DSGD DISCUSSION PAPER NO. 11

PROSPECTS FOR GROWTH AND POVERTY REDUCTION IN ZAMBIA, 2001-2015

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ACKNOWLEDGEMENTS

The work presented in this paper was funded by the World Bank and submitted as input into Zambia's 2004 Country Economic Memorandum (CEM). The authors would like to thank Abebe Adugna, Hinh Dinh, Leonid Koryukin, and Jos Verbeek from the World Bank, and Moataz El-Said from IFPRI for their comments and contributions.

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ABSTRACT

Zambia is one of the poorest countries in Africa. Despite substantial reform during the 1990s, the economy has remained heavily dependent on urban-based mining. Copper's long-standing dominance led to a strong bias against agriculture, which undermined the sector's growth and export potential. Consequently poverty has remained concentrated within marginalized rural areas. Recent volatility in copper exports and growing foreign debt indicate the need for further economic diversification and pro-poor growth. These needs have been clearly identified in the country's Poverty Reduction Strategy Paper (PRSP), which outlines a series of policy objectives aimed at combating HIV/AIDS, reversing the deterioration of education and rural infrastructure, and accelerating agricultural growth.

This paper uses a computable general equilibrium (CGE) model to assess the potential impact on inequality and poverty of the key PRSP policies, as well as the effects of foreign debt forgiveness and changes in the copper sector. The findings suggest that, in the absence of very rapid growth, the pro-poor policies outlined in the PRSP will not enable Zambia to reach its Millennium Development Goal (MDG) of halving poverty by 2015. Achieving this goal will require gross domestic product (GDP) to grow at an annual rate of over ten percent. Reduction in poverty can however be achieved by addressing HIV/AIDS, which currently reduces annual GDP growth by one percent. Furthermore, substantial poverty-reduction can occur through the acceleration of agricultural growth, although limited market opportunities necessitates supporting investment in rural infrastructure. Overall, the potential of the agricultural sector depends on the government's commitment to reforms and the continued removal of the anti-agricultural bias created by the dominant copper sector.

PROSPECTS FOR GROWTH AND POVERTY REDUCTION IN ZAMBIA, 2001-2015

Hans Lofgren, James Thurlow, and Sherman Robinson [*]

I. INTRODUCTION

Zambia is one of the poorest countries in Sub-Saharan Africa (SSA). In 2001, per-capita income was US$320, only two-thirds of the Sub-Saharan average. The most recent household survey, which is for 1998, indicates that 55.8 percent of the populations fall below the national food poverty line (McCulloch *et al.*, 2000). Human deprivation is also severe: 60 percent of children suffer from chronic malnourishment and 20 percent die before the age of five (UNICEF, 2003).

Since the change in government following the 1991 elections, the Zambian authorities have engaged in far-reaching economic reforms, including stabilization programs, agricultural and trade reforms, public sector reform, and privatization. These structural reforms were expected to have a major impact on poverty and inequality. However the country's recent economic performance has been disappointing. In spite of the government meeting many of the fiscal and monetary targets stipulated under the structural adjustment programs (SAPs), economic growth has been slow and per capita incomes have declined. While this weak performance may indicate the ineffectiveness or inappropriateness of some of these policies for Zambia, a number of external factors have also hampered economic performance. These factors, which lie beyond the immediate scope of government policy, include several droughts, adverse changes in world commodity markets and, perhaps most devastatingly, the onslaught of HIV/AIDS. Furthermore, the current government inherited, and has since contributed to, an external debt that is so large that Zambia is classified as belonging to the group of heavily

[*] Hans Lofgren is a former Senior Research Fellow, James Thurlow is a Research Analyst from Development Strategy and Governance Division (DSGD), and Sherman Robinson is a former Institute Fellow of the International Food Policy Research Institute (IFPRI).

indebted poor countries (HIPCs). The burden of servicing this debt constrains the government's ability to spend on programs aimed at reducing poverty.

The objective of this research, which is focused on Zambia's economy during the period 2001-2015, is threefold. First, we analyze the implications of projections for Zambia's economic performance generated by the World Bank's Revised Minimum Standard Model (RMSM), with an emphasis on sectoral growth and poverty. Secondly, we assess the impact of changes in the current economic environment (i.e., those changes that lie beyond the immediate control of government policy). These changes include the effects of falling world copper prices, the collapse of copper mining, and external debt forgiveness. Thirdly, drawing on government documents and research on the Zambian economy, we analyze the potential roles of selected policies in accelerating growth, improving household welfare and reducing poverty. The policies that we consider include increased HIV/AIDS-related health spending, increases in agricultural productivity, public investment in transport infrastructure, and increased public spending in education.

Section 2 reviews Zambia's recent economic performance and the policies adopted by the government during the period of structural adjustment. This section also identifies from the literature key policies that may contribute to stronger growth and poverty reduction. The "base" dynamic path, which assumes a continuation of current trends and policies, is assessed using a dynamic computable general equilibrium (CGE) model for Zambia. The solution for the base year, 2001, is benchmarked to a 2001 Social Accounting Matrix (SAM). The SAM and the rest of the model database are presented in Section 3. Section 4 describes the CGE model.

Using the CGE model and its database, Section 5 presents the BASE scenario for 2001-2012. Selected model parameters have been fine-tuned so that the scenario matches the aggregate projections of the RMSM. The section then analyzes the role of Zambia's economic environment in influencing the country's economic performance. Finally, Section 5 addresses the potential impact of alternative government policies. The final section draws together the findings and reviews the prospects for Zambia's economy

during the coming decade. In an Appendix, we present additional details on the assumptions that underlie the model simulations.

II. RECENT ECONOMIC DEVELOPMENTS AND CURRENT DEVELOPMENT STRATEGY

Although Zambia enjoyed high growth following its independence in 1964, growth slowed strongly following the rise in oil prices and the fall in copper prices during the mid-1970s. Acting as if the collapse of the world copper price was temporary, the government borrowed heavily in order to protect current consumption. However, by the early 1980s the government had realized that its own attempts at reform had failed and that the economy was not going to attain the growth rates of the 1960s if it continued along its current growth path. In 1983, the government adopted a SAP designed by the World Bank and the International Monetary Fund (IMF). This program failed to maintain political support within Zambia and was revoked in 1986. In response to a sudden economic downturn, the government in 1989 resumed negotiations with these two international institutions, leading to the elaboration of a new SAP in 1990.

Structural Adjustment and Economic Performance in the 1990s

Given the turbulent economic developments of the 1970s and 1980s, the chief objectives of the SAPs of the last decade were to establish macroeconomic stability, implement agricultural reforms, liberalize trade, strengthen industrial policy, and privatize state assets (McCulloch *et al.*, 2000). Figures 1 to 4 show the state of the Zambian economy at the beginning of the 1990s, and how the SAP influenced the country's recent economic performance.

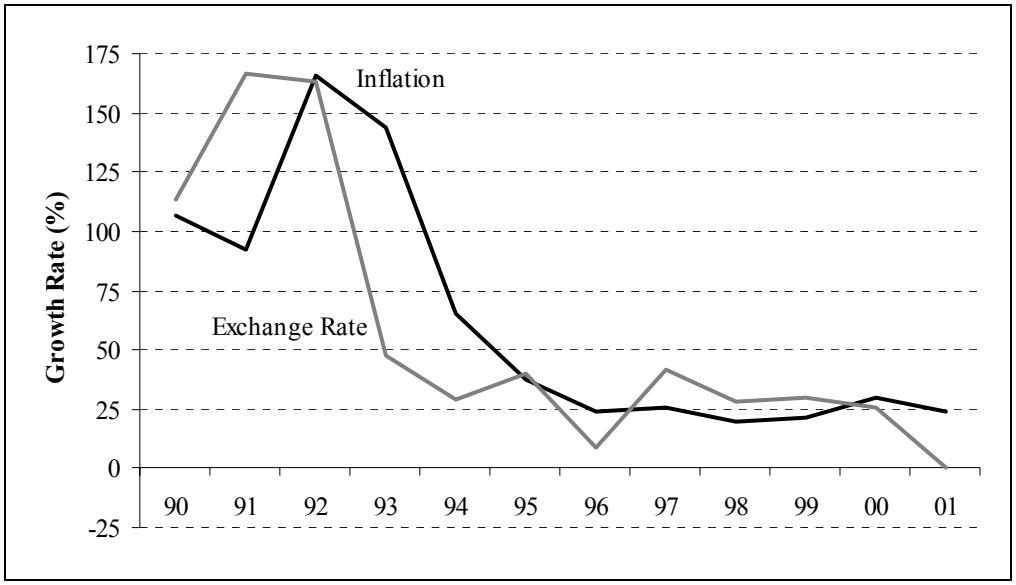
At the start of the 1990s, the economy had entered a period of stagnation. National production was declining, inflation exceeded 100 percent, the government deficit was over seven percent of Gross Domestic Product (GDP), and scheduled debt service was 61 percent of export earnings (McCulloch et al., 2000). It was in this context that the newly elected Zambian government adopted a new SAP. Over the course of the next ten years, the authorities managed to curb much of the instability that had plagued the economy up until the 1990s. By the mid-1990s inflation had been reduced from its original triple-digit levels to around 25 percent per year, a rate that was maintained until

2001 (Figure 1). These lower levels of inflation also promoted a slower nominal depreciation of the exchange rate from 1995 onwards. The combined lowering and stabilization of these two indicators partially explain the gradual rise in investment as a share of GDP over the last five years (Figure 2).

Stable GDP growth rates have not been achieved despite an increased spending share for investment (Figure 3). Between 1990 and 2001 the economy grew on average at only one percent per year. This weak aggregate performance is partly explained by the changing composition of GDP over this ten-year period (Figure 4). During the early 1990s, GDP growth rates appear to have been driven by changes in agriculture. Between 1990 and 1992, the government initiated the SAP by abolishing and ”de-monopolizing” agricultural markets, and by removing maize and fertilizer subsidies. Removing price-floors and subsidies on maize, Zambia’s most important crop, led to a sharp decline in agriculture. Furthermore, there was a severe drought in 1992, which stalled reforms and further reduced GDP. In 1993 the government reduced agricultural subsidies, which resulted in increased pressure on the credit system, which eventually collapsed in 1994. The result was a significant shift away from maize production, towards higher value and more drought-resistant crops. In the context of other sectoral developments (including the downturn for copper mining), the share of agriculture in GDP has increased only marginally since the 1994 slump.

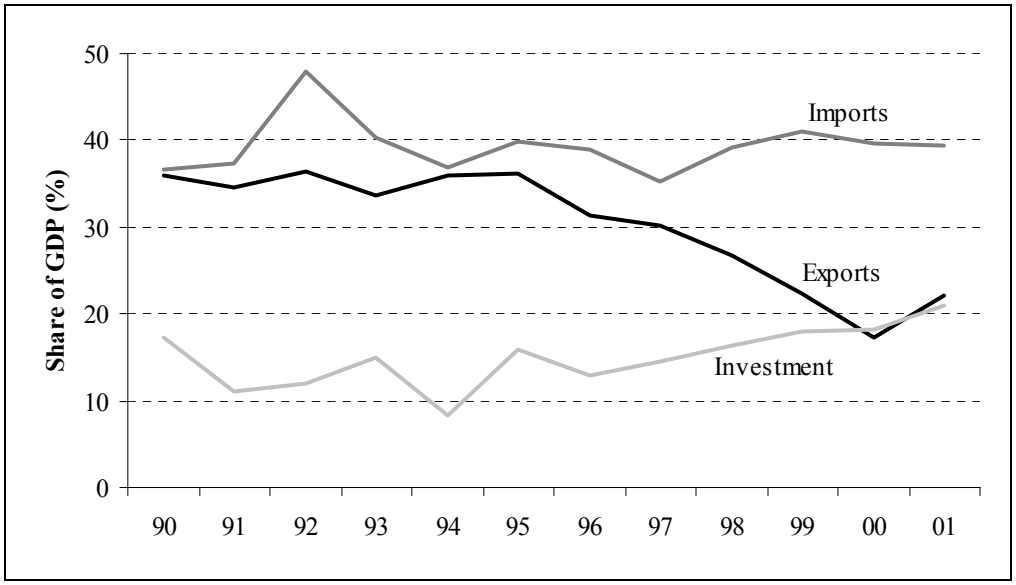
Although agricultural reform has had a marked effect on domestic production, the largest compositional shift has been between industry and services (Figure 4). During the 1970s and 1980s, capital-intensive manufacturing had been promoted through high tariff protection and an overvalued exchange rate. Furthermore, the country’s dependence on mining, and copper in particular, was most pronounced during this period. In 1992 the government initiated a comprehensive program of trade liberalization in an attempt to encourage competition and efficiency. Quantitative restrictions were converted into tariffs, and Zambia’s commitment to various multilateral trade agreements was

Figure 1. Inflation and the Nominal Exchange Rate



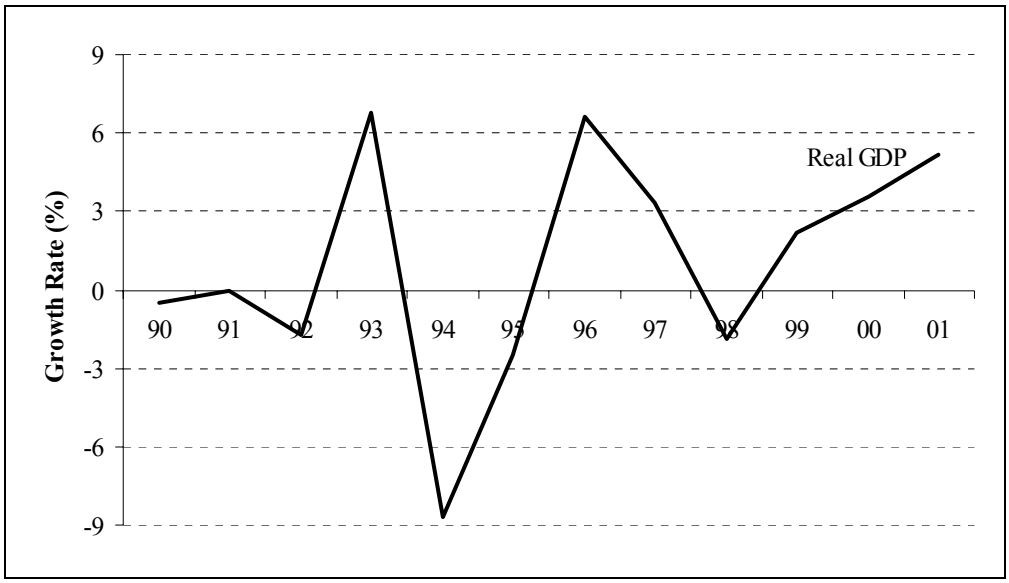
Source: World Bank's World Development Indicators (World Bank, 2002).

Figure 2. Imports, Exports and Investment (1990-2001)



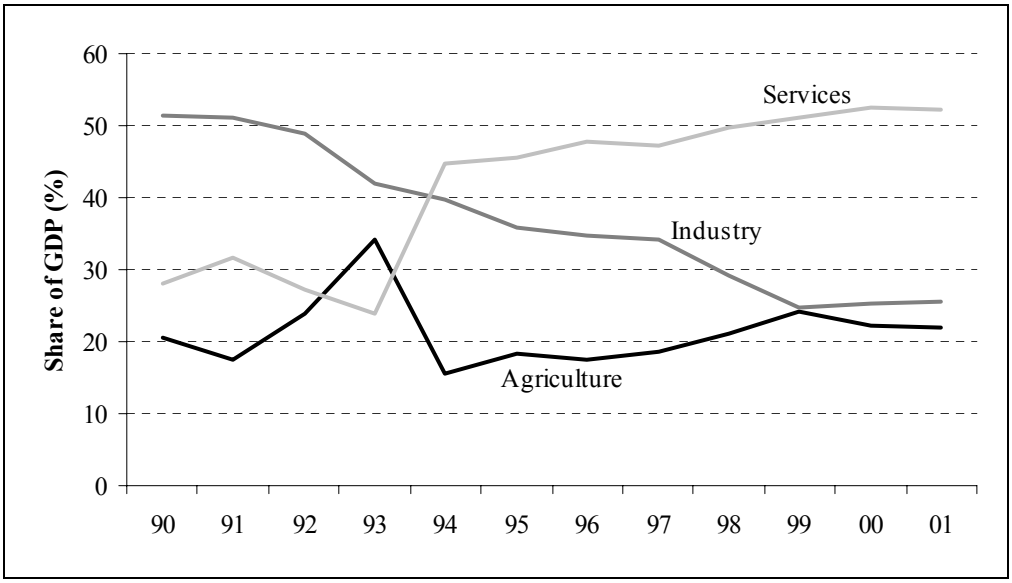
Source: World Bank's World Development Indicators (World Bank, 2002).

