any case long enough to do. An area for further research could be to estimate the equations in first differences, though longer time series would be required and it would give the short-run relationship only.

Formal, cross-country econometric analysis of expenditure, output and costs has, as indicated in Chapter 3, been frequently performed for education. It has also, though less often, been performed for primary health care – though not immunisation – using health outcomes (e.g. mortality) or 'patient episodes' as the explained variable, neither of which is a satisfactory output measure. Cross-country analysis might, with profit to practical resource planners, now be deployed to explore further the generic characteristics of cost structures in public expenditure programmes, how explicable these are in terms of the objective features of poor countries, and to what extent programme costs are case-specific and a function of local circumstances which need to be documented and forecast case-by-case.

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Annex 1: Case Studies in Basic Education

This Annex analyses the costs of providing primary or basic (i.e. primary or primary + junior secondary) education during episodes of education expansion occurring in the 1980s and 1990s in eight very different countries – Bolivia, Ghana, Ethiopia, Mauritania, Mozambique, Uganda, Vietnam, and Yemen. These countries are now included in (or are under consideration for)[7] the World Bank's Fast Track Initiative which rewards countries which have exhibited commitment to achieving the Millennium Development Goals in education, but which require additional resources to do so. In all the countries there have been episodes of rising real expenditure on basic/primary education over the last two decades - some short-lived, but others more sustained. The hypothesis tested is that in episodes of rising expenditure unit costs also increase.

A1.1 Methodology

The methodology of analysis used consists of dividing total expenditure on primary/basic education by the number of pupils enrolled in order to calculate unit (or average) costs, and of comparing these with incremental (or marginal) costs calculated from the coefficient on the enrolment variable in the simple time series regression of total expenditure on enrolment. When unit costs are falling, incremental costs are (predictably) found to be below unit costs; when unit costs are rising, incremental costs are (sometimes substantially) above unit costs.

In order to understand the reasons for rising expenditure on primary/basic education, and for rising unit costs, each country case study gives a thumb-nail sketch of the state of education, and of policies and developments in recent years. The costs of primary education consist predominantly of staff salaries. Salary costs make up between 80% and 95% of primary recurrent costs, exclusive of administrative overheads. Unit costs can thus be driven down by dint of reducing real staff remunerations. However, the cumulative effect of real pay reduction is to lower educational quality and to reduce schools' internal efficiency, which is inimical to MDG achievement. Achieving the goal of 100% primary completion requires quality education, with duly remunerated, trained, teachers, the provision of teaching materials and school facilities, and incentives for poor parents (and those in ethnic minorities) to leave their children in school. If, at the outset, schooling is of low quality, there is a high probability that countries which seriously seek to achieve the MDG will find that their unit costs have to rise.

The results broadly uphold the hypothesis that unit costs rise when expenditure rises and that, as a consequence, incremental costs exceed average costs. Research results are summarised in Table A1.1. The major exceptions are Ethiopia and Mauritania, where (previously excessive) teachers' salaries were reduced in real terms over a ten-year period, inducing a substantial reduction in unit costs. For most of this time real expenditure was flat, but unit-cost reduction continued for 3-4 years after real expenditure had started to increase. Thereafter, the more usual pattern emerged of rising unit costs and higher incremental costs.

Mozambique also experienced a transitory episode of falling unit costs following its internal peace agreement of 1992. Enrolments began a phase of growth (after wartime decline) which persisted for four years before the education budget was increased to cater for the rising demand. Thereafter, rising real outlays brought a rise in unit costs.

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[7] Bolivia's inclusion was proposed but was still awaiting endorsement in January 2006.

Increases in real expenditure were intended in all cases to increase school enrolments, and in most cases also, at least latterly, to raise the quality of teaching and of the learning environment through higher outlays on teacher training, materials, facilities and curriculum development.

Table A1.1 Unit and incremental costs in primary education in eight countries

	Currency unit (base year for price deflation)	Unit cost range (constant prices, '000s)	Incremental cost (constant prices, '000s)	Ratio incremental cost/unit cost [a]
Bolivia 1990-2000	bolivianos (1990)	0.25 - 0.45	0.74	2.11
Ghana 1990-2001	cedis (1990)	19 - 33	60	2.31
Ethiopia 1992-2002[b]	birr (1995)	0.24 - 0.12	0.10	0.55
Mauritania 1980-2002[c]	ouigiya (1985)	6.17 - 3.50	0.14 & 4.43	0.04 & 1.08
Mozambique 1990-2003	meticáis (1995)	250 - 350	617	2.06
Uganda 1995-2002[d]	shilling (1998)	7.5 - 16.0	14.7	1.25
Vietnam 1990-2001	dong (1995)	110 - 470	1,280	4.41
Yemen 1990-2003	rials (1990)	2,000 - 3,300	4,120	1.55

Sources: Author's calculations based on EdStats, World Bank, *World Development Indicators*, World Bank (2001, 2003a, 2004, 2005) and Republic of Yemen (2004)
*Notes*: a = Denominator is the mid-point of the unit cost range; b = costs expressed in birr; c = incremental costs were UM 142 in 1985-95 and UM 4,425 thereafter; d = incremental costs were U Sh 8,650 in 1985-2000, U Sh 14,700 in 1985-2002 and U Sh 19,025 in 1996-2002.

The tendency for unit costs to rise as education services are extended and improved is also reflected – though in widely varying degrees - in these countries' Education Fast Track Initiative sector development plans. In Ghana, recurrent expenditure per pupil in primary schools is projected to rise by (a relatively modest) 21% in constant prices between 2002 and 2015 (Government of Ghana, 2004). In Vietnam, unit costs are projected to rise massively by almost 300% over the same period (Socialist Republic of Vietnam, 2003). Ghana proposes incremental improvements in the quality of provision for a school enrolment which has to grow by 3% p.a. to meet the MDG of 100% primary completion. Vietnam, by contrast, is already very close to the Goal, expects school rolls to fall by 1.5% p.a., and will focus rapidly rising expenditure on major qualitative improvements in the learning environment.

One implication of these results – if on further analysis they are found to be general – is that the costing of education sector expansion plans should be based on expected incremental costs, and not on historic average costs. Budgets based on real historic costs are likely to underestimate seriously the volume of resources needed to achieve policy goals.

A1.2 Bolivia: Education in the 1990s

Public expenditure on education increased rapidly in the 1990s to a level, relative to GDP, which is now high by international standards, and exceeds the average share in middle-income countries (World Bank, 1999a: Chapter 4). In the early 1990s, it amounted to 2.4% of GDP (6.9% of total public expenditure); by the mid-1990s it had risen to 3.5% of GDP (10.4% of public expenditure); and by 2001, after a steep increase, it stood at 5.6% of GDP (23.7% of public expenditure) (World Bank, 2003: Annex 1). The Bolivian economy was growing in the 1990s at an average rate of a little more than 4% p.a., so that, by 2001, it was 50% larger in real terms than it had been in 1991. The combined effect of economic growth and of the increase in the ratio of education expenditure to GDP was to raise real outlays on education by no less than 260% over the years 1991 – 2001, i.e. at 14% p.a. (Fig. A1.1).

Fig. A1.1 Bolivia: Public expenditure on education as share of GDP
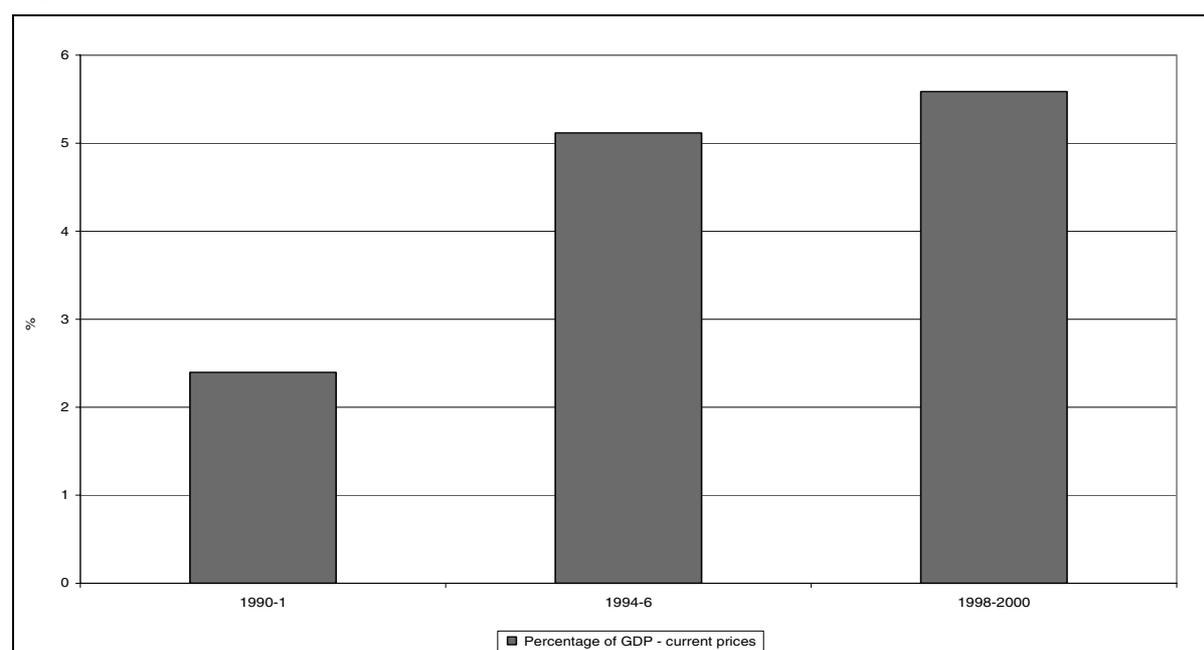
Source: World Bank, *World Development Indicators*

Bolivia spends quite lavishly on university education, devotes an above-average share of its education budget to primary schools and teachers' training, and underfunds secondary education. In the early 1990s, universities received more than 28% of public spending on education; ten years later their share had fallen to below 23%. This leaves 77% of the budget for education available for schools and colleges under the Ministry of Education.

There was a notable expansion in total primary and secondary school enrolments in the 1990s. Pupil numbers rose between 1990 and 2000 by 60% (Fig. A1.2). The increase in primary enrolment,[8] which was already high, was only 17%. Gross primary enrolment rose from 94.5% of the primary age group in the early 1990s to 108.4% in 2001; the net enrolment rate increased from 91% to 97%. However, the previously neglected secondary schools saw their enrolment rise by almost 200%, with their gross enrolment rate rising from 38% to 67% (Cotreras and Talavera, 2003).

Average public expenditure per pupil increased over the 1990s by 76% from 250 Bolivianos in 1990 to Bs 450 in 2000 (in 1990 prices) (Fig A1.2). Total expenditure on primary and secondary schooling deflated by the GDP deflator rose over the period by 177%. Of this, 14 percentage points were accounted for by an increase in teacher numbers, 12 percentage points by investment expenditure, and the remaining 74 percentage points by an increase in teachers' relative remunerations (Fig. A1.3).

On a crude measure of productivity, Bolivia's education system was becoming less productive in the course of the 1990s because real expenditure was rising at 10.7% p.a., over twice as fast as aggregate enrolments (4.7% p.a.). As indicated in Fig. A1.4, incremental (marginal) costs associated with each extra pupil, at Bs 741 (in 1990 prices), were in excess of unit costs (which rose from Bs 250 to Bs 450 – Fig. A1.2).

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[8] The gross enrolment rate may be exaggerated (World Bank, 1999a).

Fig. A1.2 Bolivia: Gross enrolment, public expenditure and per-pupil expenditure in primary and secondary schools 1990-2000
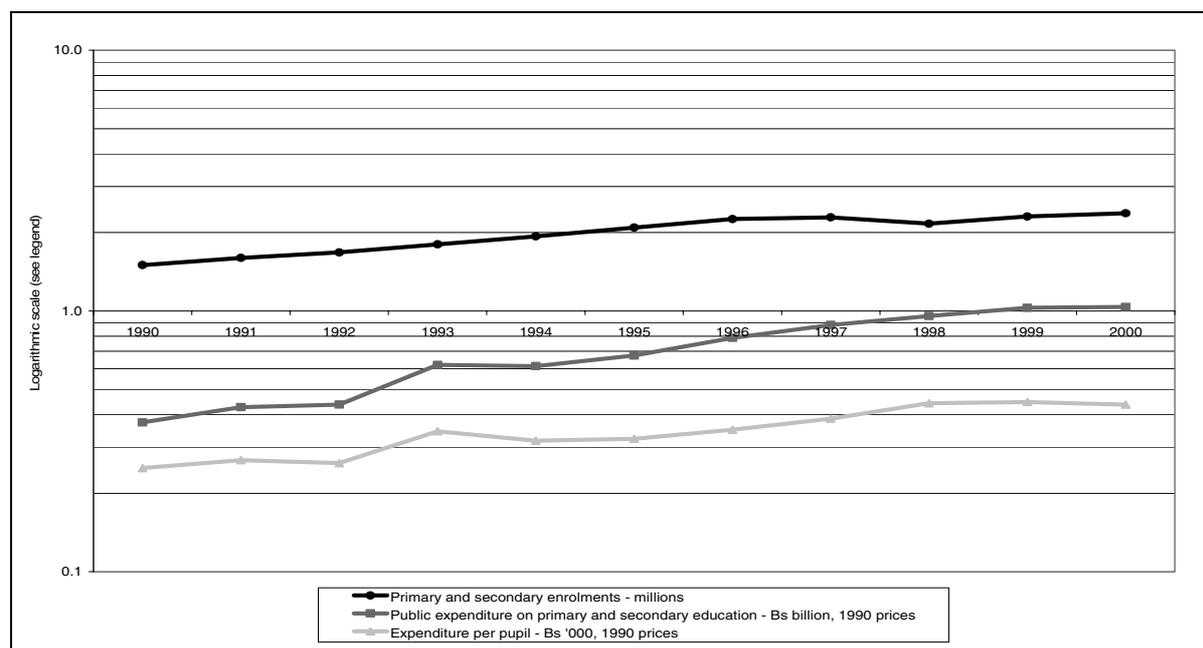
Source: ibid.

Fig. A1.3 Bolivia: Increase in primary and secondary education expenditure 1990-2000
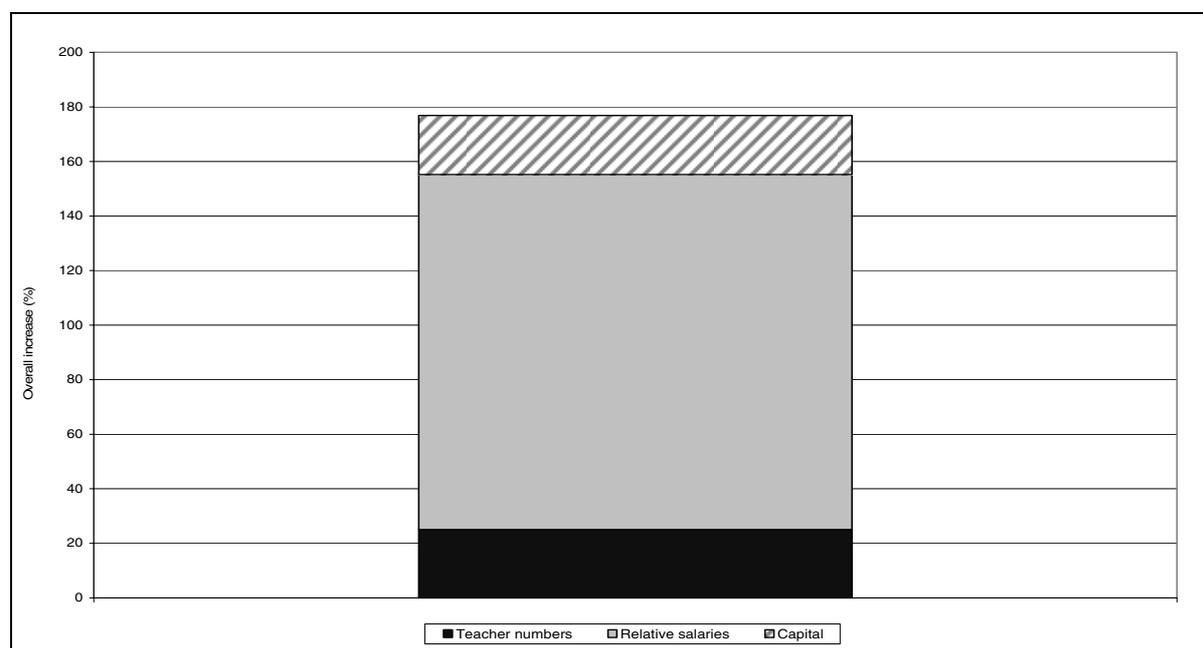

Sources: World Bank, *World Development Indicators*, and author's calculations

If sector output is measured by gross enrolments, the cost-effectiveness of expenditure on primary and secondary education fell by 43% between 1990 and 2000. It is also visible in Fig. A1.5 that the growth trajectory of enrolments follows that of expenditure only in trend, but not in first differences. The cost-effectiveness measure, by contrast, progresses as the mirror image of expenditure, declining most sharply when the latter rises most sharply (e.g. in 1993). It stabilises when the rate of expenditure growth wanes in the late 1990s.

Fig. A1.4 Bolivia: Primary and secondary education 1990-2000

| _____ | Regression line (slope = marginal cost) | ------------- | Ray through data means (slope = average cost) |
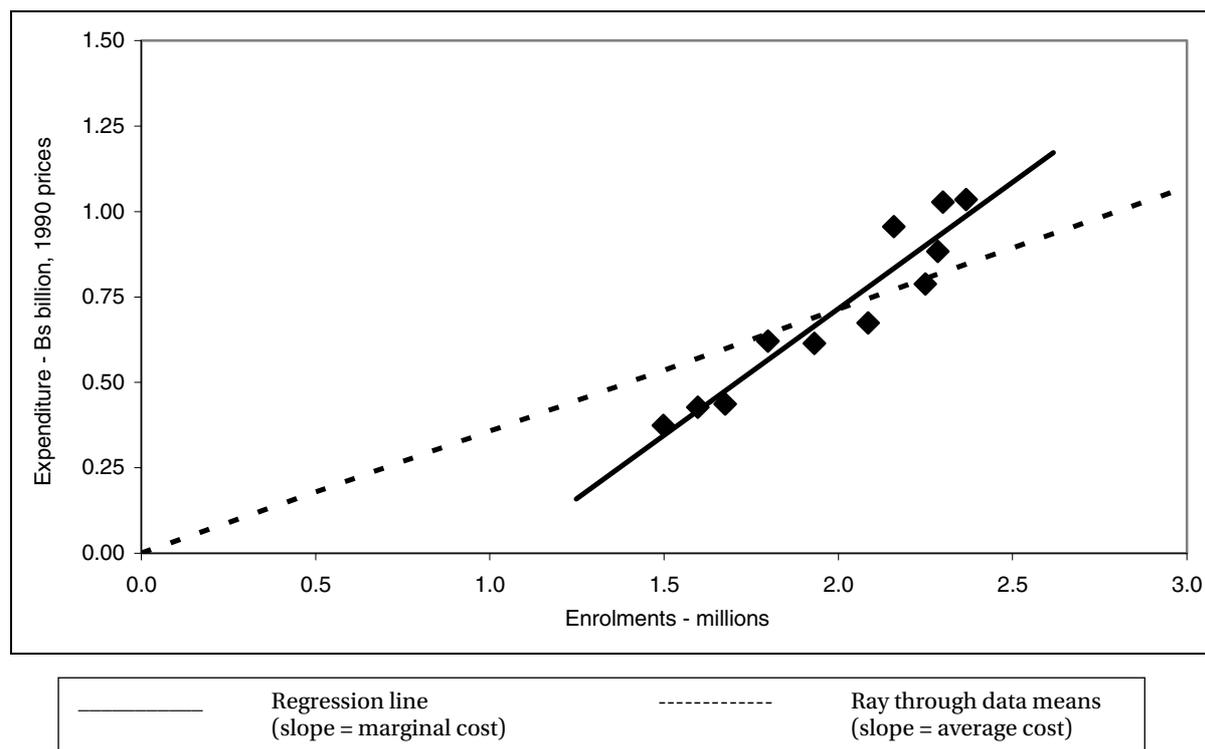
Regression equation: EXPENDITURE = -0.77 + 0.74*ENROLMENT (R-squared=0.90)
$$[8.99]$$
Sources: ibid.

Fig. A1.5 Bolivia: Cost-effectiveness of primary and secondary education 1990-2000
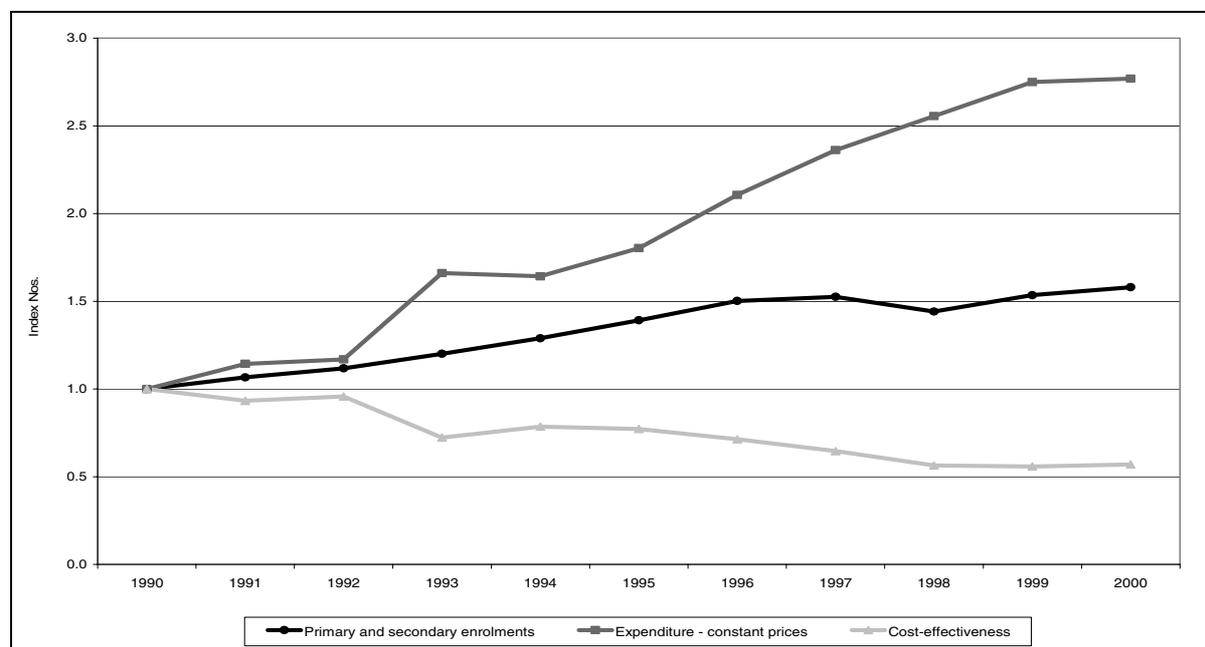
Sources: ibid.

The conclusion that cost-effectiveness has fallen becomes more nuanced when the crude productivity measure is disaggregated into its unit input cost and technical efficiency components. Teacher productivity rose; the average pupil/teacher ratio increased by 67%, and the marginal productivity (Δpupils/Δteachers) by 140%. This efficiency gain was more

than offset in the overall cost-effectiveness calculation by the large, 130%, increase in the unit cost of the main input, i.e. teachers' salaries.

The Bolivian case gives credence to the hypothesis that marginal costs rise more steeply in the shorter run – in this instance because of the escalation of unit input costs – but more gently in the longer run as capacity bottlenecks are widened. Expenditure per pupil rose steeply when the reform started in 1992 (from Bs 260 in 1992 to Bs 360 in 1993, cf. Fig. A1.2), whereafter it stabilised as efficiency measures were introduced.

The crude productivity analysis, moreover, obscures important qualitative improvements in the contribution of the education system to the life chances of Bolivians. Starting in 1992, the Bolivian government implemented a thoroughgoing programme of reform designed to bring about major improvements in the quality and accessibility of education, especially in the rural areas. This comprised community participation in school management, recruiting and training more teachers, curriculum reform, and, using the donor-supported Social Investment Fund, constructing and equipping many schools. The intention was to raise the internal efficiency of the schooling system, decreasing drop-out rates, increasing completion rates and improving test scores. There was also a policy of increasing the numbers of children entering secondary school on completing their eight years of primary education. Average unit costs in secondary education are invariably higher than in primary education.

To a significant extent, internal efficiency objectives were achieved (Table A1.2). There was a marked (60% overall) improvement during the 1990s in the percentage of enrolled pupils advancing beyond sixth grade; the improvement was especially strong in the rural areas, where results at the outset were distinctly poor. Disappointing test score results, on the other hand, cast doubt on the qualitative impact of Bolivia's education reform (World Bank, 1999a; Newman et al, 2002).

Table A1.2 Bolivia: Primary education efficiency and results indicators

|	Early 1990s	2001
Drop-out rate (%)	6.2	5.9
Sixth Grade completion rate (%)	52.8	84.7
- o/w rural (%)	41.0	74.0
Repetition rate (%)	7.1	3.8
Pupil/teacher ratio	15.0	25.0
Adults' average school years	4.4	7.9

Source: Contreras and Talavera (2003)

A1.3 Ethiopia: Education since 1990

Education received low priority in Ethiopia through the long years of civil war, concluding in 1990. Little progress was made in the initial years of peace. However, in 1994, the new government launched the New Education and Training Policy aimed at achieving universal primary education and at expanding and improving provision at other levels. Resources allocated to education rose sharply with the new policy, and thereafter grew constantly. Total public expenditure on education (at 1995 prices) increased by 78% from Birr 955.4 million in 1994 to Birr 1696.8 million in 2002. As a share of GDP, it rose from 2.8% in 1993 to 4% in 2002.

Real primary education expenditure, however, increased over the same period by only 39% - from Birr 658 million to Birr 923 million (at 1995 prices), and secondary education

expenditure rose by only 27%, from Birr 114 million to Birr 145 million (Fig. A1.6). Meanwhile, tertiary education was favoured with a 230% real increase.

Fig. A1.6 Ethiopia: Primary education: Enrolment and total and unit costs 1994-2002
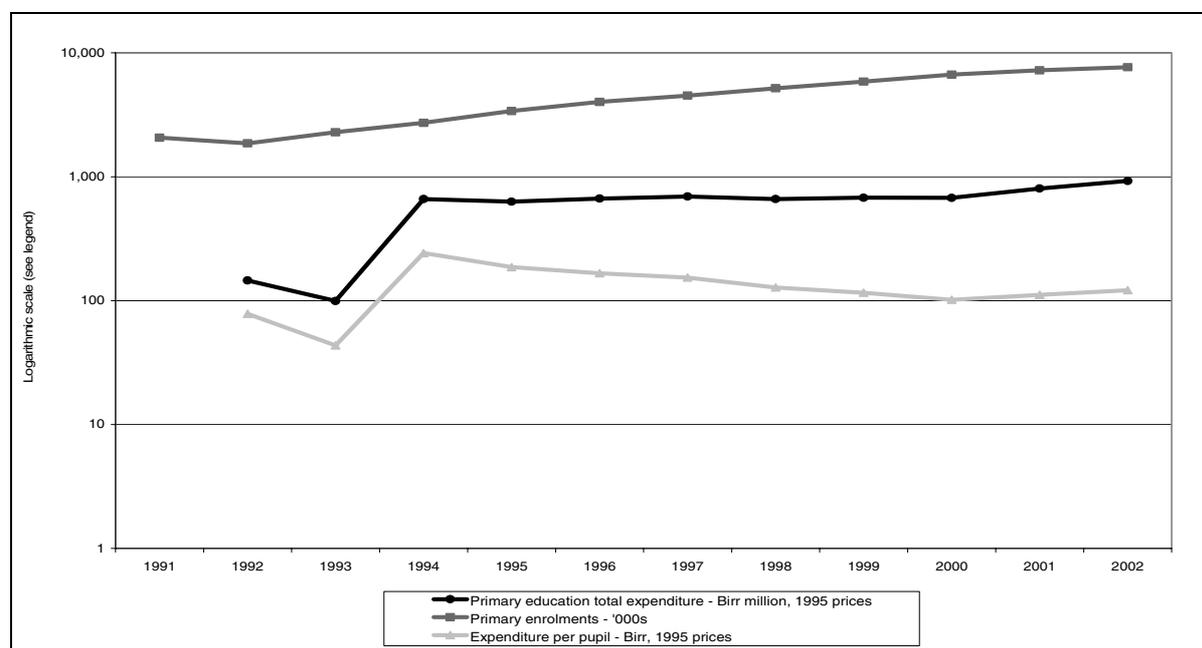
Sources: EdStats and World Bank (2005)

Enrolment, mainly in primary education, grew faster than expenditure. Primary enrolment expanded by 300%, from 1.86 million in 1992 to 7.62 million in 2002 (Fig. A1.6), increasing the gross enrolment rate (GER) from 23% in 1992 to 66% in 2002. In secondary education the GER rose more modestly from 11% in 1992 to 19% in 2001 (EdStats).

However, most growth in public expenditure on education occurred in the capital budget, which was largely devoted to new school construction. Construction costs proved to be excessive (up to $19,000 per primary school classroom - World Bank, 2005) because construction standards were set too high, preventing more schools from being built.

Unit costs in primary education fell by 50% during this recent 1994-2002 episode of educational expansion, from Birr 244 to Birr 121 per pupil (at 1995 prices) (Fig. A1.6). This was made possible because of significant economies in recurrent expenditure – which remained unchanged as a share of GDP – caused both by falling input unit costs and higher technical efficiency:

- teachers' salaries – some 87% of total costs in 2002 - were reduced in real terms from an initially high level relative to per capita GDP; and
- the pupil/teacher ratio was drastically raised - from 27 in 1992 to 65 in 2002.

