Potential economic impacts of an HIV/AIDS epidemic in Papua New Guinea

Prepared for AusAID

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Glossary

AIDS   Acquired Immune Deficiency Syndrome

AusAID   Australian Agency for International Development

CGE   computable general equilibrium

GDP   gross domestic product

GNP   gross national product

HCW   health care workers

HIV   Human Immunodeficiency Virus

MTCT   mother to child transmissions

ODA   official development assistance

PLWHA   People living with HIV/AIDS

PMGH   Port Moresby General Hospital

PNG   Papua New Guinea

STD   sexually transmitted disease

STI   sexually transmitted infection

WHO   World Health Organization

Summary

HIV/AIDS imposes economic as well as personal costs on a country

Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) is a problem impacting on all countries around the world. A recent Asia Pacific Ministerial Meeting on HIV/AIDS focused on the economic and security aspects of the escalating epidemic in the region. It was recognised in the discussions that HIV/AIDS could come to place unaffordable demands on countries in the region if the spread of the disease goes unchecked. This makes prevention an essential reaction to this threat (Asia Pacific Ministerial Meeting, October 2001). Papua New Guinea (PNG) is facing one of the greatest potential epidemics if actions are not undertaken or are not successful in controlling the spread of the virus. This study explores the potential economic impact of HIV/AIDS in PNG. It focuses on the macroeconomic and sectoral impacts for PNG if an epidemic should follow along the paths of selected countries in sub-Saharan Africa. The results demonstrate the potential for HIV/AIDS to exacerbate poverty in PNG, an issue of great concern to the PNG government and its development partners.

The economic impacts are diverse

There are three main avenues in the medium term for economic impacts

HIV/AIDS impacts on the economy at the household, firm and economy–wide levels through three key avenues. The first is through a reduction in the capacity of the labour force — with a decline in numbers of workers and worker productivity and a rise in the cost of employment. Despite considerable under employment in PNG, loss of skilled labour will impose significant costs especially on the manufacturing and services sectors. The second avenue is through shifts in the composition of demand as households, and possibly government, shift expenditure toward the health and medical sector and meeting funeral costs. A final avenue is through domestic savings feeding through to lower investment. Savings are expected to fall as household resources are used to deal with the consequences of the disease. This final avenue of impact is likely to be relatively unimportant for PNG given the low domestic savings rate and

reliance on foreign capital for investment. Chart 1 provides a framework to capture the principle sources of impact.

Chart 1   **Summary of the economic impacts and the three issues**

HIV/AIDS	Government	Institutions
epidemic — how prevalent will it become?	what is their policy reaction in prevention, in medical services and in financing these expenditures?	are they vulnerable to the epidemic?

Households

Household — loss of income	Shift in expenditure to health, medical and funeral expenditures and decline in expenditure	Decline in savings and possibly investment in education

Firms

Decline in the effective supply of labour § skill shortages § rising real wages § absenteeism § productivity impacts	Increasing costs of employment § health insurance § training § recruitment	Shift in demand by households and decline in demand in some sectors	Substitutions of capital for labour affected by cost of capital

Economy

Impacts § decline in GDP § increase in real wages but decline in private consumption § per capita GDP rises but per capita gross national product falls	Shift in sectoral composition § minerals hardly impacted § large decline in subsistence agriculture	Impact on access to funds for investment depends on international reaction and willingness to lend.

Falling investment in children can have profound impacts on long term growth

HIV/AIDS also impacts on long-term growth potential if children are removed from school, if nutrition falls to critical levels for significant parts of the population, and if institutions that provide social services and essential infrastructure deteriorate. It is quite possible for HIV/AIDS to both lower a country's total GDP and to raise its GDP per capita. The key to this counterintuitive result is capital replacing labour so that the decline in production is less than the decline in labour inputs. Such a result is quite likely in a labour surplus economy such as PNG and this potential outcome is indicated by the modelling undertaken in this study.

But an economic perspective does not capture all the costs

A study of the economic impact of HIV/AIDS does not capture the true cost of the epidemic to a country. It is only a partial measure and ignores the social impacts (pain and suffering) that result from the spread of this fatal disease. However, economic measures do help the government and its development partners to plan strategies to mitigate the consequences of an HIV/AIDS epidemic. Economic measures also allow the net benefits of strategies focused on addressing HIV/AIDS to be compared with strategies on issues in areas such as primary health care and education. And they allow the interactions between HIV and other strategies to be explored.

The evidence on HIV/AIDS in PNG suggests the potential for a serious epidemic

HIV and AIDS cases are rising rapidly

PNG is poised on the brink of a serious epidemic. Current estimates of prevalence are 0.6 per cent of the population, or around 14 000 people. At the end of 2000, a total of 3421 cases of HIV, including 1155 cases of AIDS and 237 AIDS deaths had been reported. The most recent surveillance update at June 2001 puts the cumulative number of HIV cases reported at 4075, with 464 cases reported in the six months to June, a 48 per cent increase over the same period in the previous year. Estimates of the number of people in PNG infected with HIV range from 5 500 to 22 000, with the National Consensus Workshop in 2000 estimating the likely range as 10 000 to 15 000.

There are similarities in behaviour between PNG and some of the countries that have experienced serious epidemics

Incidence rates in some population groups and indicators of high-risk behaviours such as the high prevalence of STIs suggest that the disease could spread rapidly in PNG. As in other developing countries, the initial incidence appears higher in higher skilled groups and in urban areas, but there is evidence that the virus is not geographically isolated, and as in other countries HIV/AIDS will be a disease that impacts predominantly on the poorer members of society.

Measures of HIV/AIDS incidence in PNG are partial in nature and routine detection is biased towards detection in urban and higher income groups. Sero-surveillance has focused on high risk groups or easily surveyed members of the population (pregnant women, defense forces and police, prison population, blood donors) which may not be representative.

Box 1 summarises the main information available on the prevalence and incidence of HIV/AIDS in PNG.

The potential impact on the working age population is large

Three scenarios were developed for the spread of HIV/AIDS in PNG based on the actual and predicted paths of the disease in Kenya (low), South Africa (medium) and Zimbabwe (high). The prevalence pathways in these countries were used to predict the impact on the population aged 15 to 49 in PNG. As most of the deaths due to HIV/AIDS occur in this working age population cohort an epidemic has major ramifications for the size of the labour force.

If PNG follows the low scenario the working age population will be 13 per cent smaller than it would otherwise have been by 2020. If PNG follows the medium pathway the working age cohort will be smaller by 34 per cent and if it follows the high scenario, it will be smaller by almost 38 per cent by 2020. Chart 2 summarises the impact on the working age population under the 3 scenarios.

Box 1   **Most recent evidence on HIV/AIDS in PNG — to June 2001**

§   4075 reported HIV antibody positive cases

§   Confirmed AIDS cases reached 1 366

§   Reported deaths due to AIDS were 249

§   Gender — the distribution is approximately equal — 51 per cent male and 43 per cent female (6 per cent gender not reported)

§   Age — while age is not reported for 42 per cent of cases, of the remainder 6.1 per cent of reported cases are children under 5, 1 per cent children between 5 and 15 years, and 88.2 per cent between the ages of 15 to 49

§   Means of transmission — 69 per cent is unknown, 28 per cent heterosexual, and 3 per cent peri-natal transmission.

§   Province of reporting — of the recently reported cases 57 per cent were in the NCD and 28.5 per cent in the Highlands Province. However, the province of reporting need not reflect the province of origin.

§   Province of origin — 71 per cent of cases did not report on the province of origin, making what data is available of little use.

§   Occupation — as at December 2000, 81 per cent of cases did not report occupation, making the remaining data on occupation unreliable.

Source: National AIDS Council Secretariat and the Department of Health, June 2001.

Chart 2   **Impact of HIV/AIDS on population aged 15–49, 2000–20**
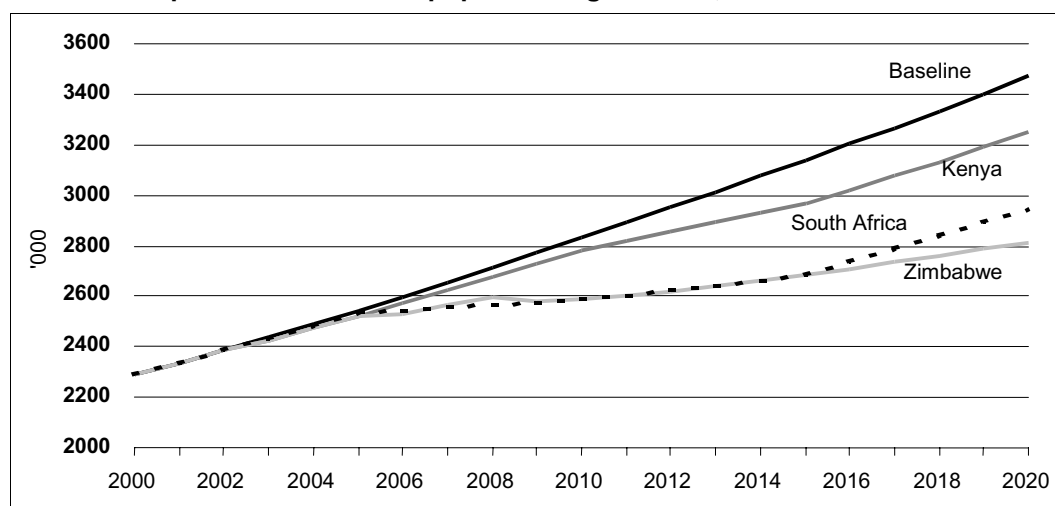
Data source: CIE projections, drawing on Jorari and Lasia (1996) and Gregson et al. (1998).

The macroeconomic effects — results from the CGE model

The impact estimates are based on a computable general equilibrium model (CGE) of the PNG economy. This model captures the interactions between five broad sectors of the economy — households, government, finance, production (43 industries including subsistence agriculture and crime) and the external sector (balance of payments). The benefit of using this model is that it allows the impact of changes in the labour supply to be traced through to wages, prices and levels of production (including imports and exports). The model is closed by assuming that the nominal exchange rate remains fixed. As a result upward pressure on domestic prices result in a real appreciation of the currency lowering the competitiveness of domestic production.

Key economic indicators

The key results from modelling the economic impact under the 3 scenarios are given in table 1.

Table 1 **Impact of HIV/AIDS on the main economic indicators — deviation from baseline in 2020**

	Low scenario	Medium scenario	High scenario
	%	%	%
Labour force	-13.2	-34.0	-37.5
Real GDP	-2.6	-6.8	-7.5
Real GDP per worker	12.0	41.0	47.9
Economic welfare (proxy for GNP per capita)	-5.8	-15.0	-16.6
Real consumption	-2.3	-6.0	-6.6
Real investment	3.9	9.9	11.0
Exports	-0.1	-0.2	-0.2
Imports	0.7	1.7	1.9
Current account (% of GDP)	-0.5	-1.3	-1.5
Tax revenue	2.5	6.5	7.2
Budget surplus (% of GDP)	-8.8	-19.4	-20.8
Real exchange rate	-0.6	-1.5	-1.6
Urban crime	-7.2	-16.6	-18.0

Notes: 1. Economic welfare refers to the full economic impact on domestic residents. This is distinct from GDP, which measures the impact on domestic production. 2. Tax revenue is stated in real terms by deflating with the price index for government consumption purchases. 3. The real exchange rate is defined as real kina per unit of real foreign currency.

Source: PNG economy model simulations.

Domestic production declines

The macroeconomic effects of such a large reduction in the labour force are profound, and quite complex. The key result is an overall decline in real Gross Domestic product (GDP) by 2.6 and 7.5 per cent under the low and high scenarios respectively relative to what it would have been without HIV/AIDS. This decline is well below the decline in the labour force as capital is substituted for labour and some labour is more fully employed.

Modelling shows rising GDP per capita but declining economic welfare

The greater relative decline in the labour force translates into an increase in real per capita GDP. Unfortunately the increase in GDP per capita does not mean higher national income per capita. The reduction in the labour supply pushes up wages, particularly for high skilled workers. This leads business to substitute capital for labour. With low domestic savings, investment growth results in a higher share of GDP accruing to the owners of foreign capital. The measure of economic welfare (a proxy for GNP per capita) declines by 5.8 and 16 per cent under the low and high scenario assumptions respectively.

External performance is little affected

The real appreciation of the exchange rate results from an increase in the domestic price level as a result of the increase in wages. With export prices fixed due to the closure of the model with a fixed nominal exchange rate, there is a shift in resources to the non-traded good sector. Imports rise slightly and exports fall, but mining exports are only slightly impacted.

Fiscal performance deteriorates

The budget deficit widens under all scenarios as the cost of providing government services increases. Tax revenue increases as a result of higher returns on income taxes due to higher wages and a structural shift to higher taxed industries but it falls far short of the rise in the cost of government services.

Social performance is mixed with falling crime, but increasing crime per capita

Urban crime, which is a measure of the unemployed labour force who have to rely on crime for survival, declines in absolute terms. But with falls of 5.1 and

14.5 per cent respectively under the low and high scenarios the crime rate declines by less than the decrease in population growth.

The model results assume PNG can continue to access foreign capital to finance investment and that the impact on public institutions is minimal

New investments with significant development costs may be deterred if institutional stability — law and order, government functions and so on — is threatened by an epidemic. Evidence from Africa suggests that higher morbidity and mortality can have debilitating effects on institutions. If this occurs then the risk premium on lending to PNG is likely to rise. This international market response would see that the nominal exchange rate depreciate, reversing some of the price effects seen in the model.

Sectoral effects from the model

The sectoral effects depend on the ease of substitution between capital and labour in the sector.

§ The mineral sector suffers little impact, declining by 0.6 per cent under the most pessimistic scenario.

§ Plantation agriculture is more affected, with decline relative to the baseline of between 2.8 and 7.9 per cent.

§ Subsistence agriculture suffers the greatest decline relative to the baseline without HIV/AIDS scenario, declining by 8.5 per cent under the low scenario and 24.2 per cent under the high scenario.

The impact of this on poverty in subsistence households is not clear as these falls reflect the decline in the number of workers. If, as expected, the epidemic increases the dependency ratio then these large falls in subsistence production are likely to exacerbate poverty in subsistence dependent areas.

Microeconomic effects and implications for development

Microeconomic effects flow from changes in income, costs and expenditure patterns

While a CGE model is a useful tool to look at the broad macroeconomic aggregates it is only as good as the information it is fed. There is considerable

uncertainty about how the epidemic might progress in PNG and what the household, government and firm responses will be. The key impacts are on:

§ households

– death and illness of a breadwinner and loss of income

– the burden of caring for the sick and orphans

– the cost of funeral and other related expenditure shifting patterns of family spending

– the possible removal of children from school in response to reduced income and/or the need for carers

§ firms

– reduced labour supply and reduced productivity of labour due to rising morbidity

– increased recruitment and training costs and costs associated with employee benefit schemes

– shift to more capital intensive technologies

§ government

– increased demands for public spending on health and the impact of shifts in resources on other sectors

– increased costs for the same reasons that firms are facing increased costs

– reduced revenue raising capacity, although this may be dampened by higher wages.

As the impacts depend very much on household, firm and government responses to these pressures no assessment is made as to the impact of HIV/AIDS in PNG in each of these areas. The implications for PNG suggested below are based on experience elsewhere in the world.

Sectoral impacts are potentially large, especially for health, education and infrastructure

The health sector is facing massive increase in demand

Tertiary care facilities will probably bear most of the burden, putting pressure on other treatment programs. The cost of treating HIV/AIDS patients comes not just from hospital bed time and treatment costs, but from the additional equipment and training required to minimise risk to health care workers. Higher wages for skilled labour and a premium for the increased risk exposure are likely to impact

severely on the cost of providing health services. How well PNG's health system can handle an HIV/AIDS epidemic will depend on the success of prevention including projects such as the treatment of STDs, and the cost-effectiveness of treatment and palliative care, such as home based care.

The education sector faces teacher shortages and possibly declining student numbers

The impact of HIV on the demand for education is uncertain. Evidence from other countries suggests that children, particularly girls, will be taken out of school to help care for the ill and because of decline in household income. However, with the increase in wages for skilled workers, there may be an increase in demand for, particularly vocational, training. On the supply side, teachers tend to be disproportionately affected by an HIV/AIDS epidemic. The government and its development partners face a challenge to ensure that there will be sufficient trained teachers available and that the vocational education and training sector can provide quality programs to meet potentially increasing demand.

Firms and other sectors face rising costs, but can also provide a good conduit for prevention education

The evidence from around the world suggests that employers who look after their employees face high costs associated with an HIV/AIDS epidemic in sick leave, health insurance, pensions, and the cost of replacing well trained staff. This provides these firms with a very good incentive to implement education programs to reduce infection rates among their staff. Infrastructure firms face a generally higher rate of infection due to the nature of their work. Major infrastructure projects will need to be aware of higher production costs likely in the future due to an increase in HIV infection.

The effect on subsistence agriculture is uncertain

While there is surplus labour in agriculture the macroeconomic modelling found that production declined by a substantial proportion, although not a great as the decline in the labour force resulting in increased production per worker. This outcome is driven in the model by the substitution between capital and labour and the availability of unemployed labour. There are a number of other reasons why this result would be expected. These are the lack of access to capital, which will be exacerbated by an HIV/AIDS epidemic, rigid roles based on gender and

social status that limits the substitution of one worker for another, an increase in time dedicated to caring for the ill and in funeral arrangements, and lack of incentive to produce more than can be consumed or easily sold into the cash market.

HIV/AIDS is likely to exacerbate poverty and reduce progress in gender equity

The impact of HIV/AIDS on people aged 15 to 49 will increase the dependency ratio, currently at 80 dependants per 100 workers. This will result in increased poverty unless income per worker rises considerably. Expenditure will also be diverted to dealing with the consequences of the disease such as medical and funeral costs. This could result in lower expenditure on the needs of children, women and the elderly as the more vulnerable groups in society. Women are also likely to bear the major burden of caring for the sick.

Future research needs

This study is a starting point to building a knowledge base on the potential impact of HIV/AIDS

The analysis in this study highlights the need to better understand the likely responses to HIV/AIDS in PNG. The impact on the economy, particularly in the long run, depends as much on household expenditure shifting and government policy as it does on whether the incidence of the disease is higher in skilled or unskilled workers. This report is a starting point for exploring the potential impact of HIV/AIDS on PNG. It sends a message that the impact could be profound and efforts to prevent a widespread epidemic are essential. Key areas for further research are to improve understanding of:

§   patterns of transmission through better sero-surveillance — this is essential for designing prevention programs;

§   behavioural responses to HIV/AIDS, key areas being:

–   willingness to take protective action to prevent transmission

–   how households adjust consumption and other investment decisions in response to the illness of a family member;

§   the extent to which firms and the public service are exposed to insurance and other employment related costs that are impacted by HIV/AIDS and how

they can balance this burden and continue to provide such services to their workers; and

§   the robustness of the government and market institutions to loss of workers and the impact on morale.

Policy evaluation should look at the opportunity cost of targeting HIV/AIDS

HIV/AIDS imposes considerable economic and social costs on countries and people around the world. But so do many other diseases of the poor that have received less attention. Malaria and tuberculosis may impose higher costs and be easier to tackle than HIV/AIDS, so diverting resources from programs in these areas to HIV/AIDS may reduce economic and social welfare. Creative approaches that look at ways of addressing combinations of problems and focusing on the most cost-effective options — prevention in the case of HIV/AIDS — are required. Future research should provide information for policy makers to help them make better informed policy choices.

1 Understanding the economic impact of HIV/AIDS

The economic impact of Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) in Papua New Guinea (PNG) has the potential to be significant in the next two decades. This study develops projections of the possible spread and demographic consequences of the epidemic. These are applied in an economy-wide model of PNG to examine how the disease may affect economic aggregates and different sectors. Different sectors in the economy are likely to be affected in different ways and the relationships governing the impact are explored at a micro as well as macro economic level. In drawing conclusions the focus is on aspects relevant to the development of policies and programs of development assistance related to prevention and mitigation of the effects of the disease.

Economic analysis is useful for planning

Economic analysis helps in evaluating the impacts of HIV/AIDS and the costs and benefits of mitigation and treatment programs. For example, economic analysis helps remind us that even epidemics causing great personal misery can have positive consequences for some people in the community — such as owners of human capital that becomes scarce as a result of death and disease. Economic analysis can help to assess the likely impact on the capacity of the economic system to deliver improved standards of living in the future. This has implications for the need for development assistance outside of areas directly related to the epidemic.

Economic measures fall short of being measures of national or local wellbeing in a number of important ways. No measure is made of the human misery created by disease, nor is account taken of the impact on production and consumption of goods and services that are not conventionally included in national accounts. The modelling also assumes that the institutional underpinning of the economy remains unaffected — even though an unchecked AIDS epidemic will erode these institutions in a number of ways.

While many human costs are not included the economic focus has value

While this work provides, at best, imperfect measures of the impact of HIV/AIDS on national wellbeing, it can still be of use to policy makers and agencies involved in development cooperation. In the first instance, the estimates of economic impact can help in judging the scale and direction of some of the effects of the disease. Focus on the economic impacts on households and industries as well as economic aggregates can help to sharpen understanding of the indirect as well as the direct effects of HIV/AIDS and the likely impact of measures adopted to address the disease. And, finally, the process of using such a framework can help identify priorities and needs for further information on the progress of the disease and its linkages with economic activity.

A conceptual framework

Production, consumption and investment decisions of households with sick members are affected by changes in ability to earn income and the need to reallocate resources to care for the sick and perhaps deal with the costs of a death. Policy makers have a special interest in the economic implications of HIV/AIDS because:

§ with no cures, and given the transmission mechanisms, the scale of infection can become very large; and

§ AIDS tends to strike young adults — affecting people in their peak earning years and when they may have significant numbers of dependents.

Because AIDS is very slow moving in the early stage of an epidemic the economic impacts may not become significant for some time. The lag between infection and death delays the impacts on infected individuals and the cumulative impact may remain small until a significant proportion of the population is infected. As the experience of some African countries shows, a mature epidemic can affect a large proportion of the population (Gregson, Zaba, Garnett and Anderson 1998).