Figure 3. Real Gross Domestic Product (Market Prices) (1990-2001)



Source: World Bank's World Development Indicators (World Bank, 2002).

Figure 4. Value-added by Economic Sector (1990-2001)



Source: World Bank's World Development Indicators (World Bank, 2002)

strengthened. Imports rose temporarily in response to reduced tariffs and the newly unprotected manufacturing sector went into sharp decline. The level of exports was only maintained through continued devaluations of the exchange rate and the expansion of mining production.

After 1995 the world price of copper began a slow and prolonged decline. This trend eroded Zambia's ability to generate the foreign earnings needed to finance imports, and deepened the country's foreign indebtedness. Both mining and manufacturing, the major industrial sectors, declined rapidly over the decade (Figure 4). By contrast, the services sectors have grown slightly and, since the level of GDP has been growing very slowly, services' share of GDP has risen. Among the service sectors, growth has been particularly high for wholesale and retail trade.

Finally, Zambia initiated a far-reaching program of privatization. Between 1968 and 1976 the Zambian government created a large number of state enterprises, which by 1991 generated three-quarters of total GDP. Privatization began slowly in 1993 and picked up pace throughout the decade. Although the privatization of the state copper mines was initially politically opposed, the authorities finally agreed to sell the copper mines in 2000 following growing pressure from foreign donors. However, rapid declines in world copper prices in 2001 caused Anglo-American, the prospective buyer, to withdraw its offer to purchase the mines. As a result of Zambia's dependence on copper mining, both the falling world copper price and the possible withdrawal of investment from the mining sector may seriously threaten economic growth and stability in the coming decade.

The Current Development Strategy

Despite the far-reaching economic reforms that have been adopted over the last decade the Zambian economy has failed to achieve significant economic growth and reduction in poverty. Zambia has recently drawn up a Poverty Reduction Strategy Paper (PRSP) (Republic of Zambia, 2002). Although this document does not describe the country's macroeconomic strategy in full, it does provide the framework from which

broader economic strategies will be derived. This section looks both at broad macroeconomic issues and the more specific policies that have been highlighted in the PRSP.

Starting with macroeconomic policies, the government has identified the need to maintain economic stability through the reduction of inflation. Although there has been considerable progress in recent years in curbing the high levels of inflation experienced during the 1980s and early 1990s, the current objective is to further reduce inflation to around five percent.

One of the causes of high inflation has been the expansionary monetary policy adopted by the government to finance its budget deficit. Therefore a reduction in the deficit is seen as a prerequisite to reducing inflation and promoting economic stability. Such an environment is expected to attract both domestic investment (through lower interest rates) and foreign investment (by stabilizing the exchange rate and encouraging investor confidence).

Investment is one of the two cornerstones of the proposed development strategy (Republic of Zambia, 2002). Exchange rate instability, low national savings, expensive short-term working capital, and a lack of microfinance currently hamper investment spending. In response, the government hopes to encourage domestic capital markets through a number of financial reforms and the extension of micro-credit schemes. Furthermore, the government hopes to attract private investors through the privatization of state assets (most notably the copper mines). According to the plan, revenues from privatization and government savings (from a cut in subsidies to loss-making state enterprises) will be used to implement pro-poor development policies.

The most notable pro-poor policy shift is increased support of agriculture and rural development. Given the fall in world copper prices and the threatened contraction of mining, the agricultural and agro-processing sectors are seen as the main avenue for diversification (Lofgren *et al.*, 2002). The government intends to expand agricultural production by promoting greater land utilization and higher productivity. Currently, land

ownership in Zambia is relatively informal, discouraging small farmers from investing in productivity-enhancing technology or assets. Through established property rights, explicit land ownership, and micro-credit, the government hopes that agricultural investment, land utilization, and productivity will rise. Broader rural development will also be encouraged via improvements in the road network, both by improved maintenance of the existing network and by extending it in rural areas. Such infrastructure improvements are also expected to promote growth and productivity in the tourism sector, which was identified in the PRSP as having high growth potential. Increased accessibility to more remote areas should increase land utilization and encourage investment in agriculture and tourism. Investment in energy infrastructure is also seen as important in stimulating economic growth in Zambia, where energy prices are higher than elsewhere in the region. Greater productivity, both within agriculture and manufacturing, should improve Zambia's competitiveness in international markets.

Exports are seen as the second cornerstone of the country's development strategy (Republic of Zambia, 2002). However, judging from recent developments in world copper markets, export-led growth will need to originate from outside the copper mining sector. Through further trade liberalization and tax-incentives, the governments hopes that greater productivity and improved access to world markets will translate into greater exports from the non-mining sectors. Given the shortage of foreign exchange and the growing need for imported capital, the success of the country's poverty-reduction and development strategies are likely to rest on the performance of these export sectors, facilitated by an exchange rate policy that provides incentives for export growth.

The spread of HIV/AIDS is of great economic and social concern. The PRSP recognizes that this epidemic has contributed enormously to the prevailing poverty in the country by lowering worker productivity and causing the death of breadwinners. Furthermore, both the state and extended families are now responsible for large numbers of street children whose parents have been killed by HIV/AIDS. Addressing HIV/AIDS through increased health spending is therefore seen as a high priority. Both HIV/AIDS and limited government resources have contributed to the deterioration of the country's

education system. Since greater worker productivity is important for job-creation, poverty-reduction, and economic growth, the improvement of this system is seen as a key policy-objective.

In sum, Zambia's development strategy entails the promotion of investment and export-led growth. While recognizing the important role of mining, the PRSP has placed emphasis on agriculture, tourism, transport, and energy infrastructure for the productive sectors, as well as on education, health and HIV/AIDS spending.

This report first analyzes sectoral and welfare implications of Zambia's current growth path. Based on the country's stated development strategy, the report then assesses the impact of changes in the economic environment and the adoption of those government policies that are seen as critical for the country's development. Given that these interventions have repercussions that extend throughout the economy, the analysis is based on an economy-wide general equilibrium framework that is built around a database for Zambia with 2001 as its base year.

III. THE ZAMBIAN ECONOMY IN 2001

In light of persistent poverty and inequality in Zambia, the authorities have proposed a number of policies aimed at strengthening poverty-alleviation. The economy-wide impact of these policies forms the focus of this report, and are assessed using a computable general equilibrium (CGE) model for the country. This model is benchmarked or calibrated to a SAM for the year 2001 (Evans *et al.*, forthcoming) that summarizes the structure of the Zambian economy. Knowledge of how the Zambia economy is represented in the database is critical to understanding the results of the simulations to follow. This section is therefore concerned with describing the Zambian economy as reflected in the 2001 SAM.

Production and Trade

Table 1 shows the structure of production and trade in 2001.[1] Agriculture accounts for less than a quarter of GDP, which is well below the Sub-Saharan average of 32.8 percent.[2] While agricultural exports contribute only 9.1 percent to total export earnings, the export-intensities of the traditional and non-traditional agricultural sectors are high. For example, 76.6 percent of the total domestic production of traditional crops is exported. Although these sectors are relatively integrated with international markets, they account for only a small share of total Zambian agriculture. As such the overall export and import intensity of agriculture remains low.

Zambia's small agricultural sector and its low export-intensity are undoubtedly a result of the long-standing dominance of copper mining exports. Although total mining contributes only 9.1 percent to GDP it is the largest export commodity, with a vast

[1] 'Staples' include maize, groundnuts, wheat, vegetables, livestock, and other staples crops. 'Traditional' includes sugar, tobacco and coffee. 'Non-traditional' includes cotton and export horticulture (e.g. cut flowers). 'Other' agriculture includes fishing and forestry.

[2] Sub-Saharan average (which excludes South Africa) is taken from World Development Indicators (World Bank, 2003); Zambia data is taken from the Zambian provisional 2001 Social Accounting Matrix (Evans et al., 2003).

majority of these exports being copper.[3] The high export-intensity of 85 percent suggests that almost all of domestic mining production is exported. The domestic mining that remains in the country is largely comprised of gemstones, which are passed onto the manufacturing sector to be polished before being exported. Manufacturing dominates imports, accounting for over 85 percent of total imports in 2001. Most of these imports comprise capital goods used for investment.

Table 1. Production and Trade (2001)

Sector	Percentage Share of Total			Exports' Share in Output	Imports' Share in Demand
	GDP	Exports	Imports		
Agriculture	22.2	9.1	2.2	16.8	5.7
Staples	18.9	0.6	1.9	1.8	7.0
Traditional	1.3	5.2	0.0	76.6	0.0
Non-traditional	1.2	3.3	0.2	52.2	8.8
Other	0.9	0.0	0.0	0.0	0.0
Industry	25.7	85.8	86.0	28.1	46.3
Mining	9.1	53.3	0.7	85.0	15.1
Manufacturing	11.1	28.0	85.3	16.7	55.7
Other	5.5	4.5	0.0	7.1	0.0
Services	52.1	5.1	11.9	1.6	5.9
Private	41.9	5.1	11.9	2.1	7.4
Public	10.2	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	13.4	25.4

Source: Authors' calculations from the Zambian Social Accounting Matrix (SAM) for 2001.

Services form a large part of the economy and generate more than half of GDP. The government accounts for only a fifth of total services produced in the country. Education and health spending are the two largest components of the government budget, accounting for 18.9 and 14.2 percent of total government spending, respectively. Government spending on the agricultural, industrial, and transportation sectors is comparatively low at 4.1, 1.8 and 3.3 percent of the budget respectively. Private services are dominated by the trade and transportation, as well as by financial services and real estate sectors.

[3] Cobalt has recently become an important export, but since this commodity is a by-product of the copper mining process it is tied to the performance of copper exports.

Table 2. Distribution of Value-Added Across and Within Sectors, 2001

	Labor by Education Group				Capital by Sector			Land	Total
	None	Primary	Secondary	Post-secd (%)	Agri.	Mining	Non-agri.		
Factor value-added across sectors									
Agriculture	79.4	39.2	13.0	9.7	100.0	0.0	0.0	100.0	22.2
Staples	71.1	34.4	11.0	8.5	65.6	0.0	0.0	81.0	18.9
Traditional	2.9	1.6	0.7	0.4	15.0	0.0	0.0	11.9	1.3
Non-traditional	3.9	2.1	0.7	0.5	5.3	0.0	0.0	7.1	1.2
Other	1.5	1.1	0.5	0.4	14.1	0.0	0.0	0.0	0.9
Industry	8.9	15.6	14.5	14.0	0.0	100.0	29.1	0.0	25.7
Mining	0.1	1.0	1.2	0.6	0.0	100.0	3.7	0.0	9.1
Manufacturing	8.1	12.9	10.8	10.5	0.0	0.0	14.4	0.0	11.1
Other	0.8	1.8	2.4	2.9	0.0	0.0	11.0	0.0	5.5
Services	11.7	45.2	72.6	76.3	0.0	0.0	70.9	0.0	52.1
Private	9.8	39.2	49.6	39.3	0.0	0.0	62.5	0.0	41.9
Public	1.9	6.0	23.0	36.9	0.0	0.0	8.3	0.0	10.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Factor value-added within sectors									
Agriculture	45.1	26.0	5.2	4.1	14.5	0.0	0.0	5.1	100.0
Staples	47.6	26.9	5.2	4.2	11.2	0.0	0.0	4.9	100.0
Traditional	27.6	17.9	4.5	2.8	36.9	0.0	0.0	10.3	100.0
Non-traditional	42.4	26.6	5.5	3.8	14.7	0.0	0.0	7.0	100.0
Other	21.4	18.0	5.3	4.1	51.1	0.0	0.0	0.0	100.0
Industry	4.4	9.0	5.0	5.1	0.0	27.8	48.7	0.0	100.0
Mining	0.1	1.6	1.2	0.6	0.0	78.8	17.7	0.0	100.0
Manufacturing	9.3	17.2	8.7	8.8	0.0	0.0	56.0	0.0	100.0
Other	1.7	4.7	3.8	4.9	0.0	0.0	84.9	0.0	100.0
Services	2.8	12.8	12.4	13.6	0.0	0.0	58.4	0.0	100.0
Private	2.9	13.8	10.5	8.7	0.0	0.0	64.1	0.0	100.0
Public	2.4	8.7	20.1	33.7	0.0	0.0	35.1	0.0	100.0
Total	12.6	14.7	8.9	9.3	3.2	7.1	42.9	1.1	100.0

Source: Authors' calculations from the Zambian Social Accounting Matrix (SAM) for 2001.

Table 2 shows the distribution of factor incomes both across and within sectors. The agricultural sectors account for a majority of the value-added generated by lower-skilled labor. This is seen in the upper half of the table where agriculture's share of value-added for uneducated educated labor is 79.4 percent. Most of this agricultural labor is employed in staples production. According to the lower half of the table, this sector is most intensive in unskilled labor. Non-traditional crops are also intensive in unskilled labor, but this is largely due to cotton production. Traditional crops by contrast are the most capital intensive of the crop sectors.

The industrial sectors are the most capital intensive. In the case of mining, almost all value-added is generated by either the mineral resource or capital. The services sector is intensive in its use of both capital and higher-skilled labor.

Household Income and Expenditure

Table 3 shows the distribution of the population across different household categories. These categories are chosen based on geographical and poverty-related considerations. Although a majority of the population is still in rural areas, rural-urban migration has been rapid. High migration has been encouraged by the long-standing bias against agriculture created by a large mining sector and a protected manufacturing sector. Most of the rural population lives on small-scale farms, while most of the urban population is in households headed by low-skilled self-employed workers.

The interaction between factor incomes and household factor endowments determines household income. Rural households generate most of their income from returns to lower-skilled employment. The only exception to this is large-scale farms that are more dependent on high-skilled labor and capital. Medium-scale households are most dependent on primary-educated labor and land, while small-households rely on uneducated labor and land.

Urban households by contrast generate most of their income from higher-skilled labor and capital. Households headed by public employees are most dependent on labor incomes, while high-skilled self-employed households rely on capital income. Mining

resource returns are largely earned by households headed by public employees and high-skilled, self-employed workers.

Table 3. Population Distribution (2001)

Household Category	Population	Share of Total
Rural	6,507,407.0	62.6
Small-scale	5,724,640.0	55.0
Medium-scale	253,291.0	2.4
Large-scale	9,827.0	0.1
Non-farm	519,649.0	5.0
Urban	3,892,593.0	37.4
Self-employed low skill	1,713,648.0	16.5
Private employees	811,704.0	7.8
Public employees	1,264,103.0	12.2
Self-employed skilled and employers	103,138.0	1.0
Total	10,400,000	100.0

Source: World Bank Development Indicators for total population, and 1998 LCMS for household distribution.

