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A MACROECONOMETRIC MODEL FOR FIJI

by

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A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Arts in Economics

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DECLARATION OF ORIGINALITY

I, Rup Singh, hereby declare that this thesis is my own work and to the best of knowledge does not contain material(s) published elsewhere. However, wherever materials have been borrowed, due acknowledgment has been rendered in an appropriate manner.

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Rup Singh
20 October, 2005.

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ABSTRACT

Undoubtedly, the modern macroeconomy is large, difficult to define, measure and control. Therefore, economists attempt to build macroeconometric models to approximate it. Models may be used to conduct experiments such as policy analysis, forecasting or testing of theoretical relationships. But a single model cannot fulfill all the three objectives simultaneously. Far and large these models are the tools for economists that help them interpret the reality and therefore, the search for better specifications and estimation methods of model building is an ongoing process.

Models are built for specific purposes and therefore should be evaluated on the basis for which they are built. The parameters of a model are estimated using relevant historical data together with reference to economic theory. Based on empirical estimates, inferences are made regarding the dynamic structure of the economy. Generally, for structural models, Two/Three Stage Least Squares (2/3SLS) or Full Information Maximum Likelihood Methods (FIMLE) are appropriate. Nonetheless, single equation estimation of such models based Ordinary Least Squares (OLS) or Partial Adjustment Methods (PAM) are also common. This is largely due to data limitations. However, these methods have come under serious criticisms in light of the recent developments in time series econometrics particularly following the unit roots literature.

Consequently, in this thesis, we attempt to build a small scale structural macroeconometric model for Fiji using two time series methods, viz, General to Specific (GETS) and Johansen Maximum Likelihood (JML) approaches by paying full attention to time series properties of variables. The complete model is then simulated over the historical period and standard simulation evaluation tests are performed.

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LIST OF ABBREVIATIONS

ADB - Asian Development Bank

ALTA - Agricultural Landlords and Tenants Act

APF - Aggregate Production Function

ARDL - Autoregressive Distributed Lag

ARIMA - Autoregressive Integrated Moving Average Process

BOS - Fiji Islands Bureau of Statistics

CES - Current (Key) Economic Statistics

CGE - Computable General Equilibrium

CRS - Constant Returns to Scale

CV(s) - cointegrating Vector(s)

DGP - Data Generation Process

DOLS - Dynamic Ordinary Least Squares

ECM(s) - Error Correction Model(s)

FMOLS - Fully Modified Ordinary Least Squares

FSIC - Fiji Standard Industrial Classification

FTIB - Fiji Trade and Investment Bureau

GETS - General to Specific

HPF - Hodrick-Prescott Filter

IMF - International Monetary Fund

JML - Johansen Maximum Likelihood

LSE - London School of Economics

NLLS - Non-Linear Least Squares

NLTB - Native Land Trust Board

NLTA - Native Lands Trust Act

OLS - Ordinary Least Squares

PIB - Prices and Incomes Board

PICs - Pacific Island Countries

PPP - Purchasing Power Parity

RBF - Reserve Bank of Fiji

SER - Standard Error of Regression

SPARTECA - South Pacific Regional Trade and Economic Co-orperation Agreement

SSED - School of Social and Economic Development

TOT - Terms of Trade

TTZ - Tax Free Zone

USP - The University of the South Pacific

VAR - Vector Auto-Regressive Model

VECM - Vector Error Correction Model

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1 THE FIJI ECONOMY

1.1 INTRODUCTION

In this introductory chapter, we provide a brief overview of the Fiji economy and discuss some important stylized economic facts. Our discussions are based on past trends and future growth prospects of major macroeconomic variables such as output growth, investment patterns, trade performance, money supply, inflation, labor force, wage rate and government finance. We avoid the details of industry performances/prospects since these are available in the monthly economic updates of the Reserve Bank of Fiji (RBF).

1.2. AN OVERVIEW OF THE ECONOMY

Fiji is a small open economy located in the South Pacific some 5100 kilometers (kms) Southwest of Hawaii, USA, and 3100 kms Northwest of Sydney, Australia. The isles of Fiji has 332 islands of which 110 are inhabited. Together the Fiji islands are scattered over 1,290,000 square kms of the South Pacific Ocean and are situated around the 180th meridian of the longitude and the 10th parallel of the latitude South of the equator - the international dateline swings east, so that the entire group shares the same day. The total population is slightly over 893,000 (The World Factbook (2005) reports a recent estimate of 893,354) just over half of them are Fijians, some 44% are Indians and the rest are Chinese, Europeans and people of other mixed descents.

Although Fiji is an archipelago, the country is dominated by two main islands - Viti Levu and Vanua Levu - which together account for 90% of Fiji's 18,272 square kms of land area. Viti Levu has over 50% of the land with around 65% of the total population, while Vanua Levu, which is just over half the size of Viti Levu, has 25% of land

and inhabits around 30% or less of total population. The remaining islands are therefore very small and support only a fraction of total population.

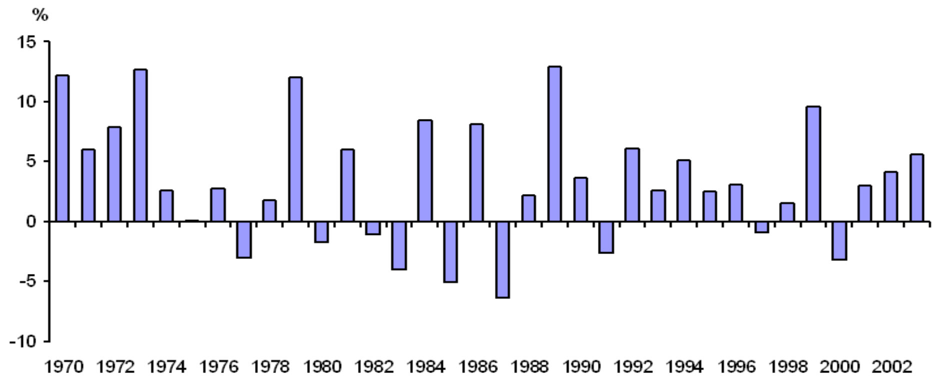
The Fiji economy is based almost exclusively on the exploitation of natural resources: tourism, agriculture (sugarcane is the largest agro-based activity), mining, forestry and fisheries. However there is a wide range of small but important manufacturing trade and retail sectors. In comparison to some other Pacific Islands Countries (PICs), Fiji has well developed financial institutions and its own currency. As one of the largest and much developed islands in the region, Fiji provides a number of services in transport, communications and aviation to other PICs. The economy has well educated workforce and is endowed with abundant land, marine and other natural resources. It is classified as a lower middle income country with real GDP per capita of $F5900 PPP (World Factbook, 2005). Fiji's social indicators are reasonably high. On average, life expectancy is around 69 years, overall literacy rate is 94% and the infant mortality rate is 1.3% per 1000 live births.

The economy has followed a pattern of mixed growth with short episodes of both excessive and at times, sharply reduced outputs. The real GDP growth as shown in Figure-1 has been moderate averaging around 2.5% per annum. The fluctuations in output have been underpinned by both domestic and external influences. Domestically, Fiji's concentration on a narrow range of agricultural commodities makes the economy vulnerable to large fluctuations in weather-related shifts in primary production. Empirical evidence, see for example, Williams and Morling (2000), suggests that agricultural supply shocks such as changes in productivity of sugar play a significant role in determining output fluctuations in Fiji. Further, the two political coups in 1987 and 2000 have had significant implications for growth as noted by Singh (2000), William and Morling (2000) and Jayaraman and Ward (2003). Data suggests that following these events, there were sharp deterioration in output largely due to the loss of consumer and investor confidence, massive declines in tourist arrivals and rapid exodus of financial and human capital.

Fiji being an insignificant player in the world market and dependent on trade with narrow export base is vulnerable to external shocks. Variations in global economic conditions have significantly influenced growth in domestic output. Empirical evidence suggest that much of the short-term fluctuations in output are beyond policy makers' direct control, see for example, Williams and Morling (2000) and Waqabaca

FIGURE-1

GROWTH RATE OF FIJI'S OUTPUT



and Morling (1999). In such a situation, the best policy option would be to establish broad macroeconomic conditions that provide the necessary cushion for the economy against adverse supply shocks.

However, recent economic performance is largely underpinned by growth in consumption expenditure which constitutes around 65% of total output. Over the period 1970-2000, consumption growth has been quite volatile mainly due to fluctuations in domestic demand. Increased currency in circulation and lower lending rates for consumption purposes together with booming tourism sector have led to high consumption in recent years. However, growth in consumption would be shortlived due to increasing levels of unemployment in the economy. Further, the recent decline in the trend growth rate of real GDP and continued growth in population implies that future growth of income per capita would be low or even negative. With a low and volatile per capita income, consumption growth will not be sustainable. In addition, there have been massive layoffs of garment workers due to the closure of many garment factories following uncertainties surrounding the SPARTECA trade arrangement. Furthermore, the ailing sugar industry faced with the problems of land tenure and potential expiry of preferential trade access to the European Union (EU) markets, will have serious implications on incomes and livelihood of over 50,000 people. Prasad and Narayan (2004) conducted an impact analysis of a 30% decline in sugar production and found that real GDP will decline by around 1.8% and the informal sector which absorbs excess labor from the agricultural sector will also shrink causing loss of welfare and incomes. Therefore, the short-to-medium term growth prospects do not look promising and it is likely that with increasing unemployment, other social problems such as poverty and crime will escalate.

Low investment remains a major problem in the economy with current levels well below what is desired. The ratio of investment to output (investment ratio, henceforth) has declined from above 20% in 1970s to around half its level in mid 80s and has since remained low. While government investment ratio has largely been stagnant at around 3.5%, data shows that there is a clear reduction in public investment expenditure since 1982. Public sector investment has been largely undertaken for replacing the depreciated infrastructure and other social capital. It is not obvious if the Government is seriously looking into investing in new capital projects since their allocation for capital expenditure has been declining over the past few years. However, the allocations seem to heavily favor the recurrent spending. The private investment ratio has been volatile from as high as 15% in 1971 to below 10% in 1987. Since then it has remained low. These are direct consequences of the two military coups. However, recently, some new tourism and commercial building projects and investment in residential property development are taking shape.[1] Lured by higher profit expectations in the growing tourism sector, private investment in tourism resorts such as at the Momi-bay and Natadola Resorts, Sofitel Island Resort, Hilton at Denarau are increasing. These have an estimated potential investment value of around $500m in current prices to be spread over some two-to-three years.

The recent pickup in investment activities has been possible through low interest rates on lending and better management of investment proposals by the Fiji Trade and Investment Bureau (FTIB).

[1] Some of the major projects are: The Rewa Bridge, Fiji School of Medicine Campus, Prouds Gallery, New Colonial Building, Fiji Islands Revenue and Customs and Great Council of Chiefs' Building and Maritime and Ports Authority Complex.

Nonetheless, overall private investment has been on a downward trend indicating that various incentives put in place since 1987, such as the Tax Free Factory/Tax Free Zone scheme, Schedule 5 Export Tax Incentive, depreciation allowances, hotel investment incentives and loss carry forward have failed to induce private investment to the levels recorded in the early 1970s and 1980s. This could be because investors place greater priority on macroeconomic stability, good governance and adequate property rights. It is important to note that incentives alone will not encourage investments. Political and economic stability and law & order play a significant role in raising investment in Fiji. Further, current investment activities reflect investment decisions taken a few years ago when growth prospects were relatively better. However, given the less promising growth outlook, it is doubtful if more capital projects would be undertaken in the near future.

Following controversial arguments surrounding the level of investment required to sustain 5% output growth, Rao (2004) has estimated the investment gap in Fiji. His estimates show that the gap is around 12% of GDP if the economy is to grow at any rates near to 5% per annum as initially targeted by the government in its 2003-2005 Strategic Development Plan. This simply means twice of the current investment ratio, that is, from about 13% to 25%. However, with the low growth projections for 2005-2007 by the Fiji Islands Bureau of Statistics (BOS) and RBF, this seems highly unlikely. Rao as well as other prominent academic economists of the USP, see for example Prasad (2003, 1999, 1997) and Shah (2004), suggest that a 5% output target is unsustainable in the medium to long-term. They indicate that in order to improve growth performance, important institutional changes, improvement in land tenure system, property rights and other institutional factors together with investment promotional polices are necessary. However, these require considerable time and political will.

Empirical studies in Fiji such as Williams and Morling (2000) indicates that 1% increase in Fiji's trading partners' GDP leads to a similar magnitude increase in Fiji's aggregate output in the long-run. However, these observations are caveat to some specification problems in their paper. In a recent study, Rao and Gounder (2005) argue that while trade liberalization, institutional reforms and accumulation of human capital are important, factor accumulation - labor and capital - are required in the early stages of development. The other factors are more significant in later stages of development of an economy.

Fiji's trade performance has not been very impressive. The economy has experienced export-led growth following the export promotion policies implemented in late 1980s. Primary exports such as sugar, gold, marine products and other agricultural produce are important export commodities for Fiji and contribute around 60 - 65% towards total exports. However, reliance on the sheer good fortunes of the trading partners will do no good to Fiji. These economies, in addition to having direct influences on domestic production through the demand for exports are also likely to have an indirect influence through relative prices. Thus, Fiji needs to look into alternative ways of improving productivity and consequently reduce the production cost of exports. In fact, both Fiji's export quality and prices need to be competitive in the world market. Such a heavy reliance on exports with a very narrow export base coupled with an export composition that differs markedly from import composition is likely to induce large TOT shocks to the Fiji economy. With a very open economy and the nominal exchange rate being pegged, this is likely to be reflected in amplified fluctuations in domestic income with subsequent effects on domestic consumption, investment and production. Indeed, the TOT has moved quite sharply at times in response to fluctuations in world prices of Fiji's major export commodities such as sugar and gold. Thus, to maintain international competitiveness, the RBF devalued the domestic currency in 1998. Imports have generally increased due to purchases of consumption and intermediate goods. The trade balance has been quite volatile, but private transfers and official aid keep the BOP close to equilibrium.

The monetary policy stance has varied depending on the financial situation in the economy. It was highly restrictive following the 1987 coup and was later relaxed in the 1990 period. Monetary policy was again tightened in 2000 and then from 2001, it was more accommodative with high levels of liquidity in the system. The interest rates were also reduced. However, in mid-2004, the RBF increased the policy interest rate to slow down the economy with a view that consumption growth is unsustainable. In our view, this will do more harm than benefit to the already depressed economy. While on one hand efforts are being made to boost investment, this stance by the RBF will increase the cost of funds and slowdown the momentum picked up by investment.

Inflation has been moderate over the years and the forecast for 2005 is around 3.5%. This is in line with the excess capacity in the economy which if utilized would lead to higher growth outcomes and prospects for employment. Labor market conditions have been improving since 2000. The massive brain drain which started in 1987 was subdued following improvements in growth prospects in the early 1990s. However, exodus of skilled labor and financial capital has escalated after the coup in 2000 and is not expected to abate due to the unsettled political situation in the country. The recent RBF labor market survey indicates that job prospects are improving with strengthening activities in building and construction sectors. Wage rates in many sectors were reviewed and on average, wage rate is around $2.50 per hour. However, different rates are offered in different sectors of the economy depending on skill requirement and levels of productivity.

In line with low growth, government finance figures indicate that the underlying deficit is expected to be 4.3% of GDP. The 2005 National Budget suggests that total expenditure is expected to increase by 4%, while revenue is to go up by 7%. However, like in other years, Government has frequently resorted to short-term borrowings through appropriation bills during the course of the 2004/05 fiscal year. This is due to uncontrolled/mismanaged expenditure in nearly all government ministries; see the Auditor General's report, 2004. The Government is expecting that public debt which is currently over 50% of GDP will decline, although it is not clear in the 2005 Budget as to how will this eventuate in the face of lower than expected growth projections for the short to medium-term. Therefore, it is hard to anticipate an improvement in the government's financial position in the near future.