The number of teachers in primary education rose by 67% from 70,000 in 1992 to 117,000 in 2002 to cater for a much more rapidly rising number of enrolled pupils.

The incremental cost of primary education over the 1992–2002 period, Birr 99.3, was below average costs (Table A1.1 and Fig. A1.7). If pre-reform observations for the years 1992 and 1993 are omitted from the calculation, the incremental cost of enrolment for the years 1994-2002 falls to Birr 41.

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Fig. A1.7 Ethiopia: Primary education 1992-2002

	Regression line (slope = marginal cost)		Ray through data means (slope = average cost)
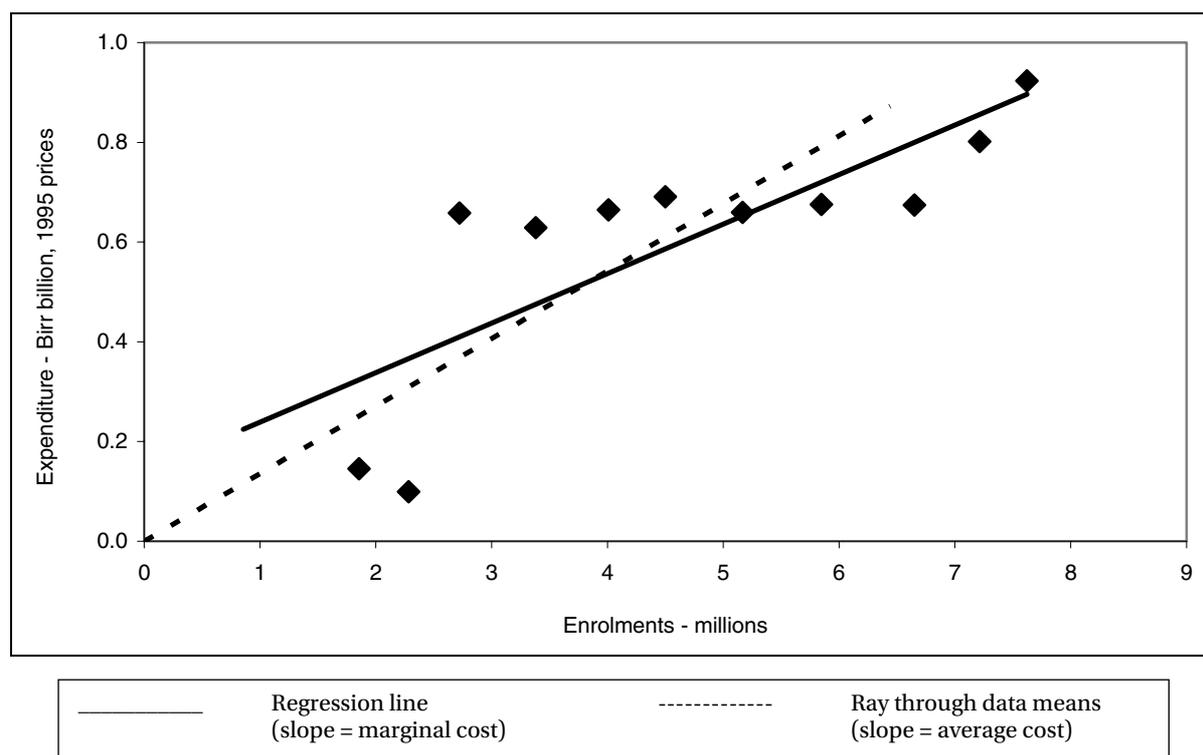
Regression equation: EXPENDITURE = 0.14 + 0.01*ENROLMENT (R-squared=0.63)
[3.88]

These cost reductions proved ultimately unsustainable. Unit costs in both primary and secondary education began to rise after 2002. The decline in real teachers' salaries had an adverse effect on recruitment levels and on teacher qualification and motivation. Teaching standards and the quality of the learning environment fell, leading to a reduction in the 'internal efficiency' of the school system.

Symptoms of this decline in internal efficiency are an increase in repetition rates, and falling survival rates (Table A1.3 and Fig. A1.8). Repetition rates in primary schools rose from 8.6% in 1993 to 10.7% in 2002. Survival rates among pupils enrolled in Grade 1 have, on the other hand, remained relatively constant, at least up to Grade 4, although there has been some apparent increase in drop-out rates since 2000.

Table A1.3 Ethiopia: Primary education efficiency and performance indicators 1990-2002

	1990	1993	1995	2000	2002
Completion rate (%)	-	16.5	-	28.9	36.9
Repetition rate (%)	-	8.6	9.7	9.0	10.7
Survival to Grade 5 rate (%)	-	49.0	-	54.0	51.0
Pupil/teacher ratio	36.1	30.2	37.9	61.1	65.2

Sources: EdStats and World Bank (2005)

Fig. A1.8 Ethiopia: Primary education efficiency indicators 1994 - 2002
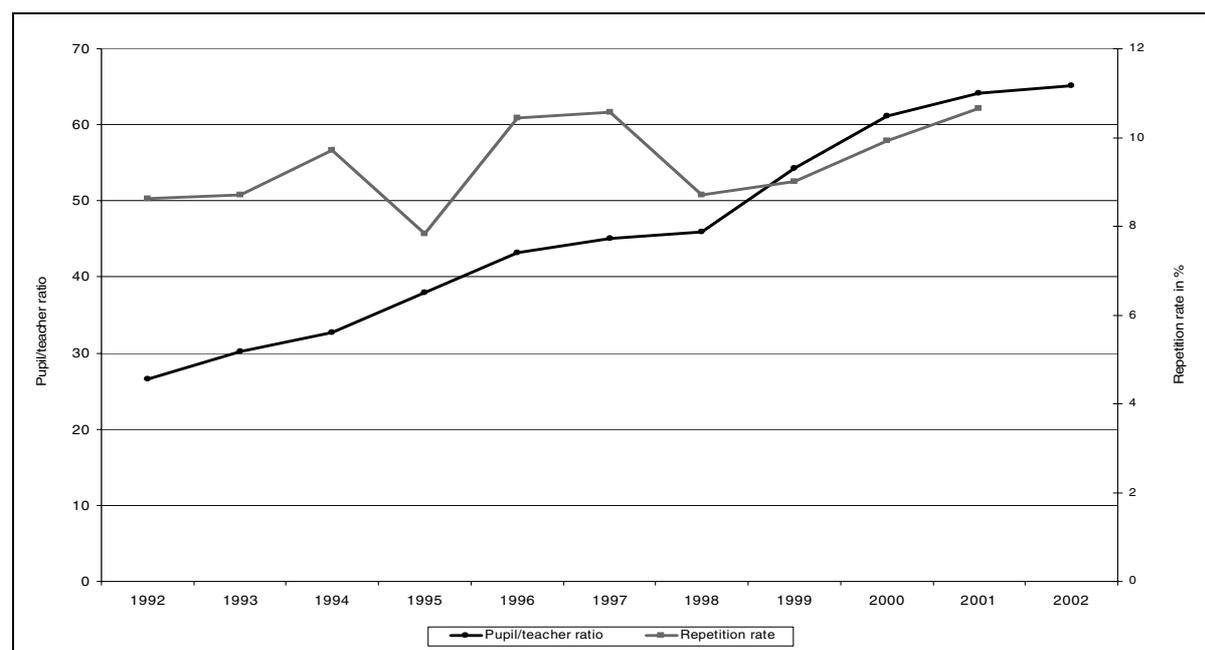
Source: EdStats

A1.4 Ghana: Primary education since 1980

In the early 1960s, Ghana was reputed to have one of the best education systems in Africa. Prolonged economic crisis, lasting until the early 1980s, then starved the system of resources, causing its performance to deteriorate. Expenditure on education fell from a high of 6.4% of GDP in 1976 to only 1.5% in 1983 and 1984, before rising again to 3.4% in 1989, 4.5% in 1995 and 5% in 2000. Enrolment rates responded with a lag: gross primary enrolments rose from 62% of the primary age cohort in 1970 to 79% in 1980, but then fell to 72% in 1990 before recovering to 79% in 2000 (EdStats; World Bank, 2004).

In 1986 a structural reform was implemented which reduced the length of secondary education, increased cost recovery from senior secondary and tertiary education, and re-focused the public education budget on 'basic' education at the primary and junior secondary levels (lasting respectively 6 and 3 years). This reform was followed in 1996 by a programme known as FCUBE (Free, Compulsory, Universal, Basic Education) to enhance the quality of basic education and to increase access to it. The programme comprised training and incentive payments for teachers, provision of teaching materials, bursaries for girls, and school building. It attracted significant support from both multilateral and bilateral donors.

However, on evaluation, these initiatives were found to have been only partially successful. The steady growth in real expenditure which started in the mid-1980s was found to have been largely devoted to increasing the numbers and real remunerations of teachers, with serious shortfalls in budget execution in respect of teacher training and the provision of teaching materials and facilities. Salary costs exceeded 95% of recurrent expenditure. Enrolments grew from 1.4 million in 1980 to 1.9 million in 1990 and 2.5 million in 2000, with the most rapid increase occurring between 1985 and 1995 (Table A1.4 and Fig. A1.9). Teacher numbers increased more or less *pari passu* - leaving the pupil/teacher ratio only slightly raised. However, the quality and internal efficiency of primary education fell in the 1990s, as evidenced by the fall in the percentage of teachers with training and in pupil survival to Grade 5, and the rise in repetition rates (Table A1.5).

Table A1.4 Ghana: Primary education yearly enrolment growth 1980-2000 (%)

1980-85	1985-90	1990-95	1995-2000
1.79	4.53	3.18	2.77

Source: EdStats

Fig. A1.9 Ghana: Primary school enrolment and expenditure 1989-2001
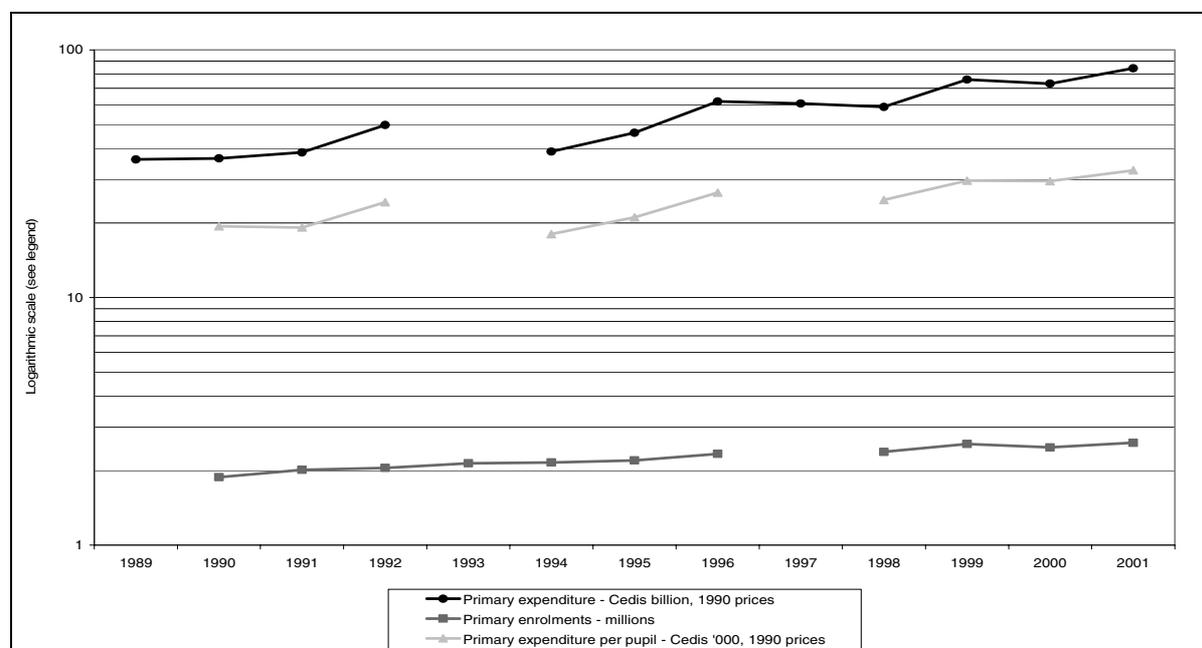
Sources: EdStats and World Bank (2004)

Table A1.5 Ghana: Primary education performance indicators 1980-2002

	1980	1990	1995	2000	2002
Completion rate %)	-	61.42	62.61	58.22	61.22
Repetition rate (%)ᵃ	2.06	2.90	-	5.21	5.90
Survival to Grade 5 rate (%)ᵇ	-	80.49	-	-	63.29
Pupil/teacher ratio	28.75	29.06	32.78	33.00	31.31
Teachers trained (%)ᵃ	-	-	71.80	68.61	62.88

Source: EdStats
Notes: a = First data point is for 1998; b = second data point is for 2001

The 1990s were a period of high but variable inflation in Ghana. Real expenditure on primary education[9] rose erratically as wages and salaries were adjusted in line with inflation from Cedis 36 billion in 1990 to Cedis 84 billion in 2001 (at 1990 prices) (Fig. A1.9). The progression of unit costs (per pupil) was similarly erratic, but on a rising trend. Annual cost per pupil rose from Cedis 19,000 in 1990 to Cedis 33,000 in 2001 (at 1990 prices). The rise in unit costs is explained essentially by increases in real wages and salaries for staff, the policy of simultaneously improving educational quality by providing more and better facilities and materials and incentives for teacher qualification not having been properly implemented.

Rising average costs imply that incremental costs are higher than unit costs. This is confirmed by the coefficient of the simple regression of expenditure on enrolments over the years 1989–2001 (Fig. A1.10) which shows that the cost of catering for each extra pupil was

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[9] I.e. current outlays deflated by the GDP deflator.

(on average) Cedis 60,160. If quality-enhancing expenditures on facilities and teaching materials had been made, the incremental costs associated with enrolment growth would have been higher still.

Fig. A1.10 Ghana: Primary education 1989-2001

| _____ | Regression line (slope = marginal cost) | ------------ | Ray through data means (slope = average cost) |
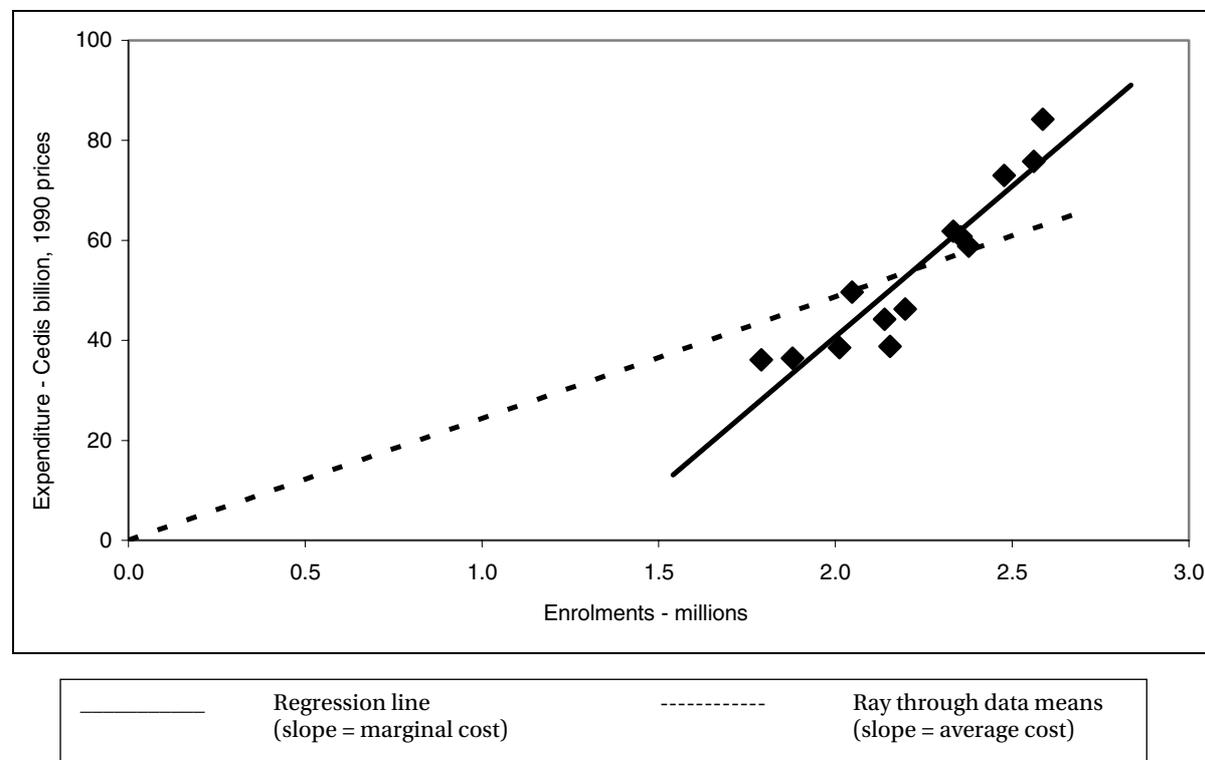
Regression equation: EXPENDITURE = 0.14 + 60.16*ENROLMENT (R-squared=0.87)
[8.54]

Sources: EdStats and World Bank (2004)

A1.5 Mauritania: Primary education since 1980

Mauritania has achieved a major expansion in enrolments in its primary schools, starting in the first half of the 1980s, then, after a pause, resuming strongly in the first half of the 1990s. Gross enrolments rose from 36% of the primary school age cohort in 1980 to 48% in 1985. Between 1990 and 1995, they rose further from 50% to 75%, and then reached a plateau at 86-8% after 1997 (Fig. A1.11). Net enrolments rose from 35% in 1990 to 67-8% at the turn of the century.

In terms of numbers, enrolments grew by 56% in the 1980-5 period, by 75% in the 1990-5 period, and by 24% between 1995 and 2000 (Fig. A1.12).

Fig. A1.11 Mauritania: Primary education gross and net enrolment rates 1980-2002
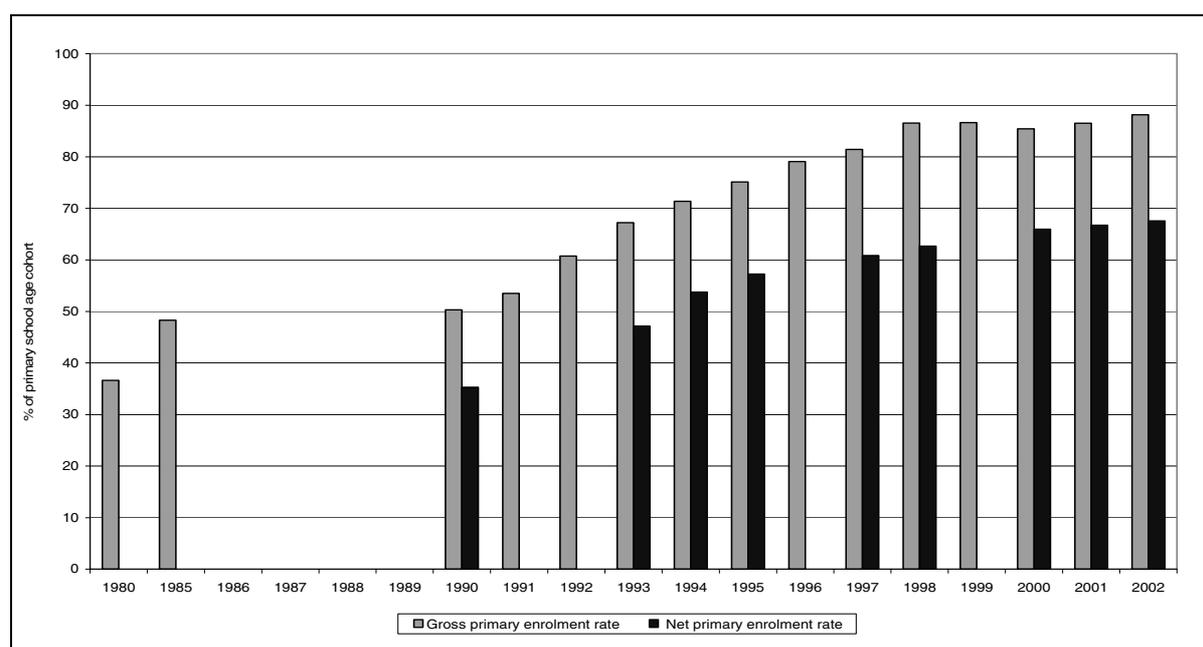
Source: EdStats

Fig. A1.12 Mauritania: Primary school enrolments, recurrent expenditure and unit costs 1980-2002
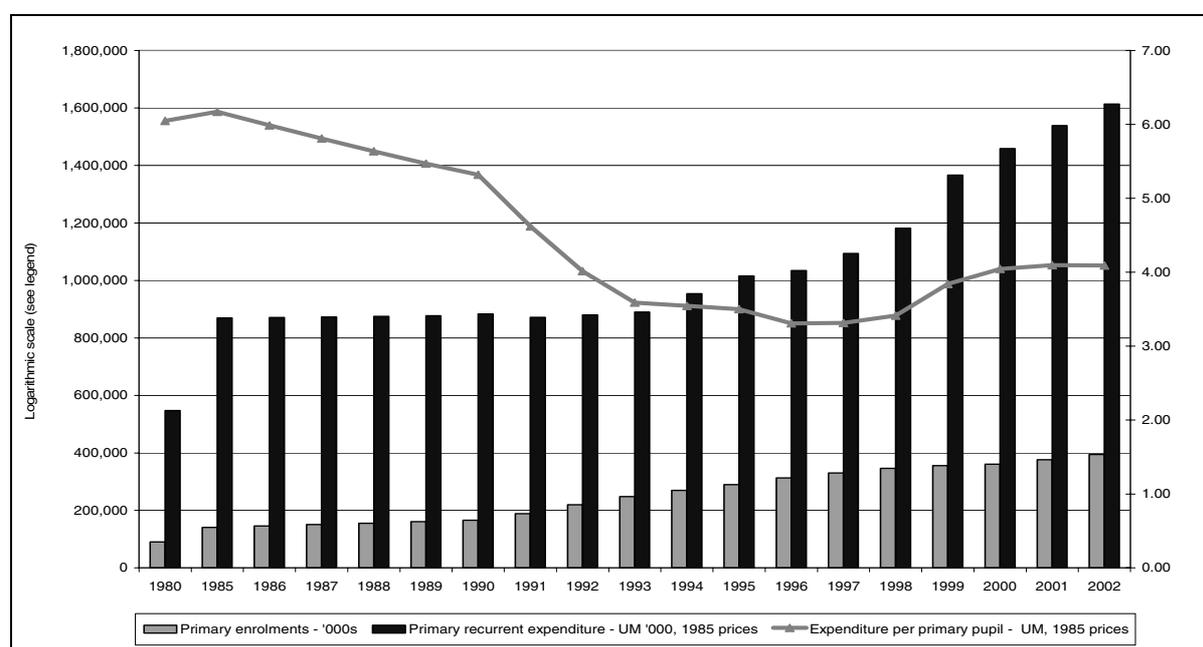

Sources: EdStats, World Bank (2001) and author's estimates

Recurrent expenditure on primary education, meanwhile, rose in real terms from 1980-5, but thereafter remained more or less constant until 1993. From the mid-1990s, expenditure rose with enrolments (Figs. A1.13 and A1.14). Unit output costs (expenditure per pupil), therefore, were on a downward trend prior to 1993. They were more or less constant in the 1980-5 period, but fell by 14% between 1985 and 1990 from UM 6,170 to UM 5,300, and a further 34% to UM 3,500 in1995, before rising by 16% over the period 1995-2000 to UM 4,100.

Fig. A1.13 Mauritania: Primary education 1990-2002 (regression 1992-2002)

| _____ | Regression line
(slope = marginal cost) | ------------ | Ray through data means
(slope = average cost) |
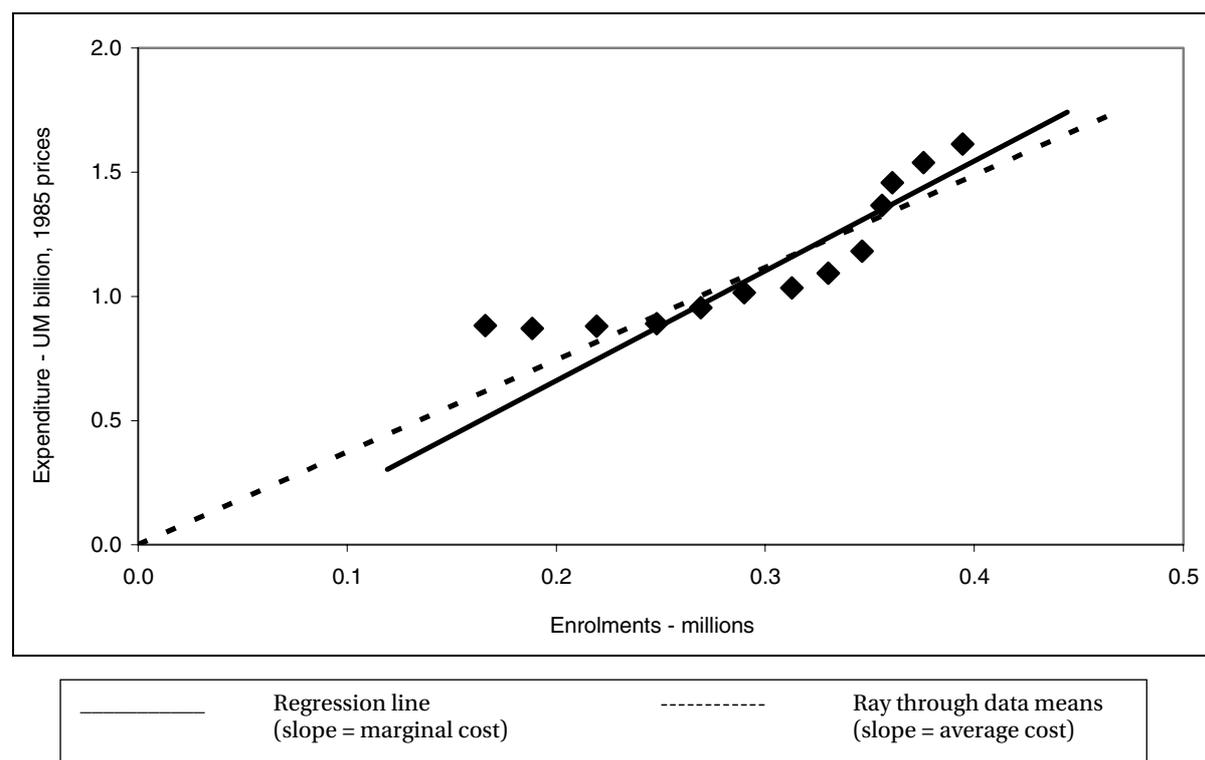
Regression equation: EXPENDITURE = -0.22 + 0.44*ENROLMENT (R-squared=0.86)
[7.47]

Sources: EdStats and World Bank (2001)

The incremental (marginal) cost[10] was negligible in the years 1985–93 (UM 142 at 1985 prices – way below average costs). It rose consistently only after 1996 in the period of consolidation and incipient investment in quality improvement and incentives for teachers. Over the years 1996-2002, it was UM 4,425, i.e. somewhat more than average costs over the same period, as would be expected at a time of rising average costs.

The period of fastest enrolment expansion – 1990-5 – thus corresponds to the period of the most rapidly falling unit costs. This result is counter-intuitive. Explanations need to be sought in the structure of education costs and in policies for cost control.

The cost of primary school building in Mauritania is not readily available. Capital budget data for education are not broken down by level of education. In any case, primary school buildings are jointly financed by the Ministry of National Education and local communities – generally in the proportion 70% - 30%. A breakdown of costs entering the recurrent budget is, however, available. This shows that a very high proportion of expenditure goes on personnel – both teachers and support staff. Staff costs rose from 92% of the budget in 1985 to 96% in 1998 (World Bank, 2001). The remainder of the budget was devoted to teaching and maintenance materials.

Variations in the pupil/teacher ratio explain some of the fluctuations in unit costs. Fig. A1.14 shows that the ratio has fluctuated between 40 and 50, rising in the early 1990s but falling in

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[10] Defined as the coefficient on enrolments in a simple regression of recurrent expenditure (at 1985 prices) on numbers enrolled. The equations for 1985-93 and for 1996-2002 are respectively EXPENDITURE = 85.2+142.0*ENROLMENT (R^2=0.6), and EXPENDITURE = -22.5+4424.8*ENROLMENT (R^2=0.86).

the second half of the 1990s. The 15% rise in the ratio which occurred between 1990 and 1994 would, on its own, have reduced unit education costs by some 12%, considerably less than the overall 34% fall in unit costs. By contrast, the 12.5% fall in the ratio occurring between 1994 and 1999 was more than enough to account for the 10% rise in unit costs over the 1996-9 period. Changes in the pupil/teacher ratio, therefore, do not account for the whole of the output unit cost changes observed: they under-account for the falls in unit costs when ratios are rising, and over-account for rises when ratios are falling.

