Determinants of Economic Growth
(Panel Data Approach)

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Abstract

This paper uses a sample of 41 middle-income developing countries, including Fiji, to develop an empirical model for growth. Both cross-country and time variation specifics were used in an attempt to explain determinants for sustained economic growth in developing countries. This paper also presents a wide-ranging examination of both theoretical and empirical evidence on the many ways macroeconomic policies affect growth. Most studies have shown that a macroeconomic policy framework conducive to growth is a necessity. Countries with strong macroeconomic fundamentals tend to grow faster than those without them, though there are many individual cases, of both developing and developed countries, that suggest that satisfying only some of these conditions does not result in faster growth. However, it is important to recognise that the direction of causation is somewhat ambiguous: whether good macroeconomic policies are conducive to growth or whether strong growth is conducive to good macroeconomic policies. The results suggest that apart from growth in the labour force, investment in both physical and human capital, as well as low inflation and open trade polices (less trade barriers), are necessary for economic growth. Furthermore, the ability to adopt technological changes in order to increase efficiency is also important. Since many developing countries have a large agricultural sector, adverse supply shocks in this sector was found to have a negative impact on growth.

1.0 Introduction

Like many developing countries, the primary focus of policies in Fiji is to have high and sustainable growth. However, to achieve and maintain a high growth rate, policy makers need to understand the determinants of growth as well as how policies affect growth. Since World War II, the trend growth of real GDP has become a key policy objective in almost all countries (See Crafts 2000). Numerous studies have been carried out to find the long-run growth path. The earliest studies were conducted by Solow (1956) and Swan (1956) based on the neoclassical theory. Its simple structure and assumptions - a well behaved neoclassical production function, a single homogenous good, exogenous labour-augmenting technical progress, full employment and exogenous labour force growth - has been used by economists for the past four decades.

The Solow-Swan growth model predicts that in steady-state equilibrium the level of GDP per capita will be determined by the prevailing technology and the exogenous rates of saving, population growth and technical progress. They conclude that different saving rates and population growth rates might affect different countries' steady-state levels of per capita income. That is, other things being equal, countries that have higher saving rates tend to have higher levels of per capita income, and vice versa.

However, recent growth theorists dismiss the Solow-Swan model in favour of an endogenous growth model that assumes constant and increasing returns to capital. The critics allege that the standard

neoclassical model fails to explain the observed difference in per capita income across countries. The different implications of exogenous and endogenous growth models have led to renewed empirical work in recent years. One of the major concerns has been the issue of convergence.[1]

Recent studies have shown that a macroeconomic policy framework conducive to growth is a necessity. There seems to be a broad consensus that long-term growth is negatively associated with inflation and positively correlated with good fiscal performance and undistorted foreign exchange markets (See Fischer 1993). Furthermore, studies have also found that if human capital is not accounted for in the model, then the quantitative implications of different saving and population growth rates are biased upward (See Knight, Loayza and Villanueva 1993). Human capital development is positively correlated with savings and population growth.

To better understand the growth process, this paper develops an empirical model using a panel data approach, which attempts to explain some of the necessary ingredients for sustained economic growth in developing countries.

Foreshadowing the results, the paper finds that apart from growth in the labour force, investment in both physical and human capital, coupled with low inflation and open trade polices, is necessary for economic growth. Furthermore, the ability to adapt to technological

[1] Convergence refers to the tendency of a poor economy to grow at a higher rate per capita than a rich economy and thereby closing the gap between the two economies.

changes in order to increase efficiency is also important. Since many developing countries have a large agricultural sector, adverse supply shocks in this sector were found to have a negative impact on growth rates.

From a policy perspective, the results have some important implications. Governments in developing countries need to channel more money into education and capital works programmes, such as investment in infrastructure and health. It also needs to undertake tariff reforms, in a consequential manner to promote openness and deregulate markets to encourage efficiency. Furthermore, developing countries need to broaden their resource and industry base, in order to minimise the adverse effects on economic growth of supply shocks in the agricultural sector.

The rest of the paper is structured as follows: Section 2 briefly reviews literature on economic growth. Section 3 discusses economic growth in middle-income developing countries. Section 4 examines developments in Fiji. Section 5 sets out the conceptual framework of the model. Section 6 presents the empirical results and Section 7 concludes the paper.

2.0 Literature Review

A variety of studies have addressed the issue of economic growth, mostly using either cross-country or panel data approach (see Appendix 2). While most of these studies utilise the standard neo-classical growth model or its extended version that includes human capital, more recent

studies focus on endogenous growth models. A key element of the neo-classical growth theory is the assumption that technical change is exogenous and that the same technological opportunities are available across countries. This assumption implies that steady state growth solely depends on exogenous population growth and exogenous technical progress. In other words, the model predicts that poor countries should gradually converge towards richer countries. However, studies undertaken by Romer (1986) and Lucas (1988) have dropped this central assumption.

A few studies have also attempted to explain cross-country differences in total factor production. Most of these studies have focused on cross-country differences in growth rates, with the exception of Hall and Jones (1998), who use growth levels. The growth rates are important as they are a determining factor of levels. Cross-country differences in growth rates may be transitory because technological transfers across countries imply convergence in growth rates as technological transfers prevent countries from drifting apart from each other indefinitely.

The broad consensus highlighted in these studies is that a country's growth over a long period is basically determined by three factors, namely: (1) the efficient utilisation of the existing stock of resources, (2) the accumulation of productive resources such as human capital, and (3) technological progress. However, these broad categories can be further broken down into various determinants of economic growth. The influences considered here include human capital,

investment, geography, government policies, revolutions and coups, inflation, financial systems and technological progress.

The first source of economic growth, human capital, can be measured in terms of education level and health. As such, Barro (1991), for 98 countries in the period 1960-1985, concludes that the growth rate of real per capita GDP is positively related to initial human capital (proxied by 1960 school-enrollment rates). In 1995, he further concludes that for a country to grow adequately, human capital in the form of education and health is an important element. He emphasises that the faster a country grows, the greater its current level of human capital development, since physical capital expands rapidly to match a high endowment of human capital. Also, the country is better equipped to acquire and adapt the efficient technologies that have been developed in the leading countries. Sach and Warner (1997) also noted that a rapid increase in human capital development would result in rapid transitional growth. Gallup et al. (1998) further note that a well developed labour force, in terms of better education and health, is likely to be able to produce more from a given resource base, than less-skilled workers.

