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Papua New Guinea: Selected Issues and Statistical Appendix

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PAPUA NEW GUINEA

Selected Issues and Statistical Appendix

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Approved by the Asia and Pacific Department

January 26, 2006

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I. GROWTH ACCOUNTING AND MEDIUM-TERM GROWTH PROSPECTS IN PAPUA NEW GUINEA¹

A. Introduction

1. **Papua New Guinea has experienced decelerating and volatile growth rates since independence in 1975.** While economic cycles have generally paralleled the many mineral sector booms and busts, the downward trend in growth rates may reflect other factors. This paper explores the trends underlying Papua New Guinea's historical growth experience and considers what implications these might have for the medium term outlook. The analysis begins with a review of the changes in the production structure, followed by a look at trends in GDP and GDP per capita over time. The subsequent sections considers investment trends and international comparisons. The penultimate two sections discuss the empirical results of the estimated sources of growth for the aggregate economy and their implication for medium-term growth under alternative scenarios. The last section concludes the paper.

B. Structure of The Economy

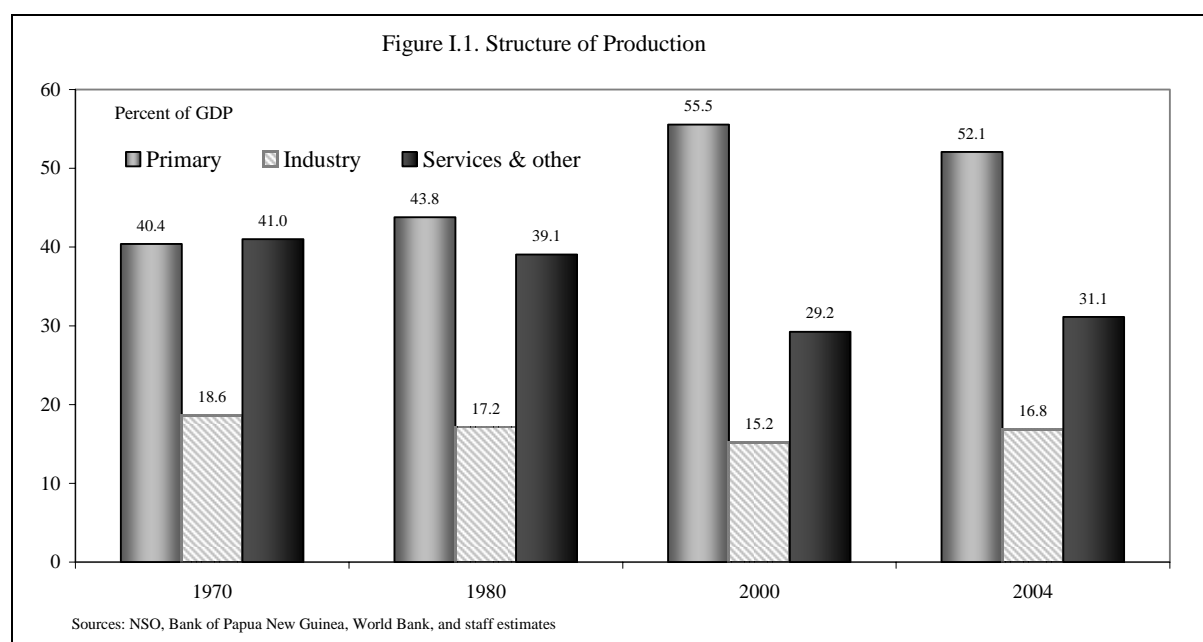
2. **Papua New Guinea's economy is dominated by a large labor-intensive agricultural sector and a capital-intensive oil and minerals sector.** The formal sector consists of enclave extractive industries (mining, petroleum, and logging), cash crop production, and a small, import-substituting manufacturing sector. The informal sector is largely subsistence agriculture. Over the years, Papua New Guinea's uneven and volatile growth rates have been accompanied by structural transformation (Figure 1). Unlike the trend observed in many developing countries, the share of the primary sector in GDP which includes the mineral sector, has increased steadily since 1975, while those of the tertiary and secondary sectors have declined. At the same time, while the share of the secondary sector generally increases over time in most mineral and petroleum producing countries, it has declined steadily in Papua New Guinea, an indication of the enclave nature of the extractive sector.

3. **The importance of the agriculture sector is currently about the same as at independence, reflecting structural impediments which have deterred more rapid growth.** In the 1970s, the agricultural sector (including forestry and fishery) accounted for about 40 percent of GDP. The GDP share of agriculture declined to about 30 percent in 1985 before increasing again to about 38 percent in 2002–04, due to increases in the share of fisheries and forestry. Both of the latter are marked by the presence of large, foreign-owned enterprises. The main agricultural sector, including the cash and subsistence crops, is dominated by small farmers and has been hurt by the deterioration of physical infrastructure and of weak law and order.

¹ Prepared by Ebrima Faal.

4. The mining sector's share of GDP increased from negligible levels in the 1970s to about 30 percent in the early 1990s, before slipping to about 13 percent during 2003–04.