The economic impacts of HIV/AIDS are identified by tracing through the effects on households, firms and the government and thus on measures of overall economic activity. It is important to recognise that while measures of the impact on economic aggregates — such as GDP or per capita GDP provide useful indications of the overall economic impact they typically fail to capture a

significant proportion of the economy's delivery of economic wellbeing to its people. This is because lots of economic activity is often unmeasured. More importantly, measures such as production and consumption are only a partial indication of welfare, so that small changes in measured economic impact may not mean that welfare impacts are small.

Channels for the economic impact of HIV/AIDS

Chart 1.1 presents a simplified view of some of the main channels for transmission of the direct economic impacts of HIV/AIDS.

Impact on households is severe and comes through lower income and increasing health and related costs

The impact of HIV/AIDS derives mainly from the effect on households. Sickness and death of family members with AIDS usually reduces household income. It also creates pressures for a reallocation of expenditures and of internal resources to address the care needs. Adult sickness and death and household responses to cope with the resulting loss of income can lead to a withdrawal of children from school to substitute for adult labour. This can have longer-term effects on the income earning potential of these children. If the infection is transmitted to other adult household members, other households may ultimately have to bear the burden of caring for orphans.

If the epidemic becomes sufficiently widespread, the impact on labour supply and consumption patterns will be transmitted through to the enterprise and government sectors of the economy.

Chart 1.1 **Major channels for economic impact of HIV/AIDS**

Households

Illness, death of breadwinner

Loss of family income

Re-allocation of household tasks

Shift in patterns of family expenditure

Illness, death of spouse

Take children from school

Burden of caring for orphans shifted to other households

Firms

§ Reduced supply and productivity of labour

§ Increased recruitment and training costs

§ Differentiation according to labour intensity

Government

§ Increased public spending on health with impacts on other spending and deficit

§ Changing production structure impacts on tax revenues

Macroeconomic impacts

§ Lower domestic savings

§ Lower investment in human capital

§ Increased skill shortages

§ Impact on growth, wage differentials, income distribution, relative return to capital and labour

Government is squeezed on both sides — with increased demand for health and medical services and reduced capacity to raise revenue

Governments may experience effects on both the revenue and expenditure sides of the budget. Reductions in household incomes and changes in expenditure

patterns may affect revenues from direct and indirect taxes. Governments may experience changes in demand for publicly provided services — especially health and education and social safety net payments. How this affects spending depends on explicit policy responses and how access to such services is rationed.

Governments may react to these pressures in a number of ways. Reduced revenues and increased health spending may, for example, be accommodated by increases in tax rates or the base for taxation, reduction of spending in other parts of the health portfolio or in other sectors, or by borrowing and an increased fiscal deficit — or some combination of these actions.

Lower incomes and increased health related expenditure at the household and government level might impact on domestic savings. If the country is relatively closed to foreign capital this tends to lead to lower levels of investment in physical and human capital, with consequences for the country's growth path. For an open economy like PNG with low levels of domestic saving and a reliance on foreign capital for investment, it may lead to increasing levels of foreign ownership if investment levels in the resource sector are maintained.

Firms face higher costs and a potential shortage of particularly skilled labour — some face falling demand and structural change is likely

Enterprises may experience additional labour costs due to increased costs of health insurance packages. More rapid turnover may mean that the workforce is less experienced, which will, along with increased absenteeism, impact on productivity. If the epidemic impacts differently on different types of labour, firms may need to pay relatively more for workers with skills that become relatively scarcer.

As well as affecting broad economic aggregates, the epidemic will produce pressures that may change the structure of the economy. Enterprises in sectors that make intensive use of the types of labour most affected by the epidemic may be forced to adopt different technologies or to contract. Similarly, the regional distribution of economic activity may alter. All these changes in turn feed back to households in the shape of changing prices, employment and investment opportunities.

The impact on subsistence agriculture is complex and depends on surplus labour, cash crop opportunities and social mores

For some households, such as those engaged primarily in subsistence agriculture, much of this feedback may be internalised, since they have limited engagement with the wider cash economy through which the mechanisms described above operate. Such households may be involved in some production of cash crops, and may receive remittances from migrant workers, but the bulk of subsistence needs are met through farming for own consumption. While the primary impact of HIV/AIDS is the same as for other households, the economic effects may not be readily measured in national statistics, although still being significant for overall community wellbeing.

Chart 1.2 traces some of the complex economic and social consequences HIV/AIDS disease may have on households and their local communities. Since the immediate effect is a reduction in available labour, the consequences for the farm/household system will depend on the nature of farming activities and the scope and nature of labour inputs they require. This is influenced by rainfall patterns, soil conditions and crop choice.

Some crops, often in localities with seasonal rainfall and a propensity for drought, may require bursts of labour at particular times in the cropping cycle; other crops in fertile regions with regular rainfall may not require such intensity of effort. Another important factor is the extent of 'surplus' labour and underemployment. If labour provided by a household member lost through illness or death can be replaced by increased effort by other household members, production levels need not fall. However, despite underemployment, availability of substitute labour will depend on the extent and rigidity of gender division of home and farm work. The ability of households and communities to cope with the effect of illness and premature death will also depend on land tenure and inheritance systems, along with customary practices dealing with marriage, widowhood, orphans and communal safety nets.

Chart 1.2   **Impact of HIV/AIDS on subsistence farming households**

Factors affecting impact

§ Climate (labor shortages more severe in seasonal rainfall climates).

§ Gender specification (women in food crop production, child care).

§ Land tenure, inheritance systems (transmission of land use rights to survivors).

§ Relative scarcities of land and labour.

§ Access to knowledge (on farming systems).
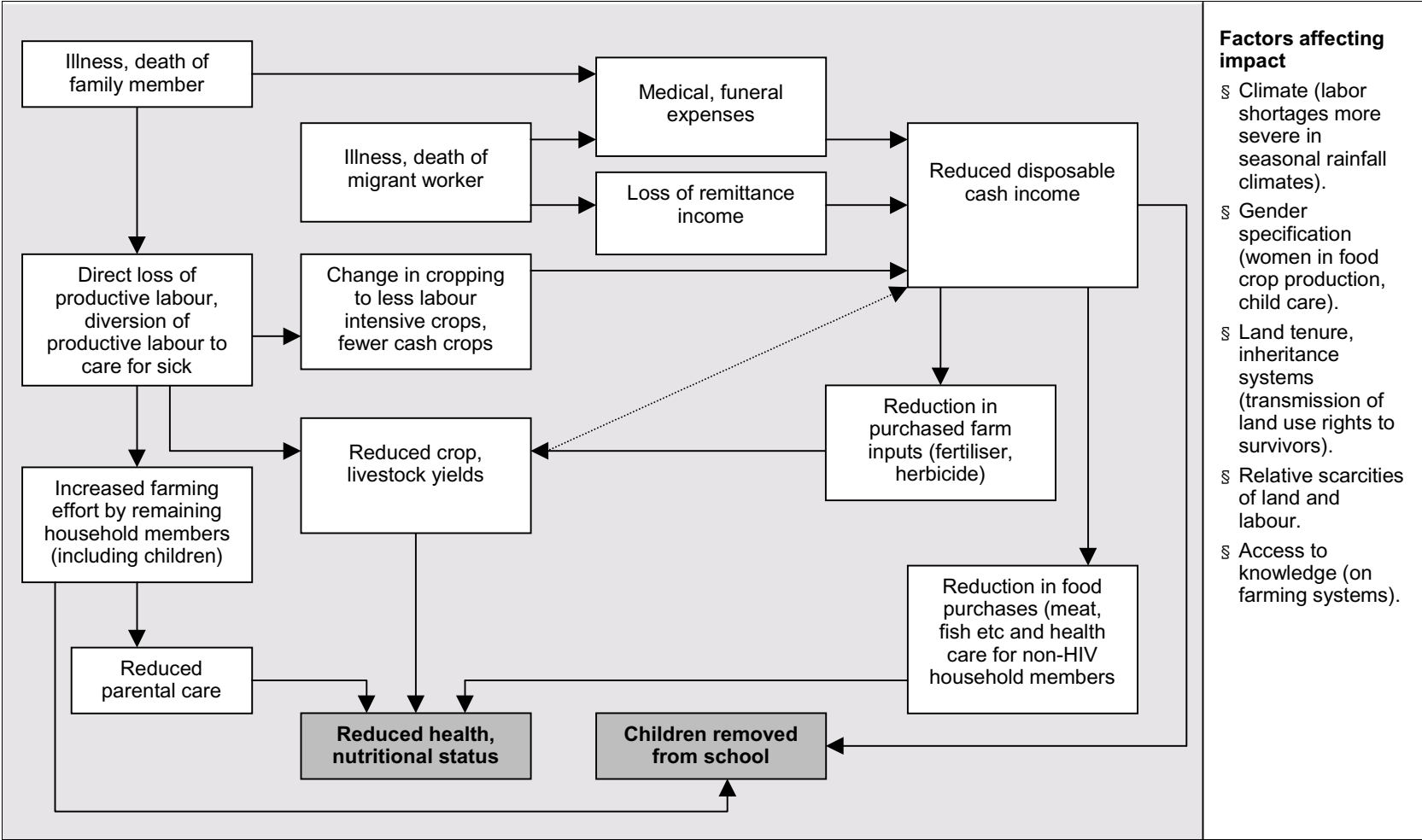
Source: Based on Panos Institute (1992), reproduced in Barnett, Blas and Whileside. (1996).

The interplay between economic forces and HIV has long been recognised. On the transmission side, HIV poses a risk in some professions, with relatively high incidence of HIV infection among professions such as sex workers. The high costs of diagnosing and treating AIDS impacts not only on households but also on governments. And high private income and potential national output losses result from the concentration of working age individuals among AIDS cases. The question is how big are these effects, and whether the reduction in the population offsets the impact on income. The answers found indicate a diversity of experience depending on the key factors of how much investment is affected, whether HIV/AIDS prevalence is higher for skilled labour, the extent of surplus or underemployed labour, and whether behaviour adjusts in response to the epidemic over time, thus reducing incidence and eventually prevalence.

Analyses where there is a disproportionate impact on skilled labour and on investment via domestic savings find potentially large declines in per capita GDP

Early analyses examined the possible consequences for growth in GDP arising from the effects of AIDS on labour supply and domestic savings using neoclassical growth models (Cuddington 1993, Cuddington and Hancock 1994, Over 1992). The models used for these analyses assumed a direct link between domestic savings and investment, and explored the effects of alternative assumptions about how much of the increased spending on medical costs is funded at the expense of saving, and about the distribution of AIDS across different skill and occupational categories of the work force. This work showed that with certain values for the parameters characterising these assumptions, per capita GDP growth could be negatively affected. Over, for example, concluded that if 50 per cent of the increased medical costs were financed by reduced savings (and hence investment), and AIDS is disproportionally concentrated among the more educated, urban classes, then GDP per capita growth rate in sub-Saharan African countries could be depressed by 0.15 to 0.33 percentage points per year after ten years.

Large impacts on labour supply and productivity also contribute to findings of lower per capita income

Other studies (for example, Kambou, Devarajan and Over 1992 and Arndt and Lewis 2000) have used economy-wide models to examine the effect of AIDS, concentrating on impacts on labour supply, productivity, and household and

government spending (and, as a consequence on savings and investment). These studies again suggest that the effects may be significant in African countries with well-advanced epidemics. Arndt and Lewis, for example, suggested that under certain assumptions per capita GDP in South Africa in 2010 could be 7 per cent lower than it would otherwise have been as a result of AIDS.

But there are a number of reasons why the impact could be mitigated

These analyses have not gone unchallenged. Bloom and Mahal (1997) have argued that these studies are likely to overstate the threat that AIDS poses to per capita economic growth. They put forward five reasons why this may be happening.

§   Most developing countries covered by these analyses have significant surplus labour that should mitigate the output losses due to AIDS morbidity and mortality.

§   If AIDS is, as increasingly appears to be the case, linked to poverty, then AIDS related output losses, income losses and medical expenditures will be fairly low on a case by case basis — poor people have lower productivity because of lower human capital, lower earnings and lower access to medical services.

§   The incentives created by the direct price and expenditure effects of AIDS will stimulate responses from individuals and the community, and other economic adjustments may occur. Higher wages for skilled labour may, over time, increase the supply of people willing to acquire skills. Experience also suggests that community and family network coping mechanisms often emerge as lower cost ways of addressing the medical treatment of the epidemic than the formal health care system.

§   The impact on savings may be smaller in the long run, as other adjustments in household and government expenditure may occur. (As discussed above, the link between investment and domestic savings may also not be as strong as these models assume, if foreign investment can enter the country relatively easily.)

§   Some kind of behavioural response to the consequences of high-risk behaviour might be expected to reduce the number of AIDS cases from projected levels.

Bloom and Mahal take an alternative approach by examining the impact of AIDS on economic growth directly from the actual experience of countries with

different levels of HIV prevalence. They use standard growth models to measure the nature and strength of the statistical association between the prevalence of AIDS and the growth rate of per capita GDP across 51 countries, after controlling for other factors likely to influence growth. They find that AIDS had no statistically significant impact on growth in per capita GDP in the sample countries over the period 1980 to 1992. They compare the results with smaller analyses of the early 20th century influenza epidemic and the Black Death epidemic of the Middle Ages, where a similarly negative conclusion is reached.

What are the lessons for the likely impact on PNG?

While the arguments Bloom and Mahal present are credible, the sample of the 51 countries reflects a wide range of experiences with HIV/AIDS. In these types of analyses there is a tyranny of the middle, and for the 'average' country it may be that the forces for and against a large economic impact are roughly equal. For PNG the balance of the forces needs to be examined.

In PNG there are a number of important features of the economy that will play a key role in shaping the economic impact of HIV/AIDS. The structure of the economy and the behavioural relationships are the two main factors that will influence the impact of HIV/AIDS. But as outlined below the relationships are not always straightforward.

§ Large shares of GDP and government revenue come from the capital intensive mining and petroleum sectors selling into world markets. These sectors are not labour intensive and skilled labour is often sourced offshore. The implication is that these sectors and the government revenue they generate will not be greatly affected in the short to medium term. New investments with significant development costs may however be deterred if institutional stability is threatened by an epidemic.

§ A large proportion of the population is engaged in quasi-subsistence agriculture. This sector appears to have considerable surplus labour, and in some areas surplus land. Production responses will be affected by:

    – behavioural considerations such as gender differentiation with respect to the division of labour which will shape the labour response,

    – the extent to which production is determined by the number of people that need to be supported by subsistence production, and

    – the opportunities for cash cropping, which if limited by access to markets anyway may be little impacted.

§   The educational attainments of the population are low — adult literacy is 70.6 per cent for men and 56.8 per cent for women, and the supply, at least in the short–term, of skilled workers is limited despite unemployment and under employment among unskilled workers. This shortage of skilled workers means that an HIV/AIDS epidemic is likely to push up real wages for skilled workers, resulting in contraction in sectors that require skilled labour. While higher wages may encourage the acquisition of greater skills, the poor state of the education sector will make this response difficult to deliver.

§   The main source of financing for major investment is foreign investment and with an open capital market and confidence in political stability, capital flows should not be greatly affected. For subsistence farmers with cash crops however the small household investment required could be eroded by the diversion of savings to medical and funeral expenses.

§   The capacity of the government and of community organisations to respond to the epidemic will have a strong influence over behavioural change and the costs borne by households. It is not clear what this response will be, but given the poor state of the health system households are likely to bear much of the cost.

§   Income and asset distribution in the country will shape reallocation of household expenditure and the pressure on the government to supply additional HIV/AIDS related services. Very little is known about likely household responses to having a family member with HIV/AIDS, which in any case are likely to vary from region to region. Given this lack of know-ledge the economic analysis that follows focuses on the one thing that can be projected with at least some confidence — the impact of HIV/AIDS on the supply of labour.

2 HIV/AIDS in PNG: now and in the future

Current knowledge about the PNG epidemic

HIV was first reported in PNG in 1987. Since then, the number of reported cases of the HIV and its sequelue, AIDS, has steadily grown (charts 2.1 and 2.2). By the end of June 2001, a total of 4075 cases of HIV including at least 1366 cases of AIDS, had been reported and 249 deaths had been attributed to AIDS (National AIDS Council Secretariat and Department of Health, June 2001).

The only thing that is sure about the reported numbers is that they under-represent the extent of HIV infection in the population. Testing is very limited and is largely confined to high risk groups. For example, a high proportion (34 per cent) presented with an AIDS defining illness at the time of diagnosis. Despite the data limitations, these reports reveal some important characteristics of the HIV epidemic in PNG.

Chart 2.1 **Number of reported HIV and AIDS cases by year of detection, 1987–2000**
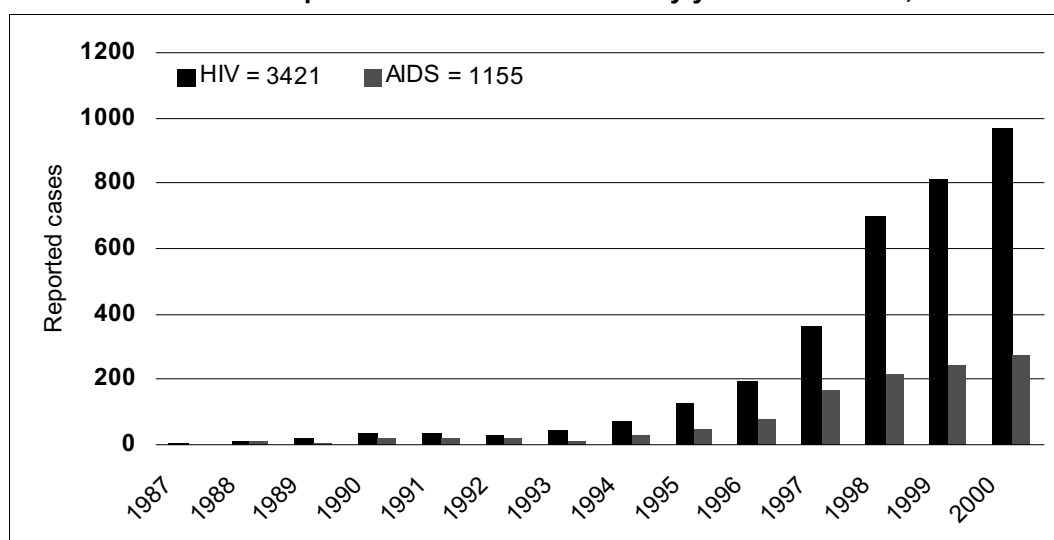
Data source: National AIDS Council Secretariat and Department of Health, PNG (2000).

Chart 2.2 **Cumulative reported HIV & AIDS, by year 1987–2000**
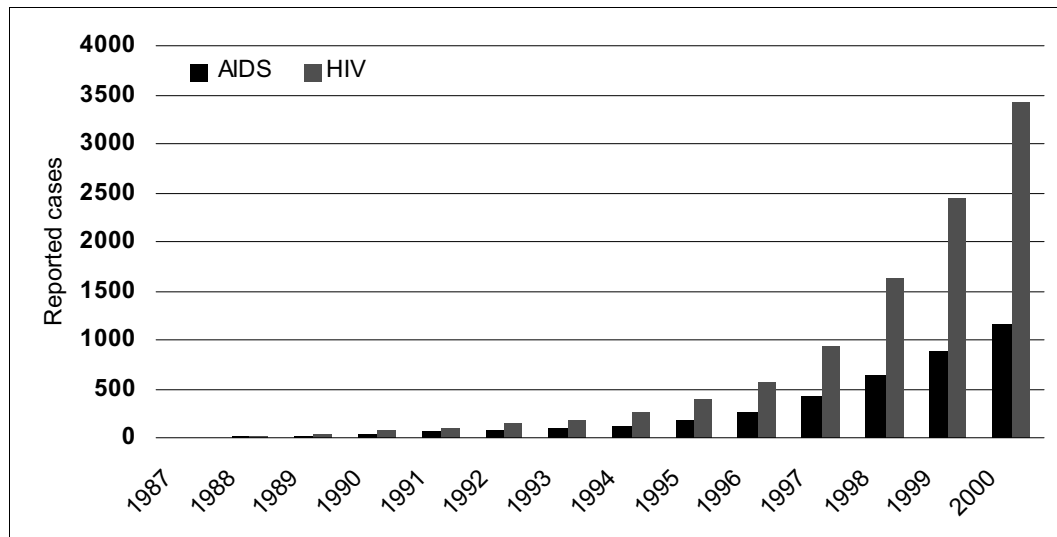
Data source: Derived from National AIDS Council Secretariat and Department of Health, PNG (2000).

Internationally, UNAIDS/WHO classify three different epidemic states.

§   *Low-level.* HIV infection may have existed for many years but has never spread to significant levels in any sub-population. Recorded infections are largely confined to individuals with higher risk behaviour. Networks of risk are rather diffuse, with low levels of partner exchange or sharing of drug injecting equipment. HIV prevalence does not exceed 5 per cent in any defined sub-population.

§   *Concentrated.* HIV has spread rapidly in a defined sub-population but is not well established in the general population, suggesting active networks of risk within the sub-population. The frequency and nature of links between highly infested sub-populations and the general population determine the future course of the epidemic. HIV prevalence is over 5 per cent in at least one defined sub-population but below 1 per cent in pregnant women in urban areas.

§   *Generalised.* HIV is firmly established in the general population. Although sub-populations may contribute disproportionately to the spread of HIV, sexual networking in the general population is sufficient to sustain an epidemic independent of high-risk groups. HIV prevalence is consistently over 1 per cent in pregnant women (UNAIDS/WHO 2000).

The current measured HIV/AIDS prevalence places PNG in either the low-level or concentrated phase. The indicators presented in this chapter suggest that there is a high risk of PNG moving to the generalised epidemic state.

Evidence on the characteristics of PLWHA

The characteristics of people living with HIV/AIDS (PLWHA), and how and where they were infected is important information in predicting the likely spread of the disease. Currently there is too little information available even about reported HIV-positive cases to make firm conclusions about likely transmission patterns. Below some tentative conclusions are presented. The data on which this discussion is based is given in appendix A.

§ *Gender* data is fairly good (see table A.3). The fairly close sex ratio of known HIV-positive people points to the certain heterosexual transmission of the infection (Caldwell 2000). This suggests that, barring considerable behaviour change, the epidemic will progress quickly in PNG.