Table 4. Household Consumption Patterns (2001)

	Share of Total Household Consumption Spending				
Household Category	**Agric. & Food**	**Manufactures**	**Utilities**	**Services**	**Total**
Rural	80.2	11.3	0.5	8.0	100.0
Small-scale	84.5	8.7	0.4	6.4	100.0
Medium-scale	67.7	18.8	0.5	13.0	100.0
Large-scale	48.5	26.3	3.6	21.7	100.0
Non-farm	69.9	18.5	0.8	10.9	100.0
Urban	48.5	20.6	4.5	26.5	100.0
Self-employed low skill	53.2	19.2	4.3	23.3	100.0
Private employees	48.9	21.3	3.5	26.3	100.0
Public employees	47.9	20.0	4.6	27.5	100.0
Self-employed skilled and employers	35.6	25.4	6.1	32.9	100.0
Total	59.3	17.4	3.1	20.2	100.0

Source: Authors' calculations from the Zambian Social Accounting Matrix (SAM) for 2001

Table 4 shows how household consumption patterns differ across household categories. Rural households spend more of their income on agricultural and food products than do urban households (with the exception of large-scale rural households). Spending shares for manufactured commodities are similar for urban and rural

households, although within rural areas it is the larger farms that spend most of their income on these commodities. Rural households consume fewer utilities as a share of their total spending as compared to urban households. Urban households have considerably higher consumption shares for services, although large-scale rural farm households also have a high spending share in this area.

Government and Rest of the World

In 2001 the government generated a majority of its revenue from personal taxes paid by higher-income urban households and from corporate taxes paid by non-agricultural enterprises. Combined current spending exceeded revenues, however, leading to a budget deficit of 3.6 percent of GDP (i.e., negative government savings).

On the current account (of the balance of payments), imports greatly exceeded exports in 2001. Despite some remittances received by households from the rest of the world, the current account balance was dominated by the trade deficit. The current account deficit in 2001 equaled 20.1 percent of GDP.

Summary

In its structure of production and trade, Zambia is typical of many Sub-Saharan countries. There is a strong reliance on the primary sector both in production and exports. A majority of import demand is for manufactured commodities, which are largely used for investment or intermediate demand. Services, which tend to be non-traded, are dominated by trade and transportation. Public services are also an important source of value-added in the economy.

The distinction between rural and urban households is strong. The former are more dependent on farm-labor and land income, while the latter receive a majority of the income from capital and higher-skilled labor. Rural households spend more of their income on agricultural and food products, while urban households consume more services.

For its revenue, the government is dependent on direct taxes. The cost of servicing the foreign debt forces the government to borrow abroad, thereby further raising the debt burden. The debt repayments also worsen the current account, which in 2001 was in substantial deficit.

Based on this information describing the Zambian economy, a CGE model is constructed to reflect the structure of the economy and the specific constraints it faces. A description of this model is presented in the next section.

IV. MODEL AND DATA

The dynamic Zambia model described below has developed from the neoclassical-structuralist modeling tradition originally presented in Dervis *et al.* (1982), and represents an extension of the standard static CGE model developed at the International Food Policy Research Institute as described in Lofgren *et al.* (2002). The model is formulated as a set of simultaneous linear and non-linear equations, which define the behavior of economic agents, as well as the economic environment in which these agents operate. This environment is described by market equilibrium conditions, macroeconomic balances, and dynamic updating equations.

The model belongs to the recursive dynamic strand of the dynamic CGE literature, which implies that the behavior of its agents is based on current and past conditions as opposed to future conditions (as is assumed in dynamic inter-temporal optimization models). The model is solved one period at a time and it is possible to separate the *within-period* component from the *between-period* component, where the latter captures the dynamics of the model. This section provides an overview of the model's structure.

Within-period Specification

The within-period component describes a one-period static CGE model. Following the disaggregation of the SAM to which the model is calibrated, the model identifies 30 productive sectors or activities that combine primary factors with intermediate commodities to produce output. The eight factors of production identified in the model include: (i) four types of labor distinguished according to maximum education attained (uneducated, primary, secondary, and post-secondary); (ii) three types of capital (agricultural, mining, and non-agricultural); and (iii) agricultural land. Producers make decisions in order to maximize profits with the choice between factors being governed by a constant elasticity of substitution (CES) production function. This specification allows producers to respond to changes in relative factor returns by smoothly substituting between available factors so as to derive a final value-added composite. Profit-

maximization implies that the factors receive income where marginal revenue equals marginal cost based on endogenous relative prices. Once determined, these factors are combined with fixed-share intermediates using a Leontief specification. The use of fixed-shares reflects the belief that the required combination of intermediates per unit of output, and the ratio of intermediates to value-added, is determined by technology rather than by the decision-making of producers. The final price of an activity's output is derived from the price of value-added and intermediates, together with any producer taxes or subsidies that may be imposed by the government per unit of output.

In addition to its multi-sector specification, the model also distinguishes between activities and the commodities that these activities produce. This distinction allows individual activities to produce more than a single commodity and conversely, for a single commodity to be produced by more than one activity. Fixed-shares govern the disaggregation of activity output into commodities since it is assumed that technology largely determines the production of secondary products. These commodities are supplied to the market.

Substitution possibilities exist between production for the domestic and the foreign markets. This decision of producers is governed by a constant elasticity of transformation (CET) function, which distinguishes between exported and domestic goods, and by doing so, captures any quality differences between the two products. Profit maximization drives producers to sell in those markets where they can achieve the highest returns. These returns are based on domestic and export prices (where the latter is determined by the world price times the exchange rate adjusted for any taxes or subsidies). Under the small-country assumption, Zambia is assumed to face a perfectly elastic world demand at a fixed world price. The final ratio of exports to domestic goods is determined by the endogenous interaction of relative prices for these two commodity types.

Domestically produced commodities that are not exported are supplied to the domestic market. Substitution possibilities exist between imported and domestic goods under a CES Armington specification. Such substitution can take place both in final and

intermediates usage. Again under the small country assumption, Zambia is assumed to face infinitely elastic world supply at fixed world prices. The final ratio of imports to domestic goods is determined by the cost minimizing decision-making of domestic demanders based on the relative prices of imports and domestic goods (both of which include relevant taxes).

Transaction costs are incurred when commodities are traded in markets. Demand for trade and transportation services is a fixed coefficient per unit sold. The coefficient is disaggregated by type of commodity and trade (export, import, or domestic sale). . The final composite good, containing a combination of imported and domestic goods, is supplied to both final and intermediate demand. Intermediate demand, as described above, is determined by Leontief technology and by the composition of sectoral production. Final demand is dependent on institutional incomes and the composition of aggregate demand.

The model distinguishes between various institutions within the Zambian economy, including enterprises (mining and non-mining), the government, and 11 types of households. The household categories are primarily distinguished according rural or urban areas. Rural households are further broken down into small-scale, medium-scale, large-scale farms, and non-farm households. Urban areas are disaggregated according to household head into low-skilled or high-skilled self-employed, and private or public employees.

The primary source of income for households and enterprises are factor returns generated during production. For each factor, the supply is fixed within a given time-period. Capital is immobile across sectors and fully employed, earning a flexible return that reflects its sector-specific scarcity value. The non-capital factors are mobile across sectors and fully-employed, with an economy-wide wage clearing each market. For the non-capital factors, each activity pays an activity-specific wage that is the product of this economy-wide wage and a fixed activity-specific wage distortion term. Final factor incomes also include remittances received from and paid to the rest of the world.

Households and enterprises earn factor incomes in proportion to the share that they control of each factor. Enterprises or firms are the sole recipient of non-agricultural capital income, which they transfer to households after having paid corporate taxes (based on fixed tax rates), saved (based on fixed savings rates), and remitted profits to the rest of the world. Households within each of the 11 representative groups are assumed to have identical preferences, and are therefore modeled as 'representative' consumers. In addition to factor returns, which represent the bulk of household incomes, households also receive transfers from the government, other domestic institutions, and the rest of the world. Household disposable income is net of personal income tax (based on fixed tax rates), savings (based on fixed savings rates), and remittances to the rest of the world. Consumer preferences are represented by a linear expenditure system (LES) of demand, which is derived from the maximization of a Stone-Geary utility function subject to a household budget constraint. Given prices and incomes, these demand functions define households' real consumption of each commodity. The LES specification allows for the identification of supernumerary household income that ensures a minimum level of consumption.

The government earns most of its income from direct and indirect taxes, and then spends it on consumption and transfers to households. Both of these payments are fixed in real terms. The difference between revenues and expenditures is the budget deficit, which is primarily financed through borrowing (or dis-saving) from the domestic capital market.

Savings by households and enterprises are collected into a savings pool from which investment is financed. This supply of loanable funds is diminished by government borrowing (or dis-saving) and augmented by capital inflows from the rest of the world. There is no explicit modeling of the investment decision or the financial sector within a particular time-period, but aggregate savings-investment equality is required. One possible mechanism through which this balance is achieved is via adjustment in the interest rate (which may affect savings and/or investment). The disaggregation of investment into demand for final commodities is done assuming a fixed bundle of

investment commodities with changes in aggregate investment leading to proportional increases in the demand for individual commodities.

Production is linked to demand through the generation of factor incomes and the payment of these incomes to domestic institutions, including households. Balance between demand and supply for both commodities and factors are necessary in order for the model to reach equilibrium. This balance is imposed on the model through a series of system constraints.

The model includes three broad macroeconomic accounts: the government balance, the current account, and the savings and investment account. In order to bring about balance in the macro accounts, it is necessary to specify a set of mechanisms or macro 'closure' rules.

For the government, consumption is fixed in real terms. For most simulations, all tax rates are also fixed, with savings (showing the difference between current revenue and current spending) clearing the government account.[4] For the current account of the balance of payments (the rest of the world account), a flexible exchange adjusts to maintain a fixed level of foreign savings. In other words the external balance is held fixed in foreign currency. Nominal investment is a fixed share of nominal absorption — other things being equal, real investment will respond positively (negatively) to decreases (increases) in the prices of investment commodities relative to other commodities. Adjustments in household savings rates assure that savings and investment values are equal (i.e., savings is driven by investment). Finally, the consumer price index was chosen as the numéraire.

Between-period, Dynamic Specification

The static model described above is extended to a recursive dynamic model. Selected parameters are updated based on the modeling of inter-temporal behavior and results from previous periods. Current economic conditions, such as the availability of

[4] In some of the simulations, government savings is fixed while all direct tax rates on households are scaled to generate the revenue required to generate this level of savings.

capital, are thus endogenously dependent on past outcomes. The dynamic model is also exogenously updated to reflect demographic and technological changes that are based on projected trends.

The process of capital accumulation is modeled endogenously, with previous-period investment generating new capital stock for the subsequent period. Although the allocation of new capital across sectors is influenced by each sector's initial share of aggregate capital income, the final sectoral allocation of capital in the current period is dependent on the capital depreciation rate and on sectoral profit-rate differentials from the previous period. Sectors with above-average capital returns receive a larger share of investible funds than their share in capital income. The converse is true for sectors where capital returns are below average.[5]

Population, labor force and productivity growth are exogenously imposed on the model based on separately calculated growth projections. It is assumed that a growing population generates a higher level of consumption demand and therefore raises the supernumerary income level of household consumption.

Projected changes in the current account balance are exogenously accounted for. Mining production is assumed to be predominantly driven by a combination of changes in world demand and prices, and other factors external to the model. Accordingly, the value-added growth of these sectors and the world price of exports are updated exogenously between periods.

The Zambian dynamic model is solved as a series of within-period equilibria, each one representing a single year. By imposing the above policy-independent dynamic adjustments, the model produces a projected or counterfactual growth path. Policy changes can then be expressed in terms of changes in relevant exogenous parameters and the model is re-solved for a new series of equilibria. For policy shifts that involve additional government spending, we increase real government consumption, thereby the main burden of these policies, the diversion of resources from private consumption and

[5] For more details see Dervis *et al*. (1982).

investment in non-government production. Differences between the policy-influenced growth path and that of the counterfactual can then be interpreted as the economy-wide impact of the simulated policy.

Database

The model database, which captures the structural features of the Zambian economy, consists of a SAM; base-year and projected values for labor force, population, government policies, foreign savings, foreign borrowing, interest payments on foreign debt, and factor productivity; and a set of elasticities (for trade, production and consumption).

The SAM was constructed using input-output data, including an earlier SAM (Hausner, 1999), as well as the database assembled by the World Bank for its 2001 RMSM of Zambia and the 1998 Living Standards Measurement Survey (LSMS) (Evans *et al.*, forthcoming).

Base-year data on the population of each household group and the labor force are from the 1998 LSMS. The population and labor force numbers were scaled to match 2001 totals extracted from other World Bank data (World Bank, 2003). The AIDS-adjusted growth rates from 2001 to 2015 for population and labor are from IMF (2003). The size of the capital stock was estimated on the basis of value-added and gross capital income data in the SAM, a depreciation rate of 4% (from the RMSM), and an assumed net profit rate of 25 percent.

The RMSM provided the data related to the foreign debt for the entire planning horizon: the base-year capital stock and, for each year during the planning horizon, interest payments actually paid and due, net foreign borrowing, and foreign grants.

The model is used to simulate the impact of policies and economic shocks on growth and poverty. Its structure supports analysis of trade-offs and synergies between different policies, the consequences of alternative financing mechanisms, and the extent to which foreign debt forgiveness can facilitate the task of reducing poverty.

V. SIMULATIONS

The Base Growth Path Simulation

The World Bank has used the Zambia RMSM to project a growth path for Zambia's economy for the period 2001-2015. In this section, the Zambian CGE model is used to determine the implications of this current or 'base' macro growth path for disaggregated growth, trade, welfare, and poverty. The dynamic or 'between-period' component of the model is calibrated to the RMSM in order to replicate the performance of key economic indicators. The indicators chosen to be important in calibrating the model and the values used in the base growth path are described below. This section then describes in detail the results of the base simulation.

Describing the Base Growth Path

Table 5 outlines the key assumptions used to determine the Base growth path. Population and labor force growth are taken from the IMF (2003) study on the impact of HIV/AIDS on the Zambian economy. The Base growth path therefore includes the projected effect of HIV/AIDS on the accumulation of human capital and overall mortality. All capital depreciates at four percent per year, which given the capital-output ratio, implies a net profit rate of around 20 percent.

Government expenditure comprises both consumption spending and transfers to domestic institutions. In the Base growth path, transfer spending grows at three percent per year in real terms. Drawing on RMSM data, real government consumption grows at three percent per year. In later simulations government consumption spending increases as new government policies are implemented. These include health spending for HIV/AIDS treatment, agriculture spending for agricultural investment, and transportation spending for improved rural infrastructure.

Based on projections from the World Bank, the current account deficit is expected to gradually decline over the coming decade at a rate of two percent per year. Furthermore, work presented in Chapter 7 of the World Bank CEM (Country Economic

Memorandum) for Zambia (World Bank, 2004) identified three possible scenarios for the copper export sector: a high, average, and low-case scenario. In the Base growth path, it is assumed that the average-case scenario is realized and that output and world prices decline at annual rates of one and two percent, respectively. Alternative assumptions regarding the copper mining sector are explored later and are contrasted to this Base assumption.

Table 5. Base Simulation Assumptions

Item	Annual growth rate (%)	Source
Real gross domestic product (GDP) growth	4.1	RMSM
Population growth	2.0	RMSM & IMF (2003)
Labor force growth		
Uneducated	2.0	IMF (2003)
Primary educated	2.0	IMF (2003)
Secondary educated	1.7	IMF (2003)
Post-secondary educated	1.7	IMF (2003)
Capital depreciation rate	4.0	RMSM
Total factor productivity growth	2.3	Endogenous
Government spending		
Consumption	3.0	RMSM
Transfers	3.0	Assumed
Foreign inflows (foreign savings)*	2.0	RMSM
Interest rate on foreign debt		
Due	2.8	RMSM
Paid	1.1	RMSM
Copper mining sector		
Output growth	-1.0	World Bank (2004)
World export price growth	-2.0	World Bank (2004)

**In the base year, foreign savings (the current account deficit) represented 20.1 percent of GDP.*

Interest payments due on government debt correspond to an annual rate of 2.8 percent. However, in the past, the government has paid interest at a rate of only 1.1 percent. This influences foreign debt growth, as any shortfall in interest payments is added to the debt in the following year, with implications for future interest payments. The effect of reducing annual debt and interest payments through HIPC debt relief are explored in this paper.