The sector is overwhelmingly foreign-owned, though the government holds equity in some projects, and developments largely track events in the global mineral sector. However, domestic law and order issues played a role in sector developments when the Bougainville copper and gold mine (at one time providing about one-third the country's income) was closed in 1989 due to violent disputes with landowners. The early 1990s were a mineral boom period, when a number of new mines began production. Currently, significant new developments are occurring with the Ramu Nickel Project, and the Papua New Guinea-Queensland gas project, which will entail collecting and processing gas in the highlands fields and transporting it by pipeline to markets in Queensland, Australia.



5. The manufacturing sector has been shrinking. This sector includes food, soft drinks, beer, food canning, tobacco processing, and furniture making. Small-scale engineering and metal processing, clothing and other light industries are also present. The sector is dominated by firms geared to the domestic market. Its expansion has been hampered by a range of structural impediments, including the shortage of entrepreneurial, managerial, and labor skills, complicated regulations, high utilities and transportation overheads, and the high cost of labor relative to productivity. Its contribution to GDP has varied in the range of 5 to 11 percent since the 1970s, and is now about 6 percent.

6. The output of the construction sector is characterized by sharp year-to-year variations reflecting the impacts of large individual projects. The sector grew rapidly in the early 1970s, with the establishment of the Bougainville mine, followed by a declining trend over the 1980s as many planned major infrastructure projects were not carried out. The contribution of the sector settled at around 5 percent of GDP during the first half of the 1990s. Construction sector activity picked up since the recovery began in 2002 as

housing construction has increased. Significant future expansion is expected with the commencement of the Ramu-Nickel and Papua New Guinea-Queensland Gas projects.

7. **The services sector accounted for more than 40 percent of GDP during the 1970s and the 1980s, then has declined steadily to 29 percent in 2004.** This sector includes economic activities such as transportation and communications, which have sharply deteriorated over time, as well as community and personal services, which are sensitive to weaknesses in law and order and governance.

C. Trends in GDP and Per Capita GDP Growth

8. **Papua New Guinea experienced a decelerating trend in growth rates until the early part of this decade** (Figures 2 and 3). Between 1960 and 1975, Papua New Guinea's economy grew at an average annual rate of over 5.5 percent, reflecting rapid growth in public expenditure and the establishment of the Bougainville copper mine in 1968.² With population growth of about 1 percent annually, per capita real GDP improved significantly. Economic growth began to slow in the late 1970s and early 1980s due to the first oil price shock and a slowdown in overall productivity growth associated with the repatriation of Australian expatriates in the period around independence in 1975 (see Jarrett and Anderson (1989)).