In light of the above, we anticipate a very low economic growth in the short-to-medium term and with a depressed investment climate, lower productivity in major sectors of the economy. These translate into a gloomy long-term growth prospects for Fiji. Against this background the following stylized facts are noted:

Fact 1: Output is venerable to supply shocks

Fiji is highly susceptible to supply shocks such as natural disasters and other climatic conditions. Thus, developments in agricultural sector has a large influence on aggregate output. Since these natural events are not under the control of policy makers, it is difficult to vaccinate the economy against their effects. Nonetheless, efforts should be made to revitalize agriculture.

Fact 2: Political instability has undermined growth

Political instability has had negative impact on the economy and these are noted in almost all spheres of economic activity. Investment ratios are low due to the loss of confidence and optimism and therefore future growth prospects are not promising.

Fact 3: Vulnerability to terms of trade shocks

Fiji is a price taker in the world market and therefore international forces have potential to significantly affect trade prices. This implies that Fiji is vulnerable to TOT shocks which is difficult to evade. Therefore, low production costs of exports and competitive export quality are the key to turning the tables in Fiji's favor.

Fact 4: Eroding trade concessions

Trade concessions under LOME will be and SPARTECA has been faced out. This implies serious consequences not only at the macro, but at the industry levels as well. Output, employment and livelihood of a significant proportion of the population will be seriously affected.

1.3. CONCLUSION

In this chapter, a brief overview of the Fiji economy is presented with some observed stylized facts. Needless to say, each one of these topics require much more space and discussion especially if all the relevant literature and underlying developments are comprehensively discussed. However, it would have made this thesis significantly longer and therefore forced us to write a comprehensive monograph rather than a masters thesis.

2 THE METHODOLOGY

2.1 INTRODUCTION

In this chapter, we outline the methodology adopted in estimating our macroeconometric model. While large scale models estimated with simple dynamic structures based on the classical methods of Ordinary Least Squares (OLS) or Partial Adjustment framework (PAM) were popular, recently times series models are on the forefront. This is because since 1980's, time series approach in applied economics has become very popular. Their impact on modeling economic behavior has been quite significant irrespective of whether one is interested in single equation estimation or Vector Autoregressions (VARs). cointegration, Unit roots, VARs and Vector Error Correction Models (VECMs) are widely being used. However, recently, there seems to be a renewed interest in developing large-scale structural models along the Cowls Commission approach. This is because VARs have failed to live-up to expectations.

The Systems estimation methods of Two or Three Stage Least Squares (2/3SLS) or Full Information Maximum Likelihood (FIMLE) yield efficient parameter estimates. However, applying these techniques in cases where low frequency small sample data are available is not pragmatic. On the other hand, it is also inappropriate to use the classical methods by disregarding the time series properties of variables which assume that data is stationary i.e. the variables have constant means and variances. It is well known that most macroeconomic series such as output, money supply and aggregate consumption etc. are non-stationary and therefore unsuitable for analysis with classical econometric methods. Thus ignoring the stationary properties and estimating relationships between two or more non-stationary series would often yield spurious results. This led to the re-examination of many empirical relationships, particularly in macroeconomics. In doing so, the cointegration technique was discovered which assumes that if two series are integrated, some linear combination between them may turn out to be stationary. Therefore, one may apply the classical methods of estimation.

In light of the above, many model builders take practical and selective approaches. However those advocating the VAR methodology like Christopher Sims pay little attention to unit roots. Sims (1980) who popularized the VAR models, claim to have developed an accurate method for forecasting. However, recently it was discovered that VARs do not give good forecasts of real GNP for the USA. Bischoff et. al (2000) suggest that while forecasts from the standard VAR models have failed to live up to expectations, unrealistic claims are still being made regarding the accuracy of VARs. Other criticisms against the VAR are that they are a-theoretical and require large samples of data.

While time series methods have been applied to estimate single equations and occasionally multi-equation models, where data are available for long periods, they have been not used so far to estimate a number of structural equations of an econometric model for the entire economy. In the past, it was not uncommon to use single equation estimation methods to estimate a large number of structural equations in a macroeconometric model and use such models for forecasting and policy analysis. The RBA Macroeconometric Model of Beechey et. al (2000), Shand and Treadgold (1971) model of the PNG and the Murphy (1992) Macroeconometric model for Fiji are some examples where single equation estimation method is used. All these models use OLS or PAM without paying adequate attention to the unit root problems in data.

This thesis, therefore, is a modest attempt to fill this gap. By and large, we have used the LSE-Hendry General to Specific approach (GETS) to estimate some key structural equations for Fiji and develop a model for the entire economy with a view to examine how well it explains the macroeconomic variables. GETS is chosen because of its computational attraction and easy implementation; see Maddala and Kim (1998) for a similar view on GETS.

However, we have also used a computationally demanding alternative method of the Johansen cointegration approach based on the maximum likelihood method (JML or VECM) mainly for comparing our results obtained with GETS. In many cases we found no major differences between these two types of estimates. Thus this thesis is an attempt to examine how well the modifications to estimation for unit roots in the variables may improve the quality of a small macroeconometric model. We are optimistic that since time series methods such as GETS and JML are expected to capture the dynamic adjustments better than PAM, our dynamic simulation results would be good. Ideally a comparison between a macro model estimated with PAM and GETS is desirable, but we did not estimate the PAM version of our model for two reasons. First, that would make this thesis significantly longer and second, since it is well known that estimation with the standard methods with unit root variables are spurious. We have briefly commented on the latter in Rao and Singh (2005) with the demand for money in India.

Thus our thesis is primarily methodological and explores whether our methodology can be used for estimating a small scale Keynesian type macroeconometric model that describes the Fiji economy. More specifically, we attempt to test how well such a methodology explains the observed facts in our macroeconomic data. Since our aim is more methodological, we do not claim to have estimated a model that can be used, without substantial further modifications, for policy analysis but may be used for forecasting. Our forecasts may be compared with the Autoregressive Integrated Moving Average (ARIMA) model's forecasts to evaluate the merits and de-merits of our approach. However, this cannot be done within the scope of this thesis and therefore may be completed in a later study. Nonetheless, we perform the standard historical simulation of the complete macroeconometric model to evaluate how well it replicates the actual data.

The structure of the thesis as follows: The rest of this chapter discuss at length, our estimation methods followed by a brief discussion on the existing macroeconometric models in Fiji. Estimation details of the key equations of our model are in chapters 3-7. The full exposition of the model with historical simulation and evaluation tests are presented in chapter 8. Conclusions and limitations are stated in this final chapter.

2.2 OUR ESTIMATION METHODS

Each behavioral equation in our model is estimated with the two aforesaid time series methods. While it is hard to comment which method (GETS or JML) gave better results, we included the preferred equations from both the estimators in our macroeconometric model and selected the one that produced better simulation results. In doing so, we noted that most of our equations in the model are based on GETS; see the dynamic model in chapter 8. It may be noted that while JML and GETS are useful and widely used in single equation framework with small number of variables, it is difficult to use them in large scale macro models to obtain meaningful cointegrating relationships and VECM formulations for all variables. Even in smaller multi-equation models, the VAR methodology has failed to live up to expectations and the predictive success of VAR models, compared with the judgementally adjusted large scale models built along the Cowles Commission methodology. Nonetheless, our methodology which is a mixture of the Cowles Foundation tradition to specification and time series approach to estimation, seems to have produced good results.

2.2.1 THE GETS APPROACH

The LSE-GETS approach was developed before the present developments in time series methods had any impact. It does not conflict with the Cowles Commission approach, essentially based on PAM, since GETS is only an alternative and more attractive method for dynamic specifications. GETS originated because the econometricians at the London School of Economics (LSE) were concerned with the methodological conflict between the static nature of equilibrium relationships and the data that is used to estimate them. It is argued that data are collected from the world which is seldom in equilibrium. In addition the economic theory provides no guidance on how the dynamic adjustments take place. Thus it is hard to determine an equilibrium relationship with dis-equilibrium data. In the past, this gap was reconciled by the arbitrary lag specifications like PAM and Almond lags. Rao (2005) notes that Professor Saragan took the view that it is appropriate to determine the dynamic adjustment structure by using the data itself so that it is consistent with the Data Generation Process (DGP). This compromise attracted a lot of interest and laid the foundation for the GETS approach.

In GETS, a very general dynamic lag structure between the dependent and explanatory variables consisting of their lagged levels and first differences is estimated. This overly long general unrestricted model (GUM, for short) is reduced into a manageable parsimonious dynamic adjustment equation by using the standard variable deletion tests while ensuring that the residuals satisfy the underlying classical assumptions. A good exposition of GETS can be found in Charemza and Deadman (1997).[1] Briefly, GETS formulation can be shown using an example of a basic equilibrium specification for the demand for money:

$$ln\left(\frac{M_t}{P_t}\right) = \alpha_0 + \alpha_1 lnY_t + \alpha_2 R + \epsilon_t \tag{5}$$

where, $ln\left(\frac{M_t}{P_t}\right)$ is the log of real money balance, lnY_t is the log of real income and R_t is the nominal rate of interest. Equation (5) can be equivalently written as:[2]

$$\begin{aligned}\Delta ln\left(\frac{M_t}{P_t}\right) =& \beta_0 + \beta_1 ln\left(\frac{M_{t-1}}{P_{t-1}}\right) + \beta_2 lnY_{t-1} \\ &+ \beta_3 R_{t-1} + \beta_4 \Delta ln\left(\frac{M_{t-1}}{P_{t-1}}\right) + \xi_{1t}\end{aligned} \tag{6}$$

Although this equation seems simple, it is computationally demanding because the general dynamic specification of (5) will include many more lagged values of the relevant variables. Furthermore, there are no guidelines on how to reduce the long lag structure to arrive at a manageable parsimonious final equation. The general dynamic version

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[1] The famous Davidson, Hendry, Srba and Yeo (1978), DHSY for short, work on the consumption function for the UK is now a classic paper on the GETS. Subsequently, Hendry and Ericsson (1991) have used this approach to re-estimate and test the money demand function for the USA implied by the classic and historical work by Friedman and Schwartz (1991).

[2] This formulation is due to Benerjee, Dolado, Hendry and Smith (1986). For a simpler exposition of this transformation, see Cuthbertson (1995).

of (5) can be specified as:

$$\begin{aligned}\Delta ln\left(\frac{M_t}{P_t}\right) =& \lambda\Big[ln\left(\frac{M_{t-1}}{P_{t-1}}\right) - (\beta_0 + \beta_1 lnY_{t-1} + \beta_2 R_{t-1})\Big] \\ &+ \sum_{i=0}^{n} \lambda_i \Delta lnY_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta lnR_{t-i} \\ &+ \sum_{i=1}^{j} \tau_i \Delta ln\left(\frac{M_{t-i}}{P_{t-i}}\right) + \xi_{2t} \qquad (7)\end{aligned}$$

It can be seen that this specification retains the error correction part given by the lagged levels of the variables (in the square brackets) with the implied long-run coefficients of β_0, β_1 and β_2. The speed of adjustment parameter, (λ) measures how quickly adjustments to equilibrium take place and the rest, except ξ_t, are the dynamic adjustment variables which depend on DGP.

If the three level variables are cointergrated, since their first differences are stationary, the error term (ξ_t) will be I(0) and the standard classical assumptions are satisfied. Therefore, OLS can be used to estimate equation (7). However, a standard but somewhat unjustified criticism against GETS is that it does not pretest the order of the variables and therefore, specifies an unbalanced equation that has both I(0) and I(1) variables. In response, Hendry repeatedly states that if the economic theory is correct, then the levels part of GETS should be cointergrated and therefore a linear combination of the variables (which is the equilibrium relationship) should be stationary. Thus, the implied long run parameters are estimated with reference to economic theory. However, in general if the underlying theory is incorrect, then the implied long run elasticities would be contradictory to expectations. This may indicate revision of the model or a revisit of the theoretical justifications.

It is important at this stage to shed some light on the speed of adjustment parameter. The value of λ should be negative and it indicates the proportion of adjustments that are completed in the next period. Sometimes it may exceed unity but in most cases it would be less than one. If it exceed far above one, an overshooting is possible, but eventually there would be convergence. However, a positive value of λ implies divergence from the long-run equilibrium which may be unstable.

2.2.2 THE JML APPROACH

This method was developed by Johansen (1988) and is a variant of the VAR model. However, unlike VAR, in JML, all coefficients are identified and a close attention is paid to the underlying economic theory. It is also the most widely used approach in applied time series studies and the routines are found in most econometric softwares. In this approach, pre-testing of variables for time series properties is important. In JML, all variables are assumed to be endogenous and exogeneity tests are applied to justify that the regressors are exogenous. The LAR tests for block Granger Non-Causality with the null that the coefficients of the lagged values of the dependent variable are insignificant in the equations of independent variables are conducted. The computed LAR test statistics indicate if there is endogeneity bias in the variables i.e whether the dependent variable Granger causes the independent variable(s).

Briefly, the JML procedure and the causality tests may be shown using equation (5). The theory of demand for money implies that $ln\left(\frac{M_t}{P_t}\right)$ depends on lnY_t and R_t. With the assumption of endogeneity of all variables, a three equation system is formed as:

$$ln\left(\frac{M_t}{P_t}\right) = \alpha_{10} + \alpha_{11}\ lnY_t + \alpha_{12}R_t + \epsilon_{1t} \tag{8}$$

$$lnY_t = \alpha_{20} + \alpha_{21}\ ln\left(\frac{M_t}{P_t}\right) + \alpha_{22}R_t + \epsilon_{2t} \tag{9}$$

$$R_t = \alpha_{30} + \alpha_{31}\ lnY_t + \alpha_{32}\ ln\left(\frac{M_t}{P_t}\right) + \epsilon_{3t} \tag{10}$$

The assumption that $ln\left(\frac{M_t}{P_t}\right)$ is the dependent and lnY_t and R_t are independent variables need to be tested provided that all the three are non-stationary in levels. To do this, first, subtract (from both sides) $\left(\frac{M_{t-1}}{P_{t-1}}\right)$ from 8, lnY_{t-1} from 9 and R_{t-1} from 10, respectively. This gives:

$$\Delta ln\left(\frac{M_t}{P_t}\right) = \alpha_{10} + \alpha_{11}\ lnY_t + \alpha_{12}R_t + (\alpha_{13} - 1)\ ln\left(\frac{M_{t-1}}{P_{t-1}}\right) + \epsilon_{4t} \tag{11}$$

$$\Delta lnY_t = \alpha_{20} + \alpha_{21}\ ln\left(\frac{M_t}{P_t}\right) + \alpha_{22}R_t + (a_{23} - 1)\ lnY_{t-1} + \epsilon_{5t} \quad (12)$$

$$\Delta R_t = \alpha_{30} + \alpha_{31}\ lnY_t + \alpha_{32}\ ln\left(\frac{M_t}{P_t}\right) + (a_{33} - 1)\ R_{t-1} + \epsilon_{6t} \quad (13)$$

Like in GETS, the dependent variables in the above three equations are I(0) and if the levels of these variables move together, as the underlying theory implies, they should be cointergrated and therefore, a linear combination of these level variables, known as the cointegrating vector, should be stationary. Following this, we proceed to test for the existence of the cointegrating vector(s). These tests are conducted with a procedure that allows for unrestricted intercept and restricted trend to be included in the VAR. In the JML, the null of no cointegration can be rejected/not rejected with the computed eigenvalue and trace test statistics. Details of these tests may be obtained from a standard econometric text or software manuals.