**Fig. A1.14 Mauritania: Primary school pupil-teacher ratios**
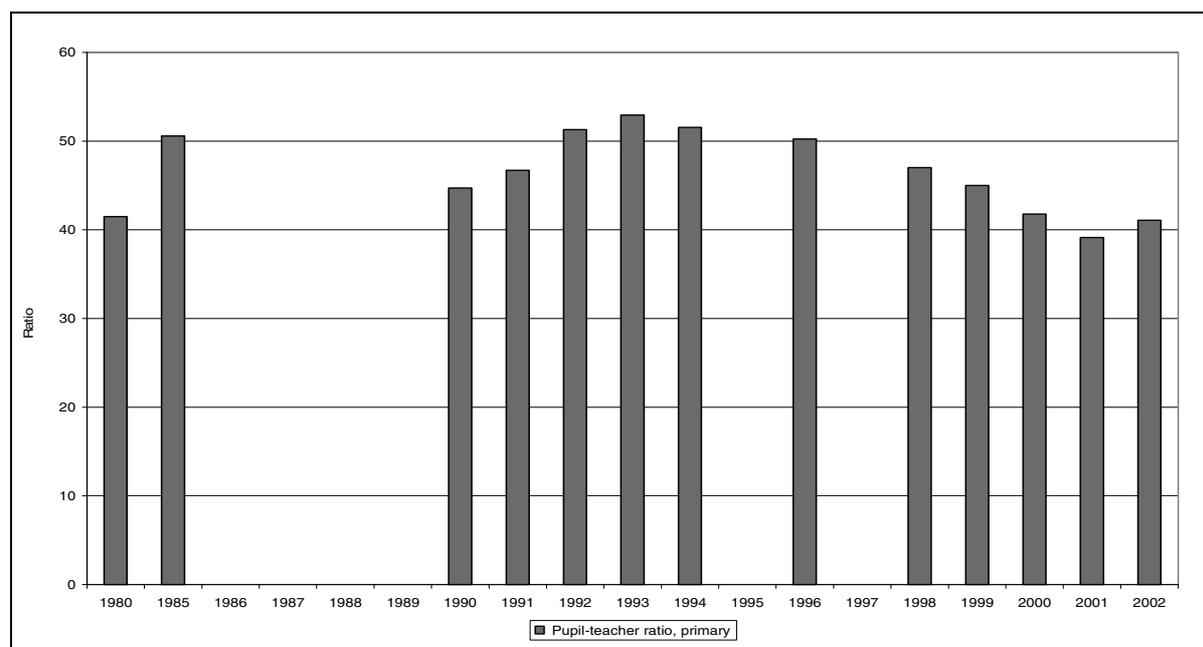
Source: EdStats

The other major element in the explanation of changes in output unit costs is to be found in input unit costs, i.e. in the wages and salaries of teachers and non-teaching staff. The World Bank (2001: Chapter 3) estimates that average teacher salaries in primary education fell by 56% between 1985 and 1998. In 1985, the average primary teacher's salary in Mauritania was 9.5 times per capita income; by 1998, it had fallen to a multiple of 5.2 times per capita income. This decline in relative pay was parallel to, but steeper than, the decline found in other Francophone African countries.

The increment in total costs in primary education between 1985 and 1998 (UM 316.5 million in 1985 prices) can be broken down into real and price effects. The effect of increasing teacher numbers (at a period-average salary level in 1985 prices) would have been to increase costs by approximately UM 1,080 million. This was partly offset by the effect of the decline in real teacher unit costs (times the period-average number of teachers) which amounted to about UM425 million, and by the fall in expenditure on teaching materials (UM 20 million) (Fig. A1.15). This necessarily rough calculation overestimates the actual increase in total costs by an unexplained UM 90 million in 1985 prices, possibly due to an overestimation of the increase in teacher numbers.[11]

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[11] Estimates of pupil/teacher ratios are different in EDSTATS and World Bank, 2001.

Fig. A1.15 Mauritania: Decomposition of increase in total costs of primary education 1985-1998
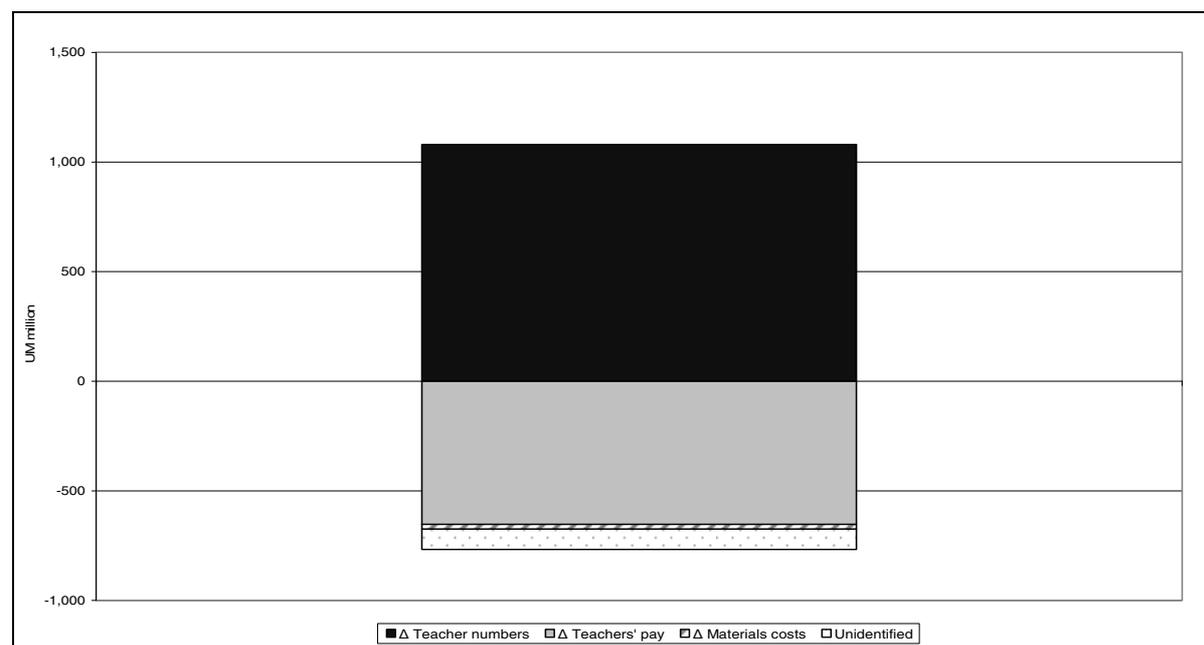
Sources: World Bank (2001) and author's estimates

The consequence of cost compression in primary education in Mauritania in the 1990s was a deterioration in educational quality and internal efficiency, and, as noted above, a decline in the rate of enrolment growth in the second half of the decade. The quality of educational provision was very uneven, and was particularly poor in rural areas. Only an estimated 17.5% of schools – serving only 55% of enrolled pupils - offered a full, six-year, primary curriculum. Textbook provision was extremely sparse.

The most eloquent testimony to declining quality is the fall in the rate of pupil survival to Grade 5, which fell from 75% in 1990 to 55% in 2000 (Table A1.6). In rural areas, the survival rate fell to 30%. Repetition rates remained stubbornly high at 15%. Though gross enrolment in Grade 1 rose from 56% in 1990 to 91% in 1995, and further to 102% in 2002, this was largely the effect of the presence of over-age children, most of whom dropped out of school before reaching Grade 5. Net enrolment in Grade 1 in 2002 was only 35% of children aged 6. Completion rates rose from 33% in 1990 to 52% in 1999, before falling to 46.5% in 2002.

Table A1.6 Mauritania: Primary education efficiency and results indicators

	1980	**1985**	**1990**	**1995**	**1999**	**2000**	**2002**
Completion rate (%)	-	-	33.0	34.2	51.6	49.5	46.5
Repetition rate (%)	14.0	18.3	18.0	15.8	15.3	15.2	15.2
Survival to Grade 5 rate (%)	-	92.5	75.3	64.0	61.2	54.7	-
Pupil/teacher ratio	41.5	50.6	44.7	51.0	45.0	41.8	41.1

Source: EdStats

The fall in real teacher salaries did not have the effect of causing a decline in teacher numbers. Numbers rose by 133% between 1990 and 2000. During these years, there was downward pressure on all public service remunerations, and there were few salaried employment opportunities outside the public services. However, there was a decline in the quality and training of teaching staff.

In its PRSP drafted in 2000, the Mauritanian government set out its proposals for rectifying these qualitative deficiencies, including action on teacher training, teacher numbers and remuneration, on free textbook provision, and on the teaching of a full primary curriculum in more schools. These actions are intended not only to enhance quality but also to encourage the return to enrolment growth with a view to achieving universal primary education by 2010. The effect on unit costs is not immediately obvious, but there is a strong likelihood that marginal (incremental) costs will exceed current average (unit) costs by a wide margin, as is seen to have been the case in the 1996-9 period.

Mauritania shows that, over a prolonged period, rapid expansion can occur with falling marginal costs provided (a) there is an elastic supply of staff at below the current wage, (b) the state is a monopsonist in the labour market, and (c) outputs are measured quantitatively, without quality discount.

## A1.6 Mozambique: Primary education 1980 - 2003

From 1980, Mozambique experienced twelve years of civil strife. It has emerged from this, following the peace settlement of 1992, into a period of rapid recovery and sustained economic growth. The country's education experience has reflected these political and economic developments. Economic reforms initiated in 1987 were accompanied by a significant donor-supported increase in public expenditure on education. This bore fruit only after the restoration of peace, when school enrolments began a period of uninterrupted growth.

The government's strategy for primary education, articulated in its PRSP of 2001, has been to achieve universal primary education by enrolling 3 million children in Grades 1-5 (by 2004) and to improve the quality of education through programmes for school building, provision of teaching material and teacher training.

Enrolments. Prior to the civil war, in 1980, 1.4 million children were enrolled in Grades 1-5 (EP1 lower primary schools). The gross enrolment rate was 99% of the 7-11 age group, though net enrolments were only 36%. As a result of war and dislocation, gross enrolments fell below 1.2 million in 1991, a gross enrolment rate of only 62%. But they have subsequently grown strongly and consistently, to reach 110% in 2003. 68% of the age group now attend school (Fig. A1.16).

Expenditure. Public expenditure on primary education, which fell during the war years, has increased since the early 1990s to accommodate the rising numbers of children enrolled (Fig. A1.17). Domestically financed expenditure remained low in real terms until the later 1990s, but it has been supplemented by external donors whose contributions virtually doubled the primary education budget in the immediate post-war period, paying for a high proportion of capital outlays. Total expenditure decreased in 2002 and 2003 because of falling externally financed capital outlays; however, domestically financed expenditure continued to rise during these years.

Fig. A1.16 Mozambique: Gross and net EP1 enrolment rates 1980-2003
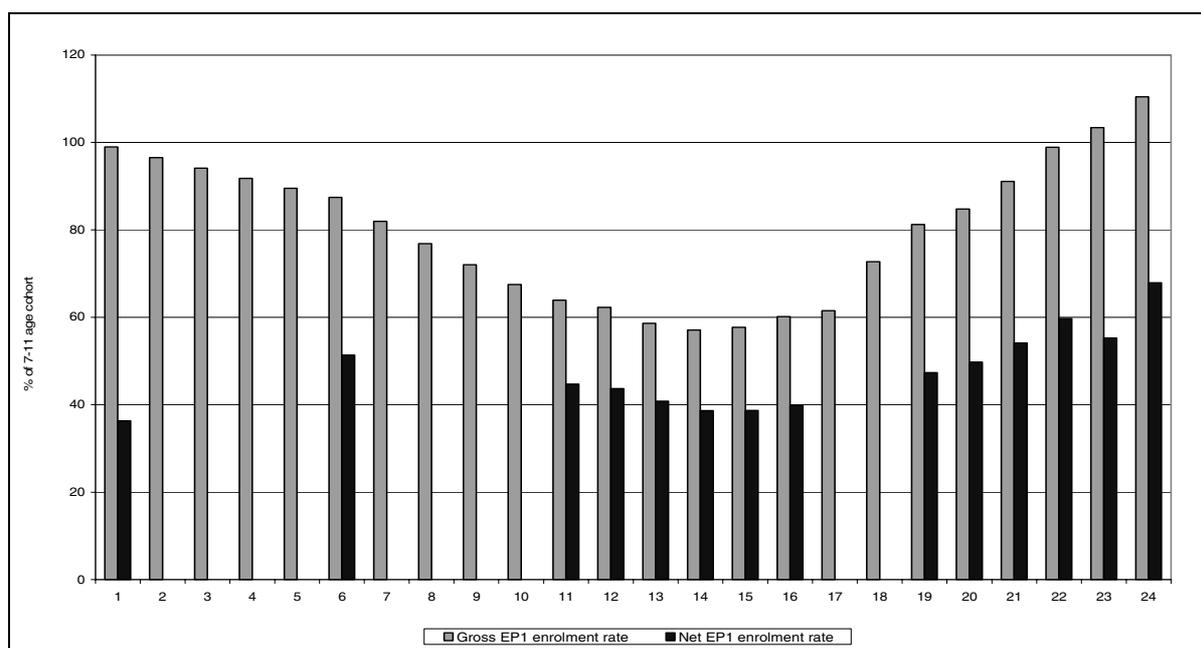
Sources: EdStats, World Bank (2003a), Republic of Moçambique (2004) and author's estimates

Fig. A1.17 Mozambique: Primary education (EP1) enrolments and expenditure 1980-2003
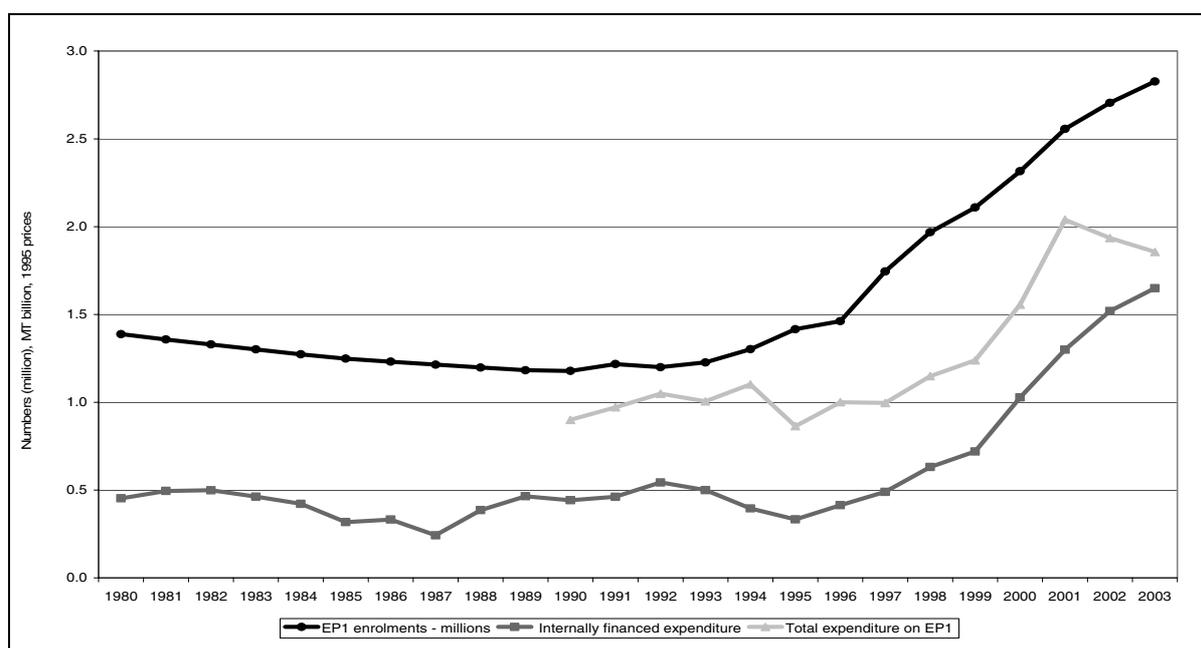
Source: ibid.

Fig. A1.18 shows the approximate composition of increases in domestically financed costs during the 1990s. Just over one-third of the increase is accounted for by increases in teacher numbers, and just below one-third each was caused by increases in teachers' pay and other (largely recurrent) costs, including teaching materials.

Fig. A1.18 Mozambique: Primary education (EP1) 1990-2001: Composition of growth in internally financed expenditure
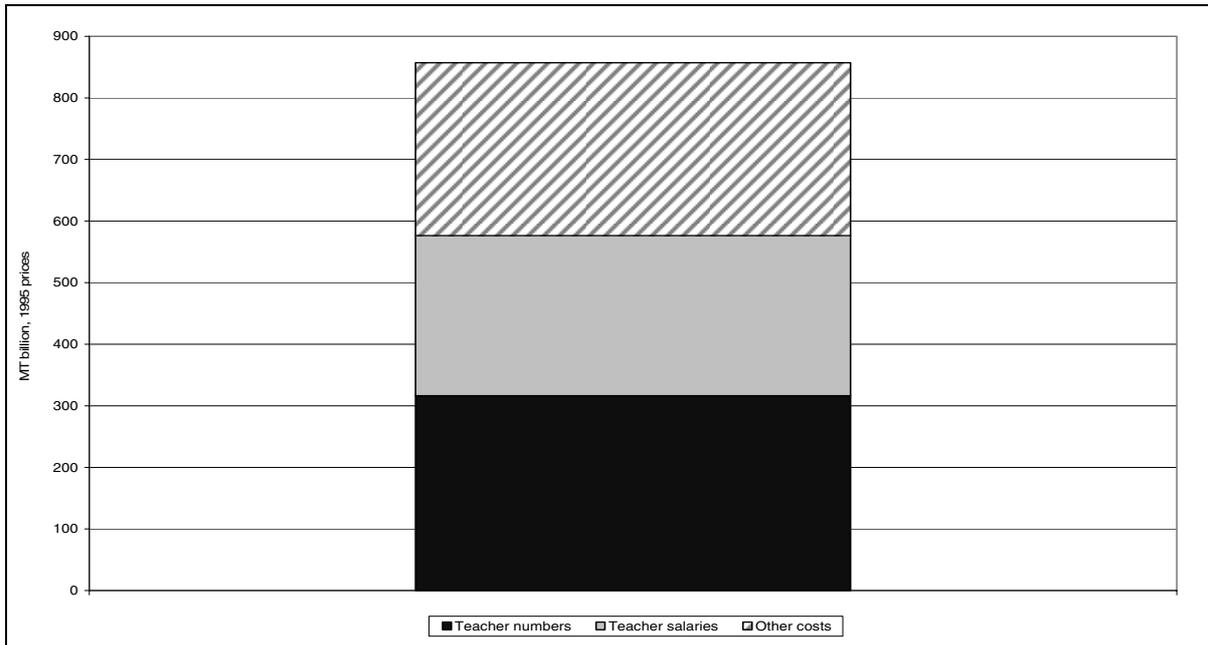
Sources: EdStats and author's estimates

Average and incremental costs.   Unit costs declined during the early war years 1983-7, with outlays falling faster than enrolments. Thereafter, as external donors became involved, they shot up, reaching 0.35 million Meticais per pupil enrolled (in 1995 prices) in the early 1990s. Enrolments responded to increased expenditure with a lag, growing vigorously from 1996 onwards (Fig. A1.19). As they did so, unit costs declined to less than MT 0.25 million in 1997 and 1998. However, a sharp rise in expenditure thereafter precipitated another increase in unit costs, which reached over MT 0.30 million in 2001.

Fig. A1.19 Mozambique: Primary education (EP1): Enrolments, total expenditure and unit costs 1990-2003
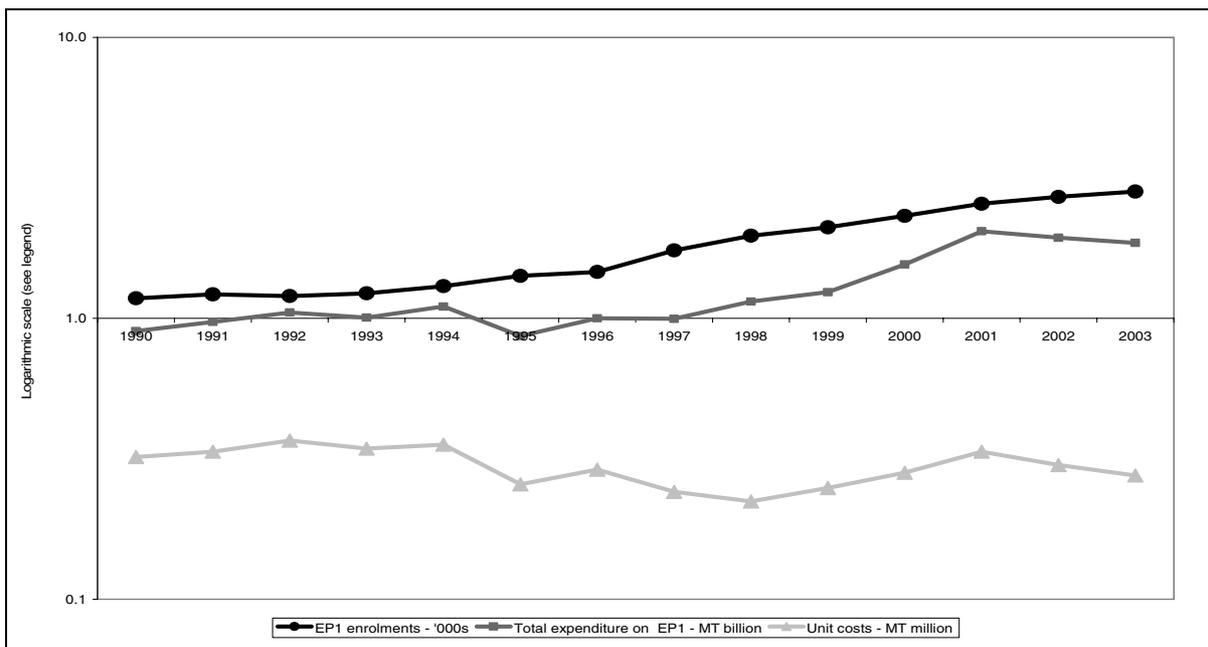
Source: ibid.

This average cost was below the incremental cost of increasing EP1 enrolment over the years 1990-2003. The coefficient of the regression of expenditure on enrolment indicates an incremental cost of MT 0.617 million (at 1995 prices), i.e. approximately double the period-average unit cost. (However, the relationship was not strictly linear, cf. Fig. A1.20).

Fig. A1.20 Mozambique: Primary education (EP1) 1990-2003
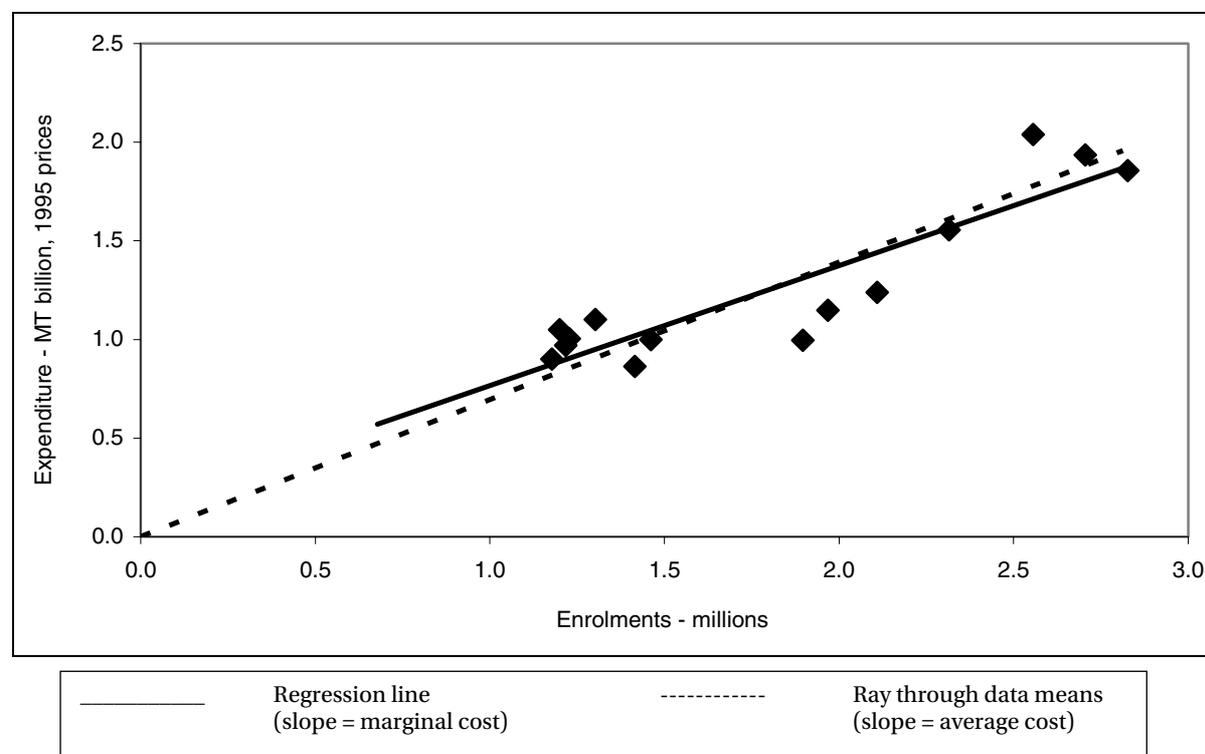
Regression equation: EXPENDITURE = 0.02 + 0.62*ENROLMENT (R-squared=0.84)
[7.28]

Sources: EdStats, World Bank (2003a), Republic of Moçambique (2004) and author's estimates

Cost implications of education reforms.   The 'internal' efficiency of education in Mozambique remains very low by the standards of other low-income countries. Rates of repetition and of abandonment in 2000 were high (respectively 25% and 13%) and, despite improvements in recent years, only 36% of pupils entering Grade 1 complete the EP 1 cycle (Table A1.7 and World Bank, 2003b).

Table A1.7 Mozambique: Primary education internal efficiency indicators

	1985	1990	1995	2000	2003
Completion rate (%)	-	27.54	25.81	37.73	52.41
Repetition rate (%)	23.55	26.06	25.73	22.74	-
Survival to Grade 5 rate (%)	-	32.68	-	51.89	-
Pupil/teacher ratio	61.52	54.54	57.60	63.99	65.96

Source: EdStats

The low quality of schooling is explained in part by pupil/teacher ratios which are well above the international norm (of 35-40). In 1980, there were 80 pupils per teacher in EP1 schools. This fell to 55 in 1990, but thereafter was allowed to rise, reaching 66 in 2003 (Table A1.7). This explains much of Mozambique's success in containing unit costs in EP1 schools during the 1990s, even in the second half of the decade when total expenditure was rising.

Some 75% of recurrent expenditure - excluding administrative overheads - is devoted to staff costs (World Bank, 2003a). Teachers' salaries in EP1 schools averaged 3.2 times per capita GNI in the late 1990s, which was rather less than the norm in Anglophone African countries (3.6 times), and much less than in Francophone countries (6.3 times) (World Bank, 2003a).

With the implementation of reforms intended to raise educational standards and achievement rates, and thus to increase internal efficiency, it is likely that unit costs will rise. Low teachers' salaries are a reflection of the poor standards of teacher training.[12] The reforms will improve teachers' qualifications. Trained teachers' remunerations will be higher than those of their untrained colleagues. As more trained teachers are recruited, there will be pressure to lower the pupil/teacher ratio, and so to increase the likelihood of pupil survival and completion. Unit teaching staff costs will accordingly increase.

A1.7 Uganda: Primary education

Uganda began a period of sustained economic recovery and growth in the later 1980s, following a decade and a half of misrule, disruption and domestic conflict when social services were allowed to decay. The government's emphasis in the initial stages of the post-1985 recovery period lay in the restoration of infrastructure services and the revival of agriculture, manufacturing and exports. During the 1985-95 period, the gross enrolment rate in primary schools never exceeded 75%, and the net enrolment rate barely rose above 50%, leaving a large minority of school-age children out of school.

The number of children enrolled in primary schools rose at 3% p.a., from 2.1 million in 1985 to 2.9 million in 1995 (Fig. A1.21). Expenditure on primary education remained at about 45% of total public expenditure on education; it fluctuated from year to year, growing in real terms on trend by 6% p.a. The small real annual increase in expenditure per pupil did little to improve educational standards.

A major change occurred in 1996 when the government decided to accelerate progress towards universal primary education by abolishing fees in primary schools for up to four children per family. Primary school enrolments thereupon rose by 120%, increasing from 3 million in 1996 to 6.6 million in 1998 (Fig. A1.21), taking the gross enrolment rate from 76% in 1996 to 143% in 1998 as numerous over-age children enrolled (EdStats). Enrolments net of over-age children are estimated to have reached 89% of school-age children - both male and female - by 2000 (World Bank, 2002a).

Though the increase in enrolments far exceeded expectations, the Uganda government swiftly made additional financial provision available to build new classrooms, and to hire new teaching staff. Class sizes nevertheless rose. Primary school teacher numbers fluctuated in the range 80-85,000 in the years 1990-5 (they were 82,750 in 1995). By 1998, they had increased to almost 110,000; in 2002, they were almost 140,000. The pupil/teacher ratio nevertheless rose from 38 in 1995 to 60 in 1998, before falling to 53 in 2002.

Other factors mitigating the fiscal costs of accommodating the sharp and sustained rise in enrolments were the greater use of teaching in two shifts, the use of community-based construction contracts for building new classrooms, and efficiency gains in textbook procurement, leading to price discounts of almost 65% (World Bank, 2002b).

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[12] In 2003, 42% of EP1 teachers were untrained, up from 30% in 1997 and 27% in 1992 (EdStat surveys, quoted in World Bank, 2003b).