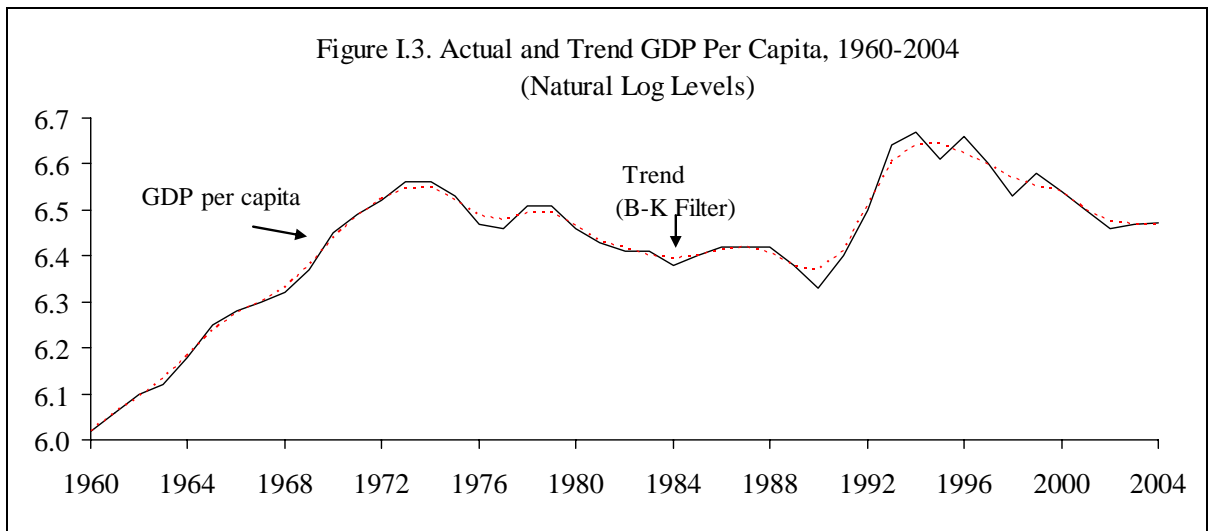
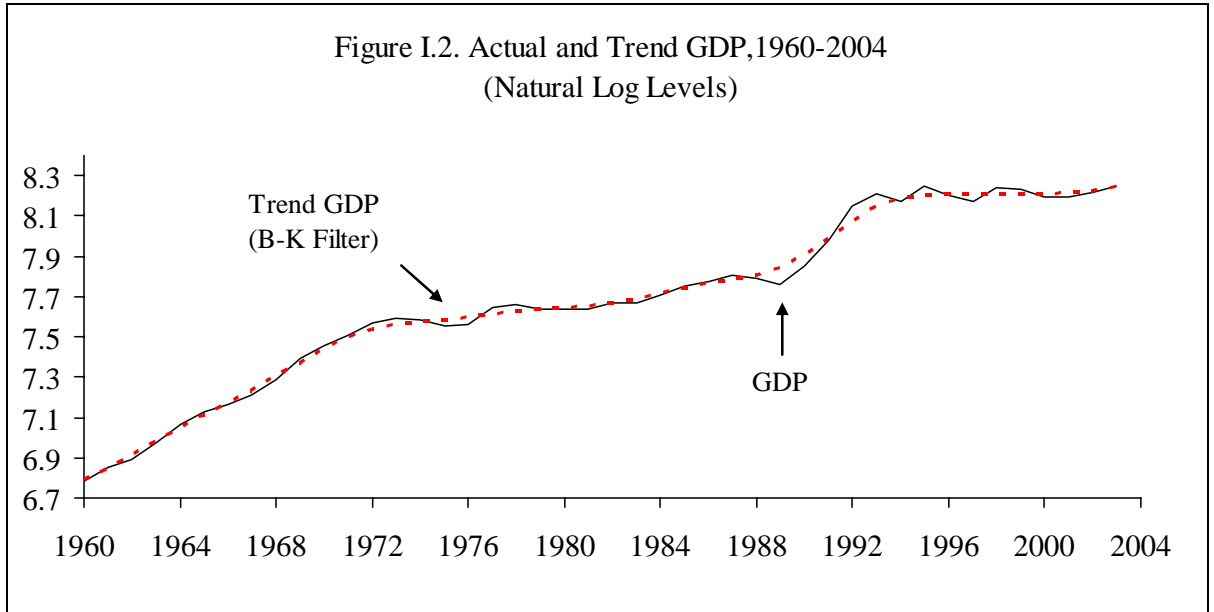
9. **A dependence on commodity exports is reflected in Papua New Guinea's vulnerability to economic shocks.** Strong commodity prices in 1985–88 for Papua New Guinea's mineral and agricultural exports led to higher production and improvements in infrastructure spending with the result that real GDP growth resumed for a brief period. The recovery was short-lived, however, as economic growth declined sharply in 1989 with the closure of the Bougainville mine and a significant decline in minerals prices.³ Over the period 1991–94, the adverse effects of the mine closure on GDP and income growth were partly offset by a boom in other parts of the mineral sector, including petroleum.

10. **By 1994, however, macroeconomic imbalances that had been building since the late 1980s—spurred by an unsustainable fiscal expansion during the early 1990s and weak mineral prices—led to a balance of payments crisis and sharp declines in GDP growth.** With support from the IMF and other donors, the government adopted economic and structural policies that included significantly curtailed public expenditure, a devaluation of the kina, and abandonment of the 'hard kina' policy that had been in place since 1975. Economic growth recovered briefly with some expansion in mining output, but fell in 1997 as the economy was adversely affected by severe drought, lower external demand due to the Asian crisis, low prices for mineral exports, and growing law and order problems. The decline in economic activity and exports led to a further deterioration of the fiscal position,

² The paper uses the Baxter-King (BK) Filter (1995) to estimate trends.

³ The Bougainville mine is still closed as of late 2005.

resulting in heavy public borrowing from the central bank to finance the large budget deficits, significant loss of international reserves, a protracted depreciation of the kina, and sharp increases in inflation. Real GDP grew by less than 1 percent in 1996–2002 and GDP per capita growth decelerated sharply.



