

The Macroeconomic and Welfare Implications of Public Spending Choices: A Computable General Equilibrium (CGE) Analysis for Madagascar *

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February 8, 2008

Abstract

This paper provides an analysis of public spending choices in an economy benefitting from debt relief. It proposes a theoretical framework and nests it within a dynamic Computable General Equilibrium (CGE) model, which is then applied to Madagascar. Results suggest that expenditure allocations with more weight on investment in public infrastructure yield the greatest improvements in key macroeconomic variables and household welfare. This is to be contrasted with the Enhanced HIPC debt relief formula which leans more heavily towards social spending. The simulation results are robust to a number of factors identified in the theoretical framework, but rely on the existence of a 'sufficiently high' degree of externalities to public infrastructure.

1 Introduction

The allocation of public spending among competing uses is a long-standing policy dilemma in Low-Income Countries (LICs). Many of them face binding budget constraints and have been forced into austere fiscal consolidation at some point or another. Recent multilateral aid efforts, including the Enhanced Heavily Indebted Poor Countries (HIPC) debt relief initiative, have brought this dilemma to the fore. They have incidentally exposed the lack of consensus, both within the theoretical literature and among policy-makers themselves, on the expenditure categories to which scarce government resources in LICs should

*Preliminary draft

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[‡]I thank Christopher Adam for his guidance and for sharing his GAMS model codes with me. I am grateful to Paul Dorosh and Steven Haggblade for their data. All remaining errors and omissions are mine.

be allocated. In particular, the debate centres around the respective allocation of government resources between social spending and infrastructure spending, often in the context of achieving the twin objectives of growth and poverty reduction. The Enhanced HIPC initiative, for example, comes with an explicit requirement that governments use the savings on debt servicing to increase 'poor' social spending.¹ But this approach, especially its 'conventional wisdom' status, has been challenged by the World Bank's Operations Evaluation Department (OED) Report on the HIPC initiative (2003) and by Paternostro *et al* (2005). They argue that primacy of social spending lacks both theoretical foundations and empirical support.

This paper aims to provide a theoretical framework for the analysis of the allocation of public spending. It combines elements from growth theory and public economics to identify the relevant considerations which a Low-Income Country government may face in deciding on the composition of public expenditure. The paper does not solve for the optimal level of public spending by categories. Rather, it asks about how best to allocate additional resources accruing to the government between competing uses given the structure of the economy, including the current level of government expenditure.

In the paper, I cast the government's problem in the context of debt relief. I then nest the theoretical framework within a dynamic Computable General Equilibrium (CGE) model calibrated to Madagascar data to assess the quantitative significance of the factors identified. I consider several public expenditure experiments. First, I assume that no savings are actually realised on debt servicing. This means that debt relief has no income effect. Results from this set of 16 experiments accord with intuition. A switch from expenditures which are indirectly productive or utility-enhancing (government cash transfers to households) to those which directly improve production and/or welfare (infrastructure, expenditure on health and education). improves both macroeconomic indicators and intertemporal welfare.

For the case when debt relief has income effects, seven policy experiments are examined. In experiment 17 all savings on debt servicing are used to increase public infrastructure. Experiment 18 considers the opposite scenario where all savings are used to finance increased public provision of health and education. Experiments 19(a)-19(c) are intermediate cases with the weight on infrastructure investment at 0.6, 0.5 and 0.4, respectively. Experiments 20 and 21 provide for net income transfers to the private sector which results in the relaxation of financing constraints for investment and the budget constraints of households, respectively. Simulation results indicate that public spending choices which allocate proportionately more resources to infrastructure spending are also those which maximise growth and discounted aggregate intertemporal welfare, but that spending choices which relax investment financing and household budget constraint tend to maximise static intratemporal welfare in the immediate years following the debt relief shock. A sensitivity analysis with respect to key para-

¹See for example Poverty Reduction Strategy Papers (PRSPs) for various Enhanced HIPC beneficiaries.

eters suggest that these results depend on the existence of a 'sufficiently high' degree of externalities from public infrastructure. If externalities are low, then allocating resources to public infrastructure is no longer the preferred option. The results however remain robust to a number of other factors identified in the theoretical framework.

The remainder of the paper is organised as follows: Section 2 summarises related theoretical and empirical work. Section 3 presents the theoretical framework and highlights the main features of the simulation model. Section 4 provides some background information about Madagascar together with a description of data and key parameters. Experiments and results are presented and discussed together with a sensitivity analysis in section 5. Section 6 concludes.

2 Related Literature

Samuelson's "Pure Theory of Public Expenditure" (1954) is one of the earliest contributions in the theoretical literature on optimal public spending. The focus of Samuelson's analysis is on deriving a set efficiency conditions to characterise optimal levels of a private consumption good and a collective consumption (public) good in an economy, given feasibility constraints and individual preferences. Samuelson argues that normative judgements about the relative 'ethical' desirability of some expenditure configurations can be also incorporated in the model by specifying a set of comparable interpersonal norms or a social welfare function representing the set of all 'ethical' feasible states. Samuelson's analysis, however, is based on the demand side, and deals with only one subset of government activities, namely pure public goods.

More recent theoretical literature has followed two different strands. Barro's (1990) seminal work paved the way for an approach, rooted in growth theory, which provides for analysis of the effect on steady state growth rates of various aspects of fiscal policy. The key element here is an endogenous growth model, in which government spending is 'productive' and complementary to private sector investment. Barro (1990) analyses, among other scenarios, the case where the government can also, alongside 'productive spending', spend on services which are 'utility-enhancing' for households. He concludes that depending on how the government spending is financed and on the form of the production function, growth-maximising and welfare-maximising shares of productive expenditure (in total government expenditure) need not coincide. Agénor (2005) and Agénor and Neanidis (2006) extend Barro's work along several dimensions, providing among other things for greater disaggregation of government expenditure categories (for example, infrastructure investment, health spending, education spending) and complementarities between them. They argue that for certain model parameterisations, there may be a case for a 'big push in infrastructure investment' relative to other forms of public expenditure.

Ferroni and Kanbur (1991) propose a microeconomic framework which emphasises the respective marginal contributions to individual welfare of either

social spending or 'productive' spending². They articulate simple, yet plausible, interrelationships between an agent's 'basic needs attainment'³, income and welfare on one hand and exogenously determined social and 'productive' spending by the government on the other. This enables them to express individual welfare only in terms of the two categories of government expenditure. Ferroni and Kanbur (1991) thus propose, a marginal allocation rule for the restructuring of government expenditure which depends on the magnitudes of parameters such as (i) the respective productivities of social spending and income in the 'basic needs attainment' function (ii) the respective productivities of basic needs and 'productive' spending in the production function and (iii) the valuation of 'basic needs attainment' and income in the agent's welfare. Ferroni and Kanbur (1991) argue that the marginal allocation rule can be combined with poverty indices and poverty lines to yield a restructuring of government expenditure that is 'poverty-conscious'.

In the empirical literature, analyses have been mainly about the effect of the composition of government spending on various outcomes. Most involve the use of econometric techniques or dynamic simulation models. Econometrics-based work have tended to be 'growth-centric' in their approach, but have not so far yielded definitive conclusions about the effects of varying public expenditure composition on growth. The sample and time period under consideration appear to matter, as do the classification and disaggregation of public expenditure. Devarajan *et al* (1996), for example, use panel data for 43 countries from 1975 to 1985 and find that increasing the share of current expenditure has positive and statistically significant effects on growth, while increasing the share of capital expenditure has a negative effect. The authors argue that their results indicate that both the respective productivities of the various forms of expenditures and their initial shares matter, and imply that developing country-governments have been overallocating resources to capital expenditure relative to current expenditure. Recent work by Gupta *et al* (2005) which examines fiscal expansions and contractions in 39 LICs with IMF-supported programs during the period 1990-2000 only partially supports these findings. Gupta *et al* (2005) do find that allocating government resources to more productive uses (from certain selected forms of current expenditure such as wages and salaries) is growth-enhancing. However, their results also indicate that protecting capital expenditure is key to promoting growth, amid fiscal consolidation.

Contributions to the empirical literature on the effects of public spending using simulation models include work by Jung and Thorbecke (2003), Agénor *et al* (2004), Adam and Bevan (2006) and Lévy (2006)⁴. Agénor *et al* (2004) con-

²Note that this classification by Ferroni and Kanbur (1991) is slightly misleading, as it could imply that social spending is unproductive. However, in their framework, social spending is indirectly productive, entering the production function via the 'Basic Needs Attainment' term (pg 97).

³Note that 'basic needs attainment' in Ferroni and Kanbur (1991) is purely a theoretical concept. The authors do not suggest the use of particular indicators to capture 'basic needs attainment'.

⁴Recent country-specific policy-based research have also made use of the MAMS model developed by the World Bank (see for example, Lofgren and Diaz-Bonilla, 2006) and the

sider a reallocation of public spending between capital expenditure and current expenditure on health and education, against growth and Millennium Development Goals (MDGs), while the focus of the Jung and Thorbecke (2003), Adam and Bevan (2006) and Lévy (2006) papers is slightly different.

Agénor *et al* (2004) develop a macroeconomic simulation framework with a single household and calibrate it to Ethiopian data to capture the links between foreign aid, the level and composition of government expenditure and growth and poverty. They consider among other scenarios, an experiment whereby the composition of spending is changed by reducing government current consumption by 7 per cent, and increasing the shares of public infrastructure (0.7 per cent) and outlays on health (3.5 per cent) and education (2.8 per cent). The authors conclude on the basis of their results that the effect of such a policy on growth and poverty is limited over the simulation horizon, as the supply side effects of the policy tend to be gradual and muted by the adverse effect on aggregate demand.

Jung and Thorbecke (2003) use a multi-sector CGE model to examine the macroeconomic and distributional consequences of raising public investment on education in Tanzania and Zambia under of the HIPC initiative. They find evidence of growth effects through the human capital accumulation process and the supply of skilled labour. The authors also argue that an increase in public expenditure on education should be matched by supporting public investment in physical capital in order to maximise the growth benefits.

Adam and Bevan (2006) and Lévy (2006) focus on the role of government spending to offset Dutch Disease. In their most stylised static form, each of their respective models is conceptually similar to the 1-2-3 model of Devarajan *et al.* (1993), i.e., one country, two producing sectors (tradables and non-tradables) and three goods (domestic goods, exports and imports). The authors reach broadly similar conclusions from applications to Aid inflows in Uganda (Adam and Bevan) and a resource boom in Chad (Lévy). Their results show that public investment can overturn Dutch Disease and the growth maximising level of public investment is not necessarily distributionally neutral or welfare-maximising.

3 Theoretical framework

The theoretical framework underpinning the numerical simulation model has been inspired by Paternostro *et al* (2005), and similarly draws some elements from Ferroni and Kanbur (1991). Equations 1 to 12 below summarise its key features. A more detailed description is provided in Appendices 1-3 to this paper.

Equation 1 illustrates the public spending choices facing a country receiving debt relief, modelled here as a reduction in foreign interest obligations F : It can spend the money on 'Social Services' (interpreted here as public health

SPAHD model developed by Agénor and others (2006). Both are macro-simulation models which feature an explicit MDG/ Human Development Module to track the effect of public spending on the relevant indicators.

and education) E_g , on infrastructure spending I_g , or on net transfers to the private sector, NTr_P . By *net* transfers is meant cash transfers to households or a reduction in public sector borrowing requirements which results in more resources being available for investment by the private sector.

$$-F = E_g + I_g + NTr_P \quad (1)$$

I make two assumptions about the productive or supply-side effects of social spending E_g and infrastructure spending I_g . First I assume that social spending by the government adds to the human capital stock of agents through a human capital production function, which is a Constant Elasticity of Substitution (CES) composite of public spending on health and education⁵ and the agents' spending on private health and education services. Thus

$$IPH_{it} = AP[\theta E_{pit}^{1-\frac{1}{v}} + (1-\theta)(\zeta E_{git})^{1-\frac{1}{v}}]^{1-\frac{1}{v}} \quad (2)$$

where AP is a shift parameter, θ is an Armington share, the subscripts p and g , denote private and public services respectively, ζ is an index of quality of government services and v is the elasticity of substitution between E_p and E_g . The subscript i denotes the appropriate units of analysis, which in this case are representative households (urban and rural), while t is a time subscript.

Human capital stocks for each unit is updated using the Perpetual Inventory Method as follows:

$$H_{it+1} = H_{it}(1 - \delta_h) + IPH_{it} \quad (3)$$

A similar process applies for the stock of public infrastructure where:

$$K_{gt+1} = K_{gt}(1 - \delta_g) + I_{gt} \quad (4)$$

Next, consider the Aggregate Production Function for the economy, which is a Cobb-Douglas exhibiting constant returns to scale to land, labour (augmented by human capital) and private capital. There are also externalities to public infrastructure, occurring through the α_g term.

This yields equation 5

$$Y_t = Land_t^{\alpha_1} (H_t L_t)^{\alpha_2} K_{pt}^{1-\alpha_1-\alpha_2} K_{gt}^{\alpha_g} \quad (5)$$

I then define a variable B , which is a social indicator capturing the level of human development⁶, for each microeconomic unit. This indicator could, data permitting, be taken to be the same as the UNDP's Human Development Index. In this paper, however, it is defined differently as an average of four dimensions of human development, namely: Adult Literacy Rate, Infant Mortality Rate,

⁵Human Capital Services defined as the flow of health and education services.

⁶Ferroni and Kanbur(1991) define a similar variable B to represent 'basic needs attainment'. The approach followed here is different. Notably, using a measure of human development as opposed to basic needs attainment does not require specification of minimum requirements.

Access to Sanitation, and Access to Safe Water. B is modelled by a logistic function, as in equation 6.

$$B_{it} = \frac{2}{(1 + e^{-z_{it}})} - 1 \quad (6)$$

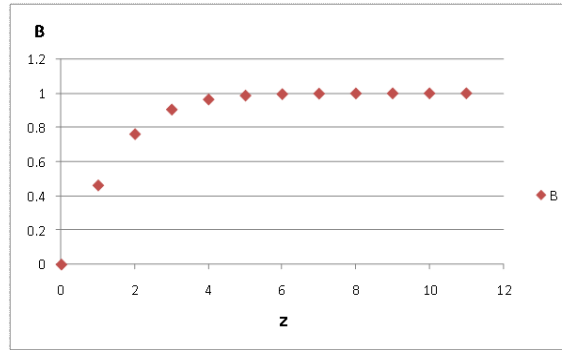
Z_{it} is a CES composite in human capital stock and private incomes.

$$Z_{it} = [H_{it}^{1-\frac{1}{\kappa}} + (\beta_i y_{it})^{1-\frac{1}{\kappa}}]^{\frac{1}{1-\frac{1}{\kappa}}} \quad (7)$$

where κ is the elasticity of substitution between the two dimensions, and β_i is a share in income.⁷

Equations 6 and 7 suggest that agents' level of human development depends on their human capital stock (which in turn is a function of government services) and private incomes.

Figure 1 plots the assumed relationship between the human development variable B and human capital stock and private incomes as captured in one dimension by the composite variable Z .



There are two key motivations for defining the Human Development Indicator variable B . First, it captures one dimension of welfare which utility does not. It is the 'being-well' dimension of well-being as opposed to command over resources which can be measured by utility (Anand and Ravallion, 1993). Second, and by the same token, it establishes a link between publicly provided services and human development. There are of course a number of issues surrounding the nature of this link, not least the behavioural response of individuals or households to increased public sector provision of health and education services. This is not addressed in the paper.

The agent's welfare is assumed to be made up of both a measure of 'being well' and command over resources. To obtain a measure of command over

⁷The CES representation of welfare in Equation 7 can be justified by the non-additivity and separability properties of the function. These properties suggest that while the two dimensions of welfare are to some extent substitutes, the marginal gain from either dimension is not independent of the other.

resources, I follow Deaton and Zaidi (2003), first by defining an agent-specific Price Index, notably a Paasche Index as follows:

$$P_{it}^p = \frac{p_{io} \cdot q_{it}}{p_{it} \cdot q_{it}} \quad (8)$$

where p_{io} represent reference prices.

For each household, I then obtain money metric utility as :

$$UM_{it} = \frac{x_{it}}{P_{it}^p} \quad (9)$$

where x_{it} represents total expenditure on goods and services by agent i at time t .

