Economic growth in Papua New Guinea: some empirical evidence

Azmat Gani

This article presents econometric results of economic growth in Papua New Guinea on the basis of annual time-series data covering the period 1970–92. The results do not show any statistically significant evidence of investments in physical and human capital contributing to economic growth. Exports and stable exchange rates have positively contributed to economic growth, while high inflation and high government consumption have, statistically, significantly depressed economic growth. There is weak evidence of the external economic environment and social and political instability having adverse effects on economic growth.

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The economic performance of Papua New Guinea has generally been disappointing with sluggish growth in GDP during the 1970s and 1980s and declining real per capita incomes during the 1980s. Further, the economy of Papua New Guinea does not compare favourably to similar economies elsewhere. For example, according to the data presented in Table 1, the annual average real GDP growth during the 1970–93 was less than the annual average for low-income economies generally and for the East Asia and Pacific regions. In fact, except for the years 1971–73 and 1991–93, annual real GDP growth rates were well below those for the low-income economies and East Asia and the Pacific (Table 1).

have focused on Papua New Guinea’s general economic trends and public policy debates. However, econometric investigation of factors influencing economic growth in Papua New Guinea is rare. Elsewhere, particularly in the semi-industrialised or large developing economies, a number of studies, for example, Otani and Villanueva (1990), Barro (1991), Renelt (1991), Levine and Renelt (1992), Mankiw et al., (1992), Savvides (1995) and Ghura (1995), have examined the sources of growth performance, making contributions towards understanding the various factors influencing economic growth.

This study presents empirical evidence of the factors influencing growth in Papua New Guinea by developing a simple growth model and testing a number of hypotheses.
ECONOMIC GROWTH IN PAPUA NEW GUINEA

Economic background

Papua New Guinea is the largest Pacific island country by land area (452,860 square kilometres), population (4,042,400 mid-1995 estimate) and gross output (see Asian Development Bank 1996: Tables 1,10 and country tables). It has abundant natural resources: minerals (copper and gold), oil and natural gas reserves, vast expanses of agricultural land and extensive areas of forest and maritime fisheries. Like other Pacific island economies, it claims a 200 mile exclusive economic zone, proven to be rich in fisheries. Papua New Guinea is categorised as a lower-middle-income economy with a gross national product per capita of US$1,240 (World Bank 1996). Subsistence agriculture is the source of livelihood for almost 85 per cent of the population (World Bank 1994). Commercial agriculture accounts for one third of GDP and mineral resources for two thirds of total exports (Browne and Scott 1989). This country’s developmental prospects are constrained by a number of factors: a traditional redistribution system (wantok) which emphasises the distribution of income and wealth rather than production (AIDAB 1994), a serious law and order problem (Dinnen 1996), poor workforce skills and low productivity of labour (Duncan 1996), insecurity of land tenure (Duncan and Duncan 1996), inadequate economic infrastructure, ineffectice government administration and small markets. Papua New Guinea’s economic state is a result of these constraints to development.

Long-term socioeconomic progress has been disappointing in spite of Papua New Guinea’s abundant resources. For example, population growth during 1970–92 averaged 2.1 per cent per annum, while per capita real GNP for most of the 1980s has been declining (Table 1). Low adult literacy and educational attainment, with social and administrative fragmentation, is a result of cultural and ethnic diversity as well as low levels of human capital investment (Fairbairn et al. 1993). These low levels of social development indicators have led the United Nations Development Programme to categorise Papua New Guinea as a ‘medium human development’ country, defined to include countries with a human development index between 0.500 and 0.799 (UNDP 1996). According to the UNDP, the human development index of Papua New Guinea is 0.504, well below the average index of 0.647 for all medium human development countries. Papua New Guinea ranks 126th, well behind some countries of similar size and per capita incomes.