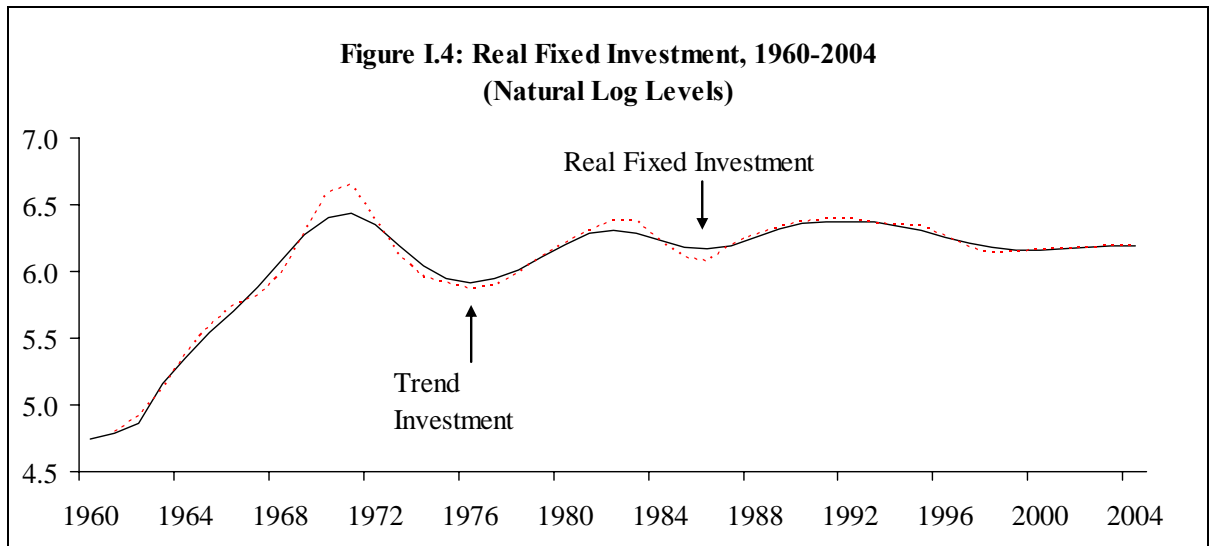
D. Investment

11. **Investment in Papua New Guinea is largely concentrated in the mining sector.** Gross capital formation averaged about 21 percent of GDP during 1984–2004, although it fluctuated considerably over the years. High investment activities during 1976–85 were associated with mining and mining-related construction. The sharp drop in aggregate investment in the mid-1980s was due mainly to the completion of major construction activity

at the Ok Tedi mine, but gross domestic investment increased sharply from 1990 onwards, due to an upsurge in construction activity on the large Kutubu and Porgera mining projects (Figure 4).

12. **Public investment, low by global standards, has nonetheless had a stimulative impact on private investment.** Higher investment in the construction sector resulted from the publicly funded construction of a new airport and the Poreporena Highway in Port Moresby. Investment in the manufacturing sector is not high except in some protected industries.

13. **Foreign investors have played a significant role.** Australia is the largest foreign investor in both mining and nonmining sectors of Papua New Guinea. Development of new mines such as OK Tedi (copper and gold), Hides (gas), Kutubu (oil), Lihir (gold), Porgera (gold), and Misima (gold) have also attracted US, UK, and Canadian mining interests. Malaysia has become a significant investor in fisheries, timber, and other trade and construction sub-sectors. Real gross fixed capital formation fell to 13.7 percent of GDP in 1998 compared with 21 percent in 1984 due mainly to outflow of foreign capital since 1994 when macroeconomic performance decline sharply (Curtin, 2001), although it has since recovered.



E. International Growth Comparison

14. **Table 1 presents purchasing-power-parity-based (PPP) estimates of growth in GDP per capita for Papua New Guinea and selected Asian countries.**⁴ Within the region, Papua New Guinea's per capita growth rate of about 3.5 percent during 1960–75 was behind only Thailand and Malaysia. After independence, Papua New Guinea's growth rate fell to negative 1.4 percent during 1976–85, and was the weakest performance of the comparator group. PPP-based GDP per capita for Papua New Guinea recovered briefly during 1986–95, before declining by around 5 percent from 1996–2004, a significantly worse performance than the comparator countries despite the impact of the Asian crisis on those countries.

Table I.1. Papua New Guinea: Average GDP Per Capita Growth Rates For Selected Countries, 1961-2000 (PPP-based, in percent)				
	1961-75	1976-85	1986-95	1996-2000
Papua New Guinea	3.4	-1.4	1.8	-4.8
Developing Countries				
Bangladesh	-0.4	1.9	2.4	2.8
Fiji	2.8	0.8	2.0	1.1
Nepal	0.8	1.3	2.2	3.3
Emerging Market Economies				
Indonesia	2.8	4.9	4.8	0.2
Malaysia	3.6	4.2	4.8	2.7
Thailand	4.7	4.6	7.5	0.5
Advanced Economies				
Australia	2.6	1.7	2.0	2.8
New Zealand	1.9	0.6	0.8	1.6

Sources: Alan Heston, Robert Summers and Bettina Aten, Penn World Tables Version 6.1, WEO and Staff estimates.

F. Growth Accounting and Total Factor Productivity

15. **The growth accounting approach is used in this section to provide some insights on historical growth trends and medium-term growth prospects for Papua New Guinea.** Assumptions of constant returns to scale and competitive factor markets make it possible to calculate the growth rate of output implied by the growth of physical and human capital. This section estimates how much of the growth in output in Papua New Guinea is associated with

⁴ GDP per capita (PPP US\$) accounts for price differences between countries. In principle, at the PPP rate, 1 PPP dollar has the same purchasing power in the domestic economy as 1 U.S. dollar has in the U.S. economy.

growth in physical capital and labor inputs, and how much is due to technology, institutional change, and other factors.

16. **The results from the growth accounting exercise indicate that both factor accumulation and productivity contributed to GDP growth.** Table 2 shows the resulting contributions of the three factor inputs from 1965 to 2004. From 1965 to 1975, real GDP grew at an average rate of 5.6 percent, while TFP rose by 2 percent. From 1976 to 2004, after independence, real GDP growth slowed to 2.3 percent. Most of the decline in output growth is explained by a significant slowdown in the capital input and to a lesser extent by lower TFP growth—indeed, the contributions of the capital input and TFP to output growth slowed to an average rate of 0.3 percentage points over this period.