§ *Age* is reported in only 60 per cent of cases and therefore the information is fairly weak. The known age distribution is similar to that in other countries where heterosexual contact is the main means of transmission — 69 per cent of the known age HIV-positive people are aged 20–39 years (table A.3). This constitutes the young section of the economically active population.

§ *Means of transmission* is reported in only one third of cases. Other evidence confirms the preponderance of heterosexual transmission. The only other significant category is peri-natal transmission (table A.4).

§ *Province of reporting* is mostly complete but this information is probably misleading as some people come to Port Moresby for testing, some might be short-term migrants, others might have lived there for some time (table A.5).

§ *Province of origin* is not reported for two-thirds of known PLWHA. Where they were infected, and where they are now living and possibly infecting other people are the important, but unknown, matters (table A.5).

§ *Occupation* data is very weak — 81 per cent of cases have no occupation recorded (WHO et al. 2000). The recording is best in the National Capital District (larger Port Moresby) where just over one-third (38 per cent) of cases have no occupation recorded, but even this is too big a gap across which to assume the known distribution mirrors the total distribution (table A.6). Among the known cases the distribution is:
  – unemployed, 24 per cent
  – housewife, 21per cent
  – child under 6 years, 17per cent
  – farmer/villager, 10 per cent
  – sex worker, 8 per cent

–   professionals, 5 per cent

–   office/shop worker: 5 per cent

–   disciplined forces, 5 per cent

–   unskilled worker, 3 per cent

–   student, 2 per cent.

Care is needed in interpreting the available data

The main problems with the information on HIV/AIDS fall into three categories.

§   *Under-reporting, late reporting and under-diagnosis.* The real number of infections is thought to be many times greater than the reported numbers, but it is not possible to be exact about how much greater. HIV is largely asymptomatic and AIDS is an underlying condition, not the immediate cause of a person's illness or death. There has been some sero-surveillance of the HIV epidemic in PNG but this is not complete, partly because of insufficient funds for baseline surveys but also because of the difficulty of identifying the correct sentinel groups and their small size. When someone is clinically sick through AIDS this should enter into the disease reporting system; HIV reporting is more haphazard. Some known HIV-positive people are not included in the official count for various reasons, and some people who are diagnosed overseas or treated by a private doctor may not be officially reported to health authorities. The constraints facing rural medical services and the vital registration and the death registration systems, also contribute to under-reporting of HIV and AIDS.

§   *Incomplete information about the known cases of infection.* Of the reported cases, 3.6 per cent are of unknown sex, 70 per cent have no identified means of transmission, 42 per cent are of unknown age, 85 per cent have no record of their province of origin (National Aids Council Secretariat and Department of Health June 2001), and 81 per cent have no occupation recorded (WHO et al 2000). It cannot be assumed that the characteristics that are recorded fairly represent those that are not. For example, of the 551 cases with known employment, 24 per cent were unemployed, but that is not necessarily true of the other 2877 people.

§   *Possible bias.* Around 70 per cent of new HIV cases are diagnosed in Port Moresby General Hospital (PMGH). HIV testing is very limited in rural provinces, other than Western Highlands Province. The higher prevalence of HIV in Port Moresby may reflect the true situation or it could be an artifact of measurement, resulting from the location of most testing and recording facilities.

The prevalence of HIV: estimating the number of PLWHA

Current estimates of prevalence

Official estimates of PLWHA in PNG are in the range of 10 000 to 15 000 cases. (WHO et al. 2000). These estimates were based on the 1990 projections of the population of 4.5 million in 2000 and an estimated HIV prevalence (that is, the proportion of the population currently infected) of 0.6 per cent of the population. The detailed estimates are given in table 2.1. The PNG population was most recently counted in the 2000 National Census finding that the national population is considerably bigger than expected at 5.13 million. A larger Port Moresby population would lower the current prevalence estimate, while the larger population implies more people with HIV/so there is a need for caution in interpreting the estimates.

Surveys form the basic information for estimating prevalence

The base evidence for the estimation of prevalence rates is surveys of prevalence in sentinel groups. Sero-surveillance has been focussed on high risk groups (sex workers, STI clinic attendees) or easily surveyed sub-populations (ante-natal

Table 2.1 **Expected prevalence of HIV in PNG, 1999**

Population	Assumption	Estimated size of population	Average HIV prevalence rate	Estimated HIV prevalence
		No.	%	No.
Port Moresby				
General adult population 15–49 years	Same HIV prevalence as antenatal clinic attendees	140 000	0.345	480
STD patients	30 per cent incidence per year of most common STI	60 000	7.0	4 200
Rest of country				
General adult population 15–49 years	Same HIV prevalence as blood donors in 1999	1 575 000	0.15	2 360
STD patients	30 per cent incidence per year of most common STI	675 000	1.0	6 750
Total		**2 450 000**	**0.6**	**+/- 13 800**

Source: WHO, National AIDS Council and Dept Health (2000).

clinic attendees, blood donors) whose exposure to HIV may be more similar to the general public — although blood donors are a self-screening population and may have lower prevalence. These surveillance activities have included:

§   establishment of the National AIDS Surveillance Committee in 1987 and HIV reporting mechanisms;

§   anonymous sero-surveillance in representative government antenatal and STDs clinics;

§   surveys of sex workers and Defence Force personnel; and

§   behavioural studies in selected populations.

Table 2.2 presents survey evidence from PNG.

Table 2.2   **Measurements of HIV prevalence, 1999**

Urban	HIV prevalence
	%
Port Moresby: STD Clinic	7
Port Moresby: general Hospital Antenatal Clinic	0.32
Port Moresby: blood donors	0.25
Port Moresby: female sex workers (1997)	17
Lae: female sex workers (1997)	3
Other STD clinics in four locations (1999)	1.2
Whole country	
Defence Force personnel	0.4

Source: WHO (2000)

National prevalence estimates are based on various assumptions about the ratios between reported and unreported cases of HIV and whether or not the levels of infection detected in some places or among some groups apply throughout the country. The sero-prevalence of high-risk groups (sex workers, STI clinic patients) is usually well above the general population, but as there are no firm rules on what this means, these results can also give mixed signals about the direction in which the epidemic is heading (Caldwell 2000).

The ratio of reported to unreported cases needs to be estimated

Internationally, the ratio between reported and unreported HIV was not so long ago thought be around 1:100 (United Nations 1996). In 1996, the World Health Organization (WHO) estimated that 5 per cent (1:20) of all HIV infections in PNG were reported (WHO 1996). The more recent WHO/NACS/Department of

Health estimates suggest that the ratio of reported to unreported HIV is some-where in the range of 1:3 to 1:4.

Another indication of prevalence is the ratio of reported HIV to reported AIDS. AIDS is clinically apparent — most cases are detected when a person becomes ill. HIV is mostly asymptomatic and therefore less likely to be detected unless picked up in a surveillance program. There should be many more cases of HIV in a population than of AIDS because of the incubation period for AIDS. As the epidemic progresses, it is likely that the ratio will increase and then decline. In the United States in the 1980s, where there was fairly comprehensive sero-surveillance, the ratio between reported HIV and reported AIDS was in the order of 18 to 1 (Jim McMaster, pers. comm., May 2001). The close ratios in PNG suggest that HIV is considerably under-reported (chart 2.3). A related issue is the speed at which HIV progresses to AIDS. Early indications were that the progression was faster in less developed countries, possibly less than five years, but recent data in progression rates shows the difference between countries is quite small. In sub-Sahara Africa, median survival after infection is probably around 6.5 years (Gregson et al. 1998).

The incidence of HIV/AIDS: showing the trends in infection rates

Incidence refers to the number of people who become infected with HIV during a particular period, usually per year. It ideally measures the rate of new infection but actually reflects changes in both the tempo of the epidemic and the efficacy of

Chart 2.3 **Ratios of reported AIDS and HIV in PNG, 1987–2000**
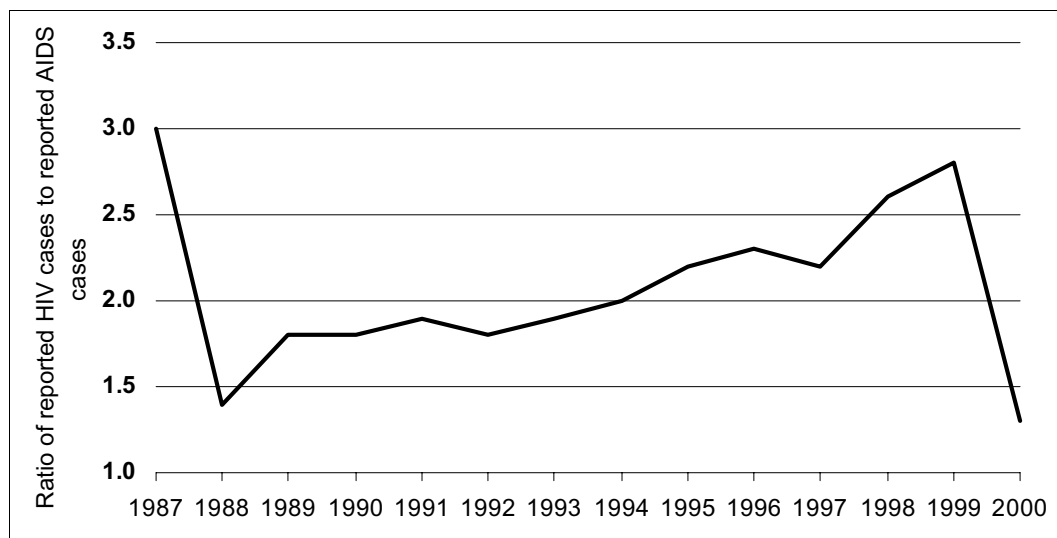
Data source: Derived from National AIDS Council and Department of Health (2000).

reporting.

Chart 2.4 shows a high national incidence rate in the early 1990s that fell — primarily as the initial base expanded (it is easy to double small numbers). The incidence rate then picked up steeply from 1993. At its peak in 1997 and 1998, the number of reported HIV and AIDS cases grew by around 60 per cent each year. Its recent decline may again reflect the fast growing base number and forecast an even greater wave to follow.

The interpretation of the incidence rate needs to take into account the way in which the epidemic is expected to grow. It is assumed HIV will incubate within core groups — that is people at special risk — and become a concentrated epidemic within these groups before it crosses out to the general public and becomes widespread. Depending on the size and behaviour of these core groups, their connections with the wider population, and the extent to which they are monitored for HIV, the national incidence may remain low even as the momentum of the epidemic is increasing in the core groups.

Chart 2.4 **Rate of incidence of reported HIV and AIDS in PNG, 1989–2000**
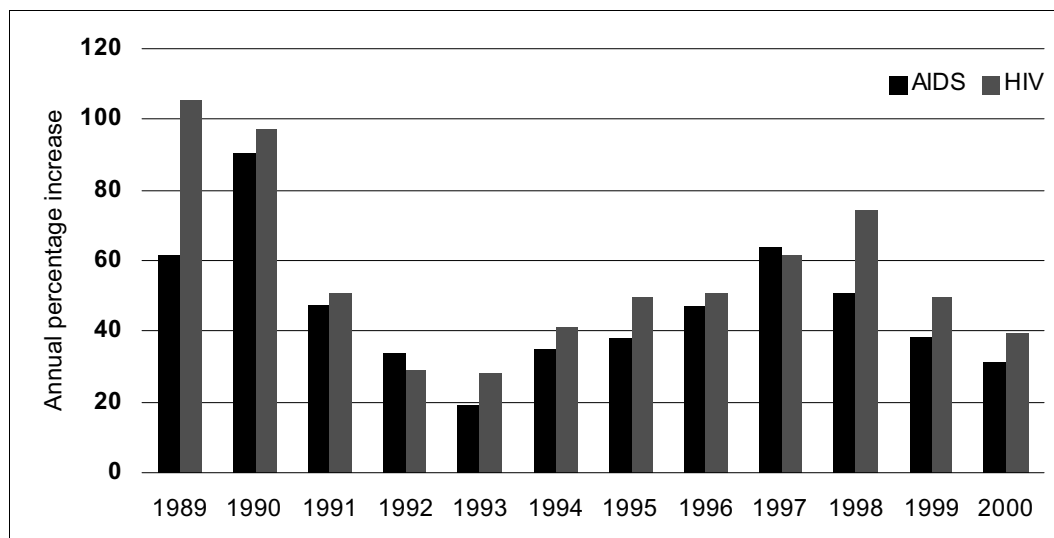
Data source: Derived from National AIDS Council Secretariat and Department of Health, PNG (2000).

What evidence there is suggests a rise in prevalence, if not incidence

From the surveillance that has been conducted in PNG, some groups show rapidly rising HIV infection. In particular:

§   patients at STI clinics — in Port Moresby, HIV prevalence more than doubled during 1998-99, from 3 per cent to 7 per cent. In four other locations it increased from 0.7 per cent to 1.2 per cent from 1997 to 1999;

§   healthy blood donors — HIV prevalence increased from 0.09 per cent to 0.25 per cent between 1998 and 1999;

§   women attending the PMGH Antenatal Clinic — HIV prevalence doubled from 1998 to 1999; and

§   there has been a rapid increase in all surveyed groups in Port Moresby since 1999 (WHO, et al 2000).

Certainly, as the number of AIDS cases has grown, more attention has been given to diagnosing HIV, but it is still patchy and mostly confined to Port Moresby. Diagnostic services are virtually non-existent for a large part of the population.

Given the shortcomings in HIV testing and reporting in PNG, it is not possible to decompose the incidence rate to account for improved HIV monitoring for, what is perhaps, a greater propensity for people to be checked for HIV as the community sees more AIDS in their midst — as may be happening in parts of Port Moresby. Together with the relatively small number of reported cases to date, this makes any projections of the future growth of HIV infections inherently uncertain.

Projecting the progress of the epidemic

The projected growth in adult and peri-natal HIV and AIDS to 2005 is shown in chart 2.5. From a base estimate of 13 800 HIV-positive people in 1999 more than 1200 new cases of AIDS were estimated to have occurred in 1999. By 2005 the annual increase in AIDS cases is expected to exceed 1800 (WHO et al. 2000).

Chart 2.5   **HIV estimates (1986–2000) and AIDS estimates and projections (1986–2005)**
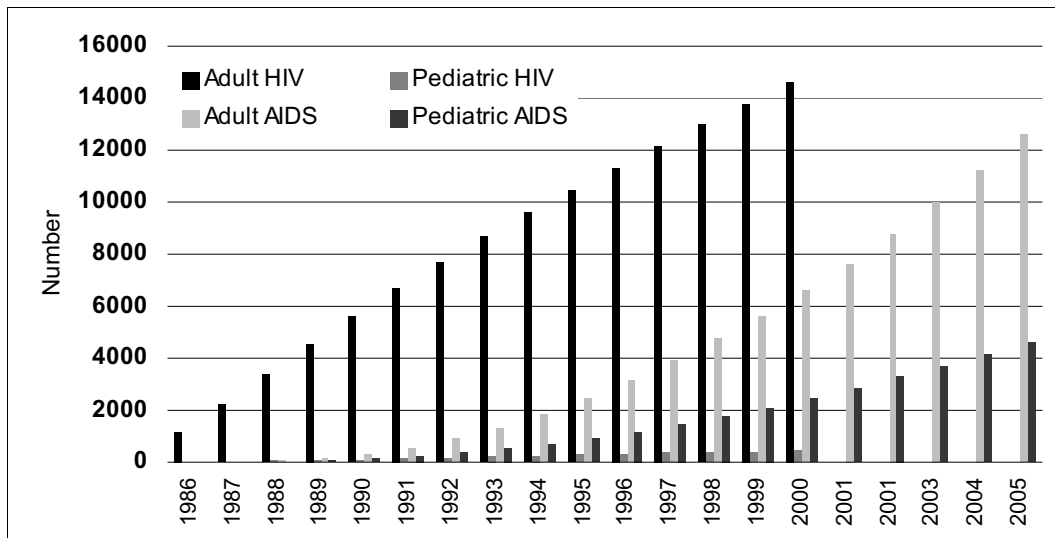
Data source: WHO, National AIDS Council and Dept Health (2000).

There are two major factors that will influence the progress of the epidemic. The first is the extent to which the disease is isolated geographically, the second is the extent to which it is isolated socially. According to Caldwell (2000), the following conclusions can be drawn from the development of the epidemic in PNG .

§   a major epidemic, perhaps greater than in Thailand and Cambodia is probable;

§   there already are epidemic levels of HIV/AIDS in Port Moresby, especially among the poor and migrants into shanty areas; and

§   having taken firm hold in Port Moresby, the disease will soon spread through migration to other parts of the country.

Evidence on transmission patterns

PNG has the highest rates of HIV/AIDS in the Pacific island region but currently a moderate incidence compared to neighbouring Asian countries — a relativity that reflects the present duration of the epidemic, not its potential impact. The HIV epidemic in PNG passed 'take-off' point somewhere around 1994. Caldwell (2000) tentatively attributed the late start of a major epidemic in PNG to the small size of the urban population, the absence of a highway system across the whole country, the small size of the commercial sex sector {sic}, and possibly the lack of chancroid to act as a cofactor.

Evidence on the urban/rural nature of the disease and likelihood of spread

Patterns of migration can play a major role in the progress of an HIV epidemic. PNG's population is largely rural — in 1998 just under 17 per cent of the population were urban residents (AusAID, 2000). The main migration flows in PNG are the movement of people from rural to urban areas, principally to Port Moresby, with a very much smaller counter-flow; and quite intense local circulation between the other towns or economic enclaves and their rural hinterland. It is likely that the HIV epidemic began in the urban areas, most likely Port Moresby, although as discussed the relatively high incidence rates in Port Moresby may reflect the concentration of testing there. Various studies on urban and rural commercial sex have suggested population circulation acts to distribute STIs and HIV throughout the rural population.

Geographic concentration in Port Moresby?

The speed at which the epidemic develops depends on the extent to which it is now concentrated. The important question in PNG is whether or not this is a predominantly urban epidemic, centred on the capital city, Port Moresby. The following points support this view.

§ In Port Moresby, the epidemic appeared to generally intensify in 1999 (Crockett 2000).

  – Annual surveys of new patients attending the STD Clinic at PMGH show rising prevalence.

  – Among healthy blood donors in Port Moresby HIV prevalence rose abruptly between 1998 and 1999 (WHO, National AIDS Council and National Department of Health 2000).

  – Among women attending antenatal clinic at the PMGH prevalence doubled from 1998 to 1999.

§ Port Moresby is isolated from the rest of the main island by steep mountain ranges, and the disease could have incubated there, somewhat independently of the rest of the country. While there is migration between Port Moresby and other parts of the country, it is restricted by the need to travel in and out of the city largely by air. This both limits the traffic and restricts it to mainly higher income groups — but there is little information about how this may affect sexual networking in PNG. Jenkins (1994) documented some sex work on commercial coastal sea traffic between Port Moresby and other coastal

towns. This is a relatively small flow of people but, again, it is difficult to judge its cumulative impact on sexual networking across the country.

§   High-risk sexual behaviour is widespread in Port Moresby, including formal and informal sex work. Widespread high-risk sexual behaviour is also reported in other towns and commercial enclaves, such as around mines. In urban areas particularly, high rates of commercial sex are driven by economic need, in particular the high rate of unemployment and lack of alternative income generating possibilities (Crockett 2000).

§   There is some general association between HIV and urban areas. In Africa, HIV prevalence is consistently and significantly higher in urban areas (Loewenson and Whiteside 1998).

Much higher prevalence rates have been found for Port Moresby than other parts of PNG, and these rates have recently escalated. Although the limited information available which shows other urban centres also have higher prevalence than rural areas (see table 2.1 above) which suggests that the urban areas rather than just Port Moresby are more vulnerable. If Port Moresby is the front-runner in PNG's HIV epidemic, this sudden intensification may be the harbinger of things soon to come throughout the country.

Factors suggesting a widespread epidemic

Higher urban prevalence may mostly reflect the location of the better health centres and testing facilities in the towns, particularly Port Moresby. The following points support the view that HIV may be almost as much a rural as an urban epidemic:

§   Multiple sexual partners, sexual violence, poverty, and other conditions in which a heterosexual HIV epidemic spreads quickly are by all accounts widespread in PNG (National Sex and Reproduction Research Team 1994; Toft (ed) 1985; Counts (ed) 1990; National Statistical Office 1997; Duncan 2001; UNDP 1999).

§   HIV has now been reported in all provinces, but information on the national distribution of infection is incomplete. Apart from the National Capital District (Port Moresby) (830 cases), other concentrations of reported infection are in Western Highlands Province (114 cases), Simbu (40 cases), Morobe (38 cases), and Enga (34 cases) (see appendix A). Again, these provincial reports are certainly under-counts.

§   The presence of HIV infection in provincial urban centres suggests it would be spreading into the rural hinterland of these towns. Circular migration

between provincial centres and rural communities is not as constrained as from Port Moresby. Although most towns are very small service centres, with populations of 5000 or less, there is a lot of movement of people to and from them (King 1993). A 1998 survey in Lae, one of the larger urban centres, found 3 per cent of female sex workers to be HIV-positive but there are doubts whether the sample is representative. Lae is a portal to the highlands via the Highlands Highway. HIV-prevalence was measured at around 1 per cent among STD clinic attendees in Lae, Kundiawa and Hagen in 1999. Among tuberculosis patients in Goroka, HIV-prevalence rose from 2.8 per cent to 4.6 per cent from 1994 to 1996 (WHO et al. 2000).

§ In areas where cash is readily available, such as around mines, social mores have changed fast. Clark and Hughes reported an upsurge in commercial sex in Tari following the mineral boom there in the early 1990s (Clark and Hughes 1995, Hyndman 1991 in J. Connell and R. Howitt (eds.).

§ In parts of the Highlands where it now supersedes coffee in value, the production of marijuana has reportedly brought large amounts of cash into previously quite remote and cash-poor rural settlements (Time Magazine March 2001). An upsurge in cash earnings has often been associated in PNG with an increased exchange of sex for cash, as documented above.