Fig. A1.21 Uganda: Primary education 1985–2002: Enrolment, total expenditure and unit costs
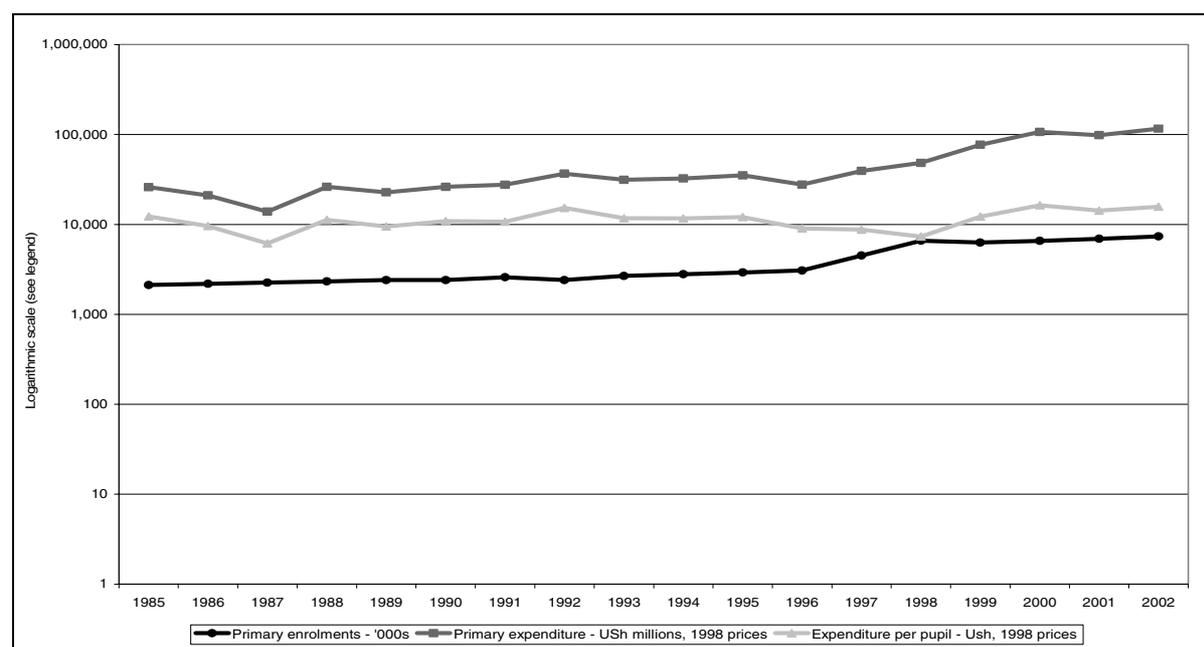
Sources: EdStats and author's estimates

The effectiveness of public expenditure on primary education was also raised, following expenditure tracking research, by improving public information about the distribution to individual schools of central government capitation grants, and by encouraging parents to complain if the facilities which they were intended to finance were not provided. The share of capitation grants reaching schools rose thereupon from 36% in 1996 to 90% in 2001 (ibid.). The flow of funds to school administrators has also become more timely and predictable.

Public expenditure on primary education nevertheless rose dramatically in the course of this episode of sharply increased enrolments. The share of public expenditure on education devoted to the primary sector increased from its historically little changed rate of about 45% in the years up to 1996 to 69% by 2001. Outlays leapt from USh 28 billion in 1996 to USh 106 billion in 2000 and USh 116 billion in 2002 (all figures in 1998 prices) (Fig. A1.21). Factors contributing to this increase in expenditure were the recruitment and training of new teaching and administrative staff, the construction of new classrooms, and the distribution of additional teaching materials. A major teacher training effort was undertaken such that the ratio of trained to total teacher numbers rose from 73% in 1995 to 83% in 2000 (World Bank, 2002a).

Unit costs fell immediately after the abolition of fees - from USh 12,000 per pupil in 1995 to only USh 7,300 in 1998 (in 1998 prices), as the growth in enrolments outstripped additional budget provision. Thereafter, however, expenditure programmes needed to restore and further improve educational quality became effective, with the result that real per-pupil expenditures soon exceeded historic levels. In 2000, expenditure per pupil reached USh 16,000 (in 1998 prices), and in 2002 it was still USh 15,700 (Fig. A1.21).

The incremental cost of primary education calculated over the years 1985 to 2002 was USh 14 700 per pupil (in 1998 prices) (Fig. A1.22). This figure is somewhat higher than average (unit) costs in all years up to 2000, but not greatly so. The incremental cost calculated using data for years prior to 2000 was only USh 8,650; however, the equivalent for the years 1996 to 2002 when fees were abolished was USh 19,025. This illustrates how sensitive unit cost

trends are to recent decisions on public expenditure, motivated, in this case, by the need to make urgent provision to arrest and reverse a perceived decline in educational standards.

Fig. A1.22 Uganda: Primary education 1985-2002

_____	Regression line (slope = marginal cost)	------------ Ray through data means (slope = average cost)
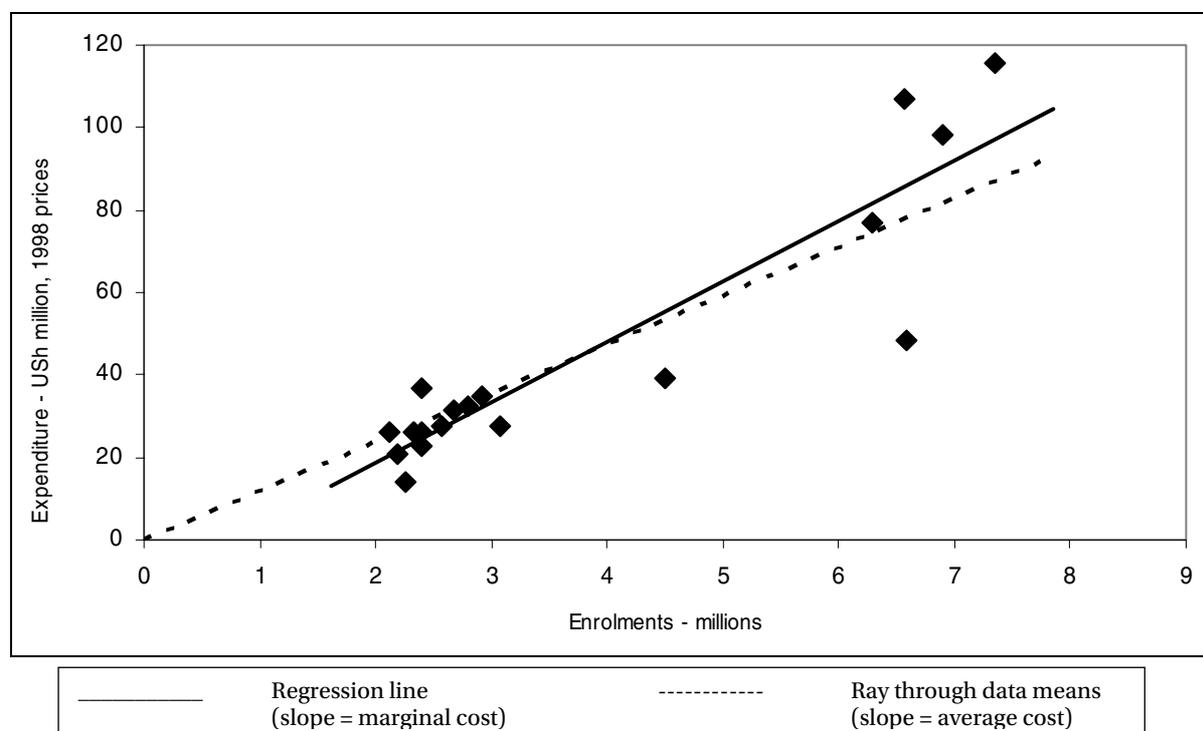
Regression equation: EXPENDITURE = -10.60 + 14.70*ENROLMENT (R-squared=0.83)
[8.83]

Although the fall in standards following the abolition of fees has received much comment, objective evidence is relatively sparse. Repetition rates have declined, survival to Grade 5 reached 64% in 2001, up from 55-60% in the early 1990s, and the completion rate reached 64% in 2002, well up on the early 1990s rate of 35% (EdStats; World Bank, 2002a) (Table A1.8). However, a pronounced decline in English and maths test scores gives legitimate cause for concern (World Bank, 2002a).

**Table A1.8 Uganda: Primary education internal efficiency indicators**

	1990	1995	1998	2000	2002
Completion rate (%)	-	35	-	50	64
Repetition rate (%)	-	17	-	10	11
Survival to Grade 5 rate (%)	55	-	-	57	64
Pupil/teacher ratio	29	35	60	59	53

Source: EdStats

A1.8 Vietnam: Primary education since 1990

Vietnam has for long enjoyed rates of schooling well in excess of those of other low-income countries. Even during the war years gross enrolments in primary education were over 100% of the primary school-age cohort (6-10 years), and net enrolments exceeded 90% (Fig. A1.23).

Fig. A1.23 Vietnam: Primary education gross and net enrolment rates
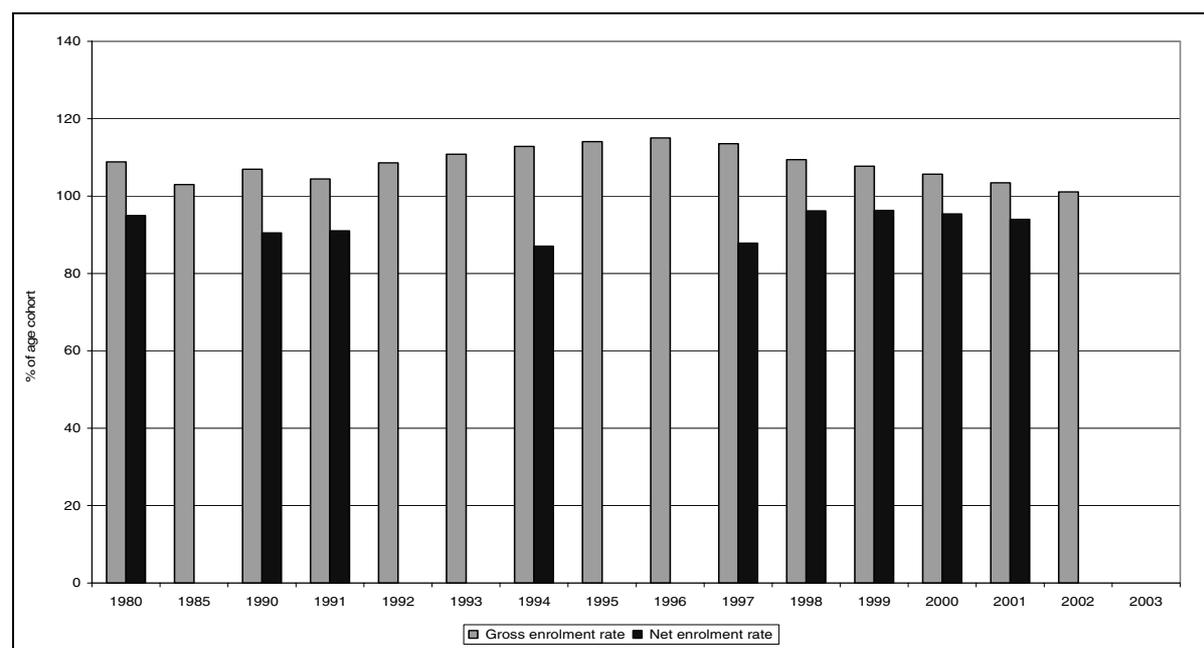
*Sources*: EdStats, World Bank (1999b) and author's estimates

In 1986, after the end of the war and the unification of the country, *Doi Moi* economic reforms were initiated. These included introducing the payment of fees and other parental contributions to the costs of primary education, the administration of which was devolved on district authorities. By the early 1990s, an estimated 42% of the costs of primary education was met from fees and charges (World Bank, 1999b). These were abated for poor households, with the result that primary schooling was worse funded in poor districts and rural areas than in more prosperous districts and in the towns.

The charging policy was one of the reasons for a noticeable drop in net enrolment rates in the 1990s (to 87% in the mid-1990s). Meanwhile, gross enrolments rose under the influence of high rates of repetition (8.8% in 1990-91 – World Bank, 2002c) and the presence of over-age children. Public expenditure increased to accommodate rising school rolls, and to attempt to reverse the downward trend in net enrolments.

In the later 1990s, three further influences came to bear on enrolments and public expenditure in primary education. Demographic transition was stabilising the number of school-age children, the number of over-age children in primary classes was diminishing, bringing down the overall number of children enrolled, and, thanks to evidence from household budget surveys, there was a better understanding of why over 10% of school-age children remained out of school. Between 1996 and 2002, the gross enrolment rate fell from 115% to 101%, the number of children enrolled fell from 10.4 million to 8.8 million, but the net enrolment rate increased to around 95%. The fall in total numbers did not bring a fall in funding. On the contrary, expenditure continued to rise, but with a growing concentration on curriculum and teaching material reform, teacher training and remuneration, and increasing the public subsidy for poor rural areas and minority ethnic groups among whom rates of enrolment were well below the national average.

In fact, estimated real public expenditure on primary schooling rose exceptionally fast in the years 1991-2002 – at an average rate of 13.8% p.a. In view of the fall in pupil numbers over this period, it is not surprising that real costs per pupil enrolled (unit costs) rose substantially – by 16.3% p.a., more than quadrupling over the eleven years (Fig. A1.24).

Fig. A1.24 Vietnam: Enrolments, expenditure and unit costs in primary education 1991-2002
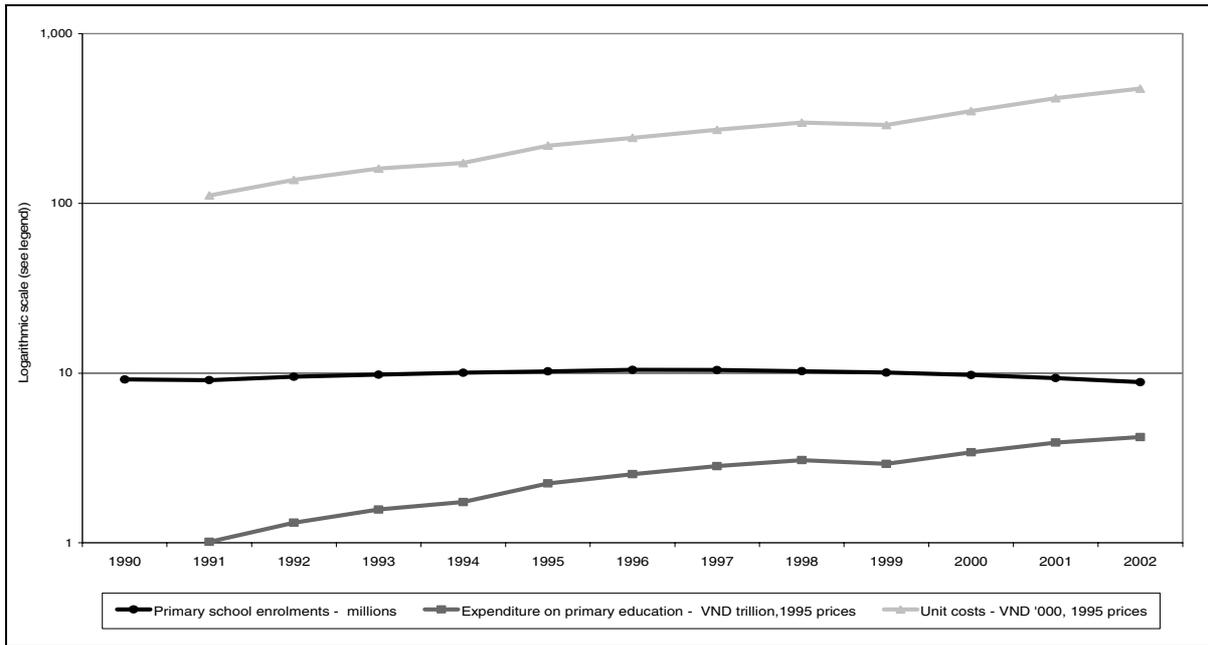
Sources: EdStats, World Bank (1996a and 2002c), Socialist Republic of Vietnam (2003) and author's estimates

Fig. A1.25 Vietnam: Primary education 1991-2002 (regression 1991-1997)

_____	Regression line (slope = marginal cost)	------------	Ray through data means (slope = average cost)
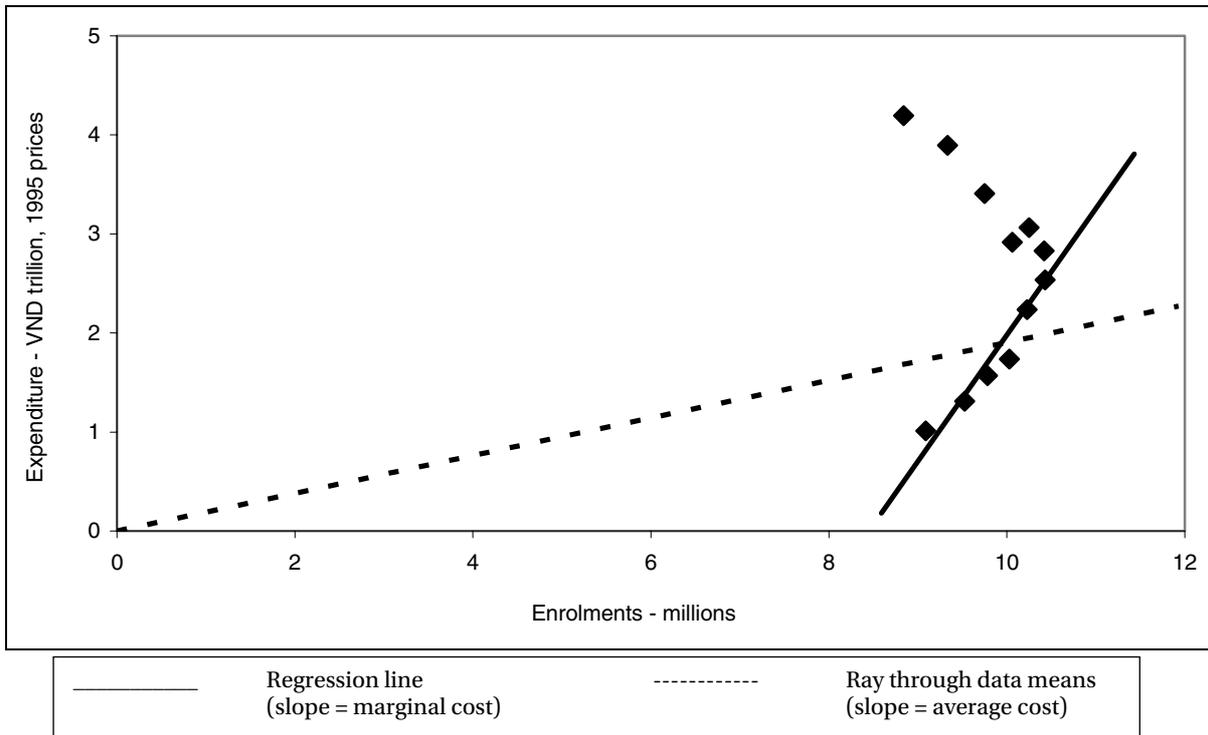
Regression equation: EXPENDITURE = -10.79 + 1.28*ENROLMENT (R-squared=0.91)

[7.16]

Incremental costs are calculable for episodes in which outputs are rising – as was the case between 1991 and 1997. Needless to say, with rapidly rising unit costs, the additional cost associated with enrolling each additional pupil was very high. In terms of 1995 prices, the incremental cost in these years was VND 1.28 million, well above average (unit) costs which

rose from VND 0.11 million in 1991 to VND 0.47 million in 2002. After 1997, expenditure continued its rapid growth in real terms as enrolments began to fall, giving rise to a negative relationship between the two time series (Fig. A1.25).

What were the reasons for this rapid escalation of unit costs in the course of the 1990s? As salary and overhead costs represent some 80% of the fiscal costs of providing primary education in Vietnam (World Bank, 1996a: Chapter 4), most of the answer to this question lies in the cost of teaching, administrative and support staff relative to the general level of prices. However, the rise is only partly explained by the number of teachers – which grew only at a rate of 3% p.a., though this was still sufficient to bring the pupil/teacher ratio down substantially, from 35 in 1990 to 25 in 2002 (Table A1.9). A more important reason was a rise in real teachers' salaries, as part of a general decompression of public service remuneration. At the start of the period, war economy dispensations were still in force, in which public service workers received much of their salary in kind, the monetary equivalent of which was recorded at low administrative prices. Real wages declined in the early stages of *Doi Moi.* In 1990, the government began to reform the conditions of public service employment, introducing employment contracts, eliminating subsidies for rationed consumer goods, housing and health, and, from 1993, paying remunerations in cash at levels (eventually) high enough to attract growing numbers of qualified and trained staff (World Bank, 1996a: Chapter 5). Public service wages had to rise to levels competitive with those in the growing and increasingly decontrolled private labour market.

The effect of this was progressive and accelerating. EdStats indicates that the share of teachers' pay alone in public expenditure on primary education rose from 62.6% to 66% in the short period 1994-7. In 2003, teachers' pay was increased by a massive 38% as part of the government's *Education for All* programme of improving educational quality. Vietnam's investment in educational quality was rewarded by high standards of internal efficiency: completion rates have been high, survival rates have risen, and repetition rates have been low (Table A1.9).

Table A1.9 Vietnam: Primary education internal efficiency indicators

	1990	**1995**	**2000**	**2003**
Completion rate (%)	-	-	106.9	95.5
Repetition rate (%)	-	4.3	2.9	2.4
Survival to Grade 5 rate (%)	-	68.1	89.0	-
Pupil/teacher ratio	35.1	34.2	28.0	25.0

Sources: EdStats and World Bank (1996)

## A1.9 Yemen: Basic education since 1990

Yemen became united politically in 1990, and the education systems of the two antecedent states were aligned with effect from 1992. It was decided in that year that schooling would consist of two cycles, starting with nine years of basic education followed by three years of secondary education.

Educational attainment in the country was low, with an adult illiteracy rate of 67 % and gross enrolment in primary grades 1-6 of only 65%. The rural areas, often remote but containing 80% of the population, were much worse served than the urban centres. Gross enrolments in grades 1-6 were over 80% in towns, but as low as 30-40% in the rural areas. Schools were often poorly equipped, lacking basic facilities. Trained teachers were in short supply: some

25% of teachers were expatriates from other Arab countries; many indigenous teachers were unqualified.

Enrolments in basic education expanded somewhat in 1991-3 from 2.2 million to 2.7 million, then drifted down until towards the end of the decade when they started to increase again, reaching 3.7 million in 2003 (Fig. A1.26). They grew on average by only an estimated 1.8% in the years 1991-9, i.e. by around 1% p.a. less than the growth of the school-age population. But in the years 1999-2003 enrolments grew by 10.2% p.a.

Fig. A1.26 Yemen: Basic education: Enrolments, expenditure and unit costs 1991-2003
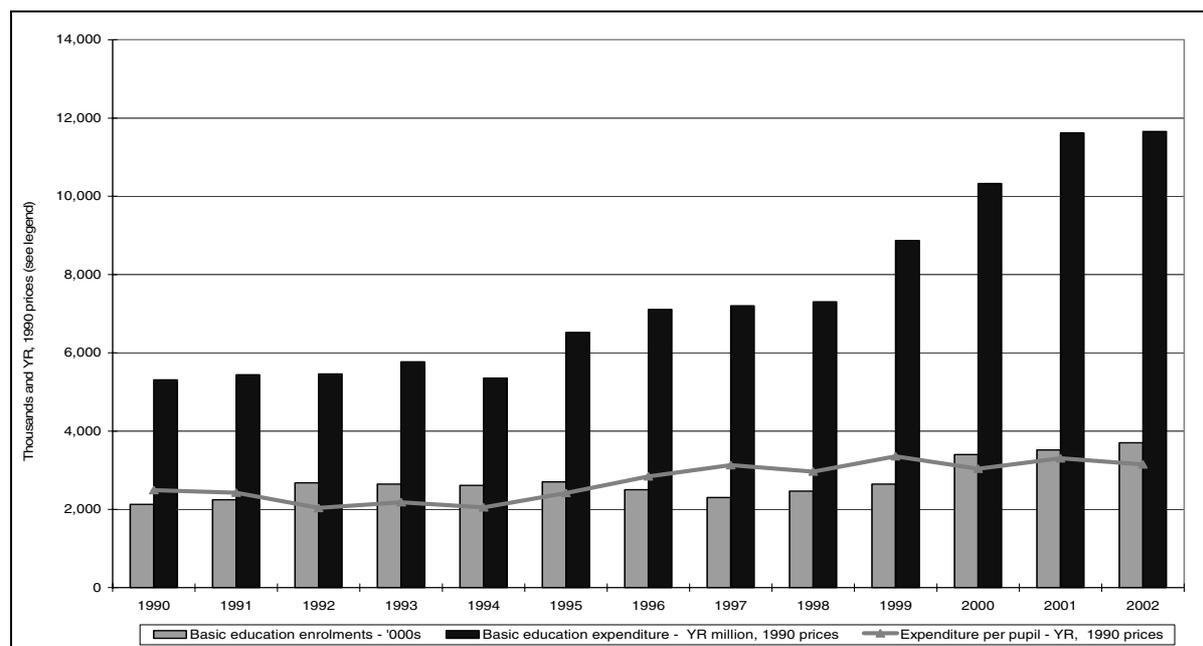
Sources: EdStats, World Bank (1996b), Republic of Yemen (2004) and author's estimates
Note: Expenditure from 1995 estimated on the assumption that 85% of public expenditure on education is spent on schools, of which 85% is spent on basic education.

Enrolment in Grade 1 grew very fast in these years, rising from 77% of 6-year-olds in 1998 to 103% in 2002 (Fig. A1.27). However, drop-out rates remained high, with only 64% of children entering Grade 1 reaching Grade 6, and only 46% reaching Grade 9. Thus, the overall rate of gross enrolment in grades 1-6 in 2002 was 83% and in grades 1-9 only 65%. Net enrolment in Grades 1-6 is only 72%. With nearly 30% of its Grade 1-6 children out of school, Yemen faces an uphill task in achieving its goal of universal basic education by 2015.

Total expenditure rose little in constant prices until 1995, but increased thereafter in the years up to 2003 at a rate of 10.3% p.a. (Fig. A1.26). Expenditure on basic education has grown faster than GDP,[13] rising from 3.7% of GDP in the mid-1990s to 4.7% in the years since 2000. Its increase in real terms coincided with the increase in the rate of GDP growth which occurred in the second half of the 1990s, when the country was free from domestic conflict and was benefiting from growing oil revenues. Yemen's expenditure on basic education has been reasonably high, but its cost-effectiveness has been low, compared with other low-income countries.

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[13] With an elasticity of 1.16.

Fig. A1.27 Yemen: Enrolment rates: Grades 1-6 gross and net and in Grade 1
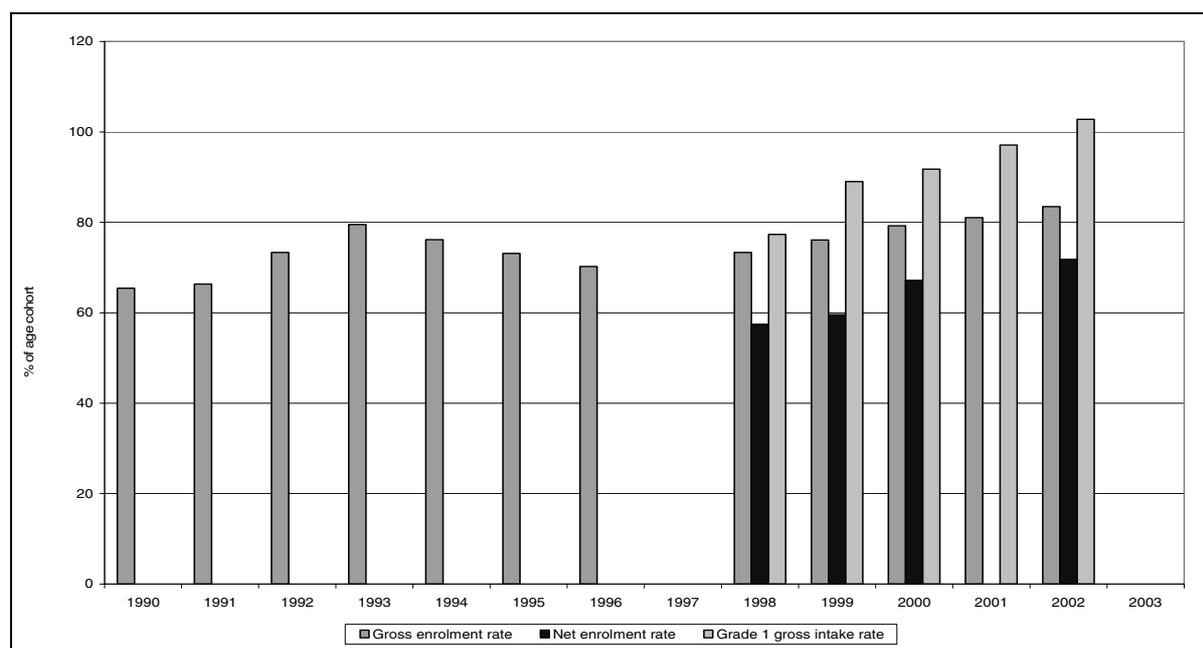

Source: EdStats

Recurrent and capital costs per pupil were falling in most years up to 1995, then rose in most years up to 2000, before levelling out. In the early 1990s, unit costs were about Yemeni Rials 2.4 million p.a. (in 1990 prices). At their lowest in 1995, they fell to close to YR 2 million. They then rose to YR 3.3 million in 2000 (in 1990 prices), before settling just below this level in subsequent years. The average incremental cost, YR 4.12 million in 1990 prices, was well in excess of unit costs (Fig. A1.28).[14]

In summary, unit costs have risen somewhat over the period along with increases in total expenditure, but have stagnated or fallen at times when enrolments have expanded quickly. The trend has been upward under the influence of the growth in expenditure since the mid-1990s, despite the rise in enrolments since the late 1990s. Incremental costs have exceeded average costs.