	1965-1975	1976-2004	1986-2004	1996-2004
Real GDP growth	5.6	2.3	3.0	0.8
	Factor growth rates (percent)			
Capital	6.9	1.6	1.0	0.3
Labor	1.9	2.4	2.5	2.6
TFP	2.0	0.1	1.0	-1.0
	Contributions (percentage points)			
Capital	2.3	0.5	0.3	0.1
Labor	1.3	1.6	1.7	1.7
TFP	2.0	0.1	1.0	-1.0
Memorandum items:				
Potential output growth	5.3	2.3	2.7	0.6
Trend TFP growth	1.7	0.1	0.7	-1.2

Sources: NSO, IFS, and staff estimates.

17. **The decline in the contribution of capital during the latter period reflected the slowing of investment since independence in 1975, except during the booms in mineral production, when investment usually spiked up.** The increased pace of investment during the boom periods was not sustained, as governance, law-and-order and other structural issues discouraged investment flows to other sectors. The performance during the 1996–2004 sub-period was even more disappointing, with TFP contributing negatively to GDP growth.⁵ The results emphasize the role of factor inputs as the main engines of growth, with the labor input

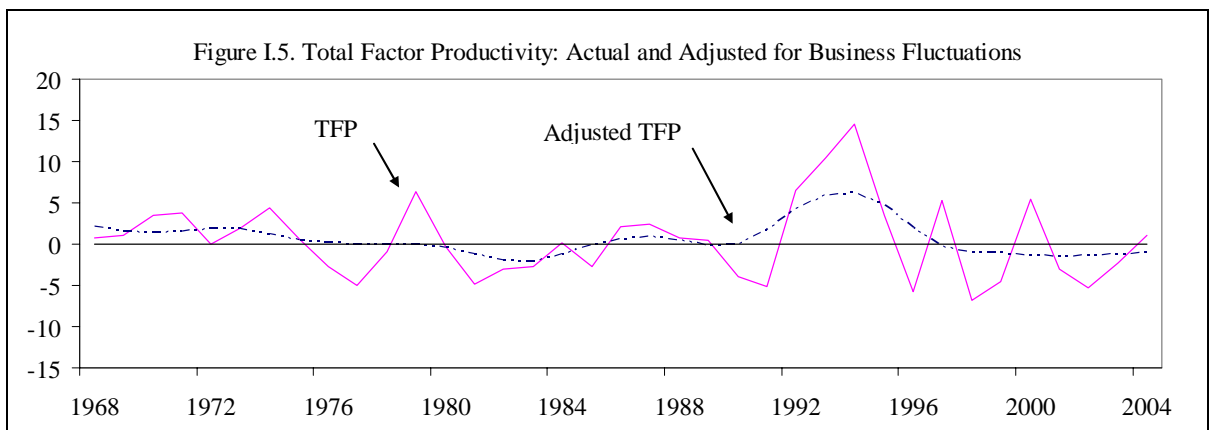
⁵ The national accounts include an estimate of output of the informal sector, but the official “formal sector” employment measures exclude the self-employed, family workers, and jobs in the informal sector. We use the more comprehensive measure—the economically active labor force—in our analysis to try to capture the contribution of workers in the latter categories.

in particular, providing the largest contribution of growth since independence in 1975. The implication is that Papua New Guinea's GDP growth has been achieved largely by adding labor to production. On average, no productivity improvements have been achieved since independence.

18. **A key weakness of the growth accounting framework relates to the interpretation that the measured residual from the growth accounting exercise represents TFP growth.** In practice, in addition to providing a measure of gains in economic efficiency, the residual may also reflect a number of other factors, including institutional changes, external shocks, changes in government policies, political disturbances and conflicts, and measurement errors. This limitation is particularly relevant for Papua New Guinea, which has experienced law-and-order problems, conflicts, and external shocks.

19. **Another problem with the growth accounting framework estimates is that it does not properly decompose growth stemming from the exploitation of natural resources or for different types of factor inputs.** Due to data limitations, our analysis did not attempt to consider separately the mining and non-mining sectors nor to control for changes in the quality of human capital. There are several types of labor and capital. If data are available, aggregated factor inputs can be decomposed to measure sectoral factor inputs. For example, the aggregated figure of labor inputs can be decomposed to determine how labor quality changes affect TFP growth in a given sector. The same method can be applied for capital. However, as the necessary data on capital are not available, this paper focuses only on the adjustments for business fluctuations.

20. **To remove the effect of business fluctuations from the estimates of TFP growth, TFP was adjusted using the Baxter-King filter.** Annual TFP estimates from 1968 to 2004, together with the business-fluctuation-adjusted TFP, are shown in Figure 5. In most of the years, TFP fell below zero. Positive estimates are seen in the period before 1975 and in 1990–96.