Economic performance has been impressive in some periods. For example, Papua New Guinea’s GDP growth averaged 6.9 per cent annually during the first half of the 1970s as a result of agricultural expansion (diversification into palm oil) and mineral extraction which absorbed the adverse impact of the first oil price increase and provided impetus to growth. Economic performance deteriorated during 1975–79 as a result of a drop in demand for copper and worldwide economic decline, resulting in an average annual growth rate of 1.4 per cent. Papua New Guinea experienced a marked improvement in economic activity in the second half of the 1980s as a result of the development of the mining sector and the recovery of agriculture. However, the economy went through a series of crises in the 1980s: the impact of the second oil shock during 1981–82 together with a fall in prices of
copper, gold and coffee; the fall in export prices of coffee and cocoa in 1984 and the closure of Ok Tedi and Bougainville mines since 1989. Combined, these effects have hindered overall growth and development in Papua New Guinea.

Empirical model and hypotheses

A simple model using Solow's early work is formulated here to capture the basis of the growth relationship (Solow 1956). The simplest formulation can be shown as

\[ Y = f(L, K) \]  

where \( L \) is labour and \( K \) is capital. The logarithmic differentiation of Equation 1 produces Equation 2.

\[ \dot{Y} / Y = \alpha_1 \dot{L} / L + \alpha_2 \dot{K} / K \]  

where a dot on top of a variable represents the growth rate form and \( \alpha_1 \) and \( \alpha_2 \) are the elasticities with respect to labour and capital.

The formulation presented in Equation 2 provides the basis of the econometrically estimable relation explaining aggregate growth in terms of the rates of growth in capital and labour.

It is worth noting that Equations 1 and 2 carry two presumptions: that the economy under study is always on its production possibility frontier and that all factors are fully and efficiently utilised all the time. However, it was seldom the case that the Papua New Guinea economy actually met these conditions. Therefore, it is necessary to model the divergence between the efficient path and the actual historically observed path of the Papua New Guinea economy.

It is postulated that the divergence between the dependent and the explanatory variables in Equation 2 is affected by economic factors that determine capacity utilisation and the level of economic activity. This means that in an econometric estimable model analysing the growth process, the discrepancy between the dependent and explanatory variables in Equation 2 cannot be entirely attributed to random shocks, but part should be predictable by economic variables such as the rate of inflation, the involvement of government in the economy, the level of investment in physical capital, the extent of participation in international trade and the stability of the exchange rate. Since social and political factors also contribute to the current activity level, it is worthwhile to control for these factors as well.

In view of the above, Equation 3 is formulated to describe the data-generation process of the Papua New Guinea economy. The model presented by Equation 3 assumes linearity of the process with respect to all macro-economic state variables. The empirical model has been specified in terms of the per capita growth rate for reasons of expediency.

\[ Y_t = Z \beta_t + \mu_t \]  

where \( \dot{Y} \) is the average annual growth rate of real per capita gross domestic product (thus accounting for population growth) as a determinant of growth, \( Z \) is a vector of right hand side variables influencing growth and \( \mu \) is the error term which is assumed to be normally distributed with an expected mean value of zero. The data sources are discussed in the data appendix. A discussion of the
theoretical justification of the \( Z \) variables and their measures follows.

**Physical capital (\( PC \))**

The variable \( PC \) is investment in physical capital measured by the percentage change in real annual gross domestic investment/GDP ratio. According to the Harrod–Domar standard growth theory, investment is the main element that moves the economy (Harrod 1948; Domar 1957). An increase in investment is hypothesised to increase the real per capita GDP. Thus, \( PC \) is expected to have a positive sign on the estimated coefficient.

**Human capital (\( HC \))**

The variable \( HC \) is human capital measured by the percentage change in real education expenditure as a proportion of total government expenditure. Nelson and Phelps (1966) suggest that a larger stock of human capital makes it easier for a country to absorb new products or ideas that have been discovered elsewhere, thus allowing a quicker rate of growth and higher output. In the Lucas (1988), Romer (1990) and Becker et al., (1990) models, investments in human capital enhance the productivity of both the recipients of human capital and society. This may be due to government policies promoting education as well as health and nutrition, thus allowing larger returns in enhanced long-run growth and development. The coefficient of \( HC \) should be positive.