The factors determining these developments are trends in input unit costs in the technical efficiency with which inputs have been converted into outputs (enrolments). The main input cost item has been teachers' salaries which have amounted on average to some 80% of recurrent expenditure. Other recurrent cost items have been administrative overheads, teaching materials and maintenance of facilities. The purchasing power of teachers' salaries was severely eroded in the 1990s by inflation and by a policy of holding down nominal pay rates in the public sector. The average wage of YR 5,560 per month in 1990 was reduced by 1996 to only YR 810 per month (at constant 1990 prices) (World Bank, 1996b). This policy was reversed for the teaching profession by the 1998 Teachers' Law which introduced substantial incentive bonuses. A major part of the total expenditure increase over the years 1998-2003 depicted in Fig. A1.26 is due to increases in teachers' pay.

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[14] Annual incremental costs cannot be defined for the (several) years in which estimated enrolments declined. An average incremental cost is therefore calculated by regressing total expenditure on enrolment.

Fig. A1.28 Yemen: Basic education 1991-2003

_____	Regression line (slope = marginal cost)	----------	Ray through data means (slope = average cost)
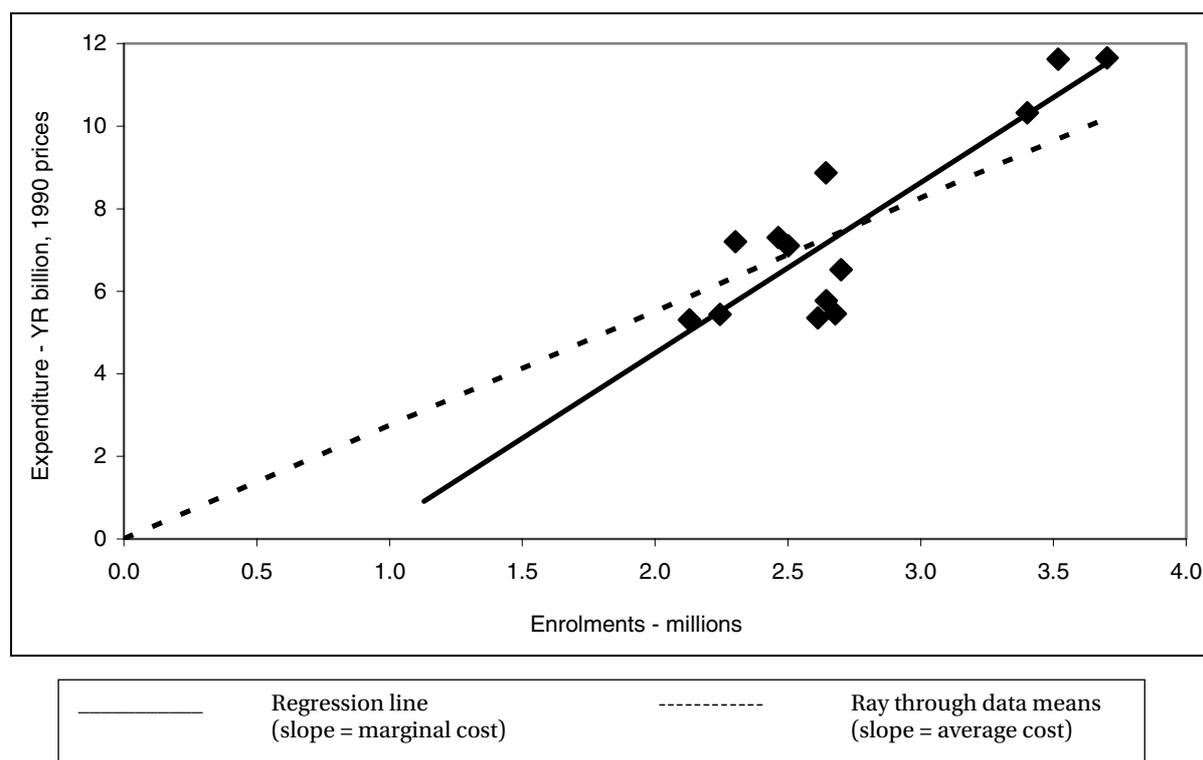
Regression equation: EXPENDITURE = -3.75 + 4.13*ENROLMENT (R-squared=0.76)

[5.91]

Sources: EdStats, Republic of Yemen (2004) and author's estimates

Basic education in Yemen has had low levels of technical and 'internal' efficiency, though there are indications of recent improvement, with gratifyingly lower repetition and higher completion rates (Table A1.10). The average pupil/teacher ratio is quite low (just below 30), teachers are excessively congregated in urban areas and their work schedules are often light, and the ratio of administrative overheads to teaching costs has been excessive. Teaching quality is often poor, and pupils' cognitive skills are below those of their peers in other countries. When repetition rates were over 10%, pupils were taking a reported average of 14.6 years to complete the nine-year curriculum.

Table A1.10 Yemen: Basic education efficiency indicators

	1995	1998	2000	2002
Primary completion rate (%)	-	57.8	57.9	65.5
Repetition rate (%)	-	10.6	7.0	4.3
Survival to Grade 5 rate (%)	-	-	74.5	75.9
Pupil/teacher ratio	29.8	-	29.8	-

Source: EdStats

Reforms intended to increase access, raise education quality, rectify a severe gender imbalance, focus resources on basic education and improve management have been under way since 1998. A Basic Education Expansion Programme covering four governorates was succeeded in 2001 by a more ambitious, nation-wide, Basic Education Development Strategy. These programmes have set out to improve the skills and motivation of teachers through in-service training and financial incentives, upgrade school buildings and facilities and improve the supply of teaching materials. They have also sought to shift resources from administration to front-line services, and to redeploy teachers. Though some of these

reforms have been cost-saving, their net effect has been to raise the costs per pupil enrolled in basic education. Their main benefit will be to improve the system's internal efficiency – by reducing repetition and raising the rates of retention and completion.

Basic education costs have thus risen faster than enrolments since the mid-1990s – and seem set to continue to do so – because of:

i.   a rise (reversing the earlier decline) in the relative price of the principal input, viz. staff salaries,

ii. the need to make good an investment backlog - through expenditure on new and improved facilities, training and higher quality inputs - in order to continue raising enrolment rates by means of internal efficiency-enhancing reforms,

iii. technical inefficiencies in producing outputs, mainly related to administrative weaknesses and the inefficient deployment of professional staff, and

iv. the necessarily rising marginal cost of providing a quality public service in remote and mountainous rural areas where population densities are low.

Annex 2: Costs of Scaling Up Public Expenditure: The Case of Road Maintenance

A2.1 Introduction

All countries need to maintain their roads. They pay a high price in terms of higher road users' costs – with higher expenditure on fuel and vehicle maintenance, and longer journey times - and of expenditure on remedial rehabilitation if they allow the state of their road networks to deteriorate through neglect of maintenance.

A2.1.1 Definitions

Information on the costs and output of road maintenance activity, usually disaggregated by province and district, is routinely kept (if not published):

- Expenditure on road maintenance is identifiably recorded in the fiscal accounts of most countries, either because responsibility for this function is entrusted to public sector entities such as central or local public works departments, or because it is outsourced under contract to arms-length public agencies or to private contractors.

- Road maintenance output is usually measured by the number of kilometres of (each category of) road which has been subject to defined maintenance procedures.

This information makes it readily possible to relate expenditures incurred to outputs achieved.

Road maintenance work is usually divided into the two categories of routine maintenance and periodic maintenance. Both of these are generally charged to the recurrent budget.

- Routine maintenance covers: grass cutting, bush clearing, drain and culvert cleaning, filling and patching potholes and gullies, and light grading. It should occur annually.

- Periodic maintenance involves: spot improvements and surface repairs, including regravelling and resealing. The periodicity of these operations is determined by traffic densities, and roads' proneness to damage from weather and subsidence. The median maintenance cycle may last five years.

A2.1.2 Cost structures and contract types

Cost structures in road maintenance are variable according to the choice of technique and technical efficiency in resource use. Conventional techniques make use of mechanical equipment not only for transporting staff and materials to site but also for performing on-site works such as grading, re-surfacing and rolling. Labour-based techniques have been found in some countries (Ghana, Tanzania) to be up to 30% cheaper than conventional ones because of savings in the user costs of plant and equipment (Heggie and Vickers, 1998).

This said, as a rough guide, the financial cost structure of road maintenance is as follows. The largest cost item in routine maintenance is fuel and other vehicle user- and capital-costs (40-60%), followed by materials (10-20%) and labour (10-20%). The remainder consists

of administrative overheads. Techniques may be more or less labour-intensive, depending on technical preference, location, and the relative costs and availability of labour and equipment. In the case of periodic maintenance, the cost structure comprises a larger (though variable) element of materials costs.

This cost structure makes road maintenance relatively immune from possible increases in input prices consequent on increases in activity levels. The supply of fuel, vehicle spare parts and unskilled labour is generally fairly elastic – except in periods of high demand for labour in agriculture. The greatest danger lies in shortages of management and skilled supervisors. If maintenance is performed departmentally, these shortages result in bottlenecks and implementation delays, but not in cost increases. If maintenance is contracted out in a sellers' market where few contractors compete, tender prices may rise – and *vice versa* in a competitive buyers' market.

Traditional public works departments have made inefficient use of both personnel and machinery for maintenance works, because of erratic flows of funding and thus of activity levels, and institutional resistance to efficient methods of working. In the absence of accrual budgeting, there has been no proper budgetary measure of the cost of the (often donor-provided) equipment in their plant pools, which have typically had low levels of availability and utilisation (ibid.).

The advantages of outsourcing maintenance operations to private contractors are threefold. First, contractors have greater flexibility than government departments in the hiring and deployment of labour. Second, they have a better sense of the opportunity cost of plant and equipment - which they must buy or hire. And third, if they are working to satisfactorily structured contracts, and if factor price ratios reflect scarcities, they have a financial incentive to deploy their resources with both technical and economic efficiency.

Budgeting for road maintenance works has traditionally been based on norms and stated unit costs. Budget bids by roads agencies are usually couched in terms of the funds required to maintain stated lengths of road of stated types to desired standards, for each of which there is an empirically ascertained unit cost. In a number of countries roads agencies have road management models which calculate maintenance needs and budget requirements based on the current state of road surfaces and traffic densities. Little or no account is taken in budget bids of possible variations in input prices, or in technical efficiency, resulting from changes in activity level.

Road maintenance contracts may be structured in various ways, ranging from lump-sum payments where contractors shoulder all risks of cost variations to cost-plus contracts where the government agency bears all the risk. In developing countries price-based ('admeasure') contracts are common in which bills of quantity are established, and contractors are paid negotiated unit costs for work done, plus an element of profit, subject to verification that the works have been performed to the prescribed standard. The roads agencies negotiate from prior information about acceptable unit costs which they are able to impose on inexperienced contractors (ibid.). More experienced contractors may challenge agencies' costs, but they can only increase their profitability by reducing their costs below agreed rates by means of astute procurement and hiring practices and technical efficiencies. In short, traditional contracting practice induces contract price stickiness. In some developing countries new forms of term contract have been tried wherein contractors are held responsible, over multi-year periods, for maintaining given roads in a prescribed state.

The difference between efficient and inefficient maintenance operations lies primarily in the physical productivity of workers engaged in the maintenance and in logistics. The longer the journeys required to bring supervisors, staff and materials to sites of activity, the higher the

labour costs, vehicle/equipment user costs and materials costs are likely to be per km of road maintained.

A road maintenance department or contractor which increases its activity rate may experience rising short-run marginal costs if required to mobilise to sites remote from the main operating base, thus incurring high logistical costs. In the absence of competition, this may be reflected in contract prices. On the other hand, if road maintenance activity is raised permanently from a low level to a higher level, new contractors with lower mobilisation costs may well be encouraged to enter the market, thus reducing long-run marginal costs below the level of short-run marginal costs. Strong competition between contractors may even raise technical efficiency and lower profit margins, causing contract prices to fall.

There is therefore no dominant prior hypothesis about whether unit expenditures will rise or fall when road maintenance activity is stepped up. Factor and input prices will not necessarily rise, neither will technical efficiency necessarily fall. Institutional and management reforms combined with strengthened competition may even cause unit costs to fall.

A2.1.3 Financing road maintenance

Many developing countries have under-funded road maintenance, especially in times of budgetary austerity. The reason for this is that, when public expenditure limits are tight, it is an easy option to cut deferrable recurrent expenditures – such as maintenance and the procurement of materials and services – so as to ensure that the wages and salaries of established staff can be paid from the funds available. In addition, governmental public works departments, the entities traditionally entrusted with road maintenance, have been found to be inefficient in their use of resources, leading to high costs per km of road treated (unit costs) and low maintenance standards (Harral and Faiz, 1988).

Accordingly, since the mid-1980s the World Bank has been encouraging developing countries to establish 'road funds' dedicated to the financing of maintenance expenditure. These funds in many cases increased road maintenance budgets substantially. This Annex reviews financing developments and activity levels in Ghana, Tanzania and Zambia, three countries which have succeeded in expanding their maintenance budgets and programmes.

Road funds have collected the proceeds of road user charges, such as road and bridge tolls, international transit fees, weighbridge charges, and traffic fines. However, the main source of revenue in all cases has been a vehicle fuel levy, which is notionally distinct from and supplementary to the normal excise tax on fuels. The principle underlying these arrangements is that user charges fulfil a different economic purpose from taxes, and can therefore be hypothecated to meet road users' needs without undermining the integrity of the budget. Some countries have, however, supplemented these dedicated sources of funding with transfers from general taxation.

Road funds have been administered separately from the consolidated state budget; they are managed by their own accountable boards or administrators. They are not, however, executive agencies for roads or highways: they disburse funds to established public works departments, ministries of transport or roads agencies to finance agreed programmes of maintenance activity.

Where established, road funds have had the desired effect of – eventually - raising the volume of public funds devoted to maintenance. Disbursement increases have in practice lagged behind the creation of funds, sometimes by several years, because of administrative

and procedural difficulties associated with the opening of new funding channels. These road fund-induced increases in public expenditure offer an opportunity for examining the evolution of the unit costs of maintenance activity during episodes of activity expansion.

A2.2 Country case studies

A2.2.1 Ghana

Ghana has a network of some 12,400 km of trunk roads, 24,000 km of feeder roads and nearly 4,000 km of urban roads. The Ministry of Roads and Transport has overall responsibility for policy and financing on road maintenance, but executive responsibility (for maintenance and construction) is exercised respectively by the Ghana Highways Authority (GHA), the Department of Feeder Roads (DFR) and the Department of Urban Roads (DUR).

Ghana established a Road Fund financed by user charges in 1985, and restructured it in 1997. It has the same objective as in other countries with a similar institution, namely, of providing an enhanced and regular flow of funding for the routine and periodic maintenance of the road network, for which it is the sole source of domestic funding. The user-charge resources which it collects - 90% of which are the proceeds of a fuel levy - are distributed to the three executing agencies (GHA, DFR, DUR) on the basis of the budgets which they submit to it. The GHA is awarded 50-70% of annual allocations (Fig. A2.1). The Road Fund's user-charge collections have typically exceeded its allocations to the executing agencies – strongly so since 1998 - and the agencies' recorded receipts have exceeded their recorded disbursements.

Fig. A2.1 Ghana: Road fund collections and allocations by agency
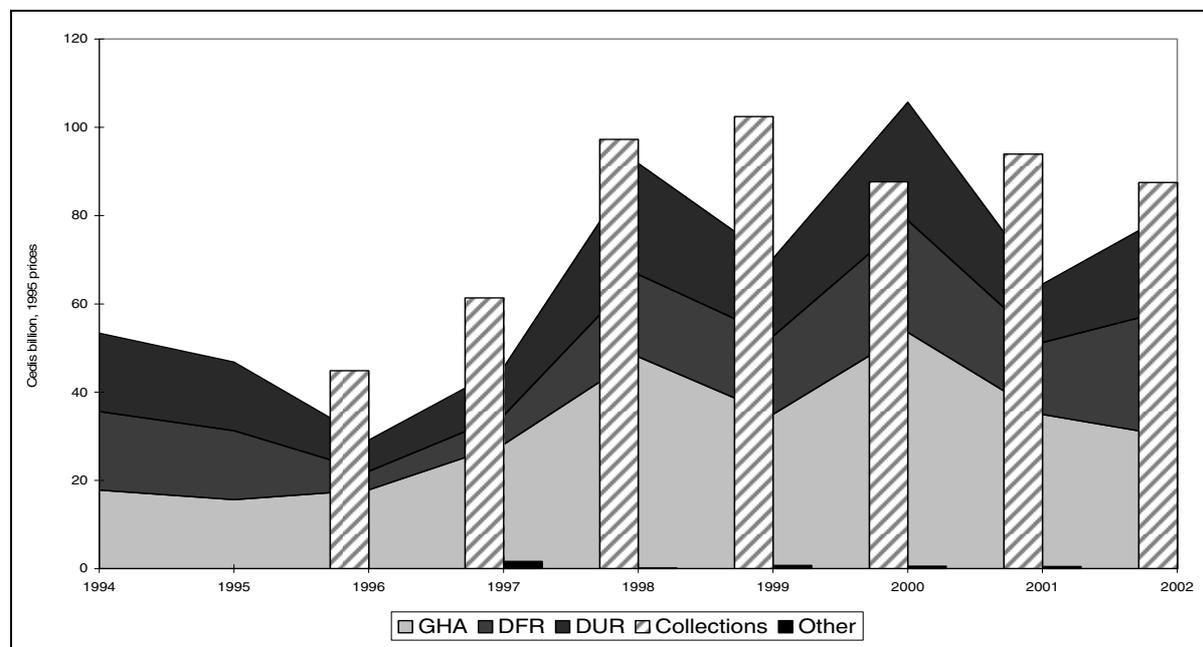
Sources: Road Fund Secretariat, MRT reports (quoted in Adams, 2001) and author's estimates

The state of Ghana's road network deteriorated in the 1970s and 1980s because of the underfunding of its maintenance and falling real wages for the departmental labour forces. Maintenance was undertaken departmentally until the introduction by the GHA in 1983 of

'single-man contracts' under which the routine maintenance of short sections of road was contracted out to individuals (or small companies). The practice of contracting out maintenance developed progressively from that time until, by the mid-1990s, 90% of routine maintenance was undertaken by contractors on the basis of competitive bidding.

The objective of rectifying a maintenance backlog and ensuring satisfactory levels of maintenance financing has not been fully achieved. The country was, in the early 1990s, prone to high levels of inflation which eroded the purchasing power of sums collected and allocated. In the later 1990s, however, real allocations and disbursements increased considerably.

The length of trunk roads receiving routine maintenance rose from 4,400 km in 1996 to 6,300 km in 2000 and 13,100 km in 2004. The length of feeder roads receiving routine maintenance rose from 2,000 km in 1996 to 11,000 km in 2000 and to 18,500 km in 2004. As a result, the proportion of the trunk road network rated as in 'good' condition rose from 19% in 1997 to 30% in 2000, and the proportion of the network in 'fair' condition from 23% in 1997 to 38% in 2000. (The condition of the network has not changed markedly since 2000).

Efforts in the 1990s to control inflation through limits on releases of public expenditure compounded serious management problems in the road sector, leading to persistent arrears in payments to contractors. This had the adverse effect of raising unit costs as contractors augmented their bids in expectation of late and erratic payment. Payment arrears have subsequently been contained and reduced. The fall in unit costs, notably in feeder road maintenance, is partly explicable by the now greater professionalism of road sector agencies' contract management practices.

Data availability on road maintenance in Ghana has improved since 1996 when regular performance evaluations began. An analysis of the costs of routine maintenance of both trunk and feeder roads indicates that real unit costs have been constant, or even falling over most of the last decade (Figs. A2.2 and A2.3).

Total expenditure on trunk road maintenance (in 1995 prices) rose from Cedis 6.2 billion in 1996 to Cedis 12 billion in 1998; it then fell to Cedis 7.3 billion in 2001, and then increased to 20 billion in 2004. Expenditure on feeder road maintenance rose similarly, from Cedis 2.4 billion in 1996 to Cedis 5.9 billion in 1998 and Cedis 8.5 billion in 2003. Expenditures have fluctuated roughly in line with the length of road undergoing maintenance; there has therefore been relatively little annual variation in per-km maintenance costs. In the case of trunk roads unit costs have varied between Cedis 1.1 million and 1.7 million per km of road; for feeder roads unit routine maintenance costs have fallen from Cedis 1.2 million per km in 1996 to Cedis 0.4 million in 2004.

Fig. A2.2 Ghana: Trunk road maintenance 1996-2004: Km maintained, total cost and unit cost
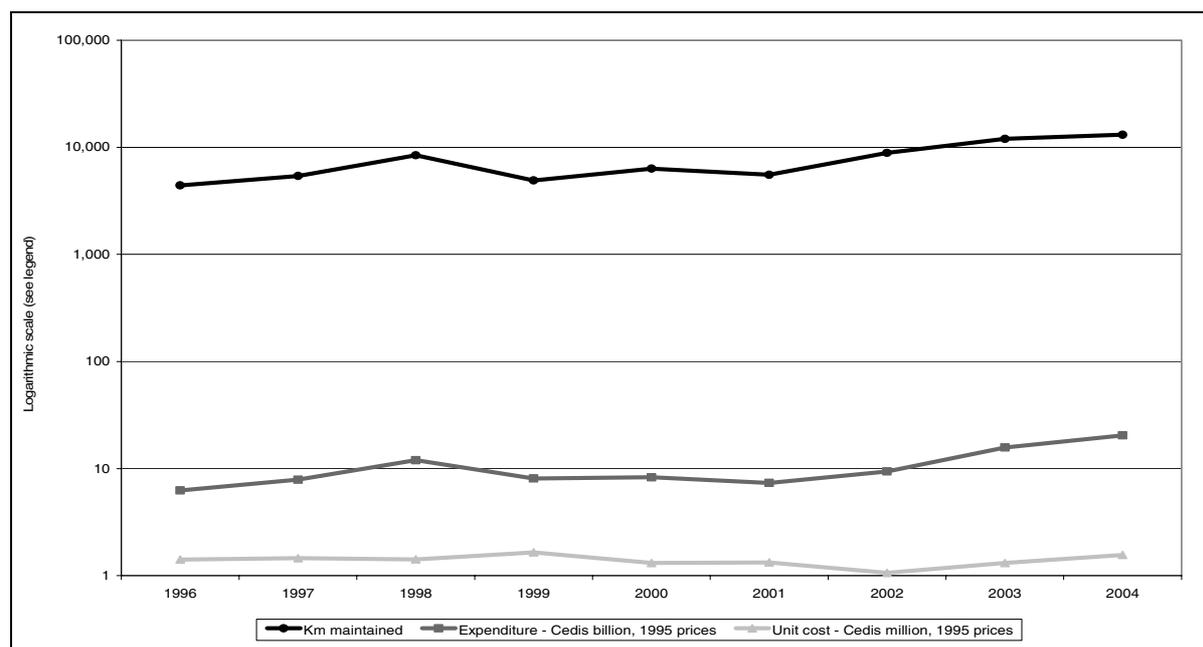

Fig. A2.3 Ghana: Feeder road maintenance 1996-2004: Km maintained, total cost and unit cost
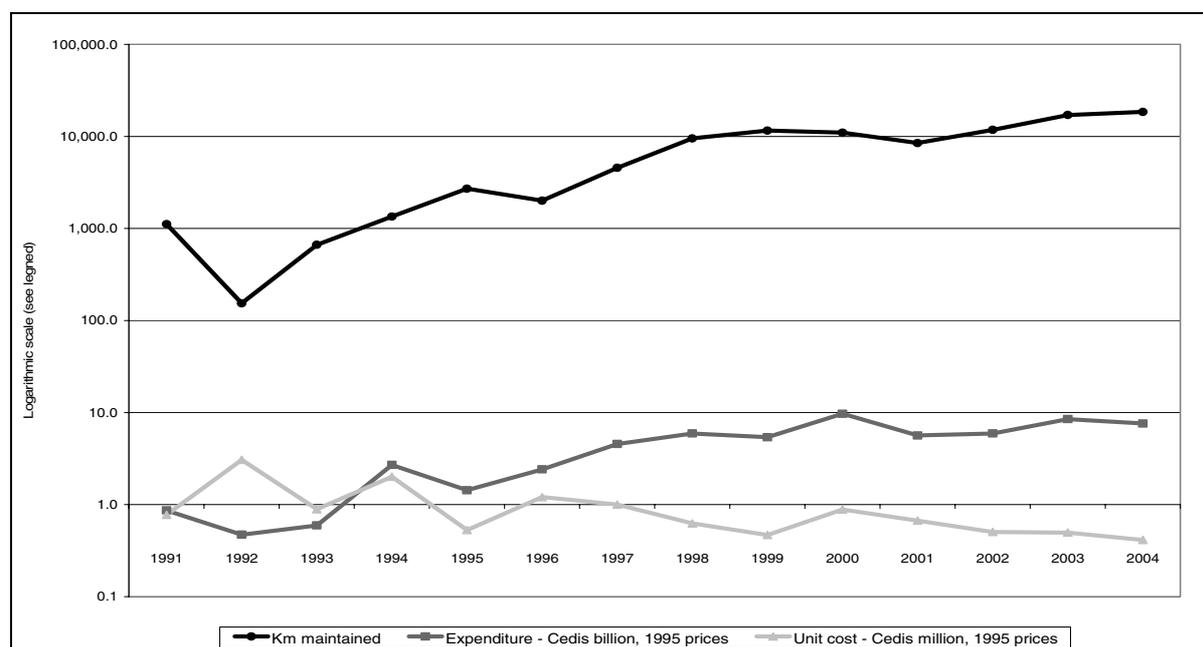

Sources: Adarkwa (2005) and author's estimates
*Note*: Feeder road expenditure from 1991-5 comprises an element of periodic as well as routine maintenance.

The incremental cost of maintaining trunk roads has been Cedis 1.44 million per additional km of road maintained - which is roughly the average of annual unit costs. The incremental cost of feeder road maintenance, by contrast, has been well below the range of annual unit costs at Cedis 0.32 million. (Incremental costs are derived from the simple regression equations, the results of which are reported in Figs. A2.4 and A2.5). Marginal routine maintenance costs have thus been constant for trunk roads and falling for feeder roads.