Finally, the economy-wide total factor productivity (TFP) growth rate is adjusted in order to match the GDP growth rate of the RMSM, 4.1 percent. To attain this rate of GDP growth, an annual TFP growth of 2.3 percent is required. As shown in Chapter 2 of the CEM (World Bank, 2004), while this TFP growth rate is attainable if recent upward trends in TFP growth persist, it is higher than the growth rates achieved over the last decade.

Results for the Base Scenario

The macroeconomic results for the Base scenario are summarized in the second column of Table 6. Real annual GDP growth of 4.1 percent matches the projected growth rate from the RMSM. The slow decline in copper production and world copper prices causes export earnings to decline, other things being equal requiring more rapid export growth and/or slower import growth. As a result, the growth in total absorption (the sum of private consumption, government consumption, and investment) falls short of GDP growth by around one percent. The growth rates for private consumption and investment are close to the exogenous growth rate for government consumption, three percent. The depreciation of the real exchange rate suggests that the projected growth in foreign inflows or borrowing is insufficient to relieve the pressure on the current account. The real exchange rate therefore responds to this pressure by depreciating in order to encourage exports and reduce imports. The growth of real investment, which is the most import-intensive GDP component, is slowed down by the depreciation of the exchange rate.

At a sectoral level, mining production is stagnant while mining exports decline (second column of Table 7). Following the depreciation however there is a shift in production towards those sectors that are either relatively strong exporters (including manufacturing) or sectors with a high but underutilized propensity to export (including agriculture). Accordingly, there is rapid export growth within the traditional and non-traditional agricultural sectors and an overall strong growth in the agricultural sector.

Table 6. Macroeconomic and Poverty Results, 2001-2015

	Initial value (2001)	Base growth path	Copper: high road	Copper: low road	HIPC: debt relief	AIDS: costless treatment	AIDS: publicly financed	AIDS: balanced budget	AIDS: HIPC funded
Real gross domestic product	**(Mn Kwacha)**			**Annual percentage growth rate (2001-2015)**					
GDP (factor cost)	11,843	4.1	4.3	3.9	4.1	5.0	4.6	4.6	4.3
Private consumption	10,659	3.2	4.3	2.9	3.3	4.1	3.1	3.1	2.8
Investment	2,604	2.6	4.0	2.3	2.7	3.3	2.9	2.9	2.8
Government consumption	1,689	3.0	3.0	3.0	3.0	3.0	6.0	6.0	6.0
Exports	3,708	5.8	4.5	5.4	5.7	6.8	6.2	6.2	5.7
Imports	-6,025	3.0	4.0	2.8	3.1	3.8	3.4	3.3	3.2
Real exchange rate		0.9	0.4	1.0	0.9	0.9	0.9	0.9	0.9
Growth decomposition				**Percentage contribution to GDP growth rate**					
Factor accumulation		1.8	2.1	1.6	1.9	2.2	2.0	2.1	1.9
Labor		0.9	0.9	0.9	0.9	1.2	1.0	1.0	0.9
Capital		1.0	1.2	0.7	1.0	1.0	1.0	1.0	1.0
Land		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TFP growth		2.3	2.2	2.4	2.3	2.8	2.5	2.5	2.3
Real GDP growth		4.1	4.3	3.9	4.1	5.0	4.6	4.6	4.3
Poverty headcount	**(%)**			**Final percentage poverty headcount (2015)**					
Rural	63.2	55.0	53.9	55.0	54.9	55.2	56.0	55.9	55.9
Small-scale	65.5	57.0	56.0	57.0	57.0	57.2	58.0	58.0	58.0
Medium-scale	45.4	36.7	35.7	36.7	36.2	36.7	37.7	37.2	37.4
Large-scale	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Non-farm	48.5	43.0	41.1	43.1	42.5	43.0	44.0	43.5	43.5
Urban	43.4	38.9	34.9	39.9	38.6	39.0	39.5	39.2	39.3
Total	**55.8**	**49.0**	**46.8**	**49.3**	**48.8**	**49.1**	**49.8**	**49.6**	**49.7**

Table 7. Consumption, Production and Trade Results, 2001-2015

	Initial value (2001)	Base growth path	Copper: high road	Copper: low road	HIPC: debt relief	AIDS: costless treatment	AIDS: publicly financed	AIDS: balanced budget	AIDS: HIPC funded
Real per-capita consumption	**(Th Kwacha)**			**Annual percentage growth rate (2001-2015)**					
Rural	550	1.9	2.2	1.8	2.0	2.0	1.4	1.7	1.4
Small-scale	470	2.0	2.2	1.9	2.1	2.1	1.5	1.8	1.5
Medium-scale	1,010	1.9	2.2	1.9	2.0	2.0	1.4	1.7	1.4
Large-scale	12,080	1.6	2.2	1.4	1.7	1.6	1.5	1.2	1.7
Non-farm	900	1.2	1.8	1.1	1.3	1.3	0.6	1.0	0.7
Urban	1,770	1.0	2.6	0.6	1.1	1.0	0.5	0.3	0.5
Low-skill self-employed	1,430	1.2	1.8	1.0	1.3	1.4	0.6	0.7	0.6
Private employee	1,500	1.1	2.8	0.8	1.2	1.0	0.7	0.2	0.8
Public employee	1,890	1.0	2.9	0.6	1.1	0.9	0.6	0.4	0.7
High-skill employer	8,070	0.2	3.5	-0.6	0.3	0.2	-0.6	-1.5	-0.5
All households	1,000	1.3	2.4	1.1	1.4	1.4	0.8	0.8	0.8
Real gross domestic product	**(Mn Kwacha)**			**Annual percentage growth rate (2001-2015)**					
Agriculture	2,634	4.6	4.4	4.6	4.6	5.9	5.0	5.1	4.5
Staples	2,236	3.8	4.1	3.7	3.8	4.8	3.8	4.0	3.5
Traditional	155	6.2	4.3	6.7	6.0	7.2	7.0	6.9	6.5
Non-traditional	137	10.9	7.5	11.6	10.6	13.8	13.0	12.8	11.6
Other	106	4.7	4.6	4.7	4.7	5.6	4.8	4.9	4.6
Industry	3,039	3.7	4.0	3.1	3.7	4.3	3.9	3.9	3.7
Mining	1,072	0.0	1.4	-3.9	0.0	0.1	0.0	0.0	0.0
Manufacturing	1,310	5.3	5.0	5.4	5.3	6.1	5.5	5.5	5.2
Other	657	4.8	5.0	4.8	4.8	5.4	5.1	5.1	4.9
Services	6,170	3.9	4.3	3.8	4.0	4.7	4.5	4.5	4.3
Private	4,966	4.1	4.5	4.0	4.2	5.0	4.4	4.3	4.1
Public	1,204	3.0	3.5	2.9	3.1	3.4	5.1	5.1	5.0
Total	***11,843***	***4.0***	***4.2***	***3.8***	***4.1***	***4.9***	***4.5***	***4.5***	***4.2***

Table 7 cont. Consumption, Production and Trade Results, 2001-2015

	Initial value (2001)	Base growth path	Copper: high road	Copper: low road	HIPC: debt relief	AIDS: costless treatment	AIDS: publicly financed	AIDS: balanced budget	AIDS: HIPC funded
Exports	**(Th Kwacha)**			**Annual percentage growth rate (2001-2015)**					
Agriculture	337	9.5	6.1	10.3	9.2	12.0	11.5	11.2	10.3
Staples	23	4.9	3.4	5.2	4.8	6.1	5.4	5.4	4.9
Traditional	194	6.4	4.0	7.0	6.2	7.3	7.4	7.2	6.9
Non-traditional	121	13.2	8.9	14.0	12.8	16.5	15.7	15.4	14.1
Other	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industry	3,180	5.0	4.1	4.3	4.9	5.5	5.0	5.1	4.8
Mining	1,975	-1.3	0.7	-7.7	-1.3	-1.3	-1.3	-1.3	-1.3
Manufacturing	1,039	10.0	7.7	10.7	9.9	10.8	10.1	10.1	9.7
Other	166	8.3	7.4	8.6	8.3	8.6	8.2	8.3	8.2
Services	191	6.7	5.2	7.2	6.6	7.9	6.8	6.8	6.2
Private	191	6.7	5.2	7.2	6.6	7.9	6.8	6.8	6.2
Public	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	***3,708***	***5.6***	***4.4***	***5.3***	***5.6***	***6.5***	***6.0***	***6.0***	***5.6***
Imports	**(Mn Kwacha)**			**Annual percentage growth rate (2001-2015)**					
Agriculture	130	2.1	3.9	1.8	2.2	2.7	1.7	1.7	1.6
Staples	115	2.2	4.1	1.9	2.4	2.9	1.9	1.9	1.8
Traditional	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-traditional	14	1.1	2.7	0.9	1.3	1.0	0.2	0.3	0.4
Other	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industry	5,179	3.0	3.9	2.7	3.1	3.7	3.3	3.3	3.1
Mining	41	7.0	6.5	7.0	7.1	8.0	7.4	7.5	7.2
Manufacturing	5,138	2.9	3.9	2.6	3.0	3.7	3.2	3.2	3.0
Other	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services	716	3.4	4.1	3.2	3.5	4.2	3.7	3.7	3.5
Private	716	3.4	4.1	3.2	3.5	4.2	3.7	3.7	3.5
Public	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	***6,025***	***3.0***	***4.0***	***2.7***	***3.1***	***3.8***	***3.3***	***3.3***	***3.1***

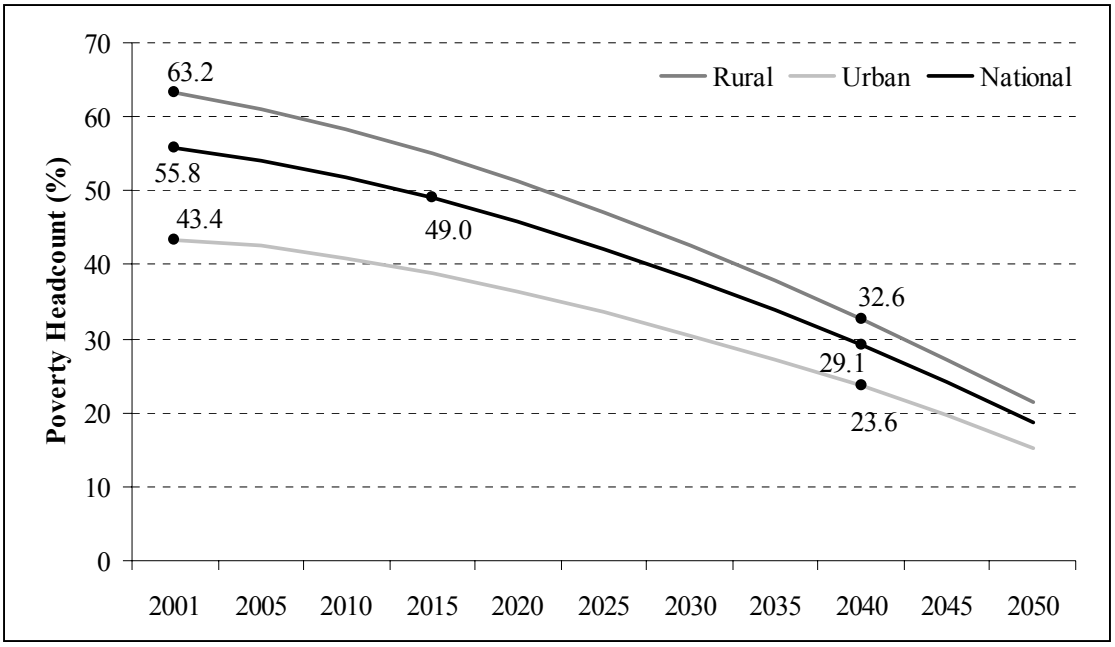
Growth in household consumption exceeds population growth, permitting per-capita consumption to increase. The growth pattern is pro-rural: per-capita consumption grows more rapidly for rural households than for their urban counterparts. Accordingly, rural households have the greatest declines in poverty, as measured by the poverty headcount rate. Rural poverty declines by over eight percentage points, as compared to only 4.5 percentage points for urban households. Within rural areas, it is small and medium-scale households that benefit the most. This result arises from the gradual shift towards agricultural export production. At the crop level, it is small-scale-intensive cotton and medium-scale-intensive horticulture that grow fastest. Both sectors grow in excess of ten percent per year, a rate that is consistent with recent trends in these crops. However, the model does not disaggregate poverty spatially. This may be important given that cotton and horticultural production currently take place in the Eastern, Central and Lusaka regions where access to markets is better.[6] Accordingly, the reduction in poverty is unlikely to extend to more remote rural households.

Figure 5 shows the long-run effects of the Base growth path on poverty-reduction. The results suggest that Zambia will be unable to meet the Millennium Development Goal (MDG) of halving poverty by 2015. Rather, poverty will only decline moderately, from 55.9 percent to 49 percent. A model simulation that was extended further into the future suggests that Zambia will not be able to halve poverty until after 2040. In extending this finding, Thurlow (2004) estimates that a sectorally balanced GDP growth rate of between 10.5 and 11 percent per year is necessary in order to achieve the MDG. These findings are broadly consistent with McCulloch *et al.* (2002), who estimate the necessary GDP growth rate to be between seven and nine percent.[7]

[6] See Chapter 5 of the CEM for a detailed account of agricultural production in Zambia (World bank, 2004).

[7] McCulloch *et al* (2000) base their estimate on growth-poverty elasticities calculated from the 1991, 1996 and 1998 household surveys. The estimated necessary growth rate varies according to assumptions regarding the initial and later fixed distribution of consumption across households.

Figure 5. Long-run Poverty Reduction under the Base Scenario (2001-2050)



Despite average per-capita consumption rising by 1.3 percent per year, the Base growth path does not suggest that Zambia will be able to reduce poverty sufficiently over the coming decade to satisfy its ambitious poverty-reduction goals. Accordingly, the government needs to search for additional policies that can bring about more rapid growth and/or direct the gains from growth more effectively toward the poor. However, such policies would have to be implemented in an environment where a number of external factors continue to force the economy through a process of structural adjustment. Perhaps the most important of these external forces are the recent and ongoing developments in the copper mining sector, and the worsening onslaught of HIV/AIDS.

Copper Sector Simulations

Copper dominates mining, which in turn is one of the country's most important sectors. The sector has recently been afflicted by a decline in export prices by almost 50

percent since the 1995 peak.[8] Furthermore, copper mining in Zambia has been jeopardized by the threatened withdrawal of investment by the Anglo-American mining company, which might well result in the closing of some of the copper mines (Craig, 2002; World Bank, 2002). Zambia's PRSP identifies the collapse of the copper mining sector as posing the most immediate and significant risk to poverty reduction (Republic of Zambia, 2002).

The copper mining simulations presented in this section draw on predictions outlined in Chapter 7 of the CEM (WB, 2004). Three potential scenarios were described in detail and have been incorporated into the model. As mentioned earlier, the Average-case scenario, in which exogenous output and price changes are imposed on the copper mining sector, has already been assumed for the Base scenario. In this section, the two remaining scenarios are compared to the Base scenario. The assumed annual output and price changes for the three scenarios are presented in Table 8 and are described in detail in the Appendix.

Under the Average-case scenario, world copper prices would continue their decline from their current rate of US$1.16 per pound to US$1.07 in 2005. This implies an annual fall in copper prices of two percent. In the Base scenario, this decline was assumed to continue across the 15 years of the study. Furthermore, it was predicted that output is likely to decline by 100,000 tons during the period of consolidation leading up to 2006. This loss would then be regained in the years until 2010, when output would fall again by 40,000. This implies an annual decline in output over the coming decade of one percent.