**Inflation (\( IFN \))**

The variable \( IFN \) is the rate of inflation measured by the percentage change in the consumer price index. There are two lines of argument in regard to the effects of inflation on growth. The Tobin–Mundell effect involves a shift away from real money balances towards real capital as a consequence of higher anticipated inflation, and hence greater economic growth. Contrary to this, Feldstein (1982) notes that through interaction with the nominal tax system, inflation may increase the cost of capital, thus reducing investment and economic growth. Also, inflation affects economic growth negatively as it overvalues the domestic currency and leads to loss of international competitiveness if a fixed exchange rate regime is adopted. The coefficient of \( IFN \) may be negative or positive.

**Government consumption (\( GC \))**

The variable \( GC \) is government consumption measured by the percentage change in the real government consumption/GDP ratio. Bailey (1971), Buiter (1977) and Kormendi (1983) argue that government is the provider of valuable public goods such as education, health, economic infrastructure and defining property rights (thus complementing private investment), and is beneficial to growth. Another line of argument is that increased government consumption is usually accompanied by increasing taxes and increasing monetisation of the deficit, distorting allocation of resources and increasing the inefficiency, thus reducing growth (Barro 1991). The coefficient of \( GC \) may be negative or positive.

**Exports (\( X \))**

The variable \( X \) is exports measured by the growth rate in real exports as a proportion of GDP. A positive relationship between export growth rates and GDP
growth rates has been found in a number of studies: Balassa (1978), Ram (1987), Fosu (1990) and Doraisami (1996). The usual justification for specifying exports as an additional argument of the production function is its contribution to economies of scale and enhancement of competition, introduction of new technology, specialisation and expansion of markets, thus allowing higher economic growth.

Exchange rate stability (ERS)

One feature of stable macroeconomic policy is the maintenance of exchange rate stability. A high exchange rate variability can have a depressive effect on economic growth. Exchange rate stability may be crucial for exporters as prices received for their products depend on it, among other factors.

Weather (WEA)

Papua New Guinea, like other small Pacific island economies, is vulnerable to adverse weather conditions. The impact of natural disasters, cyclones, flooding drought and volcanic eruptions, is relatively large, resulting in severe destruction in the agricultural sector and village settlements, disruptions to transport and communication systems and loss of lives which can slow long-term growth and development. The variable WEA is proxied by the percentage change in food production per capita with an expected negative sign on its coefficient.

External disturbance (ED)

The Papua New Guinea economy is also affected by changes in the international economic environment. For example, its reliance on industrialised countries for trade means that growth, recession and inflation of trading partners are transmitted directly and immediately to the domestic economy. Further, being more open and reliant on few exports, it is greatly affected by the international economic forces: substantial fluctuations in the prices of primary goods, securing export markets, fluctuations in exchange rates and changes in interest rates on foreign debts. Variable ED is measured by the real GDP growth rates of OECD countries.

Social and political instability (SPI)

A stable social and political environment should facilitate economic performance and economic growth, while an unstable social and political environment may discourage investments in physical capital. The risk of capital loss may increase as rules governing investments change when political regimes are volatile. The 1980s have been especially volatile in Papua New Guinea with increased lawlessness on the mainland and the guerilla war on Bougainville. In 1988, violence erupted at the two major mining projects in Papua New Guinea—Ok Tedi in the western province and the Bougainville Copper Mine in the North Solomons. At Ok Tedi, mine workers were given suitable compensation. At the Bougainville Copper Mine claims for billions of dollars in landowner compensation were lodged. Both cases resulted in rioting, looting and sabotage, leading to the closure of the mines and a capital loss of millions of dollars. Due to lack of suitable measures of instability, SPI is proxied by a dummy variable with zeros allocated to years 1981–83 and 1986 onwards, years with increased levels of lawlessness and political instability. The estimated coefficient of SPI is expected to be negative.
Empirical results

The results presented in Table 2 show the fit of the model to the data and signs, and the significance of the variable coefficients. In all reported regressions the t-statistics are in parentheses below their respective coefficient. A number of equations involving a combination of variables was successively estimated. Specification 1 tests the effect of a number of macroeconomic variables while excluding weather, external economic forces and political instability. In specifications 2, 3 and 4 variables WEA, ED and SPI are successively included to avoid specification bias.