Nelson and Phelps (1966) similarly suggest that a large sized labour force makes it easier for a country to absorb new products or ideas that have been discovered elsewhere. Romer (1990) states that quality development of labour force generates new products or ideas that underlie technological progress. He also notes that those countries with a large and well developed labour force experience a more rapid rate of introduction of new goods and thereby tend to grow faster.

Gallup et al. (1998) draw their variables from Barro and Lee (1993), and find a strong relationship between initial levels of health and economic growth, using life expectancy at birth as their basic measure of overall health of the population. They conclude that improved health is associated with faster economic growth. However, after using the average total years of education of the adult population as their main measure of education, they are unable to find a statistically significant relationship between initial levels of education and subsequent economic growth in their sample of countries.

According to Levine and Zervos (1993), countries that have more students enrolled in secondary schools grow faster than countries with lower secondary school enrollment rates. Brunetti et al. (1998) noted that education, measured by secondary school enrollment, is positively related to growth. Martin and Xavier (1997) also support the view that various measures of education are positively related to growth. Levine and Renelt (1992) concur.

Some theories in which the initial values of human capital and per capita GDP matter for subsequent growth rates also suggest relations with physical investment and fertility (Barro, 1991). The writer also suggests that countries with higher human capital also have lower fertility rates and higher ratios of investment to GDP. He notes that in endogenous growth models of Rebelo (1990) and Barro (1990), per capita growth and the investment ratio tend to move together. Becker et al. (1990) state that higher rates of investment in human and physical capital lead to higher per capita growth. This is because well developed

human capital will lead to an improvement in productivity, and an increase in the growth rate and investment ratio.

Geography is another factor that determines economic growth. However, it has been studied by very few researchers. Gallup et al. (1998), Sachs and Warner (1998), and Hall and Jones (1997) are a few of the cross-country growth studies that take geography into account. They generally conclude that countries located in the tropics tend to grow more slowly than countries in more temperate climates.

Developing countries that largely depend on the agricultural sector as their main source of export earnings are often adversely affected by the tropical climates, which hinder growth. Gallup et al. (1998) state that two possible reasons for this negative relationship could be as follows: (1) the presence of parasitic diseases in tropical countries; and (2) the tropics have more fragile soils and more natural disasters, all of which hinder agricultural growth. The writers further note that a geographical obstacle facing many countries is access to major shipping lines and important export/import markets.

Government policies also play a very crucial role in determining where an economy will go in the long run. For example, favourable public policies - including better maintenance of law, fewer distortions of private markets, less non-productive government consumption and greater public investment in high-return areas – lead, in the long run, to higher levels of real per capita GDP (Barro, 1995). Similarly, a greater willingness of the private sector to save, raises living standards in the

long run. Favourable settings of government policies and private sector choices are essential for poor countries to grow quickly.

Hall and Jones (1997) believe that differences in levels of economic success across countries are driven mainly by the institutions and government policies (or infrastructure) that frame the economic environment.

Brunetti et al. (1998) state that two channels through which policies may influence economic growth are efficiency and reliability. Efficiency reflects the implementation of macro and micro-economic policies in a timely manner. On the other hand, reliability of policies refers to the stability surrounding their implementation.

Gallup et al. (1998) explore the relationship between three basic government policies - openness[2] to the global economy, government saving and the composition of government expenditures - and the growth of per capita income.

They conclude that open economies are generally in a better position to import new technologies and new ideas from the rest of the world. In addition, they are likely to have a greater division of labour and production processes that are more consistent with their comparative advantages, which enable them to grow faster.

The central government savings rate is an important policy indicator. The authors measure this variable as a proportion of GDP,

[2] The openness measure used by the writers is that derived by Sachs and Warner (1995). A country is classified as open, if (i) import duties average less than 40%; (ii) less than 40% of imports are covered by quotas; (iii) the black market premium on the exchange rate is less than 20%; and (iv) export taxes are moderate.

and average it over their study period. They note that higher government saving is likely to support aggregate economic growth through two ways: (1) countries which have higher government saving rates also tend to have greater overall savings and investment, and therefore grow faster; and (2) higher government saving indicates sound overall macroeconomic management,[3] which lowers risks for investors and increases investment. They conclude that prudent government fiscal policies appear to be associated with faster overall economic growth.

The third policy examined by them is the composition of government spending, particularly, the extent of government spending on health and education. They find a positive relationship between government spending on health and education (measured as a share of GDP) and growth of per capita income.

Many studies examine the role of government fiscal surpluses and deficits in affecting economic growth. The general view is that high levels of government deficits are bad for growth.

Fischer (1993) notes that large budget deficits and growth are negatively related. Among other variables such as inflation and distorted foreign exchange markets, he emphasises the importance of a stable and sustainable fiscal policy, to achieve a stable macroeconomic framework. Easterly and Rebelo (1992) find a consistent negative relationship between growth and budget deficits.

[3] This includes lower aggregate budget deficits, more prudent monetary policies and lower inflation.

Levine and Zervos (1993) attempt to measure the role of government in economic activity by using the ratio of government consumption to GDP. They find a negative relationship between government consumption to GDP and growth, though insignificant.

Higher government saving, increased global integration, and better institutional quality all raise steady-state income and, therefore, bolster transitional growth (Sachs and Warner, 1997). Barro (1991) states that growth is inversely related to the share of government consumption in GDP, but insignificantly related to the share of public investment.

The fourth factor that has an impact on growth, is political instability. It is generally believed that countries that experience more revolutions and coups grow more slowly than more stable countries. This view is strongly supported by Levine and Zervos (1993). However, Brunetti and Weder (1995) note that Thailand, characterised as a country with high political uncertainty still has a strong institutional framework and the number of coups it has experienced did not affect the functioning of the country's entrepreneurial class.

Gallup et al. (1998) find a strong negative relationship between political instability and economic growth. Their measure of political instability is based on the number of assassinations per million people per year and the number of coups per year. They conclude that political instability is a statistically significant deterrent to economic growth.

Barro (1991) notes that growth rates are positively related to measures of political stability and inversely related to a proxy for

market distortions. He finds measures of political instability inversely related to growth and investment.