A very important point emphasized by the JML is that the underlying theory for demand for money implies that lnY_t and R_t cause $ln\left(\frac{M_t}{P_t}\right)$. However, in reality, the three variables change all the time and therefore, the direction of causation needs to be investigated. Here comes the exogeneity tests. Each of the above three equations (11-13) are estimated with the lagged residuals from the cointegrating vector and the test for significance of this lagged residuals are performed. For the weak exogeneity test, the equations may be specified as follows:

$$\begin{aligned}\Delta ln\left(\frac{M_t}{P_t}\right) =& \lambda_1\Big[ln\left(\frac{M_{t-1}}{P_{t-1}}\right) - (\alpha_{01} + \alpha_{21}\ lnY_{t-1} + \alpha_{31}R_{t-1})\Big] \\ &+ \sum_{i=0}^{n} \lambda_i \Delta lnY_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta R_{t-i} \\ &+ \sum_{i=1}^{j} \tau_i \Delta ln\left(\frac{M_{t-i}}{P_{t-i}}\right) + \epsilon_{7t} \qquad (14)\end{aligned}$$

$$\begin{aligned}\Delta lnY_t =& \lambda_2\Big[ln\left(\frac{M_{t-1}}{P_{t-1}}\right) - (\alpha_{02} + \alpha_{22} lnY_{t-1} + \alpha_{32}R_{t-1})\Big] \\ &+ \sum_{i=1}^{n} \lambda_i \Delta lnY_{t-i} + \sum_{i=0}^{m} \gamma_i \Delta R_{t-i}\end{aligned}$$

$$+ \sum_{i=0}^{j} \Delta ln\left(\frac{M_{t-i}}{P_{t-i}}\right) + \epsilon_{8t} \tag{15}$$

$$\begin{aligned}\Delta R_t =& \lambda_3\Big[ln\left(\frac{M_{t-1}}{P_{t-1}}\right) - (\alpha_{03} + \alpha_{31} lnY_{t-1} + \alpha_{32} R_{t-1})\Big] \\ &+ \sum_{i=0}^{n} \lambda_i \Delta lnY_{t-i} + \sum_{i=1}^{m} \gamma_i \Delta R_{t-i} \\ &+ \sum_{i=0}^{j} \tau_i \Delta ln\left(\frac{M_{t-i}}{P_{t-i}}\right) + \epsilon_{9t}\end{aligned} \tag{16}$$

Where λ_i measures the corresponding speed of adjustments in each of the equations. If λ_1 is significant and negative in (14) but is not so in (15 and 16), one may conclude that $ln\left(\frac{M_t}{P_t}\right)$ does not contribute to the explanation of lnY_t and R_t and therefore, lnY_t and R_t could be treated as weakly exogenous variables in money demand equation. This implies that the cointegrating vector can be interpreted as the equilibrium demand for money function, rather than the monetarist income or interest rate equation.

It may be said that the JML offers a more unified framework for estimating and testing cointegrating relationships in the context of ECMs. Therefore, more or less, it is the de-facto procedure in applied cointegration works. However sometimes, the JML may yield unsatisfactory cointegrating relationships and therefore it is important to apply more than one method and check for consistency between these approaches.[3] Also in a three equation system there could be more than one but at most two cointegrating vectors (CVs). In such a situation, the choice of the relevant CV should be made with reference to the underlying economic theory and by evaluating the signs and magnitudes of the respective implied long run coefficients. However, if both CVs are plausible, a two equation system must be estimated by imposing cross-equation restrictions. This calls for a VAR approach which is not only computationally demanding but is also somewhat unsuitable for developing a medium scale model for the economy.

It may be noted that while GETS and JML are similar, GETS

[3] See Chapter 7 where the JML did not give good results for our estimates of exports. In this case, GETS and FMOLS gave plausible and consistent results.

is based on the single equation approach and assumes that there is a unique cointegrating vector implied by the underlying economic theory. Further, it assumes that all the explanatory variables are exogenous–a practice that is common in the single equation approach to developing small and medium sized models for the entire economy. In contrast, the JML is a systems based approach in which all variables are treated as endogenous and therefore exogeneity tests are required. Nonetheless, our limited experience show that, if the equations are well specified, both methods should produce comparable results.

2.3 MACROECONOMETRIC MODELS IN FIJI

In this section, we discuss the existing macroeconometric models estimated for the Fiji economy. To date, only one conventional macroeconometric model and a CGE model have been developed for Fiji. Chris Murphy (1992) has estimated a traditional macroeconometric model using annual data from 1974 to 1986. While his work provides some insight in structural modeling no further attempts have been made to refine or update the Murphy model. The model was aimed at analyzing the demand and supply shocks that affect the Fiji economy. It is a small-scale model of which a significant portion (40 out of 58 equations) are identities. The model is highly aggregated and therefore does not provide detailed description of sectoral level information and is not suitable for forecasting. We have detailed and explained the important estimated equations from the Murphy model in chapters 3-7. Added with a very small sample size of around 12 observations, Murphy has failed to provide sound theoretical justifications for his equations and has used either OLS or PAM to estimate the relevant parameters. Nonetheless, Murphy's attempt is pioneering and noteworthy.

Levantis (1999) developed a Computable General Equilibrium (CGE) model for Fiji which he later revised in 2003. Nonetheless, both these works are important for policy institutions like the National Planning Office (NPO) and the RBF who are the key users of the CGE. At its inception, the Levantis model was extensively used by the RBF to compare the validity of its own forecasts.[4] The parameters

[4] While at the RBF, I had the first hand experience in generating macroeconomic forecasts and analyzing the effects of various shocks using the CGE model. However, due to software licensing problems, the Bank restricted further use of

of his model were imposed at PNG's estimates and these were later revised with Fiji estimates in 2003. While there are limitation in static CGE models, these models give detailed breakdown of the effects of changes in exogenous variables at sectoral level. However, it would be even more valuable if a traditional time series dynamic econometric model like the Murphy's and a CGE model are used together, often to check and re-affirm each other's predictions. The advantage of the conventional models such as Murphy's is that they can generate the actual dynamic adjustment paths of variables which provides insightful information and room for assessment.

Currently there doesn't seem to be a reliable and usable structural macroeconometric model for Fiji. This is understandable given the nature and type of technical expertise, data and motivation required and available in Fiji. Even at the RBF, currently only single equation framework is used to generate inflation forecasts.[5] The NPO which once relied on the CGE model now uses spreadsheet analysis to calculate growth figures. Thus forecasts of national accounts and other key statistics are judgmental concensus between the major policy institutions comprising the NPO, RBF, BOS and the Ministry of Finance (MOF) under the jurisdiction of the Macroeconomic Policy Committee headed by the Governor of the RBF. Often one argues the reliability of their forecasts on the grounds of questionable methodologies. Both academic and professional economists in many occasions have had disagreements with macro forecasts and economic judgments applied by the Policy Committee. Attempts have been made to improve their analysis through the IMF's technical support, but these too are yet to produce any better results. It should be noted that forecast and analysis based on some macroeconometric model may not always be correct, but will be relatively consistent and appealing than the judgmental and back-of-envelop calculations.

Therefore, attempts to construct structural macroeconometric models are enormously supported and encouraged in empirical research in Fiji and perhaps in other PICs. Thus, in this respect, our work is a starting point for further works aimed at developing structural models which may address policy questions. Both the basic structure of our model and the estimated dynamic model are given

Levantis model.

[5] While there are indications that the RBF is developing a small scale macroeconometric model, we are privy to details of their work.

in Chapter (8) with detailed description of the model and simulation results. The specification of each behavioral equation is based on economic theory and various empirical works on Fiji and other developing countries. However, controversies still persists over the structural specifications of macroeconometric models and macroeconomic relationships in general. In this respect, our work addresses some of these issues, but all the relevant issues can not be adequately addressed within the scope of a masters thesis.

The data used in our model are derived from the RBF Quarterly Reviews and the Current Economic Statistics of BOS (various years) and the IMF-CD ROM (2003). Specific data construction and definition of variables are in appendix A and the standard unit root tests results are given in Appendix B.

2.4 CONCLUSION

In this chapter, we have discussed the methodology adopted in estimating our macroeconometric model and have highlighted the current state of macroeconometric models in Fiji.

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3 THE CONSUMPTION FUNCTION

3.1 INTRODUCTION

Consumption expenditure is the largest component of aggregate demand and the marginal propensity to consume (MPC) is an important determinant of the size of the aggregate expenditure multiplier. Consumption has implications for long run growth policies since higher savings imply higher levels of investment and growth rates. Therefore, proper estimation of the consumption function is important. In this chapter, we have used the two aforesaid time series methods, viz, JML and the GETS to estimate the consumption function for Fiji. Our results show that income elasticity is unity and the elasticity with respect to the availability of credit is around 0.30. We also found that inflation and consumption tax such as VAT reduced consumption, while the political coups had positive impact on consumption in Fiji.

This chapter is organized as follows: Sections 2 and 3 are, respectively, brief surveys of consumption theories and empirical works on Fiji. Section 4 discusses our specification and empirical results and the conclusions are stated in Section 5.

3.2 THEORIES OF CONSUMPTION: A BRIEF SURVEY

Theoretical debates, one of which later became famous as sensitivity vs. smoothing controversy between the Keynesian and neo-classical economists have generated significant research on consumption. The simple Keynesian specification, known as the Absolute Income Hypothesis (AIH), argues that current consumption is a function of current disposable income (income, henceforth). This has attracted a lot of controversy. It is well known that AIH is a-theoretical and does not allow for consumptions decisions which are made under optimization motives. The AIH seems to suggest that consumption is based on some fundamental psychological law, that are not well received by other economists. Empirical evidence in the post war period showed that AIH is unsatisfactory and cannot explain some observed facts in consumption. Firstly, when aggregate long-term data are used consumption becomes proportional to income, implying that the long-run consumption function passes through the origin and therefore, autonomous consumption is zero. Second, it is noted that the slope coefficient changes over different samples of cross-sectional datasets - the consumption function shows ratchet-effect - which implies that the model is unstable and is not useful for policy. Moreover, AIH does not allow for current consumption decisions that depend on future income expectations. When inter-temporal decision making framework is used, the implied short-run MPC becomes much smaller than what Keynes had suggested and the long-run MPC is close to unity. These extensions indicate that current consumption is not only determined by current income but consumers take a long-run view of the average flow of income when making consumption decisions. It is assumed that rational consumers optimize consumption decisions and resort to smoothing consumption patterns which may not be as sensitive to changes in the current income as implied by Keynes.

Along the lines of a long-run view of income and smoothing consumption patterns, an early and powerful attack on AIH was by Friedman (1957), which became known as the Permanent Income Hypothesis (PIH). Friedman argued that there is no justifiable reason to assume that rational consumers would behave in such a mechanical way as Keynes thought. He argued that since income can be received over the course of the lifetime, current consumption need not depend exclusively on current income but depends on what they expect to receive over their entire lifetime - which he called the permanent income. The PIH suggests that an unexpected income gain of Z in the current period will raise the current income by Z but will only raise the permanent income by $(\frac{Z}{T})$, where T is the consumer's lifespan. Thus, the change in permanent income will be small, given T is generally large; a good exposition of the optimization model is in Romer (2001).

In general, an increase in current income is associated with an increase in consumption only to the extent that it reflects an increase in permanent income. When variations in permanent income are much greater than that of the transitory income, almost all variations in current income come from permanent income and thus consumption raises nearly one-for-one with permanent income. But when variations in permanent income are small relative to the transitory income, little variation in current income comes from the permanent income and therefore consumption raises only by a little. However, the major problem with the PIH is that Friedman's forward looking consumers have to make an assessment of their permanent income based on the past actual incomes. As Hall's (1978) Random-Walk Model (RW Model henceforth, see discussions below) has pointed out, there are biases (forecasting errors) involved with this type of the assessment of permanent income.

The PIH implies that time pattern of income is critical for savings. That is, when current income is less than permanent income, people dis-save or borrow to smooth the path of consumption. This is the key idea of Modigliani and Brumbergs' (1954) Life-Cycle (LCH) hypothesis. The LCH re-iterates the smoothing and rational choice argument even further than Friedman. It characterizes consumers as rational economic agents planning for an optimal lifetime pattern of consumption based on their expectations of earnings over their entire lifespan. The saving-dissaving behavior based on the income-age profile of the population, expected future income, wealth (human and non-human capital wealth) and the nature of income distribution took the center stage in the LC consumption functions.

However, many economists now treat PIH and LCH equal as they are based on a similar inter-temporal optimization framework and their implications are similar. The important issue, however, is that the value of MPC which determines the size of aggregate expenditure multiplier has implications for the magnitude of the effects of shocks and policy on the economy. Therefore, many textbooks now pay less attention to their differences and discuss Hall's criticisms and subsequent developments in consumption theory.

According to Hall's RW model, both LCH and PIH are unsatisfactory because their income expectations are not rational. In both theories income expectations are proxied with past incomes. Therefore, this year's error is correlated with the past year's and it is not a rational expectation. However, if we use all the available information to form a rational expectation, there should not be any systematic deviation of the actual future income (when realized in the future) from today's (rational) estimate of that expected future income. Therefore, the deviations (or the forecasting errors) should truly be random. Hall then argued that if these theories are correct and if future income expectations are rational, consumption in the next period should equal consumption in the current period and any deviations are white noise. This is a startling conclusion because it implies that observed changes in consumption are random, i.e. they are not caused by any factors other than changes in the expected future income.

However, empirically, it is hard to explain all the observed changes in consumption with changes in permanent income only. The RW model implies that changes in consumption are unpredictable and there are no available information in period t that can be used to forecast consumption in period $t+1$. Hall's model has been tested by many and while some found support for PIH, others have questioned these results. However, in an important paper Campbell and Mankiw (1989) have developed a framework in which both the AIH and PIH/LCH are nested. They have estimated their model for the USA and the G-7 countries with quarterly data and found that while about 50% of consumers use permanent income, the other 50% are dependent on current income.

An important issue concerning consumption involves its response to changes in interest rates. If consumers have weak risk aversion, i.e. the elasticity of inter-temporal substitution is high, financial variables will have significant effects on consumption/savings decisions. This would be the case in many developed economies like the USA and G-7 countries. But in the Campbell-Mankiw tests, the coefficients of the rate of interest were not significant.[1] In developing countries the elasticity of inter-temporal substitution is likely to be low for two reasons. First, by nature consumers are likely to be more risk averse and second, consumer credit markets are relatively underdeveloped and limit the opportunities for inter-temporal substitution. Therefore, consumption is less likely to respond to changes in the real rate of interest.

[1] Subsequently Ogaki and Reinhart (1998) have developed a framework to estimate the risk aversion coefficient, the inverse of elasticity of substitution, by disaggregating consumption into durable and non-durable components. Such a disaggregation of consumption is not possible for many developing countries due to lack of data. See also Fuse (2004) for an application of the Ogaki-Richardson approach to Japan.

3.3 EMPIRICAL STUDIES IN FIJI

In spite of the elegant theoretical developments, there is little consensus on how to characterize the consumption behavior empirically. Some investigators focus on the importance of optimizing behavior in a world of complete markets with infinitely lived consumers while others model on the impact of imperfect markets, rule of thumb and life cycle effects. Hall did considerable work in testing the PIH hypothesis in developed countries. His initial tests were favorable to PIH, but as discussed earlier, Campbell and Mankiw (1989) found that data did not unequivocally support PIH. In Fiji, empirical work on consumption function has attracted little interest. Recent studies include that of Murphy (1992), Rao (2005b) and Rao and Singh (2004). Murphy estimated a simple Keynesian consumption function in his macro econometric model by constraining the income elasticity as unity and found it to be satisfactory. This was later verified by Rao and Singh (2004) as a valid restriction. Murphy's consumption function is as follows:[2]

$$\begin{array}{llll} lnC_t = -\,0.063 + 1.000\ lnY_t^d & - 0.021R_t & - 0.0120T & \\ \qquad\quad (0.65) \quad (--) & (0.616) & (2.68)^* & (1) \end{array}$$

$$SEE = 0.054, \quad DW = 2.09, \quad Period: 1974 - 1986$$

where:

C_t = Real private consumption expenditure in 1995 prices.
$Y_t^d = [(1-t_i)Y/(1+t_c)]$ is the real private sector income adjusted for the taxes.
Y = is the real private sector gross earnings.
t_i = income tax rate.
t_c = consumption tax rate.
R_t = The difference between nominal short and long-term interest rates, used as the proxy for credit availability.
T = the time trend variable.