In the High-case scenario, prices are expected to rebound slightly to US$1.18 in 2006. An annual growth rate of 0.5 percent is therefore applied across the 2001-2015 period. Output is expected to increase by 100,000 tons by 2007/08, and the again by 150,000 tons in 2010 as new mines open. Mining output is therefore expected to rise at an average annual rate of 4.3 percent over the 15-year period.

[8] For an analysis see Lofgren *et al* (2002).

Table 8. Output and World Price Changes for the Copper Mining Sector (2001-2015)

	Annual Percentage Change (2001-2015)		
	High-case scenario	**Average-case scenario (Base assumption)**	**Low-case scenario**
World copper export price	0.5	-2.0	-5.0
Copper mining output	4.3	-1.0	-5.0

Source: Authors' calculations based on Chapter 7 of the CEM (WB, 2004).

Finally, in the Low-case scenario, mining output is expected to decline first by 100,000 tons until 2006/07 before rebounding by the same amount in 2009. However, unlike the High-case scenario, the Low-case scenario assumes that the additional investment necessary to open the new mines in 2010 will not be forthcoming. Mining output is expected to decline sharply by 150,000 in that year. Furthermore, world prices are expected to continue their sharp declines of the late 1990s, with the price dropping to US$0.95 in 2006. Both output and world prices are therefore expected to decline at an annual rate of five percent. This is imposed for the entire 15-year period.

High-case Copper Scenario

Under the Base scenario the decline in world copper prices and domestic output results in falling export earnings, which in turn places pressure on the current account. Since no additional foreign borrowing is assumed to take place, the real exchange rate depreciates, encouraging exports and reducing imports. However, falling mining output erodes urban incomes, a development that is only partially offset by expanded manufacturing resulting from the depreciated exchange rate. Rather, the rural areas benefit from greater international competitiveness for agricultural exports. In this way, the failing mining sector contributes to faster declines in rural poverty than urban poverty.

Under the High-case scenario, however, the contraction of the mining sector is replaced with a rapid expansion that is coupled with a gradual rise in copper export prices. As seen in the third column of Table 7, mining exports reverse their decline and

begin to grow, albeit at the relatively slow rate of 0.7 percent per year. This growth in exports relieves some of the pressure placed on the current account under the Base scenario, resulting in a slower depreciation of the real exchange rate. Accordingly, while mining exports grow faster than under the Base scenario, all other export growth rates decline. The incentive to diversify production and exports away from the mining sector has been partially removed. By contrast, the lower depreciation of the exchange rate lowers the import price relative to the Base scenario. Since investment demand is highly import intensive it grows faster under the High-case scenario. Higher investment compensates for slower export growth and result in a GDP growth rate that is slightly higher than that of the Base scenario.

All households are better off under the High-case scenario, as reflected in more rapid private consumption growth (Table 7) and the lower poverty headcounts (Table 6). Urban households benefit the most from the improved copper mining performance, since these households (in this case high-skilled employer households) are the main recipients of mining income.

Low-case Copper Scenario

In contrast to the previous simulation, the Low-case simulation presents a worst-case scenario for the copper mining sector. Both output and world prices fall rapidly resulting in pressure being placed on the current account. This terms-of-trade shock requires a smaller trade deficit in non-mining products, with a negative impact on absorption. The real exchange rate depreciates in order to offset the fall in export earnings by encouraging production of tradables while discouraging their consumption locally, thereby raising exports, and reducing imports. The sectors that respond the greatest are the agricultural sectors, which have the highest export-intensities. Within agriculture it is the traditional and non-traditional crops sectors that grow the fastest.

Depreciation also raises the price of imported capital equipment and vehicles, which form the bulk of fixed investment demand. Accordingly, investment growth

declines slightly more strongly than private consumption, with a negative impact on the GDP growth rate.

For the households, the slow down in consumption growth relative to the base is limited to urban households and relatively well-off rural households. Even though the overall poverty headcount rises compared to the Base scenario, rural households actually experience a slight decline in their poverty headcount (although this is not evident from the table) while the urban rate increases by one percentage point. As shown in Table 7, the cushioning of rural poverty is driven by growth in the agricultural sectors' exports as a result of the more heavily depreciated real exchange rate.

The results from the Base and copper mining scenarios suggest that, while falling copper output and prices have a negative impact on economic growth, a further collapse of the copper mining sector does not greatly affect rural households. The recent and ongoing developments in the copper sector and its threatened closure might actually result in a pro-poor contraction of the economy relative to the Base scenario.[9]

One way for the government to avoid the declines in the GDP growth rate experienced under the Low- and Average-case scenarios is to increase foreign borrowing in order to supplement falling export earnings. However, such a move would bring about a slower depreciation of the real exchange rate and thereby dilute any incentives for the country to diversify production of tradables and exports away from mining. Given the long-standing dependence of the country on copper mining, and the need to overcome the vulnerability caused by threatened closures of mines and price falls, the government should be hesitant to drastically alter this restructuring process.

HIPC Debt Forgiveness Simulation

As already mentioned, Zambia is heavily burdened by debt. Much of this debt was accumulated during the late 1970s when world copper prices fell and the government borrowed to alleviate what was seen as only a temporary terms-of-trade shock. Unfortunately the shock was not temporary and foreign debt has continued to increase,

[9] See Baulch and McCullouch (2000) and Ravallion (2003) for alternative definitions of pro-poor growth.

accelerating during the 1990s. The servicing of this debt, which exceeds 150 percent of total export earnings, has become a substantial burden for the country and limits its ability to reduce poverty and improve living standards.

Given that foreign exchange expenditure continues to exceed revenues, the government has not been able to pay back the debt. The RMSM estimates the annual interest rate due on the debt at 2.8 percent, but the government is estimated to pay only one percent. As such, the debt increases further at a rate equal to this interest differential. In 2000, Zambia was selected as one of the HIPC countries. On this basis and starting from 2002, Zambia is entitled to debt relief that, in the absence of other changes, would lower the total external debt by 69 percent in 2003 (Bigsten *et al*, 2001; WTO, 2002).

The following simulations assume that the actual impact of debt forgiveness is not the full interest due annually, but rather the interest that the government has effectively been paying in recent years. Apart from this debt reduction, the Base scenario remains unchanged, implicitly assuming that Zambia is meeting the different conditions of the debt-relief program, including implementation of (including allocation of additional resources to) the country's poverty-reduction strategy, and progress in fighting HIV/AIDS and educational reforms (Bigsten *et al.*, 2001).[10]

The direct effect of debt reduction is reduced government debt servicing, thus limiting the tendency of the real exchange rate to depreciate. This raises government savings, investment growth, and growth in the capital stock. However, the final effects are very limited. As shown in column four of Table 6, investment grows more rapidly, raising import demand (a large share of capital goods are imported) and counteracting the tendency toward appreciation. Marginally higher capital stock growth permits real GDP and household consumption to grow more quickly.

All households are slightly better off following debt relief since they enjoy higher income and consumption levels resulting from higher GDP growth. Ultimately, the

[10] These programs are the focus of the simulations in the next section of this paper. It is also assumed that that the program does not suffer from corruption and other problems surrounding the debt relief of the early 1990s. (For a review of these issues, see Copestake and Weston 2000). See the appendix.

impact of debt relief is positive but relatively small, implying that debt relief has a very limited impact on poverty unless accompanied by additional and effective measures aimed at poverty reduction.

Pro-Poor Policies for Poverty Reduction

The scenarios in the previous sections considered the impact of changes in conditions that are largely outside of government control. By contrast, the scenarios in the following sections analyze the impact of policy actions that the government might implement over the coming decade.

Four focus areas for policy changes are considered, including (i) increased HIV/AIDS health spending; (ii) the public provision of education; (iii) measures that accelerate agricultural growth; (iv) public investment in transport infrastructure. The HIV/AIDS and education scenarios address two problems that are seen as most pressing for Zambia in terms of their effects on human development (Republic of Zambia, 2002). Finally, accelerating agricultural growth and investment in transport infrastructure are complementary components of Zambia's rural development strategy.

For most of these policy changes, the actions that are considered generate significant changes in the balance between government spending and revenues, with consequences for domestic government borrowing and other components of absorption. To explore the impact of this repercussion, some of the following simulations are implemented both with and without complementary changes in direct tax rates. This additional tax revenue from mainly urban households is sufficient to keep the government's domestic borrowing in each year at the same level as under the Base scenario. Furthermore, given that the results of the HIPC scenario suggest that debt relief on its own is not likely to greatly influence poverty, many of the following sections present simulations in which the government funds that are saved through the HIPC agreement are used to implement pro-poor policies.

HIV/AIDS Simulations

HIV/AIDS is a rapidly growing problem for Zambia. Prevalence rates already exceed 20 percent of the adult population (Republic of Zambia, 2002). According to Cheru (2000), the virus has become the greatest present threat to development, reversing past achievements in generating economic growth, improving life expectancy, and decreasing child malnutrition.

In light of this current crisis, the government of Zambia may have little choice but to expand its current level of AIDS-related health spending. However, according to IMF (2003), the cost of the drugs necessary to combat the epidemic is prohibitively high. Estimates from other countries on the costs per patient of providing basic treatment range between 100 and 400 percent of GDP per capita. Furthermore, while there is some scope for private sector involvement, it seems likely that a majority of domestic health spending will originate from within the public sector. In its PRSP, the government has outlined a series of actions to be taken in response to this growing threat, including educational programs, community-based home care, and measures targeted at orphans and vulnerable children (IMF, 2003).

The main channels through which HIV/AIDS is assumed to influence the real economy are through the growth rates of the population, labor force, and total factor productivity (TFP). IMF (2003) has conducted a study in which they estimate growth rates both with and without HIV/AIDS. In the Base scenario it was assumed that HIV/AIDS is a reality in Zambia and as such should be included within the Base assumptions. However, in order to gauge the extent to which HIV/AIDS has reduced GDP growth and increased poverty, the AIDS treatment scenarios increase population, labor force and TFP growth rates towards the levels that the IMF (2003) estimate would have prevailed in the absence of HIV/AIDS. The assumed changes in these growth rates are presented in Table 9 and are discussed in detail in the appendix.

Population growth in particular would be significantly higher were it not for the high mortality caused by HIV/AIDS. Mortality is also captured through a decline in labor

force growth rates, which is assumed to more greatly affect lower-skilled workers. Morbidity is captured through declines in the TFP growth rate. Beyond mortality and morbidity, the declines in labor force and TFP capture decreased work hours and increased care giving for non-sick workers. No adjustment is made however for changes in household consumption patterns to account for increased health spending. Higher dependency ratios are implicitly captured in the model since the population growth rate exceeds the labor force growth rate by a higher percentage than under the AIDS treatment scenarios.

Table 9. HIV/AIDS Scenario Assumptions for Productivity, Population and Labor (%)

Assumption	Base scenario (annual growth rate)	AIDS treatment scenarios (annual growth rate)
Total factor productivity (TFP)	2.3	2.8
Population	2.0	3.3
Labor force		
Uneducated	2.0	3.3
Primary	2.0	3.3
Secondary	1.7	2.5
Post-secondary	1.7	2.5

Source: Base scenario population from RMSM, labor force from IMF (2003), and TFP from Zambia model. AIDS scenarios from IMF (2003).

Costless Treatment Scenario

In light of the objectives stated in the PRSP, the first AIDS scenario ('costless treatment') assesses the impact of removing the effects of AIDS without requiring the government to increase its level of health spending. Column 6 of Tables 6 and 7 presents the results.

Increased factor growth rates and TFP allow production to increase, thus raising the level of GDP. In the absence of HIV/AIDS the Zambian economy would have grown annually at five percent. Comparing this to the Base scenario suggests that HIV/AIDS costs the Zambian economy almost one percent in GDP growth per year. At the sectoral

level, growth accelerates the most for agriculture, i.e. the part of the economy that is relatively intensive in labor with little or no education.

The benefits of more rapid growth are dispersed over a larger population. In terms of per-capita consumption, the removal of AIDS has little impact, with minimal changes in per-capita consumption, overall and for the different groups, and a very small increase in the total poverty headcount rate. In reality there is likely to be some differences in infection rates across rural and urban areas with implications for the distribution of gains across rural and urban areas. However, this information was not available for this study. With the exception of South Africa, where rural infection rates are highest, other countries in the region (e.g. Tanzania) have lower infection rates in rural areas.

Public Financed Treatment Scenario

The above simulation suggested that GDP growth would increase by one percentage point per year if AIDS were not a reality in Zambia. However, the economic impact of treating the disease may be very different. The cost of funding an AIDS treatment program remains very high in spite of declines in recent years. For example, the estimated annual cost of anti-retroviral treatment for a single patient is around US$360 in Zambia. This is higher than in Malawi where AIDS treatment is cheapest at US$288 per person.

Given the high cost of treatment, the following simulations do not assume that the government will be able to afford to treat the entire infected adult population. Rather, we will assume that only half of the infected population is treated, with the government bearing the full cost of this program. This amounts to the treatment of 650,000 people at a total cost of 7.1 percent of GDP in 2001. Such a large increase in spending increases total government expenditure by 50 percent in 2001, thus more than tripling current government health spending. In the model, this is reflected in increased government consumption. It is assumed that the additional health spending will have to continue throughout the 2002-2015 period. Since only 50 percent of the infected population is

being treated, the acceleration in population, labor force and TFP growth is only half of what is shown in Table 9.

The impact of both the partial alleviation of AIDS and the increase in government health spending is shown in column 7 of Tables 6 and 7. Although the increases in the labor force and TFP have a positive effect on GDP growth, the cost of the treatment program greatly outweighs these gains. Government consumption growth increases considerably from three percent in the Base scenario to six percent in the Publicly Financed scenario. The rate of real investment growth increases, but by less than GDP growth while household consumption stagnates.[11] However, the increased economic growth caused by a greater supply of productive factor resources, leads to an accelerated investment growth rate of 2.9 percent. Rising investment demand increases import demand, with exports rising alongside GDP.

On the sectoral level, the growth acceleration is spread across the three main sectors. Agriculture grows faster under the current scenario, although this growth is concentrated in the export agriculture crops. Manufacturing and services sectors benefit from the increases in investment demand and government consumption.

The burden of publicly financed AIDS treatment is evident in the declines in annual per-capita consumption growth, by around a half percent for most household groups. Similarly, poverty increases moderately, by slightly less than one percentage point. The results for this scenario show that if government consumption is increased as required while investment is protected (in terms of its absorption share), cuts in private consumption are necessary. These losses should be compared to the gains of treatment in the form of increased longevity and healthier lives for those treated.

[11] The distribution of growth between household consumption and investment is influenced by the macro closure rule that investment is a fixed share of nominal absorption with balancing adjustments (in this case an increase) in household savings rates. If, alternatively, household savings rates would have been fixed, household consumption would have increased in the short to medium run, until the resulting decline in capital stock growth would impose reduced consumption.

Balanced Budget Scenario

The following simulation considers the impact of treating the same 50 percent of the infected population as in the previous simulation, but with a compensating increase in direct tax rates on domestic institutions. As can be seen from column 8 of Tables 6 and 7, the growth rate of government consumption still rises by the same amount as in the previous simulation. However, increased revenues through increased direct taxation now offset the increase in government spending. The average aggregate direct tax rate on households almost doubles from an initial average rate of 8.5 percent to 12.4 percent.[12]

This increase in revenues prevents an increased budget deficit from crowding-out investment. However, the higher tax rates imposed on the country's higher-income households reduce their level of savings, thus reducing the gains from lower government spending. Ultimately investment to grows at 2.9 percent per year. As seen in Table 7, the increased tax rates reduce the level of disposable income for higher-income urban households, and this reduces the level of private consumption growth. Ultimately, while investment growth raises import demand, this is offset by falling import demand from urban households.