The fifth factor that has a very strong impact on growth is inflation. Policy makers typically believe that inflation has important adverse effects on long-run economic performance (Clark, 1993). The reason for this, as noted by Fischer and Modigliani (1978) is that firms and workers devote productive resources to deal with inflation. They further note that inflation uncertainty reduces efficiency by discouraging long-term contracts and increasing relative price variability.

A high and unpredictable rate of inflation generally results in poor performance of businesses and households. Fischer (1993) presents cross-sectional and panel regressions showing that growth is negatively associated with inflation. Levine and Renelt (1992) state that high growth countries are also lower inflation countries.

While most authors find growth and inflation to be inversely related, with the implication that inflation is quite costly, there are exceptions: in his comments on Fischer's (1991) estimates, Sala-I-Martin (1991) reports an insignificant link between growth and inflation (Clark, 1993).

Clark (1993) in a sample of 85 countries attempts to provide a summary of inflation's effects on growth. He concludes that theory provides little or no guidance for specifying the empirical relationship between growth and inflation. His conclusion arises from his findings that across low and moderate inflation countries there is no consistent and significant relationship between growth and inflation. However, his

study shows investment rates and inflation volatility to be inversely related in almost all country samples.

Levine and Zervos (1993) conclude that marginal changes in moderate inflation rates may not be negatively associated with growth. However, very high inflation rates may be associated with a breakdown in normal economic relationships and lower economic growth. The writers, however, contradict their view by later asserting that very high inflation for very long periods may make people accustomed to inflation and hence lead them to develop various mechanisms for coping with inflation. This, they believe, makes growth unrelated to very high inflation.

According to Cozier and Selody (1992), their results based on data from 22 countries belonging to the Organisation for Economic Co-operation & Development (OECD), suggest that inflation has a negative effect on economic output which is economically large and statistically significant. They further conclude that a permanent 1 percentage point reduction in inflation would raise growth by just over 0.1 percentage points, and would eventually raise output by about 6 percent.

Dewan, Hussein and Morling (1999), carried out a study on the inflation process in Fiji and found that a 1.0 percentage point increase in permanent inflation, reduces output growth by close to 0.2 percentage point.

Jarrett and Selody (1992) examine the link between output and inflation in Canada over the 1963-1979 period. They conclude from their estimate that a 1 percentage point decrease in inflation would cause

a 0.3 percentage point increase in the growth rate of labour productivity and hence GDP. By using Canadian data for the period 1955-1989, Selody (1990) estimates that a 1 percentage point decline in inflation should increase labour productivity growth by 0.2 percentage points.

Clark (1982) uses American data for the period 1947-1981 and his results show that a 1 percentage point decline in inflation would result in 0.4 percentage point increase in productivity growth and hence GDP growth. Grimes (1990) uses time-series data from 21 countries for the period 1961-1987 and estimates that a 1 percentage point reduction in inflation increases output growth by 0.1 percentage points.

A detailed industry study by Buck and Fitzroy (1988), for 40 West German industries over the period 1950-1977, shows that a 1 percentage point decrease in inflation would increase output growth by 0.16 percentage points in the mining sector, by 0.14 percentage points in the production goods sector, by 0.04 percentage points in the investment goods sector, and by 0.45 percentage points in the consumer goods sector.

Barro (1995) uses data for around 100 countries from 1960-1990 to assess the effect of inflation on economic performance. He concludes that if a number of country characteristics are held constant, then the regression results suggest that an increase in average inflation of 10 percent per annum reduces the growth rate of real GDP by 0.2-0.3 percent per annum and lowers the ratio of investment to GDP by 0.4-0.6 percent.

The financial system is also known to affect the level of economic growth in a country. According to Levine and Zervos (1993), new research suggests that economies with more developed and more efficient financial systems will be able to more effectively allocate savings to the best investments, which in turn leads to increased productivity, potentially higher savings rates, and faster growth. The authors use the ratio of liquid liabilities to GDP to examine the relationship between financial policy and growth. Their results show that countries with larger per capita growth rates tend to have larger financial systems.

Finally, technological progress is another important factor which determines growth. According to Romer (1990) and other studies, the world economy grows because of technological progress, through the invention of new ideas. However, it should be noted that a country should be effective at taking advantage of technologies invented elsewhere. Hence, technology transfer and diffusion, are both essential contributory elements to the growth of a country.

3.0 Middle - Income Developing Countries' Growth Experience

Over the sample period from 1965 to 1997, five year average growth rates in developing countries have been between 2.5 percent to around a little under 7 percent (see Table 1). These countries experienced relatively high growth rates in the 1960's and 1970's, before they started to cool off in the 1980's and early 1990's. However,

there are signs of a pick-up in economic prosperity in the late 1990's. Growth rates in the middle-income developing countries also followed the same pattern. However, the upper middle-income developing countries grew more strongly in the 1960's and 1970's than the lower middle-income developing countries.

The investment in human input for an average developing country grew annually by around 2 to 3 percent. For middle-income developing countries, growth in the labour force is a similar pattern to that of an average developing country.

In the review period, the average growth rate of gross domestic investment in the sample countries was as low as 1.8 percent and as high as 11.4 percent. Growth in investment was relatively high in the 1960's and 1970's before declining in the 1980's. In the 1990's, investment started to gain momentum once again. The middle-income developing countries experienced a similar investment pattern as the overall developing countries. However, the growth in investment in the lower middle-income developing countries was generally less than that of the upper middle-income developing countries.

Inflation in developing countries has been one of the major concerns. In the 1960's inflation was fairly low, but, it rose quickly thereafter. During the 1985-1989 period, inflation averaged around 70 percent, but it has fallen after the mid 1990's, to around 15 percent. Inflation rates in the upper middle-income countries were relatively higher than those of lower income countries. This was mainly due to high inflation experienced by Brazil and Argentina.

From the years 1965 to 1997 public spending on education, for each five-year period, averaged between 2.5 percent of GDP to 9.3 percent of GDP. During the same period, average investment in human capital in upper middle-income countries has been higher than that of lower middle-income countries.

Over the sample period, there has been very little change in import duties of an average developing country. However, it seems that there were some differences in movements of duty in upper and lower middle-income countries. That is, from 1980 onwards, period averages for changes in import duties in upper income countries are mostly negative, while for lower middle income countries they are positive. This suggested that import duties in the upper middle-income countries has been continuously reduced, whereas lower income countries have mostly concentrated on maintaining or increasing barriers to international trade.