G. Implications For Medium-Term Growth

21. **Some possible medium-term growth scenarios for Papua New Guinea using the production function and the results of the growth accounting exercise are considered in this section.** The baseline scenario assumes no new significant hydrocarbon or mineral projects, i.e., it excludes the prospective Highlands-Queensland gas pipeline. The degree of structural reforms is assumed to be continuous but modest in line with past performance. The medium-term projections assume that growth in the capital stock is consistent with keeping the capital-output ratio constant at 2.3. Hence, the capital contribution is higher as the economy moves from a low- to a higher-growth scenario, because more investment is needed to maintain the fixed capital-ratio with faster growth. The labor force grows by 2.4 percent, and a baseline scenario assumes trend TFP growth of 0.5 percent, broadly in line with trend TFP growth over the last 2 decades. The latter is above the average pace since 1976, but below that in the 1960s and early 1970s. Potential output is derived as the sum of trend TFP and the contributions of the capital and trend labor inputs.

- Based on these assumptions, under the baseline scenario, projected GDP would grow at an average rate of 3 percent during 2005–10, while potential output grows by 2.7 percent (Table 3). Per-capita incomes would improve marginally, but not enough to have an impact on poverty reduction.
- The alternative ‘high reform’ scenario shows the TFP growth that would be needed to support GDP growth of 5 percent over the medium term—about 2.5 percentage points higher than actual growth over 1976–2004. The implied trend TFP growth rate of 3 percent appears optimistic, given Papua New Guinea’s experience. Significant improvements in governance and law-and-order, and acceleration of key reforms under the MTDS would be important factors that could lead to TFP growth at this level. Per-capita incomes would start to recover under this scenario, growing at a rate of 2.5 percent per annum.
- The ‘low reform’ scenario extrapolates the experience observed over the period from 1996–2004 of low TFP, resulting in GDP growth of only 1.0 percent. Under this scenario, per capita incomes would continue to decline with negative growth rates and poverty would increase with continued population growth.

Table I.3. Papua New Guinea: Medium-Term Growth Projections, 2005-10 Alternative TFP Growth Rates			
	Low scenario	Baseline	High scenario
Real GDP growth	1.0	3.0	5.0
	Factor contributions (in percentage points)		
Capital	0.5	0.5	0.5
Labor	1.5	1.5	1.5
TFP	-1.0	1.0	3.0
Memorandum items:			
Potential GDP growth	0.7	2.7	4.7
Trend TFP	-1.3	0.7	2.7
Source: Staff estimates.			

22. **A similar analysis is done for the amount of investment required for higher growth.** This study shows that a target of 5 percent GDP growth over the medium to long term, assuming depreciation of the capital stock by 5 percent, would imply that the minimum gross rate of investment needed for sustained growth would be about 23 percent of GDP. Similarly, a 7 percent target would require an investment rate of 27 percent of GDP. In reality, the actual rate of investment has averaged only 17 percent since 1985 (Table 4).

Table I.4. Papua New Guinea: Real GDP Growth and Real Investment			
Assumptions			
Steady state capital-output ratio	2.3	2.3	2.3
Depreciation (in percent)	5	5	5
Target growth rate	3	5	7
Required investment to GDP	18	23	27
Memorandum items:			
Investment to GDP			
1976-2004	19		
1986-1995	17		
1996-2004	13		
Source: Author's estimates.			

H. Summary and Conclusions

23. **This paper has examined Papua New Guinea's historical economic growth patterns through a simple growth accounting framework.** The analysis shows that swings in growth are mostly accounted for by a significant slowdown in the capital input and lower TFP growth. It also suggests that raising real GDP growth will require increases in both investment levels and productivity. With a ratio of investment to GDP of 13 percent during the last decade, significantly higher productivity growth and investment will be needed to sustain GDP growth rates at 5 percent or higher. The historical performance also indicates that, in the absence of structural reforms and strong institutions, higher rates of productivity growth would be hard to achieve. This implies that Papua New Guinea should: (i) push forward with its implementation of structural reforms to improve governance and remove impediments to private sector investment; and (ii) maintain strong capital formation by increasing public investment and improving the focus of these investments to promote a crowding-in of private investment, especially in the non-mineral sector.

A. Growth Accounting

24. **The framework assumes that output (Y) follows a Cobb-Douglas production function and is measured as deflated value added.** Inputs are aggregated into the two primary inputs labor (L) and capital inputs (K) with factor shares in total costs of $\alpha = S_K$ =share of capital and $1-\alpha = S_L$ =share of labor. The Solow (1956) growth accounting equation can then be stated as:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha} \quad (1)$$

Under this process, labor and capital contribute to value-added growth with contributions measured as the rate of change of each input times its share in total costs. The change in value added not explained by these contributions is attributed to total-factor productivity growth, captured by the variable A. In practice, the rate of change of A is measured as a residual, by subtracting the contributions of labor and capital from the rate of output growth.

$$\text{Output growth} = g = S_k * \Delta K + S * \Delta L + \text{growth rate of TFP} \quad (2)$$

Rearranging equation 2, yields TFP as

$$\text{TFP growth} = A = \Delta GDP_t - S_K * \Delta K_t^* - S_L * \Delta L_t^* \quad (3)$$

25. **The growth accounting exercise was performed over the 1960–2004 period assuming a Cobb-Douglas production function with output elasticities of capital and labor of 0.33 and 0.67 respectively.**⁶ Capital stock is derived from national accounts data on gross fixed investment using the perpetual inventory method, with an assumed depreciation rate of 5 percent (see Annex I.2.). It is assumed that the capital output ratio in 1960 is 2.3. The labor input is the labor force proxied by data on the economically active population. All data except for capital, which is derived, are from IFS or from the National Statistical Office. TFP is derived as a residual.