[2] The t-values are given in brackets. Murphy did not report other summary statistics.

ln is the log of the variable, t is the time subscript and (−−) indicates that the statistic was not reported in the original paper.

Murphy assumed that the effects of consumption tax could be captured through its effects on disposable income. This is a pragmatic simplification because VAT was introduced in 1992 whereas his sample period is 1974-1986. This actually implies that consumption taxes in the past and the current VAT do not significantly contribute to the explanation of consumption due to no variation in data in his sample.[3]

Murphy obtained a negative coefficient for credit availability, which is contrary to expectations since R_t is expected to capture the credit market conditions. Justifications for this can be derived from the standard IS-LM model. When money supply increases, LM shifts right causing a decline in the short-term nominal interest rate. However, higher nominal money supply implies higher inflation expectations and therefore, higher long-term nominal interest rate. Thus, the spread between the nominal short-term and long-term interest rates increases reflecting higher liquidity and availability of consumer credit. Therefore a smaller value for R_t indicates tighter credit market situation and thus for Fiji, one would expect its coefficient to be positive. Moreover a sample of 12 observations is very small and therefore, his estimates cannot be taken as robust. Nonetheless, his results are useful and noteworthy.

Rao (2005b) extended the Campbell-Mankiw framework to test the significance of PIH and AIH for Fiji. The following is his most preferred equation with p-values in the brackets below the coefficients.

$$\Delta \ln C_t = \underset{(0.05)}{-0.068} + \underset{(0.05)}{0.753}\Delta \ln Y_t^d + \underset{(0.04)}{0.018}R_t - \underset{(0.00)}{0.053}T_c \qquad (2)$$

$$SEE = 0.045 \qquad Period: 1974 - 2002$$

where:
C_t = Real per capita private sector consumption in 1995 prices.
$Y_t^d = [(1 - T_x)Y]$ is the real per capita private sector income adjusted for income tax.

[3] Rao (2005b) found that VAT seems to have significant but temporary negative effect on consumption for the period of 1974-2002. He has used a VAT dummy in which it was 1 in 1992, 1993 and 1994 and zero in all other years.

Y = Real per capita private sector gross earnings.
T_x = Income tax rate.
T_c = Dummy for VAT.
R_t = The spread between the nominal short and long term interest rates.

Rao suggests that consumers in Fiji are faced with low and volatile per capita incomes which offer them limited opportunities for intertemporal substitution. Based on his prefered equation, we can say that current income is the main determinant for about 75% of consumers in Fiji, which, as expected is much larger than the estimates by Campbell and Mankiw for the USA and G7 countries. He also finds that the availability of consumer credit (R_t) is an important determinant of consumption and therefore an effective tool for monetary policy in Fiji. Unlike in Murphy's equation, the coefficient of R is positive and significant in his equation. However, he estimates a low and insignificant value for the elasticity of substitution parameter and therefore, did not find a significant effect of the rate of interest, both the short and the long-term rates on consumption. His results show that the introduction of VAT has had a temporary negative effect on consumption and therefore he claims that policies based on income tax and availability of credit would be more effective than those based on consumption tax or changes in the interest rates. His results thus imply that a simple Keynesian consumption model with appropriate measure for credit availability would be adequate for explaining consumption behavior in Fiji.

Rao and Singh (2004) have used the JML and GETS approaches in their estimate of a Keynesian consumption function for Fiji using the Murphy specification as a starting point. Their most preferred GETS equation is as follows:

$$\begin{aligned}\Delta lnC_t = & \underset{(2.96)^*}{2.641} - \underset{(1.10)}{0.005T} - \underset{(3.78)^*}{0.599\ lnC_{t-1}} + \underset{(3.21)^*}{0.6411\ lnY^d_{t-1}} + \underset{(3.64)^*}{0.033R_{t-1}} \\ & - \underset{(3.64)^*}{0.521\Delta lnP_{t-1}} - \underset{(1.95)^{**}}{0.401\Delta lnC_{t-1}} + \underset{(2.18)^*}{0.251\Delta lnC_{t-4}} \\ & + \underset{(2.43)^*}{0.396\Delta lnY^d_t} + \underset{(2.38)^*}{0.013\Delta R_t} \end{aligned} \tag{3}$$

$$\overline{R}^2 = 0.618, DW = 2.05, SEE = 0.038, Period : 1975 - 2002$$

$$\chi^2_{sc1} = 0.413, \quad \chi^2_{ff} = 1.279$$

$$\chi^2_{n} = 1.681, \quad \chi^2_{hs} = 0.150$$

Where ΔlnP_t is the GDP deflator based inflation rate. The t-ratios are reported in parenthesis and significance at 5% and 10 % levels are indicated by * and ** respectively. χ^2_{sc1}, χ^2_{ff}, χ^2_{n}, and χ^2_{hs} are respectively, for the first order serial correlation, functional form misspecification, normality of residuals and heteroscedasticity. Based on the above results, it can be said that the implied long run elasticity of consumption with respect to income is unity. The elasticity of consumption with respect to credit availability is around 0.20 and a one percent increase in the rate of inflation leads to a 0.87% reduction in consumption in the long run.

Their ECM equation based on the JML is estimated in two steps. First, they found a single cointegrating vector, by performing a cointegration test on the levels of lnC_t, lnY_t^d and R_t with a time trend and a constant term. They also included the rate of inflation as an exogenous variable in their VAR(1) framework. Their cointegrating vector normalized on lnC_t is as follows:

$$(-1.00\ lnC_t + 0.90949\ lnY_t^d + 0.033667R - 0.008338T) \qquad (4)$$

In the second stage, they have used the one period lagged residuals (ECM_{t-1}) from the above equation together with some parameter restrictions to obtain their most preferred parsimonious VECM model reported below. Note that the error correction term has the correct sign and therefore the consumption function has a builtin negative feedback mechanism. It suggests that consumption reverts back to its long run equilibrium by about 56% in one year once it experiences a shock. All other summary statistics are good.

$$\begin{aligned}\Delta lnC_t =& 2.675 + 0.529\Delta lnY_t^d + 0.008\Delta R_t - 0.559ECM_{t-1} \\ & (4.40)^* \ (4.49)^* \qquad (1.97) \qquad (4.38)^* \\ & - 0.625\Delta lnP_{t-1} - 0.324\Delta lnC_{t-1} + 0.275\Delta lnC_{t-4} \\ & \quad (3.24)^* \qquad\quad (2.01)^* \qquad\quad (2.33)^* \qquad (5)\end{aligned}$$

$$\overline{R}^2 = 0.586, DW = 1.68, SEE = 0.039, Period : 1975 - 2002$$

$$\chi^2_{sc1} = 1.237, \chi^2_{ff} = 0.024$$
$$\chi^2_{n} = 3.856, \chi^2_{hs} = 0.204$$

Both these estimates confirm Rao's conclusion that a simple Keynesian consumption model together with some proxy for consumer credit fits the Fiji data reasonably well. The results suggest that the income elasticity is unity and the elasticity with respect to availability of credit is significant and has the correct sign.

3.4 OUR SPECIFICATION AND RESULTS:

In what follows, we detail our results based on Rao and Singh's specification together with their estimation methodology. Our sample period is 1970 to 2002 and the basic specification is:

$$ln\ C_t = \alpha_0 + \alpha_1 ln\ Y_t^d + \alpha_2 R_t + u_t \quad (6)$$

where:
C_t = Real private sector consumption including durables.
Y_t^d = Real private sector income net of income tax.
R_t = Credit availability proxy; the spread between the short term and long term interest rates.
u_t = error term with usual classical properties.

A detailed description of the variables are in Appendix A. We first tested for the stationary of variables with the standard tests procedures using Microfit and E-views. These unit root test results are detailed in Appendix B. Since the variables in the consumption equation are $I(1)$ in levels and $I(0)$ in first differences, we applied the GETS and JML approaches.

3.4.1 THE GETS APPROACH

The GETS results are obtained with lags up to four periods for the first differences of the variables. The justification of this approach is given in Cuthbertson (1995) and Charemza and Deadman (1997) and is also in our methodology section; see chapter 2. Following sequential deletion of insignificant variables, we obtain 6a given in the first column of Table-1. The implied income elasticity is around 0.70 and the elasticity with respect to availability of credit, at its mean rate of 3.60, is around 0.16. Both the crucial coefficients are significant and have the expected signs. The inflation rate has the correct negative sign and is highly significant. Further, the results show that an increase in the availability of consumer credit has significant positive effect and lagged inflation has the expected negative effect on consumption. Moreover, none of the χ^2 statistics are significant at 5% level.

We tested for unit income elasticity and the null is easily accepted. However, ΔlnY_{t-1} became insignificant and is consequently deleted. The results are reported in 6b. Moreover, we introduced two dummy variables viz, the COUP and VAT, to determine the impact of the two political coups in 1987 and 2000 respectively, and the imposition of VAT in 1992. Our results show that VAT had a strong negative effect on consumption while the COUP had a weak but positive effect.[4] It may be noted that there are signs that consumption may have actually increased during the coups due to accumulation of buffer stocks and precautionary food supplies during these times. Further, we realized that ΔlnP_{t-1} and $\Delta^2 lnP_t$ are similar in signs and magnitudes. Thus we tested if they are equal and the null was accepted. Moreover, ΔlnC_{t-3} and $\Delta^2 lnP_{t-4}$ have opposite signs and are equal. The same was concluded for ΔR_t and the VAT dummy. Therefore, we tested these restrictions and both the nulls were accepted. Incorporating these restrictions, we obtained our final GETS results given in 6c.

It may be noted that none of the χ^2 summary statistics are significant at 5% level. The SEE is around 0.022 and the implied income and interest rate elasticities are well determined and plausible. An in-sample plot of actual vs. predicted values of the growth of consumption is given in Figure-1. It can be said that the model predicts changes in consumption, within the sample period, reasonably well.[5]

We tested for temporal stability using the TIMVAR tests and none of the tests indicated any instability in (6c). The tests results are given in Figures-2 and 3, respectively.

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[4] The COUP dummy was insignificant at conventional level. The dummy variables are constructed as 1 from 1987 onwards for the COUP and 1 from 1992-2002 for the VAT with zeros for all other periods. We have also used a dummy to measure the temporary effect of VAT. However, the results were not significant.

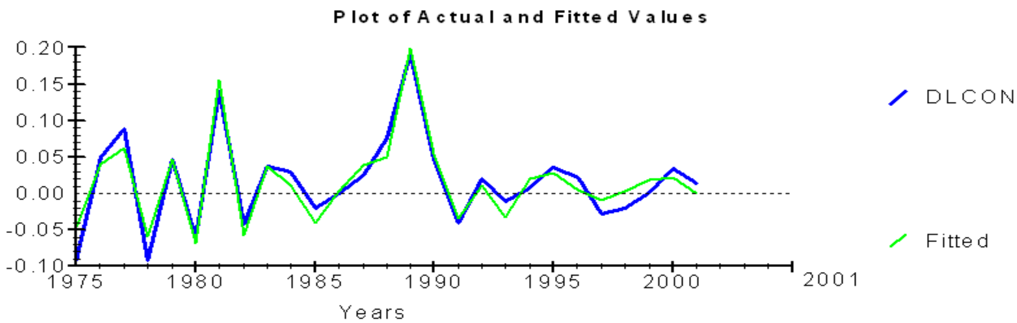
[5] The fit of the actual vs. predicted values of growth of consumption gives $\overline{R}^2$ of 0.887 and the SEE = 0.02. The fitted equation has an intercept of zero and the slope is unity.

Table 1: GTS and ECM Equations

	6a	6b	6c	8a	8b	8c
Constant	1.220 (1.91)**	-0.038 (-1.03)	-0.039 (-1.23)	0.061 (2.56)*	-0.115 (-4.70)*	-0.114 (-5.19)*
Trend	-0.003 (-0.99)	-0.010 (-5.64)*	-0.007 (-7.11)*	-0.001 (-0.80)	0.005 (2.99)*	0.005 (3.18)*
$\ln C_{t-1}$	-0.589 (-4.63)*	-0.605 (-4.84)*	-0.517 (-5.65)*			
$\ln Y_{t-1}$	0.409 (2.86)*	0.605 (4.84)*	0.517 (5.65)*			
R_{t-1}	0.025 (2.02)**	0.054 (6.78)*	0.056 (7.16)			
$\Delta\ln Y_t$				0.468 (3.70)*	0.545 (5.38)*	0.532 (6.02)*
$\Delta\ln Y_{t-1}$	0.182 (2.02)*					
$\Delta\ln Y_{t-3}$				0.268 (2.41)*	0.225 (2.09)**	0.207 (3.04)*
$\Delta\ln Y_{t-4}$						
$\Delta\ln C_{t-1}$				-0.387 (-3.27)*	-0.690 (-5.40)*	-0.691 (-6.58)*
$\Delta\ln C_{t-2}$	0.215 (2.60)*	0.186 (2.11)*	0.131 (1.72)	-0.306 (-2.34)*	-0.264 (-1.98)**	0.227 (-2.77)*
$\Delta\ln C_{t-3}$	0.392 (4.21)*	0.400 (4.01)*	0.326 (5.42)*	-0.434 (-3.14)*	-0.466 (-3.91)*	-0.434 (-6.06)*
ΔR_t	0.015 (4.50)*	0.018 (5.12)*	0.015 (5.68)*	0.014 (3.34)*	0.014 (3.70)*	0.014 (4.77)*
ΔR_{t-1}				-0.029 (-3.59)*	-0.032 (-5.00)*	-0.030 (-6.16)*
ΔR_{t-2}				-0.011 (-2.07)*	-0.015 (-3.29)*	-0.014 (-4.77)*
$\Delta\ln P_{t-1}$	-1.732 (-5.69)	-1.809 (-5.52)*	-1.607 (-8.49)*			
$\Delta^2\ln P_t$	-1.705 (-8.02)*	-1.669 (-7.28)*	-1.607 (-8.49)*			
$\Delta^2\ln P_{t-1}$					-0.412 (-2.68)*	-0.434 (-6.06)*
$\Delta^2\ln P_{t-3}$						
$\Delta^2\ln P_{t-4}$	-0.267 (-3.61)*	-0.298 (-3.73)*	-0.326 (-5.42)*			
VAT			-0.015 (-5.68)*		-0.068 (-2.33)*	-0.065 (-2.46)*
ECM_{t-1}				-0.633 (-5.61)*	-0.618 (-6.26)*	-0.617 (-6.82)*
$\bar{R}^2$	0.867	0.842	0.857	0.732	0.836	0.855
SEE	0.021	0.023	0.022	0.030	0.024	0.022
$\chi^2(sc)$	3.449 (0.06)	0.598 (0.44)	1.768 (0.18)	1.159 (0.28)	0.152 (0.70)	0.429 (0.51)
$\chi^2(ff)$	0.209 (0.65)	0.267 (0.61)	1.486 (0.22)	1.192 (0.28)	1.025 (0.31)	0.370 (0.54)
$\chi^2(n)$	0.419 (0.81)	0.163 (0.92)	0.172 (0.92)	1.098 (0.58)	0.793 (0.67)	0.883 (0.64)
$\chi^2(hs)$	0.573 (0.03)*	0.794 (0.37)	0.332 (0.56)	0.528 (0.51)	1.246 (0.26)	1.203 (0.27)

FIGURE 1

Actual vs. Predicted Values



3.4.2 THE JML APPROACH

In this section, we report the Johansen cointegration test results and the VECM estimates of the consumption equation. We tested for the cointegration of lnC_t, R and $lnYD_t$ with an intercept and a trend term in a VAR(3) framework, by treating ΔlnP_t as an exogenous I(0) variable. The lag length of the VAR is based on the Akaike Information Criteria (AIC). The eigenvalue and the trace statistics rejected the null that there is no cointegrating vector, but accepted the alternative of at least one cointegrating relationship. The eigenvalue and the trace statistics are, respectively, 42.029 (25.420) and 65.921(42.340) for the null that there were no cointegrating vectors and 13.637(19.220) and 23.892(25.770) for at least one long run relationship. The 95% critical values are given in parenthesis.