	Table 1:	*Period Averages (Percent)*					
	1965-1969	1970-1974	1975-1979	1980-1984	1985-1989	1990-1994	1995-1997
Developing Countries							
GDP Growth Rate	5.6	6.9	4.8	2.3	3.2	2.5	3.7
Change in Labour Force	2.1	2.6	2.7	2.6	2.4	2.4	2.3
Change in Gross Domestic Investment	9.4	11.4	6.2	1.8	4.8	5.9	6.5
Change in CPI	5.7	15.0	22.2	33.4	70.0	54.5	14.7
Change in Goods Imports	0.0	3.1	10.9	3.7	7.2	11.0	12.9
Change in Public Spending on Education	5.6	9.3	6.0	4.5	2.5	6.9	5.8
Change in Imports Duty	0.0	-0.6	2.4	0.5	1.7	2.3	-0.6

Developing countries are further classified into upper middle income developing countries and lower middle income developing countries, in accordance to Direction of Trade Statistics, Sept. 1999 issue.

Upper Middle Income Countries							
GDP Growth Rate	6.0	7.6	4.8	2.6	2.6	1.9	4.0
Change in Labour Force	1.9	2.5	2.5	2.4	2.1	2.0	1.8
Change in Gross Domestic Investment	11.3	16.8	4.8	0.5	4.2	3.8	6.2
Change in CPI [1]	6.3	11.3	30.0	42.4	121.9	111.5	16.6
Change in Goods Imports	0.0	2.4	10.6	4.0	6.3	11.9	15.0
Change in Public Spending on Education	6.0	7.5	7.5	7.8	1.5	6.7	9.8
Change in Imports Duty	0.0	-0.6	3.3	-2.0	4.3	-0.7	-8.8
Lower Middle Income Countries							
GDP Growth Rate	5.5	6.5	4.8	2.2	3.5	2.8	3.5
Change in Labour Force	2.3	2.6	2.8	2.6	2.6	2.6	2.6
Change in Gross Domestic Investment	8.5	9.0	6.8	2.4	5.0	6.9	6.7
Change in CPI	5.4	16.8	18.5	29.2	45.9	28.1	13.9

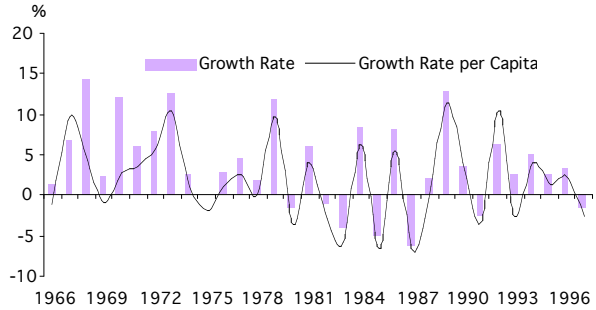
Change in Goods Imports	0.0	3.5	11.0	3.6	7.7	10.6	11.9
Change in Public Spending on Education	5.5	10.2	5.3	3.0	3.0	7.0	3.9
Change in Imports Duty	0.0	-0.6	2.0	1.7	0.5	3.7	3.2

1. Inflation in upper middle income countries for periods 1975-1979, 1980-1984, 1985-1989 and 1990-1994 are generally higher than that of the lower middle income countries due to the fact that Brazil and Argentina experienced hyperinflation during the 1980's and 1990's. Upon excluding Brazil and Argentina from the upper middle income countries sample, average inflation falls to 10.4% for period 1975-1979, 14.6% for period 1980-1984 and 16% and 34% for periods 1985-1989 and 1990-1994, respectively.

4.0 Fiji's Growth Experience

For the period 1966-1999 economic growth in Fiji averaged around 4 percent, while per capita GDP grew on average by 2.2 percent. Although, the average growth rate for the period is similar to that of some of the well performing developing countries, there have been protracted periods of strength and weakness in Fiji's economy. This is indicative of a growth pattern in a volatile economy (see Figure 1). The extreme swings in output have generally obscured the underlying growth path of the economy and have masked any evidence of the broad swings in activity, usually associated with more traditional business cycles (see Williams and Morling 2000).

FIGURE 1
Economic Growth



In this section, we attempt to assess Fiji's growth pattern in relation to some of the long run determinants of economic growth identified in the paper. In other words, how have factors of sustainable economic growth such as the growth in the labour force, investment in both human and physical capital, the level of import duty and inflation performed over the last three decades?

Gross domestic investment as a percent of GDP has averaged 20 percent for the last three and half decades. However, the level of investment has dropped significantly from as high as 34 percent of GDP in 1981 to around 11 percent of GDP in 1996. Over the last decade, the investment level as a percent of GDP has followed a downward trend and on average has been around 15 percent.

The growth rate in the labour force has averaged 2.7 percent over the last three decades and the average long run natural rate of economic growth, resulting solely from an increase in human input in Fiji, has been around 1.5 percent per annum.

For the period 1979-1997, import duties as a percent of total imports, which proxies as a measure of "openness" (less trade barriers) in the economy has averaged around 17 percent. However, over the years, tariff rates have been lowered, in line with the World Trade Organisation regulations. The reduction in overall tariff rates is expected to bring in new ideas and create increased competition for domestic firms, which will in turn lead to increased efficiency and hence, economic growth.

Over the last three decades, investment in human capital, proxied by public spending on education, as a percent of GDP, has averaged 5 percent. In recent years, government has announced various education policies and programmes and this is likely to promote growth in the coming years. Government policies such as compulsory education coupled with increases in scholarship funds and free education up to fourth form is likely to produce a higher quality labour force in the coming years.

In section 5, we incorporate these factors into a more formal model of economic growth.

5.0 Growth Framework

In this paper, the production function is used to explain the determinants of growth. This function has formed the basis for explaining the economic growth theory and it has been in use for over

the past four and a half-decades.[4] This approach is based on the neo-classical model of Solow (1956) and Swan (1956) which identifies the channels through which macroeconomic variables affect economic growth.

The neo-classical model states that, at any point in time, the total output of the economy depends on the quality and quantity of physical capital employed, the quantity of labour employed and the average level of skills of the labour force. However, once the economy reaches the full equilibrium level, additional growth in the stock of capital per worker will only take place if productivity increases, either through enhanced capital stock or through improvements in the quality of the labour force.