The agent's welfare is given by:

$$W_{it} = [\mu B_{it}^{1-\frac{1}{\psi}} + (1-\mu)(UM_{it})^{1-\frac{1}{\psi}}]^{-\frac{1}{1-\frac{1}{\psi}}} \quad (10)$$

For a more general specification however, I define two Social Welfare Functions. Equation 11 describes an intratemporal welfare function, which is a CES in welfare of individuals or groups of individuals and can be used to capture inequality aversion by the policy-maker. Equation 12 depicts the intertemporal Social Welfare Function and can be used to show willingness on the part of the policy-maker to substitute welfare across time periods.

$$\Omega = \left[\sum_{i=1}^n \chi_i W_i^{-\rho} \right]^{-1/\rho} \quad (11)$$

Units of analysis are as before indexed by i , χ_i is the weight of each unit in the intratemporal social welfare function Ω , and the parameter ρ captures inequality aversion by the policy-maker. Higher values of ρ denote a greater degree of inequality aversion, and the special case of $\rho = -1$ indicates that the policy-maker does not care about inequalities in welfare.

$$\Pi = \left[\sum_{s=1}^t \frac{\beta^{s-1} \Omega^{1-\sigma}}{1-\sigma} \right] \quad (12)$$

where s is a time index and $1/\sigma$ is the intertemporal elasticity of substitution.

The theoretical framework presented in this section has combined elements from growth and public economics to highlight some of the relevant considerations public spending choices by the government. They are the effect of these spending choices on the supply-side through factor accumulation and growth, the extent of complementarities or externalities arising from each form of expenditure and welfare effects. In addition, factors such as agent heterogeneity and inequality aversion by the policy maker may influence the allocation of public expenditure.

From an intertemporal perspective, a policy-maker's willingness to substitute welfare across periods suggests that there may potentially exist an optimal sequencing of public expenditure choices over time.

3.1 Simulation Model

The CGE model presented in this section incorporates the elements described in the theoretical framework above. It draws heavily on the Adam and Bevan (2006) model for Uganda and belongs to the class of recursive dynamic models.

Recursive dynamic models comprise within-period modules and between period modules. The within period modules are solved sequentially to provide updated values of parameters for the between period modules. In these models, there is no role for forward-looking expectations. Agents are assumed to be myopic, ignorant or to naively assume that the present is the best guide to the future. An important implication of this is that agents do not make intertemporally optimal decisions about savings and investment.

Recursive dynamic models thus seek to trace out the path of the economy given a series of static optimisation decisions which are linked through updating equations for stock variables and certain parameters. Equations (3) and (4) provide examples.

This treatment of dynamics has drawn a number of criticisms to CGE models, more so because it appears to be at odds with the relatively complex optimisation by consumers and producers for within-periods decisions (Devarajan and Go, 1998). However, as explained by Lofgren and Robinson (2004), the absence of forward-looking expectations can be a valid assumption, especially when information asymmetries, market imperfections and credit constraints matter sufficiently to obscure agents' knowledge of the future.

3.2 The Set-up

This section is intended as an introduction to the main features of the Madagascar simulation model.

3.2.1 Within-Period Module

Production

The model distinguishes between private and government activities. The private sector is organised into 5 activity groups, namely, Primary Sector Tradables, Non-Tradables⁸, Secondary Sector, Tertiary Sector, Human Capital Services (Education and Health Services) and Commercial Margins. The government also provides Human Capital Services and Other Services. This provides for 8 activity sectors in all, and translates into 7 commodities available for final consumption. The reasons for this asymmetry is that the commercial margins sector does not provide marketable commodities but instead reflect the costs of taking goods to markets, which in Madagascar, are significant.

For all tradable goods, production maps into domestic supply and exports according to a Constant Elasticity of Transformation (CET) function. Aggregate supply, on the other hand, is described by a CES composite, drawing on

⁸Note that the terms "tradable" and "non-tradable" are used in the context of external trade. Non-tradables include traditional agriculture and construction.

the Armington (1969) assumption of imperfect substitutability between domestically produced and imported goods.

Production in each sector is characterised by a Cobb-Douglas technology as in equation 10, with land (La), Human Capital augmented labour (HL) and sector-specific capital (Kp) and economy-wide government infrastructure (Kg) as factor inputs. Government infrastructure is thus also assumed to have public goods characteristics, as described in the previous section.

Prices

Transaction costs are assumed to drive a wedge between the supply price and the demand price. Following Lofgren *et al* (2002), transaction costs are modelled as a fixed quantity of commercial margin inputs entering the each unit of produce sold domestically, imported, or exported. This exogeneity of transaction costs with respect to government spending does not provide for an additional dimension along which to directly explore the optimal use of savings on debt servicing. Transaction costs matter however in that they influence the real exports and imports exchange rate in response to shocks, thus affecting incentives to import, export or sell on the domestic market.

Factors

Four factors are identified in the model. Land is used only in the two agricultural sectors while labour, sector-specific capital and economy-wide government infrastructure enter as inputs, with varying intensities, in all sectors. The agricultural sectors are most intensive in rural labour, the energy sector in capital and the services sector in urban labour. Except for government sector capital and public infrastructure, all factors are owned by the two household types in the model (rural and urban). The pattern of ownership thus defines a baseline *functional* distribution of income against which the distributional incidence of macroeconomic shocks are examined.

Final Demand

Final demand for marketed goods and services in the model comprises four elements. They are: demand for the transaction costs commodity (commercial margins), investment demand, government's final demand and households' consumption. Transaction costs fully exhaust the output of the commercial margins sector. Sector-specific investment demand is determined by the size of the differential between the sectoral gross profit rate and average gross profit rate in the economy. Government final demand includes the total output of the public 'other services' and 'human capital services' sectors. Households' consumption is thus defined, by a Stone-Geary Linear Expenditure System (LES) as illustrated in Equation (13), over all marketed privately-produced output.

$$q_i = \varphi_i + \frac{\varrho_i}{p_i} (Y - \sum_j p_j \gamma_j) \quad (13)$$

Where φ_i gives the quantity of subsistence consumption, Y is total income and ϱ_i are budget shares governing the allocation of supernumerary income (i.e. expenditure over and above the subsistence consumption requirements).

Subsistence consumption is assumed to vary across household types and commodity groups. The commodities subject to subsistence consumption are agricultural products, for both rural and urban households.

Macroeconomic Closure Rules

A neoclassical closure will be used for all the experiments, reflecting the macroeconomic situation in low-income small open economies . This closure rule has three elements. The government current account is characterised by, flexible government savings with fixed direct tax rates. Fixed foreign savings and flexible exchange rates ensure external current account adjustment. Finally, investment is savings-driven, being constrained to be determined by the sum of private, government and foreign savings.

3.2.2 Between-Period Module

Dynamics, or the linking of economic decisions over the simulation period, are captured both by updated values for some model variables which get carried forward from one simulation period to the next, as discussed above.

4 An application to Madagascar

4.1 Background

Madagascar is one of the poorest countries in Sub-Saharan Africa (SSA). In 2005, it ranked 192 out of 208 based on the World Bank’s Country Ranking of per capital Gross National Income (GNI). With GNI per head of USD290, Madagascar was just behind Mozambique (USD 310), at par with The Gambia, and it preceded Uganda (USD 280)⁹. Development indicators were also low, as can be inferred from Table 1.

Table 1. Madagascar: GNI per capita and Selected HDI

	2000	2001	2002	2003	2004
GNI per capita (Current US\$)	240	250	220	280	290
<i>Selected Human Development Indicators</i>					
Life expectancy at birth (Total Years)	54.79	n.a.	55.31	55.48	55.65
Literacy rate, adult total ¹	n.a.	n.a.	n.a.	n.a.	70.68
Immunisation rate, measles ²	56	57	58	59	59

Notes: n.a.: not available; GNI per capita in 2005 was US\$290

1. Percentage of people 15 and above

2. Percentage of children aged 12-23 months

Source: World Development Indicators Database

⁹Gross National Income calculated using the World Bank Atlas Method (Source: World Development Indicators Database as at 1 July 2006).

Table 2 provides a summary of the structure of the Malagasy economy and of the evolution of key macroeconomic indicators including external debt for the period 2000 to 2004.

Table 2. Madagascar: Selected Economic Indicators					
	2000	2001	2002	2003	2004
GDP at market prices (annual % change at 1984 prices)	4.7	6.0	-12.7	9.8	5.3
<i>Value Added</i>					
			<i>% of GDP</i>		
Agriculture	29.1	28.6	31.7	29.2	28.8
Industry	14.5	14.7	14.4	15.4	16.0
Services,etc. ¹	56.4	56.7	53.9	55.5	55.2
Exports of Goods and Services	30.7	29.1	16.0	23.1	31.7
Imports of Goods and Services	38.1	32.3	22.6	32.1	48.0
Inflation, GDP Deflator (%)	7.2	7.3	15.3	2.8	14.3
Overall Fiscal Balance (commitment basis,exc. grants)	-6.8	-8.2	-7.7	-9.3	-13.1
Total external debt ² (Current US\$ million)	4120	4052	4433	4847	5142
Total external debt to GDP (%)	106.4	89.5	97.9	88.7	117.7
Total external debt to Exports (%)	346.8	308.0	611.3	412.6	366.0

Notes

1. The services sector includes commercial margins. In 1999, the contribution of commercial margins to valued added was 23.4 per cent.
2. After traditional debt relief (Naples flow rescheduling of 1997).
3. The sharp deterioration of all indicators in 2002 is due to the political crisis.
4. Indicators for 2004 reflect a severe depreciation of the currency and adverse weather.

Sources: IMF Country Report 05/321, World Development Indicators Database, Dorosh et al. (2003) data set, and author's computations.

Madagascar's total external debt represented 108.3% and 437.5% as a percentage of GDP and exports respectively in 1999, the year in which it qualified for consideration under the Enhanced Heavily Indebted Poor Countries (HIPC) multilateral debt relief initiative. At Decision Point in 2000, the country secured savings on debt service of USD59 million per year, on average, over the period 2001-2019 (1.1 per cent of 1999 GDP on average)¹⁰. Equivalently, the amount of debt relief approved at Decision Point for Madagascar was USD 822 million in Net Present Value Terms¹¹. Madagascar reached Completion Point under

¹⁰Source: "Madagascar:Decision Point Document for the Enhanced Heavily Indebted Poor Countries Initiative" (IMF and IDA,2000).

¹¹This was later revised upwards to USD 836 million in NPV terms when the country reached Completion Point in 2004. (*IMF Country Report 04/406*).

the Enhanced HIPC in 2004. In practical terms, this meant that most of the precommitted amount of debt relief would accrue over the period 2004-2019. Another wave of debt relief was granted to Madagascar in 2005 under the G8's Multilateral Debt Relief Initiative (MDRI)¹², which provides for the complete writing off of all outstanding debts post Enhanced HIPC Completion Point.

Debt relief under both the Enhanced HIPC and the MDRI differ from debt relief efforts of the 1980s in two important respects. The fact that they are mostly concerned with the sovereign debt of Low-Income Countries (LICs) is one of them. Another is that their primary aim is not to cure Low-Income Countries of the debt overhang in order to maximise their chances of meeting remaining debt obligations. Rather, debt relief is associated with an explicit poverty reduction objective, epitomised in the equally explicit requirement that recipient governments use the savings on debt servicing to increase social expenditures and target these to the poor. In the Malagasy context, this represents nothing short of a challenge to fiscal policy given the pervasiveness of poverty.

Poverty Analysis conducted by the IMF and IDA (International Development Association) in the context of the Enhanced HIPC indicates that about 70 per cent of people lived in poverty in 1999. It also suggests the existence of urban-rural poverty divide in Madagascar, with 80 per cent of the poor living in rural areas (IMF and IDA, 2000). Different causes are identified for rural and urban poverty. Limited access to irrigated land, public infrastructure such as electricity and roads are closely linked to rural poverty. By contrast, urban poverty, which accounts for 16 per cent of total poverty, is associated with labour markets and education. These findings suggest that varying the composition of debt-relief financed government expenditure can have very different implications for distribution and poverty. The policy experiments discussed in the next section are designed against this background, although the focus is not on poverty *per se* but on welfare of rural and urban households.

Table 3 below summarises some of the indicators of poverty, based on the headcount index, while table 4 gives a measure of inequality in this distribution in 1999 based on a regional disaggregation of households.

		1993	1997	1999
Poverty	National	70.0	73.3	71.3
	Urban	50.1	63.2	52.1
	Rural	74.5	76.0	76.7

Notes:

1. Based on Household Surveys conducted in 1993,1997 and 1999.
2. The poor are defined as those who spent 313,945 MalagasyFrancs (USD 164) or less in 1993 prices

Source: IMF and IDA (2000).

¹²See the factsheet by the IMF (2006).

Household Type	Number	Total Income (FMG bn)	Annual Avg Inc. per household FMG	Annual Avg Inc. per household USD ¹	Annual Avg Inc. per household (% of Mean) ²
Urban	670,656	9,575	14,277,066	2,272	175.2
Rural	2,192,364	13,761	6,276,786	999	77.0

Notes:

1. Based on the period average FMG/USD exchange rate for 1999 (IMF Country report 03/07)

2. Mean Income per household at USD1,297 for 1999.

Sources: Dorosh *et al.* (2003) data set and author's computations.

4.2 Data and Choice of Parameters

The base year data used in to calibrate the model has been kindly provided by Paul Dorosh and Steven Haggblade. Dorosh *et al* (2003) draw data from various sources, most notably from the National and Balance of Payments accounts and the 1999 *Enquête Permanente auprès des Ménages* (EPM or Household Survey) to construct a 34-sector, 20-producing factors and 16-household groups Social Accounting Matrix (SAM) for Madagascar in 1999. This SAM underpins their analysis of "Economic Motors for Poverty Reduction", in which they investigate the poverty implications of investment in four key activity sectors using the static version of the IFPRI Standard CGE model (Lofgren *et al*, 2002). A note on the Social Accounting Matrix and its aggregation is provided in Appendix 6.

To keep the analysis of the questions at hand tractable, I aggregate the data into an 8-sector, 5-producing factors and 2 household groups SAM which I supplement with additional data sources where appropriate. For example, I use the World Bank's 2005 Public Expenditure Review for Madagascar to disentangle government production of health and education services from other public services. Similarly, the composite indicator of human development is constructed using data on Adult Literacy Rates, Infant Mortality, Access to Sanitation and Access to Safe Water from the 1999 *Enquête Permanente auprès des Ménages*.

Most parameters are computed in GAMS¹³, the simulation software, by calibrating the base year data to the relevant functional forms and equations. Exceptions include key parameters such as the Armington elasticities of substitution and transformation, the degree of externalities from public infrastructure, the valuation of basic needs attainment and income in social welfare, the inequality aversion parameter and the intertemporal elasticity of substitution of welfare. For these parameters, I use, where available, estimates commonly employed in the literature (for example, Adam and Bevan (2006) and Lévy(2006)). I then test the robustness of my results by conducting a sensitivity analysis with respect to changes in the value of these non-estimated, non-calibrated parameters. Table 5 below describes the value of key parameters used in the core

¹³General Algebraic Modeling Software.

simulations.

	Description	
α_g	Externality Parameter for Public Infrastructure	0.25
β^s	Intertemporal Discount Factor	0.97
δ_g	Depreciation rate of Public Infrastructure	0.04
δ_h	Depreciation rate of human capital	0.02
β_R	Share of rural income in Z composite	0.75
β_U	Share of urban income in Z composite	0.63
κ	Elasticity of substitution Z composite	0.50
μ	Weight of Human Development in Welfare function	0.67
ϕ	Net change in annual debt service obligations	0.30
ψ	Elasticity of substitution in agent's welfare function	0.25
σ	intertemporal welfare substitution parameter	0.50
ρ	Inequality aversion parameter	1.00
ς	Index of quality of government services	1.00

4.3 Policy Experiments

The policy experiments in this section are designed to capture the public expenditure choices for the government of a small open economy benefitting from debt relief, as per the theoretical framework articulated in section 3.

Two sets of core simulation experiments are run. The first consists of 16 experiments. It considers a reallocation of public spending without any income effects from debt relief. The aim is analyse the macroeconomic and welfare effects of public expenditure restructuring in the absence of any realised savings on debt servicing. This set of experiment potentially addresses concerns that the value of recent debt relief is largely overstated. Cohen (2000), for example, shows that the value of debt relief for a country which was not going to be able to repay its debt obligations in the first place is effectively zero.

The second set of simulations is based on the received wisdom that debt relief results in real savings on debt servicing, making more resources available for other public spending categories.

The simulation horizon is in each case 1999-2015. The baseline is defined by a static steady state, and unless otherwise stated, all numerical results in Appendix 4 are expressed as percentage deviations from this baseline. Results are reported for selected macroeconomic variables and welfare for the immediate (2000) and long-run effects (2015) as well as intermediate years 2004 and 2009.