FIGURE 2

CUSUM TEST-6C

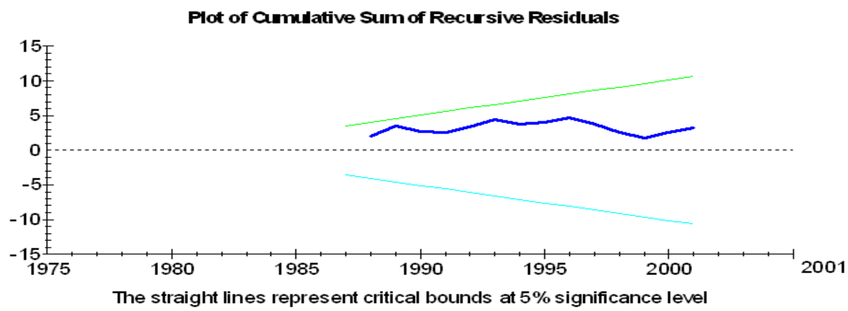
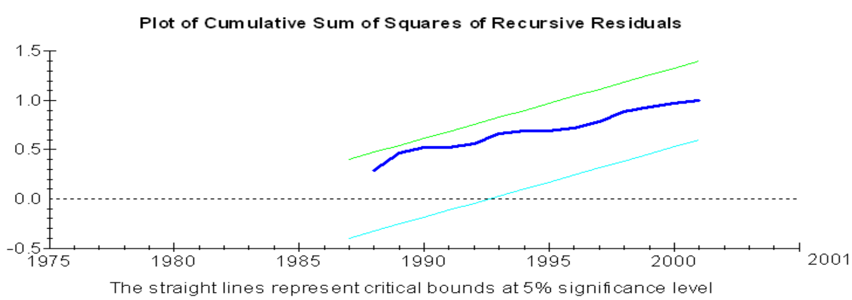


FIGURE 3

CUSUM SQUARES TEST-6C



The cointegrating relationship normalized on lnC_t is:

$$(-1.000 \ln C_t + 0.958\ lnY_t^d + 0.0859\ R_t - 0.012\ T) \qquad (7)$$

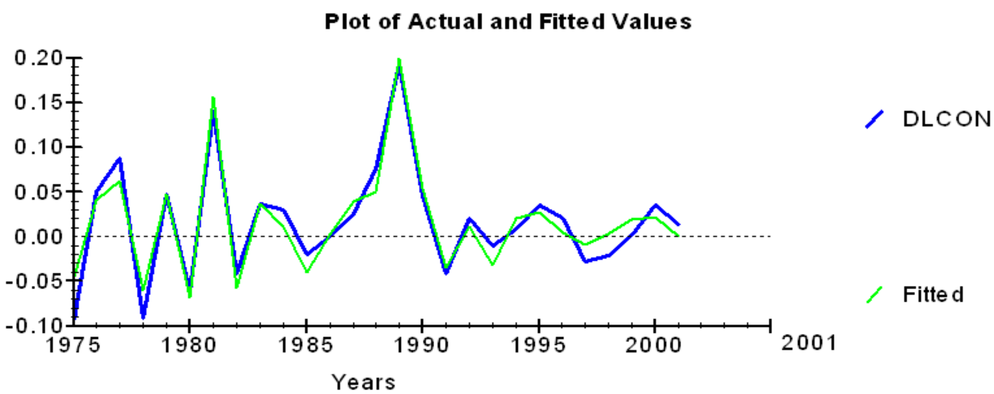
Note that the long-run elasticity of consumption with respect to disposable income is 0.96 which is not significantly different from our GETS estimates. The implied elasticity with respect to the credit availability is around 0.31. However, it is well known that without conducting further exogeneity tests on the cointegrating vector, one should not proceed to interpreting it as a causal relationship. Therefore, following Enders (2004) three parsimonious VECM equations were estimated with one period lagged residuals from the above cointegrating vector included as one of the dependent variables in each of the three implied equations of consumption, income and availability of credit. The error correction term is only significant in the equation in which the dependent variable is ΔlnC_t. The t-ratios for the ECM_{t-1} term in each of the three equations, in order of ΔlnC_t, $\Delta lnYD_t$ and ΔR_t as being the dependent variable, are -3.910, -1.002, 1.998. Although ECM_{t-1} is significant at 10% level in the equation for ΔR, it is highly significant in consumption equation. Therefore, we interpret the cointegrating vector as the equation for consumption rather than proceeding into estimating a bi-variate VAR model.

In estimating the VECM equation we applied GETS in the second stage. Starting with lags upto 4 periods and by sequentially deleting insignificant variables we obtained our parsimonious VECM equation (8a) in Table-1. The estimates are reasonable and the error correction term has the correct negative sign with nearly 60% adjustment being completed in an year. Further, none of the summary χ^2 statistics are significant at 5% level and the SEE is low at 0.030. However, our best GETS equation included some additional lagged values of ΔlnP_t and the dummy variables. Therefore, we added lags of ΔlnP_t up to four periods together with the dummy variables and re-estimated (8b). Following sequential deletion of the resulting insignificant variables, we obtained (8b).

We then imposed some parameter restrictions to improve our results further. Firstly, we noted that ΔlnC_{t-3} and $\Delta^2 lnP_{t-1}$ are similar in both their signs and magnitudes. Thus, we tested if they are equal and the null is easily accepted. Secondly, ΔR_t and ΔR_{t-2} are of similar magnitudes but opposite in signs. We tested if their sum is zero and this is also accepted. Our constraint VECM estimates are given in (8c). None of the coefficients had any significant changes compared with our previous estimates and (8c) is our most preferred VECM model. Note that the VAT seems to have a permanent rather a temporary effect on consumption. We plotted the actual vs. fitted values of growth rate of consumption in Figure 4. It can be said that the model predicts changes in consumption, within the sample, reasonably well.[6] The TIMVAR stability tests results are shown in Figures-5 and 6 and our preferred VECM model is structurally stable.

FIGURE 4

GOODNESS OF FIT: ACTUAL VS. PREDICTED VALUES



[6] A fit of the actual vs. predicted values of the growth of consumption has zero intercept and 1.00 as the slope. The $\overline{R}^2 = 0.892$ and the SEE is 0.02. These are comparable to what we obtained for the prefered GETS equation.

FIGURE 5

CUSUM TEST-8C

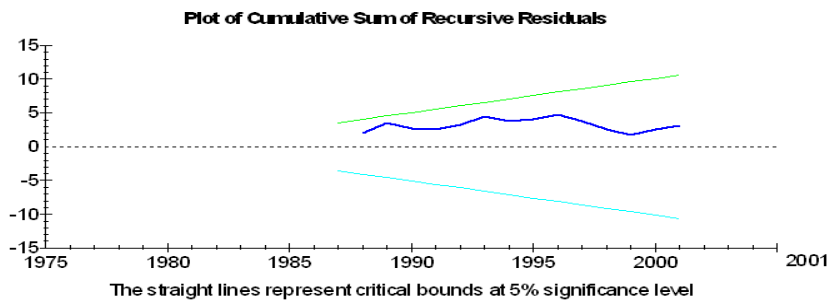
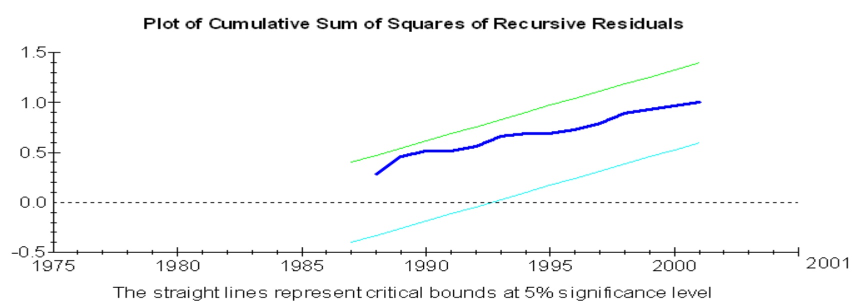


FIGURE 6

CUSUM SQUARES TEST-8C



3.5 CONCLUSION

In this chapter, we conducted a brief survey of literature on consumption and examined previous works on consumption functions in Fiji. We applied two time series techniques and both approaches yielded equally impressive and similar results. The two crucial elasticities are well defined and plausible. The implied income elasticity is unity and elasticity with respect to availability of credit, at its mean rate of 3.60, is around 0.30. We noted that inflation has had negative impact on consumer spending and VAT has permanently reduced consumption. This last finding on the impact of VAT is different from Rao and Singh (2004) and Rao (2005b) in which VAT was found to have only a temporary effect.

Since the differences between the two preferred equations (6b) and (8c) are only marginal, we shall include each of them for performing in sample simulations in a complete macroeconometric model setup. The selection of the best equation that would finally be adopted in the model depends on simulation results.

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4 THE INVESTMENT EQUATION

4.1 INTRODUCTION

This chapter is devoted to investment equation. It is well known that the concept of investment is difficult and overly complicated covering a wide range of issues. Although it constitutes a smaller proportion of total output relative to other components of aggregate demand (AD) such as consumption, investment is most volatile component of AD. In comparison to other important functions empirical investment equations have higher standard error of estimation. Therefore, estimating investment equation is important in the exercise of macroeconometric model building.

There are three main reasons for studying investment. First, firms' investment demand and households' supply of savings jointly determine how much of an economy's output is invested or added to its capital stock. Investment through capital formation determines the level of aggregate supply or the long-run productive capacity of an economy. Therefore, it is an important determinant of future growth, that is, if investment is sluggish, growth and employment may decline and consequently, labor productivity, wages and living standards could fall. Second, investment expenditure is highly volatile and fluctuations in investment are generally seen as the main source of fluctuations in the level of economic activity. Therefore, analyzing its volatility could help evaluate the short-term output fluctuations in an economy. Third, the investment function links the goods market to the money market and therefore it is the primary link through which interest rates (monetary policy) affect the economy. It also shows the impact of fiscal policy such as capital tax, tax breaks, investment subsidies and depreciation allowances etc. on output.

Our results show that a simple Keynesian accelerator model augmented with the real rate of interest, as a measure of the user cost of capital, adequately explains private sector investment (investment, henceforth) in Fiji. We define private investment as the flow of capital spending from the private and statutory bodies (excluding the government sector) that adds to the formation of plants, machinery and residential properties. In addition, the use of dummy variables that capture the effects of the uncertainties surrounding the two political coups have improved our estimates.

This chapter is organized as follows: Sections 2 and 3, respectively, provide a brief surveys of investment theories and empirical work on Fiji. Section 4 discusses our specification & empirical results and conclusions are stated in Section 5.

4.2: THEORIES OF INVESTMENT

There are two major theories of investment - the Keynesian and neo-classical. In his famous exposition, *The Theory of Interest*, Fisher (1930) emphasized that in a perfectly competitive environment, firms hire capital upto the point where the rate of return on investment equals its rental cost (also known as the user cost, UCK, henceforth) of capital. This relates to the modern concept of the present value of investment and its internal rate of return.

The Keynesian debates which dominated the post World War II period were along the lines of the marginal efficiency of capital (MEK, for short). The MEK measures the expected profitability of investment. Put simply, it is the discount rate which makes the present value of expected profits just equal to its replacement cost. Therefore, in its basic form, the Keynes's MEK is very similar to Fischer's internal rate of return. On the contrary, the Keynesian models also emphasizes expectations, uncertanities and other fiscal and financial factors as being the key determinants of investment.

In the 1960s, returning to Fisher's idea, Jorgenson responded to the Keynesian approach. In fact, Jorgenson's model forms the basis of the modern the Neo-classical framework because it assumes that firms can easily calculate the balance between marginal benefit and marginal cost of incremental capital outlays. The marginal benefit of investment can be estimated by expected future output and the marginal cost can be represented by additional costs associated with buying or renting an additional unit of capital such as the interest costs, depreciation and expected capital losses. Thus, in the Jorgenson's model, both the growth rate of output and the UCK play important roles. However, their relative importance depends on the elasticity of substitution between labor and capital ($\sigma_{L,K}$). If the nature of the production function is Cobb-Douglous, in which $\sigma_{L,K} = 1$, both the factors receive the same weights in investment equations. However, if fixed coefficient production function is used where $\sigma_{L,K} = 0$, the UCK would have no effect.

While empirical investment equations in developed countries use this framework, in developing countries, simpler variants of these theories are used where UCK is proxied with the real rate of interest. However, there is no clear-cut empirical measure of UCK and this problem has given raise to a large body of literature on the cost of capital. Briefly, the UCK can be estimated by evaluating the costs incurred in retaining a unit of capital. These are first, the firm foregoes the interest income it would receive by selling off the capital as opposed to retaining it. This has the real cost of $r_tP^iK_t$, where r_t is the real rate of interest and the P^iK_t is the real market value of capital. Second, firms incur depreciation costs of $\delta_tP^iK_t$, where δ_t is the effective rate of depreciation. Third, the price of capital may fall due to technological improvements in new machines which causes capital loss. This can be expressed as -$P^{i*}K_t$. Putting the three components together yields a measure of the user cost of capital as:

$$UCK_t = r_tP^iK_t + \delta P^iK_t - P^{i*}K_t \tag{1}$$

Thus, the after tax profit function for a typical profit maximizing firm would be:

$$PQ - WL - \left[r_t + \delta - \left[\frac{P^{i*}K_t}{P^iK_t}\right]\right]P^iK_t - Tx \tag{1'}$$

Where PQ is the total revenue, WL is the wage cost and Tx is the tax paid by the firm. However, in reality, only a certain proportion of these costs are tax deductible. To factor this out, suppose ϕ_1 proportion of depreciation, ϕ_2 of interest rate and ϕ_3 of capital loss are tax deductible and the proportionate tax rate is tx. Thus equation ($1'$) may be re-written as:

$$(1-tx)\left[(PQ-WL) - \left[\frac{\left[(1-\phi_1 tx)r_t + (1-\phi_2 tx)\delta - (1-\phi_3 tx)\left(\frac{P^{i*}K_t}{P^iK_t}\right)\right]P^iK_t}{(1-tx)}\right]\right]$$

Note the definition of UCK and associated limitations in its approximation.[1] In the simple Jorgenson model, adjustment to the desired capital stock is perfectly inelastic in response to UCK and the elasticity with respect to output is unity. Further, instantaneous capital adjustments imply perfect reversibility of investment with minimum lag effects and negligible adjustment costs. However, in reality,

[1] I am grateful to Professor Rao for the clarifications in deriving the implied user cost of capital.

there are significant costs associated with ordering and installing new plants and machinery and in training workers to use the new technology. Further, the price of capital may raise if firms face an inelastic supply for capital and in many cases, investment decisions may not be instantaneous as fixed investment are generally irreversible and thus long range planning is important.

Due to data limitations on UCK, a more popular and widely used model is the Keynesian accelerator model of investment. Baddeley (2003) reports that this model is actually due to Clark (1917) and was later refined by Harrod (1936/39). According to the accelerator theory investment activity is seen as the process of adjusting the current stock of capital to a desired level. The model assumes that firms plan to close a fraction (γ) of the gap between the actual and the desired stock of capital in each period. Thus the actual capital stock at the end of the current period may be given as:

$$K_t = K_{t-1} + \gamma(K_t^* - K_{t-1}) \qquad (2)$$

In order to increase the capital stock to the desired level, firm need to make a net investment of $K_t - K_{t-1}$ Substituting the latter into the former yields the definition of net investment as:

$$I_t = \gamma(K_t^* - K_{t-1}) \qquad (2')$$

Adding a depreciation cost of δK_{t-1} in (2′) would yield gross investment. The greater the value of γ, the higher is the speed of adjustment.