§ A rising prevalence of tuberculosis is often associated with a spreading HIV epidemic. In a developing country, people with HIV can be more susceptible to tuberculosis and AIDS often manifests itself as a tuberculosis infection. Furthermore, deaths from tuberculosis may mask deaths from AIDS, depending on what is recorded as the cause of death. The national incidence of tuberculosis has risen from 0.8 per 1000 in 1974, to 10.7 per 1000 in 1984, to 51 per 1000 in 1999 — surging to account for 7 per cent of all deaths in 1995–97. It has moved from being the sixth leading cause of death between 1960 and 1984, to fourth in 1995–97, and the trend continues upward (National Statistical Office 1997).

Evidence on the characteristics of PLWHA and the implications for spread of the disease

The main route by which HIV is spreading in PNG is heterosexual intercourse, which has accounted for 91 per cent of the infections for which a transmission route is known (that is, only one-third of reported cases) (WHO et al. 2000). Peri-natal transmission accounts for another 8 per cent, a figure that will rise as the epidemic affects more women of childbearing age. There are no recorded cases of transmission through injecting drug use and only seven cases recorded of male-to-male transmission.

Concentration in high risk professions

The size of and extent to which the high-risk groups are self-contained impact on the likely spill over to the general population. Studies in Africa identified the significant distributive role of people in highly mobile professions, such as long-distance truck drivers, migrant labour, and business travellers in spreading HIV. Carol Jenkin's (1994) study suggested a similar process is occurring in PNG.

In her 1994 study of potential HIV distribution via road and sea transport, Carol Jenkins noted the high extent that truck drivers along the Highlands Highway and sailors on coastal ships engaged in commercial sex. She proposed that these few major routes were important conduits for HIV transmission into rural PNG — as the highway was for the spread of syphilis in the 1960s (Jenkins 1994; Van de Kaa 1971).

Because sex workers work mostly in an informal manner in PNG, they are a difficult group to delineate. There is also a high crossover between people who engage in sex work and people with STIs, and so high-risk behaviour spans several categories. In all, however, it appears the commercial sex industry in PNG is large and has a lot of contact with the general population in both urban and rural areas.

Levantis (2000) from a survey of urban 'unemployed' found that 48 per cent of unemployed young women partly supported themselves through sex work. Fiti-Sinclair (1996) from a survey of female sex workers in Port Moresby found the commercial sex sector was amorphous and little organised. Most worked only when they needed cash, did not use pimps, and often collected payment much later. Hammar (1996a, 1996b) found in Daru that 'prostitution' was so pervasive within the society that the term was difficult to define. From examining the importance of sex in the local economy of Daru, and the nature of marital relationships, sex work and sexual networks, he concluded that, 'prostitute,' 'wife,' 'boyfriend,' 'customer,' 'marriage,' 'prostitution,' and 'husband,' were insufficiently stable categories upon which to rely in his fieldwork, much less so in HIV prevention work.

People with STIs

STIs are widespread, under-diagnosed and under-reported. People who attend STI clinics are just a small proportion of the number of people with STIs. This 'high risk' group is also very large and well integrated with the general

community (table 2.3). One quarter of the men and women surveyed in a study in 1994 reported a history of STIs (National Sex and Reproduction Research Team 1994).

A high prevalence of STI in the population significantly increases the risk of HIV transmission. Infection with another STI by one or both partners in a sexual liaison makes it easier to transmit HIV between them, especially with infections that cause genital ulcers, like syphilis. The high prevalence of STIs indicates a high degree of unprotected sex with several partners, which puts people also at risk of HIV infection. A national study in 1994 found that most young people had several sexual partners before marriage, and almost three quarters of married men and about one quarter of married women reported having extramarital relationships at some time. Men sought treatment more often than did women (National Sex and Reproduction Research Team 1994).

The impact of human behaviour in PNG on transmission

In 1997, PNG was categorised as being one of the 10 Asia-Pacific countries with epidemic HIV spread, with a moderate and rising HIV incidence and low and rising HIV prevalence (Monitoring the AIDS Pandemic (MAP) 1997). To that extent, PNG was similar to India, Malaysia, and Vietnam — although the epidemics in these countries may take quite different courses, as has been shown to happen throughout the world. Human behaviour — principally sexual behaviour — plays a key role in determining the trajectory of the epidemic in any society (UNAIDS/WHO 2000).

Most social researchers with long experience in PNG have predicted HIV will spread rapidly. The main reasons are the prevalence of multiple sexual partners,

Table 2.3 **Prevalence of sexually transmitted infections, from surveys, 1998**

	High risk population	Low risk populations	
	Sex workers	**Ante-natal women**	**Highland villagers**
	%	%	%
Gonorrhea	36	-	15
Chlamydia	31	-	26
Syphilis	32	4 (unknown year)	4
Trichomoniasis		-	50
§ Lae	44		
§ Port Moresby	21		

Source: WHO, National AIDS Council and Department of Health (2000).

gender violence, poverty, and poor public understanding of transmission (Allen 1997; Caldwell 2000; Dwyer and Lovell-Jones 1997; Hide 1998; Jenkins 1995 and 1996, National Sex and Reproduction Research Team 1994; Riley 2000.)

Factors that encourage the rapid spread of HIV in PNG include the following.

§   Sexual behaviour that involves many people having multiple partners, through polygamy (including approximately 14 per cent of currently married women (Pala 1996)), sex work, multiple sex partners, and group sex and sex that can cause trauma or bleeding, such as anal sex and rape.

§   Rapid social change, particularly where it changes gender relations and increases acceptance of violence against women (Nash 1981; Clark 1993; Nihill 1994).

§   Poverty, particularly in association with urban migration, commercial sex, poor health services, illiteracy, and lawlessness.

§   Poor health status, which can increase susceptibility to HIV and AIDS. PNG has the lowest basic health status in the Pacific island region (UNDP 1999). Around one-third of PNG's urban population live in settlements where there is no potable water, no waste disposal, overcrowded houses, and very low levels of personal and domestic hygiene (Bukenya 1993).

§   Poor antenatal care (43 per cent of births are supervised) (NDOH vol 3) and high prevalence of breast-feeding (approximately 97 per cent of children) (Siopun 1996), both of which assist peri-natal transmission of HIV.

§   High and rising prevalence of STDs. These serve as a marker of widespread practice of multiple sexual partners. Some also assist HIV transmission.

§   Little public understanding about the transmission of STDs and HIV. The National Demographic and Health Survey, 1996, found among the 65 per cent of women who indicated they had some knowledge of HIV/AIDS, only 19 per cent correctly identified condoms as a way to protect against HIV transmission. As well, 73 per cent considered themselves not to be at personal risk of HIV infection.

Evidence on changes in behaviour in response to HIV/AIDS

Other than the discovery of an anti-HIV vaccine, which is not expected any time soon, the only factor that could constrain the growth of the HIV epidemic is behaviour change, particularly the use of safe sex techniques.

There is some evidence this is happening. A survey conducted by the PNG Institute of Medical Research found the proportion of sex workers who said they had used condoms in the previous week increased substantially between 1996 and 1998. This and other surveys have found 25 per cent to 50 per cent of sex workers in Port Moresby said they now consistently used condoms.

Possible avenues of behaviour change include public education (although there are problems of language and culture diversity, inaccessibility, and religious and cultural taboos), community action, public media programs and the demonstration of political commitment to confront and contain the epidemic.

An antidote to optimism about the possibility of sufficient change to make a real difference to the trajectory of the HIV epidemic is the failure of attempts to stem previous sexually transmitted disease (STD) epidemics (Riley 2000). Riley noted that PNG has experienced three epidemic waves of STDs since medical records were first kept: gonorrhea, perhaps from the 1830s; syphilis in the late 1960s; and HIV since the mid-1980s. Difficulties in controlling gonorrhea, syphilis and other STIs included the asymptomatic nature of some infections, the inability of many patients to appreciate the seriousness of these diseases, cultural barriers that prevented people seeking treatment or advice or openly discussing the issues; the difficulty of women particularly in using health services — in other words, very much the same problems posed by the HIV epidemic today. Attempts to control earlier sexually transmitted infection (STI) epidemics were also confounded by too great a focus on a single disease and its pathological effects and the imposition of culturally alien concepts of sexuality.

Scenarios for the future

General demographic changes

HIV epidemics have manifested themselves very differently in different countries. HIV affects particular geographical areas and population sub-groups in various ways at disparate times. Because of this diversity, prediction of the epidemic's trajectory requires solid behavioural data to identify sub-populations at risk and focus sero-surveillance resources where they will give most information about the epidemic (UNAIDS/WHO 2000). Yet, as explained earlier, there are no such solid data for PNG. Furthermore, because of the diversity, mathematical projections of future levels of infection are not as good tools for

prediction as was earlier expected (cf. Chin J. and Lwanga S. 1991; Gregson et al. 1998).

There has been experience of sufficient duration in enough countries around the world for general effects of the HIV epidemic to be known. Table 2.4 summarises the experience in four countries — Kenya, South Africa, Zimbabwe and Thailand. The main expected demographic changes are listed below.

§   *Population size* depends on the underlying population growth rate, the mortality rate due to AIDS, and the impact of HIV on fertility. The impact on population size increases with time. For example, by 2015 Zimbabwe's population is projected to be 19.0 per cent smaller than it would otherwise have been. The projections for South Africa, Kenya and Thailand are 16.3, 12.6 and 2.4 per cent respectively (UN 2000).

§   *Population composition* changes from a pyramid to a 'chimney' shape as people who are infected with HIV early in their sexual lives begin to die in their mid-adult years. Women are usually infected at a younger age than men. Up to 60 per cent of all new cases in some regions are among 15–24 year olds, with females out-numbering males by two-to-one in that young population

Table 2.4   **General demographic effects approximately 10, 20 and 30 years after onset of HIV, selected countries**

Demographic effect	Units	Kenya	South Africa	Zimbabwe	Thailand
Year widespread transmission began		1974	1985	1976	1985
Adult HIV prevalence (1998)		10.4	11.8	21.5	1.8
Approximately 10 years after onset of epidemic					
Decreased population size	%	0.0	0.2	0.1	0.2
Increased number of deaths	%	3.0	3.6	6.1	5.8
Decline in life expectancy at birth	Years	0.9	0.8	1.5	0.8
Increased infant mortality rate	%	0.9	1.7	2.3	0.9
Approximately 20 years after onset of epidemic					
Decreased population size	%	1.0	6.8	2.3	1.4
Increased number of deaths	%	54.3	121.0	124.2	26.0
Decline in life expectancy at birth	Years	11.5	17.0	19.4	3.7
Increased infant mortality rate	%	14.9	44.5	35.2	4.5
Approximately 30 years after onset of epidemic					
Decreased population size	%	6.5	16.3	12.5	2.4
Increased number of deaths	%	120.6	116.5	156.4	14.3
Decline in life expectancy at birth	Years	19.7	20.1	24.1	2.7
Increased infant mortality rate	%	37.3	64.2	55.4	7.4

Note: Decreased population is compared to the 'without' HIV/AIDS population scenario.

Source: UN World Population Prospects, The 1998 Revision (2000).

(Fransen 1998). As a result of increased infant and early adult deaths and the greater survival of older people, the population ages rapidly. The changing age structure has important implications for labour supply. It is important to note that the decline in the working age population is much greater than the population as a whole as this is the age cohort where deaths predominantly occur.

§ *Family and household composition* also changes dramatically. Many children lose at least one parent, putting great strain on traditional welfare systems, such as PNG's wantok system. One outcome in some countries has been the 'descholarisation' of youth (World Bank 1997).

§ *Fertility rates* generally decline, although whether this is a clinical or behavioural response is not clear. Evidence from Africa shows fertility is around 20 per cent lower in HIV positive women, when adjusted for age and marital status. Pregnancies among infected women are only half as high as among those not infected (Pisani 1998).

§ *Morbidity and mortality* will increase especially affect people of reproductive and economically-active ages. The demand for health services will escalate particularly as there is an association between HIV and increased prevalence of other diseases, especially tuberculosis

§ *Life expectancy* will decline. Even before the impact of AIDS deaths is felt, PNG has the lowest life expectancy at birth of all Pacific island countries, and the unusual situation of women having lower life expectancy than men (UNDP 1999). In the worst affected African countries, predictions are that life expectancy at birth will be lowered by 20 per cent (US Bureau of the Census). By 2010–15, life expectancy in Zimbabwe is projected to have fallen by 24.1 years, for South Africa, Kenya and Thailand the figures are 20.1, 19.7 and 2.7 respectively.

Approaches to projecting HIV and AIDS in PNG

Planners and policymakers need information on the expected numbers of infected people, expected deaths, and likely repercussions on the family and social fabric of the country. However, in PNG, projections of HIV, AIDS and related deaths using epidemiological models are particularly weak and unstable because:

§ the epidemic is still at a low level and its duration has been relatively brief. In order to properly predict the level and shape of its prevalence curve requires prevalence observations that are well spaced over time — that is, the first and

last non-zero observations need to be at least eight years apart (Gregson et al. 1998). The difficulty with basing predictions on less data is shown in chart 2.6;

§   there is insufficient epidemiological data to model the epidemic, let alone to do so separately by each of the different risk groups in the population;

§   it is not possible to disaggregate the reported cases into rural and urban, in part because of the concentration of testing and recording facilities in the urban areas; and

§   the modelling process is not as straight-forward as it initially appeared. The prevalence curve in different countries has taken a variety of shapes. The data on which standard modelling programs are based may not give an accurate measure. In particular, the use of antenatal clinic prevalence estimates probably under-count infection because of HIV's lowering effect on fertility.

Chart 2.6   **Difficulty of predicting from limited epidemiological data the prevalence curve of an HIV epidemic**
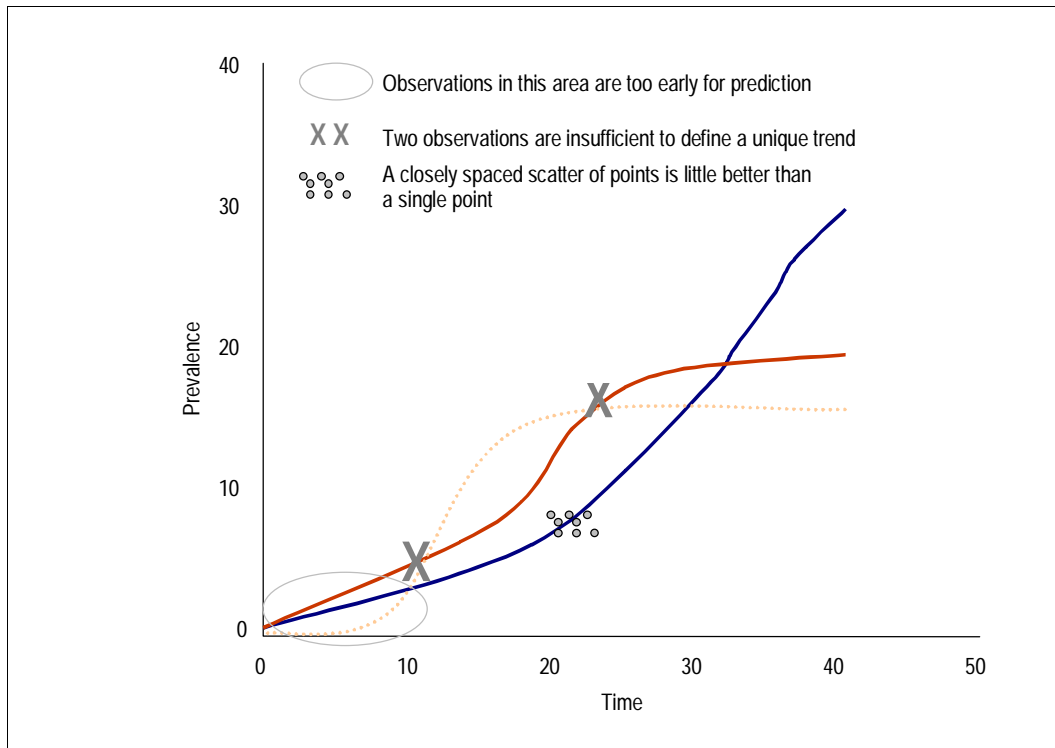
Note: Particularly in third world countries, assumptions about the growth of the HIV epidemic have perforce been made on very limited information. What has emerged is that the epidemic can take a variety of paths. Where two observations cannot define a unique trend, more observations progressively improve predictive power. Gregson et al. note that 7-8 years at least should elapse between data points.
Source: Gregson et al. (1998).

Epidemiological models

In the absence of basic data on current HIV prevalence, it is still possible to make model-driven projections, but it must be understood that these projections are flimsy and need to be revised in the light of fresh evidence (Gregson et al. 1998).

The difficulty is that point prevalence estimates are too weak to alone use to identify the epidemic curve that would best describe the spread in PNG. The most important missing information is:

§   the representativeness of antenatal clinic sites (there is no firm knowledge as to why Port Moresby figures are so high);

§   the effects of HIV on fertility (no information at all);

§   male to female ratio of HIV infections (we can only guess it is the same as reported and the unknown cases are similarly distributed); and

§   urban to rural prevalence differentials (no real information).

The epidemiological models produce very conservative predictions in the early stage of an HIV epidemic. This was the experience in other parts of the world, especially some African countries, where infection rates have risen much higher and more sharply than first predicted. For example, in Sub-Sahara Africa, the prevalence rate went from less than 1 per cent in the early 1980s to between 10 and 36 per cent by the late 1990s. Progress in Asia has been much slower, but it still moved from around 0.1 per cent to between 2 and 5 per cent over the same period (WHO/UNAIDS Working Group on Global HIV/AIDS and STI Surveillance 2000).

These conventional methods have been applied to PNG for this study but due to the problems discussed above, the results are not very meaningful (they are reproduced in appendix A).

Building scenarios based on experience in other countries

An alternative approach is to assume a similar growth in the epidemic in PNG as has happened in countries with a similar behavioural base for its spread (recommended by Gregson et al. 1998 and Schwartlandes et al. 1999). A sub-Sahara Africa model appears to be the most likely, on the grounds that transmission there and in PNG has been almost exclusively heterosexual. There is some male-same-sex behaviour in PNG but it is generalised, not a separate social group as perhaps in the Caribbean. The predominantly heterosexual early

spread is not common — yet it is common to both PNG and sub-Sahara Africa — and it implies the most rapid onset and growth of the epidemic.

Three scenarios for the PNG population over the next 20 years are developed for the PNG HIV/AIDS epidemic based on the trajectories of three quite different sub-Sahara HIV epidemics. The epidemics in Kenya and Zimbabwe both apparently began in the early to mid-1980s. South Africa began later, in the early 1990s. The epidemic is expected to plateau lower in Kenya, with prevalence in women aged 15–49 of around 9 per cent. Chart 2.7 tracks the past and projected evolution of HIV prevalence in adult women in these three countries. The higher epidemic in Zimbabwe has been attributed to behaviour patterns. They include a high level of movement between urban and rural areas, which is assisted by labour migration, trading and good communication infrastructure, and which encourages greater sexual mixing between different population sub-groups. Other factors may be a high level of sexual partner change and the rarity of male circumcision, the latter being associated with susceptibility to other STDS and greater transmission possibility of HIV (Gregson et al. 1998). The situation in South Africa is now unfolding. A more optimistic prediction than shown in chart 2.7 is that HIV prevalence will plateau out at around 15 per cent, but even this is much higher than an earlier prediction of 10 per cent (Gregson et al. 1998).

Table 2.5 provides three scenarios for the evolution of adult prevalence and mortality in PNG from 2000 to 2020. The low scenario is based on prevalence and incidence trends in Kenya, the medium scenario on trends in South Africa and

Chart 2.7 **HIV prevalence in women aged 15-49 in three African countries, by year**
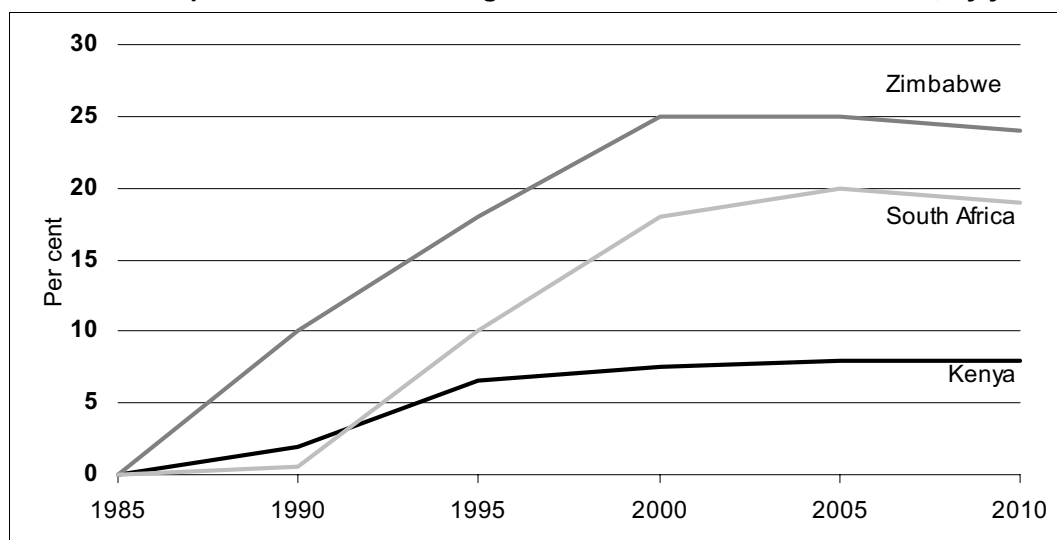
Data source: Derived from Gregson et al. (1998).

the high scenario on trends in Zimbabwe. The projections draw on population projections for PNG based on the 1990 census (Jorari and Lasia 1996). The information now available from the most recent census is that the population is much larger than anticipated with 5.13 million people as opposed to a predicted 4.51 million people based on the 1990 numbers (Jorari and Lasia 1996). This may be due to under counting in 1990 or a much higher than expected birth rate. As age cohort information was not available for the 2000 census at the time of the study, the projections are based on the Jorari and Lasia projections.