⁶The assumption of fixed weights of 0.67 for labor and 0.33 for capital is consistent with those of other researchers. See for example Bosworth (1998), Santaella (1998), and Loayza, Fajnzylber and Calderon (2002).

B. Calculating the Capital Stock

Data on capital stock (K) are not published and has to be estimated. The most common method for its calculation is the so-called ‘permanent inventory method’, which can be described briefly with the equation:

$$K_t = I_t + (1 - \delta)K_{t-1} \quad (1)$$

Equation (1) allows for recursive substitution back in time and also in the future. For example, if the formula is rewritten for period (t – 1), then:

$$K_{t-1} = I_{t-1} + (1 - \delta)K_{t-2} \quad (2)$$

Substituting (2) in (1) yields:

$$K_t = I_t + (1 - \delta)I_{t-1} + (1 - \delta)^2 K_{t-2} \quad (3)$$

The process can be replicated back to some definite time so that in general,

$$K_{t-1} = \sum_{i=0}^{n-1} (1 - \delta)^{n-i} I_{t-i} + (1 - \delta)^n K_{t-n} \quad (4)$$

where n is the definite time under consideration, from which the initial capital stock is taken. It can be shown that even with $n \rightarrow \infty$, the expression for the amortized value of the initial capital stock never becomes exactly zero, i.e. this way of calculation implies ‘eternal life’ for some part of the capital stock. For the purposes of our analysis the capital has to have a finite life – i.e. to depreciate entirely for a finite number of years. The latter is also required from a practical point of view, since after a specified period of time the capital stock loses its ability to create new value. For this reason the following variant of equation (4) has been used here to the calculation of the capital stock.

$$K_{t-1} = \sum_{i=0}^{n-1} (1 - i\delta)I_{t-i} + (1 - n\delta)K_{t-n} \quad (5)$$

Equation (5) implies a constant and an even (linear) reduction of the value of the initial capital, as well as of the value of investments that are made between the initial and the present moment. Also, in such a way one allows for full depreciation of a capital unit for $1/\delta$ periods.

REFERENCES

- Baxter, M. & King R.G. 1995, "Measuring business cycles. Approximate Band-Pass Filters for Economic Time Series," *NBER Working Paper Series*, 5022.
- Bosworth, B. 1998, "Productivity Growth in Mexico," Background paper prepared for a World Bank Project on productivity growth in Mexico, *Mexico: Enhancing Factor Productivity Growth, Report No. 17392-ME, Country Economic Memorandum*, August, 1998.
- Jarrett, F. G., & Anderson, K. 1989, "Growth, Structural Change, and Economic Policy in Papua New Guinea," *Australian National University, Pacific Paper*, 5.
- Loayza, N, Fajnzylber, P, & Calderón, C. 2002, "*Economic Growth in Latin America and the Caribbean*," mimeograph, The World Bank.
- Santaella, J., 1998, "Economic Growth in Mexico," IADB, manuscript.
- Solow, R. M. 1956, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics*, 70: 65–94.

II. DETERMINANTS OF PRODUCTIVITY IN PAPUA NEW GUINEA¹

A. Introduction

1. **Papua New Guinea's economic growth performance since independence has not been as strong as in comparator countries** (see Chapter I, Table I.1). The preceding Chapter I discussed how the low growth rates experienced may be accounted for by both a significant slowing of capital inputs and falling total factor productivity (TFP) growth. Recent empirical studies suggest that a key distinguishing factor between high-growth and low- or negative-growth countries may be differences in TFP, which is affected by the quality of a country's economic, social, and political institutions.² Using time series analysis, this chapter investigates some determinants of productivity growth that may explain the poor performance of real GDP and TFP growth in Papua New Guinea. The second part of the paper then attempts to test for and evaluate some of these factors and their relationship to TFP.

B. Factors Affecting TFP Growth

2. **The authorities' Medium-term Development Strategy (MTDS) highlights the need to improve institutions to raise growth and targets measures to remove impediments that hinder achievement of that goal.** Papua New Guinea has already made important efforts to remove structural impediments that hold back its potential for more rapid growth. The reforms of the early 1990s, including the floating of the kina, initially led to a recovery in investment and growth. More recent reforms undertaken include price and trade liberalization, tax reform, investment policy reform, improvements in public expenditure management, pension reform, privatization, financial sector reform, and decentralization of financial responsibilities from the national to the provincial and district levels—in addition to the restoration of macroeconomic stability. However, although a full analysis is beyond the scope of this paper, it is recognized that many of the reforms remain incomplete or have not been sufficiently profound. Therefore, as noted in the MTDS, additional reform is needed to bring growth rates up to the higher level required to sustain improvements in per capita GDP and to reduce poverty. The following discussion highlights several key areas for further reform.