4.3.1 Expenditure reallocation

In these 16 experiments, reallocation takes place from each of four public expenditure categories, namely infrastructure investment, human capital services, other services and cash transfers to households. Each reallocation from one expenditure category is either to one of the remaining three categories or passed on to the private sector via the savings-driven investment closure rule. In other

words, reallocation here also takes the form of simply cutting back on a particular category of public spending so that more resources are available for private investment. Experiments in this set are labelled 1-16, and details of each are provided in the discussion of results.

Expenditure reallocations are modelled such that they are spread over the simulation horizon and, by the end of 2015, equal in magnitude to the counterfactual where the government makes real savings on debt servicing (see below). The equivalence is achieved by modelling reallocations from infrastructure investment of about 2 per cent of the initial level per year, and for other expenditure categories, of about 4 per cent of the initial level per year.

4.3.2 Debt relief

Annual average debt relief equivalent to 1.1 per cent of Madagascar’s GDP in 1999 translates into a 70 per cent reduction in the value of the baseline foreign interest payments. In terms of magnitude, the debt relief shock may appear trivial. However, there are a number of reasons for not literally modelling debt relief as recurring annual reductions in foreign interest obligations equivalent to 70 per cent of the baseline. The most compelling is a technical one. Such magnitudes could generate an endogenous regime switch. The economy would turn from a net debtor to the rest of the world to a net creditor, and the equilibrating mechanisms of the model would be altered. In addition, it is conceivable that the effects of debt relief on foreign interest obligations could be muted by offsetting influences, which could be either be endogenous or exogenous to the model. I abstract from detailed analysis of these considerations and characterise debt relief by the following dynamic equation for foreign interest obligations.

$$fint_{t+1} = fint_t(1 + \phi) \tag{14}$$

where ϕ is a parameter which captures the yearly net *change* in foreign interest obligations, inclusive of debt relief. For the analysis, we want to consider negative values of ϕ since these imply some amount of realised savings on debt-servicing which can be used to increase public spending. A value of ϕ of -0.3 is used throughout the simulation horizon. This value of ϕ considered correspond to cumulative net reductions of 99 per cent in foreign interest obligations at the end of the simulation period.

In the context of debt relief, I consider seven core experiments. Experiments 17 and 18 are bipolar counterfactual exercises, considering the cases when all the savings on debt servicing are entirely spent on public infrastructure or publicly provided health and education respectively. Note that increasing the provision of publicly provided health and education services involve both recurrent and sector-specific capital outlays. Experiment 19(a)-19(c) are intermediate scenarios, with the weight on public infrastructure at 60, 50 and 40 per cent respectively. In experiment 20, the savings on debt servicing translate into an equal reduction in the government’s borrowing requirements, thus enabling the private sector to increase investment out of available resources. Finally, Exper-

iment 21 examines the effect of using savings on debt servicing to make cash transfers to households.

5 Results

5.1 Core Simulations

The model calibrates to a zero-growth¹⁴ steady state in the baseline, replicating the SAM values over the entire simulation horizon (1999-2015) in the absence of any shocks.

Tables 6(a), 6(b) and 6(c) report the baseline values of some of the main indicators of interest, classified under the headings of macroeconomic data, sectoral data, and factors and households.

Table 6(a): Macroeconomic Data	
Absorption	25,555
Private consumption	20,845
Government consumption	1,837
Private investment	1,730
Government fixed investment	1,143
Net exports	-2,182
GDP at market prices	23,373
Net indirect taxes	2,175
GDP at factor cost	21,198
Foreign interest obligations	325
Government deficit(-)/surplus(+)	-1337
Real Export Exchange Rate ¹	1.00
Real Import Exchange Rate ²	1.00

¹Real Export Exchange Rate is the ratio of domestic export price to domestic supply price

²Real Import Exchange Rate is the ratio of domestic import price to domestic demand price

All figures in FMG billion except exchange rates.

¹⁴There is no growth in population and labour supply.

Table 6(b): Sectoral Data	
Value Added to GDP	<i>Per cent</i>
Primary Sector Tradables	17.01
Non Tradables	14.82
Secondary Sector	13.27
Tertiary Sector	23.73
Human Capital Services	1.91
Commercial Margins	23.44
Public Human Capital Services	2.01
Other Public Services	3.80

Table 6(c): Factors and Households Data	
Factor remuneration	
Rural labour	4,914
Urban labour	5,184
Sector-Specific capital	7,621
Land	3,479
Institutional Income	
Rural households	13,678
Urban households	9,658
Consumption	
Rural Households	13,115
Urban Households	7,730

All figures in FMG billion

In all subsequent experiments, the shocks intervene at the end of 1999. A subset of numerical results from the core simulations are reported for values of ϕ of -0.3 in Tables 7(a)-9(c) in Appendix 4. In all cases, the impact effect (1 year after the shock takes place) and the accumulated net effects in 2004, 2009 and 2015 on macroeconomic variables and welfare are presented.

The policy experiments in this section are designed to capture the public expenditure choices for the government of a small open economy benefitting from debt relief, as per the theoretical framework articulated in Section 3.

5.1.1 Expenditure reallocation

To make sense of the results from this set of experiments, two things are worth noting. First, shifts in relative prices are an important part of these expenditure reallocations. Second, the other mechanism for the propagation of these expenditure shocks relates to the nature of each of the expenditure categories. Public infrastructure investment is productive (Equation 5) and indirectly, welfare enhancing (by successive substitution from Equation 7 onwards). Public spending on the provision of health and education is productive (Equations 4 and 5)

and welfare-enhancing via the Social Indicator variable B . Cash transfers to households enhance welfare acting on money metric utility through the budget constraint. Government other services, on the other hand, is often the case in applied general equilibrium modelling, a source of distortion requiring financing via non lump-sum taxation.

Results from all expenditure reallocation experiments are consistent with prior expectations based on the role of each expenditure category.

Reallocation away from public infrastructure go into government other services (Exp 1) , health and education services (Exp 2), private investment (Exp 3)¹⁵ and cash transfers (Exp 4). In all four scenarios, the impact effect is small given the magnitude of the shock but macroeconomic indicators worsen over time. Real GDP for example is on impact(2000) lower by -0.02 per cent across experiments 1-4 . However, by the end of the simulation horizon (2015), it is between -1.61(Exp 3) to -2.85(Exp 1) per cent lower relative to the baseline. Net exports follow a similar pattern, changing little on impact or during the intermediate years 2004 and 2009. By 2015, however net exports are lower under all four scenarios, with the fall relative to baseline ranging by between 5.86 per cent(Exp 3) and 16.74 per cent(Exp 4). Appreciation of both the real import exchange rate and real export exchange rate can explain the observed behaviour of net exports. By 2004, and through to 2015, the real exchange rates are appreciated relative to the baseline under all four scenarios. However, under experiment 3, the real export exchange rate appreciates by proportionately less, and the real import exchange rate proportionately more. The fiscal deficit worsens progressively under scenarios 1, 2 and 4, being 8.32, 4.72 and 9.31 per cent, respectively higher relative to baseline in 2015. It improves considerably (and predictably) when infrastructure investment is cut back to allow the private sector to invest(Exp 3), i.e by 8.50 per cent by 2015.

Nearly all household variables (wages, income and consumption) worsen over time under either scenario. Intertemporal welfare is also lower relative to the baseline, with the lowest reduction in welfare occurring when the reallocation takes the form of a budget cut which is passed on to the private sector (Exp 3).

Next, consider **reallocation away from human capital services** into government infrastructure(Exp 5),Other government services(Exp 6), private investment(Exp 7) and cash transfers(Exp 8). As before the impact effect on real GDP is small. By the end of the simulation horizon however, a mixed picture emerges. Under experiment 5, real GDP is higher relative to baseline by 1.18 per cent. Under all other scenarios, it is lower by between 0.83 (Exp 7) to 2.71 (Exp 6) per cent. Net exports increase significantly in the long run (2015) in two circumstances (Exp 5) and (Exp 7). Relative to baseline, they are higher by 17.76 and 10.26 per cent respectively. This has to be viewed against a depreciation of the real exchange rate also observed under experiments 5 and 7. The effect of this expenditure reallocation on human development is (predictably) negative. The indicator of human development is lower for rural households by 1.96 per cent and urban households, by 1.23 per cent compared to baseline val-

¹⁵Note: this amounts to cutting back public infrastructure spending.

ues of 0.507 and 0.812 respectively. On balance, rural households benefit from a reallocation of public health and education expenditures under experiments 5 and 7, registering small but positive gains in wages, disposable income and consumption. Urban households by contrast are unequivocally worse off under experiments 5-8. Consistent with these observations, and the relative weights of each household type, intertemporal welfare improves relative to baseline under experiments 5 and 7 but falls under scenarios 6 and 8. This highlights a potential efficiency-equity trade-off from public expenditure restructuring. The trade-off arises because the health and education services sector employ predominantly urban workers.

A third subset of experiments relate to the **restructuring of public expenditure from other services** to public infrastructure(Exp 9), government human capital services(Exp 10), private investment(Exp 11) and cash transfers(Exp 12). The distortionary nature of public other services, in the model, is borne out by the results. Reallocation causes macroeconomic indicators and household variables to improve. Similar to previous experiments, the impact effect is negligible for all variables, except for investment variables. Private Investment for example immediately increases relative to baseline by between 0.86 (Exp 9) and 2.83(Exp 11) per cent. At the end of the simulation horizon, real GDP is between 0.92 (Exp 12) and 7.82 (Exp 9) per cent higher, net exports increase by between 3.37(Exp 12) and 45.16(Exp 9) per cent and the overall fiscal deficit improves by between 4.24(Exp 12) and 24.72(Exp 9) per cent respectively! The real import and export exchange rates are depreciated relative to baseline, except for the real import exchange rate under experiment 11. While these numbers represent in no way actual gains from feasible reallocations, the message which can be taken away is that the progressive removal of distortions can have important efficiency gains. Except for experiment 12, where the average rural wage is lower by 2.16 per cent at the end of the simulation horizon, household variables improve over time with the gains being slightly skewed towards rural households. Intertemporal welfare is unambiguously higher under all configurations.

Finally, consider **expenditure reallocation away from cash transfers** to public infrastructure investment(Exp 13), human capital services(Exp 14), private investment(Exp 15), and government other services (Exp 16). Some improvements to macroeconomic variables occur. Real GDP for example is higher relative to baseline under experiments 13-15, by between 1.43 per cent(Exp 14) to 4.63(Exp 13). It is lower by 0.47 per cent under experiment 16. In all cases, net exports are higher at the end of the simulation horizon, with the increase ranging between 6.88 to 27.82 per cent. This is broadly consistent with a depreciation of the real export exchange rate for experiments 13 to 15 and real import exchange rate for scenarios 15 and 16. Rural households benefit from this subset of reallocation experiments, except under experiment 16. Urban Households, on the other hand, while registering gains in their average wage are worse off in terms of disposable income and consumption throughout. This can be explained by the fact that in the baseline they benefit proportionately more from cash transfers than their rural counterparts.

Results further suggest that the experiments are neutral in their effect on human development for rural households, except for experiment 13 where they register a cumulative gain of 1.96 per cent at the end of the simulation horizon. Conversely, the indicator for human development is lower for urban households under experiments 14 to 16. Intertemporal welfare is higher relative to baseline under three scenarios only, namely 13 to 15.

The overall conclusion from the above results is that the magnitude and distribution of the gains from public expenditure reallocated are very much shaped by the nature of the expenditure categories-i.e., whether productive, welfare-enhancing (or both) or distortionary. In addition, distributional effects can arise from the reallocation.

5.1.2 Debt relief with savings on debt servicing

Within the second set of core simulations, experiment 17 ('the big push in infrastructure') is the preferred public spending option. It yields the highest improvements in real output and aggregate intertemporal welfare. The behaviour of macroeconomic indicators suggest the creation of a 'virtuous circle' effect, arising from the assumption of the externality effect of infrastructure. Intuitively, the effect of investment in public infrastructure is an across the board increase in productive capacity which raises the returns to private factors and over time, causes the relative prices of domestically produced commodities to fall. This is borne out by the results, which indicate that private investment grows strongly throughout the simulation period, being 20.59 per cent above its baseline value by 2015. Average wages also take an upward trend, being initially higher for rural labour (0.91 per cent, 3.01 and 4.62 per cent against 0.56, 2.42 and 4.45 per cent for Urban labour). From 2009 onwards, the growth rate of wages is strongest for urban households and by 2015, average wages are 6.59 per cent and 6.85 per cent above the baseline for rural and urban households respectively. Real GDP is 5.79 per cent higher over its baseline value.

Results from experiment 17 also confirm earlier findings that Adam and Bevan (2006) and Lévy (2006) about public infrastructure reversing Dutch Disease. The immediate impact of the investment in public infrastructure is an appreciation of the real export and import exchange rates and worsening of the trade balance. However, although by 2015, the real exchange rates are appreciated relative to the baseline, there is evidence of a depreciation between 2009 and 2015. Further, the trade balance indicates an improvement over the baseline of 10.72 per cent.

The combined cumulative effect of Experiment 17 on real GDP and the indicator of human development, as shown in Table 9e of Appendix 4, translate into discounted intertemporal welfare being highest under this configuration. However, a comparison of period by period welfare gains shows that the effect on static intratemporal welfare the immediate years following the shocks is actually higher under experiments 20 and 21 (net transfers to the private sector financing investment and consumption, respectively). This illustrates the point made in section 3 about the possible existence of optimal sequencing of public

expenditure choices.

Considering experiments 18 and 19(a)-19(c) reinforces the conclusion that a public spending program that allocates proportionately more resources to infrastructure investment relative to increasing public health and education provision is more 'pro-growth' and yields higher improvements in intertemporal welfare. A ranking of these four public spending choices, in ascending order, in terms of their effects on growth and discounted intertemporal welfare would be: Experiments 18, 19(c), 19(b) and 19(a). The corresponding respective weights on public infrastructure investment are 0, 0.4, 0.5 and 0.6 respectively. The results about the immediate effect on intratemporal welfare still endure however.

An explanation of the difference in the growth and welfare outcomes of Experiments 17-19(c) can be found in an analysis of the macroeconomic indicators. Results for Experiment 18, for example, shows that increased provision of social services by the government has lower growth and complementarity effects (with private factors), and as such is not effective in reversing Dutch Disease. In terms of end-of-simulation horizon magnitudes, real GDP is 2.30 per cent above the baseline; private investment is up by 10.99 per cent and the real export and real import exchange rates are appreciated relative to their baseline values by 1.63 per cent and 1.99 per cent. Interestingly, the effect of Experiments 18-19(c) on human development are the same. Thus the differences in intertemporal welfare is being driven more by growth effects. It is worth noting however, at this stage, that the results discussed so far could be sensitive to the assumptions about the degree of externalities from public infrastructure. It is plausible that in the presence of lower externalities from public infrastructure (for example, due to congestion costs), the observed differences in growth and welfare outcomes may be smaller or even reversed. This is considered in the sensitivity analysis.

The results on macroeconomic variables from Experiments 20 and 21 are in line with what would be expected. To the extent that experiment 20 enables the accumulation of factors of production (private sector capital), it has a higher effect on output than experiment 21 (2.70 per cent and 0.30 per cent, respectively), the immediate effect of which is merely a relaxation of the budget constraint of households. There are, as expected no offsetting effects, on Dutch Disease as the real export and import exchange rates are considerably appreciated relative to their baseline value. For experiment 20, there appears to be diminishing returns to private sector investment. This result may at first seem to be counterintuitive considering that LICs are more often than not characterised by acute shortages of private capital. However, it needs to be viewed against the backdrop of the static steady-state baseline, which features a zero-labour supply growth assumption. Another interesting result from experiment 20 is that it results in the highest improvement in overall fiscal deficit, namely 25.84 per cent by 2015. To the extent that the need for debt relief are often brought about by developing country governments' difficulties in managing deficits, this suggests that allowing the gains from debt relief accrue to the private sector could be a potentially attractive policy option.

The effect of experiments 20 and 21 on period-by-period welfare in the immediate years following debt relief can be traced to the evolution of the Household

variables in Table 7e (Appendix 4). For rural households, the immediate effects of both experiments 20 and 21 on the average wage, disposable income and consumption are relatively high compared to other public expenditure configuration. Urban households similarly experience the highest immediate increase in disposable income and consumption under experiment 21.

5.2 Sensitivity Analysis

Results from simulation experiments suggested that public infrastructure investment was an effective way of improving macroeconomic and welfare outcomes, both in the case of reallocation and debt relief experiments. To some extent, this could be due to the assumptions about the externality effects of such infrastructure and the efficiency of government in turning investment into actual usable capital stocks. For both sets of experiments, the value of the externality parameter α_g is set to 0.25, following Adam and O'Connell (2004). Also, investments by the government fully and immediately add to the infrastructure capital stock. However, in the words of Pritchett (2000) "CUDIE (Cumulated, Depreciated Investment Effort) Is Not Capital".

