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Government Expenditures, Financing, and Economic Growth in Cape Verde

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Abstract

In the last 15 years, the economy of Cape Verde has grown steadily and doubled its GDP. Part of this success could be attributed to having one of the world's highest public investment shares of GDP. However, Cape Verde faces potential challenges due to allocating too much public investment to infrastructure versus human capital formation (health and education) and due to an increase in public debt. Using a two-sector endogenous growth model, we find that reallocating public spending from infrastructure to human capital can have large positive effects on long run growth rates.

Keywords: productive government spending, economic growth, two-sector endogenous growth models, debt financing, less developed countries

JEL Codes: C63, H20, H50, H60, O41, O55

1. Introduction

The economy of Cape Verde has performed remarkably well in the last fifteen years. With per capita GDP growth averaging 4.5% per year, GDP per capita has doubled in that period. Indicators of poverty, health, and education have showed continued improvement. Furthermore, four of the Millennium Development Goals have already been met, and the other eight are on schedule to be met by 2015. This successful performance resulted in Cape Verde being moved from the UN's Least Developed Country list to the developing country group at the end of 2007.

High GDP growth rates have been led by growth in the tourism sector and aided by concessional lending, which helped fund capital investment including public investment in infrastructure. In fact, public investment in Cape Verde has averaged a very high 13% of GDP. In comparison, public investment averages about 5% of GDP in other developing countries in the Caribbean and in Latin America. While public investment infrastructure is certainly a foundation for growth as the economics literature has shown, the contribution of infrastructure likely experiences diminishing returns. Moreover, there are trade-offs between public spending on infrastructure and on other sectors like education and health. Public spending on health and education build human capital, which has also been shown to be a key determinant of long-run growth.

High levels of public expenditures must be funded from various sources. However, the funding sources for Cape Verde may face a reduction in the near future due to some recent developments.

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First, given Cape Verde's accession to the developing country group, concessional lending at very low interest rates will be reduced, with lending taking place at higher interest rates. Second, given the countercyclical fiscal policy undertaken to cushion the effects of the global financial crisis of 2008-09, national debt has risen significantly in the last few years to about 80% of GDP. As a consequence the government will face tradeoffs in funding public expenditures and in how those expenditures are allocated. One question the policymakers will have to address is what are the growth effects of not maintaining the high levels of public investment of the past decade? Also, what would be the growth effects of reallocating expenditures from public infrastructure to health and education?

To explore the issues above, we develop a two-sector endogenous growth model in which public investment is divided between physical capital (infrastructure) and human capital (education and health). We use the model to analyze how public investment spending, funded by taxes on income or consumption or by borrowing, affects long-term output growth. We also examine the effect of varying the composition of public expenditures, re-allocating between different types of public investment, or shifting between consumption and investment spending.

The model is calibrated to reflect economic conditions of Cape Verde. We find that, financing public investment with additional debt may reduce growth given the latest high level of debt.

Conversely, using tax financing for additional public investment can increase growth rates. More importantly, reallocating public spending from infrastructure to human capital can have large positive effects on long run growth rates. The policy mix that attains the largest increase in the growth rate to about 6% per year involves simultaneously restructuring the composition and financing of public investment in favor of stronger emphasis on human capital formation financed by taxes rather than borrowing.

Our model has a basis in several strands in the literature. First, it is related to the literature of productive public expenditures in endogenous growth models which includes Barro (1990), and Glomm and Ravikumar (1994, 1997), among others.[3] In particular, we extend an endogenous growth model similar to Greiner and Semmler (2000) and Futagami, Morita, and Shibata (1993) by distinguishing between different types of public capital. Second, the paper is related to the literature on the composition of public expenditures and growth. This literature includes Feltenstein and Ha (1995), Devarajan, Swaroop, and Zou (1996), Agénor and Neanidis (2006), among others. Our model builds on this body of work, explicitly recognizing the inherent complementarities and tradeoffs among different types of productive government expenditures. A third strand of related literature is the work on the various ways of financing public expenditures and includes Turnovsky (1996), Greiner and Semmler (2000), Futagami, Iwaisako and Ohdoi (2008). Our work extends this literature by showing that the optimal strategy to finance public investment will also depend on the existing fiscal conditions of the economy.

The rest of the paper is organized as follows. Section 2 compares data from the economy of Cape Verde to similar countries that may be at the next stage of development. Section 3 presents the theoretical model. Section 4 describes the solution and calibration procedure, while section 5 discusses the results of various policy experiments. A sensitivity analysis is carried out in section 6 and section 7 concludes.

2. Cape Verde and Comparison Economies

It is interesting to compare basic economic indicators from Cape Verde to other similar island nations: Seychelles and Mauritius in Africa and three Caribbean countries – Barbados, Jamaica,and Trinidad and Tobago. While all these countries have higher GDP per capita than Cape Verde, they may serve as an aspirational benchmark for Cape Verde looking to the future. We also compare indicators with Singapore, an island nation that became one of the wealthiest countries in the world.

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[3]There is also a large empirical literature on the growth effects of public infrastructure summarized in Ligthart and Martin Suarez (2011).

Having graduated to the developing country group, Cape Verde can continue advancing economically towards benchmarks that have been reached by these countries. Consider the data in Table 1 comparing Cape Verde's indicators to those from the group of similar countries. Cape Verde's GDP per capita is lower than in the other countries, but could close the gap with Jamaica in about a decade if the average growth rates for 1995-2010 are sustained or increase into the future. In terms of infrastructure, the quality of port infrastructure and the percent of roads that are paved generally lag those from the comparison countries. So, while Cape Verde has invested heavily in infrastructure, which certainly has helped expand and improve its infrastructure, there are still improvements needed to attain the Caribbean countries' benchmark. In terms of education, while literacy rates are comparable, secondary and tertiary school enrollment are lower in Cape Verde. As countries develop, human capital tends to play a larger role in sustaining growth rates.

Only about 18% of the relevant age population seems to be enrolled in tertiary education in Cape Verde, versus 66% in Barbados and 25% in Jamaica and Mauritius.[4] The picture is similar in terms of health indicators. As Table 1 shows, the mortality rate of children under 5 years old is 35.6 per 1000 children in Cape Verde, which is higher than in all the countries in the comparison group which average around 20 per 1000. In sum, Cape Verde will need to consider reaching certain benchmarks in health and education which will likely require additional public funding. Of course, the provision of some of these public goods and services is made more difficult due to Cape Verde being an archipelago with a dispersed population, which makes provision more expensive.