Fig. A2.4 Ghana: Trunk road maintenance 1996-2004

——————— Regression line (slope = marginal cost)	------------ Ray through data means (slope = average cost)
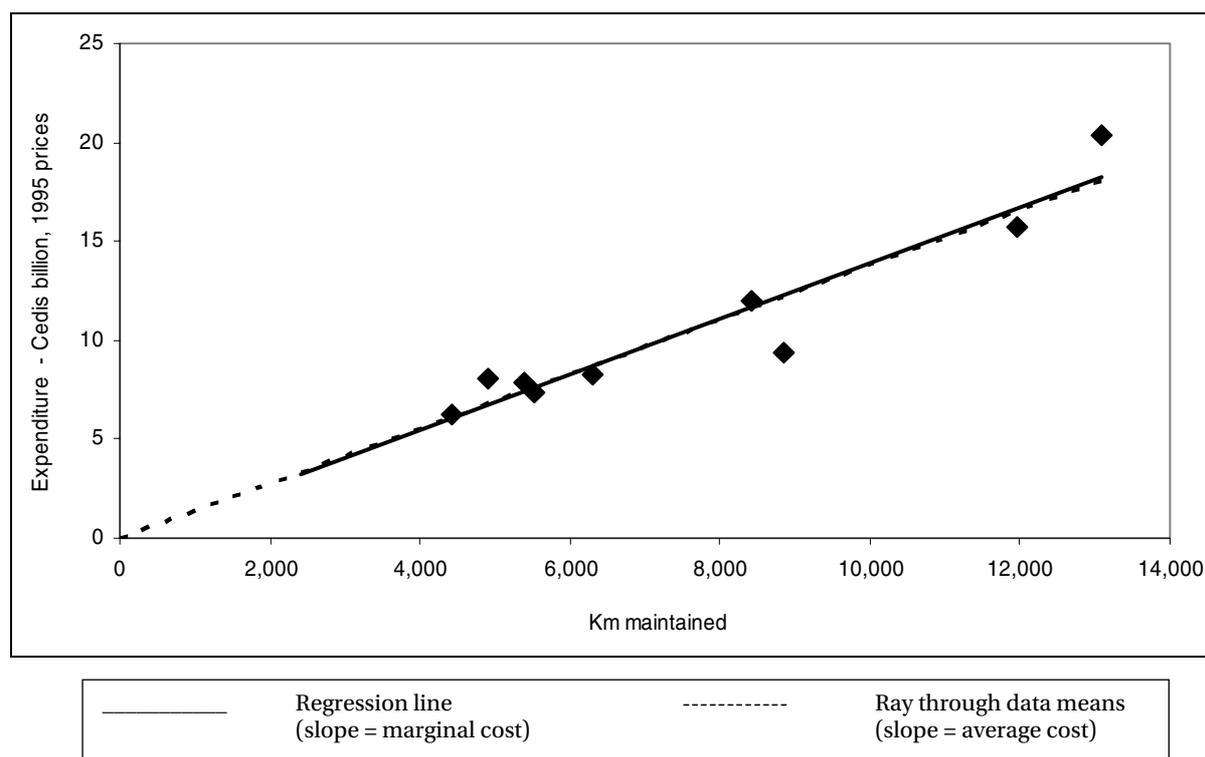
Regression equation: EXPENDITURE = -0.19 + 0.0014*KM (R-squared=0.91)
[8.20]

Fig. A2.5 Ghana: Feeder roads routine maintenance 1996-2004

——————— Regression line (slope = marginal cost)	------------ Ray through data means (slope = average cost)
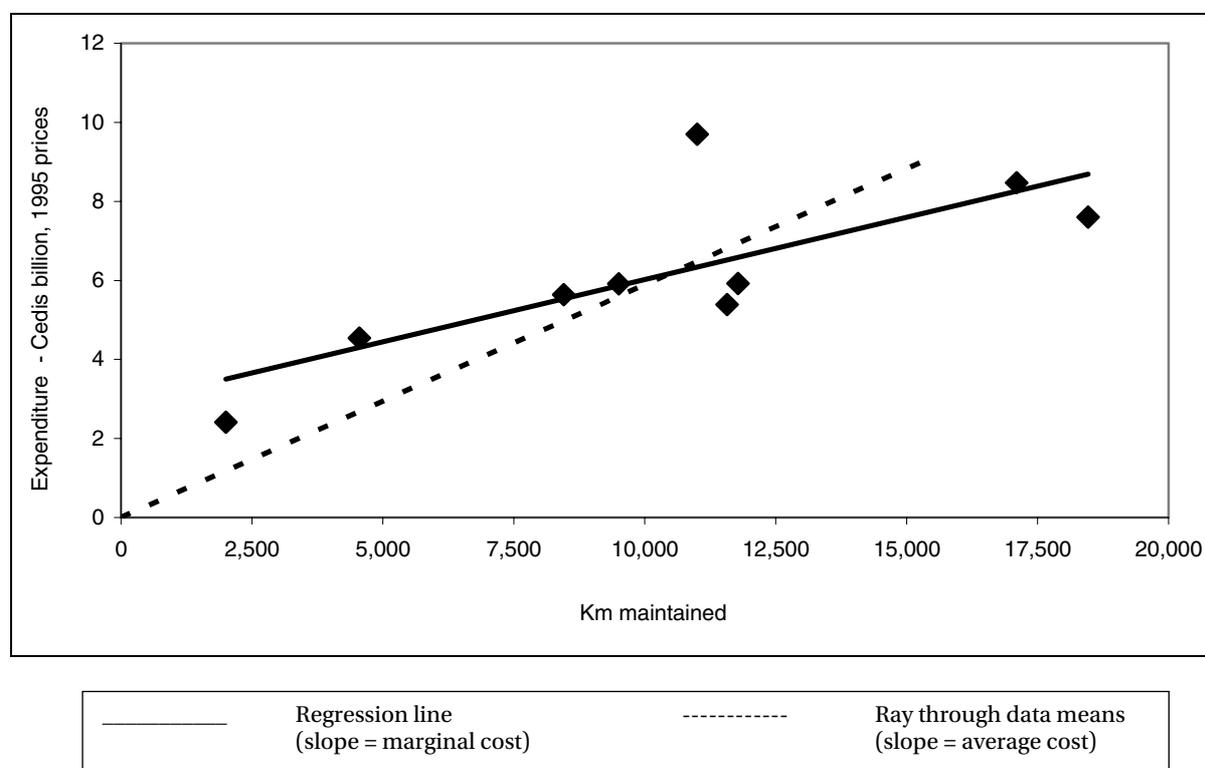
Regression equation: EXPENDITURE = 2.87 + 0.0003*KM (R-squared=0.59)
[3.16]

A2.2.2 Tanzania

Tanzania was an early adopter of the Road Management Initiative approach to the financing of road maintenance promoted by the World Bank. An Act of Parliament in 1985[15] authorised the collection of road tolls. Two road maintenance funds were created later for roads which were the responsibility of the central government and of local government authorities respectively. These were financed from the proceeds of tolls, and later from a specific duty (levy) on petrol and diesel fuel. A later reform in 1998 amalgamated the funds, creating a statutory Road Fund − 90% of whose resources were earmarked for maintenance - to be managed by a Road Fund Board.

Some 95% of the resources of the Road Fund are currently derived from the proceeds of the fuel levy of approximately 15% of the retail price of petrol and diesel (Kweka and Wanga, 2005). The remainder comes from transit fees levied on international goods traffic, HGV licence fees and fines (for overloads). Fig. A2.6 shows that Fund receipts rose rapidly in real terms in the early 1990s (from TSh 21,000 in 1991/2 to TSh 55,000 in 1995/6 in 2000 prices[16]), but fell in the later 1990s, only recovering to the earlier peak in 2003/4 and 2004/5.

The Road Fund distributes (the bulk of) its resources to the Ministry of Works - and from 2000 to TANROADS, a new executive agency - for trunk and regional road maintenance, and to the Presidential Office for Local Government for distribution to the local authorities for the maintenance of district and feeder roads within their jurisdiction. The share allocated to local government roads has increased from 15-20% in the early 1990s to 25-30% in recent years (Fig. A2.6).

Fig. A2.6 Tanzania: Road fund collections and allocations to TANROADS and local governments (1991/2 to 2004/5)
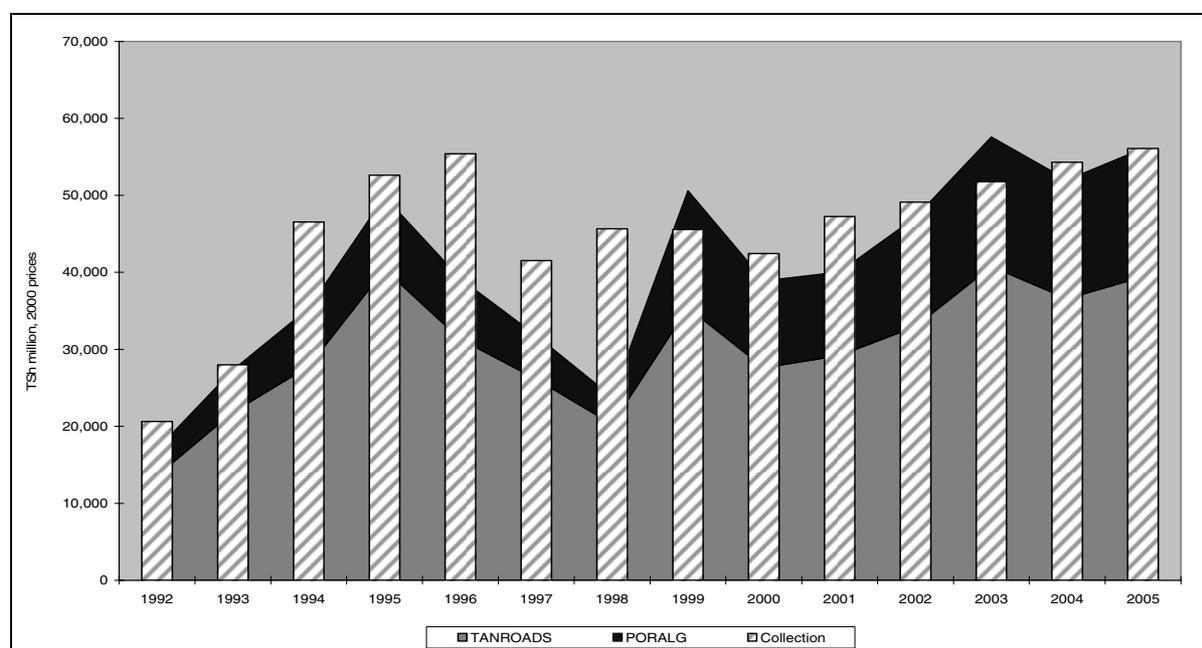
Source: Kweka and Wanga (2005)

After the reform of 1998, the rate of maintenance budget execution, i.e. actual expenditure as a share of budget allocation, improved considerably (Kweka and Wanga, 2005). For trunk

[15] Roads (Amendment) No. 2 Act.
[16] Current price data on receipts and expenditures are deflated by the GDP deflator.

and regional roads expenditure was only 57% of estimate in 1997/8, and 89% in 1998/9. After 2000, when TANROADS became operational, the execution rate rose to, and stayed at, 100% (ibid.). There was a similar and simultaneous improvement in the rate of maintenance budget execution by local authorities. The post-1998 arrangements have nevertheless been criticised on grounds of (a) their administrative complexity, with too many entities involved, (b) delays and unpredictability in the release of funds through executing agencies to contractors, giving rise to nugatory costs, (c) imprecision about the performance criteria to which executing agencies were held, and (d) diversion of funds and poor accounting standards (Kumar, 2002b). TANROADS has a performance contract with the Ministry of Works, but this initially did not specify unit cost targets or ceilings for administrative expenses; the only targets set pertained to the condition of the road network.

The relatively small number of road maintenance contractors which are deemed technically and financially qualified has been another difficulty. Most contractors are very small and few have specialist equipment and qualified staff. Most maintenance works are contracted out, but over-reliance on too small a field of qualified contractors leads to delays, especially in periodic maintenance.

Notwithstanding these problems and shortcomings in institutional arrangements, the state of the road network has improved and there have been major increases in the rate of annual maintenance activity (Kweka and Wanga, 2005). At present, for trunk and regional roads over 90% of their paved and 75% of their unpaved length is stated to be in a good or fair condition. For local authority roads the figure is only of the order of 53%, however (Road Fund Board, 2005). The rate of maintenance activity on trunk and regional roads rose from 2,500 km in 1991/2 to 21,000 km in 1999/2000 and 27,000 km in 2004/5. For district and feeder roads, the increase in activity rate was from 1,300 km in 1991/2 to 16,000 km in 1999/2000, and to 26,500 km in 2004/5 (Figs. A2.7 and A2.8).

Road maintenance unit costs fell consistently from the early 1990s to the end of the decade, and since 2000 costs have been contained at a low level.

- Prior to 1995, the average annual cost per km of combined routine and periodic maintenance on trunk and regional roads lay between TSh 5,000 and TSh 6,000 (in 2000 prices). After 2000, it was only TSh 1,200-1,600. The average incremental cost over the 1991/2 to 2004/5 period was as little as TSh 610/km (Fig. A2.9).

- For district and feeder roads before 1995, combined average annual maintenance costs per km in 2000 prices were TSh 2,200-2,600; since 2000, they have been only TSh 650-800. The average incremental cost over the 1991/2 to 2004/5 period was only TSh 522/km (Fig. A2.10).

In both cases, the fall in unit costs was noticeably faster in the 1991/2 to 1995/6 period when real expenditures were expanding fast, than in subsequent years when they falling or stagnating.

Fig. A2.7 Tanzania: Maintenance of trunk and regional roads: Costs and activity rates 1991/2 to 2004/05
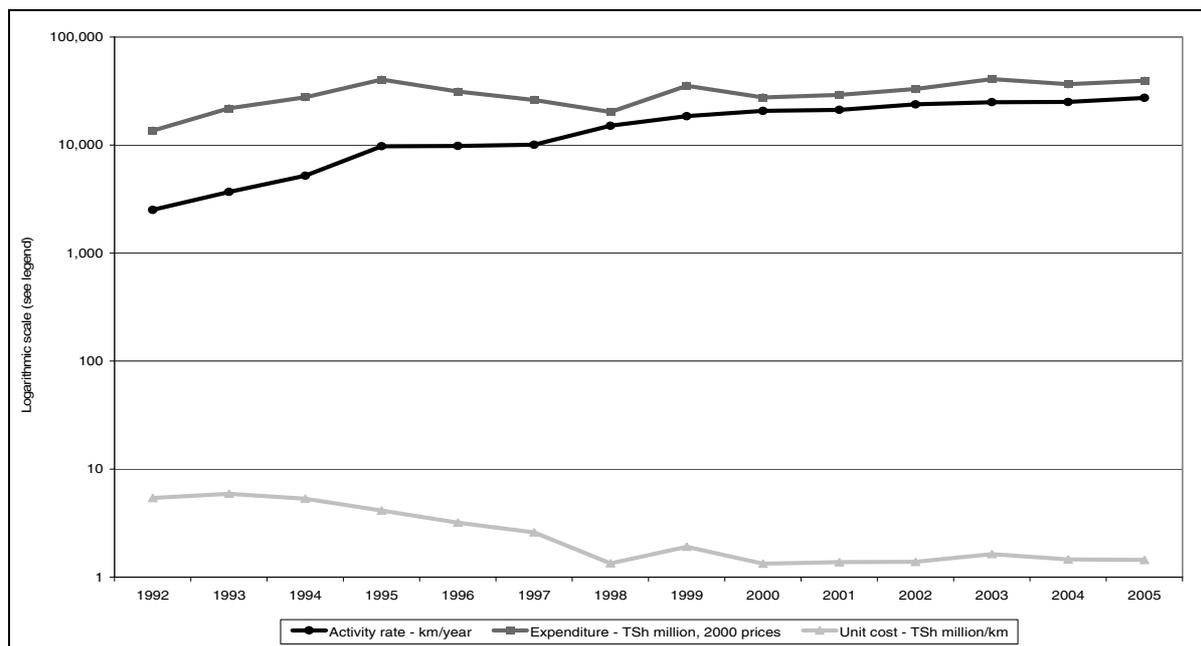

Fig. A2.8 Tanzania: Maintenance of urban, district and feeder roads: Costs and activity rates 1991/2 to 2004/05
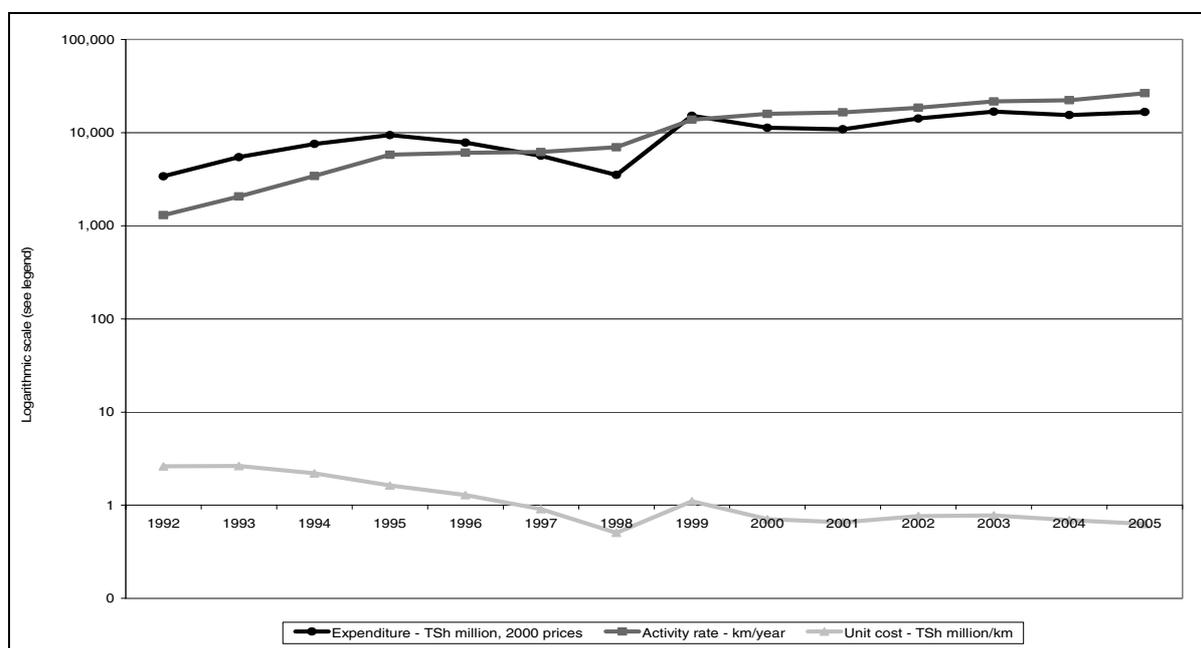

Sources: Kweka and Wanga (2005) and author's estimates

Fig. A2.9 Tanzania: Trunk road maintenance 1992-2005

| _____ | Regression line (slope = marginal cost) | ------------ | Ray through data means (slope = average cost) |
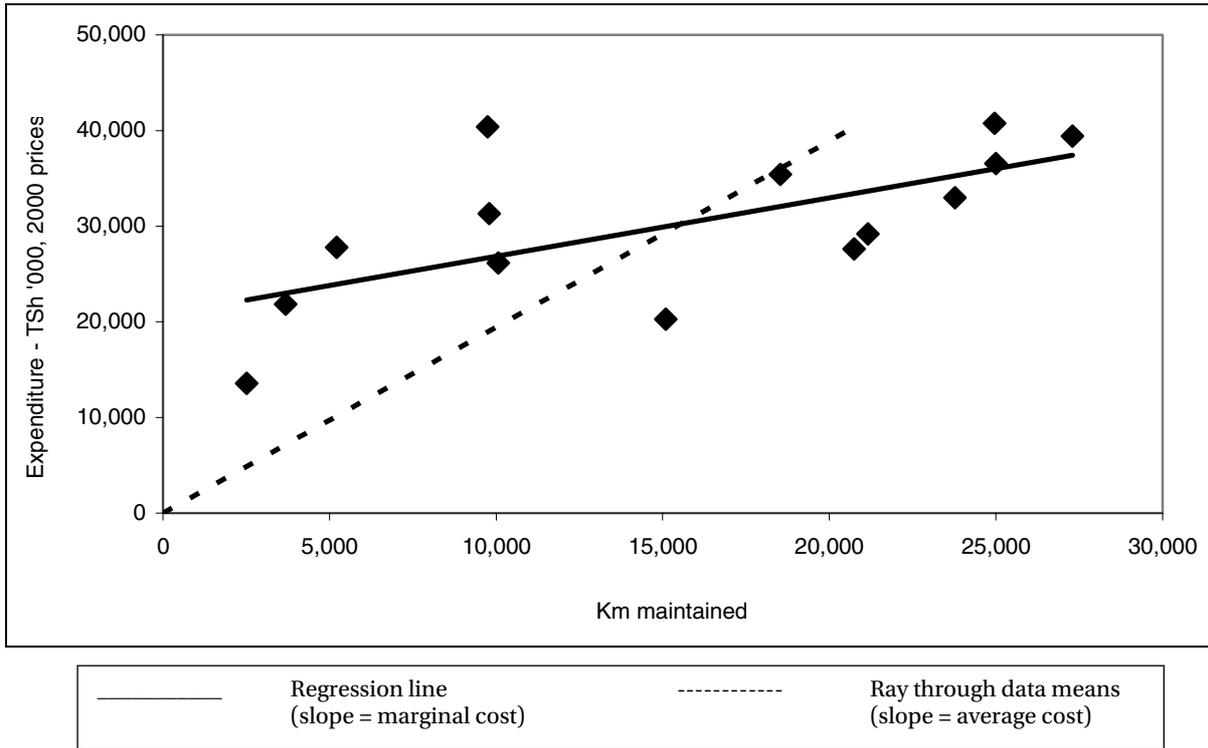
Regression equation: EXPENDITURE = 2074 + 0.61*KM (R-squared=0.42)
[2.96]

Fig. A2.10 Tanzania: Urban, district and feeder road maintenance 1992-2005

| _____ | Regression line (slope = marginal cost) | ------------ | Ray through data means (slope = average cost) |
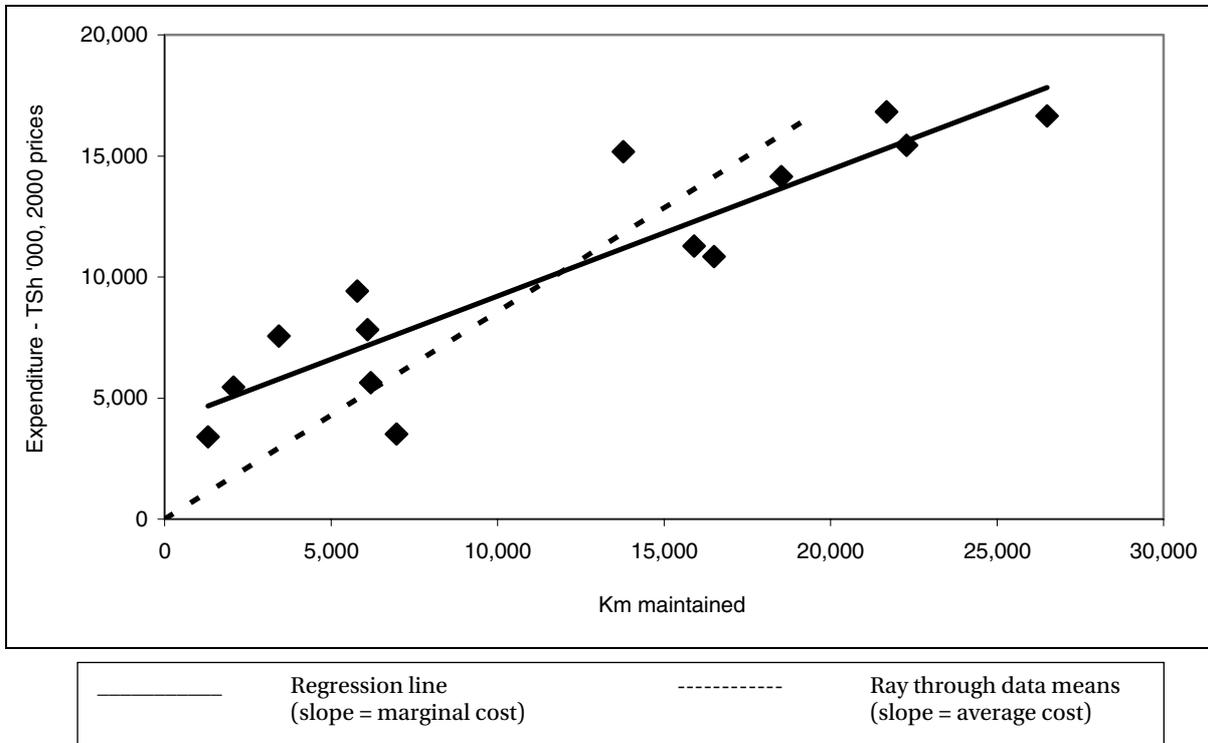
Regression equation: EXPENDITURE = 4002 + 0.52*KM (R-squared=0.82)
[7.38]

Sources: ibid.

A2.2.3 Zambia

Zambia's roads deteriorated severely as the country's economic crisis deepened in the later 1980s. In 1984 40% of its roads were in a good condition, and only 30 % in a poor condition. In 1995, only 20% were good, and 51% poor.

In 1994, the National Roads Board (NRB) was established to manage the Road Fund dedicated to the financing of road maintenance and rehabilitation by central and local government agencies. The Board was created by the Minister of Transport, but with 7 members statutorily appointed by professional and road users' groups and only 4 (non-voting) members representing central and local government. The Fund's resources were drawn from a fuel levy – raised in stages to reach 17% of the wholesale price of fuel by 1997 - and other road user charges. They were to be disbursed through established public sector agencies – the Ministries of Works and Supply and of Local Government and Housing, and the public works departments of provinces and districts - but with the proviso that private contractors should be involved as far as possible in the execution of works (Kumar, 2002a).

The NRB was renamed National Road Fund Agency in 2004, and placed under the responsibility of the Ministry of Finance. The Roads Department of the Ministry of Works and Supply was at the same time made into an autonomous Roads Development Agency (Harland, 2005).

The Board set to work vigorously, and soon formulated a first National Programme of Road Maintenance. Private consultants were appointed to assist provinces and districts to draw up maintenance plans. At the outset in 1994, there were only 4 contractors in Zambia qualified for road maintenance work; by the end of 1997 there were 120 (Kumar, 2002a). The growing number and experience of qualified contractors and the heightened competition between them have doubtless had the effect of compressing maintenance unit costs, though the extent of this cannot be quantified from the evidence available. The Board was also entrusted with formulating and prosecuting a donor-supported ten-year Road Sector Investment Programme focused on rehabilitation.

Resources for road maintenance increased from an annual average of ZK9,040 million in 1995-7 to ZK14,027 million in 1998, but declined in real terms in subsequent years, averaging ZK9,357 million p.a. in 2000-4, in 1995 prices (Fig. A2.11). Over the period 2000-3, only half the funds due to it were remitted to the NRB. In the very recent past some unearmarked funds have been added to funds statutorily earmarked for road maintenance, such as a share of the World Bank-financed Emergency Drought Recovery Project of 2003 and a share of expenditure destined for rural areas under the government's Poverty Reduction Programme (Harland, 2005).

Maintenance costs have been reduced through the practice of contracting out under consultant supervision. By 1999, only 10% of expenditure was on activities undertaken by direct labour. Contracts are let competitively. There are currently 10-12 large contractors, and some 650 small ones. Simple routine maintenance is commonly undertaken by small contractors working under 12-month, performance-based, contracts which make them responsible for keeping defined sections of road in a prescribed condition. Earlier malpractice surrounding consultants' completion certificates seems to have been suppressed (ibid.). Expectation of delays in payment are, however, a source of cost increase as contractors pad their bids.

Fig. A2.11 Zambia: Road fund maintenance disbursements 1995-2004
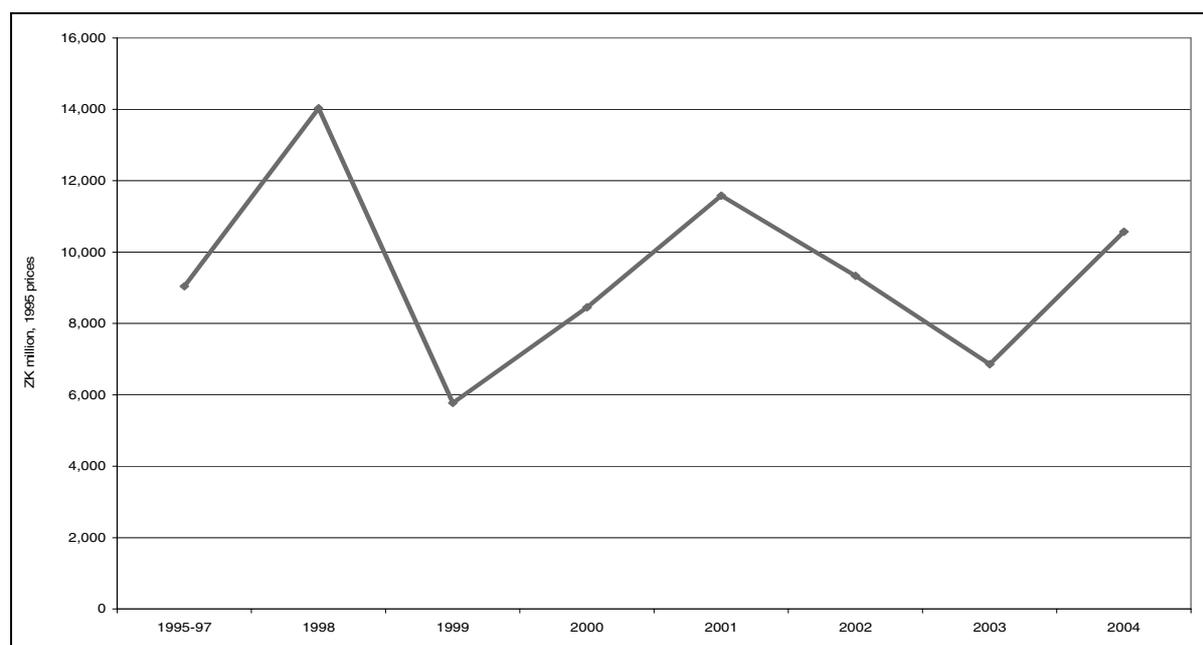

Source: Harland (2005)

Data on the volume of maintenance works performed – supplied by the Road Fund and the executing agencies concerned - are available only from 2000 to the first half of 2005.[17] They are broken down by location (urban/non-urban), road type (paved/unpaved) and according to whether the works were routine or periodic. Although the available time series is very short, it is sufficient to provide some *prima facie* evidence of a relationship between the intensity of activity undertaken (km per annum) and unit costs. The analysis has been performed for non-urban roads only, because of the inexplicably high variability of unit costs implicit in the data on urban road maintenance.

Routine maintenance

Figs. A2.12 and A2.13 display the evidence on costs and activity rates on unpaved and paved roads respectively.

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[17] Data for the first half of 2005 have been annualised so as to make activity rates comparable with those of previous years.