Thus, in this sensitivity analysis on experiments 17-21, I examine firstly how lower externalities from public capital affect the results, by considering a range of values from 0.00 to 0.20 for α_g . Next, I consider a form of congestion whereby only some sectors benefit from public infrastructure. Two sectors are of particular interest: the Primary Sector Tradables sector and the commercial margins sector. The idea is that even if the externality is concentrated in these two sectors only, relative prices changes in the form of a depreciation of the real export exchange rate and a fall in transport costs may be sufficiently large to matter.

I also examine the idea of inefficiency by introducing, similar to Adam and Bevan (2006), gestation lags in infrastructure formation.

In addition to the sensitivity analysis on the infrastructure parameters, there is a rather large number of permutations and combinations of parameters that can be used to check for the robustness of results from core simulations. I examine the effects of a few, labelling them as experiments (a)-(y). Tables 10, 11(a) and 11(b) in appendix 4 provide details on each and reports selected results. The findings from the sensitivity analysis are summarised below.

Sensitivity analyses with respect to the size of externality parameter, results indicate that reducing the value of α_g successively from 0.20 to 0.00 suggest that infrastructure investment becomes a dominated public spending option once α_g is lowered below 0.15. Instead experiment 20 consistently emerges as the public spending choice which yields the highest intertemporal welfare, closely followed by allocations that place a higher weight on human capital services spending, and ,for some experiments, cash transfers. For 'low enough' α_g cash transfers also dominate infrastructure investment as a public spending option. These results also hold for the analysis of 'congestion'.

When α_g is set to 0.25 but there is inefficiency, as proxied by lags in infrastructure formation, affects the magnitude of the various macroeconomic in-

dicators but not the qualitative nature of the results. Rankings on the basis of intertemporal welfare are however altered. In particular, introducing lags of 2 and 3 years results in the largest welfare gains being achieved under experiment 20. Further, for longer lags, the intermediate expenditure allocations with a lower weight on infrastructure rank higher in terms of intertemporal welfare.

Other sensitivity analyses are conducted with respect to μ , the weight of the indicator of human development in household welfare with α_g set to 0.25. The effects of varying the inequality parameter ρ , and the discount factor β^s , are examined both for $\alpha_g = 0.25$ and $\alpha_g = 0.05$. Macroeconomic outcomes are not as expected affected by changes in the value of these parameters (except as before when moving from $\alpha_g = 0.25$ to $\alpha_g = 0.05$). Welfare outcomes in some cases are. Considering for example, changes in μ such that urban households place more weight on human development preserves the rankings established in core simulations. Public spending configurations which place higher weights on infrastructure are preferred. This holds under the assumption that the policy maker is indifferent to inequality among household groups.

Introducing inequality aversion by setting ρ to 5, for example, brings interesting insights. When sufficiently high externalities accrue from public infrastructure, experiment 17 results in the biggest gains in intertemporal welfare, followed by the 'allow the private sector to invest' option and expenditure allocations which emphasise public infrastructure investment.

However, if there are low externalities to public infrastructure, the 'allow the private sector to invest' option yields the highest intertemporal welfare, followed by the expenditure allocation described by experiment 18, i.e. investing in health and education services.

Finally, considering the effect of the discount factor, the conclusions are that is not so much the value of β^s which makes a difference to the ranking of alternative welfare policies, but the interaction of β^s with α_g . The results from these sensitivity analyses yield qualitatively similar conclusions on intertemporal welfare as the ones resulting from changing α_g from 0.25 to 0.05.

6 Concluding Remarks

This paper has proposed a theoretical framework, which can be used for an analysis of alternative of public spending choices. It has tested the quantitative significance of the relevant factors thus identified using a CGE model calibrated to Madagascar data. Several Public Spending configurations were analysed, in the context of debt relief. In a first set of experiments labelled 1-16, expenditure reallocations, under the assumption that debt relief entails no real savings on debt servicing, were examined. The results were consistent with economic theory in that reallocations away from expenditure categories which are not directly productive or welfare-enhancing yielded the most improvements in macroeconomic variables and welfare.

The next set of experiments (17-21) assumed that the government benefitted from real savings on debt servicing arising from debt relief. In experiment 17, all

savings on debt servicing were used to increase public infrastructure. Experiment 18 considered the other end of the spectrum, with debt relief financing increased public provision of health and education. Intermediate cases with the weight on public infrastructure is 0.6, 0.5 and 0.4 were examined in experiments 19(a), 19(b) and 19(c), respectively. Experiment 20 and 21 examined the effect of net income transfers to the private sector which result in the relaxation of financing constraints for investment and the budget constraint of households respectively. The main results that emerge from these simulations are that public spending choices which allocate proportionately more resources to infrastructure spending are also those which result in the highest gains in output and discounted intertemporal welfare. Spending choices which relax investment financing and household budget constraint tend to raise period by period welfare most in the immediate years following the debt relief shock.

To some extent, the results from both sets of simulations concur. They also confirm previous results by Adam and Bevan (2006) and Lévy (2006) about how public infrastructure can be used to reverse Dutch Disease. A sensitivity analysis with respect to key parameters has indicated that the degree of externalities to public infrastructure is crucial. Hence, it would appear that a 'big push' in infrastructure is only warranted for sufficiently high degree of externality. For LICs such as Madagascar, it is not inconceivable that large externalities to public infrastructure, for example roads, exist so that spending proportionately more on public investment in infrastructure might be preferable. On the other hand, results suggest that for 'low enough' externalities to public infrastructure intertemporal welfare can be maximised by allowing the savings on servicing to accrue to the private sector for investment or by investing more in health and education services. In addition, lags in public infrastructure formation affect the ranking of different policies with respect to the intertemporal welfare criterion.

Another insight from the sensitivity analysis is that other parameters, such as the degree of inequality aversion affect the ranking of policies, based on the intertemporal welfare criterion, in conjunction with the externality parameter.

These results must of course be considered against the assumptions and limitations of the model(s) used to generate them. The most important limitations concern (i) the simplifications made in specifying the theoretical framework and (ii) the assumptions behind the simulation model and experiment design.

In the theoretical framework, for example, the suitability of the recursive dynamic structure and of the modelling the public expenditure allocation process as a series of separate static decisions, depends on the nature and extent of information asymmetries. While plausible for a low income country such as Madagascar, these assumptions need not be fully appropriate.

The simulation model itself is based on assumptions, which could be relaxed. Examples include: the modelling of debt-relief, calibration to a static steady-state baseline with zero labour supply growth, the role of cash transfers and the absence of lags, especially in the process human capital formation. External debt could involve distortions in an economy that go beyond the transfer problem in an economy, in which case the effects of debt relief may be understated. Equally, cash transfers may have a role to play in overcoming market failure, and as such

are likely be a more relevant public spending choice than the results from the model would suggest. This is another aspect of the model, other than the effect of higher public provision of services, where the behavioural response of households is absent and therefore precludes normative analysis of the optimal allocation of public spending.

In both the theoretical and simulation model, the assumptions of costless reallocation across expenditure categories and, related to this, the savings-driven investment macroeconomic closure could also be exaggerating the output and welfare effects. By assumption, and by design, the 'allow the private sector to invest' option creates no distortion in the economy. Thus political economy considerations such as rent-seeking and state capture are ignored. In practice, all these factors may upset the ranking of different public spending categories, either on the output or welfare criteria.

There can be no doubt that further research and improved structural modelling is required to address the issue of the optimal allocation of public spending. This begs the question then as to whether, inspite of the limitations discussed above, the analysis in this paper can help shed light on anything at all. In fact, it does. Somewhat echoing the conclusions of the World Bank's OED Report (2003), and Agénor (2005, 2006), it does show that a focus on human development (or MDGs) may not always necessarily require spending proportionately more on publicly provided health and education. This is a non-trivial insight, considering that much concern has been expressed lately about how to improve the effectiveness of aid.

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Appendix 1: Parameters and Sets¹

AC_i	Armington shift parameter for CES function
AD_i	Sectoral Production Function Shift Parameter
ADJ	Investment adjustment parameter
$*AP$	Armington Share Parameter for Human Capital Investment
αg_i	Share of public infrastructure in production
αk_i	Share of private capital in production
αl_i	Share of labour in production
αs_i	Share of land in production
$*\beta_{hh}$	Household share of food expenditure based on EPM 99
$*\beta^s$	Intertemporal Discount factor
$CLES_{hh}$	Consumption share parameter
δ_i	Armington share parameter for importables
$*DEPH_{hh}$	Depreciation rate on human sector capital
$DEPR_i$	Depreciation rate on sector specific capital
$DEPRKG$	Depreciation of public sector capital
$DTAX_{hh}$	Direct tax rate
ε_c	Armington elasticity of substitution
ε_t	CET elasticity of transformation
γ	CET shift parameter
$*gf_{hh}$	Share of government human capital services to households
HW	Household weights
$*icd_i$	Qty of commercial margins per unit sold domestically
$*ice_{ix}$	Qty of commercial margins per unit exported
$*icm_{ima}$	Qty of commercial margins per unit imported
$imat$	Capital composition coefficients for sector-specific capital
$imatp$	Capital composition coefficients for infrastructure
$IO(i, j)$	Input-Output Coefficients
$itax_c$	Indirect tax rate
KI_{ip}	Capital share
$*\lambda_1$	Parameter for reallocation of expenditure from infrastructure
$*\lambda_2$	Parameter for reallocation of expenditure from all other categories
LG_{lc}	Labour supply growth rate
mps_{hh}	Marginal propensity to save
$*\mu_{hh}$	valuation of human development in household welfare
$*\phi$	Net change in foreign interest obligations
$*\rho$	Inequality aversion parameter

¹Original parameters, sets, variables and equations due to Adam and Bevan (2006). * indicates new or modified. The modelling of transaction costs is based on Lofgren *et al* (2002).

Appendix 1: Parameters and Sets (Continued)

Parameter	
$*shrl_{hh}$	Share of land rent to household
$*shr_{kh}$	Share of gross profit to household
σ_c	CES elasticity of substitution
$t_{e,ix}$	Export duty rate
$t_{m,ima}$	Tariff rate on imports
$*\theta$	Armington share parameter for HCS formation
$*v$	Substitution parameter for HCS formation
$WDIST$	Wage distortion parameter
wc	Weights for consumer price index
wp	Weights for producer price index
$*\zeta$	Index of quality for public HCS
Set	
i	Activity and commodities set
$*ic \subset ich$	Consumption commodities exc HCS
$*ich \subset i$	Consumption commodities
$ig \subset i$	Government sector
$*ihe \subset ip$	Private HCS
$*ima \subset i$	Importables
$*in \subset i$	Non-Traded sectors exc HCS
$*inma \subset i$	Non-Importable sectors exc HCS
$*inxa \subset i$	Non-Exportable sectors exc HCS
$ip \subset i$	Private sectors
$ir \subset i$	Land-intensive sectors
$it \subset i$	Transaction costs sector
$iu \subset i$	Land Non-intensive sectors
$ix \subset i$	Exportables
hh	Household type
lc	Labour category

Appendix 2: Variables

Exogenous	
<i>AID</i>	Foreign Savings (US\$million)
<i>CBASE_{i,hh}</i>	Base consumptions hares
<i>ER</i>	NominalFMG/US\$exchangerate
<i>FINT</i>	Foreign interest obligations
<i>GD_{ig}</i>	Government Final Consumption
<i>*H_{hh}</i>	Household Human Capital Stock
<i>K_{P,i}</i>	Sector Specific Capital Stock
<i>K_g</i>	Public Sector Infrastructure
<i>LAND_i</i>	Land by sector
<i>LS_{lc}</i>	Labour supply by labour type
<i>*P_{lc}</i>	Per worker Human Capital stock
<i>PWE_{ix}</i>	World Price of Exports
<i>PWM_{im}</i>	World Price of Imports
<i>*QDK_{ig}</i>	Quantity of public sector specific investment
<i>*QDKG</i>	Quantity of infrastructure investment
<i>RMIT_{hh}</i>	Remittances in Local Currency Units
<i>TRNS_{hh}</i>	Government transfers to households
Endogenous	
<i>*B_{hh}</i>	Measure of Human Development Households
<i>CDM_{i,hh}</i>	Private consumption at market prices
<i>CD_{i,hh}</i>	Private consumption at producer prices
<i>CPI</i>	Consumer Price Index
<i>DEPRC</i>	Depreciation expenditure for physical capital
<i>DEPRH</i>	Depreciation expenditure for human capital
<i>DIRTAX</i>	Direct tax revenue
<i>DINT</i>	Interest on domesticdebt
<i>*DK_i</i>	Investment by destination
<i>E</i>	Quantity of exports
<i>GDPVA</i>	GDP (Total value added) at factor cost
<i>HSAV_{hh}</i>	Household savings
<i>INDTAXC_i</i>	Indirect tax by sector
<i>*IPH_{hh}</i>	Human capital formation for household
<i>LD_{lc}</i>	Employment
<i>M_i</i>	Quantity of imports
<i>ND_i</i>	Intermediate Input Demand
<i>*Ω</i>	Value of Intratemporal Social Welfare

Appendix 2: Variables (Continued)

Endogenous	
<i>*Paasche_{hh}</i>	Household specific price Index
<i>PC_i</i>	Price of Composite Goods
<i>*PDD_i</i>	Domestic Good Demand Price
<i>*PDS_i</i>	Domestic Good Supply Price
<i>PE_i</i>	Domestic Price by Exports
<i>*Π</i>	Value of Discounted Intertemporal Social Welfare
<i>PGDP</i>	GDP Deflator
<i>PK_i</i>	Capital Price
<i>PM_i</i>	Domestic Price of Imports
<i>PPI</i>	Producer Price Index
<i>PVA_i</i>	Value added by sector
<i>PX_i</i>	Composite output price
<i>Q</i>	Composite supply
<i>QTD</i>	Demand for commercial margins
\bar{R}	Average gross profit rate
<i>RDGP</i>	Real GDP at factor cost
<i>RK_i</i>	Gross profit
<i>R_i</i>	Gross profit rate
<i>RS_i</i>	Land rent
<i>*TCDOM_i</i>	Commercial margins on domestic sales
<i>*TCEXP_i</i>	Commercial margins on exports
<i>*TCIMP_i</i>	Commercial margins on imports
<i>TTE_i</i>	Export duties
<i>TTM_i</i>	Tariff on imports
<i>VA_i</i>	Value added by sector
<i>WA_{lc}</i>	Average wage rate by labour type
<i>X_i</i>	Domestic output by sector
<i>XD_i</i>	Domestic sales by sector
<i>*UM_{hh}</i>	Money Metric Utility for Households
<i>*WM_{hh}</i>	Welfare measure for Households
<i>YD_{hh}</i>	Private disposable income
<i>Y_{hh}</i>	Private gross income

Appendix 2: Variables (Continued)

Initialisation	
<i>*B0_{hh}</i>	Measure of Human Development for Households
<i>*CAP0_i</i>	Value of capital stock by sector
<i>CLESX_{ich,hh}</i>	Dummy for constructing base
<i>*EXP0_i</i>	Competitive exports value
<i>*IMP0_i</i>	Imports incl. of freight and tariff
<i>LY0_{lc}</i>	Labour income by category
<i>*OUTPUT0</i>	Total output value
<i>*QCC0(i, j)</i>	Dummy for construction of IMAT0
<i>*QCCP0(i, j)</i>	Dummy for construction of IMATP0
<i>QD_i</i>	Dummy for computing AD
<i>*QIDO_i</i>	Quantity of investment by destination
<i>*QINT(i, j)</i>	Quantity of commodity i used by activity j
<i>*QCC0(i, j)</i>	Dummy for construction of IMAT0
<i>*QCCP0(i, j)</i>	Dummy for construction of IMATP0
<i>XLE0_{i,lc}</i>	Employment by sector and labour type (million)
<i>XLLB_{i,lc}</i>	Dummy variable for computing <i>XLE0_{i,lc}</i>
<i>*WMO_{hh}</i>	Welfare Metric for household

Appendix 3: Key Model Equations

Prices Block

$$\begin{aligned}
 *PDD_i &= PDS_i && \text{Domestic Demand Price} \\
 PM_{ima} &= PWM_{ima}(1 + t_{ima}) + PC_{it}.icm && \text{Domestic Import Price} \\
 PE_{ix} &= PWE_{ix}(1 - t_{ix}) + PC_{it}.ice && \text{Domestic Export Price} \\
 *PC.Q &= PDD.XD + PM_{ima}.M_{ima} && \text{Composite Commodity Price} \\
 *PX.X &= PDS.XD + PE_{ix}.E_{ix} && \text{Composite Output Price} \\
 *PC.X_{hcs} &= PDS.XD_{phcs} + PGX.XD_{ghcs} && \text{Composite Price for HCS} \\
 PK &= \sum_{jp} PC(JP).IMAT(jp, i) && \text{Price of Capital}
 \end{aligned}$$