Table 2.5 **Possible future adult deaths in PNG, based on Kenya, South Africa and Zimbabwe prevalence patterns**[a]

Year	Low scenario		Medium scenario		High scenario	
	Prevalence	**Deaths**	**Prevalence**	**Deaths**	**Prevalence**	**Deaths**
	%		%		%	
2000	1	386	0.5	386	1.0	386
2001	1.2	443	2.4	443	3.0	443
2002	1.4	2 452	4.3	2 452	4.0	2 452
2003	1.6	8 766	6.2	2 580	5.0	8 766
2004	1.8	5 058	8.1	2 713	8.0	5 058
2005	2.0	5 338	10.0	2 852	10	5 338
2006	2.9	5 536	11.6	42 921	11.6	45 479
2007	3.8	7 663	13.2	46 951	13.2	26 982
2008	4.7	13 812	14.8	49 270	14.8	33 866
2009	5.6	10 582	16.4	51 663	16.4	78 604
2010	6.5	11 094	18.0	54 131	18.0	58 419
2011	6.7	28 649	18.4	83 040	19.4	85 010
2012	6.9	31 723	18.8	87 299	20.8	70 611
2013	7.1	38 423	19.2	90 048	22.2	77 685
2014	7.3	36 594	19.6	92 812	23.6	114 571
2015	7.5	38 216	20.0	95 588	25.0	98 842
2016	7.6	36 145	19.8	89 001	25.0	114 587
2017	7.7	39 134	19.6	92 384	25.0	103 613
2018	7.8	45 315	19.4	94 571	25.0	109 164
2019	7.9	43 953	19.2	96 753	25.0	136 110
2020	8.0	45 647	19.0	98 928	25.0	124 070

a Assumes five year lag between infection and death from AIDS.

Source: CIE projections, drawing on Jorari and Lasia (1996) and Gregson et al. (1998).Three scenarios used for estimating the economic impact

The economic modelling of the impact of HIV/AIDS is driven off the impact of the epidemic on the working age population. A reduction in the labour supply is reflected in production and flows onto demand for goods and services by households and by firms. The key variable is the percentage change in the labour supply so the impact of the revision in population figures is minimal. Note that the big jumps in deaths come from the large increases in incidence (increase in

prevalence rates) five years prior to the year in question. This is likely to be an artifact of poor, but improving, data collection making prevalence figures 'lumpy' in the early years of an epidemic.

Chart 2.8 shows the projected size of the adult population under the baseline projection and projections under the three models of evolution of the disease. If the epidemic follows the low scenario, the working age population might be some 13 per cent lower in 2020 than would have been the case without the epidemic. With the medium scenario, the diminution in the work force would be around 34 per cent under the high scenario it would be 38 per cent.

The projections have not taken account of the possible impact of HIV/AIDS on fertility. Studies have shown that HIV/AIDS will not significantly shorten the lives of a large enough number of women to reduce national birth rates unless infection lowers age-specific fertility rates (Ainsworth and Over 1994). There is no evidence to provide a basis for sorting out how things might go in PNG so the estimates may understate the population impacts if fertility does decline.

Chart 2.8   **Impact of HIV/AIDS on population aged 15–49, 2000–20**
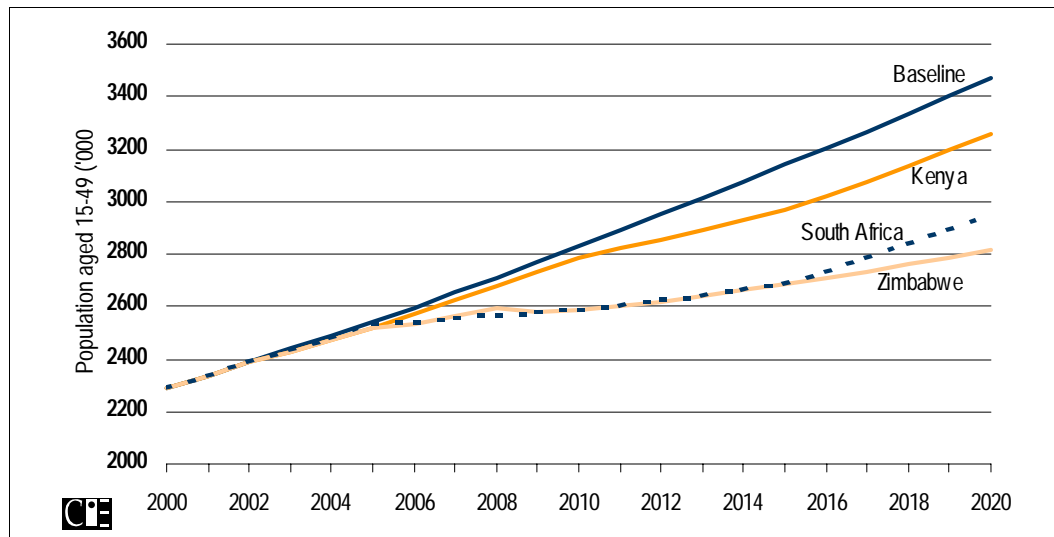
Data source: CIE projections, drawing on Jorari and Lasia (1996) and Gregson et al. (1998).

3   HIV/AIDS and the PNG economy — projections of the macroeconomic impact

The PNG economy

Growth rates have been low, with declining GDP per capita

The starting point for any analysis is understanding the current state of the PNG economy and recent trends in investment, employment and productivity growth. Real GDP growth averaged just 2.2 per cent between 1975 and 2000 — which is below the average rate of population growth of 2.3 per cent. Without the mineral boom of the early 1990s growth would have been much lower as growth in non-mineral economic activity averaged just 1.6 per cent over the same period (table 3.1).

The passing of the minerals boom saw economic growth turn negative in the second half of the 1990s. Since the Morauta government came to power in July 1999 there has been an improvement in the performance of government, with the implementation of significant structural reforms, lifting expectations of future economic prospects. While estimates put growth in 2000 at 0.8 percent (AusAID 2000), GDP is estimated to have fallen by 3.3 per cent in 2001 (Economic Insights and Imps Research Limited, 2001).

Table 3.1 **Average rates of economic growth, 1975–2000**

	Real GDP	**Real non-minerals GDP**	**Minerals value added**
	%	%	%
1975–80	1.0	0.9	1.8
1980–85	1.4	2.0	-4.4
1985–90	1.1	0.2	9.0
1990–95	7.8	4.3	20.5
1995–2000	-0.3	0.7	-2.7
1975–2000	2.2	1.6	4.9

Source: Mainly constructed using World Bank data and data provided by the Department of Finance and Planning.

Poor growth has contributed to rising poverty

Poor economic growth has been largely responsible for the worsening poverty situation in PNG. It is estimated that the number of people living in poverty doubled between 1985 and 1996 to 1 million or some 30 per cent of the population (Duncan 2001). High levels of poverty — and its corollary, low levels of assets — means that a large number of people are vulnerable to the adverse economic effects of an HIV/AIDS epidemic. Low growth has contributed, through its effect on government revenues, to an increasingly limited capacity in the public sector to respond to the challenge that a serious epidemic may pose.

The economy is dominated by agriculture, mining and forestry, but subsistence farming is the major source of employment

In 1999, the minerals sector — dominated by gold and oil production — accounted for 26 per cent of GDP, up from 12 per cent in 1975 (table 3.2). In contrast, the manufacturing sector, accounted for just 9 per cent of GDP. Agriculture comprised 30 per cent of GDP in 1999, but this is not indicative of the importance of agriculture for the livelihood of Papua New Guineans. Agriculture employs 90 per cent of the work force (table 3.2). The majority of the population are self-employed farmers living in the village environment and engaged in a mixture of subsistence and cash crop production. Recent estimates suggest that around 12 per cent of measured GDP comes from the non-market sector of the economy (AusAID 2000). Most of the balance of the work force is employed in the service sector especially in the public sector and in commerce. Only a small fraction of the labour force is employed in mining and oil despite the importance of these industries for GDP.

The mining sector, which has accounted for much of the increase in GDP since independence is capital intensive and relies heavily on foreign investment (most domestic equity is financed from project earnings) and expatriate labour. Future investment in, and output of the sector will be driven largely by mining prospects in PNG and the overall climate for foreign investment. Unless an AIDS epidemic affects the political risk of investing in PNG, the consequences for the sector may be quite limited.

Table 3.2 **Sectoral composition of the economy and labour force**

	GDP share	Employment share	Average rate of GDP growth	Average growth in employment
	1999	1990	1995–99	1995–99
	%	%	%	%
Agriculture	30.0	90.2	0.7	2.2[a]
Mining and oil	26.1	0.3	-5.7	4.8
Manufacturing	8.6	1.1	1.5	4.0
Services	35.3	8.4	1.9	3.3

a There is no data on employment in agriculture post 1990. It is considered that the estimated rural population growth rate of 2.2 per cent would act as a reasonable proxy.

Source: Constructed from data in 2001 Budget Papers, from Levantis (2000), and from the Bank of PNG employment index.

The labour force is predominantly unskilled and unemployment is high in urban areas, but there has been growth in employment

Labour market reform in 1992 resulted in growth in employment in non-rural industries. Average employment growth in minerals, manufacturing and services exceeded 4 per cent in the second half of the 1990s, well outpacing growth in economic activity (table 3.3). This represents a turnaround on the stagnation in non-rural employment prevailing before the 1992 reforms (Levantis 2000). However, with recent downsizing of the public service and privatisation plans for a number of publicly owned firms, this improvement in employment may not continue.

There is a shortage of skilled labour

While the pool of low-skilled labour is in abundance and growing rapidly, the market for tertiary and technically trained workers has become increasingly tight. This is despite weakness in economic growth and a high rate of population growth. The rural labour market almost entirely comprises poorly educated low-skilled workers. In contrast, the work force in urban areas is dominated by skilled and semi-skilled workers. Only 17 per cent of employment in the urban private sector is in low-skilled occupations such as labourers and guards. Highly skilled workers make up 21 per cent, while most of the balance work in trades, sales, or clerical occupations. Employment of youth with low educational achievement is rare in urban areas (Levantis 2000).

Savings and investment in PNG are volatile and not highly related

Domestic savings is government rather than household savings

Domestic savings in PNG have been quite volatile — fluctuating between 16 and 32 per cent of GDP in the last decade (Economic Insights 1999). The changes in domestic savings have been driven largely by variations in the budget deficit and public sector savings, as well as changes in foreign financing of these deficits. To a fair degree, public sector savings and deficits have been linked to movements in mining sector revenues.

Investment has been driven by foreign investment in the mineral sector

Investment has also been volatile — ranging from 16 to 30 per cent of GDP over the period (Economic Insights 1999). Much of the fluctuation in investment has been caused by changes in foreign investment in the mining sector. Foreign investment in the resources sector has in the past played a big role in driving growth in national income. However, in recent years expenditures in exploration — a key precursor of future investment — has been negligible as the overall climate for investment has been perceived to be quite poor.

A key determinant of how HIV/AIDS will affect investment is through the way it impinges on the investment climate and risk-adjusted rates of return. Thus the influence of HIV/AIDS on the quality of governance and on law and order are important factors. In the modelling it is assumed that foreign investment is not impacted by an HIV/AIDS epidemic.

Government already faces continual challenges to finance and deliver social services

Government is heavily reliant on mineral sector revenues

The minerals sector is a major contributor to the government budget (chart 3.1). Over 20 per cent of government revenue is raised from taxes on the minerals sector, mainly company taxes, whilst additional revenues are earned from dividend withholding taxes (in the 'other revenue' category) and dividends through the government's ownership share in resource projects. Forestry contributes 5 per cent of government revenue via an export tax. Company tax earnings from non-mineral business accounts for 12 per cent of revenue.

Chart 3.1 **Sources of government revenue, 2000**

Pie chart showing: Other 17%, Personal income tax 24%, Excises 13%, Import duties 3%, VAT 10%, Minerals tax 21%, Company tax 12%.
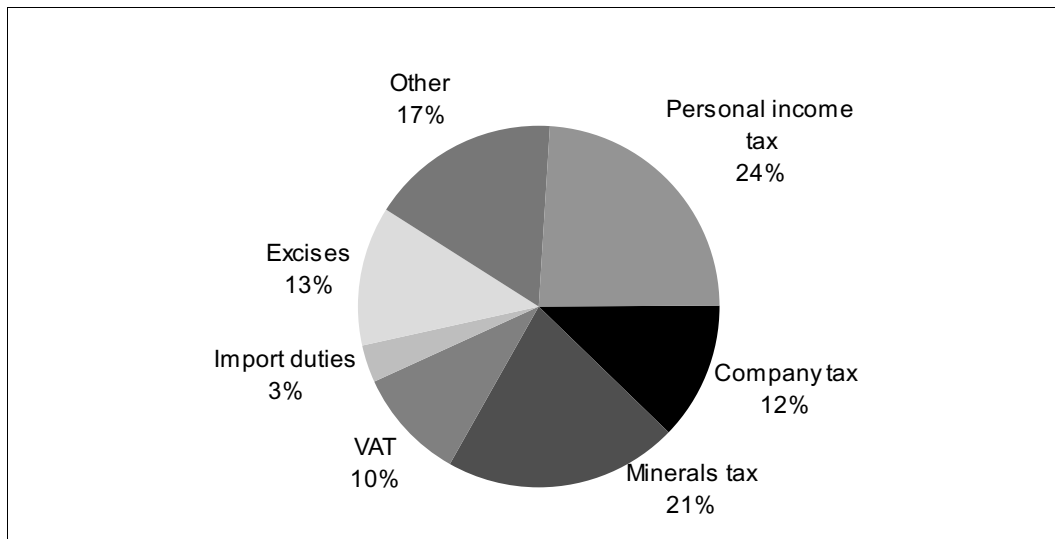
a Minerals taxes includes company taxes and other taxes raised from the minerals sector.
Data source: 2001 Budget Papers.

If HIV/AIDS has a negative impact on the growth rate of GDP, it will almost certainly also affect the trajectory of government revenue, as the base for most revenues will probably grow more slowly. Revenues derived from the mining and oil sectors may prove to be more resilient, unless the epidemic leads to a worsening of the environment for foreign investment in the sector.

Personal income tax revenues may be negatively affected, depending on how the effects on skilled and formal sector employment unfold. The impact on the income tax base of reduced supply of skilled labour may be offset to some degree by resulting increases in wage rates for such workers. With a significant proportion of personal income tax revenues contributed by government employees, the net impact on revenues will depend on the government's responses to changing conditions in the labour market.

Government expenditure is inefficient to deliver the social services needed

Government spending (expenditure and net lending) has varied between 27 and 35 per cent of GDP over the last decade.

The effect of HIV/AIDS on government expenditure will depend very much on the response to changes in demand for government funded services. The biggest effect is expected to be in the health and education sectors. In recent times, the government has spent around 5 per cent of GDP on health and education (table 3.3). Found by the Interim Report on Rural Health Services (2001) the funding of rural health services is inadequate, spending is less than the budget allocation, budgeting and planning is poor.

Provincial governments are responsible for primary care facilities, which would be the first point of demand for additional health services. These services have been declining in recent years. Tertiary services are provided by the central government. These are already under strain since the tertiary system remains the most effective part of the health system.

Table 3.3 **Government expenditures on health, education, infrastructure and law and order, 1998**

Item	Expenditure	Share of expenditures and net lending	Share of GDP
	Kina million	%	%
Health of which	**177.6**	**7.2**	**2.32**
Promotion and prevention Health services	54.3	2.2	0.7
Curative services	19.2	0.8	0.20
Medical supplies	23.7	1.0	0.30
Education of which	**2 386.0**	**9.6**	**3.0**
Primary and secondary education	115.7	4.7	1.5
Tertiary education	120.3	4.9	1.5
Training services	2.7	0.1	0.0
Infrastructure	**223.6**	**9.0**	**2.8**
Law and order of which	**197.9**	**8.0**	**2.5**
Police forces	114.2	4.6	1.5
Prisons	40.1	1.6	0.5
Total above items	**837.7**	**33.8**	**10.7**
Total expenditure	**2 475.2**	**100.0**	**31.5**

Source: AusAID (2000).

Estimating the economic impacts of a change in the labour supply

Modelling captures only the macroeconomic effects

While there is a myriad of microeconomic level impacts of an HIV/AIDS epidemic the main macroeconomic effects will arise through the change in the supply of labour and the flow on effects of changes in income onto demand for goods and services, which in turn will impact on production decisions. To capture these flow-on effects a computable general equilibrium (CGE) model of the PNG economy is used. The main economic aggregates of interest are:

§ *Domestic production* — **GDP per capita** measures the domestic income earned per head of population and reflects the capacity of the country to generate income and employment and of the government to raise revenue. It is not a measure of income per person for two reasons. Only market transactions (and an estimate of the value of household agricultural production) are included, so the estimate understates actual income, with non-market production consumed mainly in the country. Income earned on foreign capital accrues to its foreign owners so where, as in PNG, net foreign investment is large, GDP will be above Gross National Product (GNP) which better reflects income per person. An important indicator of future domestic production is the level of **real investment**, as this lays the capital base for the future.

§ *Economic welfare* — **GNP per capita** measures the income of PNG labour and investment and is a better reflection of economic welfare than GDP per capita. However, this measure is not readily available from a CGE model as capital has to be split into foreign and domestically financed capital and the rate of return on each in each sector calculated. A proxy that adjusts for the returns on foreign capital at the aggregate level is generated as an economic welfare measure. It should be noted that this measure, like GNP per capita, does not take into account income distribution or if the income is then invested off-shore. **Real consumption** is perhaps a better measure of overall economic welfare.

§ *External performance* — the **current account deficit as a percentage of GDP** is a reflection of the ability of the economy to attract net capital inflow. The current account surplus or deficit is export revenue less imports of goods and services and debt service payments. **Exports** and **imports** are important indicators of government revenue where there are taxes levied on trade, and exports reflect the capacity to service foreign investment. The **real exchange rate** is an important indicator of how the rest of the world assesses the ability of PNG to compete on world markets. However in the modelling, due to the

assumption of a fixed nominal exchange rate, the real exchange rate reflects the domestic price level. PNG had a hard Kina policy in the past but after the 1994–95 crisis has floated the currency. So in practice the Kina responds to changes in purchasing power parity or inflation rates relative to the rest of the world. The assumption of a fixed nominal exchange rate implies no change in the rest of the world's assessment of PNG's competitiveness. Given that the mining sector is the main externally traded product this assumption is not unreasonable if institutions are not impacted by the epidemic.

§   *Fiscal performance* — the **government budget surplus/deficit** and **tax revenue** are key indicators of government performance. In the modelling the government takes a passive role and the measures reflect the impact on expenditure through changes in derived demand (due to the size of the population) and how tax and other government revenue changes with production and income levels. With a fixed exchange rate the current account deficit will reflect the budget deficit due to the reliance on foreign sources of financing for saving short falls.

§   *Social performance* — the PNG CGE model is unique in that it includes urban crime as a sector. As a non-market activity for which little data is available this sector is usually ignored. However, this sector is significant in PNG and good information is available (Levantis 2000). **Urban crime** is a useful social indicator.

A computable general equilibrium (CGE) model of the PNG economy

The CGE model of PNG is a comprehensive economy-wide model incorporating five broad sectors of the economy: the household sector, the government sector, the production sector, the finance sector, and the external sector (the balance of payments). The production sectors distinguish 43 industries, which in aggregate explain the economy's total production and GDP. There are 15 rural industries, 6 of which are smallholder agricultural industries. Traditional agriculture is classified as a smallholder industry encompassing production of fruit, vegetables and livestock for subsistence and for sale at informal markets. There are 4 industries covering the minerals sector, 8 manufacturing industries, 15 service industries. A crime industry is included because of the integral part that crime plays in the economy.

The model contains a detailed treatment of the labour market. The workforce is disaggregated into high skilled, semi skilled and unskilled workers, with the

supply of labour of each skill category responding to real wage levels. The labour market is also dichotomised between rural and urban areas.

Each industry combines labour of various skill categories with capital and material inputs from domestic and overseas suppliers according to its production technology to produce its output. Growth in capital and labour employed in each industry drive productivity and growth in output and, hence, GDP.

The model explains the demands for the products produced by each industry. There are three categories of demand:

§ demands by industries for intermediate inputs into production

§ demands by households and government for goods and services

§ export demands.

The model also contains equations to explain outcomes for key financial aggregates and the components of the balance of payments.

The model closure has important implications for the results

The model is closed by assuming a fixed nominal exchange rate and fixed nominal interest rates. This implies that the HIV/AIDS epidemic does not affect foreign investment confidence and the risk premium on loans to PNG. If this were the case the foreign investment would be likely to be lower and hence the GDP growth scenarios will be more pessimistic than those presented here. In a sense expansion of the current account deficit is an indictor of the macroeconomic pressures that the epidemic creates. These would require policy response from the government but what this would be is uncertain. The modelling assumes away these pressures, this means that the main direct sectoral impacts of the epidemic are clearly identified in the model results.

The baseline scenario — some mineral development growth in the short run followed by population driven growth

In estimating the impact of a shock to the labour supply due to HIV/AIDS it is important to develop a baseline scenario — where would the PNG economy go if HIV/AIDS did not impact on the supply of labour. The baseline is based on a 'business as usual' scenario, which for PNG is a scenario with no overall labour productivity growth. Growth will be driven mainly by labour force growth — subsistence agriculture, almost by definition, grows at best at the rate of

population growth. However, in the next five years additional growth in mining is possible due to an anticipated project in which a gas pipeline is to be built into Queensland facilitating substantial gas exports from PNG's Southern Highlands.

The HIV/AIDS scenarios — a lower supply of labour

The demographic scenarios developed in chapter 2, based on different assumptions about the evolution of the epidemic, are modelled in five year snapshots using the labour force projections. Labour force is defined for the purpose of the modelling as population aged 15 to 49. As the parameter used to shock the model is the percentage change from the baseline the fact that this age cohort is not fully reflective of the true labour force has little if any effect on the results.

Table 3.4 presents the demographic scenarios underlying the projections. The share of the labour force lost is higher than total population loss as apart from infants, 15 to 49 cohort make up most of the AIDS deaths.

According to the high scenario, by 2020, the labour force would be 37.5 per cent lower than what would otherwise be the case if the PNG population were not to suffer from the transmission of HIV/AIDS. Under the less pessimistic low scenario, the labour force would be 13.2 per cent lower by 2020.