In sum, the comparison countries have in general better health and education outcomes. This provides motivation for our research in trying to establish the effects of allocating more funds to health and education.

3. The Theoretical Model

We extend the theoretical model developed by Greiner and Semmler (2000) to determine how the composition and financing of public expenditure affect long-term economic growth. This model is appealing because it moves away from the balanced government budget assumption typical of the fiscal policy and growth literature and allows governments to use bond-financing in addition to taxes, as long as long-term debt sustainability is maintained. Such a formulation more realistically captures the financing practices of many developing countries. We extend the Greiner-Semmler model by distinguishing between different types of public capital, allowing for heterogeneity in their output elasticities. This is done within the context of a two-sector endogenous growth model in which intermediary human capital and a final market good are produced. The government is assumed to supply public capital complementary to the production process in either sector. Both private and public capital can be accumulated through investing every period. All variables are in per capita form and we define public capital as non-excludable but subject to congestion. While clearly the economy of Cape Verde is open, using an open economy framework would complicate the solution significantly. Hence, given that we focus on the productive sector, public expenditures and their financing, a potential concern is not being able to capture increasing borrowing rates if public investment were to be financed with foreign debt. Nevertheless, while all debt-financing is domestic in our model, the borrowing rate can rise as the level of debt grows. Hence, using a closed-economy model may be adequate for the issues being analyzed in the paper.

[4] Tertiary education is defined as studies beyond secondary education that include university or college education aswell as poly-technical and vocational schooling.

3.1 Households

The economy is inhabited by infinitely-lived identical households who supply labor, L, inelastically. To simplify the model, we abstract from population growth and normalize the number of households to unity. The representative household derives utility from private consumption, $C(t)$, and preferences are given by the inter-temporal iso-elastic utility function

$$U(C)=\int_0^\infty e^{-\rho t}\left(\frac{C^{1-\sigma}-1}{1-\sigma}\right)dt, \quad \sigma\neq 1, \tag{1}$$

where the time argument has been suppressed.[5] $\rho \in (0,1)$ denotes the pure rate of time preference and σ is the inverse of the inter-temporal elasticity of substitution in consumption.[6] Wage income is earned from the share of effective labor used in private production, uHL, where $0 < u < 1$ is exogenously given and H is the stock of human capital per capita. Household income also comes from returns to wealth, $W \equiv B+K$, which is equal to public debt, B, and private physical capital, K. Income is spent on private consumption and new investments in physical capital, $\dot{K}$, and government bonds, $\dot{B}$, where the dot gives the derivative with respect to time. The government levies flat rate taxes, τ_K and τ_L, on income earned from capital and labor, respectively. There is also an *ad valorem* tax, τ_C, on private consumption. Normalizing labor to one, the representative household's budget identity is thus written as

$$(1+\tau_C)C+\dot{W}+\delta_K K=(1-\tau_L)wuH+(1-\tau_K)(rK+r_B B), \tag{2}$$

where $\delta_K \in (0,1)$ is the depreciation rate of physical capital, w denotes the real wage rate, r is the real return to physical capital and rB is the interest rate on government bonds. A no-arbitrage condition requires that the return to physical capital equals the return to government bonds yielding $r_B = r-\delta_K/(1-\tau_K)$.[7] Thus, the budget identity of the household can be re-written as

$$\dot{W}=(1-\tau_L)wuH+(1-\tau_K)rW-\delta_K W-(1+\tau_C)C. \tag{2a}$$

To allow the analysis to be more tractable, we abstract from depreciation (i.e., set $\delta_K = 0$) so that the household's budget constraint is more simply written as

$$\dot{W}=(1-\tau_L)wuH+(1-\tau_K)rW-(1+\tau_C)C. \tag{2b}$$

The problem for the representative household is to maximize the discounted stream of utility, defined in (1), over an infinite time horizon subject to its budget constraint in (2b), taking factorprices as given. The current-value Hamiltonian is

[5] This specification is widely accepted in the literature with variants used by Barro (1990), Bruce andTurnovsky (1999) and Corsetti and Roubini (1996). For ease of exposition, we omit the time argument t, unless doing so would cause ambiguity.

[6] For $\sigma = 1$ the utility function is replaced by the logarithmic function $U(\cdot)=\ln C$.

[7] Since both are taxed at rate τ_K, it follows that $(1-\tau_K)\, r_B = (1-\tau_K)\, r-\delta_K$, which implies that $r_B = r-\delta_K/(1-\tau_K)$.

$$J = \frac{C^{1-\sigma}-1}{1-\sigma} + \lambda[(1-\tau_L)wuH + (1-\tau_K)rW - (1+\tau_C)C], \tag{3}$$

Where λ. is the co-state variable for the shadow price of wealth.

By dynamic optimization, the necessary optimality conditions are obtained as:

$$C^{-\sigma} = \lambda(1+\tau_C), \tag{4}$$

$$\dot{\lambda} = \lambda\rho - \lambda(1-\tau_K)r. \tag{5}$$

Equation (4) equates the marginal utility of consumption to the individual's tax-adjusted shadow value of wealth, while (5) is the standard Keynes-Ramsey consumption rule, equating the rate of return on consumption to the after-tax rate of return on capital. If the transversality condition $\lim_{t\to\infty} e^{-\rho t}\lambda W = 0$ holds, which is fulfilled for a time path on which assets grow at the same rate as consumption, the necessary conditions are also sufficient.

3.2 Producers

The economy is assumed to have two sectors, producing two kinds of goods: a final private market good and intermediary human capital—a portion of the latter being used in the production of the former. While public capital is assumed complementary to the production of both goods, we distinguish between the types of public capital that enter each stage of the process. To this end, productive government spending is divided into investment in core public infrastructure assets (such as transport and communications systems, energy, water supply and sanitation) and public investment to enhance education and health services that increase the stock of human capital. As noted by Semmler et al. (2007), decomposing the productive capacity of public capital in this way more realistically captures the longer gestation lag in creating human capital relative to typical physical infrastructure. Even more importantly for the purposes of this paper, the decomposition allows us to isolate the effects of different kinds of government spending.