Recent work done by Knight, Loayza and Villanueva (1993) point out that, apart from the underlying factors stated in the neo-classical model, other factors such as the exogenous technological improvements which are absorbed domestically through imports of capital goods, the degree of openness of the economy and the level of fixed investment undertaken by the government are important as well. Earlier work done by Mankiw, Romer and Weil (1992) also confirms this.

The above specifications are particularly suitable for developing countries. The production function used in this paper is specified within

[4] Recently, the Solow-Swan model has come under attack by the new growth theorists, who favour "endogenous growth" models that assume constant or increasing returns to capital. However, recent work by Mankiw, Romer, and Weil (1992) contends, using a cross-sectional approach, that the Solow-Swan model's predictions are indeed consistent with the empirical evidence.

the conventional accounting framework with both short-term dynamics as well as long run relationships. Knight, Loayza and Villanueva (1993) provides a growth model from the conventional growth accounting framework and the derivations below follow their work very closely.

Consider the Cobb-Douglas production function:

$$Y_t = F(K_t, L_t, H_t, A_t) \qquad (1)$$

where K, L and H are physical capital, labour and human capital, respectively and A_t is an overall efficiency factor. A_t includes the level of technology, and the quality of government management of the economy etc. H_t reflects the educational level of the workforce as well as its health and nutritional status.

By differentiating equation (1), the conventional growth accounting equation is:

$$\dot{Y}/Y = \alpha_1(\dot{K}/K) + \alpha_2(\dot{L}/L) + \alpha_3(\dot{H}/H) + \alpha_4(\dot{A}/A) \qquad (2)$$

where n_i is the elasticity and $[\alpha_4(\dot{A}/A)]$ is the productivity residual.

Raw labour and labour related technology are assumed to grow according to the following functions:

$$L_t = L_0 e^{nt} \tag{3}$$

$$A_t = A_0 e^{gt} F^{\square_f} P^{\square_p} \tag{4}$$

where n is the exogenous rate of growth of labour force, g is the exogenous rate of technological progress, F is the degree of openness of the domestic economy to foreign trade and P is the level of government fixed investment in the economy.

With the savings rate exogenously determined, physical and human capital are accumulated as follows:

$$\frac{dK_t}{dt} = s_k Y_t \square \square K \tag{5}$$

$$\frac{dH_t}{dt} = s_h Y_t \square \square H \tag{6}$$

where s_k is the fraction of income invested in physical capital, s_h is the fraction of income invested in human capital and $\square$ is the depreciation rate.

Without imposing any restrictions that the economy is continuously in the steady state, the speed of convergence, that is the speed with which the output reaches its steady state, is defined by the

parameter, δ. Most studies have found that countries grow faster if they are initially below their steady-state growth path.

Substituting equations 3 to 6 into the production function, equation 2, gives:

$$Y_t = \alpha + \beta_1(n_{i,t} + g + \delta) + \beta_2 s_{k_{i,t}} + \beta_3 s_{h_i} + \beta_4 F_i + \beta_5 P_i + \beta_6 Y_{i,t-1} + \lambda_t + \mu_i + \varepsilon_{i,t} \quad (7)$$

where λ_t and μ_t are time-specific and country specific effects, ε_t is the error term and where $\beta_1,.....,\beta_6$ are parameters to be estimated.

Equation 7 is similar to the model used by Knight, Loayza and Villanueva (1993) and it forms the basis for our empirical tests in section 6.

6.0 Empirical Results

6.1 Data

Initially, 112 countries classified as middle income developing countries according to the Direction of Trade Statistics, Sept 1999 issue were selected. These countries were further categorised as lower middle income and upper middle-income countries.

Equation 7 is estimated using the cross-country data of 41 developing countries. The basic data in this study are annual observations for the period 1965 to 1997. The annual data was constructed into six 5-year average intervals and one 3-year average

interval. The intervals were, 1965-1969, 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, and 1995-1997. Appendix 1 provides a description of data sources and construction.

6.2 Estimation

Before estimating the model, it is necessary to examine the time-series properties of the data. These are determined using the testing strategy recommended by Perron (1988). The unit-root hypothesis is tested using the Augmented-Dickey-Fuller (ADF) test, which amounts to running the following set of regressions for each of the variables.[5]

$$x_t = \alpha + \beta t + \alpha_0 x_{t-1} + \sum_{i=1}^{k-1} \alpha_i \Delta y_{t-i} + \alpha_t,$$

k=1,…….

Note that for k=1, there are no Δy_{t-1} terms on the right hand side of the above equation. The lag length (k) in the ADF regression is selected using the Schwarz Criterion. Empirically, the labour force appears to be integrated to order one I(1) for all countries except Belize, El Salvador, Estonia, Latvia, Mauritius and Trinidad and Tobago, which are integrated to order 2.

For gross domestic investment, Estonia, Fiji, Latvia, Mauritius, Romania and Swaziland are integrated to order 2 while the rest are

[5] Log values of the variables were used for the unit root test.

integrated to order 1 or less. The unit root hypothesis can be rejected at the 5 percent significance level for all other countries. The unit root test shows the inflation and goods imports variables appear to be integrated to order 1 or higher. The other variables are integrated to order 0.

The panel data sets used in this paper have several observations, collected over time for a number of countries. They share properties with both time series data and cross-sectional data sets.

Panel data models are usually estimated using either fixed or random effect techniques. These two techniques have been developed to handle systematic tendency of individual specific components to be higher for some units than for others – the random effect estimator is used if the individual specific component is assumed to be random with respect to the explanatory variables. The fixed effects estimator is used if the individual specific component is not independent with respect to the explanatory variables.[6]

6.3 Fixed and Random Effects Estimators

The basic regression model for a balanced panel data set is

$$Y_{it} = X_{it}\beta + \varepsilon_{it}, \qquad i=1,.....,$$
$$t=1,....,T$$

These two types of estimators are designed to handle the systematic tendency of ε_{it} to be higher for some individuals than for

[6] See Keane and Runkle (1992) for a review of the estimation of panel data.

others (individual effects) and possibly higher for some time periods than for others (time effects).

The fixed effect estimator does this by (in effect) using a separate intercept for each individual or time period.