Governance

3. **Recent empirical studies have shown that poor governance deters investment, undermines competition, encourages rent-seeking behavior, and distorts public expenditure in an economy, and as a result, affects its productivity.** Rent-seeking activities are reportedly high in many areas in Papua New Guinea, particularly in the

¹ Prepared by Ebrima Faal.

² See Tanzi and Davoodi (1997), and Mauro (1997).

resource-based sectors as in many other resource-rich countries. Political interference in the civil service and politicization of decision-making hampers effective public administration. In addition, an unstable political environment increases uncertainties for economic actors. No government has survived a full five-year term in office, although the current Somare government has a good chance of being the first government since independence to complete a full term in office. The short political cycles have increased incentives for rent-seeking behavior, while political uncertainty has made it difficult for firms to commit to long-term investment plans since the policy environment is generally viewed as fluid. Recent reforms of the political system, including the *Organic Law on the Integrity of Political Parties*, are expected to bring some stability to the political process in coming years. The following table ranks some political risks factors for Papua New Guinea relative to other countries in the region.

COUNTRY	Corruption	Bureaucracy quality	Ethnic tensions	Law and Order	Socioecon conditions	Government Stability	Internal Conflict
Papua New Guinea	1.0	2.0	2.0	2.5	3.5	7.0	10.0
Indonesia	1.0	2.0	2.0	3.0	5.5	7.0	8.5
Bangladesh	1.5	2.0	2.5	2.5	2.5	10.0	6.5
Mongolia	2.0	2.0	5.0	4.0	3.0	7.0	11.0
Sri Lanka	2.5	2.0	1.5	3.0	3.5	6.0	6.0

Source, ICRG, 2005. First 3 columns ranked 0-6, 2nd 3 columns ranked 0-12; the lower the number, the higher the risk.

4. **Governance issues are also reflected in the ease with which the private sector can conduct business.**³ Surveys of the private sector in Papua New Guinea by the Institute of National Affairs (INA) revealed that employers rated crime, corruption, and political instability as the biggest impediments to doing business (Manning (1999), Levantis and Manning (2002)). The average company reported spending about 10 percent of its revenue on private security and losses from theft. The surveys conclude that irregular applications of law and regulations, sudden changes in public policy, and bribes to corrupt official were major costs drivers and significant obstacles to investment. The World Bank’s Doing Business survey reports that, although Papua New Guinea compares well to others in the region overall, on key factors that would deter the start-up of new activity, such as the environment for starting and closing a business, Papua New Guinea compares less poorly with its main trading partners and the region.

³ An empirical analysis of transition economies in Eastern Europe and Central Asia showed that investment levels in countries with high levels of corruption were 6 percent lower on average than in countries with medium levels of corruption (21 percent and 27 percent respectively), see World Bank (2000). The same survey revealed that firms operating in environments with high levels of administrative corruption performed significantly more poorly than firms in countries with moderate levels of corruption did.

Table II.2. Papua New Guinea: The Business Environment (2005)			
	Papua New Guinea	East Asia & Pacific	Singapore
Starting a Business			
Number of Procedures	8.0	8.2	6.0
Time (days)	56.0	52.6	6.0
Cost (percent of income per capita)	30.2	42.9	1.1
Minimum capital (percent of income per capita)	0.0	109.2	0.0
Registering Property			
Number of Procedures	4.0	4.0	3.0
Time (days)	72.0	51.0	3.0
Cost (percent of property value)	5.2	4.3	2.8
Dealing with Licenses			
Number of Procedures	20.0	18.0	11.0
Time (days)	218.0	160.2	129.0
Cost (percent of income per capita)	124.5	137.4	24.0
Enforcing Contracts			
Number of Procedures	22.0	27.0	23.0
Time (days)	440.0	316.0	69.0
Cost (percent of debt)	110.3	57.0	9.0
Closing a Business			
Time (years)	2.8	3.6	0.8
Cost (per cent of estate)	38.0	29.8	1.0
Recover rate (cents on the dollar)	34.2	30.4	91.4
Source: World Bank - Doing Business Explore Economics.			
Website: http://www.doingbusiness.org/exploreconomies/businessclimatesnapshot .			

Human Capital

5. **Access to and quality of education are major factors that impede productivity growth.** Gross enrollment in Papua New Guinea at the primary school level is 69 percent, and at secondary schools is 11 percent (Table 3)—about the same levels as at independence. Retention rates are low and dropouts are widespread, with fewer than 60 percent of children completing grade 6. Access to education, particularly at higher levels, is constrained by long travel distances to school and a shortage of teachers in remote areas, and by the significant cost of education, especially at the secondary and tertiary level. The authorities' MTDS targets an increase in the quantity and quality of basic health care, education, and other high-priority services, with a view to improving long-term growth and social indicators appreciably over the longer term.