However, there are some limitations. The model fails to account for the dynamics of investment decisions based on expectations and uncertainties. With technical rigidities in production process, the elasticity of substitution between labor and capital ($\sigma_{L,K}$) is low and therefore, the capital-labor and capital-output ratios are likely to be fixed. Since the accelerator theory is Keynesian in nature, the sticky price assumption is implied. Therefore, the possibility of factor substitution and adjustable relative factor prices are in fact ignored. Thus even if there is excess supply of productive factors relative to their demand, the model implies constant factor prices. Further, a decline in the price of capital (or the UCK) should lead to an increase in demand for capital and therefore an increase in demand for labor to maintain the fixed capital-labor ratio. However, these are not possible with firm's budget constraints and with increasing capital intensive methods and technological advancements.

More complicated accelerator theories were later developed in response to some of the theoretical shortcomings. Past output growth and investment lags were taken as proxy for expected future profits and delays in decision making, ordering, adjustment and installation of capital. This extention of the accelerator became famous as the flexible accelerator theory which sometimes is used to explain the dynamics of inventory investment. Inventory investment fluctuates proportionally with the business cycle. As a recession develops, demand recedes and firms accumulate involuntary stocks. Thus firms cut production and try selling-off their current stocks. At the end of a recession, firms voluntarily start increasing inventory by raising production. Thus, the rapid accumulation of inventories could be associated with either declining aggregate demand or expected rapid growth in economic activity.

Other refinements of the Keynesian and the neo-classical models have emerged such as the q theory, where q is defined as a ratio of the market value of capital to its replacement cost. The q-theory which is in classical paradigm incorporates rational expectations and optimism of investors who tend to maximize the present value of all future net benefits. The model assumes that firms invest up to the point where the UCK equals the marginal revenue product ($MRPK$) of a unit of capital. This is similar to what Fisher and Keynes's initially suggested. Other developments, for example, discusses uncertainties that have implications for expected future profits and consequently lowers the value of capital and thus reduces current investment. Financial market imperfections also affect investment. Asymmetric information creates agency problems between investors and firms and raises the cost of external financing which discourages investment. Firms, rather than borrowing could also raise funds by selling equity or shares. If share prices are high, firms are willing to sell shares and raise additional capital for investment. Thus, a booming share market encourages investment. Sometimes investors use the discounted cash flow method and choose an investable project which offers the highest returns in the shortest span of time. A detailed discussion of these extensions is found in standard macroeconomic texts. However, analyzing the finer details is outside the scope of our thesis.

4.3: EMPIRICAL STUDIES IN FIJI

Murphy (1992) modeled private sector investment (as a ratio to capital stock), as part of a small macroeconometric model for Fiji. The main explanatory variable in his equation was the real net rate of return on investment (RET, henceforth) which is used as a proxy for the expected profit rate. His estimated investment function is as follows:

$$\left(\frac{I_t}{K_t}\right) = \underset{(0.98)}{0.031} + \underset{(1.39)}{0.166}\left[RET_t - \frac{\delta_t + RL_t - \pi_t^e}{100}\right] + \underset{(1.37)}{0.003T} \qquad (3)$$

$$SEE = 0.014, DW = 1.00, Period : 1974 - 1986$$

where:

I_t= Real private sector investment,

K_t = Real capital stock,

T = Time trend,

RET_t = Real rate of return on investment,

δ_t = Rate of depreciation,

RL_t = Long term interest rate,

π_t^e = Medium term expected rate of inflation

Although the estimated coefficients of his equation are correctly signed, they are statistically insignificant at conventional levels. Moreover the sample size is too small to say that these are convincing results. Thus, we tried re-estimating Murphy's equation with an extended sample of 1970-2002. However, we encounted problems in estimating the RET used in his model. He estimates RET using an optimization model as the weighted average of relative prices, determined by the corresponding proportion of the quantities to total output. His specification for the RET variable is as follows:

$$\begin{aligned} RET_t = \beta_0 + \beta_1\ ln\left(\frac{P_t^{XS}}{P_t^Y}\right) + \beta_2\ ln\left(\frac{P_t^{XOG}}{P_t^Y}\right) \\ - \left[\beta_3\ ln\left(\frac{P_t^L}{P_t^Y}\right) + \beta_4\ ln\left(\frac{(1 + R_t^{TIM})\ P_t^{IM}}{P_t^Y}\right)\right] \end{aligned} \qquad (4)$$

where:

P_t^{XS} = Export price of sugar,

P_t^Y= GDP deflator,

P_t^{XOG} = Export prices of other goods,

P_t^L = Wage rate,

R_t^{TIM} = Rate of tax on imports,

P_t^{IM} =Price deflator of imports.

Murphy derived the respective weights in the above equation (β_i's) as the sample averages of the long run equilibrium values of these ratios, where the quantities are functions of their respective prices. For example, the weight β_1 is the ratio of sugar export prices to GDP deflator. On the other hand, the cost of funds is computed as the depreciation rate plus the real rate of return on the long term government bonds. Although it is possible to generate reasonable estimates for the weights used in the computation of the real rate of return, we could not compute the value of the intercept term in equation (2), since Murphy did not clarify what this term was. However, this intercept can be given an arbitrary value or estimated as an unrestricted parameter. Unfortunately, we did not get any meaningful estimates for our sample period.[2] Thus in light of these limitation, we could not pursue further on Murphy's specification.

More recently, Jayaraman (2003) and Seruvatu and Jayaraman (2001) have estimated investment equations for the private sector in Fiji for the periods 1977-1994 and 1966-1998, respectively. Both have good surveys of the literature and discuss some important trends in investment. However, while some attention is given to the time series properties of variables in Seruvatu and Jayaraman (2001), in Jayarman (2003), the investment equation was estimated using the standard methods of linear regression without testing for the stationarity of the variables. Therefore, we shall disregard the estimates in Jayaraman (2003) since these are spurious. Although in Seruvatu and Jayaraman (2001) all variables are tested for their stationarity properties, the actual specification used to estimate the investment equation seems to be inappropriate. The specification of their equation, which is said to be based on the error correction mechanism (ECM), is as follows:

$$\Delta ln\left(\frac{I_t}{P_t}\right) = \beta_0 + \sum_{i=1}^{7} \beta_i \Delta X_{it} + \sum_{i=1}^{7} \alpha_i \Delta X_{it-1} + \delta \Delta ln \left(\frac{I_{t-1}}{P_{t-1}}\right) \quad (5)$$

where:

I_t= Nominal private investment,

P_t = GDP deflator,

X_1= Real investment in the public sector,

[2] Both myself and Professor Rao have sent e-mail messages to Dr Murphy for clarification on this arbitrary intercept, but he did not respond to either messages.

X_2 = Rate of growth of real GDP,

X_3 = Real lending rate,

X_4= Real credit to private sector,

X_5 = Real effective exchange rate index,

X_6 = Terms of trade index,

X_7 = Real unit costs of labor.

All variables, except the real rate of interest are in logarithms. Their results are:

$$\Delta ln\left(\frac{I_t}{P_t}\right) = \underset{(-1.79)^{**}}{-2.017} - \underset{(-2.90)^{*}}{0.451 COUP} + \underset{(--)}{0.808 \Delta ln TOT_{t-1}} - \underset{(-3.35)^{*}}{0.371 \Delta ln\left(\frac{I_{t-1}}{P_{t-1}}\right)} \qquad (5')$$

$$Period : 1966 - 1998$$

$$\bar{R}^2 = 0.35, SEE = 0.15$$

$$\chi^2_{sc}(1) = 1.42(0.49), \chi^2_{ff}(1) = 0.67(0.66)$$

$$\chi^2_{nn}(2) = 0.80(0.67), \chi^2_{hs}(1) = 0.322(0.57)$$

t-ratios are in parentheses below the coefficients and for the χ^2 statistics, p-values are in parentheses. $*$ and $**$ signify 5% and 10% significance levels, respectively. The summary statistics are, respectively, for the first order serial correlation (χ^2_{sc}), functional form misspecification (χ^2_{ff}), non-normality in residuals (χ^2_n) and heteroscedasticity (χ^2_{hs}). (−−) indicates that the statistic was not reported in their paper.

However, there seem to be several weaknesses in their results. First, their unit root tests (not reported here, but in their Table-3) imply that the logs of the real private investment, real GDP and real private sector credit are actually stationary variables, not I(1) as they wrongly conclude, since the computed test statistics are more than the critical values. This clearly rejects the null that these are I(1) variables. Second, it is doubtful if in fact these variables are stationary since it is well known that GDP as well as other macroeconomic variables contain unit roots in virtually all the countries. This is confirmed by our unit root tests given in Appendix B. Third, it can be seen from their specification in (5) above that there is no familiar lagged error correction term, in the lagged levels of the variables, to capture the long-run relationship between the dependent and the explanatory variables. It seems that Seruvatu and Jayaraman have simply regressed the first difference of the dependent variable on the first differences of the explanatory variables and their lagged values. It is not clear how they have obtained their error correction term in their subsequent regressions and whether this term is lagged by one period, as is necessary. Fourth, there is a reference to the well-known Bewley (1979) transformation without an adequate appreciation of what this transformation is. Further, it is not obvious as to why the Bewley transformation was necessary even for the estimation of the standard error of the terms of trade variable (TOT). Further, there is no evidence that they have used the cointegration and the ECM procedures properly and only state that the Bewley transformation is used to estimate the standard error of the lagged TOT variable. It is doubtful if their results are useful since neither the specification of their investment equation nor their estimation procedures are appropriate.

Nevertheless, the aforesaid three studies are pioneering attempts, but due to their limitations, it is necessary to estimate the investment equation for Fiji afresh and with a clean slate.

4.4 OUR SPECIFICATION AND RESULTS

It is well known that the neo-classical investment equation is more general than the popular variants based on the Keynesian accelerator model. It can be easily shown that in the neo-classical formulations, investment depends on the rate of change of output and the UCK. The relative weights given to these variables, however, depends on the elasticity of substitution between the factors of production. As discussed earlier, if the production function is based on the fixed coefficients technology, UCK has no role in investment equations. These are well known results and an easy to follow explanation can be found in Rao (1980). However, our specification is based on the assumption that technology is flexible and therefore, investment depends on both the growth rate of output and the user cost. Due to data limitations on UCK, we have used real rate of interest as a proxy in our analysis and this is a standard practice when data on UCK are not available.

The dependent variable, as in some earlier studies, is the proportion of private sector investment to GDP (investment ratio, henceforth). Therefore, our basic specification is:

$$ln\left(\frac{I_t}{Y_t}\right) = \alpha_0 + \alpha_1 lnY_t + \alpha_2 RRL_t + u_t \tag{6}$$

where:

I_t = Real private sector investment

Y_t = Real GDP at factor cost

RRL_t = Real long term interest rate

u_t = error term with the usual classical properties.

We first applied the GETS approach and then the Johansen JML. However, we tested the variables for stationarity using various unit root tests available in Microfit 4.2, Eviews 5.1 and TSP. It was found that $ln(I_t/Y_t)$, RRL_t and lnY_t are non-stationary in levels but their first differences are stationary at the 5% level of significance. Later it was necessary to include the growth rate of inflation, $\Delta^2 P_t$, which was also stationary. The unit root test results are detailed in Appendix B and a detailed description of variables and their data sources are in Appendix A.

4.4.1 THE GETS APPROACH

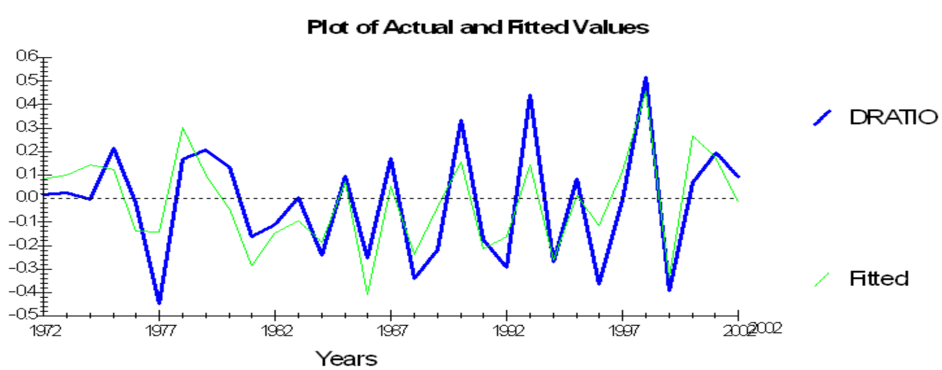
In what follows, we report our GETS results obtained with nonlinear least square (NLLS) in Microfit 4.2. Our basic equation is estimated with a time trend and growth in expected rate of inflation ($\Delta^2 lnP_{t-1}$) together with two dummy variables to capture the impact of the political coups and the devaluation of the Fiji dollar, respectively. Following sequential deletion of insignificant variables, we obtained the GETS estimates reported in column (6a) of Table-1. The implied long-run estimates are captured by the lagged level variables and the dynamics are given by the difference variables. Note that all variables are correctly signed and none of the χ^2 summary statistics are significant at 5% level. Devaluation of the dollar seems to be insignificant (not reported), while the political instability has severely reduced investment. The implied long-run output elasticity is 1.38, while the interest rate elasticity, at the mean rate of 2.80, is -0.13. However, the output elasticity is insignificant at even the 10% level. The expected growth in inflation seems to significant negative impact on investment.

To further improve our results, we incorporated a few parameter restrictions. It can be seen that RRL_{t-1} and ΔRRL_t are similar in their signs and magnitudes. The same is concluded for $COUP$ and $\Delta ln\left(\frac{I_{t-2}}{Y_{t-2}}\right)$. Thus we tested if they are equal and both the nulls are easily accepted. Further, $ln\left(\frac{I_{t-1}}{Y_{t-1}}\right)$ and lnY_{t-1} are close in magnitude but opposite in signs. Therefore, we tested the null of unit income elasticity and it was easily accepted. Thus we obtain equation (6b) with these restrictions which is our preferred GETS equation. Note that the two crucial variables, the income which has the unit elasticity and the interest rate are both highly significant. The coup and expected growth in inflation rate seem to have a significant negative impact on private investment.

The χ^2 summary statistics are good and the SER is high at 0.15, which is not far from the past empirical studies on Fiji. Although the SEE is low in Murphy, his estimates show signs of the first order serial correlation. Figure-1 shows the actual and fitted values of the growth of the investment ratio and indicates that the model tracks oscillations reasonably well given the dynamic nature of investment.[3]

FIGURE 1

Actual vs. Predicted Values



We also tested for the temporal stability of (6b) and neither the CUSUM nor the CUSUM SQUARES tests indicates any instability

[3] A fit of the actual vs. predicted values of the growth of the investment ratio gives $\bar{R}^2$ of 0.744 and the SEE of 0.128. It has a slope of 1 and the constant term is zero.