The random effect estimator is based on the following decomposition of ε_{it} where α is the individual effect, γ the time effect, and ν the purely random effect. α is estimated by the structure imposed upon ε_{it} by this assumption.

Both fixed and random effects adjust for heteroskedasticity. However, the two effects have their own advantages and disadvantages.

A fixed effects model cannot estimate a coefficient on any time-variant regressor, such as sex, schooling, etc., since the individual intercepts are free to take any value. However, the individual effects in a random effects model is part of the error term, so it must be uncorrelated with the regressors. On the other hand, because the random effects model treats the individual effect as part of the error term, it suffers from the possibility of bias due to a correlation between it and the regressors.

Hausman (1978) provides a test for discriminating between the fixed effects and the random effects estimators. The test is based on comparing the difference between the two estimators of the coefficient vectors, where the random effects estimator is efficient and consistent under the null hypothesis and inconsistent under the alternative hypothesis. The fixed effects estimator is consistent under both the null and the alternative hypothesis. If the null is true then the difference

between the estimators should be close to zero. The calculation of test statistics (distributed χ^2) requires the computation of the covariance matrix of $\beta_1 - \beta_2$. In the limit the covariance matrix simplifies to Var(β_1) – Var(β_2), where β_1 is the fixed effects estimator and β_2 is the random effects.

6.4 Specific Evaluations

Before turning to the results, it is necessary to consider the statistical properties of the model. The fixed and random effects models were tested for heteroskedasticity, residual autocorrelation and non linearities. The results suggest that both the models are well specified. The diagnostics indicate that the residuals are normally distributed, homoskedastic and serially uncorrelated and the parameters appear to be stable.

6.5 Results

The results are similar to that found by other authors such as Barro (1995), Knight, Loayza and Villanueva (1993) and Mankiw, Romer and Weil (1991).

However, before interpreting the results, it is worth noting an important limitation associated with the approach taken in the analysis. That is, while each of the regression coefficients is indicative of the impact of a change in the explanatory variable on the growth rate, it would not be valid for a particular country in the sample, unless that

country closely resembles the average country with regard to the economic structure summarised by the values of the explanatory variables. Nevertheless, despite this shortcoming, the empirical results are very informative.

Both the random and fixed effects model, have an adjusted R^2 of around 0.6, which is rare to achieve in a cross country analysis. All the coefficients have the right signs. The growth rates of the labour force and investment in both physical and human capital are strongly and positively correlated in the fixed and random effects model. On the other hand, the agricultural shock variable and proxy for countries' openness appear to have strong negative correlation with the growth rates. Inflation is also negatively correlated with growth.

The variable, import duties, defined as the change in tariff rates, has a significant negative effect on output growth. This measure of openness ("closedness" as defined as Knight, Loayza and Villanueva) affects growth through investment and efficiency. The efficiency term accounts for technological improvements. The evidence of such an independent role of openness in the middle income countries, tends to support the view that liberal trade regimes provide a source of technological progress via the freedom to import sophisticated goods from technologically advanced countries.

The results of the random effects model show that a one percent increase in growth of the labour force leads to a rise in the growth of real GDP by around 0.6 percentage points. A one percentage point increase in public spending on education increases real economic

growth by 0.2 percentage points over a 10-year period. The combined effect of a one percent increase in growth of the labour force and a one percent increase in investment in human capital, in terms of increasing education spending, leads to around 0.8 percent growth in the economy over the decade. Similar results were also obtained under the fixed effects model, albeit more significant.

The impact of investment on long run economic growth, under both the random and fixed effects model, is the same. The effect on growth in real GDP of a one percent rise in gross domestic investment is around 0.17 percent. The dummy variable, which is the proxy for a negative agricultural supply shock, has the most significant impact on economic growth. Results under the random effects model show that a one percent fall in the contribution of the agricultural sector towards GDP growth leads to 1.2 percent fall in growth of real GDP. The impact is slightly stronger under the fixed effects model. Inflation is negatively correlated with economic growth, however, the impact of a one percent rise in prices has a small impact on economic growth. But, the fact that it is negatively correlated with growth should reconfirm the importance of price stability for sustained economic growth.

The result on import of goods, used as proxy for technological progress, also lines up with the neoclassical growth theory. In both the random and fixed effects models, the effect of a one percent increase in imported goods increases real GDP by around 0.02 percentage points. Like many cross country studies on the determinants of long run economic growth, this study also reveals the importance of openness.

The results show that a one percent increase in tariff and customs duties suppresses real economic growth by as much as 0.04 percentage points. Detailed results are presented in Table 2.

Table 2: ***Determinants of Growth (A Panel Data Approach)***

Dependent variables: Growth Rate; estimation period 1965-1997

Explanatory variables:	*(Random Effects)*	*(Fixed Effects)*
Constant	0.637	
	(1.268)	
Δ Labour Force $_t$	0.566	0.896
	(3.464)**	(3.061)**
Δ Gross Domestic Investment $_t$	0.169	0.166
	(10.376)**	(10.326)**
Δ CPI $_t$	-0.003	-0.003
	(-2.047)**	(-1.705)
Δ Goods Imports $_t$	0.020	0.016
	(1.049)	(0.829)
Dummy $_t$	-1.210	-1.349
	(-3.097)**	(-3.268)**
Δ Public Spending on Education $_t$	0.121	0.090
	(6.670)**	(4.714)**
Δ Public Spending on Education $_{t-1}$	0.067	0.028
	(3.118)**	(1.229)
Δ Imports Duty $_t$	-0.036	-0.045
	(-2.909)**	(-3.598)**
Summary statistics		
Adjusted R^2	0.594	0.605

Notes: t-values are in parentheses. **(*) denotes significance at the one(five) per cent levels.

7.0 Conclusion

The objective of this paper was to determine some of the necessary determinants of sustainable economic growth in developing countries. The results provide useful insights into these factors. Apart from the natural rate of growth of the labour force, empirical evidence

also suggests growth will be supported by an increase in budgetary allocation to improve human capital, increased domestic investment, and open trade policies to encourage efficiency through assessing better foreign technologies. Since developing countries traditionally have large agriculture sectors, adverse shocks in this sector often lead to a slowdown in growth. Empirical results show that these negative shocks have very large unfavourable effects on economic growth.