3.2.1 Market Good

Production of market goods, *Y*, is carried out by many identical firms which can berepresented by one firm which behaves competitively and which maximizes static profits. Theproduction function is given by a Cobb-Douglas technology,

$$Y = AK^{1-\alpha-\beta}(uH)^{\alpha}(vK_G)^{\beta}, \tag{6}$$

where A is a productivity parameter and $K_G$represents the stock of public capital. $u, v \in (0,1)$ represent the respective shares of human capital and public capital used in the production of market goods.

The remaining portions are used to build human capital and thus influence production indirectly. $\alpha, \beta \in (0,1)$ denote output elasticities so that production displays constant returns to scale in all factors together.[8]

8The constant returns to scale assumption is restrictive but is a necessary condition to obtain aconstant endogenous growth path in the long run and to ensure the existence of a competitiveequilibrium (Minea & Villieu, 2009).

3.2.2 Human Capital Accumulation

Human capital production can be thought of as a non-market, tax-free activity (Mendoza, Milesi-Ferretti, & Asea, 1997), which uses a Cobb-Douglas technology similar to the final market good such that

$$\dot{H} = Q[(1-u)H]^{1-\varepsilon}[(1-v)K_G]^{\varepsilon}, \qquad (7)$$

where Q is the productivity parameter and $\varepsilon \in (0,1)$ represents the elasticity of the production of human capital with respect to public capital stock in education and health facilities. Thus, the technology is again assumed to have constant returns to scale in all factors together. Similar representations for human capital formation have been used by Agénor and Neanidis (2006), Bayraktar and Pinto Moreira (2007), and Monteiro and Turnovsky (2008). The share of public capital stock employed in private production, v, can be used as a policy variable to analyze how variations in the allocation of productive government spending affect growth.

Assuming competitive markets, it must hold that the cost of capital, r, and the wage rate, w, are equal to their marginal products, respectively. This gives

$$w = \alpha(uH)^{-1}Y, \qquad (8)$$

$$r = (1-\alpha-\beta)K^{-1}Y. \qquad (9)$$

3.3 The Government

The government in this economy has a range of financing options and is not constrained to run a balanced budget in each period. However, it must repay all its debt at the end of time, such that

$$\lim_{t\to\infty} B(t)\exp\left(-\int_0^t (1-\tau_K)(r(s))ds\right) = 0,$$

must hold. That is, the government is not allowed to run a Ponzi game; discounted debt converges to zero asymptotically. The government receives tax revenues from income and consumption taxes and can raise additional revenues from issuing government bonds. Note that Ricardian equivalence fails due to the presence of distortionary income taxes. Government expenditure is split between public consumption, Cp, investment in public capital, Ip, and (net) debt servicing, rB. Public investment, Ip, augments the overall stock of public capital. It includes spending on infrastructure, which is used directly in production of the final good, as well as expenditure on health and education used in the production of human capital. The accounting identity describing the accumulation of public debt in continuous time is given by:

$$\dot{B} = rB + C_p + I_p - T, \qquad (10)$$

where T denotes total tax revenue such that $T = \tau_L wuH + \tau_K rK + \tau_K rB + \tau_C C$. Public consumption[9] expenditure is assumed not to affect productivity, but has to be financed through taxes and constitutes a certain share of tax revenue, $Cp = a_1T$, $0 < a_1 < 1$. The government is allowed to borrow to finance productive expenditures which will yield returns in the future, but must finance public consumption expenditures and interest payments from current tax revenue so that $Cp + rB = b_1T$, $0 < b_1 < 1$.

[9] Here public consumption refers to social transfers and expenditure with public goods characteristics, which do notaffect production but may enter into household preferences (such as public parks, civic facilities and consumption transfers).

This formulation approximates the golden rule of public finance – a fiscal rule that allows the government to borrow only for investment but not to fund current spending (Buiter, 2001).[10] The remaining tax share allotted to public investment would thus be $Ip=b_2(1 - b_1)T$, where $b_2> 1$ implies debt financing. Variations in the fiscal policy parameter $b_2$allow us to explore the effect of debt financing on growth. Rewriting (10), the accumulation of public debt becomes

$$\dot{B} = T(1-b_1)(b_2-1), \tag{10a}$$

where T is as defined above.

Ignoring depreciation, the differential equation describing the evolution of public capitalmay therefore be written as

$$\dot{K}_G = I_p = b_2(1-b_1)T. \tag{11}$$

3.4 Equilibrium Conditions and the Balanced Growth Path

3.4.1 Equilibrium Conditions

An equilibrium allocation for this economy is defined as a sequence of variables $\{C(t), K(t), H(t), K_G(t), B(t)\}_{t=0}^{\infty}$ and a sequence of factor prices $\{w(t), r(t)\}_{t=0}^{\infty}$ such that, given prices and fiscal parameters, the firm maximizes profits, the household solves (1) subject to (2b) and the budget identity of the government (10a) is fulfilled. Using (4), (5), (6) and (9), which must hold in equilibrium, equation (4) can be rewritten As

$$C = (\lambda(1+\tau_C))^{-1/\sigma}$$

Taking logs of this expression and differentiating with respect to time yields the growth rate ofConsumption

$$\frac{\dot{C}}{C} = \frac{1}{\sigma}\left((1-\tau_K)(1-\alpha-\beta)AK^{-\alpha-\beta}(uH)^{\alpha}(vK_G)^{\beta} - \rho\right), \tag{12}$$

which is equal to the growth rate of the economy, γ, in steady-state. For the evolution of private capital, we combine the definition of Bin (10) with the individual consumer's budget constraint given in (2b) to obtain

$$\frac{\dot{K}}{K} = (1-\beta)\frac{Y}{K} - \frac{C}{K} - (a_1 + b_2(1-b_1))\frac{T}{K}. \tag{13}$$

Thus, in equilibrium the economy is completely described by (7), (10a), (20), (11) and (13) plus the limiting transversality condition of the household.

3.4.2 The Balanced growth Path

We restrict the analysis to the steady-state where we assume that all the variables in the economy grow at their long-run growth rate.

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[10]The original conceptualization of the golden rule makes a distinction between current and capital expenditures. Here, we make the distinction between unproductive and productive expenditures broadly defined, so that the latter may include recurrent expenditures that contribute to the stock of human capital, such as spending on education and health, and so may be considered productive.