Table 1

Table 2: GTS and ECM Equations

	6a	6b	8a	8b
Constant	-11.169 [-1.29]	-8.031 [-6.20]*	-6.655 [-6.30]*	-6.693 [-7.81]*
Trend	-0.053 [-1.50]	-0.038 [-3.52]*	0.041 [5.14]*	0.038 [7.00]*
$\ln Y_{t-1}$	1.390 [1.14]	0.949 [6.11]*		
$\ln\left(\frac{I_{t-1}}{Y_{t-1}}\right)$	-1.006 [-5.77]*	-0.949 [-6.11]*		
RRL_{t-1}	-0.047 [-2.36]*	-0.057 [-3.14]*		
$\Delta\ln\left(\frac{I_{t-2}}{Y_{t-2}}\right)$	-0.240 [-1.92]**	-0.212 [2.49]*	-0.266 [-2.16]*	-0.261 [-2.88]*
$\Delta\ln\left(\frac{I_{t-4}}{Y_{t-4}}\right)$			-0.278 [-2.07]**	-0.261 [-2.88]*
$\Delta^2 \ln P_t$			-7.943 [-3.34]*	-7.899 [-5.00]*
$\Delta^2 \ln P_{t-1}$	-8.344 [-3.85]*	-7.627 [-3.75]*	-13.296 [-5.84]*	-13.374 [-6.40]*
$\Delta^2 \ln P_{t-2}$	-4.147 [-1.88]**	-4.424 [-2.16]*	-7.862 [-3.38]*	-7.899 [-5.00]*
$\Delta \ln Y_t$	-1.616 [-1.81]**	-1.872 [-2.85]*	-2.544 [-4.14]*	-2.589 [-4.81]*
ΔRRL_t	-0.083 [-3.14]*	-0.057 [-3.14]*	-0.118 [-3.67]*	-0.119 [-4.12]*
ΔRRL_{t-4}			0.050 [2.60]*	0.050 [2.93]*
COUP	-0.268 [-1.67]	-0.212 [2.49]*	-0.169 [-1.53]	-0.119 [-4.12]*
ECM_{t-1}			-0.682 [-6.19]*	-0.688 [-7.75]*
$\bar{R}^2$	0.657	0.671	0.718	0.761
SEE	0.149	0.146	0.138	0.127
$\chi^2(sc)$	3.370 [0.07]**	0.310 [0.58]	4.529 [0.03]*	2.590 [0.11]
$\chi^2(ff)$	0.045 [0.83]	0.116 [0.73]	0.238 [0.63]	0.202 [0.65]
$\chi^2(n)$	2.231 [0.33]	2.45 [0.29]	0.710 [0.70]	1.154 [0.56]
$\chi^2(hs)$	0.430 [0.51]	0.205 [0.65]	0.051 [0.82]	0.161 [0.69]

at the 5% level. The stability test results are given Figures-3 and 4 below.

FIGURE 2

CUSUM TEST-6b

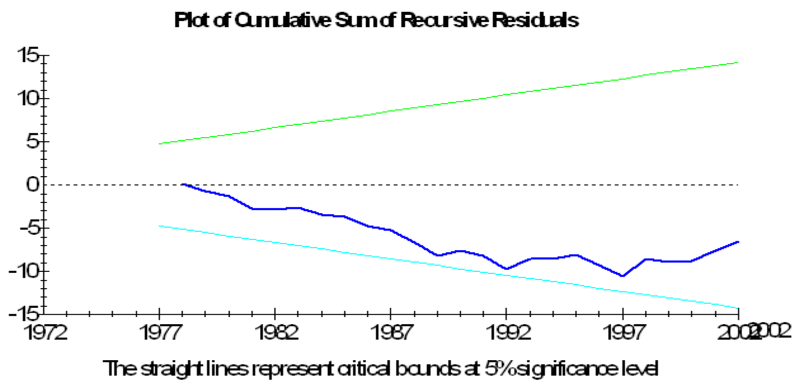
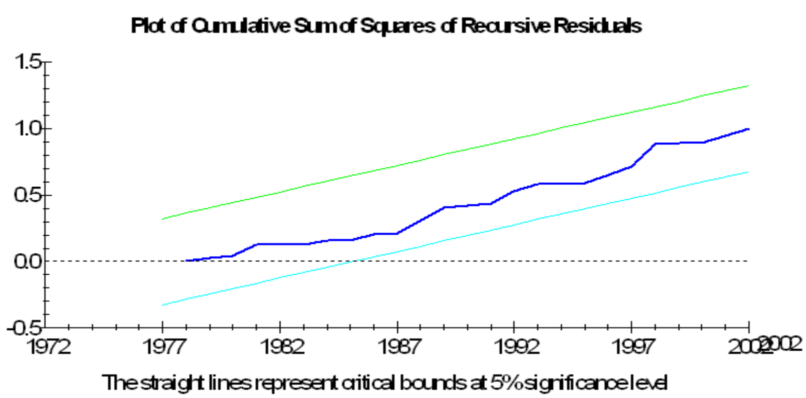


FIGURE 3

CUSUM SQUARES TEST-6b



4.4.2 THE JML APPROACH

In this section, we report our results obtained with the JML procedure. We conducted the cointegration test on $ln\left(\frac{I_t}{Y_t}\right)$, RRL_t and lnY_t by treating ΔlnP_t and COUP as exogenous variables with an intercept and a trend term in a VAR (4) framework. The AIC suggested the lag length of 2, while the SBC indicated the lag length of 4 periods. Given our small sample size, we adopted the 2 period lag length for the VAR. Both the eigenvalue and the trace statistic rejected the null of no cointegrating vectors. However, the eigenvalue accepted the alternative of at least one cointegrating relationship. The eigenvalues test statistics were 28.84 (25.42) for the null that there were no cointegrating vectors and 18.42 (19.22) for the null of at least one CV. The trace statistics suggested that there were two cointegrating equations. The trace statistics were 55.64 (42.34) for the null of no long run relationship and 8.38 (12.39) for at least 2 CVs. Thus we tested for two cointegrating vectors but the second CV was not meaningful. It had a large output elasticity and incorrect sign for the real rate of interest elasticity. The only cointegrating vector implied by the eigenvalue normalized on $ln\left(\frac{I_t}{Y_t}\right)$ is:

$$(-1.000 ln\left(\frac{I_t}{Y_t}\right) + 1.095\ lnY_t - 0.154\ RL_t - 0.040\ T) \qquad (7)$$

The implied long-run elasticity of the investment ratio with respect to output is 1.1, which is not significantly different from our GETS results of unity. The real interest rate elasticity, at its mean rate of 2.80 percent, is -0.43 is also plausible although it is on the higher side then the GETS estimates.[4] However, as is required, we subjected the above CV to further exogeneity tests. Following Enders (2004) three implied parsimonious ECM equations are estimated with the one period lagged residuals from the above cointegrating relationship (ECM_{t-1}) being included as one of the dependent variables in each of the equations. The ECM_{t-1} term was only significant in the equation when the dependent variable is $ln\left(\frac{I_t}{Y_t}\right)$. The t-ratios for the ECM_{t-1} in each of the three equations, in order of $ln\left(\frac{I_t}{Y_t}\right)$, lnY_t and RL_t

[4] These are comparable other estimates such as by Hall and Jorgenson (1967) and Jorgenson and Stephenson (1967) who estimated an output elasticity of unity. Eisner and Nadiri (1968) estimated output elasticity of 0.70 and user cost of capital elasticity of -0.20. Bean (1981) found an output elasticity of 0.91 and the elasticity of UCK was -0.05. These results are cited form Baddeley (2003).

as being the dependent variables, were -3.722, -0.193, -0.045. Since the disequilibrium in $ln\left(\frac{I_t}{Y_t}\right)$ does not significantly affect lnY_t and RL_t, we treated these two variables as being weakly exogenous in the investment equation. Further, it was hard to interpret the above cointegrating relationship as the output or the long run equation for the real rate of interest.

In estimating our VECM model, we used the one period lagged residuals from the above cointegrating vector and applied GETS in the second stage of estimation. Starting with lags upto 4 periods and by sequentially deleting insignificant variables, we obtained our unconstraint parsimonious VECM model detailed in column (8a) of Table-1. Note that the error correction term is highly significant and suggest adjustment of around 68% in one year. The COUP dummy and the growth in inflation rate together with higher inflation expectations seem to have strong negative impact on investment. However, there are signs of first order serial correlation since χ^2_{sc} is significant at the 5% level.

To further improve our results, we imposed some parameter restrictions. We noted that, $\Delta ln\left(\frac{I_{t-2}}{Y_{t-2}}\right)$ and $\Delta ln\left(\frac{I_{t-4}}{Y_{t-4}}\right)$ together with $\Delta^2 lnP_t$ and $\Delta^2 lnP_{t-2}$ had similar signs and magnitudes, respectively. Moreover, the same was concluded for ΔR_t and the $COUP$ variable. Thus we tested if these paired restrictions are valid and the all the three nulls are accepted. We re-estimated (8a) with these restrictions and obtained our most preferred VECM model given in (8b). The SEE dropped to around 0.13 and most of the other variables gained significance. The ECM term is strongly significant but none of the summary statistics are significant at the 5% level. We plotted the actual vs. fitted values of growth of investment ratio in Figure-4 and our model seems to predict changes in the ratio reasonably well.[5]

The TIMVAR stability tests results shown in Figures-5 and 6 imply that our preferred investment function is temporarily stable.

[5] The fit of the actual vs. predicted values of the growth of the investment ratio gives an $\bar{R}^2$ of 0.828 and SEE of 0.107. The Slope is unity and the constant term is zero. These are close but preferred to the GETS results.

FIGURE 4

Actual vs. Predicted Values

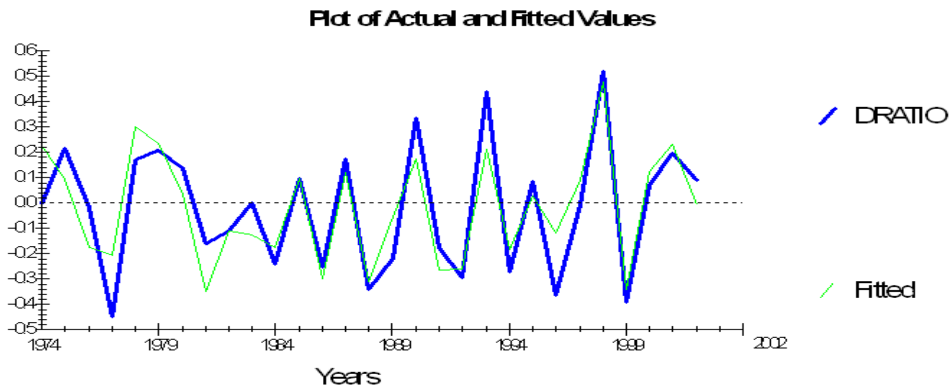


FIGURE 5

CUSUM TEST-8b

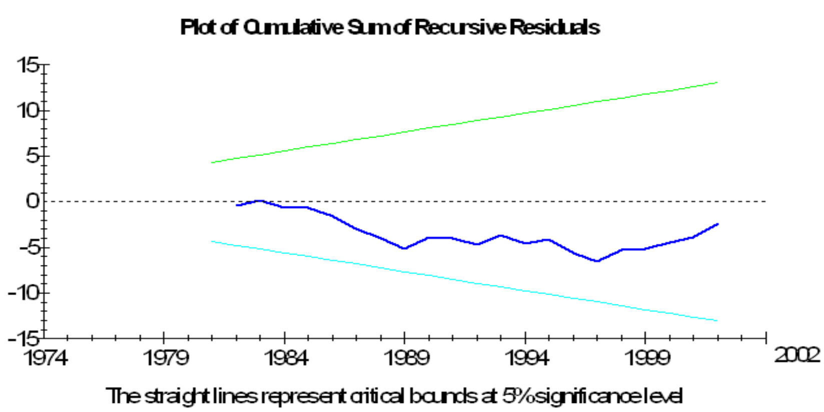
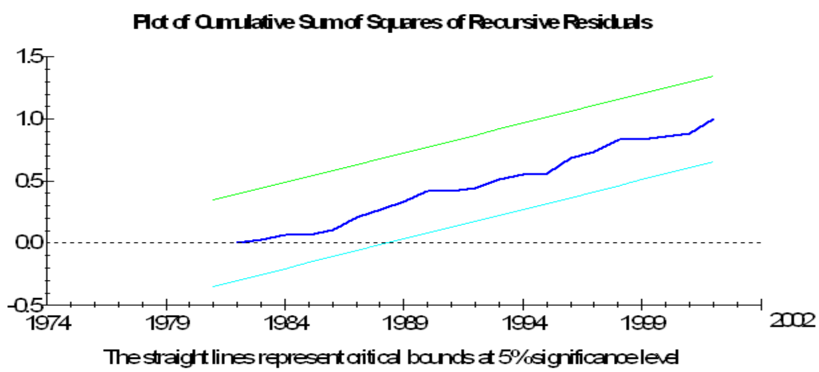


FIGURE 5

CUSUM SQUARES TEST-8b



4.5 CONCLUSION

In this chapter, we have conducted a brief survey of investment literature and noted previous studies on investment functions in Fiji. We estimated a variant of the accelerator model augmented with the real rate of interest as a measure of cost of capital. Our estimates show that both GETS and JML produced equally good results. The implied output elasticity is unity and the interest rate elasticity is as high as -0.40. With such an interest rate elasticity, the recent decision by the RBF to increase the rate of interest by 50 basis points will further reduce the already depressed investment ratio in Fiji. While the economy requires additional investment, this policy stance of the RBF is contradictory. We have noted that inflation expectations and the political coups have had significant negative impact on investment. While it is hard to quantify the impact of accelerating inflation expectations, the coup seems to have a permanent negative impact of around 20 pps on investment ratio.

In selecting the best equation for our macroeconometric model the two preferred parsimonious equations, (6b) and (8b) will subsequently be tested for in-sample simulations. The one that gives the best simulation results will be included in our final model.

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5 THE MONEY DEMAND EQUATION

5.1 INTRODUCTION

In this chapter, we explain demand for money (M1)[1]. It is noted that empirical work on demand for money continues with renewed vigor, for several reasons, in spite of some well established stylized facts about the income and interest rate elasticities. Firstly, demand for money and its stability have important implications for the selection of the monetary policy targets and for the conduct of monetary policy. According to Poole (1970) interest rate should be targeted when the LM curve is unstable and money supply should be targeted when IS is unstable. Otherwise there would be more instability. Since instability in the demand for money is a major factor contributing to instability in the LM, it is important to test for the stability of the money demand equation. Many developed countries have switched to interest rate targeting when their money demand functions have become unstable following the financial reforms in mid-1980s. However, many developing countries have also abandoned targeting money supply and started targeting the rate of interest, even though there is no significant evidence that their demand for money functions have become unstable. Secondly, estimates of demand for money are useful for understanding the limits to non-inflationary seignorage revenue and for the formulation of monetary policy targets. Finally, the unit roots and cointegrationliterature has made significant impact on modeling dynamic economic relationships and especially on the demand for money. Thus, there have been a large number of empirical studies, in both the developed and developing countries, to re-estimate demand for money and to investigate, afresh, its stability; see, Sriram (1999) for a survey.

In comparison to a large number of empirical works on the demand for money in other countries, there are only a handful of empirical studies in Fiji. Furthermore, these existing works seem to have limitations, both in the specification and estimation of the relationship.

[1] This chapter has been published as a research paper in the Pacific Economic Bulletin, June (2005): 72-86.

Therefore, we review the existing empirical works on Fiji with a view to provide a starting point for further work and highlight some key issues for further investigation. At the outset, it should be stated that the scope of this chapter is not exhaustive because a single chapter is not adequate to examine and resolve all the relevant issues.

This chapter is organized as follows: Sections 2 is a brief survey of empirical works on demand for money in Fiji. Sections 3 and 4 discuss our specification and empirical results, respectively, and conclusions are stated in the final section.

5.2 EMPIRICAL STUDIES IN FIJI

Empirical studies on demand for money in Fiji are only a handful. In 1982, the International Monetary Fund (IMF) conducted a study on money demand in Fiji. Using the then popular conventional estimation techniques, based on PAM, the IMF study found that, for narrow money, the income elasticity was close to unity and the interest rate elasticity was statistically insignificant.[2] However, the IMF results is doubtful because the real, instead of the nominal rate of interest was used to measure the opportunity cost of holding money. This has the implausible implication that the coefficient of the inflation rate should be positive. A similar error was also subsequently made by Jayaraman and Ward (2000) in their work on Fiji and by Ahmed (2001) for Bangladesh. There seems to be some confusion, because it might have been mistaken that since the real demand for money depends on real income, it should also depend on the real rate of interest. While inclusion of the real rate of interest may be appropriate when it is treated as a return on money, it is hard to justify when the real interest rate is used to measure the cost of holding money. For criticisms of the inclusion of real rate of interest, see Arrau et. al (1991), Sriram (1999), Katafono (2001) and Rao and Singh (2005c).