Output and Factors Block

$$\begin{aligned}
 X_i &= AD_i.K_{iP}^{\alpha k} \cdot \prod_{i,lc} (L_{i,lc}.P_{lc})^{\alpha l} .K_g^{\alpha g} && \text{Production Function} \\
 Q_i &= AC.(\delta M_i^{1-1/\varepsilon c} + (1 - \delta)XD_i^{1-1/\varepsilon c})^{1/(1-1/\varepsilon c)} && \text{Armington Function for Importables} \\
 IPH_{hh} &= AP[\theta CD_{hcs,hh}^{1-1/v} + (1 - \theta)(\varsigma.gf_{hh}.GD_{hcs}^{1-1/v})]^{1/(1-1/v)} && \text{Human capital formation for Households} \\
 WA_{lc}.WDIST_{i,lc}.L_{i,lc} &= X_i.PVA_i.\alpha_{lc,i} && \text{Sector Specific Labour Demand}
 \end{aligned}$$

Demand Block

$$\begin{aligned}
 PC_{ich} \cdot (1 + itax_c).CD_{ich, hh} &= && \\
 (PC_{ich} \cdot (1 + itax_c))^{1-\sigma c} .CLES_{ich, hh}^{\sigma c} / && \\
 \sum_{jch} (PC_{jch} \cdot (1 + itax_c))^{1-\sigma c} .CLES_{jch, hh}^{\sigma c} && \text{Consumer Demand} \\
 PK_{ip}.QDK_{ip} &= KI_{ip} \cdot (1 + ADJ.(R_{ip} - \bar{R}). && \\
 (SAVING - ER.DRES) - PK_{ghcs}.QDK_{ghcs} && \\
 -PK_{govs} \cdot (QDK_{govs} + QDKG) && \text{Sector Specific Private Investment}
 \end{aligned}$$

$$\begin{aligned}
 GOVSAV &= GR - GDTOT - \sum_{hh} TRNS_{hh} && \\
 - \sum_{hh} DINT_{hh} - ER.FINT - OM(KG - KG0) && \text{Government Deficit}
 \end{aligned}$$

$$\begin{aligned}
 \sum_{ima} PWM_{ima}.M + FINT + DRES &= && \\
 \sum_{ix} PWE_{ix}.E + AID + \sum_{hh} RMIT_{hh} && \text{Current Account}
 \end{aligned}$$

Household Welfare

$$\begin{aligned}
 *B_{hh} &= \frac{2}{(1 + e^{-z_{hh}})} - 1 && \text{Human Development Indicator Function} \\
 *Z_{hh} &= [H_{hh}^{1-\frac{1}{\kappa}} + (\beta_{hh}y_{hh})^{1-\frac{1}{\kappa}}]^{1-\frac{1}{\kappa}} && \text{Z Composite for each household} \\
 *Paasche_{hh} &= \frac{\sum_{ic} PC_{ic} \cdot (1 + itax_{ic}).CD_{ic, hh}}{\sum_{ic} PC0_{ic} \cdot (1 + itax_{ic}).CD_{ic, hh}} && \text{Household specific price Index}
 \end{aligned}$$

Appendix 3: Key Model Equations (Continued)

$*UM_{hh} = \frac{\sum_{ic} PC_{ic} * (1 + itax_{ic}). CD_{ic, hh}}{Paasche_{hh}}$	Money metric Utility for household
$*WM_{hh} = [\mu B_{hh}^{1 - \frac{1}{\psi}} + (1 - \mu)(UM_{hh})^{1 - \frac{1}{\psi}}]^{1 - \frac{1}{\psi}}$	Total Household welfare
Objective Function	
$\Omega = \left[\sum_{i=1}^n HW_{hh} \cdot WM_{hh}^{-\rho} \right]^{-1/\rho}$	Intratemporal Social Welfare Function
Dynamic Block	
$KPUP_i.FX = KP_i.L.(1 - DEPR_i) + QDK.L(I)$	Updating Equations for: Sector-Specific Capital
$*PUP.FX_{lc} = P.L_{lc}(1 - DEPH_{hh}) + (IPH.L_{lc}/(LS.L_{lc}(1 + LG_{lc})))$	Per worker Human Capital Stock ²
$KGUP.FX = KG.L.(1 - DEPR_{KG} + QDKG.L)$	Infrastructure
$*FINTUP.FX = FINT.L(1 + \phi)$	Foreign Interest obligations
$\Pi = \left[\sum_{s=1}^t \frac{\beta^{s-1} \Omega^{1-\sigma}}{1-\sigma} \right]$	Intertemporal Social Welfare Function

²Using the representative households assumption, households' Human Capital Stock is converted to Per worker Capital Stock by adjusting for the amount of Labour units supplied by each household.

Table 7a: Expenditure Reallocation from Infrastructure Investment

		Exp 1	Exp 2	Exp 3	Exp 4
MACROECONOMIC VARIABLES					
	Year				
Real GDP	2000	-0.02	-0.02	-0.02	-0.02
	2004	-0.33	-0.23	-0.20	-0.31
	2009	-1.18	-0.77	-0.65	-1.12
	2015	-2.85	-1.83	-1.61	-2.75
Net Exports	2000	0.01	0.01	0.02	-0.01
	2004	0.00	0.02	0.00	-0.01
	2009	0.00	0.03	0.01	0.01
	2015	11.60	8.89	5.86	16.74
Private Investment	2000	-0.18	-0.23	0.71	-0.14
	2004	-1.41	-1.21	3.05	-1.29
	2009	-4.03	-2.70	4.84	-3.93
	2015	-8.73	-5.31	5.35	-8.78
Public Investment	2000	-0.75	-0.75	-1.46	-1.52
	2004	-3.54	-3.55	-6.97	-7.21
	2009	-6.65	-6.69	-13.13	-13.61
	2015	-9.94	-10.01	-19.66	-20.38
Overall Fiscal Deficit	2000	0.23	0.31	-0.94	0.23
	2004	1.57	1.39	-4.13	1.70
	2009	4.08	2.67	-6.89	4.53
	2015	8.32	4.72	-8.50	9.31
Average Return on Private Sector Capital	2000	-0.06	-0.06	-0.11	0.06
	2004	-0.40	-0.28	-0.85	-0.11
	2009	-0.91	-0.62	-2.04	-0.40
	2015	-1.76	-1.25	-4.31	-0.91
Real Export Exchange Rate	2000	-0.01	-0.01	-0.01	0.00
	2004	-0.12	-0.08	-0.06	-0.06
	2009	-0.36	-0.24	-0.17	-0.25
	2015	-0.82	-0.52	-0.40	-0.65
Real Import Exchange Rate	2000	-0.01	-0.01	0.00	-0.01
	2004	-0.08	-0.07	0.01	-0.05
	2009	-0.24	-0.17	0.01	-0.18
	2015	-1.25	-0.90	-1.44	-0.83
HOUSEHOLD VARIABLES					
Rural					
Average Wage	2000	0.00	-0.03	0.00	-0.07
	2004	-0.10	-0.23	0.05	-0.44
	2009	-0.53	-0.64	0.09	-1.15
	2015	-1.53	-1.38	-0.03	-2.42
Disposable Income	2000	-0.03	-0.05	0.00	0.03
	2004	-0.27	-0.28	0.03	0.05
	2009	-0.82	-0.69	0.02	-0.20
	2015	-1.93	-1.41	-0.17	-0.99
Consumption of which:Human Capital Services	2000	-0.03	-0.05	0.01	0.03
		-0.03	-0.04	-0.01	0.10
	2004	-0.27	-0.27	0.03	0.05
		-0.40	-0.40	-0.09	0.23
	2009	-0.82	-0.68	0.02	-0.20
		-1.47	-1.25	-0.37	-0.24
	2015	-1.91	-1.40	-0.16	-0.98
Urban					
Average Wage	2000	0.04	0.06	-0.02	0.00
	2004	-0.05	0.04	-0.20	-0.17
	2009	-0.63	-0.43	-0.63	-0.82
	2015	-2.00	-1.51	-1.50	-2.22
Disposable Income	2000	0.00	0.02	-0.02	0.04
	2004	-0.16	-0.08	-0.16	0.01
	2009	-0.75	-0.53	-0.51	-0.40
	2015	-2.01	-1.45	-1.23	-1.45
Consumption of which:Human Capital Services	2000	0.00	0.02	-0.02	0.03
		0.02	0.07	-0.05	0.11
	2004	-0.16	-0.08	-0.15	0.01
		-0.28	-0.10	-0.47	0.16
	2009	-0.74	-0.52	-0.49	-0.40
		-1.57	-1.13	-1.45	-0.67
	2015	-1.98	-1.43	-1.20	-1.43
		-4.33	-3.24	-3.36	-2.89

Notes:

All Experiments represent re-allocations away from Public Infrastructure Investment

The magnitude of the re-allocations cumulatively add up to the amount of the debt relief

Exp 1: Reallocate to government other services (equally to recurrent and capital)

Exp 2: Reallocate to government human capital/social services (equally to recurrent and capital)

Exp 3: Simply 'Cut Expenditures' such that more is available for private sector Investment

Exp 4: Reallocate to cash transfers to households

Imports include tariffs and freight.

Real exchange rates are weighted effective exchange rates.

All figures are percentage changes over baseline; negative changes for net exports and fiscal deficit indicate improvements.

<i>adj</i>	0	<i>mu</i>	0.67	<i>dis factor</i>	0.97
<i>alphg</i>	0.25	<i>zeta</i>	1	<i>sigma</i>	0.5
<i>phi</i>	0	<i>lamda1</i>	0.02	<i>lag</i>	0
<i>rho</i>	1				

Table 9a: Effect of Expenditure Reallocation from Infrastructure Investment on Welfare Indicators

		<i>Exp 1</i>		<i>Exp 2</i>		<i>Exp 3</i>		<i>Exp 4</i>	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
B (Indicator of Human Development)	2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2009	-1.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2015	-1.96	-1.23	0.00	0.00	0.00	0.00	-1.96	0.00
Paasche Index	2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2015	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00
Money Metric Utility	2000	-0.03	0.00	-0.04	0.02	-0.01	-0.03	0.05	0.05
	2004	-0.31	-0.22	-0.30	-0.11	-0.07	-0.28	0.10	0.05
	2009	-1.03	-0.99	-0.82	-0.68	-0.29	-0.86	-0.23	-0.45
	2015	-2.45	-2.59	-1.77	-1.83	-0.84	-2.00	-1.23	-1.73
Welfare Metric	2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2009	0.00	-1.08	0.00	0.00	0.00	0.00	0.00	0.00
	2015	-1.72	-1.08	0.00	-1.08	0.00	-1.08	0.00	-1.08

Notes:

Figures are percentage changes over baseline.

Table 7b: Expenditure Reallocation from Public Health and Education

		Exp 5	Exp 6	Exp 7	Exp 8
MACROECONOMIC VARIABLES					
	Year				
Real GDP	2000	0.04	0.00	0.01	0.01
	2004	0.35	-0.20	0.03	-0.15
	2009	0.81	-0.96	-0.14	-0.86
	2015	1.18	-2.71	-0.87	-2.53
Net Exports	2000	0.03	0.01	0.01	0.00
	2004	0.00	0.01	0.00	0.01
	2009	0.01	0.01	0.00	0.01
	2015	-17.76	-1.66	-10.26	5.04
Private Investment	2000	0.44	0.16	1.57	0.23
	2004	1.89	-0.25	6.86	0.09
	2009	3.93	-2.16	11.28	-1.65
	2015	5.19	-7.02	13.35	-6.46
Public Investment	2000	2.39	1.21	0.07	-0.01
	2004	11.78	5.84	0.43	0.01
	2009	20.59	10.57	1.00	0.18
	2015	29.09	15.28	1.83	0.51
Overall Fiscal Deficit	2000	-0.65	-0.29	-2.15	-0.29
	2004	-2.60	-0.26	-9.34	-0.24
	2009	-5.02	1.13	-15.45	1.35
	2015	-6.37	5.34	-18.95	5.94
Average Return on Private Sector Capital	2000	0.06	-0.06	-0.17	0.11
	2004	0.23	-0.51	-1.19	0.00
	2009	0.23	-1.19	-2.89	-0.45
	2015	-0.17	-2.33	-6.07	-1.36
Real Export Exchange Rate	2000	0.03	0.01	0.02	0.03
	2004	0.18	-0.01	0.08	0.08
	2009	0.36	-0.17	0.12	0.00
	2015	0.52	-0.58	0.06	-0.32
Real Import Exchange Rate	2000	0.04	0.02	0.04	0.04
	2004	0.21	0.08	0.22	0.12
	2009	0.38	0.03	0.42	0.12
	2015	0.21	-1.44	-1.72	-0.88
HOUSEHOLD VARIABLES					
Rural					
Average Wage	2000	0.09	0.10	0.10	-0.02
	2004	0.52	0.36	0.60	-0.17
	2009	1.11	0.31	1.29	-0.58
	2015	1.73	-0.38	1.88	-1.59
Disposable Income	2000	0.14	0.09	0.14	0.19
	2004	0.71	0.28	0.76	0.79
	2009	1.41	0.17	1.49	1.11
	2015	2.08	-0.61	2.04	0.76
Consumption of which:Human Capital Services	2000	0.14	0.09	0.14	0.19
		0.11	0.06	0.09	0.26
	2004	0.71	0.28	0.76	0.79
		0.73	0.07	0.59	1.06
	2009	1.41	0.18	1.49	1.11
		1.76	-0.47	1.27	1.36
	2015	2.07	-0.59	2.04	0.76
Urban					
Average Wage	2000	-0.24	-0.19	-0.28	-0.23
	2004	-0.89	-0.98	-1.23	-1.18
	2009	-1.27	-2.23	-2.23	-2.52
	2015	-1.50	-4.21	-3.51	-4.52
Disposable Income	2000	-0.09	-0.08	-0.12	-0.03
	2004	-0.26	-0.52	-0.52	-0.26
	2009	-0.23	-1.36	-0.98	-0.84
	2015	-0.14	-2.88	-1.74	-2.08
Consumption of which:Human Capital Services	2000	-0.09	-0.08	-0.12	-0.03
		-0.29	-0.24	-0.38	-0.11
	2004	-0.25	-0.51	-0.50	-0.25
		-0.89	-1.38	-1.67	-0.70
	2009	-0.22	-1.34	-0.95	-0.83
		-0.95	-3.33	-3.14	-2.02
	2015	-0.13	-2.84	-1.70	-2.06
		-0.70	-6.60	-5.22	-4.59

Notes:

All Experiments represent re-allocations away from Public Infrastructure Investment

The magnitude of the re-allocations cumulatively add up to the amount of the debt relief

Exp 5: Reallocate to Government Infrastructure

Exp 6: Reallocate to government other services (equally to recurrent and capital)

Exp 7: Simply 'Cut Expenditures' such that more is available for private sector Investment

Exp 8: Reallocate to cash transfers to households

Imports include tariffs and freight.

Real exchange rates are weighted effective exchange rates.

All figures are percentage changes over baseline; negative changes for net exports and fiscal deficit indicate improvements.