Looking specifically at Fiji's economic performance, the country seems to have some of the necessary factors of growth moving in the right direction. The current low inflation environment, reduction in tariff rates, increases in human capital and continuous growth in the labour force should benefit the economy. However, a concern is the downward trend in investment. In order for a country to have sustainable long-run economic growth, investment needs to flow in. If investment levels follow their current path, it would be very difficult for Fiji to maintain a long-run sustainable economic growth path.

Appendix 1

Initially, 112 countries classified as middle income developing countries, according to the Direction of Trade Statistics, Sept 1999 issue, were selected. These countries were further categorised as lower middle income countries and upper middle income. The list of the initial 112 middle income countries that were selected are as follows:

Table 3: Lower Middle Income (71 countries)

1. Angola	26. Azerbaijan	52. Algeria
2. Djibouti	27. Bosnia and Herzegovina	53. Morocco
3. Namibia	28. Bulgaria	54. Tunisia
4. Swaziland	29. Croatia	55. Belize
5. Cameroon	30. Czech Republic	56. Bolivia
6. Cape Verde	31. Georgia	57. Chile
7. Congo	32. Kazakhstan	58. Colombia
8. Cote d'Ivoire	33. Kyrgyz Republic	59. Costa Rica
9. Senegal	34. Latvia	60. Cuba
10. Fiji	35. Lithuania	61. Dominica
11. Kiribati	37. Moldova	62. Dominican Republic
12. Korea Demo. Rep.	38. Poland	63. Ecuador
13. Marshall Islands	39. Romania	64. El Salvador
14. Micronesia Fed. Sts.	40. Russian Federation	65. Grenada
15. Mongolia	41. Slovak Republic	66. Guatemala
16. N. Mariana Is.	42. Turkmenistan	67. Jamaica
17. Papua New Guinea	43. Ukraine	68. Panama
18. Philippines	44. Uzbekistan	69. Paraguay
19. Solomon Islands	45. Yugoslavia Fed. Rep.	70. Peru
20. Thailand	46. Turkey	71. St. Vincent and the Grenadines
21. Tonga	47. Iran, Islamic Rep.	
22. Vanuatu	48. Iraq	
23. Western Samoa	49. Jordan	
24. Albania	50. Lebanon	
25. Armenia	51. Syrian Arab Rep.	

Table 4: Upper Middle Income (41 countries)		
1. Botswana	16. Hungary	31. Guadeloupe
2. Mauritius	17. Slovenia	32. Martinique
3. Mayotte	18. Gibraltar	33. Mexico
4. Reunion	19. Isle of Man	34. Netherlands Antilles
5. Seychelles	20. Malta	35. Puerto Rico
6. South Africa	21. Bahrain	36.St. Kitts and Nevis
7. Gabon	22. Oman	37. St. Lucia
8. American Samoa	23. Saudi Arabia	38. Suriname
9. Guam	24. Libya	39. Trinidad and Tobago
10. Korea, Rep.	25. Antigua and Barbuda	40. Uruguay
11. Macao	26. Argentina	41Venezuela
12. Malaysia	27. Aruba	
13. New Caledonia	28. Barbados	
14. Belarus	29. Brazil	
15. Estonia	30. French Guinea	

Elimination of Data Series

Round 1

The major oil exporting countries (Algeria, Indonesia, Iraq, Libya, Oman and Saudi Arabia) were dropped from the initial list.

The list of variables used in this paper were mostly chosen from earlier works done by Barro (1995 and 1997), Fischer (1993), and Knight, Loayza and Villanueva (1993).

Round 2

Availability of some of the crucial variables was the second elimination criterion. A country had to have at least 75 percent of the data available of each for these variables; Real GDP, CPI, labour force

and population. For countries which did not have real GDP but did have CPI and nominal GDP, real GDP was obtain by adjusting for inflation. As a result of this imputation, some caveats may apply. After the second round of elimination 63 countries remained.

Round 3

In the final elimination round, the remaining 63 countries had to have at least 70 percent of the data available for these variables: capital expenditure, investment and savings, either total or public expenditure on education and tariff rates. At the end of the third round of elimination, 41 countries were left (refer Table 4).

For these countries, data was available for almost all variables. However, for those years for which data was not available, they were interpolated.

Table 5: Sample of Countries Used

Argentina	Dominican Republic	Latvia	South Africa
Barbados	Ecuador	Mauritius	Swaziland
Belize	El Salvador	Mexico	Thailand
Bolivia	Estonia	Morocco	Trinidad and Tobago
Botswana	Fiji	Panama	Tunisia
Brazil	Gabon	Papua New Guinea	Turkey
Cameroon	Guatemala	Paraguay	Venezuela
Chile	Hungry	Peru	Malaysia
Colombia	Iran Islamic Rep.	Philippines	
Costa Rica	Jamaica	Romania	
Cote d'Ivoire	Korea Dem. Rep.	Senegal	

Empirical analysis was then conducted on these 41 middle income developing countries.

Appendix 2

The following are lists of variables and the respective coefficients obtained from work carried out by previous researchers, on determinants of economic growth.

Table 6: Results of Previous Research

Author(s)	Panel of countries studied	Independent variables identified	Coefficients, (t statistics) or (standard errors)	R^2
R.J. Barro (1991)	98 (1960-1985)	1. Constant	0.0302 (0.0007)	0.56
		2. 1960 value of real per capita GDP	-0.0075 (0.0012)	
		3. 1960 secondary-school enrolment rate	0.0305 (0.0079)	
		4. 1960 primary-school enrolment rate	0.0250 (0.0056)	
		5. Average from 1970 to 1985 of the ratio of real govt. consumption (exclusive of defense and education) to real GDP	-0.1190 (0.0280)	
		6. Number of revolutions and coups per year (1960 – 1985)	0.0195 (0.0063)	
		7. Number of assassination per million population per year (1960 – 1985)	0.0033 (0.0155)	