Fig. A2.12 Zambia: Routine maintenance of unpaved non-urban roads 2000-5: Total and unit costs
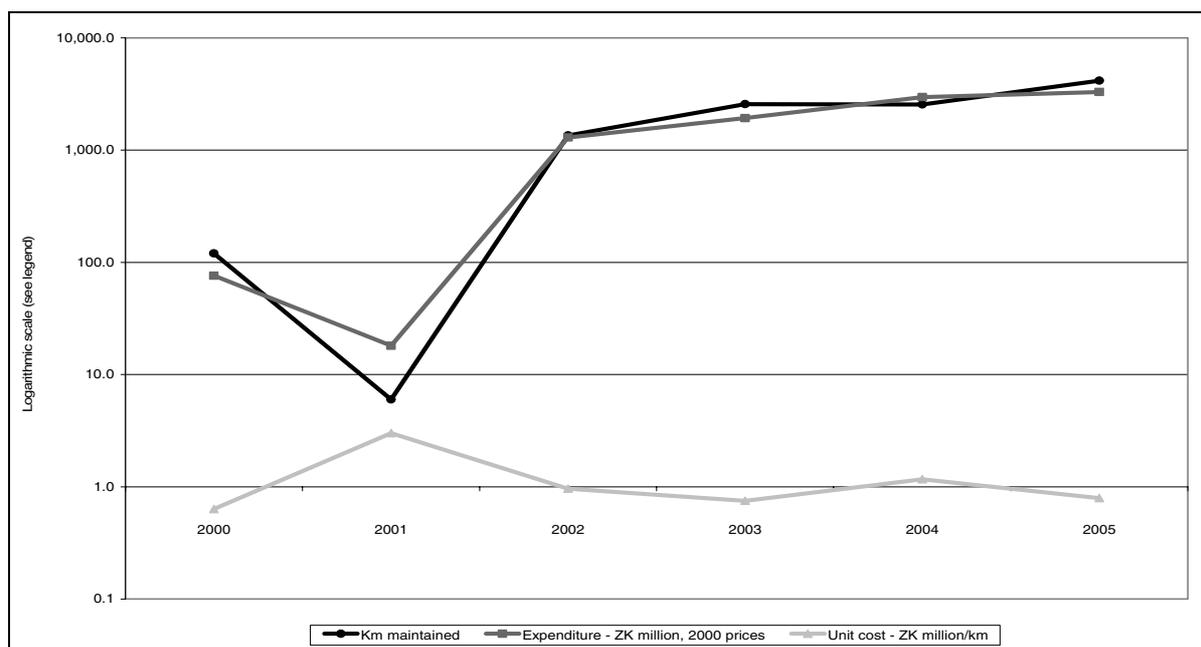
Fig. A2.13 Zambia: Routine maintenance of paved non-urban roads 2000-4: Total and unit costs
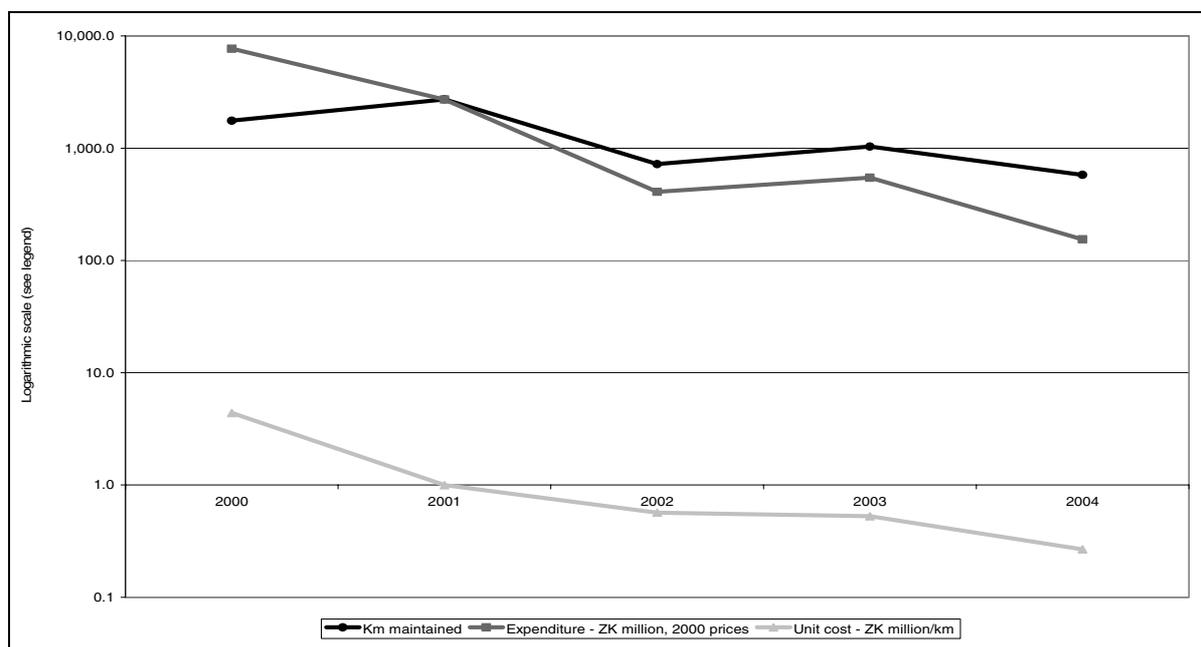
Sources: Harland (2005) and author's estimates

Routine maintenance of unpaved roads rose quickly from very low levels in 2000 and 2001 (respectively 120 km and 6 km) to reach 2,566 km in 2002 and 4,152 km in 2005. Unit costs have been fairly constant (averaging ZK0.86 million/km, in 2000 prices, except in 2001 when they exceeded ZK3 million/km). Incremental costs (ZK0.81 million) were virtually equal to average unit costs in years, apart from 2001 when costs were exceptionally high (Fig. A2.14).

Fig. A2.14 Zambia: Non-urban paved roads routine maintenance 2000-5
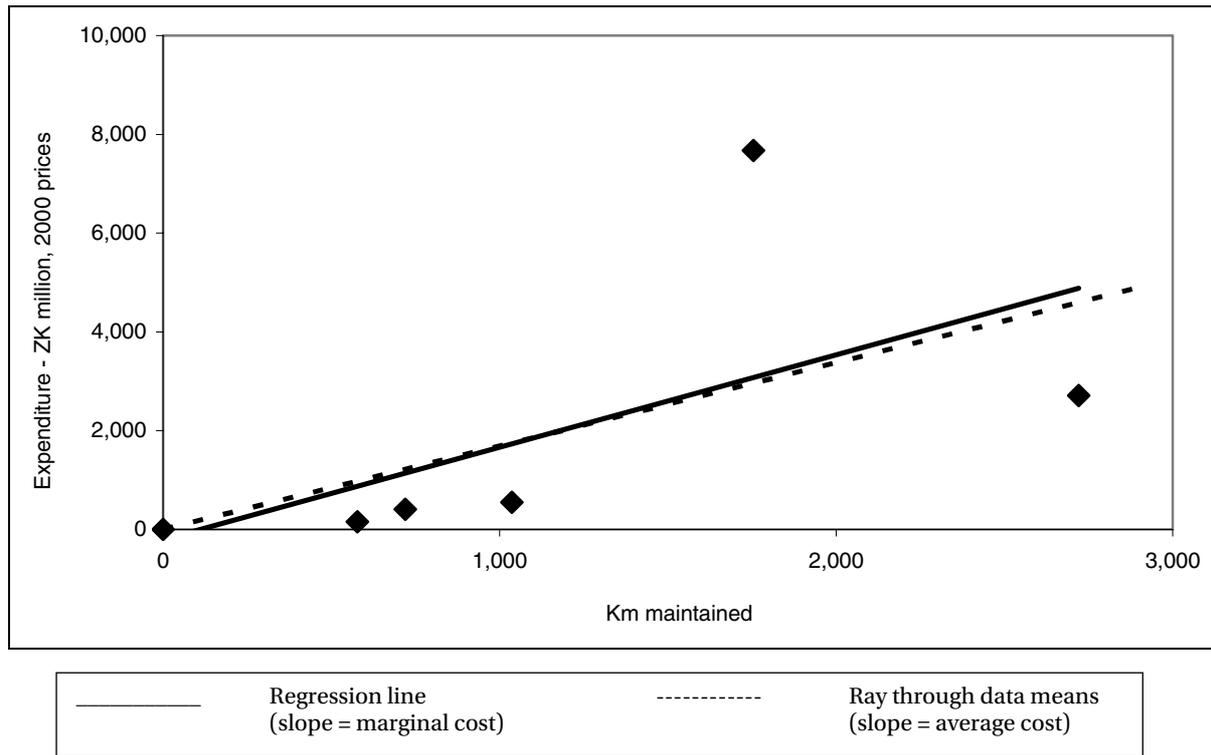
Regression equation: EXPENDITURE = -548 + 1.19*KM (R-squared=0.99)
[16.70]

Fig. A2.15 Zambia: Non-urban, unpaved roads routine maintenance 2000-5
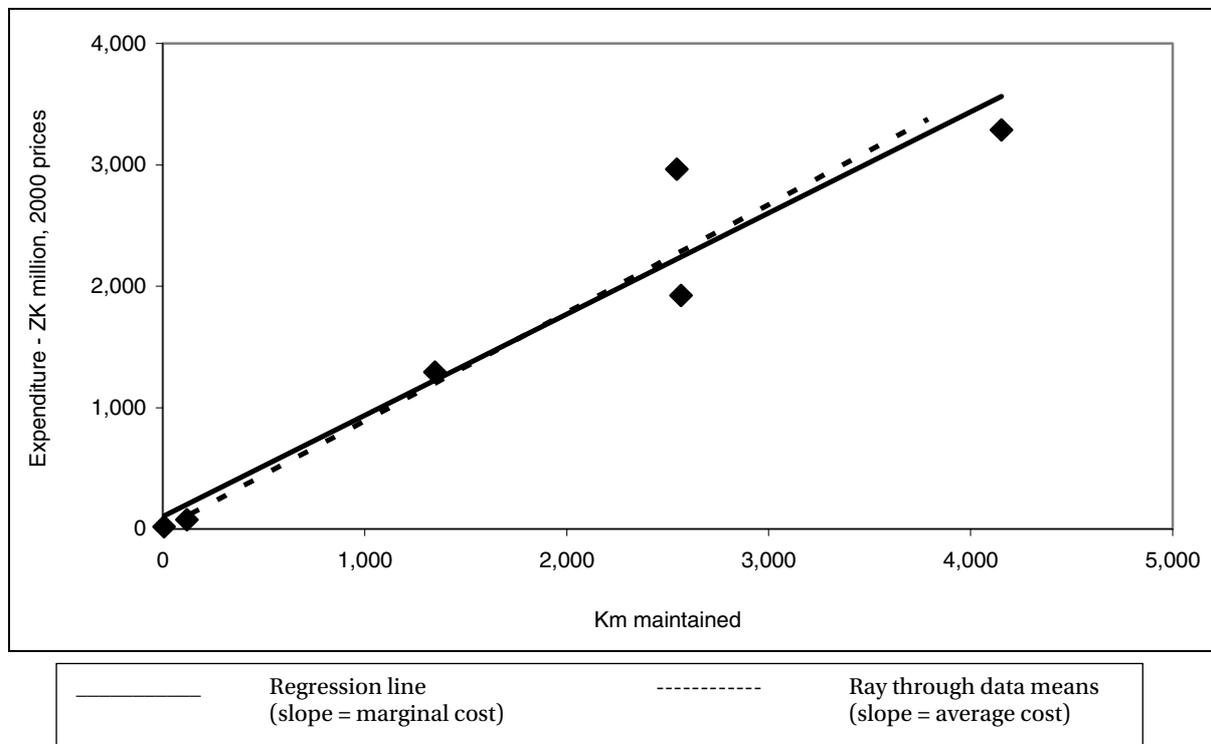
Regression equation: EXPENDITURE = 183 + 0.81*KM (R-squared=0.90)
[5.07]

Routine maintenance of paved roads, by contrast, fell from 2,720 km achieved in 2001 to 580 km in 2004 (and no recorded activity in 2005 in the period of research up to August). Unit costs appear to have fallen sharply – from ZK4.38 million/km in 2000 to only ZK0.27 million/km in 2004 (at 2000 prices). The incremental cost (ZK1.19 million/km) slightly exceeds the average of annual unit costs in this small sample of years – apart from 2000 when unit costs were exceptionally high (Fig. A2.15). In the case of paved roads, therefore, there is some evidence that higher activity rates have been associated with higher average costs.

Periodic maintenance

Periodic maintenance is more heterogeneous than routine maintenance, comprising a variety of grading, gravelling and resurfacing procedures with varying unit costs. The longer the maintenance cycle, the higher the unit costs tend to be. Increases in activity rates are *prima facie* associated with the catching-up of a backlog, and thus with likely higher unit costs. However, recent evidence in Zambia does not support this hypothesis.

Fig. A2.16 shows that activity rates on unpaved roads varied from 1,800-1,900 km p.a. in 2001 and 2003 to as little as 650-750 km p.a. in 2001 and 2005. Unit costs varied between years, averaging ZK1.47 million/km p.a. except in 2001 (when they reached ZK5.4 million), but without any obvious relationship with activity rates.

As regards paved roads (Fig. A2.17) there has been a clear upward trend in activity from 260 km in 2000 to 775 km in 2005, with short-term upward shifts in activity associated with declines in unit cost – almost as if increased activity had the effect of spreading overheads. Calculated incremental costs are negative for periodic maintenance on both paved and unpaved roads.

Available evidence from Zambia, therefore, which admittedly relates only to years when the overall level of funding for maintenance was stalling, provides no strong support for the hypothesis that larger budgets for road maintenance and higher activity rates cause unit costs to rise. Only the case of the routine maintenance of paved roads lends *prima facie* support for the hypothesis.

Fig. A2.16 Zambia: Periodic maintenance of unpaved non-urban roads 2000-2005: Total and unit costs
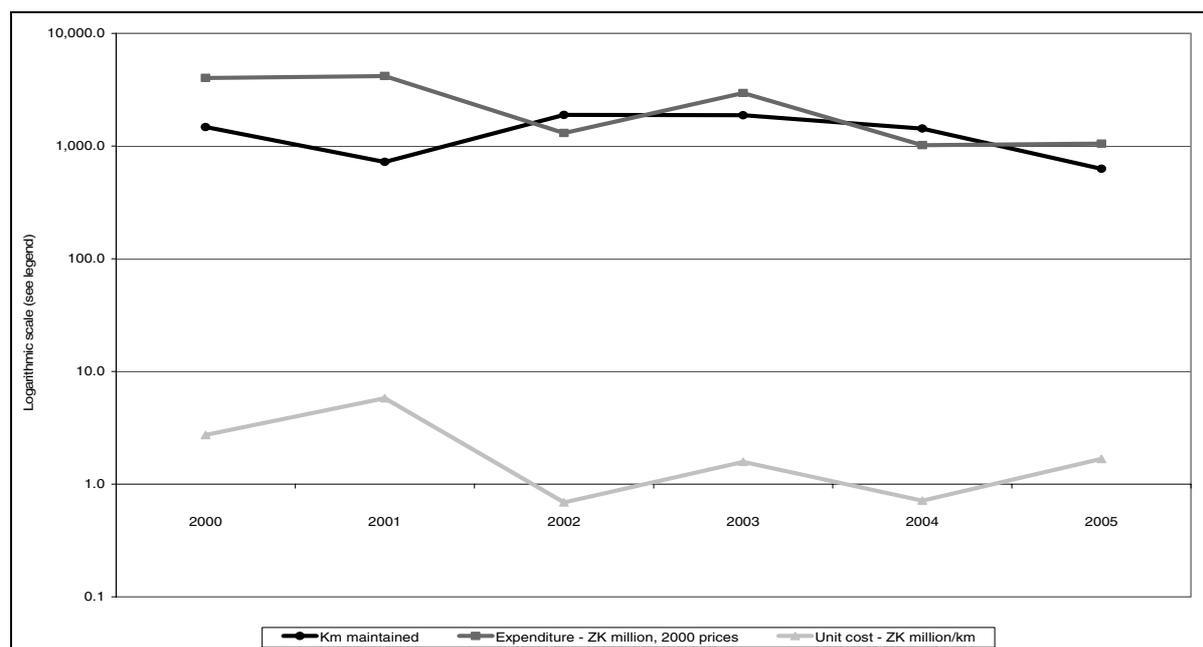
Fig. A2.17 Zambia: Periodic maintenance of paved non-urban roads 2000-2005: Total and unit costs
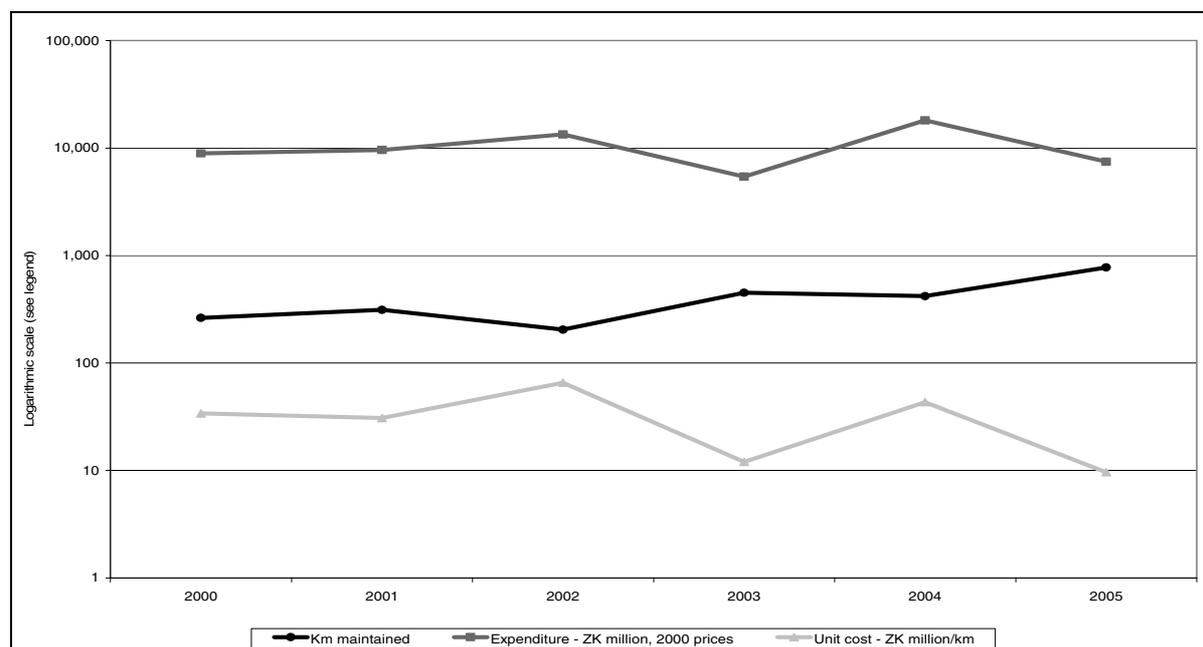
Sources: Harland (2005) and author's estimates

A2.3 Conclusions

Conclusions reached on the basis of a survey of recent experience in three countries in one continent can only be provisional. However, the evidence presented above, however incomplete, does indicate a pattern of unit costs which, contrary to the opening hypothesis of the main paper, remain broadly constant or decline as expenditure and activity rates increase. Incremental costs, where calculable, have been similar to or below unit costs.

Intensifying maintenance operations in more remote areas to which materials and labour have to be transported over longer distances should, in principle, cause costs to rise because the marginal productivity of factors of production falls. This effect has, in practice, not been detectable in the three countries examined.

The implication is that, when road maintenance activity is scaled up, there may be factors at work pushing costs down which counteract those forces – rising input prices and falling levels of technical efficiency – which elsewhere cause marginal costs to exceed average costs.

Declining costs are often ascribed to economies of scale or scope, where the unit costs of capital equipment, productive inputs, information and management fall as the scale (or scope) of activity rises. Scale/scope economies have not, however, been typical of road maintenance in the three countries, though some indication of them was noted in Zambia. However, cost savings have been sought and achieved by outsourcing maintenance works from centralised public works departments to (often quite small-scale) local contractors.

Maintenance contractors have been more technically efficient than public works departments in their use of equipment, materials and labour. The public authorities of the three countries have been able to capture the benefit of this efficiency gain by dint of improvements in their procurement procedures and through competition. As the road fund financing of maintenance activity increased, more local contractors emerged on to the market, making it possible for public agencies to seek competitive bids for maintenance works. At the same time, the design of contracts was improved, giving contractors more incentives to seek cost savings through innovation.

Unit input costs in road maintenance in developing countries, moreover, are largely unaffected by increases in activity levels. The major element is costs associated with vehicles – fuel, repairs, depreciation, interest – which are 'traded' and thus in elastic supply, unaffected by local market demand pressures. Labour used in maintenance is largely unskilled, and thus, at least seasonally, also in elastic supply. Maintenance contractors have been able to hire labour more flexibly and at wage rates closer to workers' reservation wages than was the case of public sector maintenance organisations.

Annex 3: Childhood Immunisation

A3.1 Introduction

Childhood immunisation programmes *prima facie* provide a good opportunity to assess the proposition that the unit costs of service delivery tend to rise as rates of activity increase. Programmes' activities are well defined; they have been in existence for many years; their outputs are quantified, monitored and reported; and, given the heavy involvement of donors in their financing, there ought to be good records of expenditures.

In response to an initiative by the World Health Assembly, the WHO launched in 1977 the Expanded Programme of Immunisation (EPI), whose purpose was to bring immunisation against six childhood diseases to all children.[18] The Assembly soon adopted the objective of Universal Childhood Immunisation. Prior to EPI, only some 5% of children in most developing countries were immunised. Coverage expanded rapidly, reaching 30-40% by the mid-1980s and 70-80% by 1990, but then flagged in a great many countries thereafter (Fig. A3.1). Nevertheless, a growing number of countries are now free of polio, and have ceased, or are planning to cease, polio immunisation.

Fig. A3.1 Low- and middle-income countries' immunisation coverage rates
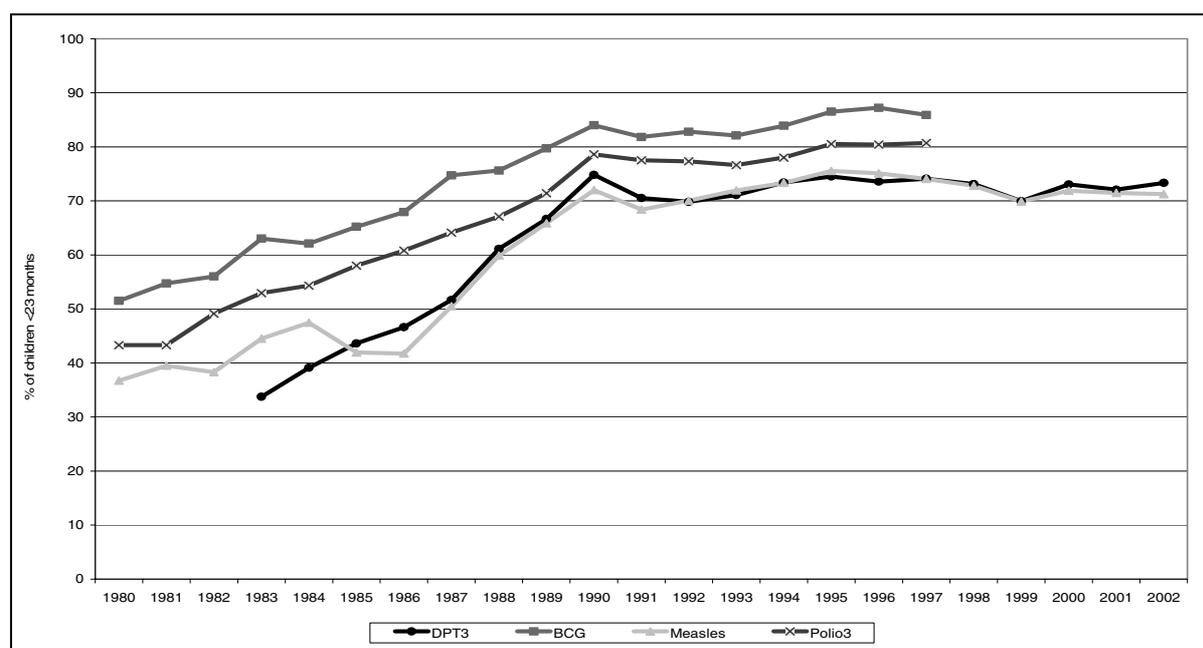
Sources: Bos and Batson (2000) and World Bank, *World Development Indicators*

The EPI has been heavily supported by donors – UNICEF, WHO and IDA among the multilaterals, and notably JICA among the bilateral donors. However, support for infectious disease control slackened in the early 1990s, with the result that it constituted only some 8% of DAC donors' assistance to health in the years 1990-8 (OECD, 2000).

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[18] The diseases were diphtheria, pertussis and tetanus – requiring 3 doses of DPT vaccine for full immunisation, polio – requiring 3 doses of polio vaccine, tuberculosis – requiring one dose of BCG vaccine, and measles – requiring a single dose of vaccine.

Immunisation returned to the top of the agenda of aid for health in the late 1990s. The Vaccine Fund, administered by the Global Alliance for Vaccines and Immunisation (GAVI - established in 1999), has, in addition to the basic EPI package, also begun to promote the use of expensive, 'under-used', vaccines against Hepatitis B and Haemophilus influenza B (HiB). As originally conceived, GAVI support for new-style immunisation programmes was supposed to end by 2007. The donors have now relaxed this deadline. Following agreement at the 2005 G8 Summit at Gleneagles, a $4 billion pilot-level International Finance Facility for Immunisation is expected to be launched whose proceeds will be earmarked for the continued external financing of these programmes.

Immunisation costs are not high, rarely exceeding 10% of public expenditure on health in developing countries, which is typically of the order of 1-2% of GDP.[19] Even with the addition of vaccinations against HiB and Hepatitis B, childhood immunisation is considered to be the most cost-effective public health intervention in most low-income countries. The World Bank (World Bank, 1993: Chapter 4) has calculated that child immunisation alone would produce two-thirds of the reduction of the burden of disease in these countries that was achievable with the application of the full range of recommended public health interventions - at 12% of the total cost to public funds.[20]

A3.1.1 Empirical studies on immunisation costs

The unit costs of immunisation have been studied by a number of authors. As early as 1979, the WHO published immunisation-costing guidelines. However, it soon became apparent that delivery costs were anything but standardised. Crease and Henderson (1980) mention country-level studies of EPI costs which highlight the wide range of expenditures per fully immunised child. Compared with the WHO's 1980 global average cost of $3/child, costs in the Philippines were found to range from $1.50 to $6, and in Zambia from $1.30 to $12. Delivery strategy – whether through vaccine campaigns or through fixed facilities – was also an important variable. These studies found that costs were highest in thinly populated rural areas, and lowest in urban areas. Much more recent studies continue to find the same wide range of unit costs. In Peru, in 2002, costs per fully vaccinated child were estimated to range from $9.58 to $20.31 in Lima (on the coast), and from $21.79 to $36.69 in Ayacucho (in the mountains) (Walker et al., 2004). Here, the key variables in determining costs were not only geography but also the quality of facilities used, the volume of vaccine administered and wastage rates.

Cross-country cost variances have also been high. A recent review of immunisation programme costs in 17 low- and middle-income countries in the 1980s and 1990s found that the costs of full immunisation (in current prices) ranged from $4.39 to $59.90 (Khaleghian, 2001). Delivery costs vary widely between countries at current exchange rates. The prices paid for inputs and supplies by different countries (and donors) also vary widely, reflecting the varying effectiveness of procurement practices.[21]

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[19] Recent cost studies indicate that EPI costs as a share of health sector budgets have been: 2.3% in Ghana (2000), 6% in Côte d'Ivoire (1998), 7% in Cameroon (2000/01), and 10% in Cambodia (2001)

[20] Immunisation costs in this calculation were those of 'EPI Plus', i.e. the basic EPI package, plus vaccination against Hepatitis B and Yellow Fever, with nutrition supplements. Other public health actions recommended were programmes for: school health, family planning, nutritional, AIDS prevention and tobacco/alcohol abuse.

[21] In the 1990s, the Pan American Health Organisation's vaccine revolving fund, which had regional responsibility for procurement, managed through bargaining strength to reduce the price per dose of HiB vaccine from $8.50 to $ 2.60 (England et al., 2001).

The costs and effectiveness of scaling-up health services for the poor also depend on the constraints to this created by weak health systems and poor governance. Eighty-four countries have been classified according to a 'constraints index', which shows countries in sub-Saharan Africa as among the most constrained (Hanson et al., 2003).[22] There is a strong correlation between this index and mortality.

This evidence of extreme variation in the costs of immunisation delivery lends *prima facie* credence to the hypothesis that increasing immunisation activity rates may well raise unit costs. This could arise because higher activity rates imply outreach to population groups which are more remote and also more likely to drop out of courses of vaccination, and thus which are more expensive to reach and to remain in contact with. It could also arise because higher activity rates may run up against the constraints on scaling-up.

In spite of this evidence that immunisation costs vary widely, standard unit costs continue to be used for estimating the financing needed to extend immunisation coverage.[23] GAVI, whose funding was originally expected to cease in 2007, has required its beneficiary countries to submit Financial Sustainability Plans projecting the costs of delivering immunisation services on an expanding scale, using new – more expensive, but simpler to administer – vaccines. These costing studies have based their estimates on the recent evidence of costs per fully immunised child under the EPI, adjusted for the projected additional per-dose costs of the new vaccines and for the higher outreach levels targeted. In the absence of empirical data from pilot studies, the information base for these projections is weak (Khaleghian, 2001).

Although there has been a recent flurry of country-level studies[24] of the costs of immunisation, there are inconsistencies between the methodologies used for calculating unit costs (per fully vaccinated child) (Khaleghian, 2001). Other information gaps noted include:

- how costs have evolved through time, since studies conducted in the 1980s;
- the scope for cost saving through technical efficiency improvements;
- the proportion of total programme costs for which governments are actually paying;
- the impact on total programme expenditures of variations in earmarked aid levels;
- countries' aptitude to procure vaccines directly; and
- whether and what user fees are charged (De Roeck and Levin, 1998).

A3.1.2 Immunisation cost structures and functions

Total EPI costs consist of 'programme-specific' costs, plus 'shared' costs. Programmes make use of staff, buildings and logistical support which are also used for other purposes, such as curative primary health care provision. Shared (or joint) costs can only be estimated; most cost analysis is therefore based on programme-specific costs which are easier to identify and quantify.

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[22] The index comprises: female literacy, health personnel numbers, UNICEF's measure of health service accessibility, the World Bank's measure of corruption and government effectiveness and Harvard Institute for International Development's measure of the proportion of the population living in the tropics.
[23] The Commission on Macroeconomics and Health recommends the expenditure of $34 per person p.a. by 2007 in low-income countries to finance a basic package of preventive interventions and (mainly) mother-and-child care (WHO, 2001).
[24] E.g. on Morocco, Côte d'Ivoire, Bangladesh, Cambodia, Laos and Vietnam under the auspices of USAID's Partnerships for Health Reform Project and on Cameroon, Madagascar, Nepal, Malawi and Ghana on behalf of GAVI.