<i>adj</i>	<i>0 mu</i>	<i>0.67 dis factor</i>	<i>0.97</i>
<i>alphg</i>	<i>0.25 zeta</i>	<i>1 sigma</i>	<i>0.5</i>
<i>phi</i>	<i>0 lamda2</i>	<i>0.04 lag</i>	<i>0</i>
<i>rho</i>	<i>1</i>		

Table 8b: Welfare effects of Expenditure Reallocation from Public Health and Education

	intra temporal											intertemporal										
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015					
$\Omega = \frac{\sum(hh, HW(h) * WM(hh)^{-\rho})^{-1/\rho}}{\pi = \sum(\Omega^{\wedge} 1 - \sigma) / 1 - \sigma}$																						
Core Simulation Set																						
Rho	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1					
Beta	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97					
Sigma	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5					
elasticity of intertemporal substitution in SWF																						
Baseline																						
omega	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342					
pi																	21.45797					
Exp 5																						
omega	0.6342	0.6346	0.6349	0.6351	0.6353	0.6354	0.6354	0.6354	0.6352	0.6351	0.6348	0.6344	0.6340	0.6335	0.6329	0.6322	0.6314					
pi																	21.46205					
Exp 6																						
omega	0.6342	0.6344	0.6345	0.6344	0.6343	0.6340	0.6336	0.6331	0.6324	0.6316	0.6307	0.6296	0.6285	0.6272	0.6257	0.6242	0.6225					
pi																	21.41086					
Exp 7																						
omega	0.6342	0.6346	0.6349	0.6351	0.6353	0.6354	0.6354	0.6354	0.6352	0.6350	0.6347	0.6342	0.6337	0.6331	0.6323	0.6315	0.6305					
pi																	21.45952					
Exp 8																						
omega	0.6342	0.6347	0.6352	0.6354	0.6356	0.6356	0.6355	0.6352	0.6348	0.6343	0.6337	0.6329	0.6319	0.6309	0.6296	0.6283	0.6268					
pi																	21.44675					

Table 9b: Effect of Expenditure Reallocation from Public Health and Education on Welfare Indicators

		Exp5		Exp6		Exp7		Exp8	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
B (Indicator of Human Development)	2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2009	0.00	0.00	-1.96	0.00	0.00	0.00	0.00	0.00
	2015	-1.96	0.00	-1.96	-1.23	-1.96	-1.23	-1.96	-1.23
Paasche Index	2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2009	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00
	2015	0.00	0.00	1.00	1.00	1.00	1.00	0.00	0.00
Money Metric Utility	2000	0.12	-0.10	0.07	-0.10	0.11	-0.15	0.20	-0.02
	2004	0.67	-0.28	0.16	-0.65	0.55	-0.73	0.81	-0.23
	2009	1.37	-0.24	-0.19	-1.74	0.98	-1.54	1.01	-0.95
	2015	2.00	-0.20	-1.37	-3.70	1.04	-2.86	0.37	-2.50
Welfare Metric	2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2009	0.00	0.00	0.00	-1.08	0.00	-1.08	0.00	-1.08
	2015	0.00	0.00	-1.72	-2.15	0.00	-1.08	-1.72	-1.08

Notes:

Figures are percentage changes over baseline.

Table 7c: Expenditure Reallocation from Public Other Services

		Exp 9	Exp 10	Exp 11	Exp 12	
MACROECONOMIC VARIABLES						
	Year					
Real GDP	2000	0.08	0.03	0.03	0.03	
	2004	1.06	0.39	0.49	0.19	
	2009	3.48	1.33	1.73	0.47	
	2015	7.82	3.09	3.91	0.92	
Net Exports	2000	0.02	0.01	0.00	0.02	
	2004	0.00	0.02	0.02	-0.01	
	2009	0.01	0.03	0.01	0.03	
	2015	-45.16	-20.00	-31.28	-3.37	
Private Investment	2000	0.86	0.23	2.83	0.49	
	2004	4.42	1.40	13.73	1.66	
	2009	12.29	4.38	26.59	3.24	
	2015	24.89	9.09	41.09	5.02	
Public Investment	2000	4.16	2.08	0.11	-0.03	
	2004	21.53	10.24	0.55	-0.18	
	2009	38.24	18.70	1.14	-0.32	
	2015	53.97	26.89	1.89	-0.43	
Overall Fiscal Deficit	2000	-1.17	-0.32	-3.77	-0.54	
	2004	-5.16	-1.74	-17.76	-1.53	
	2009	-13.05	-5.03	-33.26	-2.87	
	2015	-24.72	-9.68	-49.63	-4.24	
Average Return on Private Sector Capital	2000	0.17	0.06	-0.17	0.34	
	2004	1.19	0.34	-1.31	0.79	
	2009	2.44	0.79	-3.23	1.08	
	2015	3.75	1.42	-7.04	1.25	
Real Export Exchange Rate	2000	0.06	0.03	0.04	0.05	
	2004	0.44	0.22	0.28	0.28	
	2009	1.14	0.54	0.73	0.53	
	2015	2.21	1.04	1.44	0.82	
Real Import Exchange Rate	2000	0.06	0.02	0.06	0.04	
	2004	0.35	0.14	0.37	0.20	
	2009	0.85	0.38	0.93	0.41	
	2015	2.55	0.78	-0.87	0.70	
HOUSEHOLD VARIABLES						
Rural						
Average Wage	2000	-0.05	-0.14	-0.03	-0.24	
	2004	0.15	-0.52	0.30	-1.07	
	2009	1.28	-0.57	1.56	-1.74	
	2015	3.97	-0.02	3.98	-2.16	
Disposable Income	2000	0.16	0.03	0.17	0.25	
	2004	1.07	0.26	1.16	1.23	
	2009	2.89	0.87	3.02	2.36	
	2015	6.14	2.02	5.89	3.61	
Consumption of which:Human Capital Services	2000	0.16	0.03	0.17	0.25	
		0.11	-0.02	0.08	0.38	
	2004	1.06	0.27	1.16	1.22	
		1.32	0.17	1.07	1.93	
	2009	2.87	0.87	3.01	2.34	
		4.41	0.93	3.53	3.73	
	2015	6.10	2.01	5.87	3.58	
Urban		10.21	2.67	7.75	5.75	
	Average Wage	2000	-0.25	-0.09	-0.32	-0.24
		2004	-0.50	-0.35	-1.10	-1.00
		2009	0.64	-0.36	-1.14	-1.62
2015		3.66	0.32	-0.25	-2.00	
Disposable Income	2000	-0.07	-0.02	-0.12	0.03	
	2004	0.23	0.01	-0.23	0.25	
	2009	1.72	0.34	0.32	0.60	
	2015	4.79	1.27	1.68	1.09	
Consumption of which:Human Capital Services	2000	-0.07	-0.02	-0.12	0.03	
		-0.27	-0.10	-0.42	0.04	
	2004	0.23	0.01	-0.21	0.25	
		0.07	-0.21	-1.30	0.45	
	2009	1.70	0.34	0.34	0.59	
		3.03	0.23	-0.98	1.08	
	2015	4.73	1.26	1.69	1.08	
		9.25	1.88	0.87	2.00	

Notes:

All Experiments represent re-allocations away from Public Infrastructure Investment

The magnitude of the re-allocations cumulatively add up to the amount of the debt relief

Exp 9: Reallocate to Government Infrastructure

Exp 10: Reallocate to government health and education services (equally to recurrent and capital)

Exp 11: Simply 'Cut Expenditures' such that more is available for private sector Investment

Exp 12: Reallocate to cash transfers to households

Imports include tariffs and freight.

Real exchange rates are weighted effective exchange rates.

All figures are percentage changes over baseline; negative changes for net exports and fiscal deficit indicate improvements.

<i>adj</i>	0	<i>mu</i>	0.67	<i>dis factor</i>	0.97
<i>alphg</i>	0.25	<i>zeta</i>	1	<i>sigma</i>	0.5
<i>phi</i>	0	<i>lamda2</i>	0.04	<i>lag</i>	0
<i>rho</i>	1				

Table 9c: Effect of Expenditure Reallocation from Public Other Services on Welfare Indicators

		<i>Exp9</i>		<i>Exp10</i>		<i>Exp11</i>		<i>Exp12</i>	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
B (Indicator of Human Development)	<i>2000</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2004</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2009</i>	1.96	1.23	0.00	0.00	1.96	0.00	0.00	0.00
	<i>2015</i>	1.96	2.47	1.96	1.23	1.96	1.23	1.96	1.23
Paasche Index	<i>2000</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2004</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2009</i>	0.00	-1.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2015</i>	-1.00	-1.00	0.00	0.00	1.00	1.00	0.00	-1.00
Money Metric Utility	<i>2000</i>	0.14	-0.08	0.02	-0.02	0.12	-0.16	0.28	0.07
	<i>2004</i>	1.14	0.37	0.26	0.05	0.94	-0.44	1.41	0.47
	<i>2009</i>	3.32	2.29	0.97	0.53	2.62	-0.10	2.69	0.99
	<i>2015</i>	7.19	6.02	2.36	1.76	5.31	1.00	4.09	1.67
Welfare Metric	<i>2000</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2004</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2009</i>	1.72	0.00	1.72	0.00	1.72	0.00	1.72	0.00
	<i>2015</i>	3.45	2.15	1.72	0.00	3.45	0.00	1.72	0.00

Notes:

Figures are percentage changes over baseline.

Table 7d: Expenditure Reallocation from Cash Transfers

		Exp 13	Exp 14	Exp 15	Exp 16
MACROECONOMIC VARIABLES					
	Year				
Real GDP	2000	0.05	0.00	0.00	-0.01
	2004	0.60	0.13	0.21	-0.07
	2009	2.02	0.56	0.81	-0.22
	2015	4.63	1.43	1.91	-0.47
Net Exports	2000	0.00	0.03	0.01	0.01
	2004	0.01	0.01	-0.01	-0.01
	2009	0.02	0.01	0.03	0.01
	2015	-27.82	-11.53	-17.80	-6.88
Private Investment	2000	0.13	-0.34	1.61	-0.24
	2004	1.76	-0.69	7.83	-1.10
	2009	5.87	0.38	15.13	-2.00
	2015	13.14	2.95	23.21	-3.01
Public Investment	2000	3.13	1.57	0.10	1.58
	2004	14.33	7.25	0.47	7.29
	2009	25.76	13.09	0.92	13.23
	2015	36.56	18.61	1.43	18.90
Overall Fiscal Deficit	2000	-0.52	0.12	-2.48	-0.04
	2004	-3.46	-0.63	-11.68	-0.28
	2009	-8.67	-3.11	-21.80	-0.65
	2015	-16.52	-7.07	-32.19	-0.99
Average Return on Private Sector Capital	2000	-0.06	-0.17	-0.34	-0.23
	2004	0.34	-0.17	-1.36	-0.51
	2009	1.02	-0.06	-2.78	-0.68
	2015	1.99	0.28	-5.45	-0.68
Real Export Exchange Rate	2000	0.01	-0.01	-0.01	-0.01
	2004	0.16	0.00	0.04	-0.07
	2009	0.51	0.08	0.21	-0.15
	2015	1.12	0.26	0.52	-0.27
Real Import Exchange Rate	2000	0.01	-0.01	0.01	-0.01
	2004	0.11	-0.03	0.13	-0.05
	2009	0.32	-0.01	0.36	-0.13
	2015	1.50	0.16	-0.87	-0.52
HOUSEHOLD VARIABLES					
Rural					
Average Wage	2000	0.13	0.06	0.13	0.13
	2004	0.75	0.28	0.85	0.55
	2009	1.88	0.62	2.07	0.85
	2015	3.85	1.20	3.86	0.96
Disposable Income	2000	0.06	-0.03	0.07	0.00
	2004	0.47	-0.09	0.53	-0.06
	2009	1.37	0.01	1.44	-0.23
	2015	3.09	0.39	2.85	-0.52
Consumption of which:Human Capital Services	2000	0.07	-0.03	0.07	0.00
		0.00	-0.08	-0.02	-0.05
	2004	0.47	-0.09	0.53	-0.06
		0.48	-0.33	0.31	-0.34
	2009	1.37	0.02	1.44	-0.22
		2.05	-0.35	1.41	-0.78
	2015	3.07	0.39	2.86	-0.51
Urban					
Average Wage	2000	-0.02	0.11	-0.07	0.06
	2004	0.28	0.38	-0.12	0.19
	2009	1.41	0.67	0.24	0.22
	2015	3.65	1.22	1.11	0.12
Disposable Income	2000	-0.29	-0.26	-0.33	-0.28
	2004	-1.04	-1.20	-1.35	-1.35
	2009	-1.13	-2.10	-2.06	-2.55
	2015	-0.22	-2.67	-2.29	-3.81
Consumption of which:Human Capital Services	2000	-0.29	-0.25	-0.32	-0.28
		-0.63	-0.49	-0.74	-0.56
	2004	-1.03	-1.18	-1.33	-1.34
		-2.14	-2.34	-3.07	-2.70
	2009	-1.12	-2.07	-2.03	-2.52
		-2.13	-4.12	-4.81	-5.07
	2015	-0.22	-2.65	-2.25	-3.77
		0.03	-5.23	-5.59	-7.52
<i>Notes:</i>					
<i>All Experiments represent re-allocations away from Public Infrastructure Investment</i>					
<i>The magnitude of the re-allocations cumulatively add up to the amount of the debt relief</i>					
<i>Exp 13:Reallocate to Government Infrastructure</i>					
<i>Exp 14:Reallocate to government human capital services (equally to recurrent and capital)</i>					
<i>Exp 15: Simply 'Cut Expenditures' such that more is available for private sector Investment</i>					
<i>Exp 16:Reallocate to government other services (equally to recurrent and capital)</i>					
<i>Imports include tariffs and freight.</i>					
<i>Real exchange rates are weighted effective exchange rates.</i>					
<i>All figures are percentage changes over baseline; negative changes for net exports and fiscal deficit indicate improvements.</i>					
<i>adj</i>		<i>0 mu</i>	<i>0.67 dis factor</i>	<i>0.97</i>	
<i>alphg</i>		<i>0.25 zeta</i>	<i>1 sigma</i>	<i>0.5</i>	
<i>phi</i>		<i>0 lamda2</i>	<i>0.04 lag</i>	<i>0</i>	
<i>rho</i>		<i>1</i>			

Table 8d: Welfare effects of Expenditure Reallocation from Cash Transfers

	intra temporal													intertemporal			
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
$\Omega = [\sum(hh, HW(h) * WM(hh)^{-\rho})]^{-1/\rho}$																	
$\pi = \sum \beta_i (\Omega_i^{-1-\sigma}) / 1-\sigma$																	
Core Simulation Set																	
Rho	1																
Inequality aversion Parameter	1																
Beta	0.97																
Sigma	0.5																
elasticity of intertemporal substitution in SWF																	
<i>Baseline</i>																	
omega	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342
pi																	21.45797
<i>Exp 13</i>																	
omega	0.6342	0.6340	0.6339	0.6338	0.6338	0.6338	0.6339	0.6340	0.6343	0.6349	0.6353	0.6357	0.6362	0.6368	0.6374	0.6380	0.6387
pi																	21.47242
<i>Exp 14</i>																	
omega	0.6342	0.6343	0.6344	0.6346	0.6349	0.6352	0.6355	0.6360	0.6364	0.6369	0.6375	0.6381	0.6387	0.6394	0.6400	0.6408	0.6415
pi																	21.49889
<i>Exp 15</i>																	
omega	0.6342	0.6343	0.6344	0.6346	0.6349	0.6352	0.6355	0.6360	0.6364	0.6369	0.6375	0.6381	0.6387	0.6394	0.6400	0.6408	0.6415
pi																	21.49889
<i>Exp 16</i>																	
omega	0.6342	0.6341	0.6339	0.6338	0.6336	0.6334	0.6332	0.6330	0.6328	0.6326	0.6324	0.6322	0.6319	0.6317	0.6314	0.6312	0.6309
pi																	21.43573

Table 9d: Effect of Expenditure Reallocation from Cash Transfers on Welfare Indicators

		<i>Exp13</i>		<i>Exp14</i>		<i>Exp15</i>		<i>Exp16</i>	
		Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
B (Indicator of Human Development)	<i>2000</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2004</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2009</i>	0.00	0.00	0.00	-1.23	0.00	-1.23	0.00	-1.23
	<i>2015</i>	1.96	0.00	0.00	-1.23	0.00	-1.23	0.00	-1.23
Paasche Index	<i>2000</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2004</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2009</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2015</i>	0.00	-1.00	0.00	0.00	1.00	1.00	0.00	0.00
Money Metric Utility	<i>2000</i>	0.03	-0.32	-0.06	-0.28	0.02	-0.38	-0.03	-0.31
	<i>2004</i>	0.43	-1.04	-0.18	-1.26	0.29	-1.59	-0.20	-1.48
	<i>2009</i>	1.51	-0.92	-0.09	-2.14	1.00	-2.52	-0.47	-2.78
	<i>2015</i>	3.58	0.38	0.36	-2.62	2.24	-2.98	-0.87	-4.13
Welfare Metric	<i>2000</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>2004</i>	0.00	-1.08	0.00	-1.08	0.00	-1.08	0.00	-1.08
	<i>2009</i>	0.00	-1.08	0.00	-1.08	0.00	-1.08	0.00	-1.08
	<i>2015</i>	1.72	0.00	1.72	-1.08	1.72	-1.08	0.00	-2.15

Notes:

Figures are percentage changes over baseline.