Rural households benefit both from the increased incomes from higher labor force growth, and from being excluded from the financing of the treatment program. Therefore, while all rural households enjoy more rapid poverty reduction in the Balanced Budget scenario as compared to the Publicly Financed scenario, it is the rural households that benefit the most. Urban households suffer an increase in poverty due the higher tax burden, although lower-skilled self-employed households do have higher per-capita consumption growth in the Balanced Budget scenario.

[12] The average rate is calculated based only on the incomes received of those households and corporations that pay direct tax. Including all rural households would greatly reduce the average tax rate. It should also be noted that the stated tax rate is based on direct tax collections and not on the statutory tax rate stated in the tax register. This is an example of a simulation where all direct tax rates for households are scaled (in this case upwards) to generate the required level of government savings. Given that households with high per-capita incomes tend to have relatively high effective tax rates, the distributional impact of this adjustment mechanism is progressive.

HIPC-Funded AIDS Scenario

The HIPC debt relief simulation suggested that significant poverty reduction is unlikely to result from debt relief that is not accompanied by pro-poor policies. In the final AIDS scenario the funds saved by the government through debt relief are used to finance an AIDS treatment program.[13] Unlike in the previous AIDS simulations where 50 percent of the infected adult population was treated, the treatment of only 14 percent of the infected population can be financed through debt relief funds. The increases in population, labor force and TFP are adjusted downward accordingly.

As can be seen in the final column of Table 6, the increase in government consumption is still required in the HIPC-funded scenario, but in this scenario there is no increase in the government deficit. As a result, private consumption per-capita increases for all household groups. However, the gains are quite small given the limited scope of the program.

The AIDS simulations presented in this section find that raising government health spending to address the prevalence of HIV/AIDS may involve trade-offs between gains for the direct beneficiaries and losses for those who finance the increases in government spending that are needed. Alternative financing options should be explored. Although the use of HIPC funds to finance the grant produced the most pro-poor results the opportunity cost of such funds may prohibit their use for AIDS treatment. Alternative uses of these funds are explored in the simulations that follow. Moreover, even if HIPC funds are used exclusively for AIDS treatment they are only able to provide treatment to a small percentage of the infected population.

Education Scenarios

One of the criteria for continued HIPC debt-relief is the expansion of pro-poor education spending. Currently the Zambian education system is characterized by inadequate provision at every educational level. This is due to a number of factors,

[13] The use of HIPC funds to pay for AIDS treatment is equivalent to the use of any funds sourced abroad. As such this simulation can also provide insight into donor assisted AIDS treatment.

including insufficient numbers of teachers and inadequate teaching materials. The lack of teachers is driven by changes in government requirements, poor teacher benefits, and death due to HIV/AIDS. There are also high dropout rates even at low grades resulting from long distances to schools and the opportunity cost of child time (which could be allocated to different types of production). Over ten percent of children exit the schooling system between grades 1 and 6. Consequently, the goal of universal primary education has not been achieved (Republic of Zambia, 2002).

In light of the shortcomings of the current education system, the government has identified a number of education initiatives aimed at facilitating economic growth and poverty-reduction, including: (i) increasing investment in basic education; (ii) enhancing the existing literacy program; (iii) promoting on-the-job skills training; (iv) promoting equity, especially gender equity; and (v) investing in secondary and tertiary schooling. Expanded teacher training is also needed, especially given the fact that a large number of teachers are victims of HIV/AIDS (Republic of Zambia, 2002).

The Education scenarios simulate the affect that increased government education spending has on the skill-structure of new labor entering the labor market. In the first simulation the government is assumed to finance the additional education spending through an increase in direct taxes. In the second simulation, the funds from HIPC debt relief are used. Table 10 shows how the skill-structure of labor force growth is expected to change as well as the simulated increase in government spending.

Table 10. Assumptions for Education Simulations

	Initial work force ('000s people)	Base scenario	Education: publicly funded	Education: HIPC funded
Labor force growth rate		**Annual percentage growth rate**		
Uneducated	2,071	2.0	-1.3	1.0
Primary	1,500	2.0	4.8	3.1
Secondary	252	1.7	3.6	2.4
Tertiary	144	1.7	1.7	1.7
New cost as a percentage of GDP			***5.4***	***2.0***

Source: Authors' calculation (see appendix).

In the publicly funded simulation, government spending on education is doubled, with the additional spending, which equals 5.4 percent of GDP, being offset by an increase in direct taxes while government savings is fixed at the levels of the base scenario. This expansion in education spending allows labor force growth rates amongst the higher skill categories to increase. New workers are less likely to be uneducated hence the lower growth rate for that education category. Conversely, since one third of additional spending is allocated to secondary schooling, the supply of secondary educated workers increases more in the Publicly Funded scenario than in the Base. People are therefore drawn out of lower education categories and moved into higher ones. For both scenarios, the growth rates in the total economy-wide labor force and the total labor force of each household group are the same as for the base simulation. It is assumed that the changes in labor supply for each skill level are allocated across the different households in proportion to their shares in the total labor force, i.e. in a manner that raises the shares of initially relatively poor household groups in more educated labor categories

The results from the two Education scenarios are shown in Tables 11 and 12. Both scenarios lead to a moderate acceleration in GDP growth. For the first, publicly funded scenario, government consumption growth increases sharply. Investment expands in rough proportion to the general growth expansion whereas total household consumption declines slightly. The growth increase is driven by an increase in TFP, reflecting higher marginal productivities for more educated labor. In terms of distribution, the effects of the first scenario are strongly pro-rural. In spite of a slight decline in the aggregate household consumption, consumption increases in rural areas while poverty decreases by more than two percentage points. By contrast, in urban areas, poverty increases slightly and consumption declines. This outcome reflects the combined impact of changes in the skill structure and a financing mechanism that favors households with lower initial direct tax rates (including low-income, rural households). On the production side, the only major change is more rapid growth in public services, responding to the changes in government demand.

Under the HIPC Funded scenario the government budget deficit remains fixed and the cost of the education program is covered by funds normally allocated to the foreign debt. Apart from being smaller relative to the preceding scenario, the major difference is that, in the absence of any need to devote local resources to the program, household consumption grows more rapidly, in tandem with the rest of the economy, while government consumptions remains unchanged. In rural areas, this scenario permits a more rapid but somewhat less pro-poor consumption increase. In urban areas, consumption grows much more rapidly than under the preceding scenario, permitting poverty to fall. Among the production sectors, the gains are strongest for agriculture and services.

Accelerated Agriculture Simulations

Although agriculture is a relatively small component of GDP, it is still the main source of livelihood for most of the country's population, including the majority of Zambia's poor who live in the rural areas where the incidence and severity of poverty is greater. Central to the recent reform process has been drastically reduced government interventions in the agricultural sector. Perhaps the most important example is the elimination of subsidies and marketing support within the maize sector. Initially the government's attempt to withdraw from the maize sector was hampered by a series of severe droughts. However, by the mid-1990s, the government ceased to subsidize fertilizer, thus making the cultivation of maize production unprofitable in many areas of the country. This led to a substantial decline in maize production, particularly within the more drought-stricken Southern and Western provinces, where farmers shifted production towards crops such as sorghum and millet, which are more drought resilient and less intensive in purchased inputs. This has lessened the vulnerability of many of the more remote households in these areas, while at the same time increasing their economic distance from domestic and foreign markets.

Apart from shifts towards more diverse staples production, the performance of cash crops has improved strongly. Traditional crops, like cotton and sugar, have shown strong growth in the years following the privatization period of the mid-1990s. Cotton is

a particularly important sector for smallholders, who produce 95 percent of the crop. This is also the case for sugar, where smallholders through out-grower schemes generate half of total production. Finally, horticultural exports have grown considerably in recent years largely as a result of donor support.[14] However, with the exception of cotton, which is grown in the Eastern, Southern and Central provinces, most of the farmers engaged in cash crop production are located close to Lusaka or the country's main transport routes. Thus most of the recent gains from cash crop production have tended not to reach the more remote areas of the country.

In order to assess the constraints and opportunities for significant poverty reduction through agricultural and agriculture-related expansion, the following simulations consider the impact of accelerated TFP growth in selected agricultural sectors. In the first simulation, TFP growth is increased by 0.5 percent per year for all of agriculture. The other simulations target a smaller share of GDP (an agricultural subsector or agricultural processing). In order to make these simulations comparable with the first, the rate of additional TFP growth is scaled in inverse proportion to the size of the targeted sector relative to all of agriculture. Table 13 shows the resulting, scaled TFP growth rates for this set of simulations.

Given that the purpose of these simulations is to identify differing poverty-reduction potential across agricultural sectors, we do not attempt to account for the costs of raising TFP under these scenarios.

The general effect of increasing TFP growth is to raise the level of production in the targeted sectors. Increased supply lowers the prices of their outputs, raising quantities demanded for agricultural products in both urban and rural areas. Part of the additional output is exported. As long as the demand elasticities are sufficiently high, incomes and consumption will tend to increase for both agricultural and non-agricultural households, with a fall in poverty and more rapid growth as important consequences.

[14] Exported horticultural products include vegetables and cut flowers, which are exported to the European market. Although this sector has performed well in recent years it remains a relatively small share of total exports and production.

Table 11. Macroeconomic and Poverty Results, 2001-2015

	Initial value (2001)	Base growth path	Education: publicly funded	Education: HIPC funded	Agric: all agri-culture	Agric: staples	Agric: traditional	Agric: non-traditional	Agric: agriculture processing
Real gross domestic product	**(Mn Kwacha)**				**Annual percentage growth rate (2001-2015)**				
GDP (factor cost)	11,843	4.1	4.4	4.4	4.2	4.2	4.4	4.7	4.3
Private consumption	10,659	3.2	3.1	3.6	3.3	3.3	3.3	3.4	3.3
Investment	2,604	2.6	2.9	3.0	2.7	2.6	3.3	3.6	2.7
Government consumption	1,689	3.0	5.4	3.0	3.0	3.0	3.0	3.0	3.0
Exports	3,708	5.8	6.1	6.0	5.9	5.8	6.6	6.9	6.0
Imports	-6,025	3.0	3.3	3.4	3.1	3.1	3.6	3.9	3.2
Real exchange rate		0.9	1.0	0.9	0.9	1.0	0.4	0.0	0.8
Growth decomposition					**Percentage contribution to GDP growth rate**				
Factor accumulation		1.8	2.0	2.0	1.8	1.8	1.9	1.9	1.9
Labor		0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9
Capital		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Land		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TFP growth		2.3	2.4	2.4	2.4	2.4	2.5	2.8	2.4
Real GDP growth		4.1	4.4	4.4	4.2	4.2	4.4	4.7	4.3
Poverty headcount	**(%)**				**Final percentage poverty headcount (2015)**				
Rural	63.2	55.0	52.3	53.3	54.5	55.4	49.7	49.6	54.4
Small-scale	65.5	57.0	54.0	55.2	57.5	57.5	51.2	51.2	56.5
Medium-scale	45.4	36.7	36.8	36.0	36.7	36.7	31.3	31.0	36.2
Large-scale	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Non-farm	48.5	43.0	43.0	41.6	42.5	42.5	42.8	42.0	42.0
Urban	43.4	38.9	39.1	38.2	38.6	38.6	39.2	38.5	38.2
Total	55.8	49.0	47.4	47.7	48.5	49.1	45.8	45.5	48.4

Table 12. Consumption, Production and Trade Results, 2001-2015

	Initial value (2001)	Base growth path	Education: publicly funded	Education: HIPC funded	Agric: all agri-culture	Agric: staples	Agric: traditional	Agric: non-traditional	Agric: agriculture processing
Real per-capita consumption	**(Th Kwacha)**				**Annual percentage growth rate (2001-2015)**				
Rural	550	1.9	2.1	2.2	2.1	2.0	2.6	2.6	2.0
Small-scale	470	2.0	2.4	2.4	2.2	2.2	2.9	2.8	2.0
Medium-scale	1,010	1.9	1.6	2.0	2.1	2.0	3.1	3.1	2.1
Large-scale	12,080	1.6	1.1	1.7	1.8	1.8	1.6	1.8	1.7
Non-farm	900	1.2	0.9	1.5	1.3	1.4	1.0	1.2	1.4
Urban	1,770	1.0	0.7	1.4	1.1	1.1	0.8	0.9	1.2
Low-skill self-employed	1,430	1.2	1.1	1.7	1.3	1.4	0.8	0.9	1.4
Private employee	1,500	1.1	0.5	1.4	1.2	1.1	1.2	1.5	1.3
Public employee	1,890	1.0	0.6	1.2	1.0	1.0	0.9	1.1	1.1
High-skill employer	8,070	0.2	0.0	1.1	0.2	0.3	-0.4	-0.5	0.3
Low-skill self-employed	1,430	1.2	1.1	1.7	1.3	1.4	0.8	0.9	1.4
Private employee	1,500	1.1	0.5	1.4	1.2	1.1	1.2	1.5	1.3
Public employee	1,890	1.0	0.6	1.2	1.0	1.0	0.9	1.1	1.1
High-skill employer	8,070	0.2	0.0	1.1	0.2	0.3	-0.4	-0.5	0.3
All households	1,000	1.3	1.2	1.7	1.4	1.4	1.5	1.5	1.4
Real gross domestic product	**(Mn Kwacha)**				**Annual percentage growth rate (2001-2015)**				
Agriculture	2,634	4.6	4.6	4.8	5.0	4.9	6.1	7.2	4.6
Staples	2,236	3.8	3.8	4.1	4.1	4.1	3.7	3.5	3.8
Traditional	155	6.2	6.3	6.1	7.3	6.4	18.2	1.7	5.7
Non-traditional	137	10.9	10.8	10.8	12.2	11.1	4.9	22.4	10.7
Other	106	4.7	4.9	5.1	4.7	4.8	4.0	3.5	5.1
Industry	3,039	3.7	3.9	4.0	3.7	3.7	3.3	3.2	3.9
Mining	1,072	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Manufacturing	1,310	5.3	5.6	5.7	5.3	5.3	4.7	4.2	5.7
Other	657	4.8	4.9	4.9	4.7	4.7	4.7	4.9	4.8
Services	6,170	3.9	4.4	4.3	4.0	4.0	3.9	3.9	4.1
Private	4,966	4.1	4.4	4.5	4.2	4.2	4.0	4.1	4.4
Public	1,204	3.0	4.6	3.2	3.0	3.0	3.0	3.1	3.0
Total	11,843	4.0	4.3	4.3	4.2	4.1	4.3	4.6	4.2

Table 12 cont. **Consumption, Production and Trade Results, 2001-2015**

	Initial value (2001)	Base growth path	Education: publicly funded	Education: HIPC funded	Agric: all agriculture	Agric: staples	Agric: traditional	Agric: non-traditional	Agric: agriculture processing
Exports	**(Mn Kwacha)**				**Annual percentage growth rate (2001-2015)**				
Agriculture	337	9.5	9.4	9.3	11.0	9.8	16.5	18.6	8.8
Staples	23	4.9	5.0	5.2	5.6	6.4	0.5	-1.8	4.4
Traditional	194	6.4	6.3	6.1	7.7	6.6	19.9	0.8	5.6
Non-traditional	121	13.2	12.9	12.9	14.7	13.4	5.1	25.6	12.4
Other	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industry	3,180	5.0	5.2	5.2	4.8	5.0	3.6	2.6	5.3
Mining	1,975	-1.3	-1.3	-1.3	-1.3	-1.3	-1.4	-1.4	-1.3
Manufacturing	1,039	10.0	10.4	10.4	9.8	10.0	7.8	6.3	10.6
Other	166	8.3	7.9	8.0	8.1	8.1	8.1	6.8	7.6
Services	191	6.7	8.1	7.7	6.5	6.7	5.3	4.3	6.3
Private	191	6.7	8.1	7.7	6.5	6.7	5.3	4.3	6.3
Public	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	3,708	5.6	5.9	5.8	5.8	5.7	6.4	6.7	5.8
Imports	**(Mn Kwacha)**				**Annual percentage growth rate (2001-2015)**				
Agriculture	130	2.1	1.9	2.5	1.8	1.6	4.0	4.3	3.0
Staples	115	2.2	1.9	2.6	2.0	1.7	4.0	4.8	2.9
Traditional	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Non-traditional	14	1.1	1.2	1.7	0.5	1.0	3.6	-2.8	4.0
Other	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industry	5,179	3.0	3.2	3.3	3.0	3.0	3.6	3.8	3.1
Mining	41	7.0	7.7	7.5	6.6	6.8	5.9	4.3	5.9
Manufacturing	5,138	2.9	3.2	3.2	3.0	3.0	3.5	3.8	3.0
Other	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Services	716	3.4	3.6	3.7	3.5	3.5	3.5	3.9	3.8
Private	716	3.4	3.6	3.7	3.5	3.5	3.5	3.9	
Public	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total	6,025	3.0	3.2	3.3	3.1	3.0	3.6	3.8	

Table 13. Increases in TFP Growth for Agriculture-Focused Simulations (2001-2015)

Sector	Share of agricultural GDP (2001)	Scaled additional TFP growth rate
Agriculture	100.0	0.5
Staples	85.1	0.6
Traditional	5.9	8.5
Non-traditional	5.4	9.3
Non-agriculture		
Agriculture-processing and textiles	21.2	2.4

Note: Staples include maize, sorghum, millet, and drought-tolerant crops. Traditional include coffee, sugar and tobacco. Non-traditional includes cotton and horticulture.