Author(s)	Panel of countries studied	Independent variables identified	Coefficients, (t statistics) or (standard errors)	R^2
		8. Magnitude of the deviation of 1960 PPP value for the investment deflator (US = 1.0) from the sample mean	0.0143 (0.0053)	
S. Fischer (1993)	101 (1960-1989)	1. Inflation rate	-0.0310 (-2.7200)	
		2. Budget surplus or deficit	0.2400 (3.0000)	
		3. Log difference of the terms of trade	0.0660 (3.3900)	
		4. Black market exchange rate premium	0.0150 (-1.9400)	
		5. Log of per capita GNP	-0.0210 (-2.1800)	
		6. Tariff protection	-0.0030 (-1.2700)	
		7. Barro-Lee measure of human capital	0.0050 (1.4400)	
		8. Average ratio of liquid liabilities to GDP for the period 1960-1989	-0.0200 (-0.3600)	
R. J. Barro (1995)	Roughly 100 (1960-1990)	1. Log (GDP)	-0.0254 (0.0031)	0.58*
		2. Male secondary and higher schooling	0.0118 (0.0025)	
		3. Log (life expectancy)	0.0423 (0.0137)	
		4. Log (GDP) male schooling	-0.0062 (0.0017)	

* For 80 observations only

Author(s)	Panel of countries studied	Independent variables identified	Coefficients, [t statistics] or (standard errors)	R^2
		5. Log (fertility rate)	-0.0161	
			(0.0053)	
		6. Government consumption ratio	-0.1360	
			(0.0260)	
		7. Rule of law index	0.0293	
			(0.0054)	
		8. Terms of trade change	0.1370	
			(0.0300)	
		9. Democracy index	0.0900	
			(0.0270)	
		10. Democracy index squared	-0.0880	
			(0.0240)	
		11. Inflation rate	-0.0430	
			(0.0080)	
M. Knight, N. Loayza and D. Villanueva (1992)	81 (1960-1985)	1. Log real GDP per worker	-0.2200 (-9.4500)	n.a
		2. Log average growth rate of the working-age population plus sum of rates of technological progress and depreciation	0.1470 (-12.5200)	
		3. Log average ratio of real investment (including government investment) to real GDP	0.2013 (18.1700)	
		4. log ratio of human capital investment to GDP, proxied by the product of gross secondary-school enrolment ratio times the fraction of the working population aged 15 to 19	0.0945 (8.1800)	

Author(s)	Panel of countries studied	Independent variables identified	Coefficients, [t statistics] or (standard errors)	R^2
		5. Log "Closedness" of the economy, proxied by the weighted average of tariff rates on imported intermediate and capital goods	0.0650 (-11.7600)	
		6. Log ratio of public infrastructure to GDP, proxied by the average ratio of general government fixed investment (central government plus public enterprises) to GDP	0.0128 (0.7800)	
M. Knight, N. Loayza and D. Villanueva (1992)	59 Developing countries (1960-1985)	1. Log real GDP per worker	0.6836 (-17.7500)	n.a
		2. Log average growth rate of the working-age population plus sum of rates of technological progress and depreciation	-0.1760 (-9.0100)	
		3. Log average ratio of real investment (including government investment) to real GDP	0.2057 (14.2400)	
		4. log ratio of human capital investment to GDP, proxied by the product of gross secondary-school enrolment ratio times the fraction of the working population aged 15 to 19	0.3197 (18.1500)	
		5. Log "Closedness" of the economy, proxied by the weighted average of tariff rates on imported intermediate and capital goods	0.08197 (-15.9700)	

Author(s)	Panel of countries studied	Independent variables identified	Coefficients, [t statistics] or (standard errors)	R^2
		6. Log ratio of public infrastructure to GDP, proxied by the average ratio of general government fixed investment (central government plus public enterprises) to GDP	0.0978 (6.4700)	
X. Sala-i-Martin	75 (1970-1985)	1. Constant	0.0007 (0.0099)	0.35
		2. Log 1970 GDP per capita	-0.0128 (0.0043)	
		3. Ratio of total government spending to GDP	-0.1117 (0.0370)	
		4. Savings rate is the ratio of total investment to GDP	0.2006 (0.0357)	
		5. Average ratio of social security transfers to GDP	0.1092 (0.0509)	
		6. Ratio of total government consumption (excluding defense and education) to GDP	-0.1285 (0.0475)	
		7. Ratio of total government investment to GDP	-0.2278 (0.1728)	

Appendix 3

Data Sources

The basic data used in this study are annual observations for the period 1965 to 1997. The annual data was constructed into seven 5-year average intervals. The intervals were, 1965-1969, 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994, and 1995-1997.

Table 1: Data Sources and Construction

Series	Sources and Construction
Inflation	Calculated as a percent change in CPI. IFS *International Financial Statistics Yearbook* (1998); IFS *International Financial Statistics,* various issues*;* WDI *World Development Indicators,* various issues: Bureau of Statistics*, Current Economic Statistics,* various issues.
Labour Force	Labour force comprises people who meet the ILO definition of the economically active population. IFS *International Financial Statistics Yearbook* (1996); IFS *International Financial Statistics,* various issues; WDI *World Development Indicators*; various issues; ILO, Publications, various issues. Bureau of Statistics, *Current Economic Statistics*, various issues; Reserve Bank of Fiji, *Quarterly Review* (1996).
Gross Domestic Investment	Calculated by converting gross domestic investment as a percent of real GDP into dollars. IFS *International Financial Statistics* Yearbook (1998); IFS *International Financial Statistics*, various issues; WDI *World Development Indicators*; various issues; IFS, *Direction of Trade Statistics*, various issues.
Goods Imports	Data on the percent change in value of goods imported was used as a proxy for technological progress. IFS *International Financial Statistics* Yearbook (1998); Bureau of Statistics, *Current Economic Statistics*, various issues.
Import Duties	Import duties as a percentage of total imports were used as a proxy to measure individual countries openness. IFS *International Financial Statistics* Yearbook (1998); IFS *International Financial Statistics*, various issues; WDI *World Development Indicators*; various issues; IFS, *Direction of Trade Statistics*, various issues.
Public Spending on Education	The percent change in the dollar value of public spending on education was used as a proxy for investment in human capital. IFS *International Financial Statistics* Yearbook (1998); IFS *International Financial Statistics*, various issues; WDI *World Development Indicators*; various issues; IFS, *Direction of Trade Statistics*, various issues.

Shock	The reduction in the contribution of agriculture sector towards GDP growth for individuals countries is used in the form of dummy variable to capture the supply side shock.
	IFS *International Financial Statistics* Yearbook (1998); IFS *International Financial Statistics*, various issues; WDI *World Development Indicators*; various issues; IFS, *Direction of Trade Statistics*, various issues.

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