Table 3.4 **Projections of PNG's adult population aged 15–49, 2005–2020**

	Unit	2000	2005	2010	2015	2020
Baseline projection (without AIDS)	'000	2290	2542	2832	3140	3470
Low scenario						
Projection	'000	2288	2518	2758	2894	3014
Deviation from baseline	%	-0.1	-1.0	-2.6	-7.9	-13.2
Medium scenario						
Projection	'000	2288	2529	2573	2433	2292
Deviation from baseline	%	-0.1	-0.5	-9.1	-22.5	-34.0
High scenario						
Projection	'000	2288	2518	2564	2426	2169
Deviation from baseline	%	-0.1	-1.0	-9.5	-22.7	-37.5

Source: CIE projections, drawing on Jorari and Lasia (1996) and Gregson et al. (1998).

Model outcomes depend on assumptions about HIV/AIDS prevalence among skilled as opposed to unskilled labour

The economic impact of the labour force decline is very much contingent on the distribution of PLWHA. If the distribution of PLWHA is skewed towards skilled workers the economic losses will be greater. This is due to a greater loss in human capital, represented by the higher wage rates these workers command.

At early stages of most HIV/AIDS epidemics, the distribution of PLWHA is skewed towards skilled workers and the very limited evidence on employment supports this for PNG (table 3.5). However, as discussed in chapter 2, this may be more due to prevalence of reporting than actual disease prevalence.

Table 3.5 **Comparison of employment distribution across skill categories with distribution of people living with HIV/AIDS (1987–2000)**

	People living with HIV/AIDS	Employment
	%	%
Skilled	6.1	2.5
Semi-skilled	12.2	5.2
Unskilled	81.7	92.3

Source: Table A.6, Levantis (2000).

It is thought most likely that the distribution will even out over time as the virus is transmitted more broadly through the community, and it is this assumption that is adopted in the scenarios. At this stage, there is a paucity of information or evidence to indicate what the likely occupational infection of PLWHA will be over the medium to long term.

The main economic indicators

The results for the main economic indicators in 2020 are given in table 3.6. The first line of the table shows the reduction in the labour force that drives each of the scenarios. The impacts of the relative decline in labour force are significant.

Domestic production falls but by far less than the labour force

Baseline scenario

The baseline scenario assumes no increase in the prevalence of HIV/AIDS. GDP is forecast to increase at an annual rate of around 3.6 per cent to 2005 on the back of the growth in the mining sector. This may be optimistic given the decline in

GDP in 2001. Growth rates are then anticipated to revert back to levels barely matching expected population growth (see table 3.7). This is due to an expected continuation of the poor prospects for investment outside the minerals sector.

Table 3.6 **Impact of HIV/AIDS on the main economic indicators — deviation from baseline in 2020**

	Low scenario	**Medium scenario**	**High scenario**
	%	%	%
Labour force	-13.2	-34.0	-37.5
Real GDP	-2.6	-6.8	-7.5
Real GDP per worker	12.0	41.0	47.9
Economic welfare	-5.8	-15.0	-16.6
Real consumption	-2.3	-6.0	-6.6
Real investment	3.9	9.9	11.0
Exports	-0.1	-0.2	-0.2
Imports	0.7	1.7	1.9
Current account (% of GDP)	-0.5	-1.3	-1.5
Tax revenue (nominal Kina)	2.5	6.5	7.2
Budget surplus (% of GDP)	-8.8	-19.4	-20.8
Real exchange rate	-0.6	-1.5	-1.6
Urban crime	-7.2	-16.6	-18.0

Notes: 1. Economic welfare refers to the full economic impact on domestic residents. This is distinct from GDP which measures the impact on domestic production. 2. Tax revenue is stated in real terms by deflating with the price index for government consumption purchases. 3. The real exchange rate is defined as real Kina per unit of real foreign currency.
Source: PNG economy model simulations.

Table 3.7 **Baseline and the three scenarios growth in real GDP projections**

	Baseline scenario	**Low scenario**	**Medium scenario**	**High scenario**
	%	%	%	%
2005	3.6	3.6	3.6	3.6
2010	2.3	2.2	1.9	1.9
2015	2.3	2.0	1.5	1.5
2020	1.9	1.8	1.7	1.6

Data source: PNG economy model simulations.

Real GDP growth is lower with HIV/AIDS than baseline

Table 3.7 gives the real GDP growth results of the simulations for the three labour force scenarios. As would be expected, the considerable impact of a HIV/AIDS epidemic on PNG's labour force translates into lower outcomes for GDP. Chart 3.2 shows the trend in real GDP over the twenty year period under

the baseline and HIV/AIDS scenarios. This is generated by estimating the model over five year segments. There is very little difference between the scenarios until after 2005 — by 2020 there are very distinct differences.

The medium and high scenarios have a similar outcome with 6.8 per cent and 7.5 per cent lower GDP than the baseline. The decline in GDP is much smaller under the low scenario at only 2.6 per cent. While these are significant reductions in GDP these declines seem small in comparison to the projected decline in the labour force. This result is driven by the substitution of labour for capital, and the underemployment in the economy. The increase in real investment indicated in table 3.6 is very large relative to the baseline and this explains why growth rates can largely be maintained. As the sectoral results discussed later show, underemployment does play a role in offsetting the potential decline in GDP, but this role is minor compared to the substitution of labour for capital in most sectors of the economy.

Chart 3.2 **Estimated time path of real GDP for the three scenarios compared to the baseline scenario of no transmission of HIV/AIDS, 2000–20**
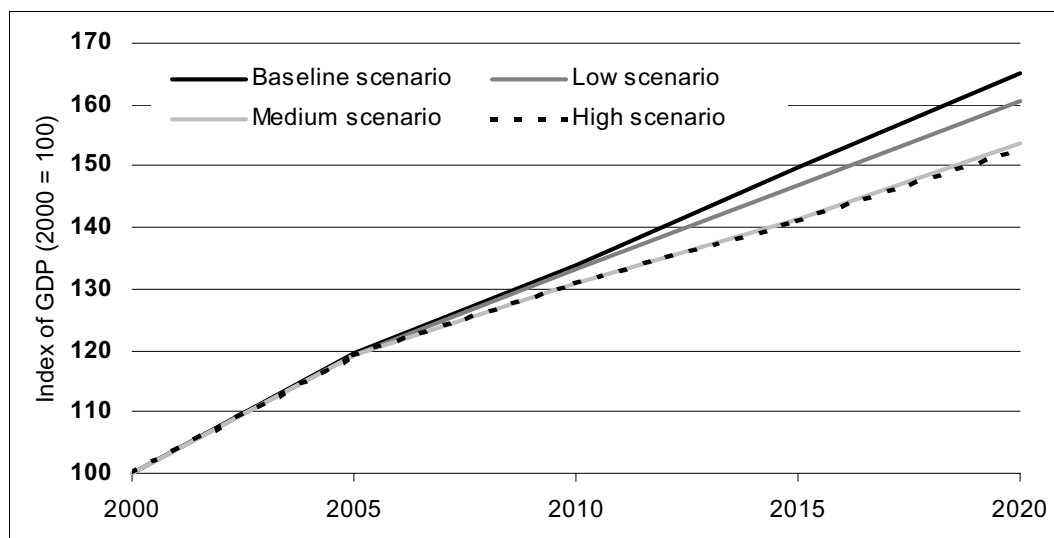
Data source: PNG economy model simulations.

Per capita GDP rises

The estimate generated in the model is GDP per worker in the labour force. This will overstate the impact on GDP per capita as this age cohort of the population suffers the greatest decline due to HIV/AIDS. As the focus is on the deviation from the baseline this approach does not have a major impact on the

interpretation of the results. Table 3.8 summarises the deviation from baseline for real GDP and real GDP per worker.

Table 3.8 **Percentage deviation from baseline for real GDP and GDP per worker**

	2005	2010	2015	2020
	%	%	%	%
Low				
GDP	-0.2	-0.6	-2.0	-2.6
GDP/worker	0.7	2.0	6.2	12.0
Medium				
GDP	-0.1	-2.1	-5.8	-6.8
GDP/worker	0.3	7.6	21.5	41.0
High				
GDP	-0.2	-2.2	-5.8	-7.5
GDP/worker	0.7	7.9	21.8	47.9

Data source: PNG economy model simulations.

Under the baseline GDP per worker rises by on average 0.4 per cent per annum out to 2020 with almost all this rise in the next 5 years associated with the gas pipeline development. But with the HIV/AIDS epidemic, GDP per worker is much higher, and the more devastating the epidemic, the better the outcome for GDP per worker. GDP per worker is an amazing 47.9 per cent higher under the high scenario. Chart 3.3 shows the rise in GDP per worker under the baseline and the three scenarios.

The keys to this perverse result are once again investment and underemployment. Production per worker rises with more capital per worker and a higher proportion of workers are gainfully employed. However, workers do not necessarily capture this increase in production themselves and this is why domestic production measures do not map into domestic income.

Chart 3.3 **Impact of HIV/AIDS on the level of real GDP per capita of working age population for the three scenarios, 2000–20**
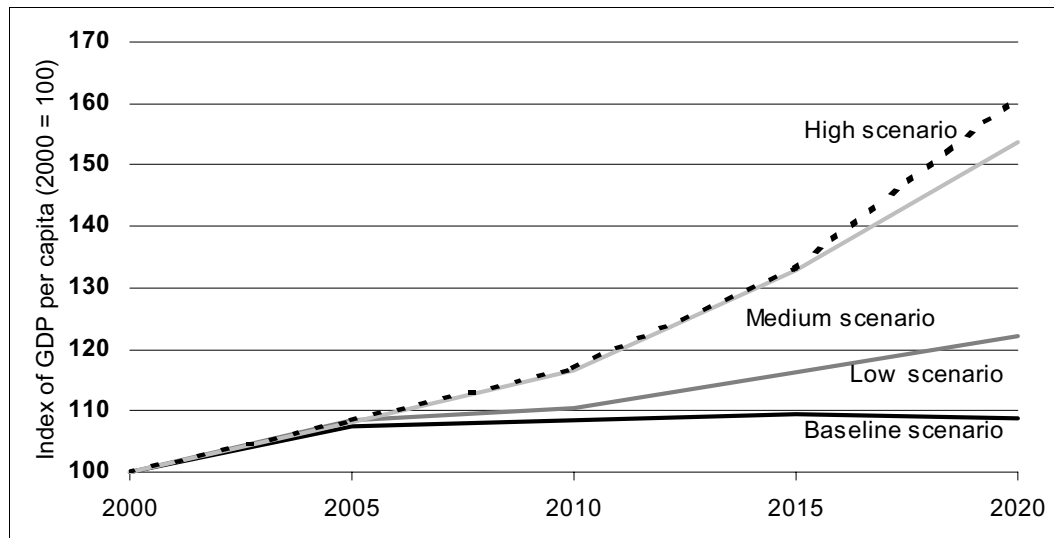
Data source: PNG economy model simulations.

Economic welfare declines, but real wages rise for those in employment

The measure of overall economic welfare is a proxy measure of GNP per capita, adjusting for the returns on foreign capital. In all the scenarios this measure declines indicating lower purchasing power on average for households. Under the high scenario economic welfare is 16.6 per cent lower in 2020 than the baseline measure. Under the low scenario it is 5.8 per cent lower (see table 3.6). This result will be of considerable concern to the PNG government and to AusAID as it indicates that an HIV/AIDS epidemic is likely to exacerbate poverty in PNG.

Supporting this pessimistic outlook is the estimated impact on real consumption that falls under all scenarios although not to the extent of economic welfare (table 3.6). The difference is largely due to the different impact on prices of traded and non-traded goods. While the price of non-traded goods rises the main non-traded good in the consumption bundle is household agricultural production. As households are both the producers and consumers they are protected from a notional rise in price. However, this rise in the price of non-traded goods contributes significantly to the lower economic welfare measure.

The impact on real wages

HIV free workers in the formal sector benefit from the epidemic as it is expected to drive up real wages for both skilled and unskilled labour. Losses in the labour market will put pressure on real wage rates as the labour market tightens — particularly for skilled and semi-skilled labour where there is a very limited pool of resources (table 3.9). The more pronounced outcome for semi-skilled labour reflects a shift in production towards the manufacturing and mineral sectors (discussed later), which are relatively intensive in semi-skilled labour. The services sector is relatively more intensive in skilled labour, and agriculture relatively more intensive in unskilled labour.

Table 3.9 **Impact on real wage rates**

	Low scenario	**Medium scenario**	**High scenario**
	%	%	%
Unskilled	5.4	12.5	13.6
Semi-skilled	13.7	31.7	34.4
Skilled	7.1	16.4	17.8

Source: PNG economy model simulations.

External performance deteriorates on the trade and current account fronts

The current account deteriorates with the real appreciation of the exchange rate. Imports are relatively cheaper, and the expansion in imports results from a greater fall in local production of traded goods than the overall decline in consumption (table 3.6). Exports decline slightly as domestic price rises result in loss of competitiveness for some sectors.

The real exchange rate appreciates

The real exchange rate appreciates by between 0.6 and 1.6 per cent due to the impact of HIV/AIDS mainly because of a rise in the domestic price level, but also due to an increase in the capital intensity of production. These flow on effects arise because of the increase in real wages in the formal sector due to a decline in the labour supply. The impact on the real exchange rate is given in table 3.6.

This result is driven by the closing of the model which holds the nominal exchange rate constant. This assumption is based on the premise of access to foreign capital at current rates to finance investment and budget shortfalls. If this

assumption does not hold the nominal exchange rate is likely to depreciate and along with it the real exchange rate is more likely to remain constant. This would result in an improved trade account, but debt servicing obligations measured in Kina would rise. It would also have sectoral effects as this would impact on labour force demands and real wages. As a result the impact on the current account would be ambiguous.

Resources shift to the non-traded sector

Improved prospects for non-traded production compared to traded production cause a shift of resources towards non-traded production. This point is illustrated within the smallholder sector where the production mix shifts towards traditional agriculture and away from export cash crop production.

The rise in the price of non-traded goods and services reflects the impact the tightening labour market has on squeezing supply (cost push), and the income effect arising from lower traded goods prices influencing demand (demand pull). A flexible Kina would offset some of these relative price effects.

Fiscal performance worsens although tax revenue rises

By 2020 the budget deficit is over 20 per cent larger than under the baseline. This is despite an increase in nominal tax revenues. The reasons for this are the massive increase in the cost of providing government services despite the model assuming no increases in demand for government services as a result of HIV/AIDS. In part this is due to price inflation and in part to the increase in wages. Real tax revenues actually decline.

The model assumes that the current account deficit and budget deficit are sustainable so there is no increase in the risk premium required on funds lent to PNG. This assumption is questionable and it is possible that penalty rates on additional borrowings may be applied. If so the impact of HIV/AIDS on the government is likely to be more profound than implied by the model results.

Social performance may improve with falling crime but crime per capita rises

The incidence of urban crime is predicted to fall by between 7.2 and 18.0 per cent (table 3.6). Urban crime can be interpreted as a measure of the unemployed labour force in urban areas who are left to rely on crime for survival. It is notable

that the decline in urban crime/unemployment is less than the decline in population, and less than the decline in gross smallholder agricultural output. This can be understood in terms of the real exchange rate appreciation, which favours non-traded production such as subsistence agriculture over traded production such as minerals and coffee. Economic activity in urban areas is almost exclusively non-traded in nature as it provides local services that cannot be exported. This is distinct from the agricultural sector, which includes a considerable level of export cash crop production. This means that economic prospects improve in urban areas relative to rural areas, thereby enticing more of the unemployed to remain in urban areas. The enticement comes in two ways — improved relative returns in crime compared to returns to labour in agriculture; and improved prospects for finding formal employment.

Sectoral effects on industries vary considerably

The impact on mining is minimal

In the high scenario, gross output of the minerals sector is forecast to be just 0.6 per cent lower than it otherwise would have been by 2020 were there to be no HIV/AIDS epidemic (see table 3.10). The reasons for the low impact have been discussed elsewhere, but the ability to substitute capital for labour and the current low share of labour in production are the key elements behind this result.

Small holder agriculture sees a major decline in production, but by less than the loss of workers

Gross output from small holder agriculture is expected to drop by up to 24.2 per cent. Traditional agriculture — which includes both subsistence production and production destined for informal market places — is incorporated in the small holder agriculture sector. Labour intensive small holder agriculture declines at a rate closer to the decline in population due to the very limited ability to substitute capital for labour. It is also clear that while there is some scope for effort per person to expand there has not been an incentive for this in the past. If this behaviour changes the impact on this sector will be smaller.

Plantation agriculture suffers significantly less than small holdings

Plantation agriculture fares better than small holder agriculture with a worst case scenario drop of almost 8 per cent.

Table 3.10 **Accumulated impact of HIV/AIDS on the level of gross production output by sector in 2020**

	Low scenario	Medium scenario	High scenario
	%	%	%
Smallholder agriculture	-8.5	-21.9	-24.2
Plantation agriculture	-2.8	-7.2	-7.9
Mineral	-0.2	-0.6	-0.6
Manufacturing	-3.2	-8.3	-9.2
Services	-5.3	-13.8	-15.2

Source: PNG economy model simulations.

Manufacturing and services face higher declines due to reliance on semi skilled and skilled labour

Manufacturing falls up to 9.2 per cent and services output 15.2 per cent. The better outcome for plantation agriculture is helped by only a small impact on forestry, which is capital intensive. The bigger impact on services is likely to reflect the importance of local skilled labour in the sector.

4   Sectoral and other economic impacts

Impacts that the modelling could not take into account

The modelling only takes into account the economic impact of the predicted decline in the labour force. There is an array of other implications of a HIV/AIDS epidemic that will also have macroeconomic consequences. Some of these include:

§   productivity impacts due to:
  –   the inability of those who are ill to work at full capacity if at all, and
  –   the diversion from productive activity of those caring for the ill, attending funerals and caring for orphaned children;

§   production cost impacts due to:
  –   higher staff turn over hence recruitment and training costs, and
  –   increased health insurance and pension costs;

§   reduced investment in education and hence future human capital due to:
  –   possible lower attendance at school, and
  –   productivity implications of any reduced capacity in the education system due to loss of teachers and budget constraints;

§   possible lower investment in sectors with limited access to capital markets due to:
  –   change in savings behaviour due to lower life expectancy, and the need for income earners who fall ill to draw on savings;

§   possible lower investment in all sectors due to higher cost of capital or reduced access to capital particularly if HIV/AIDS contributes to breakdown in institutions; and

§   either an increase in the health budget to accommodate the extra demands created by the HIV/AIDS epidemic; or a diversion of resources away from other health needs.

The considerable uncertainty about the likely magnitude of each of these effects means there is little value attempting to model them formally. They are however important considerations in understanding the long-term impact of the epidemic.

The sectoral effects

The health sector

The health sector is under–resourced

An increase in the number of HIV/AIDS cases in PNG will see an increase in the level of demand for health services, as those experiencing ill health seek medical care. This raises a number of important questions on how the health sector in PNG will cope with an HIV/AIDS epidemic.

Resources are already constrained with health services making up only a little over 2 per cent of GNP compared with 8 per cent of GNP in Australia. Around 7 per cent of PNG government expenditure is allocated to health. Household survey information found that urban households spend only 1.3 per cent household income on health and medical services (Gibson 1995).

Table 4.1 compares the resources allocated to health across the Pacific nations. PNG is clearly limited in the resources available. The National Health Plan 2001–2010 (Ministry of Health 2001) reports considerable challenges in health. Resources in the health sector are limited, management is inefficient and

Table 4.1 **Health service resources**

	GNP per capita 1997	Percentage GNP spent on health	Expenditure per head	Doctors per 100 000	Nurses per 100 000
	US$	%	US$	no.	no.
Fiji	2 460	3.5	55	37	209
Kiribati	910	12.7	94	15	212
Marshall Islands	1 610	4.6	85	43	290
Micronesia	1 920	9.1	171	46	329
Samoa	1 140	na	na	38	186
Solomon Islands	870	11.6	94	11	115
Tonga	1 810	3.5	56	46	331
Vanuatu	1 340	2.5	29	10	239
PNG	930	2.3	27	7	67

na = not available.
Source: UNDP (1999).

accessibility to basic health services is inadequate. There is a major constraint in terms of human resources, infrastructure, equipment and supplies. Many health centres are not operational due to lack of funds, vehicles, medical supplies and essential drugs, and many aid posts are not functioning. The lack of basic supplies such as disposable syringes and rubber gloves makes it impossible for health workers to adhere to universal precautions, and presents a serious challenge to the protection of health workers and clients from possible HIV infection.

Health sector spending as a percentage of total government expenditure declined through the 1990s. In comparison with other Pacific region countries, PNG has the lowest percentage of GNP spent on health and the lowest number of doctors and nurses per 100 000 residents.

Health outcomes are poor

The health status of its citizens is one of the major development challenges facing the current PNG government. Comparing PNG with other Pacific nations, PNG rates worst on a number of indicators of overall population health status (table 4.2). The infant mortality and under five mortality rates for PNG are 73 and 102 per 1000 live births respectively. The maternal mortality rate is also very high, with 370 mothers out of 100 000 dying due to complications arising from pregnancy and childbirth.

Table 4.2 **Key health status indicators**

	Life expectancy at birth	Infant mortality ratio[a]	Under 5 mortality ratio[a]	Total fertility rate	Maternal mortality ratio[b]
Fiji	67	19	23	2.7	27
Kiribati	63	54	74	4.5	225
Marshall Islands	66	63	92	na	na
Micronesia	68	20	24	4.0	226
Samoa	68	22	27	4.1	70
Solomon Islands	63	22	26	4.8	549
Tonga	71	19	23	3.6	197
Vanuatu	61	38	49	4.3	68
PNG	54	73	102	4.8	370

a Infant and under 5 mortality ratios are per 1000 births. **b** Maternal mortality ratio is per 100 000 births.
na = not available.
Source: UNDP (1999).

Infectious and preventable diseases remain at very high levels and continue to be leading health concerns, while the effects of poor nutrition, anemia, malaria and

respiratory diseases weaken the health status of much of the population. An already weakened immune system increases an individual's overall vulnerability to the effects of HIV, while the symptoms of communicable diseases can often mask the fact that a sick person may be infected with HIV.