The results from the accelerated agricultural growth simulations are presented in Tables 11 and 12 above. Although accelerated agricultural growth generally increases economic growth and lowers poverty, there are considerable differences between the different scenarios. For the first scenario, where all of agriculture is targeted, growth increases for most macro indicators. The gains from accelerated agricultural production are spread quite unevenly across all household groups. Farm-based rural households do not benefit, whereas non-farm rural and urban households benefit through declines in poverty. This urban bias in poverty reduction is driven by market constraints in the staples sector.

As seen in the Staples scenario, the increase in TFP growth marginally increases the headcount poverty rate in rural areas when compared to the Base scenario. In the context of highly inelastic demand, the fall in staples prices, following the large increase in supply, is so large that producer value added declines. These declines in price are due to the limited ability of the domestic market to absorb the higher level of supply as well as limited access to export markets.

The importance of foreign markets can bee seen in the Traditional and Non-traditional scenarios. For these commodities, the producers have better access to foreign markets where they can sell their output following the increase in TFP growth. Domestic markets are therefore not flooded by new supply and prices fall by less in this scenario

than they did in the Staples scenario. High growth in export supply generates substantial appreciation of the exchange rate. Falling import prices favor investment, which grows more rapidly under the Traditional and Non-traditional scenarios than under the Base. Rural households are better off due to higher production incomes, while urban households generally benefit from cheaper imports from the appreciated real exchange rate and linkages to agriculture as non-agricultural sectors respond to increased consumption demand from agricultural households and to increased demand for intermediate inputs from agriculture.

The final simulation in this group considers the strength of backward-linkage effects from agricultural processing sectors to agriculture. As with the traditional and non-traditional sectors, the processing sector already has an established foreign market where it can sell its output. However, the simulated reduction in poverty favors urban households more than rural households as urban households earn increased returns to non-agricultural labor and capital. A comparison across these simulations therefore indicates that, while backward linkages from the agricultural-processing sectors do stimulate poverty reduction in rural areas, the fall in poverty resulting from accelerated growth in these sectors is smaller than for agricultural sectors.

The overall conclusion from these simulations is that agricultural sectors with strong export potential are appropriate targets for efforts to raise productivity.

On a cautionary note, it is clear from current regional patterns that the gains from accelerated agricultural growth would not be evenly distributed within rural areas. This dimension should be considered when strategies for rural development and poverty reduction are formulated. For example, horticultural production tends to be concentrated close to the national airport, and cotton production is currently located in the Eastern and Central provinces. Accordingly, the gains from the Non-traditional scenario are unlikely to benefit farmers in other areas of the country. Similarly, much of the country's export agriculture is concentrated near to the main rail and road transport routes. It is questionable whether farmers in the more remote Western and Northwestern provinces would be able to gain access to foreign markets. Furthermore, even if foreign staples

markets could be identified, the high cost of transportation in more remote areas of Zambia is likely to erode the competitiveness of potential exports. This final issue of limited transportation is addressed in the following section.

Transport Infrastructure Simulations

Zambia's PRSP sees the provision of transport as critical to poverty reduction and growth promotion. The previous section emphasized the importance of market access and its role in determining whether rural farmers can benefit from economic growth. Chapter 9 of the Zambia CEM outlines the role that roads play in rural development, especially regarding farmers' access to input and output markets (World Bank, 2004).

Transportation costs currently account for between 60 and 70 percent of the cost of production (Republic of Zambia, 2002). These costs, which are high even by regional standards, contribute to the high price of goods and services and hence the prevailing poverty in the country. Although Zambia has an extensive road network, which supports the dominant modes of transportation, the system has deteriorated rapidly in recent years (Republic of Zambia, 2002). The government has identified increased investment in transportation infrastructure as an important priority that may have positive effects on the entire economy and is critical for the development of remote rural areas.

Market access is especially limited in many rural areas. Only 18 percent of rural households are within five kilometers of input markets, and few more remote households have access to health and education facilities (both of which have been identified in this report as critical for development). These households' access is limited due to either a lack of roads or the poor quality of existing roads. This section therefore attempts to explore the effects of (i) repairs and improved maintenance of the existing road system; (ii) construction of new feeder roads into rural areas; (iii) construction of new paved roads ostensibly into urban and less remote rural areas; and (iv) the use of HIPC funds to construct new feeder roads in rural areas. This is done by estimating the costs and benefits of such infrastructure investment based on information contained in Chapter 9, translating this information into additional government consumption, changes in

depreciation rates for the transport sector, and patterns of reductions in transportation costs.

Maintenance Scenario

According to the Zambia CEM, around 29 percent of the current paved road network is in need of repair (World Bank, 2004). Furthermore, much of the existing system is no longer maintained. The Maintenance scenario simulates the impact of performing the necessary repairs and then maintaining the existing system. It is difficult to simulate the impact of investment in transport given that the returns to such investment are often indirect and difficult to quantify. Information on the cost of repairing and maintaining the road network is taken from PRSP (2002) and is presented in the appendix.

Given the extent of deterioration in the existing road network and assuming that only paved and gravel roads need maintenance, the information contained in the appendix suggests that the total cost of repairing and maintaining the current system would equal 3.5 percent of GDP for the first three years as roads are repaired and functioning roads are maintained. After the third year, the road repairs are assumed to be completed and, so long as the roads are maintained, it is also assumed that no new repairs will be needed. Therefore, from year four onwards, the cost of maintenance is the only additional cost to government and amounts to 1.3 percent of GDP per year. Through repairing and maintaining the road network the deterioration of Zambia's roads will be lessened. Accordingly, the depreciation rate for the transport sector is halved from four percent to two percent.

The direct impact of reducing the depreciation rate of the transport sector is to increase its supply, thereby bringing down the cost of trade and transport services, increasing the overall supply of capital, and adding to GDP growth. On the other hand, the government-spending program reduces the room for private consumption and investment.

Table 14. Macroeconomic and Poverty Results, 2001-2015

	Initial value (2001)	Base growth path	Transport: Main-tenance	Transport: Feeder Constr.	Transport: Paved Constr.	Transport: HIPC funded
Real gross domestic product	**(Mn Kwacha)**		**Annual percentage growth rate (2001-2015)**			
GDP (factor cost)	11,843	4.1	4.5	4.2	4.3	4.2
Private consumption	10,659	3.2	3.5	3.6	3.6	3.6
Investment	2,604	2.6	3.1	3.0	3.5	2.9
Government consumption	1,689	3.0	3.6	3.6	3.7	3.0
Exports	3,708	5.8	6.3	5.9	6.5	5.8
Imports	-6,025	3.0	3.5	3.2	3.7	3.2
Real exchange rate		0.9	1.0	1.3	0.8	1.1
Growth decomposition			**Percentage contribution to GDP growth rate**			
Factor accumulation		1.8	2.2	1.9	2.0	1.9
Labor		0.9	0.9	0.9	0.9	0.9
Capital		1.0	1.4	1.0	1.1	1.0
Land		0.0	0.0	0.0	0.0	0.0
TFP growth		2.3	2.3	2.3	2.3	2.3
Real GDP growth		4.1	4.5	4.2	4.3	4.2
Poverty headcount	**(%)**		**Final percentage poverty headcount (2015)**			
Rural	63.2	55.0	52.4	50.6	52.5	52.1
Small-scale	65.5	57.0	54.2	52.5	54.5	54.0
Medium-scale	45.4	36.7	33.7	32.2	34.2	33.7
Large-scale	3.0	2.0	2.0	1.5	2.0	2.0
Non-farm	48.5	43.0	41.8	40.5	41.0	41.0
Urban	43.4	38.9	37.5	36.6	36.8	37.3
Total	55.8	49.0	46.8	45.4	46.6	46.5

Table 15. Consumption, Production and Trade Results, 2001-2015

	Initial value (2001)	Base growth path	Transport: Main-tenance	Transport: Feeder Constr.	Transport: Paved Constr.	Transport: HIPC funded
Real per-capita consumption	**(Kwacha)**		**Annual percentage growth rate (2001-2015)**			
Rural	550	1.9	2.2	2.5	2.2	2.4
Small-scale	470	2.0	2.4	2.6	2.3	2.5
Medium-scale	1,010	1.9	2.5	2.7	2.4	2.6
Large-scale	12,080	1.6	2.0	1.8	2.1	1.8
Non-farm	900	1.2	1.4	1.7	1.6	1.7
Urban	1,770	1.0	1.3	1.3	1.5	1.4
Low-skill self-employed	1,430	1.2	1.2	1.4	1.6	1.5
Private employee	1,500	1.1	1.6	1.7	1.8	1.6
Public employee	1,890	1.0	1.4	1.4	1.6	1.4
High-skill employer	8,070	0.2	0.3	0.1	0.7	0.4
All households	1,000	1.3	1.6	1.7	1.8	1.7
Real gross domestic product	**(Mn Kwacha)**		**Annual percentage growth rate (2001-2015)**			
Agriculture	2,634	4.6	4.6	4.8	4.6	4.7
Staples	2,236	3.8	3.9	4.4	4.0	4.2
Traditional	155	6.2	5.9	5.8	5.4	5.8
Non-traditional	137	10.9	10.1	8.4	9.7	9.1
Other	106	4.7	5.4	5.7	5.4	5.4
Industry	3,039	3.7	4.2	4.0	4.4	3.9
Mining	1,072	0.0	0.0	-0.1	0.0	-0.1
Manufacturing	1,310	5.3	6.0	5.8	6.3	5.7
Other	657	4.8	5.4	4.9	5.4	4.9
Services	6,170	3.9	4.4	3.8	3.9	3.9
Private	4,966	4.1	4.6	3.9	4.0	4.1
Public	1,204	3.0	3.5	3.5	3.6	3.1
Total	11,843	4.0	4.4	4.1	4.2	4.1

Table 15 cont. **Consumption, Production and Trade Results, 2001-2015**

	Initial value (2001)	Base growth path	Transport: Main-tenance	Transport: Feeder Constr.	Transport: Paved Constr.	Transport: HIPC funded
Exports	**(Mn Kwacha)**		**Annual percentage growth rate (2001-2015)**			
Agriculture	337	9.5	8.6	7.2	7.9	7.8
Staples	23	4.9	4.9	5.1	3.9	5.0
Traditional	194	6.4	5.8	5.3	5.1	5.5
Non-traditional	121	13.2	11.9	9.7	11.2	10.6
Other	0	0.0	0.0	0.0	0.0	0.0
Industry	3,180	5.0	5.8	5.6	6.2	5.3
Mining	1,975	-1.3	-1.3	-1.3	-1.3	-1.3
Manufacturing	1,039	10.0	11.1	10.9	11.7	10.5
Other	166	8.3	9.2	8.2	8.6	8.4
Services	191	6.7	6.3	5.3	5.4	5.8
Private	191	6.7	6.3	5.3	5.4	5.8
Public	0	0.0	0.0	0.0	0.0	0.0
Total	3,708	5.6	6.1	5.7	6.3	5.6
Imports	**(Mn Kwacha)**		**Annual percentage growth rate (2001-2015)**			
Agriculture	130	2.1	2.9	0.8	3.7	1.5
Staples	115	2.2	3.0	1.0	3.7	1.7
Traditional	0	0.0	0.0	0.0	0.0	0.0
Non-traditional	14	1.1	2.2	-1.8	3.5	-0.4
Other	0	0.0	0.0	0.0	0.0	0.0
Industry	5,179	3.0	3.4	3.1	3.6	3.2
Mining	41	7.0	9.5	6.7	10.8	6.9
Manufacturing	5,138	2.9	3.4	3.1	3.5	3.1
Other	0	0.0	0.0	0.0	0.0	0.0
Services	716	3.4	3.8	3.4	3.6	3.5
Private	716	3.4	3.8	3.4	3.6	3.5
Public	0	0.0	0.0	0.0	0.0	0.0
Total	6,025	3.0	3.5	3.1	3.6	3.2

The results of the simulation are shown in the third column of Tables 14 and 15. At the macro level, the growth rates for all GDP components and the capital stock increase by around 0.5 percent. All household groups gain. Poverty falls by 2.2 percentage points with a stronger reduction in rural areas. Among the sectors, growth is stagnant for agriculture but increases for services and non-mining industry, in part a reflection of that these non-agricultural sectors include the suppliers of transport services and commodities that are part of the government consumption bundle.

Construction Scenarios

Among these scenarios, the first two attempt to contrast the effects of building new feeder roads in rural areas with new paved and gravel roads in less remote rural and urban areas. The scenarios consider a ten percent increase in the supply of feeder or paved roads, with the cost of these programs calculated using the information described in the appendix. In both simulations there is a reduction in the transaction costs targeted to selected sectors in the economy. In the case of feeder roads, these benefits are limited to agricultural production. Paved roads, on the other hand, benefit non-agricultural production and export agriculture. The latter is due to the existing concentration of export agriculture along the country's main road networks. Furthermore, paved roads are expected to reduce the transactions costs in both the domestic and export markets, whereas feeder roads reduce only the transactions costs in domestic markets.

The results suggest that both construction programs increase growth and reduce poverty. GDP growth under both scenarios is similar, although the Paved Roads scenario has a slightly higher growth rate.

Despite these similarities and similar costs of relevant government programs, the two simulations differ strongly in their household effects. As expected, feeder roads in remote rural areas influence rural households more than urban households. Rural consumption increases considerably more rapidly under this scenario while final-year rural poverty declines by more than four percentage points as opposed to a two-point decline for urban households.

Under the Paved construction scenario, urban households gain more than rural households in terms of consumption with unchanged poverty reduction. Poverty still falls significantly, by 2.5 percentage points, in rural areas. Thus under this scenario, GDP growth is stronger while poverty reduction is weaker relative to the feeder roads scenario. These results highlight a trade-off between poverty reduction and growth, pointing to the need to consider not only growth but also poverty effects when developing policies.

Under the last construction scenario, funds released by foreign debt reduction are allocated to spending on feeder roads. Government consumption (from domestic funds) does not increase relative to the base scenario. The effects of road construction have been scaled down to reflect the size of available funds under the HIPC debt relief agreement.

The macro effects are similar to those of the earlier feeder construction scenario, indicating that the combined impact of a reduction in the scale of the construction program and the elimination of the need to for additional domestic government resources cancel out. At the household level, the effects are also quite close, with a substantial poverty cut and consumption gains for rural households and slightly smaller gains for urban households.