Table 7e: Experiments with Savings on Debt Servicing (No Lags in Infrastructure formation)

		Exp 17	Exp 18	Exp 19(a)	Exp 19(b)	Exp 19(c)	Exp 20	Exp 21
MACROECONOMIC VARIABLES								
	Year							
Real GDP	2000	0.13	0.01	0.08	0.07	0.05	0.01	0.00
	2004	1.26	0.36	0.91	0.82	0.73	0.52	0.06
	2009	3.22	1.13	2.45	2.24	2.03	1.51	0.17
	2015	5.79	2.30	4.58	4.23	3.87	2.70	0.30
Net Exports	2000	4.47	4.45	4.47	4.47	4.48	4.46	4.47
	2004	12.40	12.41	12.40	12.39	12.41	12.40	12.41
	2009	14.49	14.50	14.48	14.46	14.49	14.49	14.47
	2015	-10.72	0.63	-6.79	-5.65	-4.47	-1.55	12.01
Private Investment	2000	1.70	0.37	1.18	1.04	0.91	5.84	0.96
	2004	7.46	3.24	5.76	5.34	4.92	17.27	2.79
	2009	13.59	6.84	11.16	10.49	9.79	22.07	3.46
	2015	20.59	10.99	17.54	16.58	15.56	25.11	3.83
Public Investment	2000	9.24	4.87	7.49	7.06	6.62	0.73	0.43
	2004	25.21	13.44	20.50	19.32	18.15	2.12	1.22
	2009	29.05	15.62	23.66	22.32	20.97	2.62	1.44
	2015	29.48	15.92	24.03	22.67	21.31	2.86	1.49
Overall Fiscal Deficit	2000	-1.37	0.42	-0.66	-0.48	-0.30	-6.84	-0.10
	2004	-6.29	-1.57	-4.37	-3.90	-3.43	-19.66	-0.34
	2009	-11.66	-5.28	-9.43	-8.79	-8.12	-24.24	-0.54
	2015	-17.67	-9.54	-15.31	-14.49	-13.60	-26.54	-0.75
Average Return on Private Sector Capital	2000	-0.11	-0.40	-0.23	-0.23	-0.28	-0.79	0.11
	2004	0.57	-0.40	0.23	0.11	0.00	-2.50	0.06
	2009	1.14	-0.28	0.62	0.45	0.34	-4.14	-0.11
	2015	0.96	-0.51	0.45	0.34	0.17	-6.41	-0.34
Real Export Exchange Rate	2000	-0.62	-0.67	-0.64	-0.64	-0.65	-0.66	-0.62
	2004	-1.47	-1.78	-1.59	-1.62	-1.65	-1.69	-1.72
	2009	-1.26	-1.89	-1.49	-1.55	-1.62	-1.70	-1.98
	2015	-0.66	-1.63	-0.99	-1.09	-1.19	-1.39	-1.99
Real Import Exchange Rate	2000	-0.49	-0.57	-0.52	-0.53	-0.54	-0.49	-0.52
	2004	-1.22	-1.49	-1.32	-1.35	-1.38	-1.20	-1.43
	2009	-1.11	-1.56	-1.27	-1.32	-1.36	-1.11	-1.64
	2015	-0.37	-1.99	-0.95	-1.11	-1.28	-2.81	-2.14
HOUSEHOLD VARIABLES								
Rural								
Average Wage	2000	0.91	0.71	0.83	0.81	0.79	0.93	0.50
	2004	3.01	2.18	2.68	2.59	2.51	3.23	1.47
	2009	4.62	2.98	3.99	3.82	3.66	4.85	1.83
	2015	6.59	3.87	5.62	5.34	5.06	6.35	2.02
Disposable Income	2000	0.83	0.55	0.72	0.69	0.66	0.85	1.01
	2004	2.79	1.81	2.40	2.30	2.20	2.92	2.88
	2009	4.33	2.62	3.68	3.51	3.34	4.38	3.46
	2015	6.21	3.55	5.28	5.01	4.73	5.72	3.68
Consumption <i>of which: Human Capital Services</i>	2000	0.83	0.55	0.72	0.69	0.66	0.84	1.01
		0.92	0.65	0.81	0.78	0.75	0.84	1.46
	2004	2.78	1.81	2.39	2.29	2.20	2.92	2.87
		3.67	2.15	3.06	2.91	2.76	3.36	4.18
	2009	4.31	2.62	3.67	3.50	3.33	4.37	3.45
		6.56	3.27	5.30	4.97	4.65	5.65	5.06
	2015	6.18	3.54	5.25	4.99	4.71	5.71	3.66
		10.21	4.77	8.24	7.70	7.14	7.99	5.43
Urban Average Wage	2000	0.56	0.91	0.70	0.73	0.77	0.42	0.58
	2004	2.42	2.39	2.42	2.42	2.42	1.69	1.69
	2009	4.45	2.96	3.86	3.72	3.57	2.85	2.08
	2015	6.85	3.62	5.60	5.28	4.96	4.04	2.26
Disposable Income	2000	0.51	0.61	0.55	0.56	0.57	0.40	0.71
	2004	2.14	1.74	1.99	1.95	1.91	1.57	2.04
	2009	3.89	2.34	3.29	3.14	2.98	2.60	2.48
	2015	5.96	3.05	4.87	4.59	4.29	3.64	2.65
Consumption <i>of which: Human Capital Services</i>	2000	0.51	0.61	0.55	0.56	0.57	0.41	0.71
		0.36	0.74	0.51	0.54	0.58	0.04	1.00
	2004	2.14	1.75	1.99	1.95	1.91	1.58	2.04
		2.73	2.03	2.47	2.39	2.33	0.98	2.88
	2009	3.86	2.33	3.28	3.12	2.97	2.61	2.47
		6.31	2.87	4.99	4.64	4.31	2.61	3.55
	2015	5.92	3.04	4.84	4.56	4.27	3.64	2.64
		10.73	4.18	8.24	7.59	6.94	4.56	3.86

Notes:

Exp 1: Infrastructure only, Exp 2: Social Spending only, Exp 4: 'do nothing', let private sector invest Exp 5: Cash transfers
Experiment 3(a), (b) and (c) consider the allocation of government expenditure between public infrastructure and social spending. The weight on public infrastructure is respectively 0.6, 0.5 and 0.4.

Imports include tariffs and freight.

Real exchange rates are weighted effective exchange rates.

All figures are percentage changes over baseline; negative changes for net exports and fiscal deficit indicate improvements.

<i>adj</i>	0	<i>mu(hh)</i>	0.67	<i>dis factor</i>	0.97
<i>alphg</i>	0.25	<i>zeta</i>	1	<i>sigma</i>	0.5
<i>phi</i>	-0.3		<i>lag</i>		0
<i>rho</i>			1		

Table 8c: Effect on Welfare of savings on debt servicing(No lags in Infrastructure Formation)

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$\Omega = \frac{\sum(hh, HW(h) * WM(hh)^{\alpha} - r\Omega)}{1 - \sigma}$	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
$\pi = \sum \beta_i (\Omega^{1-\sigma} - 1) / 1 - \sigma$	0.6342	0.6368	0.6388	0.6405	0.6418	0.6430	0.6441	0.6452	0.6462	0.6471	0.6481	0.6491	0.6501	0.6512	0.6522	0.6533	0.6544	0.6342	0.6361	0.6376	0.6389	0.6401	0.6411	0.6420	0.6429	0.6438	0.6446	0.6455	0.6463	0.6472	0.6480	0.6489	0.6498	0.6507	0.6517	0.6528	0.6538																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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<i>Baseline</i>																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
omega	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342	0.6342																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
pi	0.6342	0.6368	0.6388	0.6405	0.6418	0.6430	0.6441	0.6452	0.6462	0.6471	0.6481	0.6491	0.6501	0.6512	0.6522	0.6533	0.6544	0.6342	0.6361	0.6376	0.6389	0.6401	0.6411	0.6420	0.6429	0.6438	0.6446	0.6455	0.6463	0.6472	0.6480	0.6489	0.6498	0.6507	0.6517	0.6528	0.6538	0.6548	0.6558	0.6568	0.6578	0.6588	0.6598	0.6608	0.6618	0.6628	0.6638	0.6648	0.6658	0.6668	0.6678	0.6688	0.6698	0.6708	0.6718	0.6728	0.6738	0.6748	0.6758	0.6768	0.6778	0.6788	0.6798	0.6808	0.6818	0.6828	0.6838	0.6848	0.6858	0.6868	0.6878	0.6888	0.6898	0.6908	0.6918	0.6928	0.6938	0.6948	0.6958	0.6968	0.6978	0.6988	0.6998	0.7008	0.7018	0.7028	0.7038	0.7048	0.7058	0.7068	0.7078	0.7088	0.7098	0.7108	0.7118	0.7128	0.7138	0.7148	0.7158	0.7168	0.7178	0.7188	0.7198	0.7208	0.7218	0.7228	0.7238	0.7248	0.7258	0.7268	0.7278	0.7288	0.7298	0.7308	0.7318	0.7328	0.7338	0.7348	0.7358	0.7368	0.7378	0.7388	0.7398	0.7408	0.7418	0.7428	0.7438	0.7448	0.7458	0.7468	0.7478	0.7488	0.7498	0.7508	0.7518	0.7528	0.7538	0.7548	0.7558	0.7568	0.7578	0.7588	0.7598	0.7608	0.7618	0.7628	0.7638	0.7648	0.7658	0.7668	0.7678	0.7688	0.7698	0.7708	0.7718	0.7728	0.7738	0.7748	0.7758	0.7768	0.7778	0.7788	0.7798	0.7808	0.7818	0.7828	0.7838	0.7848	0.7858	0.7868	0.7878	0.7888	0.7898	0.7908	0.7918	0.7928	0.7938	0.7948	0.7958	0.7968	0.7978	0.7988	0.7998	0.8008	0.8018	0.8028	0.8038	0.8048	0.8058	0.8068	0.8078	0.8088	0.8098	0.8108	0.8118	0.8128	0.8138	0.8148	0.8158	0.8168	0.8178	0.8188	0.8198	0.8208	0.8218	0.8228	0.8238	0.8248	0.8258	0.8268	0.8278	0.8288	0.8298	0.8308	0.8318	0.8328	0.8338	0.8348	0.8358	0.8368	0.8378	0.8388	0.8398	0.8408	0.8418	0.8428	0.8438	0.8448	0.8458	0.8468	0.8478	0.8488	0.8498	0.8508	0.8518	0.8528	0.8538	0.8548	0.8558	0.8568	0.8578	0.8588	0.8598	0.8608	0.8618	0.8628	0.8638	0.8648	0.8658	0.8668	0.8678	0.8688	0.8698	0.8708	0.8718	0.8728	0.8738	0.8748	0.8758	0.8768	0.8778	0.8788	0.8798	0.8808	0.8818	0.8828	0.8838	0.8848	0.8858	0.8868	0.8878	0.8888	0.8898	0.8908	0.8918	0.8928	0.8938	0.8948	0.8958	0.8968	0.8978	0.8988	0.8998	0.9008	0.9018	0.9028	0.9038	0.9048	0.9058	0.9068	0.9078	0.9088	0.9098	0.9108	0.9118	0.9128	0.9138	0.9148	0.9158	0.9168	0.9178	0.9188	0.9198	0.9208	0.9218	0.9228	0.9238	0.9248	0.9258	0.9268	0.9278	0.9288	0.9298	0.9308	0.9318	0.9328	0.9338	0.9348	0.9358	0.9368	0.9378	0.9388	0.9398	0.9408	0.9418	0.9428	0.9438	0.9448	0.9458	0.9468	0.9478	0.9488	0.9498	0.9508	0.9518	0.9528	0.9538	0.9548	0.9558	0.9568	0.9578	0.9588	0.9598	0.9608	0.9618	0.9628	0.9638	0.9648	0.9658	0.9668	0.9678	0.9688	0.9698	0.9708	0.9718	0.9728	0.9738	0.9748	0.9758	0.9768	0.9778	0.9788	0.9798	0.9808	0.9818	0.9828	0.9838	0.9848	0.9858	0.9868	0.9878	0.9888	0.9898	0.9908	0.9918	0.9928	0.9938	0.9948	0.9958	0.9968	0.9978	0.9988	0.9998	1.0008	1.0018	1.0028	1.0038	1.0048	1.0058	1.0068	1.0078	1.0088	1.0098	1.0108	1.0118	1.0128	1.0138	1.0148	1.0158	1.0168	1.0178	1.0188	1.0198	1.0208	1.0218	1.0228	1.0238	1.0248	1.0258	1.0268	1.0278	1.0288	1.0298	1.0308	1.0318	1.0328	1.0338	1.0348	1.0358	1.0368	1.0378	1.0388	1.0398	1.0408	1.0418	1.0428	1.0438	1.0448	1.0458	1.0468	1.0478	1.0488	1.0498	1.0508	1.0518	1.0528	1.0538	1.0548	1.0558	1.0568	1.0578	1.0588	1.0598	1.0608	1.0618	1.0628	1.0638	1.0648	1.0658	1.0668	1.0678	1.0688	1.0698	1.0708	1.0718	1.0728	1.0738	1.0748	1.0758	1.0768	1.0778	1.0788	1.0798	1.0808	1.0818	1.0828	1.0838	1.0848	1.0858	1.0868	1.0878	1.0888	1.0898	1.0908	1.0918	1.0928	1.0938	1.0948	1.0958	1.0968	1.0978	1.0988	1.0998	1.1008	1.1018	1.1028	1.1038	1.1048	1.1058	1.1068	1.1078	1.1088	1.1098	1.1108	1.1118	1.1128	1.1138	1.1148	1.1158	1.1168	1.1178	1.1188	1.1198	1.1208	1.1218	1.1228	1.1238	1.1248	1.1258	1.1268	1.1278	1.1288	1.1298	1.1308	1.1318	1.1328	1.1338	1.1348	1.1358	1.1368	1.1378	1.1388	1.1398	1.1408	1.1418	1.1428	1.1438	1.1448	1.1458	1.1468	1.1478	1.1488	1.1498	1.1508	1.1518	1.1528	1.1538	1.1548	1.1558	1.1568	1.1578	1.1588	1.1598	1.1608	1.1618	1.1628	1.1638	1.1648	1.1658	1.1668	1.1678	1.1688	1.1698	1.1708	1.1718	1.1728	1.1738	1.1748	1.1758	1.1768	1.1778	1.1788	1.1798	1.1808	1.1818	1.1828	1.1838	1.1848	1.1858	1.1868	1.1878	1.1888	1.1898	1.1908	1.1918	1.1928	1.1938	1.1948	1.1958	1.1968	1.1978	1.1988	1.1998	1.2008	1.2018	1.2028	1.2038	1.2048	1.2058	1.2068	1.2078	1.2088	1.2098	1.2108	1.2118	1.2128	1.2138	1.2148	1.2158	1.2168	1.2178	1.2188	1.2198	1.2208	1.2218	1.2228	1.2238	1.2248	1.2258	1.2268	1.2278	1.2288	1.2298	1.2308	1.2318	1.2328	1.2338	1.2348	1.2358	1.2368	1.2378	1.2388	1.2398	1.2408	1.2418	1.2428	1.2438	1.2448	1.2458	1.2468	1.2478	1.2488	1.2498	1.2508	1.2518	1.2528	1.2538	1.2548	1.2558	1.2568	1.2578	1.2588	1.2598	1.2608	1.2618	1.2628	1.2638	1.2648	1.2658	1.2668	1.2678	1.2688	1.2698	1.2708	1.2718	1.2728	1.2738	1.2748	1.2758	1.2768	1.2778	1.2788	1.2798	1.2808	1.2818	1.2828	1.2838	1.2848	1.2858	1.2868	1.2878	1.2888	1.2898	1.2908	1.2918	1.2928	1.2938	1.2948	1.2958	1.2968	1.2978	1.2988	1.2998	1.3008	1.3018	1.3028	1.3038	1.3048	1.3058	1.3068	1.3078	1.3088	1.3098	1.3108	1.3118	1.3128	1.3138	1.3148	1.3158	1.3168	1.3178	1.3188	1.3198	1.3208	1.3218	1.3228	1.3238	1.3248	1.3258	1.3268	1.3278	1.3288	1.3298	1.3308	1.3318	1.3328	1.3338	1.3348	1.3358	1.3368	1.3378	1.3388	1.3398	1.3408	1.3418	1.3428	1.3438	1.3448	1.3458	1.3468	1.3478	1.3488	1.3498	1.3508	1.3518	1.3528	1.3538	1.3548	1.3558	1.3568	1.3578	1.3588	1.3598	1.3608	1.3618	1.3628	1.3638	1.3648	1.3658	1.3668	1.3678	1.3688	1.3698	1.3708	1.3718	1.3728	1.3738	1.3748	1.3758	1.3768	1.3778	1.3788	1.3798	1.3808	1.3818	1.3828	1.3838	1.3848	1.3858	1.3868	1.3878	1.3888	1.3898	1.3908	1.3918	1.3928	1.3938	1.3948	1.3958	1.3968	1.3978	1.3988	1.3998	1.4008	1.4018	1.4028	1.4038	1.4048	1.4058	1.4068	1.4078	1.4088	1.4098	1.4108	1.4118	1.4128	1.4138	1.4148	1.4158	1.4168	1.4178	1.4188	1.4198	1.4208	1.4218	1.4228	1.4238	1.4248	1.4258	1.4268	1.4278	1.4288	1.4298	1.4308	1.4318	1.4328	1.4338	1.4348	1.4358	1.4368	1.4378	1.4388	1.4398	1.4408	1.4418	1.4428	1.4438	1.4448	1.4458	1.4468	1.4478	1.4488	1.4498	1.4508	1.4518	1.4528	1.4538	1.4548	1.4558	1.4568	1.4578	1.4588	1.4598	1.4608	1.4618	1.4628	1.4638	1.4648	1.4658	1.4668	1.4678	1.4688	1.4698	1.4708	1.4718	1.4728	1.4738	1.4748	1.4758	1.4768	1.4778	1.4788	1.4798	1.4808	1.4818	1.4828	1.4838	1.4848	1.4858	1.4868	1.4878	1.4888	1.4898	1.4908	1.4918	1.4928	1.4938	1.4948	1.4958	1.4968	1.4978	1.4988	1.4998	1.5008	1.5018	1.5028	1.5038	1.5048	1.5058	1.5068	1.5078	1.5088	1.5098	1.5108	1.5118	1.5128	1.5138	1.5148	1.5158	1.5168	1.5178	1.5188	1.5198	1.5208	1.5218	1.5228	1.5238	1.5248	1.5258	1.5268	1.5278	1.5288	1.5298	1.5308	1.5318	1.5328	1.5338	1.5348	1.5358	1.5368	1.5378	1.5388	1.5398	1.5408	1.5418	1.5428	1.5438	1.5448	1.5458	1.5468	1.5478	1.5488	1.5498	1.5508	1.5518	1.5528	1.5538	1.5548	1.5558	1.5568