Ability to cope with HIV is very limited

Even at the current nascent stages of the HIV/AIDS pandemic, PNG health resources are being adversely impacted. AusAID compiled the following information for PMGH.

§ Of the 3923 admissions to the 177 medical beds, 161 or 4 per cent were HIV related.

§ In 2000, there were 65 HIV related deaths in the medical ward of PMGH out of a total of 547 deaths (12 per cent) in medical wards.

§ The average length of stay for HIV cases in PMGH in 2000 was 12.1 days.

§ HIV related bed days of 1948 made up 5 per cent of the total 37 000 bed days in the medical ward.

The finding of the recent Interim Report on Rural Health Services (2001) was:

Finding 5: The spread of HIV/AIDS may cause the collapse of the health system, and there are other diseases that present a serious future burden to the health system.

1(a) In some provinces, the likely impact of HIV/AIDS has been underestimated. If infection rates follow the patterns displayed in other developing countries, the impact on the health system will be immense, in that AIDs is a chronic disease, cannot be cured, and so patients occupy hospital beds and require expensive medication over a long period of time. In some areas it is possible that the health system will collapse under the strain. Only drastic action (over and above the current efforts will prevent this from occurring.

The current National Health Plan contains some startling and alarming statistics on the impact of HIV:
"It has been estimated that if the epidemic (HIV/AIDS) is left to run at the present rate of increase, 70% of the hospital beds in the country could be occupied by AIDS patients in 2010. For every 5% increase in HIV prevalence in PNG, the total national spending on health will need to increase by 40%. At a 10% HIV prevalence rate, tuberculosis will rise 50 fold to 30% of the population".

(National Health Plan 2001–2010, pp.123–124.)

Evidence from other countries shows an increasing burden on the health system

Reports from Sub-Sahara Africa find that up to 50 per cent of hospital resources are currently absorbed by HIV/AIDS patients. Ainsworth and Over (1994) report the estimates of cost of care from a number of studies. Some are summarised below.

§   In Zaire a single 25 day episode of in-patient treatment for a pediatric AIDS case costs households US$90.

§   In Zaire HIV positive patients spent US$109 on medical treatment prior to admission — twice that spent by HIV negative patients.

§   In Tanzania 88 per cent of adults who died from AIDS in 1990-91 received medical care before death at an average cost of US$65 compared to 77 per cent of adults who died from other causes at a cost of US$47.

§   In Ghana a study of 40 symptomatic AIDS patients found a median monthly spending on treatment of US$25.

§   Lifetime treatment costs of hospitalised AIDS patients in Rwanda were estimated at US$358 in 1988–90, 91 per cent for in-patient care.

These are estimates of what is currently spent, not what constitutes an ideal treatment program. In a companion report some treatment options are explored to assess their net benefit. Further information on costs of treatment is provided there.

On the supply side there are also considerable pressures due to HIV/AIDS impact on the supply of health care workers (HCW).

§   In Zambia mortality among female nurses rose from 0.2 per cent in 1980, to 2.67 per cent in 1991 and to 4 per cent in 1994. Absenteeism rose from 10 per cent to 15 per cent over the same period (reported in Loewenson and Whiteside 1997).

§   There is evidence (Foster quoted in Barnett et al. 1996) that some health professionals continue to take great personal risks, feeling somehow pro-tected by their profession and education. Others on the other hand, so fear HIV that they are leaving the profession.

§   HIV positive health care workers (HCWs) are particularly susceptible to tuberculosis and should not be required to work with tuberculosis patients.

Implications for PNG

The most likely scenario for health services is that the tertiary health sector in urban areas will be expected to bear the increased burden on the health system due to the epidemic. This is due to the current relative strength of the tertiary sector, which is likely to continue in the future (Ministry of Health 2001). Key factors are:

§ the current scarcity of primary care facilities in both rural and urban areas;

§ the likely impact of the disease on the supply of primary facility personnel — due to death of trained personnel and to increasing reluctance to work in the facilities, particularly if they remain poorly resourced (such as no access to basic transmission prevention such as disposable gloves and needles);

§ increasing costs of supplying rural clinics due to wage increases for skilled personnel, increases in transportation costs, and a likely increase in prices of imported medical supplies due to exchange rate depreciation; and

§ as the tertiary sector is currently the most able to deal with those dying from AIDS, a pattern of reliance on these facilities is likely to be reinforced by experience.

Under this scenario considerable pressure will be placed on the tertiary sector. Rationing is likely to result and HIV/AIDS cases could crowd out chronic disease cases. People with treatable diseases may receive less care than would otherwise have been the case, imposing additional social and economic hardship on families.

While the emphasis in the HIV/AIDS Medium Term Plan on home care will ease the burden it is still likely that tertiary services will focus on palliative care rather than prolonging productive life for HIV sufferers. Anti-retroviral treatment programs will be available mainly for private patients with considerable private resources. Given the need for continual monitoring and patient commitment for such treatments to be effective the benefits from a widespread treatment approach would need to be assessed before such a commitment is made.

Given that people do not access tertiary care until the symptoms of AIDS become apparent, tertiary health services are not well situated to provide preventative services, with the possible exception of mother to child transmission (MTCT). However, palliative care pressure on the tertiary system might also crowd out maternal health care that might identify HIV positive mothers and provide treatment to prevent peri-natal and post-natal transmission.

The implications of this scenario for the PNG government, AusAID and other development partners are:

§   the need to promote home based care as a cost effective approach to care;

§   the need to restore primary care facilities is paramount to assist in prevention;

§   the cost of primary care facility provision is likely to rise not only due to increased demand for services by PLWHA for AIDS related treatments but also for opportunistic infections (pneumonia and TB in particular), increased treatments of STIs, additional consumables (syringes, gloves) and the costs of running prevention programs and improving surveillance and training for HCWs;

§   the shortage of skilled workers will be exacerbated with loss of staff to the disease as well as difficulties attracting people to train as HCWs;

§   approaches to prevention through use of the health sector are limited and so should also be pursued through other sectors;

§   demand pressures for HIV/AIDS palliative care on the tertiary health system might result in less treatment for other chronic diseases that have higher returns to health expenditure — health supply priorities need to be established and alternative ways of providing lower cost palliative care should be explored as a way to improve overall outcomes; and in a similar vein; and

§   while treatment to prolong productive life and reduce the social and economic burden is highly desirable, the delivery challenges are great and careful consideration of the costs (in terms of alternative uses of the resources) is required.

Wherever those resources come from — from other health areas, from education, from nutrition — there will be considerable opportunity costs. Government and households will face very difficult decisions. Better information on the opportunity costs is just as important in government and donor decision making as assessing the net benefits from programs to address HIV/AIDS.

The education sector

Despite an improvement, primary education still poses many challenges

In PNG, 70.6 per cent of men and 56.8 per cent of woman are literate (UN Statistics Division). Gross school enrolment (children in grades 1 to 6 as a percentage of 7 to 12 year olds) was 81.5 per cent for boys and 81.1 per cent for

girls in 1999 (National Department of Education 2001). PNG in 1994 spent 17.5 per cent of public expenditure on education or 5.2 per cent of GDP, around the average for the Pacific region (UNDP 1999). In 2002 the central government allocated 12.1 per cent of the budget to education (Department of Finance and Treasury 2002).

A survey conducted in 1996 (National Statistical Office 1997) found that 50.5 per cent of rural people had no formal education while 25.1 per cent had grades 1 to 5. In urban areas only 24.4 per cent had no education and 21.1 per cent had grades 1 to 5. Education starts later in PNG than in many comparable countries with 82 per cent of children aged 5 to 9 not having yet had formal education. For 10 to 14 year olds the proportion without education fell to 28.1 per cent and only 18.2 per cent of 15 to 19 year olds had no formal education. It is hoped that in time this will improve the literacy rate.

Retention and transition rates in education are poor. Between 1994 and 1999, grades 1 to 6 retention was 55.4 per cent. While transition in 1998 to 1999 between grades 6 to 7 and 7 to 8 were around 70 per cent, transition from 10 to 11 was just over 20 per cent (National Department of Education 2001). Early marriage for women and the economic necessity of utilising children's labour in many families impact on this retention rate. In primary school enrolment, the gender balance has improved considerably over the last decade with girls' only slightly lagging boy enrolments. While the gap is closing for secondary enrolment, enrolment rates for girls are still significantly lower than for boys.

The PNG population is very young with 34.9 per cent of the population of school age (5 to 19) (UN Statistics Division). The burden of school fees, long distances from and the need for some children to contribute to household income in rural areas have proved to be significant barriers to school attendance for many children.

The impact of HIV on demand for education in PNG is uncertain

The factors that will influence the impact of HIV on school enrolment and attendance are complex.

§   Higher infant and child mortality rate due to MTCT is likely to reduce the number of children (unless there is a significant positive impact on fertility).

§ Lower household incomes will increase the barrier presented by school fees and distance which will be compounded by a need for children to contribute to household income/production.

§ Children may be with withdrawn from school for a variety of reasons. This impact may be more profound for female children. The reasons include

– the need to work — paid and subsistence employment — in response to the loss of income, or to repay obligations accrued with the illness and death of a family member;

– distance from schools

– the need to care for an ill family member;

– earlier marriage (women), driven partly by the desire to maintain a bride price;

– to reduce the risk of infection associated with secondary schooling; and

– less incentive to gain an education if the anticipated life span is reduced, although offsetting this is the higher return to skilled labour anticipated by the labour supply impacts.

International evidence suggest falling enrollments but, more critically, loss of teachers

The impact on enrolment may be high, as some studies reported in Loewenson and Whiteside (2001) demonstrate:

§ in the Central African Republic and Swaziland school enrollments is reported to have fallen by 20 to 36 per cent due to AIDS and orphanhood, with girl children most affected; and

§ in Guatemala, more than a third of children orphaned by HIV/AIDS drop out of school.

On the supply side teachers are likely to be adversely affected, perhaps more than the general population.

§ Loewenson and Whiteside report a tenfold increase in teacher mortality and absence due to ill health.

§ UNICEF estimates that 860 000 children in Africa have already lost their teachers to HIV/AIDS.

§ In Botswana, death rates among primary school teachers rose from 0.07 per cent in 1994 to 0.71 per cent in 1999.

It is worth noting that in African countries it is estimated that the cost of treating one AIDS patient for one year is about the same as educating 10 primary school students for one year (Bollinger and Stover 1999).

Impact on supply of education in PNG

The education sector and hence AusAID's program is likely to face similar cost pressures and skilled labour shortages due to HIV/AIDS as in the health sector.

The implications for government and development partner programming are mainly due to the impact on teaching staff. Teachers, because of the mobility of their profession and long periods away from their communities and families tend to be more exposed to HIV infection. As discussed above the loss of teachers imposes considerable challenges for the government as it takes time to replace teachers. Compounding the problem is a reluctance to send young people to teacher training programs where there is concern about HIV infection.

The education system is also a critical channel for providing preventative care through education. Maintaining interest in education and providing a safe education environment become more important under this scenario.

Impacts on firms and other sectors

The impact on big firms and on government and public enterprises is potentially large

As discussed in the previous chapters firms will face higher labour costs, particularly for skilled workers due to labour shortages. They will also face increased absenteeism and higher health insurance and pension costs where these benefits are provided. For these latter reasons, the impact on large firms and on government and public enterprises is likely to be greater than small firms that do not provide benefits. This gives these organisations a major incentive to support prevention.

International evidence shows firms face substantial cost increases that can threaten firm viability

Bollinger and Stover (1999) summarises some of the studies of the impact on firms.

§ In selected firms in Kenya and Botswana costs for firms rose significantly —
37 per cent of the cost increase was due to HIV absenteeism, 15 per cent to
AIDS absenteeism, 6 per cent to funeral attendance, 16 per cent to burial costs,
21 per cent to increased training and recruitment and labour turnover and 5
per cent to health care costs.

§ A large transport company in Zimbabwe found the cost of AIDS to be equal
to 20 per cent of the companies profit, half of this due to increased health care
costs.

§ For a petroleum refinery in Zambia the annual cost was more than the annual
profit.

§ The annual cost of AIDS per employee was estimated to range from US$17 for
a Kenyan automobile firm to US$300 for the Uganda Railway Corporation,
largely reflecting the different prevalence rates and benefits available.

§ Medical aid companies in Zimbabwe have estimated that meeting all the
claims of just one per cent of HIV infected members could result in a 31 per
cent increase in insurance rates.

The impact on subsistence fishing and agriculture

Around 70 per cent of people in PNG rely on subsistence farming and fishing for
their main source of income. For women in rural areas 42.5 per cent of their
economic activity is subsistence farming/fishing and only 18 per cent is cash
cropping or fishing for sale. Only 24.5 per cent of effort is devoted to household
work (National Statistical Office 1997). This high share of time devoted to
subsistence agriculture by women reflects limited availability to increase
productive effort when faced with loss of household members or increased care
requirements. Women undertake the bulk of the work in subsistence agriculture,
and women and men may not be highly substitutable due to cultural factors. For
example, a study in the highlands found that women work on average over eight
hours per day while men work five.

In some areas there is considerable surplus labour devoted to 'leisure' or cultural
activities. This arises as opportunities for marketing cash crops are limited as is
the cash needs of households (Economic Insights 1999).

The overall extent of underemployment is not known but it has considerable
implications on how well subsistence communities will cope with HIV/AIDS.

Some findings from other countries reported in (Bollinger and Stover 1999) are summarised below. How relevant they are to the PNG situation is however questionable.

§   In Zimbabwe the death of a breadwinner led to a fall in output:

–   of 61 per cent for maize (the staple food)

–   47 per cent for cotton

–   49 per cent for vegetables

–   37 per cent for groundnuts

–   29 per cent for cattle owned.

§   In Tanzania, 29 per cent of household labour was spent on AIDS related matters where the household contained on AIDS patients.

Another study has found a shift in production to crops that require less time commitment for production, and have longer harvest periods. The extent to which this option is available in PNG is probably limited since cereal production is not a major part of subsistence farming.

Infrastructure

Infrastructure, particularly transport and communication, are seen as critical for poverty reduction in rural areas in a recent report (Duncan 2001). Limited access to cash cropping, which provides employment opportunities, is a key constraint on households being able to move out of absolute poverty. Access to markets through roads is seen as an important part of the solution.

In addition, access to capital to finance the small investment in seed and equip-ment and transport is a key constraint as is lack of distribution and marketing systems. Communal property rights and an atmosphere of distrust across communities present major challenges to the development of micro-credit markets and distribution chains.

Under the most likely scenario HIV/AIDS will compound existing problems.

§   The relative cost of the transport system is likely to increase due to loss of skilled workers and the higher risk nature of employment in the industry. The transport system is one area highly exposed to HIV related costs due to the high prevalence in workers in the sector. Higher transport costs will reduce access to markets.

§ Government funding for infrastructure faces threat from increasing recurrent expenditure due to increases in the costs of government employment as well as increasing demand for health services. Similarly assistance from development partners may be diverted into recurrent expenditure areas in response to an epidemic.

§ The costs of developing infrastructure will increase with the impact on skilled labour wages and other cost impacts on the economy.

§ There may be resistance to opening up roads to isolated communities given concern about the spread of HIV, with work crews being vulnerable to infection and a mechanism for the spread as well as opening up communities to greater exposure with improved transport access.

§ On the access to credit side, household savings are likely to be eroded by an epidemic. This would reduce capacity to raise debt and to invest, reducing the returns to improved infrastructure.

The implications of this scenario for the PNG government, AusAID and other development partners are to:

§ utilise infrastructure projects in the campaign to prevent the spread of HIV;

§ work with the government and other development partners in setting priorities to ensure that long term development through infrastructure is not compromised by higher profile demand in response to HIV/AIDS; and

§ continue to seek complementarities between what communities can undertake to improve access to employment opportunities and the infrastructure provided, in other words infrastructure projects should be assessed in terms of the opportunities they create once the infrastructure is in place, and less in terms employment creation.

Governance

Improving corporate and economic governance is increasingly seen as an important component of development. HIV/AIDS may impact on governance programs in several ways.

§ Loss of skilled government and corporate personnel lowers the return on training and can leave gaps unless redundancy is built into training programs.

§ The importance of a leader or champion for reform makes reform vulnerable to the loss of such leaders, the probability of which increases with the spread of HIV.

§ The interest in reform may be weakened by the concerns raised by an epidemic and reduced returns to individuals from their investment in reform.

§ The institutional structures themselves may be weakened by lack of continuity of personnel, perceived inability to deal with an epidemic and a feeling of futility.

The most likely scenario is one with higher costs in terms of the number of personnel that need to be involved to make capacity building work. It is also one with higher project risks due to possible loss of champions for reform, vulnerability of supporting institutions, and an overall weakening of reform as a priority for government. The main implication for development programs and projects is to put more emphasis on risk management to mitigate the risks facing the projects.

§ Possible loss of personnel means that greater redundancy needs to be built into capacity building projects — this implies training larger numbers of staff and greater emphasis on training trainers. It also implies more multi-skilling and ensuring back up in system and process design. Documentation increases in importance.

§ Additional policy support may be required to ensure development projects are well entrenched within the policy framework and have multiple champions.

§ There may be more constraints on PNG contributions to donor-funded projects both in terms of personnel and financial support.

§ The pressures on provincial governments to deliver services are likely to increase and this makes capacity building at the provincial level even more critical.

The impact on poverty and gender

It is estimated that almost one third of the PNG population live in absolute poverty (Duncan 2001). Rural poverty is much higher than urban poverty due to the lack of employment opportunities (including cash cropping) and poor agricultural productivity. The proportion of the population in absolute poverty has remained roughly constant over the last decade. With population growth of around 3.5 per cent per year the increase in the number of people and house-holds in absolute poverty is growing at about the same rate. Based on current census estimates of the population at least 1.5 million people are currently living in poverty.

HIV/AIDS is likely to exacerbate poverty

While the current impact of HIV/AIDS on GDP is relatively small the epidemic is anticipated to exacerbate the problem of poverty. HIV/AIDS impacts on poverty through the following mechanisms.

§   The demographic profile of the epidemic means that the dependency ratio — the proportion of dependants to income earners currently around 80 per cent — is anticipated to rise. Increasing dependency is usually related to increasing poverty. This impact is mitigated if there is an increase in the overall employment rate, however, this is likely to be limited to urban areas in PNG.

§   The share of the household budget spent on basic needs declines as the rate of illness and death rises increasing funeral and HIV related medical expenses. For example, Cote d'lvoire households with an HIV/AIDS patient spent twice as much on medical expenses as other households and in Ethiopia a study of 25 families found that the cost of treatment, funeral and mourning expenses was several times the average household annual income (Bollinger and Stover 1999). While after death household expenditure declines, the reduction in household income usually greatly exceeds this reduction. The response is usually a cut back in education of children and nutrition levels reduced. The latter can have immediate impacts on productivity of labour, while the impact of lower education levels is lagged.

§   The increase in expenditure during the period of illness and mourning occurs at a time when income also falls and can be funded by drawing on savings or by increasing debt. This reduces available capital for investment limiting opportunities for improving productivity and/or accessing employment opportunities. While this will impact on the potential for households to move out of poverty, the loss of even a small buffer against income fluctuations may have a long-term impact on the number of households in poverty. Many households, while not currently below the poverty line, are vulnerable. HIV/AIDS associated expenditure potentially erodes the small safety margin for affected households, seeing a higher proportion of households move into absolute poverty.

§   The distribution of income is likely to become more unequal due to an increase in the relative wage for skilled labour, while the surplus of unskilled labour means unskilled wages will changed less. Partially offsetting this impact is a reduction in the unemployment rate, but this is expected to be largely in urban areas in PNG and to be limited in scope.

§   The treatment of family assets following the death of a spouse will have a major impact on the number of households in poverty. The ability to remarry and social safety nets offered by extended family are also important deter-

minants of whether families affected by the loss of the breadwinner move into poverty. The change in the number of female headed households will be a critical factor in the impact on poverty as female headed households are several times more likely to be below the absolute poverty line. Around 50 per cent of PNG households have three or more related adults. This is in part due to polygamy, in part due to extended family. Only 7 per cent of house-holds have only one adult present (National Statistical Office 1997). This reduces the potential problems for a household associated with the loss of an adult due to AIDS.

Unequal income and asset distribution contribute to a worsening poverty outcome

The ownership of assets and access to non-labour income can be used to cushion the effects of sickness and death of working age household members. There is little official information on these matters in PNG, and the issue is complicated by the extent of traditional and communal land use and usufruct rights. It is difficult to generalise about the extent to which households may be able to also generate income or consumption from these kinds of property.

Conventional measures of the distribution of income and consumption show a high degree of inequality in PNG. According to the UNDP's Human Development Report, the richest ten per cent of the population account for 40.5 per cent of national consumption, while the poorest ten per cent account for only 1.7 per cent (UNDP 2001). Since income and asset distribution are usually highly correlated, this could be interpreted — subject to the qualification discussed above — to imply that the poorer groups in the community have little in the way of assets. The problem could be particularly acute for poor urban householders who may have lost links to rural communities and the claims on commonly managed land.

Gender impacts are complex but the burden of caring will fall disproportionately on women

Differences in the social, cultural and economic status of men and women will also shape the economic impact of HIV/AIDS in PNG. One important dimension is how the burden of caring for sick household members and addressing the shortfall in production labour is handled especially in subsistence communities. Given current gender problems of school enrolment, it is possible that one response will be to pull girls out of school or defer their enrolment. In many PNG

societies, women and men fulfil different roles in interaction with subsistence and market activities. If these gender roles are rigid, then the response to declining household production and income may fall disproportionately on women. This will, among the other things, have implications for parental care of young children, as well as for the health and welfare of female household members.

Another important gender factor is related to land management and use rights, and custom regarding inheritance/transmission of these rights in households when husbands or wives die. While some PNG societies are matrilineal, others are strongly patriarchal, and widows rights to continued enjoyment of household land and usufruct rights are limited.

There may also be 'second round' effects of HIV/AIDS with strong gender dimensions. For example, if the public health system faces increased pressure to deal with AIDS, a response may be to pull resources from already limited facilities and program delivery that have focused more on women's health issues — particularly maternal health.