For our purposes, we define a balanced growth path (BGP) as a path such that the economy is in equilibrium and such that consumption, private physical capital, human capital, public capital and government debt grow at the same strictly positive constant growth rate; that is, $\dot{C}/C=\dot{K}/K=\dot{H}/H=\dot{K}_G/K_G=\dot{B}/B=\gamma, \quad \gamma>0$ and is constant. To analyze the model around the BGP we define the new variables $c\equiv C/K,\ h\equiv H/K,\ g\equiv K_G/K,\ b\equiv B/K.$

Differentiating these variables with respect to time leads to a four-dimensional system of differential equations given by

$$\frac{\dot{c}}{c}=\frac{\dot{C}}{C}-\frac{\dot{K}}{K}=0,$$
$$\frac{\dot{h}}{h}=\frac{\dot{H}}{H}-\frac{\dot{K}}{K}=0,$$
$$\frac{\dot{b}}{b}=\frac{\dot{B}}{B}-\frac{\dot{K}}{K}=0,$$
$$\frac{\dot{g}}{g}=\frac{\dot{K}_G}{K_G}-\frac{\dot{K}}{K}=0, \tag{14}$$

Where

$$\frac{\dot{C}}{C}=\frac{1}{\sigma}\left((1-\tau_K)(1-\alpha-\beta)\frac{Y}{K}-\rho\right),$$
$$\frac{\dot{H}}{H}=Q(1-u)^{1-\varepsilon}(1-v)^{\varepsilon}\left(\frac{H}{K}\right)^{-\varepsilon}\left(\frac{K_G}{K}\right)^{\varepsilon},$$
$$\frac{\dot{B}}{B}=\frac{T}{B}(1-b_1)(b_2-1),$$
$$\frac{\dot{K}_G}{K_G}=\frac{T}{K_G}(1-b_1)b_2 \quad \text{and}$$
$$\frac{\dot{K}}{K}=\left[(1-\beta)+(1-\alpha-\beta)\frac{B}{K}\right]\frac{Y}{K}-\frac{T}{K}(1+(1-b_1)(b_2-1))-\frac{C}{K}, \tag{15}$$

with $\frac{Y}{K}=A\left(u\frac{H}{K}\right)^{\alpha}\left(v\frac{K_G}{K}\right)^{\beta}$, $\frac{T}{K}=\tau_L\alpha\frac{Y}{K}+\tau_K(1+\frac{B}{K})(1-\alpha-\beta)\frac{Y}{K}+\tau_C\frac{C}{K}$ and

$$b_1=a_1+(1-\alpha-\beta)\frac{Y}{K}\frac{B}{T}.$$

A solution $\dot{c}=\dot{h}=\dot{g}=\dot{b}$ with respect to *c, h, g, b* gives a balanced growth path for the model and corresponding ratios *c*, h*, g*, b** on the balanced growth path. The high dimension of the dynamic system makes it analytically intractable. We therefore rely on numerical simulations to establish the existence and stability of the steady-state equilibrium.

4. Model Calibration and Solution

The model is calibrated to correspond to average economic performance in Cape Verde during 1995-2009, which will serve as the benchmark for policy experiments. Table 2 gives some selected economic data and the corresponding results from the model. Over the study period, the average annual growth rate of GDP per capita was 4.54 percent. The average size of government (as measured by government spending to GDP) was 36.9 percent. Of this, roughly equal shares were spent on public consumption and public investment (approximately 13 percent of GDP each).

The remaining 10.5 percent went to debt servicing and other expenses. Public spending was financed by revenue from taxation and other sources, as well as debt. On average, total revenue was about 31.2 percent of GDP, with tax revenue constituting about two-thirds of this. The average stock of debt was quite significant at 80.0 percent of GDP. The benchmark parameters of the model are chosen to reflect these statistics.

Table 3 presents the values of parameters used in the benchmark model for Cape Verde. As specific estimates for Cape Verde for most of these parameters are not available, we use parameters for developing countries that have been estimated and used in the literature. We also perform robustness checks to ensure that the model results can be generalized and are not unique to particular parameter values. The rate of time preference, ρ, is set at 0.028, which is within the standard range reported in the literature (Bayraktar & Pinto Moreira, 2007; Rioja, 2005). We set the inverse of the intertemporal elasticity of substitution, σ, to 2. This value is lower than what is typically used for industrial country studies and is consistent with evidence indicating that the intertemporal elasticity of substitution tends to be low at low levels of income (Bayraktar & Pinto Moreira, 2007).

The share of human capital employed in private production is set to 0.94, which is in the range of values used by Semmler et al. (2007) for a set of middle- and low-income countries.

We set the elasticity of output with respect to public capital in infrastructure, β, to 0.12, which is similar to Rioja (2003), which uses 0.10 for a group of Latin American countries. This is close to the 0.138 estimated by Calderòn and Servèn (2003) for the elasticity of GDP to infrastructure for a group of comparable middle-income countries in Latin America. The value for the elasticity of output with respect to human capital, α, is put at 0.3 which is the average of the estimates used by Rioja (2005) and Semmler et al. (2007). The constant returns to scale technology used in the model, thus, implies that the output elasticity of private capital is 0.58, which is close to the value of 0.60 estimated by Elias (1992) for a group of developing countries in Latin America.

For the production of human capital, the elasticity of public capital stock in education and health, ε, is set at 0.30, which is similar to that used by Semmler et al. (2007). This value is larger than the 0.10 used by Rioja (2005) and the econometric estimate obtained by Blankenau et al. (2007) for the elasticity of the public capital stock in education only. Since our model combines public capital in both education and health for human capital production, we use a higher value to take into account externalities from complementarities between the two forms of spending.[11]

Since a fraction of public capital is used to produce human capital – itself an input factor in private market production – the final output elasticity of total public capital is derived from the model as $\varepsilon\alpha + \beta$. Given the selected parameters, the size of the output elasticity of total public capital is thus 0.21. This value is consistent with the 0.268 estimated by Bom and Ligthart (2009) in a meta-analysis on the output elasticity of public capital for a sample of 67 studies.

The remaining parameters—the shift factors and fiscal policy variables—are set to achieve a baseline growth rate consistent with the data for the period 1995 to 2009.