VI. CONCLUSIONS

Over the last four decades Zambia has become increasingly dependent on copper mining exports. This concentration of economic resources has created a bias against agriculture that was reinforced by high protection of manufacturing. The result of the bias has been to establish a pattern of agricultural production that favored non-traded staples to the detriment of export agriculture. Over the last decade Zambia has attempted a series of reforms aimed at promoting growth and poverty-reduction. While some evidence suggests that the government has been successful in promoting stability and liberalizing foreign and domestic policies, the effects of these policies on poverty and inequality has been disappointing. Overall poverty increased over the 1990s, although there were some reductions within rural areas. Urban areas have however seen significant increases in poverty as a result of contraction in the newly unprotected manufacturing sector and adverse conditions in the copper sector.

Although poverty declines, the results for the Base scenario shows that Zambia is unlikely to achieve its MDG of halving poverty by 2015. The findings suggest that if Zambia is going to substantially reduce poverty then future economic growth has to be pro-poor.

The first non-base simulations consider the impact of changes in the copper mining sector on growth and poverty. Based on current trends, world copper prices and mining output are likely to continue declining over the coming decade. The simulation results indicate that rural households would be cushioned from the negative effects of the forced structural adjustment following the decline of mining. Urban households would face increased poverty. Alternative scenarios, both more and less optimistic, are tested. Regardless of which alternative scenario is realized, the uncertainties surrounding the mining sector make diversification attractive.

The possible areas into which Zambia's economy may diversify include agriculture. The findings indicate that targeting traditional and non-traditional crops, which have strong links to foreign markets, would enhance household welfare and

poverty reduction. However, the many years of copper dependency have left a legacy with limited marketing opportunities, both domestic and foreign, for many agricultural crops and regions, especially staples and remote regions. Most of recent agricultural growth has been concentrated along the country's main transport routes. The pro-poor outcomes of agricultural expansion would be greatly enhanced if market access were widened on a large scale.

The treatment of HIV/AIDS and the provision of education are both key objectives in the country's PRSP. Approximately one percent of GDP growth is lost to AIDS every year. According to the scenarios considered in this report, alternative anti-HIV/AIDS programs (funded using domestic resources or resources released by debt forgiveness) there are trade-offs between a slight deterioration in over-all living standards (in terms of per-capita consumption and poverty rates) and gains for the direct beneficiaries of these programs. In other words, the justification for HIV/AIDS programs stems from that they contribute to longevity and healthier lives for a substantial proportion of the population. By contrast, programs for expanding education in a manner that improves the overall skill level and productivity of the labor force, promise to contribute significantly to growth and poverty reduction.

Improving the condition of the existing road network and extending the network into more remote areas are both priorities for Zambia's strategies for poverty reduction and rural development. This position is supported by the results for our simulations of increased productivity for export-oriented sectors within agriculture. Simulations of alternative programs for road maintenance and construction provide additional support for the importance of expanding roads. In particular, spending on feeder roads in rural areas leads to the strongest reductions in national and rural poverty.

Finally, Zambia is eligible for HIPC debt relief. Although the size of the foreign debt is substantial, the real effect of reduced debt is through reductions in annual interest payments. We find that, unless the funds released by HIPC debt forgiveness are used to finance pro-poor policies, the impact of debt relief on poverty reduction is likely to be modest. Three policy areas were considered as possible recipients for these funds:

HIV/AIDS treatment, the provision of educational services, and the extension of the existing feeder road network. We found that the largest reduction in poverty would be achieved if the funds were used to finance the development of the road network in more remote rural areas.

In sum, the simulations indicate that it will be extremely difficult for Zambia to achieve the MDG for poverty by 2015. No single policy measure is able to change this conclusion. Nevertheless, the simulations suggest that various measures, perhaps most importantly programs for education, infrastructure development, and improved productivity in export-oriented agriculture, each can contribute significantly to growth and reduce the headcount poverty rate by two-three additional percentage points by 2015, with scope for stronger gains from concerted measures in multiple areas. If utilized well, resources made available through foreign debt relief can provide a significant source of financing.

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APPENDIX: Detailed Description of the Simulations

Copper Simulations

The projected developments in the copper sector are expected to influence both Zambian export prices and mining output. Three scenarios are identified in the Zambia CEM: Low-case, Average-case, and High-case. The Average-case is considered to be the most likely and is therefore used in the Base Scenario. The derivation of the price and output changes is described in turn below.

The following table explains how the world copper price was derived from the information in Chapter 7 of the CEM (World Bank, 2004). Given the projected prices for each of the copper scenarios, the annual growth rate was derived based on the implied 2001 and supplied 2005 prices.

Table A1. Derived Copper Price Changes (2001-2015)

Calculating the world copper price in 2001		
Annual decline in world copper prices (%)	-2%	Chapter 7/CEM (WB 2004) (7.20)
Projected copper price in 2005 ($/lb)	1.07	Chapter 7/CEM (WB 2004) (7.22)
Implied copper price in 2001 ($/lb)	1.16	
Projected copper price in 2005 ($/lb)		
High case scenario	1.18	Chapter 7/CEM (WB 2004) (7.22)
Average case scenario	1.07	Chapter 7/CEM (WB 2004) (7.22)
Low case scenario	0.95	Chapter 7/CEM (WB 2004) (7.22)
Implied annual copper price change (%)		
High case scenario	0.5%	
Average case scenario	-2.0%	
Low case scenario	-5.0%	

The level of copper output was taken from Chapter 7 of the CEM (WB, 2004) and equaled 300,000 tons. The following table outlines the output implications of the three copper scenarios. The key distinction between the three scenarios lies in whether the investment for new mines is made available such that these mines will start operations in 2010. No new investment is made in the Low-case scenario and the mines are forced to

close in 2010, thus lowering the level of output to 150,000 tons. In the High-case scenario the new mines open and output rises to 550,000 tons. In the Average-case scenario the new mines do not open but there is almost sufficient investment in the interim period to maintain output.

Table A2. Estimated Copper Mining Output Levels (2001-2015)

	Copper Mining Output (tons)		
Year	**Low-case**	**Average-case**	**High-case**
2001	300,000	300,000	300,000
2006	200,000	200,000	
2007			400,000
2009	300,000	300,000	
2010	150,000	260,000	550,000

Source: Chapter 7 (7.22) of the CEM (WB 2004).

Taking the beginning and end period results produces an average annual growth rate for mining output. This produces annual compound growth rates of minus five percent for the Low-case scenario, minus one percent for the Average-case scenario, and 4.3 percent for the High-case scenario.

HIPC Debt Relief Simulations

Information on Zambia's total foreign debt was taken from the RMSM. Total debt in 2001 amounted to 21,046 billion Kwacha.

Table A3. Derived Cost of AIDS Treatment Program (2001-2015)

Total foreign debt in 2001 (million $)	5,833	RMSM
Exchange rate (Kw/$)	3,608	RMSM
Total foreign debt in 2001 (billion Kw)	21,046	
Interest due in 2001 (billion Kw)	581	RMSM
Interest paid in 2001 (billion Kw)	222	RMSM
Interest rate (due) (%)	2.8	
Interest rate (paid) (%)	1.0	

In the model, Zambia's foreign debt rises every year according to the difference between the interest rate due and paid. The resulting trend in foreign debt accumulation matches that of the RMSM. HIPC debt relief leads to a once-off reduction in debt by 69 percent. This reduces the interest paid and reduces the government deficit. In the simulations of HIPC funded programs for AIDS treatment, education, and development of transport infrastructure, it is implicitly assumed that these programs are entirely financed from the outside without any impact on domestic government consumption.

HIV/AIDS Simulations

The main calculation necessary for the AIDS simulations is the estimation of the total cost of the government treatment programs. This information is drawn from a number of sources as shown in Table A4.

Table A4. Derived Cost of AIDS Treatment Program (2001-2015)

Total population	10,400,000	Household survey 1998
Adult share of population (%)	50.0%	Household survey 1998
Adult population	5,200,000	
Per capita cost ($)	360	IMF (2003)
Exchange rate (Kw/$)	3,608	RMSM
Per capita cost (Kw)	1,298,844	
Infection rate (%)	25.0%	IMF (2003)
Number of adult infections	1,300,000	
Share of infections to be treated (%)	50.0%	
Total cost of treatment (Bn Kw)	844	

As described in the AIDS scenarios section, the cost of a comprehensive treatment program is prohibitively high. As such only half of the infected adult population can be treated if the public financing of the program is to remain feasible. Table A5 shows the current disaggregation of government consumption spending according to government function. This information is taken from the World Bank's Zambia RMSM.

Table A5. Government Spending by Function (2001)

Government spending function	Initial value 2001 (Bn Kw)	Percentage share of total
Agriculture	69	4.1
Industry	30	1.8
Transportation	56	3.3
Education	319	18.9
Health	240	14.2
Other	974	57.7
Total	1,689	100.0

Source: RMSM

Based on the above government expenditure information, the total cost of the treatment (844 billion Kwacha) is half of total government expenditure in 2001 (1,689 billion Kwacha). It also represents a 450 percent increase in 2001 health expenditure.

As discussed in Table 9, the impact of a full HIV/AIDS treatment program will increase annual population, labor force, and total factor productivity (TFP) growth rates. These increases are taken from the IMF (2003) assessment of the impact of HIV/AIDS on the Zambian economy. Given that the government treatment program described above only treats 50 percent of the infected adult population, the gains in population, labor force, and TFP growth rates are half of those depicted in Table 9. Similarly, the HIPC debt relief, which amounts to 236 billion Kwacha in 2001, represents only 14 percent of the cost of a comprehensive treatment program. As such only 14 percent of the gains will be realized when these funds are used exclusively to treat HIV/AIDS.

It should also be noted that there are other impacts that HIV/AIDS is likely to have other effects that are not considered in the analysis. These include changes in households' and government consumption spending patterns. Furthermore, the actual cost of a HIV/AIDS program extends beyond the cost of medication. It should ideally include the cost of care provision (e.g. nurses and other clinic staff) and the administration of the program. These costs have not been accounted for in the simulations.

Education Scenarios

The education scenarios are based on assumptions regarding the cost and impact of government education spending. Current government spending in 2001 amounted to 319 billion Kwacha. In the first Education scenario (Publicly-funded) the government triples the amount it was spending on education in 2001. In the HIPC funded scenario education spending increases by 74 percent. In both cases it is assumed that half of this additional spending is devoted to primary schooling while the other half is devoted to secondary schooling. It is also assumed that secondary school spending per pupil is five times higher than primary schooling.

On the impact of education spending, it is assumed that for every one percent increase in spending on primary education, the growth rate of primary educated labor increases by 0.65 percent (not 0.65 percentage points). For secondary education spending, the higher cost of educating secondary school pupils implies that for every one percent increase in secondary school spending there is a 0.5 percent increase in the growth rate of secondary educated labor. It is maintained that the total new supply of labor in a given year is fixed in absolute numbers. Therefore the increase in primary educated labor comes at the expense of uneducated labor supply, and increased secondary labor supply comes at the expense of primary educated labor. In other words, the supply of labor is rolled-up the education levels. The applied labor force growth rates for the two Education scenarios are shown in Table A7.

Table A7. Government Spending by Function (2001)

Labor Category	Labor force 2001 (1000 workers)	Base Scenario Annual Growth Rate	Publicly funded scenario	HIPC funded scenario
Uneducated	2071.0	2.0	-1.3	1.0
Primary	1500.5	2.0	4.8	3.1
Secondary	252.2	1.7	3.6	2.4
Post-secondary	144.5	1.7	1.7	1.7

Source: 1998 LCMS household survey for labor force; IMF (2003) for Base scenario growth rates; author's calculations for other education scenarios.

Since households now have higher educated labor, the distribution of labor income by skill must change from that described in Section 3 of this document. The adjustments are based on the assumed distribution of the stock of labor assets in the base, and the shifts in labor between labor education categories. It is assumed that the changes in labor force at each skill level relative to the base are split across the different household groups in proportion to their shares in the total labor force, thereby significantly raising the skill level of low-income households.

Transport Scenarios

Four Transport scenarios are explored in this document. The first involves a one-off repair and continued maintenance of the existing road network. The remaining three scenarios involve the construction of new roads. These new roads take the form of either feeder (rural) roads, or paved/gravel (urban/less remote rural) roads. The fourth scenario involves the use of HIPC debt relief funds to finance the construction of new feeder roads. The costing of the various scenarios is presented in Table A8.

According to the PRSP, 29 percent of the existing paved and gravel road network is in need of repair (Republic of Zambia, 2003). The cost of repairing a road per square meter is provided in the Chapter 9 of the Zambia CEM (World Bank, 2004). This cost is multiplied by the length of roads requiring repairs (29 percent of paved and gravel roads) to arrive at a final cost of 662 billion Kwacha.

The per-kilometer cost of maintaining existing paved or gravel roads was calculated by multiplying the area of one kilometer of road ($5000m^2$) by the cost of maintaining a single square meter of road. This figure was then multiplied by the length of existing roads in Zambia (excluding feeder roads which are assumed to be maintained by rural communities at no cost to the government). It was also assumed that roads do not require maintenance every year, but rather every five years. The total cost of maintaining the existing network is 212 billion Kwacha, which is 13 times greater than current government transport spending of 56 billion Kwacha (see Table A5).

Table A8. The Costing of Transport Scenarios

Estimated costs for paved roads ($ per sq m)		Republic of Zambia (2002)
Maintenance	5.8	
Repairs	12.4	
Construction	24.1	
Official exchange rate (Kw/$)	3,608.0	RMSM (World Bank)
Width of road (meters)	5.0	Authors' assumption
Number of years between maintenance (years)	5.0	Authors' assumption
Calculated cost per kilometer ($ per km)		
Maintenance		
Paved	28,750 .0	
Gravel	12,751.0	
Repairs		
Paved	61,800.0	
Gravel	27,410.0	
Construction		
Paved	120,450.0	Republic of Zambia (2002)
Gravel	53,423.0	ROADSIP I (District road) (World Bank, 2004)
Feeder/Earth	19,892	ROADSIP I (Full improvement)
Length of existing road (kilometers)		
Paved	6,476	Republic of Zambia (2002)
Gravel	8,478	
Earth	21,967	
Community/Feeder	30,000	
Share of existing network needing repair (%)		World Bank (2004)
Paved	29.0	
Feeder	0.0	
Total cost (bn Kw)		
Repairs	662	
Maintenance	212	
Construction (feeder roads)	445	
Construction (paved roads)	373	

For the Repairs and Maintenance scenario, the cost of repairs and maintenance are combined. Since the repair cost is large compared to current government transport spending, the cost was spread out over three years (2002-2004). It was assumed that

maintenance cost need not be paid on roads that have not yet been repaired. After 2004 only the cost of maintenance is imposed on the government. The impact of this spending is a reduction in the rate of deterioration of the existing road network. Accordingly the capital depreciation rate of the transport sector is reduced from four to two percent.

For the Construction scenarios it was assumed that the government increased the length of either feeder/earth or paved/gravel roads by ten percent. The cost of the two scenarios were calculated based on the length of the existing road network and the cost per square meter provided in Chapter 9 of the Zambia CEM (World Bank, 2004). The final costs were 445 and 373 billion Kwacha for the Feeder and Paved Construction scenarios, respectively.

The impact of newly constructed roads differed according to the type of roads that were built. In both cases, the transactions costs margin was reduced. For feeder roads it was assumed that these roads are exclusively in rural areas and therefore the transaction cost reduction would only affect agricultural commodities. Furthermore, only transactions costs on domestic sales are affected. The final effect was a 30 percent reduction in domestic transactions costs for all agricultural commodities.

It was assumed that paved roads are in export agricultural and urban areas, and that as such only export agricultural and non-agricultural commodities would be affected. Furthermore, both domestic and export transaction costs would be reduced. There was therefore a 20 percent decline in non-agricultural transaction costs and a ten percent decline in export agricultural transactions costs.

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