The signs and the significance level of the estimated coefficients on variables IFN, GC, X and WEA remain robust across specifications 1 to 4. The equations perform well, exhibiting no problems of heteroskedasticity as revealed by the ARCH test. The model does not suffer

<table>
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* significant at the 1 per cent level.
** significant at the 5 per cent level.
*** significant at the 10 per cent level.
from autocorrelation in residuals (DW). The F value supports the variables included in the regression, while the overall explanatory power (adjusted R²) is satisfactory. One important issue in choosing the right hand side variables is to ensure that they do not overlap one another; that is, there is no collinearity or multicollinearity. Broadly interpreted, multicollinearity refers to the situation where there is either an exact or approximately exact linear relationship among the explanatory variables. In the model adopted here, such a relationship is avoided through the choice of variables and their measures. Although there are no sure methods of detecting collinearity, the clearest sign of multicollinearity is when R² is very high but none of the regression coefficients is statistically significant on the basis of the conventional t test (Gujarati 1989). The results do not support this condition (Table 2 shows the absence of any overlapping effects among the variables chosen).

The coefficient PC is positive and statistically insignificant across all the specifications, suggesting that physical capital accumulation did not contribute to Papua New Guinea’s economic growth. Gross domestic investment as a share of GDP averaged 25 per cent for the period 1970–92, suggesting that the reasonably high level of domestic investment has not being translated into higher growth. One possible explanation is deficient microeconomic policies, such as the public sector encouraging rent-seeking behaviour and the crowding of private investment or inward-looking investment policies which discourage private investment and thus growth. Another likely reason is the poor quality and poor maintenance of public investment.

The coefficient HC is positive but statistically insignificant in all specifications. These results do not provide strong support that investments in human capital have made a significant contribution to economic growth in Papua New Guinea. This suggests that Papua New Guinea has failed to provide the appropriate quantity and type of workforce skills for economic development. This is consistent with Papua New Guinea’s current low literacy levels. For example, 48 per cent of the population in Papua New Guinea aged 15 and above are illiterate (World Bank 1994). The results are also consistent with Cole (1993) who suggests that in Papua New Guinea low skill levels are compounded by inadequate education policies and have hampered growth in manufacturing and processing sectors. But this result is also consistent with the view that the inward-looking policies provide little scope for productivity gains and that expenditure on skills development will have little pay-off in an environment of poor quality public investment.

The coefficient IFN is negative and statistically significant in all specifications, suggesting that a high rate of inflation has been detrimental to Papua New Guinea’s economic growth. Although Papua New Guinea did not experience hyper-inflation, the rate of inflation over the period 1970–92 was high, averaging 5.7 per cent per annum suggesting that it was subjected to rising inflationary pressures.

The GC coefficient is negative and statistically highly significant in all specifications. This result provides enough evidence to support the hypothesis that Papua New Guinea’s fast growing government sector is associated with slow economic growth. Over the period 1970–92, government consumption averaged 23 per cent of GDP. This is not a
high level by international standards, but the result supports the idea that government expenditure is not quality expenditure.

The coefficient $X$ is positive and statistically significant across all the specifications. Thus, the results strongly suggest that Papua New Guinea’s exports have significantly contributed to its economic growth. In addition, the import share of GDP did not exceed the export share of GDP, thus avoiding balance of trade deficits. For example, exports were 51 per cent of GDP during 1970–92. At the same time, imports were 40 per cent of GDP.