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[11] Agénor and Neanidis (2006) provide several examples of the interaction between health and education to improve the quality of human capital. Healthier students are more likely to participate and do better in school. Among the examples cited, Baldacci et al. (2008) show that health capital has a statistically significant effect on school enrollment rates. Simultaneously, the evidence shows that higher education levels can improve health. Smith and Haddad (2000) report that improvements in female secondary school enrollment rates during 1970-1995 accounted for 43 percent of the total reduction in the child underweight rate of developing countries.

The steady-state results of the numerical simulation are presented in the last column of Table 2. As is shown, the calibrated model provides a fair representation of the average economic performance of Cape Verde over the last 15 years. In particular, the steady-state growth rate, public investment and overall domestic investment correspond almost exactly with the actual averages for Cape Verde over the study period. Other indicators, such as the high public debt ratio and public expenditure levels, are also very closely replicated in the model. We use these results as the benchmark for various fiscal policy experiments.

5. Policy Experiments

In this section, we use numerical simulations to explore how variations in the composition and financing of public investment expenditure affect the steady-state growth rate. Recall that public investment augments the stock of public capital part of which is used for the production of final goods ("public infrastructure") and the remainder is used in the production of human capital (so we can think of this portion as augmenting health and education). We conduct four types of fiscal policy experiments: (a) increase public investment financed by new debt issues, (b) increase public investment financed by raising taxes (income or consumption), (c) increase public investment by re-allocating spending away from public consumption, and (d) re-allocating public investment in infrastructure toward education and healthcare. We also explore the effects of shifting public consumption expenditure to public investment, but placing more emphasis on health and education rather than infrastructure development. Finally, in an attempt to gain insight into what would be an optimal policy strategy for the Cape Verdean economy going forward, we simulate the growth effects from a suite of policy reforms implemented simultaneously. A brief summary of our results is presented on Table 4. We describe these results in detail below.

5.1 Financing Increased Public Investment by Issuing New Debt

Cape Verde currently has a fairly high debt burden with the public debt to GDP ratio hovering around 80.0 percent. The simulations show that continuing to finance public investment through increased borrowing is detrimental to growth (see Table 5). For example, suppose that public investment is increased, financed by debt rising from 75.8 to 91.8 percent; then steady-state growth rate would fall from 4.57 percent in the benchmark case to 4.32 percent.[12] The new borrowing has two effects: (a) It increases the debt to GDP ratio which then requires higher debt repayments; and (b) It also raises interest rates (the marginal cost of borrowing) so that repayments are even larger. The higher debt-servicing costs (rB/Y) eventually crowd out spending on public investment (Ip/Y) so that instead of increasing, the ratio of public investment to GDP actually falls from 11.6 to 10.1 percent in the steady state. The elevated interest rate will also discourage private investment causing an additional crowding-out effect.[13]

The model thus implies that given the high debt burdens of Cape Verde, it is better to reduce the amount of deficit-financing being used rather than accumulate more debt. Financing additional public investment by further increasing the debt stock may be counterproductive. In the next section, we simulate the effects on growth of reducing deficit-financing by increasing taxation.

5.2 Financing Increased Public Investment by Raising Taxes

The fiscal data for Cape Verde show that while total revenue as a share of GDP averaged 31.2 percent between 1995 and 2009, less than two-thirds of this (19.5% of GDP) emanated from tax revenue (see Table 2).[14]

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[12] This is achieved by increasing the parameter b_2 from 2.2 to 3.8.

[13] The model represents a closed economy so the crowding effect is fairly strong. Cape Verde is indeed an open economy with the majority of its debt originating from external sources. In addition, its former classification as a least developed country (LDC) made it eligible to receive a significant portion of its debt at low concessional rates. However, as Cape Verde has been re-classified as a developing country and there is reduced access to financing at concessional rates, its existing large debt burden may make it more of a challenge to access cheap funds internationally. Thus, future borrowing is likely to be more expensive with a greater share being sourced domestically,making the strong crowding-out effects of the model very relevant.

[14] The model does not distinguish between different sources of revenue such as grants and user fees, but rather treats all revenue as tax revenue. This makes the effective tax rates and tax shares in the model larger than what would obtainin reality. However, it does not compromise the model's ability to evaluate the general effect that changes in tax policywillhave on growth.

In a previous study for a group of Latin American countries, Christie and Rioja (2012) demonstrate that when the fiscal situation of a country is characterized by high debt and low taxes, the appropriate strategy to finance public investment and foster growth is to reduce borrowing and fund the public investment with taxes. We conduct policy experiments along similar lines for Cape Verde, the results of which are presented in Table 6.

We first simulate increasing income and consumption tax rates with only moderate adjustments to borrowing. Table 6 shows that raising both tax rates on capital and labor (τ_K and τ_L) to 0.30 and the tax rate on consumption (τ_C) to 0.33, while reducing debt, brings about an increase in the steady-state growth rate to 4.96 percent.[15] The higher tax rates increase the amount of tax revenue (*Taxes/GDP*) generated and thus enlarge the potential pool of funds available for public expenditure. This in turn increases public investment spending (*Ip/Y*), which raises the public capital stock and subsequently the growth rate.[16]

We note that increasing the tax rates as described above while further reducing deficit-financing allows for even greater rates of steady-state growth such that the extent to which taxes have to be raised is lessened. If the debt to GDP ratio is lowered from its current level of about 75% to about 60%, the model shows that growth rates would increase to more than 5 percent (even with smaller accompanying increases in tax rates). Reducing borrowing even further so that the debt to GDP ratio hovers around 36 percent of GDP could stimulate growth rates to 5.33 percent with less required increases in tax rates.

5.3 Restructuring Public Spending

5.3.1 Re-allocating Spending from Public Consumption to Investment

Shifting expenditure away from public consumption expenditures toward public investment increases the steady-state growth rate (see top panel of Table 7). This finding is consistent with the consensus in the growth literature. However, doing quantitative analysis in a fully specified general equilibrium macroeconomic model allows us to determine just how potentially stimulating even a slight restructuring of public expenditure can be. Lowering the share of public consumption to GDP by about one percent[17](from 10.15 in the baseline scenario to 9.20) increases public investment to 12.17 percent of GDP and increases the growth rate by about 0.10 percent (from 4.57 to 4.66 percent).