There is a balance of prior hypotheses about the effect of expanding immunisation programmes on their cost. On the one hand, extending outreach to remote areas and inaccessible populations should raise logistical and personnel costs as immunisation rates increase; on the other hand, the progressive incorporation of immunisation into the routine functions of health services should help to reduce costs through the sharing, and more efficient deployment, of overheads. Changes in the range of diseases covered and in the real price of vaccines are also likely to have a significant effect on costs. Vaccines are perishable and require refrigeration; wastage rates are often significant. One-off technical efficiency gains are still often possible through better staff deployment, logistic practice, storage and supply chain management. On the other hand, one-off additional costs are incurred when governments mount 'supplemental' programmes to treat older children who had previously escaped immunisation.

The majority of costs are recurrent – comprising personnel, transport and consumables. Capital costs are small – on average less than 10% of total costs – but they are lumpy and episodic. They include the purchase of transport and refrigeration equipment. The cost structure of 'routine'[25] immunisation activity varies widely between countries and between years,[26] but illustratively breaks down as shown in Table A3.1.

Table A3.1 Immunisation programmes: Typical cost shares (%)

	Share of total costs	Shares of programme-specific costs
Vaccines	25	40
Supplies	15	30
Transport	7	15
Personnel, staff per diems	40	5
Capital	8	5
Other (training, disease monitoring)	5	5

In its early days, when many beneficiary countries lacked a primary health care infrastructure, the EPI sponsored immunisation campaigns. The predominant approach to childhood immunisation is now based on the currently much more extensive and accessible local networks of primary health centres, supplemented by mobile vaccination clinics. An exception to this pattern is polio which WHO intends to see (and has largely succeeded) completely eliminated, thus eventually ending the need to continue immunisation. Polio immunisation is dispensed as a separate programme through National Immunisation Days, whose unit costs are typically higher than for other, 'routine', immunisation, and which target children of all ages.

A3.1.3 Time series evidence on costs

It ought to be possible, after more than twenty-five years of experience with the EPI, to find sources of data permitting the time series analysis of immunisation delivery costs in a great many countries. In practice, however, historic cost analysis is vitiated by the fragmentary, episodic and unconsolidated nature of disbursement records – even those of the main multilateral actors – and the difficulty of disentangling the share of local costs attributable to immunisation programmes from other items in health sector budgets.

The WHO is constructing a data base on immunisation costs, but it only covers a small number of countries so far, and data on these countries do not extend back beyond 2000.

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[25] I.e. against the six diseases originally targeted by EPI.
[26] Because of lumpiness in outlays on vaccines, disposable equipment and capital equipment.

A3.1.4 Data on costs and financing

Output records – of the percentage of surviving infants immunised – have been kept by most developing countries, using WHO/UNICEF-prescribed reporting forms. Health ministry staffs' reports of immunisation coverage have been complemented by evidence from periodic surveys – both regular Demographic and Health surveys and WHO/UNICEF-supported EPI cluster surveys which yield more precise information, by locality. International performance reporting is of immunisation rates (of children 0-23 months) rather than of the actual number of children immunised. Immunisation rates are subject to both numerator and denominator error. As regards the numerator, survey-based estimates of immunisations performed are often significantly different from those based on administrative records. These differences call for interpretative reconciliation of the evidence. Denominator error arises from uncertainty about the number of surviving infants in the population, which is aggravated by the sharp inter-censal falls in fertility rates experienced in many developing countries.

One reason for the stagnation of immunisation rates in the 1990s was that financing for immunisation programmes ceased to grow. Although the cost of immunisation programmes, and their share of health sector budgets, was low, EPI activity was, from the outset, treated as a 'vertical' programme, heavily financed by donors, and not properly integrated into the health budgets of most countries. Until the 1990s, the donors paid most of the 'programme-specific' expenses in low-income countries, leaving the recipient country to meet the costs of multi-functional facilities and staff employed in the health sector which were also used in programme delivery.

As regards funding, the largest multilateral donors have been UNICEF and the World Bank. WHO has been heavily involved on the scientific and professional front, with the design and monitoring of programmes. Bilateral donors have provided 30-50% of the external funding, partly in the form of trust funds administered by UNICEF.

In the 1990s the donors, concerned to ensure sustainability, encouraged recipient countries to play a more active role in EPI management, including the routine procurement of vaccines. They promoted the Vaccine Independence Initiative whereby they gave consenting recipients multi-year grants to enable them to procure vaccine supplies for themselves. They also stopped increasing the overall volume of external funding for the EPI, in the hope that recipient countries would increase their own financial commitment to immunisation through resource reallocation. There was, as a result, a general rise in the share of total national immunisation programme costs borne by government budgets, some of it financed indirectly by donors through sector-wide, pooled funding or through budget support.

There has been no systematic recording and monitoring of expenditure on EPI-supported immunisation programmes. Governments' costs are usually buried in more broadly defined functional classifications of health sector activity, and there has been no routine reporting of aggregate external support.

With mounting concern in the international community about the EPI's loss of momentum, and in anticipation of the emergence of new sources of external financing, initiatives were launched towards the end of the 1990s to fill the information gap about the costs of immunisation programmes and how these might be made financially sustainable. Support from GAVI's Vaccine Fund, as mentioned above, has been conditional on the submission of Financial Sustainability Plans. USAID sponsored preparatory immunisation costing studies

on Bangladesh, Côte d'Ivoire, Ghana, Morocco and Colombia.[27] UNICEF has sponsored EPI evaluation studies on a number of countries, but only those on Cambodia and Nepal focus on programme financing.

A3.2 Country case studies

A3.2.1 Output measure and data availability

For the purposes of cost analysis the number of DPT3 immunisations is, as a matter of convenience, used as a proxy measure of the output of all immunisation activity.[28] Information on DPT3 coverage rates has been gathered and published continuously for many countries for 25-30 years. The number of immunisations performed can readily be calculated from this by reference to demographic data on population size, birth rates and infant mortality rates. The proxy measure is not, however, perfect. As is evident from Fig. A3.1, in the 1980s rates of tuberculosis and polio immunisation were on average higher than for DPT. In the 1990s, there was greater convergence of rates as the 'campaign' approach to immunisation gave way increasingly to routine immunisation at fixed sites. Some divergence nevertheless remained because of differences in vaccination schedules. A better output measure would be the number of fully vaccinated children. However, though individual countries record this measure, it is not reported in international databases.

As regards unit costs and incremental costs, few of the studies mentioned above provide sufficient time series data from which to study their evolution. In the case of Bangladesh, however, immunisation cost records have been maintained by the government, so there is sufficient information for the study of costs over a period of years in which substantial progress was made. Comprehensive cost information has also been compiled for Nepal covering the later 1990s.

Some 20 countries have now prepared Financial Sustainability Plans showing projections of activity and expenditure. Although these are not yet in final form, they provide some basis for studying costs since countries' 'baseline' years – typically 2000 or 2001 – and their projected future evolution.[29] Several of these countries are from the Commonwealth of Independent States (CIS) (former Soviet Union) where historic levels of immunisation have been significantly higher than in low- and middle-income countries in other parts of the world, and where unit cost developments are likely to be atypical.

A3.2.2 Country-level evidence

A3.2.2.1 Bangladesh 1986-98

Bangladesh raised its rates of DPT3 and measles immunisation from virtually zero in the early 1980s to 70% by 1990, and 85% by 2002. It achieved this by deploying both domestic and external resources, but with a growing share of domestic budgetary resources. In terms of numbers, there was a rapid rise between 1984, when 31,000 children were immunised with DPT3, and 1990 when 2.3 million were so immunised. Thereafter numbers rose more gradually to reach 3 million in 2002 (Fig. A3.2).

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[27] Kaddar et al. (2000a, 2000b, 2000c), Levin et al. (2001)
[28] For justification of this procedure see WHO/GAVI (2003).
[29] However, as noted earlier, projections are based on untested pro forma assumptions about the procurement and delivery costs of new vaccines-

**Fig. A3.2 Bangladesh: DPT3 immunisations, total programme-specific EPI costs and unit costs 1986-98**
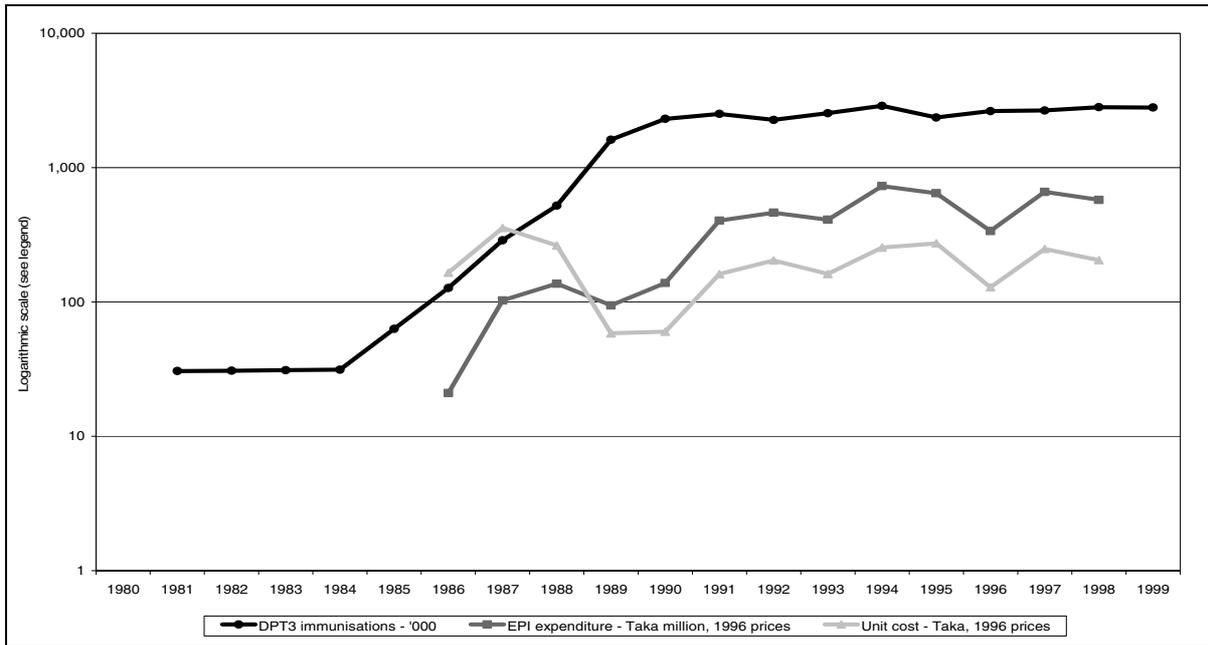
Fig. A3.3 Bangladesh: DPT3 immunisation 1986-98

| | Regression line (slope = marginal cost) | ----------- | Ray through data means (slope = average cost) |
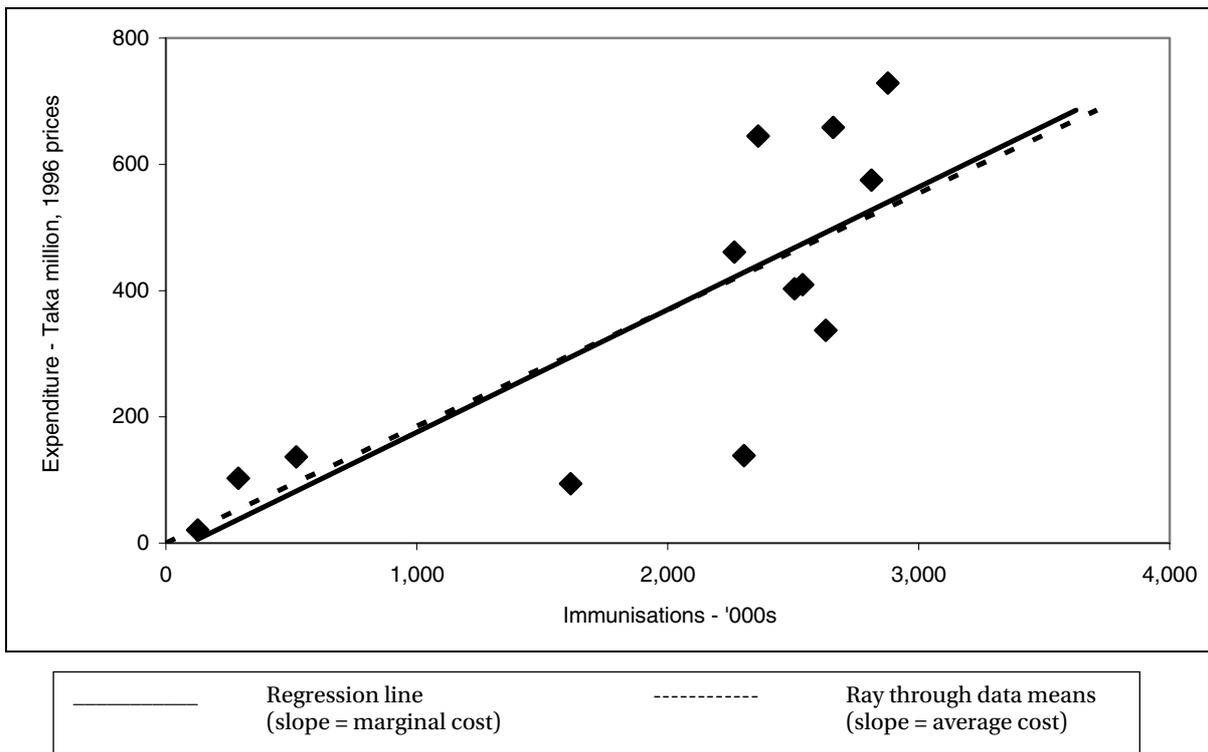
Regression equation: EXPENDITURE = -18.42 + 0.194*IMMUNISATION (R-squared=0.62)

[4.25]

Sources: World Bank, *World Development Indicators*, UN Population Database, Khan and Yoder (1998)

Real programme-specific expenditure rose rapidly, although erratically, from the mid-1980s to the early 1990s, but more slowly thereafter. As a consequence, the trend in real unit costs

has been relatively flat, though there was a sharp apparent fall in the late 1980s during a temporary downward fluctuation in total expenditure. Over the years 1986 to 1998, they averaged Taka 195 (at 1996 prices) per immunised child. Average incremental cost over the same period was Taka 194; i.e. it was almost the same as average (unit) costs (Fig. A3.3). Bangladesh thus achieved the feat of massive programme expansion without unit cost escalation.

The conclusion that average and marginal costs were virtually the same in Bangladesh in these years of programme growth might not hold if non-programme-specific (or shared) costs are also taken into account, particularly if the use made of shared resources was intensified. However, there are no estimates on which to base a judgement on this.

A3.2.2.2 Nepal

Nepal made swift progress with its DPT3 coverage which increased from only 6% in 1980 to 43% in 1990 and 78% in 1997. Thereafter progress ceased. Annual estimates of total non-salary costs are available for the years 1996/7 to 1999/2000, when the number of immunisations was roughly constant at 500,000 per annum (Fig. A3.4).

Fig. A3.4 Nepal: DPT3 immunisations, costs and unit costs
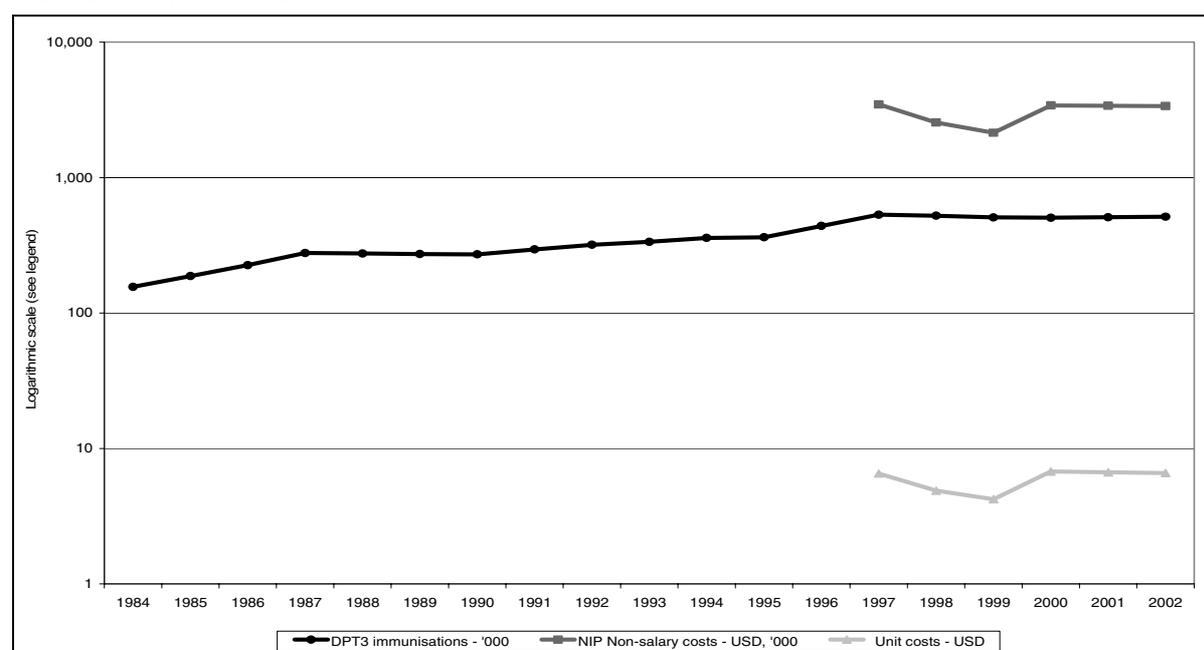
There was some fluctuation in unit costs during these years, but the trend was level at around $6 per completed DPT3 immunisation. The estimated incremental cost for these years ($6.74) was somewhat in excess of the period-average cost (Fig. A3.5), though the regression coefficient is insignificantly different from zero.

These calculations, which cover a time of programme stagnation, are insufficient to test the hypothesis that costs rise in periods of programme expansion. They do not, however, contradict the observation, based on the analysis of Bangladesh data, that the trend in unit costs seems to have been non-rising.

Fig. A3.5 Nepal: DPT3 immunisations 1997-2002

	Regression line (slope = marginal cost)		Ray through data means (slope = average cost)
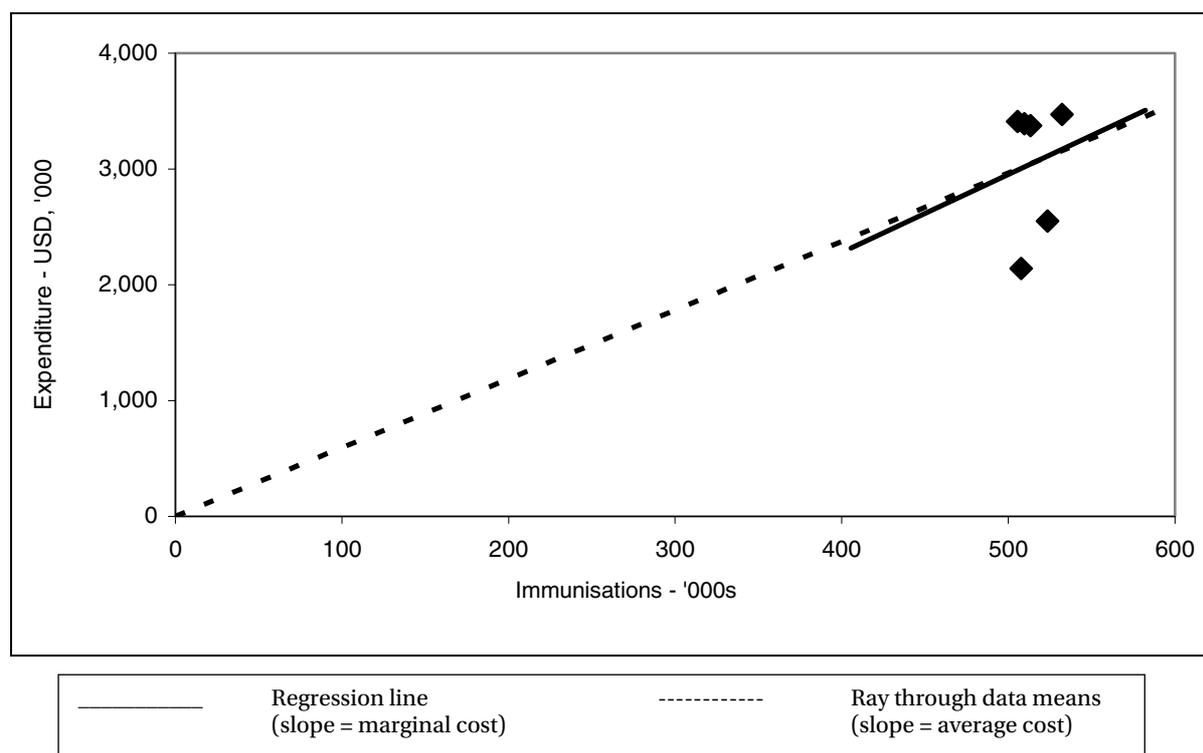
Regression equation: EXPENDITURE = -419.34 + 6.74*IMMUNISATION (R-squared=0.25)
                        [0.25]

Sources: World Bank, *World Development Indicators*, and (2003c)

A3.2.2.3 Evidence from Financial Sustainability Plans

The projected evolution of immunisation programme costs set out in the Financial Sustainability Plans of six non-CIS countries have been studied, using the same methodology as was used in the case of Bangladesh. These are all low-income countries which have achieved notable progress in immunisation coverage since the 1980s, but where coverage still falls well short of universal. In four countries – Zambia, Cambodia, Cameroon, Uganda - the costs included in the plans are 'direct' only, i.e. they exclude the bulk of personnel costs which are shared with other programmes. In the other two – Malawi and Madagascar – the projections include shared personnel costs.

The evidence is summarised in Table A3.2 and illustrated for the cases of Uganda and Zambia in Figs. A3.6 and A3.7. It shows a pronounced pattern of unit costs which are expected to rise well above those incurred in the recent past, and of incremental costs in excess of average costs. The only exception is Malawi where programmed costs for 2002 were exceptionally high, and probably well in excess of actual expenditures, thus distorting the trend.

Fig. A3.6 Zambia: DPT3 Immunisations, costs and unit costs, actual and projected
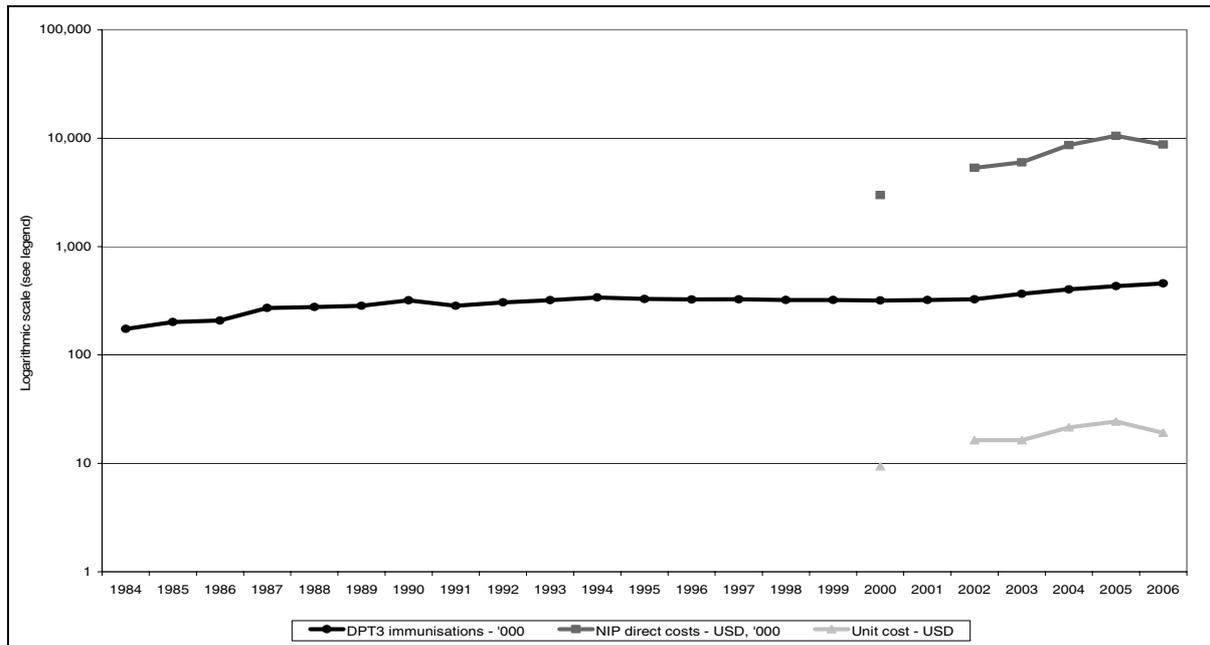
Fig. A3.7 Uganda: DPT3 Immunisations, costs and unit costs, actual and projected
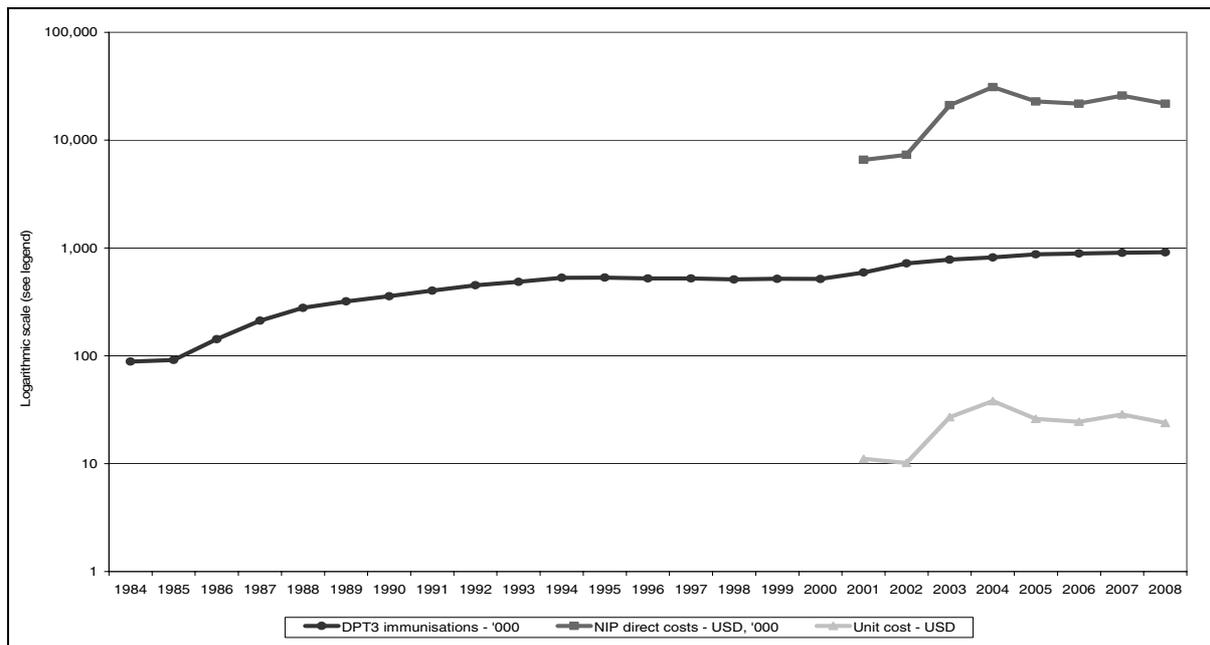
Sources: Financial Sustainability Plans for GAVI

Table A3.2 Progress with immunisation and costs in six countries with Financial Sustainability Plans

	DPT3 immunisations ('000s)			Unit cost baseline[a] ($)	Unit cost 2006 ($)	Incremental cost[b] ($)	Ratio incremental cost/unit cost[c]
	1984	2000	2006				
Cambodia	64	215	316	11.1	23.7	74.0	4.3
Zambia	174	318	457	9.4	24.3	41.2	2.4
Uganda	89	516	888	11.1	24.4	59.7	3.4
Madagascar	78	312	456	9.2	26.9	56.1	3.1
Cameroon	102	273	371	14.5	37.4	118.3	4.6
Malawi	181	313	390	11.9	30.7	11.3	0.5

Sources: World Bank, *World Development Indicators*, and Financial Sustainability Plans
Notes: a = 2000 or 2001; b = from baseline to 2007 or 2008; c = denominator is the mid-point of the unit cost range.

These cost projections cannot be used for drawing generic conclusions about unit costs in scaled-up public expenditure on immunisation for a number of reasons. First, at GAVI's behest, beneficiary countries have included (still unreliable) estimates of the costs of Hepatitis B and HiB vaccines in their future immunisation schedules, and of replacing older vaccines used in routine immunisation by more newly developed ones. These innovations will cause the cost of vaccine procurement per fully immunised child to double or treble. Second, if delivery costs shared with other primary health services were included, the increase in the inclusive unit costs of immunisation would be less dramatic than the increase in specific costs alone (cf. Table A.3.1). Third, little or no credit is taken in the projections for technical efficiency gains in delivery. Finally, the estimates submitted to GAVI by beneficiary countries in their financial sustainability studies form part of a recipient-donor dialogue in which the recipient side is minimising the financial burden which it expects to face.

A3.3 Conclusion

The very limited historic time series evidence available on low-income developing countries suggests, contrary to the hypothesis, that unit costs in EPI programmes have, after allowing for lumpiness in equipment procurement, been roughly constant through time. Inasmuch as widening outreach has incurred rising logistical costs and higher wastage rates as delivery has extended to increasingly remote areas and inaccessible population groups, these sources of technical inefficiency have been counteracted by gains arising from increasing use of fixed sites for delivery and from the incorporation of immunisation into wider child health packages with shared overheads. Donor-assisted pooled international procurement arrangements for imported vaccines, disposables and capital equipment have also played a role in containing or even compressing costs.

In the absence of the now intended switch to new, pentavalent, vaccines, unit costs would probably remain more or less constant. In a few cases they may actually decline, as the need for polio immunisation is eliminated and vaccine wastage rates are brought under control.

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