Table 9e: Effect of savings on debt servicing on Welfare Indicators (No lags infrastructure formation)

	Exp17		Exp18		Exp19(a)		Exp19(b)		Exp19(c)		Exp20		Exp21	
	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban
B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	1.23	0.00	1.23	0.00	1.23	0.00	1.23	0.00	1.23	0.00	1.23	0.00	1.23
	1.96	1.23	1.96	1.23	1.96	1.23	1.96	1.23	1.96	1.23	1.96	1.23	1.96	1.23
	1.96	2.47	1.96	1.23	1.96	2.47	1.96	2.47	1.96	2.47	1.96	2.47	1.96	2.47
Paasche Index	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00
	1.00	1.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00	1.00
Money Metric Utility	0.30	-0.04	0.05	0.08	0.20	0.01	0.18	0.02	0.15	0.03	0.26	-0.21	0.60	0.27
	1.54	0.86	0.44	0.30	1.10	0.65	0.99	0.59	0.88	0.54	1.28	-0.17	1.71	0.81
	3.21	2.74	1.11	0.76	2.42	1.98	2.21	1.79	2.00	1.59	2.46	0.52	2.09	1.02
	5.45	5.15	2.14	1.58	4.28	3.83	3.95	3.48	3.61	3.12	3.76	1.47	2.28	1.16
Welfare Metric	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	1.72	1.08	1.72	0.00	1.72	1.08	1.72	1.08	1.72	1.08	1.72	0.00	1.72	1.08
	1.72	1.08	1.72	1.08	1.72	1.08	1.72	1.08	1.72	1.08	1.72	1.08	1.72	1.08
	3.45	2.15	3.45	1.08	3.45	2.15	3.45	2.15	3.45	1.08	3.45	1.08	1.72	1.08

Notes:

Figures are percentage changes over baseline.

Table 10: Sensitivity Analysis on values of Key Parameters

	Description	Core										Sensitivity Analysis															
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)	(v)	(w)	(x)	(y)	
α^E	Externality Parameter for Public Infrastructure	0.25	0.20	0.15	0.10	0.05	0.25	0.00	0.00																		
	<i>Primary Sector Tradable</i>	0.25	0.20	0.15	0.10	0.05	0.00	0.25	0.00																		
	<i>Commercial Margins</i>	0.25	0.20	0.15	0.10	0.05	0.00	0.25	0.00																		
	<i>All other sectors</i>	0.25	0.20	0.15	0.10	0.05	0.00	0.00	0.00																		
Lag	Lags in infrastructure formation	0								1	2	3															
α^E	Externality Parameter for Public Infrastructure	0.25																									
β^{-1}	Intertemporal Discount Factor	0.97																									
μ	Valuation of human development in Welfare	0.67																									
	<i>Rural Households</i>	0.67																									
	<i>Urban Households</i>	0.67																									
ρ	Inequality Aversion Parameter	1.00																									
ζ	Index of Quality of Government Services	1.00	1.25	1.50	0.75	0.60																					

Table 11(a): Results on Sensitivity Analysis

	<i>Exp 17</i>	<i>Exp 18</i>	<i>Exp 19(a)</i>	<i>Exp 19(b)</i>	<i>Exp 19 (c)</i>	<i>Exp 20</i>	<i>Exp 21</i>
	<i>Rank on Output Criterion</i>						
Sensitivity Analysis							
(a)	1	6	2	3	4	5	7
(b)	1	6	2	3	4	5	7
(c)	5	6	2	3	4	1	7
(d)	6	2	5	4	3	1	7
(e)	6	2	5	4	3	1	7
(f)	6	2	5	4	3	1	7
(g)	7	2	5	4	3	1	6
(h)	1	6	2	3	4	5	7
(i)	1	6	2	3	4	5	7
(j)	1	6	2	3	4	5	7
(k)	1	6	2	3	4	5	7
(l)	1	6	2	3	4	5	7
(m)	1	6	2	3	4	5	7
(n)	1	6	2	3	4	5	7
(o)	1	6	2	3	4	5	7
(p)	1	6	2	3	4	5	7
(q)	1	6	2	3	4	5	7
(r)	1	6	2	3	4	5	7
(s)	1	6	2	3	4	5	7
(t)	6	2	5	4	3	1	7
(u)	6	2	5	4	3	1	7
(v)	1	6	2	3	4	5	7
(w)	1	6	2	3	4	5	7
(x)	6	2	5	4	3	1	7
(y)	6	2	5	4	3	1	7

Note: This table ranks different policy experiments based on their contribution to cumulative gains in output by 2015.

Table 11(b): Results on Sensitivity Analysis

	<i>Exp 17</i>	<i>Exp 18</i>	<i>Exp 19(a)</i>	<i>Exp 19(b)</i>	<i>Exp 19 (c)</i>	<i>Exp 20</i>	<i>Exp 21</i>
	<i>Rank on Discounted Intertemporal Welfare Criterion</i>						
Sensitivity Analysis							
(a)	1	3	4	5	6	2	7
(b)	2	7	3	4	5	1	6
(c)	7	3	6	5	4	1	2
(d)	7	3	6	5	4	1	2
(e)	7	3	6	5	4	1	2
(f)	7	3	6	5	4	1	2
(g)	7	3	6	5	4	1	2
(h)	1	7	3	4	5	2	6
(i)	2	7	3	4	5	1	6
(j)	2	7	3	4	5	1	6
(k)	1	7	3	4	5	2	6
(l)	1	7	3	4	5	2	6
(m)	1	7	3	4	5	2	6
(n)	1	7	3	4	5	2	6
(o)	1	7	3	4	5	2	6
(p)	1	7	3	4	5	2	6
(q)	1	7	3	4	5	2	6
(r)	1	7	3	4	5	2	6
(s)	1	7	3	4	5	2	6
(t)	7	6	5	4	3	1	2
(u)	7	6	5	4	3	1	2
(v)	1	6	3	4	5	2	7
(w)	1	6	3	4	5	2	7
(x)	7	2	6	5	4	1	3
(y)	7	3	6	5	4	1	2

Note: This table ranks different policy experiments based on their contribution to the sum of discounted intertemporal welfare.

8-SECTOR MICROSAM FOR MADAGASCAR

December 3, 2007		PST NT SS TS HCS COMM GHCS GOVS																	
		Factors of Production					Current Account				Private								
FMG Billions		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
		Total HH																	
Rural Labour										1093	1108	417	1013	43	745	76	331		
Urban Labour										20	129	974	1347	290	1685	284	367		
Rent										1824	1655	0	0	0	0	0	0		
Operating Surplus										530	175	1045	2077	56	2008	66	110		
Consumption of Capital										140	75	374	595	16	530	0	0		
Household -Rural		4826	0	3172	3592	1052			91	857									
Household - Urban			5096	307	2299	678			609	581									
Total Households		4826	5096	3479	5891	1730			700	1438									
Government				176			233	260	493										
Rest of World									325										
Primary Sector Tradables																			
Non-Tradables																			
Secondary Sector																			
Tertiary Sector																			
Private Human Capital Services																			
Commercial Margins																			
Public Human Capital Services																			
Public Other Services																			
Primary Sector Tradables							2965	2335	5300										
Non-Tradables							2713	1523	4236										
Secondary Sector							5412	1743	7155										
Tertiary Sector							1897	1616	3513										
Private Human Capital Services							128	513	641										
Commercial Margins							0	0	0										
Public Human Capital Services							0	0	0	670									
Public Other Capital							0	0	0	1167									
Transaction costs: Dom																			
Transaction costs: Exp																			
Transaction costs: Imp																			
Primary Sector Tradables										1369									
Non-Tradables										0									
Secondary Sector										2075									
Tertiary Sector										2116									
Private Human Capital Services										0									
Commercial Margins										0									
Public Human Capital Services										0									
Public Other Capital										0									
Household - Rural							242												
Household - Urban								1580											
Total Households								1822											
Government									476										
Government Reserves																			
Rest of World									1444										
TOTAL		4826	5096	3479	6067	1730	13590	9570	23160	2668	8442	6096	8238	9671	8362	641	7533	670	1167

8-SECTOR MICROSAM FOR MADAGASCAR

December 3, 2007	PST NT SS TS HCS COMM GHCS GOVS								PST NT FPRO TS HCS COMM GHCS GOVS																								
	Aggregate Supply								Transaction Costs			Exports							Capital Account														
	18	19	20	21	22	23	24	25	Dom	Exp	Imp	29	30	31	32	33	34	35	36	37	38	39	40	52	53	54	TOTAL						
FMG Billions																										Total HH							
Rural Labour																										4826							
Urban Labour																										5096							
Rent																										3479							
Operating Surplus																										6067							
Consumption of Capital																										1730							
Household -Rural																										13590							
Household - Urban																										9570							
Total Households																										23160							
Government	0	7	1623	339	0	206	0	0															2668										
Rest of World	0	0	5621	1796	0	325	0	0															375	8442									
Primary Sector Tradables	6096																										6096						
Non-Tradables		8238																										8238					
Secondary Sector			9671																										9671				
Tertiary Sector				8362																										8362			
Private Human Capital Services					641																										641		
Commercial Margins						7533																										7533	
Public Human Capital Services							670																										670
Public Other Services							1167																										1167
Primary Sector Tradables									1369							171	319	490	52	148								8919					
Non-Tradables									0							232	592	824	132	372								8691					
Secondary Sector									2075							198	198	396	108	304								21676					
Tertiary Sector									2116							0	20	20	6	21								10531					
Private Human Capital Services									0							0	0	0	0	0								641					
Commercial Margins									6824	893	347								0	0	0	0	0								8064		
Public Human Capital Services																0	0	0	0	0								670					
Public Other Capital																0	0	0	0	0								1167					
Transaction costs: Dom	2353	446	3997	28	0	0	0	0															6824										
Transaction costs: Exp	470	0	423	0	0	0	0	0															893										
Transaction costs: Imp	0	0	341	6	0	0	0	0															347										
Primary Sector Tradables																										1369							
Non-Tradables																										0							
Secondary Sector																										2075							
Tertiary Sector																										2116							
Private Human Capital Services																										0							
Commercial Margins																										0							
Public Human Capital Services																										0							
Public Other Capital																										0							
Household - Rural																										242							
Household - Urban																										1580							
Total Households																										1822							
Government																										476							
Government Reserves																										0							
Rest of World																										1444							
TOTAL	8919	8691	21676	10531	641	8064	670	1167	6824	893	347	1369	0	2075	2116	0	0	0	0	601	1129	1730	298	845	375	0							

Appendix 6:

Notes on the Social Accounting Matrix for Madagascar and aggregation

The 1999 Social Accounting Matrix (SAM) for Madagascar used in the analysis is an aggregated, and modified version, of that used in Dorosh *et al* (2003). This note outlines the aggregation of their 34-sector, 22-producing factors and 16-households SAM into an 8-sector, 5-producing factors and 2 households version. The idea behind the aggregation of the Dorosh *et al* (2003) SAM is to keep the analysis tractable, given the focus on the implications of varying the profile of public expenditure. The aggregation has been balanced against two major considerations. They are, first, the need to avoid a 'badly scaled' SAM with a huge spread in the level of activity across sectors. Secondly, there is the inevitable trade-off in terms of the loss of unit-specific information.

Data Sources

Dorosh *et al* (2003) reference several sources for the construction of their SAM (pp 41-49). National Accounts data for 1995, obtained from INSTAT, the statistical agency in Madagascar, establishes the classification by nature of activity, and the Input-Output table which is central to the SAM. Industrial surveys and Employment surveys conducted by the same agency enables Dorosh *et al* (2003) to specify whether activities belong to the formal or informal sector. Macroeconomic aggregates relating to the Fiscal Accounts are culled from the Opérations Générale du Trésor (OGT) while those about the external sector come from the Balance of Payments. The Enquête Permanente auprès des Ménages 1999 (EPM 99, Household Survey) provides information to characterise the profile of households by skill level of the household head (with further distinction with regards to gender), location and income level. It also details the consumption behaviour of these households and the direct taxes they face.

Aggregation over Sectors

The original SAM distinguishes between activities along two dimensions: an industry classification according to the nature of the activity and whether the activities are part of the formal or informal sector. Thus, the 34 sectors are split between 10 agricultural, 12 industrial, 11 services and 1 non-competitive import activity. To aggregate the sectors, I eliminate the "formal/informal" dimension and replace it with one which is more trade-focused. In particular, I distinguish between Tradable (importables, exportables or both) and Non-tradable sectors. This allows me to track sectoral reallocations resulting from real exchange rate movements. Activity sectors thus identified are: Primary Sector Tradables, Non-tradables, Secondary Sector, Tertiary Sector, Human Capital Services (HCS), Commercial Margins, Government Human Capital Services, and Other Government Services. The Dorosh *et al* (2003) SAM does not distinguish either public or private HCS. Hence, the data on these sectors are largely based on the World Bank's 2005 Public Expenditure Review for Madagascar, and the statistical appendices from the IMF country report 05/321.

Aggregation over Factors

Twenty producing factors, including 4 categories of labour identified according to location and skills levels, three types of capital (formal and informal, with

the latter being either rural or urban) and 8 types of land, are aggregated to 4 (Land, Rural Labour, Urban Labour, Sector-Specific Capital). Additionally, a fifth factor, namely economy-wide public sector infrastructure is added to be able to address the research question. This level of public infrastructure is an estimate, but its actual level does not matter for the analysis. In fact, it could be normalised to unity.

Aggregation over Institutions

Institutions on the Dorosh (2003) SAM comprises 16 households, an enterprises bloc, a government and the rest of the world. Households are differentiated according to location and their skill level. In addition, rural households are split into two groups depending on whether or not they are involved in agriculture. To a large extent, this reflects the question that Dorosh et al(2003) seek to address, that is whether poverty reduction can be achieved by strategic sectoral public investment, and if so, whether all household groups benefit equally. Given the focus of this paper, I adopt a simple rural-urban distinction for households. I intend to later expand this to a 2x2 (rural/urban and skilled/unskilled) to explore in greater details the role that dual economy mechanisms, including labour markets, play in shaping the impact of debt-relief funded public spending. I suppress the enterprises sectors, adopting an approach common in the literature on empirical CGE-based studies, on the proposition that enterprises are eventually owned by households.

Beyond tax-collection and revenue-redistribution, the government's role in this model is also to provide public goods (infrastructure) and private goods (human capital services). The level of provision is an estimate and is consistent with the fact that the Malagasy government's spending on health and education typically amount to no more than 2 per cent of GDP (World Bank Public Expenditure Review, 2005). The SAM representation of the government is based on Adam and Bevan (2006). Government activities are entered into either its current or capital account (in the case of infrastructure). In the Dorosh *et al* (2003) SAM, government transactions, especially those with the rest of the world and capital investments, are aggregated. For the purposes of this analysis, they have been unpacked based on the statistical appendices from the IMF country report 05/321. For example, the foreign interest obligations and Aid have been made explicit. The distribution of government investment has been defined according to a capital composition matrix.