While it is obvious that a restructuring of public spending away from unproductive toward productive expenditure is growth-enhancing, such a policy may be politically difficult to implement. It is, therefore, necessary to explore alternative shifts in spending which may be more politically feasible.

5.3.2 Re-Allocating between Infrastructure and Human Capital Spending

Over the last two decades, Cape Verde has channeled significant amounts of public funds into the development of physical capital such as public infrastructure. While the accumulation of physical capital has been shown to be an important source of growth, because of diminishing marginal returns, merely increasing the stock of physical capital alone cannot sustain high rates of growth indefinitely. Endogenous growth theory emphasizes the simultaneous development of complementary factors which can offset the diminishing returns to physical capital and engender sustained high growth rates. Thus, we use the model to simulate the effect of shifting the emphasis of public investment away from infrastructure and towards public capital which more specifically supports human capital formation, for example, investment in schools and public health facilities. We find that such a re-allocation increases the steady-state growth rate.

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[15]All the reductions in debt in this sub-section are achieved by decreasing b2 as shown in Table 6.

[16]This does not preclude the negative effect that taxation has on private investment, as higher tax rates lower the return to private capital and so act as a disincentive to investment. However, the positive overall effect on growth in the analysis implies that the positive effects of public investment and debt reduction more than offset the distortionaryimpact of taxation in this case.

[17]This is achieved by reducing the parameter *a1* to 0.27.

Changing the allocation of public funds towards human capital by just five percentage points increases the steady-state growth rate from 4.57 to 5.09 percent (see middle panel of Table 7 where $v = 0.85$).

The higher growth rate comes about through the following channel: more spending in the human capital sector raises the ratio of human capital to private capital, h^*, from 0.125 in the benchmark case to 0.153. Human capital, being the limiting factor, has a higher marginal productivity so that any given increase generates more output than a similar increase in physical capital and thus stimulates growth more. Further shifts in public investment spending towards human capital ($v = 0.83$) that bring the human/private capital ratio to 0.163 cause the growth rate to increase to 5.25 percent.

These findings are consistent with Rioja (2005) who explores similar shifts between infrastructure and education spending for a group of Latin American countries; and Monteiro and Turnovsky (2008) who calibrate a similar model for the United States. Re-allocating spending to the most productive uses will generate the best returns on public investment and give the strongest boost to growth. Productivity of the factor in relatively short supply is higher and public capital to boost this factor will have greater returns.

5.3.3 Re-Allocating Public Consumption Expenditure toward Health and Education

Given the foregoing arguments and the findings from the two previous sets of experiments, it is interesting to also explore the long-term growth effects of redirecting public consumption spending specifically towards investment in health and education rather than infrastructure development. We use the model to simulate this scenario by simultaneously changing the shares of public spending assigned to consumption and physical capital ($a_1$and v). The results, presented in the bottom panel of Table 7, reveal that even larger growth dividends can be realized by this two-fold policy. For example, lowering public consumption expenditure from 10.15% to about 8.86% of GDP[18], while simultaneously shifting the ratio between physical and human capital investment from 0.9 to 0.8, is shown to raise the steady-state growth rate to 5.60%. Compare this to the lower growth rate of 4.70% when public consumption expenditure is re-directed more heavily towards physical capital investment (top panel of Table 7).

These experiments demonstrate that there are potentially larger growth dividends to be exploited from more targeted reallocations of public consumption expenditure. Moreover, such spending shifts may be more politically feasible to implement as investments in health and education to enhance human capital can also be regarded as social spending.

5.4 Optimal Policy Mix

Given the substantial improvements to the equilibrium growth rate, derived by refocusing the emphasis of public capital accumulation from physical capital towards human capital development, it is interesting to model the effect on the economy of supporting such reallocations with lower borrowing and higher taxes. Table 8 shows the results of simultaneously restructuring the composition and financing of public investment in favor of stronger emphasis on human capital formation financed by taxes rather than borrowing.

In line with expectations, the results indicate a remarkable improvement in the growth rate—the largest of all the policy experiments—from 4.57 in the baseline case, to 6.05 percent.Also notable is the significant increase in overall public investment as lower debt servicing costs free up resources for productive investment. This type of multi-policy experiment appropriately highlights the significant effects the correct mix of fiscal policies can have on economic growth in the long run.

6. Robustness Checks

It has already been noted that due to the lack of specific empirical studies for the Cape Verdean economy, we have relied on parameter estimates from the broader empirical literature on developing countries similar to Cape Verde.

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[18]This is achieved by setting a_1= 0.26.

In order to ensure that the foregoing results are not dependent on the specific parameter values assigned, we conduct robustness checks using alternative values of the key parameters in the model. Hence, the parameters associated with output elasticities $(\alpha, \beta \text{ and } \varepsilon)$ are changed within the range estimated in the literature, and policy experiments are re-simulated in order to explore how the main results are affected. We adopt the approach taken in Rioja (2005) and calculate two extreme cases: 1) setting the parameters to their highest values ("High scenario"), and 2) setting the parameters to their lowest values ("Low scenario"). The new estimates used in the High scenario are thus α= 0.4, β= 0.2 and ε= 0.2, while those for the Low scenario are α= 0.2, β= 0.1 and ε= 0.1.[19] The remaining parameters are set to achieve a growth rate consistent with the Cape Verdean economy during 1995-2009.Estimates for the baseline models are presented in Table A1 in the Appendix. Results for the various policy experiments, presented in Table A2 and Table A3, are in line with the original model and so add credence to the main findings.

7. Conclusion

The economy of Cape Verde has exhibited strong economic performance in the last decade.

Sustained high public investment, especially in infrastructure, has played a key role in this strongeconomic performance. However, there are potential challenges to future funding for publicinvestment given the existing debt level and the increases in interest rates for concessional lending as Cape Verde has graduated to the developing country group. In addition, sustaining high growth rates in the long term usually requires building up human capital along with physical capital in the country. We develop a two-sector endogenous growth model to explore how variations in the composition and financing of government expenditures affect economic growth in Cape Verde in the long-run. Our main finding is that reallocating public spending from infrastructure to human capital can have large positive effects on long run growth rates. Furthermore, we find that financing public investment with additional debt may reduce growth due to the high level of debt and increasing debt service costs. Conversely, using tax financing for additional public investment can increase growth rates. The policy mix that attains the largest increase in the growth rate to about 6% per year involves simultaneously restructuring the composition and financing of public investment in favor of stronger emphasis on human capital formation financed by taxes rather than borrowing.