The coefficient $ERS$ is positive and statistically significant in specifications 3 and 4. The results indicate that real exchange rates have not been highly variable or that the variability did not have any depressing effect on Papua New Guinea’s economic growth.

The coefficient $WEA$ is positive and statistically significant in specifications 2, 3 and 4, inconsistent with the theoretical expectations. The results suggest that weather conditions did not adversely affect Papua New Guinea’s economic growth. It should be noted that the variable $WEA$ had a proxy measure and this may not have truly captured the effects of adverse weather conditions. Papua New Guinea has experienced some devastating natural disasters over the 1970–92 period. For example, the 1983 flooding in Lae, the 1985 earthquake of New Ireland and New Britain and the 1992 flooding of the Sepik river caused millions of dollars of damage to Papua New Guinea and would have had a negative effect on economic growth.

The coefficient $ED$ is positive and statistically significant in specifications 3 and 4. The results suggest that the PNG economy is vulnerable to external economic forces but such effects have not significantly depressed its economic growth.

The coefficient $SPI$ is negative and statistically insignificant. Thus, weak evidence exists to theorise that social and political instability has adversely affected economic growth. However, the Bougainville problem gives little sign of being resolved and, after costing the Papua New Guinea government some A$50 million per annum in security costs, Papua New Guinea is struggling to implement a range of economic reforms requested by the World Bank (Time International, April 1996:26–27). The Bougainville dispute is also deterring potential foreign investors, already alarmed by Papua New Guinea’s mainland law and order problem.

Summary and conclusion

This study presents econometric results on the determinants of economic growth in Papua New Guinea derived from annual time-series data for the period 1970–92. The estimates suggest the model has utility as a framework for growth analysis. The results did not show any statistically significant evidence of investments in physical and human capital contributing to economic growth. Exports and stable exchange rates have positively contributed to economic growth. Inflationary pressures and high government consumption have significantly depressed economic growth. There is weak evidence of external economic forces and social and political instability having an adverse effect on economic growth, while the weather did not reveal any adverse effect on economic growth.
The investigation here is an initial attempt to apply an economic framework to account empirically for growth in Papua New Guinea. Because the findings suggest that some variables have played a major role in Papua New Guinea, some policy implications may be drawn from this exercise and can be further tested in future research works. For example, the results imply that the maintenance of low inflation, substantial cuts in government consumption or improvements in the quality of government investment, investments in human capital, formulating better investment policies, and the provision of a stable and a congenial social and political environment could improve growth performance in Papua New Guinea.

Data appendix

Subject to the inherent data limitations, it was only possible to obtain reasonable annual data for 22 years with respect to the variables specified in equation three. While a sample of this size is certainly not large, it appears large enough for a modest start towards obtaining relevant parameters for the Papua New Guinea economy. The data sources for each of the variables is given as follows.

\( Y \) is annual average growth rate of real per capita GDP (World Bank 1995).

\( PC \) is calculated as the percentage change in real gross investment as a proportion of real GDP (International Monetary Fund 1995: line 93e).

\( HC \) is the percentage change in educational expenditure as a proportion of total government expenditure (International Monetary Fund, 1995: Table B, line 4).

\( IFN \) is calculated as the percentage change in consumer price index (International Monetary Fund 1995: line 64).

\( GC \) is calculated as the percentage change in real government consumption as a proportion of real GDP (International Monetary Fund 1995: line 91).

\( X \) is calculated as the percentage change in real exports as a proportion of real GDP (International Monetary Fund 1995: line 90c).

\( ERS \) is calculated as the percentage change in the weighted average of the real exchange rate of Papua New Guinea’s main trading partners, determined on the basis of the average of exports over the period 1970–92. The weights are calculated as the share in Papua New Guinea’s total exports (exchange rate: International Monetary Fund 1995: line af; export shares: UNESCAP 1980, 1995).

\( WEA \) is calculated as the percentage change in food production per capita (World Bank 1995).

\( ED \) is the real GDP growth rate of OECD countries (OECD 1996).

References