Because there is such a diversity of societies in PNG, it is difficult to generalise about the interaction between gender structure and the economic impact of HIV/AIDS. Experience in other countries suggests that the epidemic can worsen gender inequities, and its impact on food security can be particularly severe for women (and their children).

Key parameters affecting the impact of HIV — what indicators to look for

Table 4.3 summarises the main mechanisms through which HIV impacts on the economy of households, firms, wider sectors and the nation. Based on the discussion in the previous chapters it also summarises the possible impact in PNG, and raises the questions central to being able to assess the impact.

The key parameters about which little is known that will determine the impact are:

§   the household response to having a family member with HIV in terms of care and resources allocated to that member;

§   the costs of treatment, funeral expenses and so on and the arrangements for, and household capacity to, meet these costs;

§ the potential of the household to increase income/production in response to loss of the input of a household member;

§ the extent to which skilled workers have access to private health insurance and health care and hence access to treatment programs — the greater the access the lower the economic impact as this will reduce the shortage of skilled labour; and

§ the migration response to contracting HIV and/or development of AIDS — this is critical to assess the likely pressure on urban tertiary care facilities. If urban workers do not return to rural families and if rural communities expel or encourage ill members to seek treatment in urban areas the pressure will be much greater than if the flows are the reverse.

The other major response factor is that of the government. Government action will be crucial in limiting the spread of the disease and hence in controlling its cost. A number of studies for example (Ainsworth and Over, Ainsworth and Teokul 2000, Bollinger and Stover 1999) have shown that prevention is the most cost effective approach, even in situations where prevalence has reached epidemic proportions. Targeting high-risk groups is the most cost effective of the prevention strategies if the epidemic is not yet widespread. As with all programs the net benefits need to be compared to those of other programs, not only those that address HIV/AIDS but also those addressing other fundamental problems of poverty, health and education. It may be that programs to treat malaria, for example, have a higher economic and social impact than treatment for HIV/AIDS as this disease has massive implication for the productivity, but not the size, of the labour force.

Table 4.3 **Some guidelines to factors influencing the impact of HIV/AIDS**

Key parameters	Factors influencing the impact	Possible impact in PNG
Households		
Reallocation of household resources towards — health care for HIV/AIDS — funeral and mourning expenses — caring for additional family members/orphans	Share of household income spent on healthcare Size of funeral and mourning expenses Responsibilities to care for extended family or others due to obligations Share of household income on non-essential expenditure Household saving Extent to which public resources are provided	Very low share of household income is spent on health care Most families have few resources to reallocate Public provision likely to be limited to tertiary services in urban areas
Loss of income from illness — those with HIV/AIDS — carers	Share of household income lost Ability to maintain household production — diversion of other resources such as children, extent of underemployment	Urban areas — what proportion of households rely on a single income source? Rural areas — area dependent — reliance on remittances and underemployment in agriculture (is land or labour the constraining factor?)
Loss of future income — from labour due to reduced skill levels — from lower investment in fertiliser, implements, seed, land, micro enterprises etc.	Current education and response to household income and expenditure impacts Returns to education — what are the opportunities (incentives) provided by better education? Current investment and response to household income and expenditure impacts – what are the investment opportunities?	Current education levels are low. What is the response in terms of withdrawal from education likely to be? Current investment mainly in cash crops, little opportunity in micro enterprises. How will these be affected?

Table 4.3 **Some guidelines to factors influencing the impact of HIV/AIDS**   (Continued)

Key parameters	Factors influencing the impact	Possible impact in PNG
Sectoral		
Loss of labour leading to higher labour costs	Share of labour force affected by HIV/AIDS Skill level of labour affected Supply constraints on labour by skill level	Shortage of skilled labour means skilled wages likely to increase considerably Transport sector likely to be one of the most affected and this will in turn impact on other sectors – particularly cash cropping
Additional costs of employment — medical benefits — pensions — HIV/AIDS awareness programs	Share of labour force with health care benefits and coverage of benefits Share of labour force with pension benefits and size of benefits Response of companies to the problem – likely effectiveness of such efforts	Likely to impact most on the government as an employer Mining may be very effective in education efforts – but national impact is limited due to small workforce
Additional costs of labour turnover — recruitment costs — training costs	Skill needs of sector Access to skilled labour supply Level of training required Firm size and ability to provide on the job training	Impact on education and health sectors likely to be high due to shortage of trained workers and training required Mining and finance industries able to access off-shore skilled labour markets
Productivity losses — absenteeism — higher sick leave use — loss of interest and effort	Customs regarding caring for family, mourning and funerals determining absenteeism Availability and affordability of HIV treatment programs to maintain productive employment Culture in terms of impact on attitude to work and the future	Not likely to be a major issue for the mining sector(except during construction phase) but all other sectors are vulnerable

Key parameters	Factors influencing the impact	Possible impact in PNG
Sectoral (continued)		
Reduced investment / changes in investment decisions	Sector potential to replace labour with capital Source of comparative advantage – if low cost labour this reduces potential Extent to which production is for the domestic market	Most investment financed by foreign capital – mining will be governed by prospectivity and political stability
— shift to more capital intensive production		Investment in agribusiness may be negatively impacted
— reluctance to invest		Limited scope to replace labour with capital in major employment sectors (service sectors)
Government		
Impact on government capacity	Extent to which government workforce is affected	Skilled labour is currently in short supply and government workers are expected to be affected making it difficult to deliver services
— to deliver services due to loss of skilled labour	Flow on effects to attitude to future	
— to develop and deliver policies and improve governance		
Impact on government revenue – anticipated decline due to lower labour supply, lower firm profitability (higher costs)	Share of government revenue for income taxes Progressive nature of tax system, indexation of tax brackets	Income taxes are 26 per cent of government revenue, lower labour supply expected to outweigh any impact of higher wages
Impact on government expenditure anticipated increase as:	Government expenditure response to increased demand for services	Health and primary education are largely devolved to provinces and currently under resourced. Additional government funding in response to HIV is not likely
— costs rise as for other employers		Rising costs will further reduce service levels
— demand for government services rises		

Table 4.3 **Some guidelines to factors influencing the impact of HIV/AIDS**   (Continued)

Key parameters	Factors influencing the impact	Possible impact in PNG
Economy-wide		
Decline in government saving (increased dissaving) due to higher demands for expenditure and lower revenue – likely impact is reduced capital investment particularly in infrastructure (transport and communication)	Government access to international credit and budgetary support Extent to which development partners are able to provide investment in infrastructure	Debt servicing is already over 20 percent of the budget – further indebtedness will be problematic. And not eligible for concessionary debt Already heavily reliant on development partners for infrastructure projects
Impact on domestic saving – anticipated decline leading to reduced domestic investment	Openness of capital market — reliance on foreign saving for investment	Domestic saving is not a source of funds for investment except at the micro level
Impact on wages, price level and inflation	Government financing decisions on budget shortfalls (printing money contributing to the impact) Labour supply impact on wage levels and flow through to prices (elasticities of demand and supply) Impact on exports and the exchange rate feeding through into domestic prices through imports	Modelling suggests strong price effects in market prices for consumer goods and services due to wage rises
Worsening current account balance – greater reliance on foreign savings	Proportion of exports that are labour intensive in production Responsiveness of imports to income and relative price changes – the former is likely to reduce imports as incomes fall, the later to increase import as and the relative price of domestic goods rises	Exports of minerals largely unaffected Exports of agricultural commodities could be significantly affected Loss of competitiveness in manufacturing – reduced exports, greater demand for imports put pressure on the nominal exchange rate to depreciate

Table 4.3 **Some guidelines to factors influencing the impact of HIV/AIDS** (Continued)

Key parameters	Factors influencing the impact	Possible impact in PNG
Economy-wide		
Increase in poverty and inequality — decline in real wages for low income (unskilled and subsistence) households — greater inequality between skilled and unskilled workers income as skilled labour wages rise relative to unskilled due to weaker supply constraints at unskilled end of the spectrum	Relative labour supply of skilled and unskilled labour Industry structure and relative demand for skilled and unskilled labour Price impacts relative to wage impacts	Higher transport costs and higher prices of consumer goods is likely to reduce real wages of agricultural producers relying on subsistence and cash crops Impact on crime is uncertain – falling incomes and growing inequality will increase the 'demand' for crime, but the HIV/AIDS will reduce the 'supply' of crime workers as a share of the population

Appendixes

A Progression of HIV/AIDS since 1987

This appendix presents data on the progression of HIV/AIDS in PNG in the period since the infection was first reported in 1987. There are some inconsistencies between data reported in June 2001 and December 2000. The December 2000 data is more complete. The most recent data is used where possible.

Table A.1 **Pattern of reported HIV and AIDS in PNG**   1987–2000

Year	Reported HIV	Annual increase (%)	Reported AIDS	Annual increase (%)
		%		%
1987	6	--	2	--
1988	12	100	11	450
1989	19	58.3	8	-27.3
1990	36	89.5	19	137.5
1991	37	2.8	19	0.0
1992	32	-13.5	20	5.3
1993	40	25.0	15	-25.0
1994	75	87.5	33	120.0
1995	128	70.7	48	45.5
1996	196	53.1	82	70.8
1997	359	83.2	164	100.0
1998	696	93.9	215	31.1
1999	815	17.1	244	13.5
2000	970	19.0	275	12.7

Source: National AIDS Council Secretariat and Department of Health, PNG (2000).

Table A.2 **Cumulative reported HIV and AIDS in PNG**   1987–2000

Year	Cumulative HIV	Annual increase (%)	Cumulative AIDS	Annual increase (%)
		%		%
1987	6	--	2	--
1988	18	200	13	550
1989	37	105.6	21	61.5
1990	73	97.3	40	90.5
1991	110	50.7	59	47.5
1992	142	29.1	79	33.9
1993	182	28.2	94	19.0
1994	257	41.2	127	35.1
1995	385	49.8	175	37.8

Table A.2   **Cumulative reported HIV and AIDS in PNG   1987–2000** Continued

Year	Cumulative HIV	Annual increase (%)	Cumulative AIDS	Annual increase (%)
		%		%
1996	581	50.9	257	46.9
1997	940	61.8	421	63.8
1998	1636	74.0	636	51.1
1999	2451	49.8	880	38.4
2000	3421	39.6	1155	31.3

Note: National AIDS Council Secretariat and Department of Health 2001 reports 475 cumulative cases of which 758 were diagnosed as HIV, 1366 were diagnosed as AIDS and 1951 were unclassified.

Source: National AIDS Council Secretariat and Department of Health, PNG (2000).

Table A.3 **Age and sex distribution of reported HIV-positive people**
         PNG 1987 to June 2001

Age group	Female	Male	Unknown	Total	Sex ratio of known cases
0-4	57	70	3	130	1.23
5-9	9	6		15	0.67
10-14	7	1		8	0.14
15-19	137	40		177	0.29
20-24	316	154	1	471	0.49
25-29	260	238		498	0.92
30-34	169	238		407	1.41
35-39	100	159		259	1.59
40-44	50	123		173	2.46
45-49	22	84		106	3.82
50-54	16	48		64	3.00
55-59	3	23		26	7.67
60-64	4	11		15	2.75
50 & over	0	2		2	-
Unknown	664	918	142	1724	1.38
Total	1814	2115	146	4075	1.17

Source: National AIDS Council Secretariat and Department of Health, PNG (2001).

Table A.4 **Probable means of transmission for recorded HIV-positive people**

Positive people	Male	Female	Not stated	Total	Share
					%
Bi/homosexual	7	-	-	7	90
Heterosexual	505	598	2	1105	1
Peri-natal	58	53	3	114	9
Blood transfusion	2	1	-	3	-
Unknown/ Others	1543	1162	141	2846	
Total	2115	1814	146	4075	

Source: National AIDS Council Secretariat and Department of Health, PNG (2001).

Table A.5 **Province of origin (as at June 2001) and province of detection (as at June 2001) of HIV-positive people**   PNG 1987

	Province of origin[a]	Province of detection[b]
Western	18	73
Gulf	120	12
Central	134	1
National Capital District	46	2673
Milne Bay	10	4534
Oro	32	51
Southern Highlands	116	133
Enga	89	393
Western Highlands	172	103
Simbu	129	212
Eastern Highlands	110	172
Morobe	42	22
Madang	9	33
East Sepik	30	6
West Sepik	3	7
Manus	9	26
NIP	16	45
East New Britain	13	18
West New Britain	5	7
Unknown	2 314	8
Total	3 428	4075

Source: [a]National AIDS Council Secretariat and Department of Health, PNG (2000). [b]National Aids Council Secretariat and Department of Health, PNG (2001).

Table A.6 **Percentage of HIV cases by occupational group as at June 2000**

Occupational group	Per cent
Professionals	0.8
Office/shops	0.8
Disciplined forces	0.8
Unskilled worker	0.5
Farmer or villager	1.6
Housewife	3.4
Unemployed	3.8
Sex worker	1.3
Student	0.3
Child less than six years old	2.7
Unknown	84.0

Source: Derived from National AIDS Council Secretariat and Department of Health, Graph 8, PNG (2000).

B   Projecting demographic effects of HIV/AIDS

As discussed in chapter 2, two broad approaches to projecting the demographic consequences of HIV/AIDS were explored. The first approach used conventional epidemiological models, drawing on current information on the evolution of the disease in PNG. The second was based on a more qualitative assessment of the expected nature and order of change over time, assuming a similar growth of the epidemic as occurred in countries with a similar behavioural base for its spread. This appendix describes the methods employed under the two approaches, and presents for information the results produced under the first approach. The results under the second approach are presented in chapter 2, as they were used in the economic modelling.

Conventional projections

Under the conventional approach, future HIV and AIDS infections and related deaths were modelled using the WHO and UNAIDS program Epi Model, and the Futures Group program, AIDSPROJ. Both programs are based on a method developed by Chin and Lwanga.

§   Epi Model is a simple computer program designed for short-term (less than five years) projections of AIDS cases. Current thinking is that the program is suitable for countries with explosive epidemics, such as Sub-Saharan Africa, but is of questionable value for other countries (Dr G Slama, and Dr M O'Leary pers. comm.). The program also requires some important guesses, such as 'the year of widespread transmission,' in order to create the projections, and these estimations are quite sensitive. The program projects future HIV and AIDS cases and deaths. A previous projection for PNG to 2005 was produced by WHO using Epi Model.

§   AIDSPROJ is a refinement of Chin and Lwanga's method of estimating AIDS cases, based on the work of David Sokal, of Family Health International, and John Stover. This program requires a greater range of inputs yet provides a narrower range of outputs, that is, only future AIDS cases.

§   There are more refined models, such as that of Low-Beer and Stoneburner (1997) but they cannot be used in PNG because the required data are not available, in particular:

–   rates of age-related fertility decline in HIV positive women

- changes in risk behaviours (for example condom use)
- active aging — that is the risk beyond the reproductive years
- 50 selection and participation biases (for example access to ANC clinics).

These models were integrated with a medium projection of the PNG population to 2020, based on the 1990 census (as the results of the 2000 census are not yet available). The projection was adjusted for age misreporting but did not include the small non-citizen population or any adjustment for natural or 'man-made' disasters, such as epidemics (Jorari and Lasia 1996). The projections assumed that both fertility and mortality in PNG would only slowly decline. The mortality transition, which was quite rapid before 1980, had almost come to a standstill by 1991. Although the authors alluded to the threat of HIV/AIDS their background paper, it was not specifically factored into the projection.

The numbers that both Epi-Model and AIDSProj generated for the PNG population appear to be much too small. At the early stage of the epidemic, before the numbers really start to take off — where PNG is now — the curves that these programs draw may be overly conservative. These projection packages are not designed for a 20 year horizon to 2020, but for short to medium projections of three to five years. It is also recognised that they work poorly where there is not yet extensive HIV spread (WHO/UNAIDS Working Group on Global HIV/AIDS & STI Surveillance).

From these projections, it appeared that by 2020, if the transmission of HIV was somewhat contained, PNG could have around 2500 new cases of HIV and 2000 cases of AIDS each year, with perhaps around 2000 related deaths. That is, the number of AIDS related deaths in PNG by 2020 would be less than the margin of difference assumed by Jorari and Lasia (1996) in their two population projections; that is, indistinguishably small in relation to normal demographic processes.

With EpiModel, the results fluctuated widely, even with minor (and quite arbitrary) changes of assumption about the level of prevalence and year of widespread transmission. With AIDSProj, as B.1 and B.2 show, the curves drawn flatten out at the current level of prevalence, producing a steep rise but then fairly little growth. (The two graphs take different assumptions about the prevalence of HIV in PNG. The first uses the WHO et al. 2000, estimated national rate of 0.15 per cent. The second generalises adult prevalence in Port Moresby (that is, 0.3 per cent) to the whole country.) At this stage of the PNG epidemic, these programs do not seem to provide any sensible forecast. In other words, it is possible to generate numbers using this software, but impossible to give much credence to them.

Chart B.1 **Adult HIV Prevalence Assumption** Prevalence in 1999 at 0.15 per cent
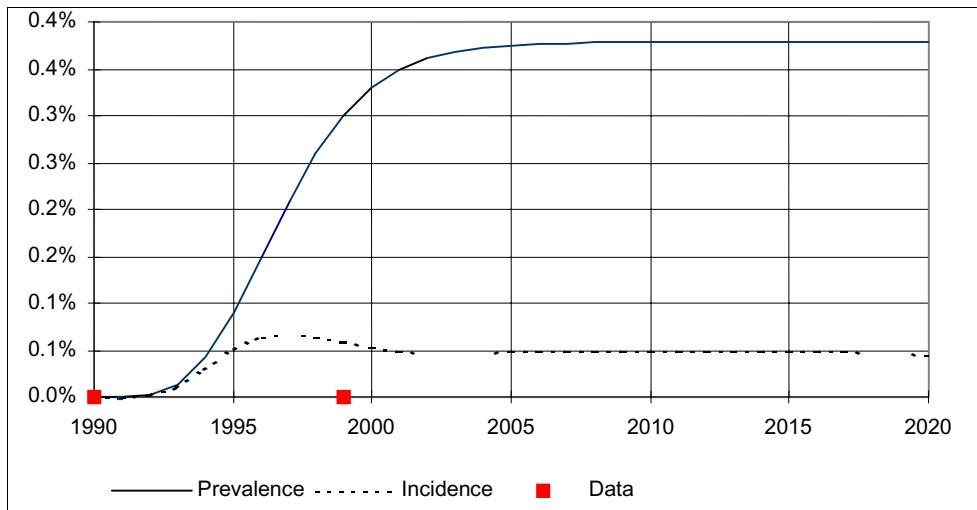
Data source: Margaret Chung, estimates from AIDS project.

Chart B.2 **Adult HIV Prevalence Assumption** Prevalence in 1999 at 0.345 per cent
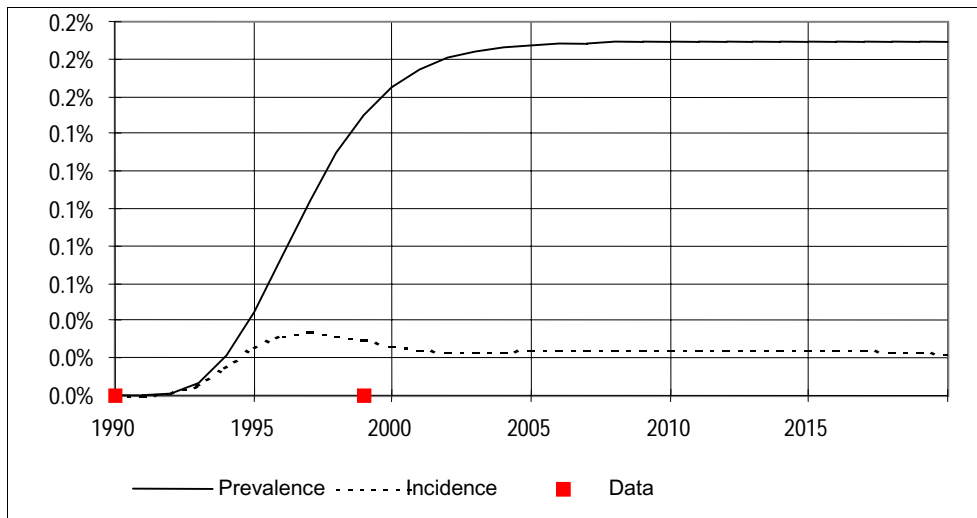
Data source: Margaret Chung, estimates from AIDS project.

An alternative approach

Given the implausibility of the numbers generated by the use of epidemiological models, an alternative approach has been used to generate the demographic projections for the economic modelling. In this approach, baseline demographic projections prepared by Jorari and Lasia based on the 1990 census were modified to take account of estimates of increased mortality in the 15–49 age cohort assuming that the prevalence of HIV infection in this group in PNG follows a

similar evolution to the problem in the Sub-Saharan African countries — Kenya, South Africa and Zimbabwe.

Methodology

The projection are based on the prevalence rates in the three scenarios. The number of new infectees each year was estimated as the number needed to deliver the prevalence rate given:

§   the starting number in each age cohort

§   deaths which would occur regardless of HIV

§   deaths due to AIDS — adjusting for those who would have died anyway

§   entrants to the 15–49 age cohort — as given by Jorari and Lasia.

The number of people with HIV dying as a result of the normal course of events was the previous year's infectees multiplied by the mortality rate (about 1 per cent). The number dying from AIDS was the number who were infected five years ago multiplied by the probability of surviving those five years (95 per cent). It was the number of deaths exclusively from AIDS that was subtracted from the number of survivors that would have been the case in the without HIV baseline.

There are two caveats . Firstly, we have assumed that AIDS has had no effect on the number of people entering into the cohort of 15-49 year olds. Secondly, our approach ignores the fact that those dying exclusively from AIDS may have died from other causes in the future, and some would have left the age cohort by 2020 as well. The first of these caveats means our calculations are an underestimation of the effect on the population, while the second caveat means we are over-estimating the effect. However, to factor these in would require two things. With the first issue we need detailed knowledge of the effect of AIDS on fertility rates and infant mortality rates. To deal with the second issue, we need knowledge of the age distribution of those infected with AIDS. It is likely that the effect on the estimates by 2020 from either of these effects is not great.

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