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[19]Recall that in the original model α= 0.30, β = 0.12 and ε= 0.30.

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Table 1: Cape Verde and Comparison Countries: Economic Indicators

Economic Indicator	Cape Verde	Barbados	Jamaica	Trinidad & Tobago	Seychelles	Mauritius	Singapore
Population	496,000	273,331	2,702,300	1,341,465	87,000	1,281,000	5,077,000
GDP per capita	3,323	15,035	5,279	15,359	10,766	7,591	41,120
Growth of GDP per capita	4.54	0.93	0.06	4.94	2.18	3.53	3.29
HDI	0.568	0.793	0.727	0.760	0.773	0.728	0.866
Infrastructure							
Paved Roads (% of total)	69	100	74	51	96	98	100
Quality port infrast. (1-7)	3.51	5.55	5.34	4.33	n.a.	4.54	6.76
Education							
School enroll. (sec.)	66	84	83	66	95	74	n.a.
School enroll. (tertiary)	17.8	65.9	25.0	11.5	n.a.	24.9	n.a.
Literacy rate (age 15-24)	98.2	99.7	95.2	99.5	99	96.5	100
Health							
Mortality rate (under 5)	35.6	19.6	23.8	27.1	13.5	15.1	2.6
Life expectancy	74	76	73	70	73	73	82

Source: World Development Indicators. Population (2010). Growth of GDP per capita is average from 1995 to 2010. HDI (2010). Quality of port infrastructure (2010): 1=extremely underdeveloped to 7=well developed and efficient by international standards. School enrollment (2010 or latest year available): % of net or gross. Literacy rate (2010 or latest year available). Mortality rate (under 5 years of age) per 1000 births (2010 or latest year available). Life expectancy (2009.

Table 2: Benchmark Solution for Model Calibrated for Cape Verde

Economic indicator	Average 1995-2009	Model
GDP per capita growth (%)	4.54	4.57
Domestic investment (% GDP)	32.0	31.4
Revenue (% GDP)	31.2	33.8
Tax revenue (% GDP)	19.5	33.8
Government expenditure (% GDP)	36.9	40.1
Government consumption (% GDP)	13.4	10.2
Public investment (% GDP)	13.0	11.6
Public debt (% GDP)	80.0	75.8

Note. The underlying equilibrium solutions are $c^* = 0.1945$, $b^* = 0.3176$, $g^* = 0.5822$, $h^* = 0.1252$, and $b1^*$ =0.8446.

Table 3: Benchmark Parameters for Model Calibration

Parameter	Value	Definition
ρ	0.028	Rate of time preference
σ	2.00	Inverse of the inter temporal elasticity of substitution in consumption
u	0.94	Share of human capital employed in private production
α	0.30	Elasticity of output, Y, w.r.t. educated labor (human capital)
β	0.12	Elasticity of output, Y, w.r.t. public capital in infrastructure
ε	0.30	Elasticity of the production of human capital w.r.t. public capital stock in education and health
Λ	0.86	Shift factor in final market production
Q	0.75	Shift factor in human capital production
Fiscal Policy Variables		
τ_K	0.20	Tax rate on capital income
τ_L	0.20	Tax rate on labor income
τ_C	0.27	Tax rate on consumption
v	0.90	Share of public capital stock employed in private production (public infrastructure)
a_1	0.30	Share of total tax revenue used to finance public consumption
b_2	2.20	Extent to which new bond issues are used to finance public investment. $b_2 > 1$ implies the use of debt financing.

Table 4: Summary of Outcomes of Policy Scenarios

Policy Experiment	Growth outcome
Increasing debt	
• Raising debt ratio from 76% to 92% of GDP	• Lowers growth rate from 4.57% to 4.32%
Lowering debt and increasing taxes	
• Lowering debt ratio to 36% of GDP, while raising average taxes to around 38% of GDP	• Increases growth rate from 4.57% to 5.33%
Re-allocating public expenditure	
• Diverting just over 1% of public consumption expenditure in favor of public investment	• Raises growth rate from 4.57% to 4.70%
• Changing the allocation of public funds towards human capital by 7 percentage points	• Increases growth rate from 4.57% to 5.25%
• Re-directing 1% of public consumption expenditure specifically towards investment in health and education	• Raises growth rate from 4.57% to 5.64%
Combination policy	
• Lowering debt, raising taxes, re-directing public investment spending towards health and education	• Raises growth rate to greater than 6%

Table 5: Steady-State Results for Financing Public Investment with Increased Borrowing

Policy variable	*Growth rate*	*Public Inv./GDP*	*Public Cons./GDP*	*Debt Service/GDP*	*Debt/GDP*	*Taxes/GDP*
	γ	I_p/Y	C_p/Y	rB/Y	B/Y	T/Y
b_2 (debt)						
2.2	**4.57**	**11.56**	**10.15**	**18.42**	**75.82**	**33.82**
2.4	4.51	11.23	10.21	19.15	79.27	34.04
3.6	4.33	10.16	10.43	21.51	90.73	34.77
3.8	4.32	10.06	10.45	21.74	91.85	34.88

Note: Benchmark case in bold type.

Table 6: Steady-State Results for Varying Financing of Public Investment

Policy variables			Growth rate	Public Inv./GDP	Public Cons./GDP	Debt Service/GDP	Debt/GDP	Taxes/GDP
			γ	I_p/Y	C_p/Y	rB/Y	B/Y	T/Y
b_2	$\tau_K = \tau_l$	τ_c						
2.2	**0.20**	**0.27**	**4.57**	**11.56**	**10.15**	**18.42**	**75.82**	**33.82**
1.6	0.30	0.33	4.96	17.18	13.76	21.37	73.96	45.87
1.4	0.30	0.30	5.08	18.28	13.00	17.29	59.14	43.34
1.2	0.27	0.30	5.33	19.62	11.44	10.34	36.00	38.13

Note: Benchmark case in bold type.

Table 7: Steady-State Results for Reallocating Public Expenditure

Policy variables		Growth rate	Public Inv./GDP	Public Cons./GDP	Debt Service/GDP	Debt/GDP	Taxes/GDP
		γ	I_p/Y	C_p/Y	rB/Y	B/Y	T/Y
a_1		(reallocating between public consumption and public investment)					
0.26		4.70	12.41	8.88	19.58	79.53	34.15
0.27		4.66	12.17	9.20	19.35	78.91	34.09
0.28		4.63	11.96	9.52	19.04	77.88	34.00
0.30		**4.57**	**11.56**	**10.15**	**18.42**	**75.82**	**33.82**
0.32		4.50	11.16	10.77	17.80	73.77	33.64
v		(reallocating between infrastructure and human capital)					
0.83		5.25	11.63	10.12	18.33	70.46	33.73
0.85		5.09	11.61	10.13	18.35	71.67	33.75
0.90		**4.57**	**11.56**	**10.15**	**18.42**	**75.82**	**33.82**
0.95		3.72	11.46	10.19	18.56	83.67	33.95
a_1	v	(reallocating public consumption expenditure towards health and education)					
0.30	**0.90**	**4.57**	**11.56**	**10.15**	**18.42**	**75.82**	**33.82**
0.28	0.85	5.16	12.02	9.50	18.97	73.62	33.93
0.26	0.80	5.60	12.46	8.86	19.54	72.69	34.06
0.25	0.80	5.64	12.67	8.54	19.86	73.63	34.15

Note: Benchmark case in bold type.

Table 8: Steady-State Results for Varying Financing and Allocation of Public Investment

				Growth rate	Public Inv./GDP	Public Cons./GDP	Debt Service/GDP	Debt/GDP	Taxes/GDP
Policy variables				γ	I_p/Y	C_p/Y	rB/Y	B/Y	T/Y
b_2	$\tau_K = \tau_l$	τ_c	v						
2.2	**0.20**	**0.27**	**0.90**	**4.57**	**11.56**	**10.15**	**18.42**	**75.82**	**33.82**
1.2	0.26	0.30	0.83	6.05	19.09	11.03	9.83	32.48	36.72

Note: Benchmark case in bold type

Appendix Tables

Table A1: Robustness Checks using Alternative Model Parameters

Economic indicator	Average 1995-2009	Original Model	High Scenario	Low Scenario
GDP per capita growth (%)	4.54	4.57	4.44	4.73
Domestic investment (% GDP)	32.0	31.4	24.0	35.6
Revenue (% GDP)	31.2	33.8	36.0	33.6
Tax revenue (% GDP)	19.5	33.8	36.0	33.6
Government expenditure (% GDP)	36.9	40.1	41.9	39.9
Government consumption (% GDP)	13.4	10.2	10.8	10.1
Public investment (% GDP)	13.0	11.6	11.8	11.5
Public debt (% GDP)	80.0	75.8	72.0	74.1

New parameter values for High scenario: α = 0.4, β = 0.2 and ε = 0.2. New parameter values for Low scenario: α = 0.2, β = 0.1 and ε = 0.1. Original parameter values: α = 0.3, β = 0.12 and ε = 0.3.

Table A2: Steady-State Results for Policy Experiments using High Scenario

Policy variables		*Growth rate*	*Public Inv./GDP*	*Public Cons./GDP*	*Debt Service/GDP*	*Debt/GDP*	*Taxes/GDP*
		γ	I_p/Y	C_p/Y	rB/Y	B/Y	T/Y
b_2		(increasing borrowing)					
2.0		**4.44**	**11.80**	**10.81**	**19.32**	**72.04**	**36.03**
2.1		4.41	11.56	10.86	19.84	74.24	36.21
b_2	$\tau_K = \tau_L$	(varying between debt and taxes)					
2.0	**0.24**	**4.44**	**11.80**	**10.81**	**19.32**	**72.04**	**36.03**
1.8	0.26	4.56	12.88	11.29	19.19	68.89	37.64
a_1		(reallocating between public consumption and public investment)					
3.0		**4.44**	**11.80**	**10.81**	**19.32**	**72.04**	**36.03**
2.5		4.66	13.41	9.04	19.81	72.31	36.18
v		(reallocating between infrastructure and human capital)					
0.9		**4.44**	**11.80**	**10.81**	**19.32**	**72.04**	**36.03**
0.83		4.95	11.4	10.89	20.28	72.04	36.31
a_1	v	(reallocating public consumption expenditure towards health and education)					
3.0	**0.9**	**4.44**	**11.80**	**10.81**	**19.32**	**72.04**	**36.03**
0.25	0.85	5.06	13.09	9.10	20.59	72.38	36.41
0.25	0.80	5.34	12.86	9.14	21.15	72.46	36.57

Note: Benchmark case in bold type.

Table A3: Steady-State Results for Policy Experiments using Low Scenario

Policy variables			Growth rate	Public Inv./GDP	Public Cons./GDP	Debt Service/GDP	Debt/GDP	Taxes/GDP
			γ	I_p/Y	C_p/Y	rB/Y	B/Y	T/Y
b_2			(increasing borrowing)					
2.2			**4.73**	**11.52**	**10.09**	**18.31**	**74.11**	**33.64**
2.4			4.71	11.20	10.16	19.03	77.24	33.85
b_2	$\tau_K = \tau_L$	τ_C	(varying between debt and taxes)					
2.2	**0.2**	**0.27**	**4.73**	**11.52**	**10.09**	**18.31**	**74.11**	**33.64**
2.05	0.21	0.28	4.76	12.25	10.49	18.50	73.75	34.97
a_1			(reallocating between public consumption and public investment)					
3.0			**4.73**	**11.52**	**10.09**	**18.31**	**74.11**	**33.64**
2.6			4.82	12.76	8.76	18.56	74.44	33.70
v			(reallocating between infrastructure and human capital)					
0.9			**4.73**	**11.52**	**10.09**	**18.31**	**74.11**	**33.64**
0.85			4.96	11.56	10.08	18.23	72.15	33.59
a_1	v		(reallocating public consumption expenditure towards health and education)					
3.0	**0.9**		**4.73**	**11.52**	**10.09**	**18.31**	**74.11**	**33.64**
0.28	0.85		4.99	11.94	9.46	18.90	74.56	33.78
0.25	0.80		5.22	13.01	8.43	18.79	72.48	33.73

Note: Benchmark case in bold type.