Luckett (1987) has estimated a money demand equation for Fiji for the period 1978-1985 using the IMF methodology. In order to increase the sample size and estimate with quarterly data, he has used the industrial production index as the scale variable. Alternative measures of the rate of interest used were: unutilized credit limits, liquid assets margin to deposit ratio and loans and advances to deposit ratio. However, these proxies themselves depend on money balances, as Katafono (2001) has pointed out, cause possible endogenous variable bias. Luckett found that both the income and interest rate elasticities

[2] Unfortunately we could not get a copy of this publication and our observations are based on Katafono (2001).

were significant. His estimates of income and interest rate elasticities were, respectively, 0.132 and -0.128 for M1. It may be noted that his estimate of income elasticity is far below the expected value of unity. Subsequently, Kanbur, in an unpublished paper, extended Luckett's work using the PAM framework. He found a significant positive, but less than unit income elasticity of 0.130 for narrow money and an insignificant interest rate elasticity of -0.051. Joynson (1997) has used time series econometric methods, for the first time in Fiji, to estimate the demand for money with the Johansen cointegrationtechnique. However, his work was not available to us for further review.

Murphy (1992) estimated a standard demand for money equation as a proportion of gross national expenditure (both in levels) in his macroeconometric model for Fiji. Initially he found an implausibily small coefficient for the rate of interest, which he later constrained to -0.10 and claims to have obtained an interest rate elasticity of -0.20. However, the demand for money equation had only a minor role in his model since he assumed that money demand was accomodated at the given rate of interest. The sample period was 1974-1986 and the SER was 0.08.

More recently there have been two studies. Jayaraman and Ward (2000) have estimated a quarterly model for the demand for broad money and found that it is stable for the period 1979(Q1) to 1996(Q4). Their estimates of long-run income and real interest rate elasticities were 0.987 and 0.022 respectively. Income elasticity was insignificant at the conventional levels the interest rate elasticity, measuring the effect of return on quasi money, was positive and significant with a t ratio of 2.05. In their justification of the positive interest rate coefficient, Jayaraman and Ward argued that the coefficient of the real rate of interest was positive because its positive effect, as the return on quasi-money, seems to have dominated its negative effect, as the cost of holding narrow money. However, as Katafono (2001) has pointed out, their finding that the demand for money in Fiji is stable – with generated quarterly GDP data – is of little use for policy because it is not possible to forecast the demand for money since quarterly estimates of GDP are not available in Fiji. Katafono's reservations on Jayaraman and Ward's work are further justified since it is hard to accept their conclusion that the monetary authorities in Fiji should target broad money because their estimated income elasticity of the demand for broad money is insignificant.

Given such limitations in these earlier works, a more recent study by Katafono (2001) stands out as a significant contribution and a good starting point for further work in Fiji and perhaps in the other PICs. Therefore, in the rest of this section, we shall review her work in some detail. Katafono has applied time series econometric techniques and her systematic approach is refreshing. She has estimated the demand functions for narrow, quasi and broad money in Fiji for the period 1975 to 1999, utilizing the existing annual data. However, the demand for narrow money, i.e., M1 has received relatively more attention in her work. Since our objective is to estimate and analyze demand for M1, we only review this part of her work. It is noted that Katafono has a good survey of demand for money in both the developed and developing countries. She has used a standard specification of the demand for money in the semi logarithmic form:

$$ln\Big(\frac{M1_t}{P_t}\Big) = \alpha_0 + \alpha_1 lnY_t + \alpha_2 SVR_t + \alpha_3 TBR + \alpha_4 lnREER_t + \epsilon_t \quad (1)$$

where M1 is nominal narrow money balance, P is price level (CPI), SVR is the nominal rate of interest on saving deposits, TBR is the nominal treasury bill rate, REER is the real effective exchange rate and ϵ is an *iid* error term.

Following the unit root tests which showed that these variables are I(1) in levels, she has conducted cointegrationtests on these variables with the JML approach and found that there is one cointegratingvector and interpreted it as the demand for money after conducting the usual causality tests. However, these tests did not conclusively establish that money does not Granger cause the two interest rates. In spite of this, as is common in many empirical works on the demand for money, she has interpreted the cointegratingvector as the demand for money because no other sensible alternative interpretation was possible. The long-run equilibrium money demand function implied by the JML approach is:

$$\begin{aligned} ln\Big(\frac{M_t}{P_t}\Big) = & -2.964 + 0.610\ lnY_t - 0.190\ SVR_t \\ & + 0.104\ TBR - 0.048\ lnREER_t \end{aligned} \quad (2)$$

Instead of estimating the short-run dynamic adjustment relationship with the lagged residuals of equation (2), where the parameters in the cointegratingequation are estimated efficiently with a systems method, she has estimated, afresh with OLS a variant of this equation based on GETS. Consequently, in Katafono's two estimates there are some minor differences in the estimated long run coefficients with GETS and JML. It would have been valuable if she has estimated a parsimonious dynamic adjustment equation with the lagged residuals from the cointegratingequation for comparisons. The implied long-run relationship of her GETS estimates is:

$$ln\left(\frac{M_t}{P_t}\right) = 0.511\ lnY_t - 0.104\ SVR_t + 0.004\ TBR \\ - 0.150\ lnREER_t \quad (3)$$

It can be seen that there are only small differences in the income and interest rate elasticities obtained with JML in equation (2) and GTS in equation (3) and their coefficients are correctly signed. The coefficients of TBR are contrary to expectations although the coefficients of REER are correctly signed. However, Katafono repeatedly states that the sign of the coefficients of SVR should be positive. This is contrary to what she has found and also with the usual expectation that, in the demand for narrow money, the rate of interest on time and saving deposits as the price of holding money (M1) should in fact be negative. However, the coefficients of TBR are positive in both equations and this may be due to some colinearity between these two rates of interest. Perhaps Katafono should have re-estimated both her equations by deleting TBR, but this is only a minor weakness in her work. The major problem with her two estimates, however, is that they imply implausibly low income elasticities of about 0.5, contrary to her claim that it is close to unity. Moreover, her final estimate of the demand for money is also found to be temporally unstable. In conclusion it may be said that in spite of some limitations, Katafono's work provides many useful insights and therefore a good starting point for further work. In particular, it is important to further investigate her estimates of the income and interest rate elasticities and her finding that the money demand function for Fiji is temporally unstable because they have important implications for the conduct of monetary policy.

5.3 OUR SPECIFICATION AND RESULTS

Our money demand function is a conventional demand equation where demand for real narrow money is expressed as a function of real income and the nominal rate of interest. The interest rate represents the opportunity cost of holding money. Thus the basic specification is:

$$ln\left(\frac{M1_t}{P_t}\right) = \alpha_0 + \alpha_1 ln\ Y_t + \alpha_2 RS_t + \epsilon_t \quad (4)$$

where M1 is narrow money consisting of currency in circulation and demand deposits, P is the GDP deflator, Y is the real GDP measured at factor cost and RS is the nominal 1-3 years weighted average interest rate on time deposits and ϵ is an *iid* error term. Our sample period extends from 1971 to 2002. Definitions of the variables and sources of data are in Appendix A.

It may be noted that in the earlier studies on demand for money, notably Katafono (2001), the real effective exchange rate was also introduced as an explanatory variable without an adequate explanation of whether holding foreign exchange balances, as a substitute for domestic money, is a realistic option in Fiji. If that were a possibility, in addition to the real effective exchange rate, there should be a return variable, e.g. a weighted average of some deposit rates in the trading partner countries. We have ignored, however, this variable because we consider that foreign exchange holdings is not a realistic option in Fiji.

We first started with the tests for stationarity of the variables viz, $ln\left(\frac{M1_t}{P_t}\right)$, lnY_t and RS_t. The conventional unit root test statistics based on ADF and PP show that they are non-stationary in levels but are stationary in their first differences, see Appendix B for test results. We applied GETS followed by the JML to estimate the money demand equation. Therefore, in what follows we report our empirical results based on these two approaches.

5.3.1 THE GETS APPROACH

In this section we report out estimates based on the GETS approach. However, before we do so, it should be pointed out that we have added some dummy variables in estimating equation (4). First, a coup dummy variable (COUP) which is 1 since 1987 and zero in all other periods is expected to capture the political uncertainty effect on the demand for money. It is reasonable to expect that its coefficient would be positive because it is likely to increase holdings of precautionary balances. Second, there have been two devaluations in 1987 and 1998. Devaluations cause an anticipated increase in the prices of the imported goods, although there would be some lag between devaluations and the increase in the prices of imports. This is the well known exchange rate pass-through effect. The effects of devaluations, therefore, would be immediate but transitory. Immediately after devaluations, there would be a sudden increase in the purchase of imported goods, causing a shift from holding money to holding real goods. Therefore, the coefficient of this dummy variable (DEV) is expected to be negative in the demand for money function. Finally, the collapse of the National Bank of Fiji in 1996 might have caused loss of confidence and a shift of deposits away from the bank in particular. These confidence loss effects seem to have persisted for a while. Therefore, our NBF dummy variable is 1 from 1996 to 1998. To gain a degree of freedom, we have combined the negative effects of the two devaluations and the collapse of the NBF into a single dummy variable DEVNBF.

In Table-1 a few parsimonious versions of equation (4) based on GETS are reported. In 4a, in the second column, all the summary statistics are satisfactory, except that the functional form misspecification χ^2_{ff} (RESET) test is significant at the 5% but not at 1% level. The t-ratios (in the parentheses below the coefficients) indicate that the estimated income elasticity is insignificant even at the 10% level. Its p-value (not given in the table), however, is 0.11 imply that it is significant at a slightly higher level. The coefficient of time trend is also insignificant. It is noteworthy that the coefficients of the rate of interest and the coup dummy variable have the expected negative and positive signs, respectively, and are significant. The implied income elasticity, although insignificant, seems to be on a slightly higher side at 1.28. However, this is not unusual for the developing countries; see Table 14 in Jayaraman and Ward (2000) for the estimates of the income elasticities of some developing countries.

When this equation was tested for temporal stability with TIMVAR tests, the CUSUM test indicated that it is unstable from 1998 onwards, but the CUSUM SQUARES test showed that it is stable. To improve the summary statistics, we have added a devaluation dummy, for devaluations in 1987 and 1998. This did not improve the results and its coefficient was insignificant. We have then also added a dummy variable for the collapse of the National Bank of Fiji 1996 but this did not improve the results. However, when these two dummies are combined as DEVNBF, there was some improvement in the summary statistics, and estimate of the income elasticity decreased marginally to 1.20 but is significant only at 18.5% level. These results are given in equation (4b) in Table-2. The CUSUM test showed considerable improvement but indicated that there was still some instability in the demand for money since 1998. The CUSUM SQUARES test, however, did not show any temporal instability.

It may be noted that the trend variable remained highly insignificant in both equations. Although it is essential to include a trend variable in the VAR models, plots of real money, real output and the rate of interest show that these variables are not strongly tended in Fiji. Therefore, we tested for the constraint that the coefficient of the trend variable is zero. The computed $\chi^2(1)$ test statistics is 0.164 and significant only at 69%. Therefore, equation (4c) in Table-2 is estimated without the trend. It can be seen that all the summary statistics showed improvements except χ^2_{hs} for heteroscedasticity, which is now significant at 5% but not at 1% level. Three interesting changes are noteworthy. First, the estimate of income elasticity is almost unity.

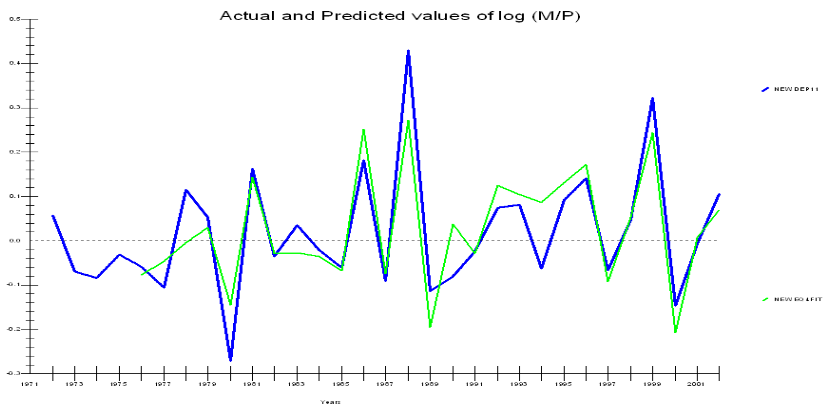
Table-1
GTS Short-Run Adjustment equations

	4a	4b	4c	4d	4e	4f
Intercept	-4.455	-3.966	-1.532	-2.147	-2.139	-2.047
	(-0.73)	(-0.53)	(-1.04)	(-5.87)*	(-5.98)*	(-5.34)*
Trend	-0.009	-0.008		-0.002		
	(-0.51)	(-0.36)		(-0.47)		
$ln\ (M/P)_{t-1}$	-1.151	-1.205	-1.189	-1.199	-1.169	-1.109
	(-5.07)*	(-5.10)*	(-5.13)*	(-5.31)*	(-5.51)*	(-5.21)*
$ln\ (Y/P)_{t-1}$	1.475	1.451	1.107	1.199	1.169	1.109
	(1.68)	(1.38)	(4.22)*	(5.31)*	(5.51)*	(5.21)*
RS_{t-1}	-0.034	-0.037	-0.036	-0.037	-0.034	-0.031
	(-2.48)*	(-2.75)*	(-2.79)*	(-2.74)*	(-2.93)*	(-2.53)*
$\Delta ln\ (Y/P)_t$	1.922	1.785	1.599	1.646	1.646	1.742
	(3.03)*	(2.65)*	(4.27)*	(3.78)*	(3.86)*	(4.71)*
$\Delta ln\ (Y/P)_{t-4}$	0.816	0.838	0.809	0.813	0.832	0.802
	(2.03)**	(1.63)*	(1.68)	(2.12)*	(2.23)*	(1.69)*
ΔRS_t	-0.052	- 0.055	-0.051	-0.053	-0.049	-0.045
	(-2.33)*	(-2.70)*	(-2.91)*	(-2.54)*	(-2.64)*	(-2.68)*
COUP	0.314	0.322	0.280	0.296	0.265	0.247
	(2.61)*	(2.45)*	(3.79)*	(3.61)*	(5.41)*	(4.07)*
DEVNBF		-0.030	-0.031	-0.031	-0.031	
		(-2.27)	(-2.36)*	(-1.08)*	(-1.12)	
$\overline{R}^2$	0.644	0.645	0.661	0.663	0.677	0.673
SEE	0.087	0.087	0.085	0.085	0.081	0.083
χ^2_{sc}	0.713	0.004	0.111	0.060	0.033	0.265
	(0.40)	(0.95)	(0.74)	(0.81)	(0.86)	(0.61)
χ^2_{ff}	4.578*	4.329	3.553	3.55	3.33	3.461
	(0.03)	(0.04)	(0.06)	(0.06)	(0.07)	(0.06)
χ^2_n	0.040	0.088	0.087	0.107	0.079	0.178
	(0.98)	0.96)	(0.96)	(0.95)	(0.96)	(0.92)
χ^2_{hs}	3.376	2.827	3.955	3.658	3.741	4.408
	(0.07)	(0.09)	(0.05)	(0.06)	(0.05)	(0.04)

t-ratios are in paranthese below the coefficients. For the χ^2 test statistics p-values are in the parantheses. $*$ and $**$ signify 5% and 10% significance levels respectively. In equations where χ^2_{hs} is significant, we have used the Newy-West adjusted standard errors.

FIGURE 1

ACTUAL AND PREDICTED VALUES FORM EQUATION 7d



Second, the functional form misspecification χ^2_{ff} statistic is insignificant at 5% level. Third, the Newy-West adjusted standard errors indicate that the devaluation and NBF dummy is significant and has the expected negative sign.

Encouraged by this result we tested for the constraint that the income elasticity of demand for money is unity with and without the trend variable. The computed $\chi^2(1)$ test statistics for this constraint are 0.080 and 0.323 and significant at 78% and 57% respectively. Therefore, equations (4d) and (4e), with and without trend, are estimated with the constraint of unit income elasticity. It can be seen that both these equations are well determined. None of the χ^2 summary statistics are significant at the 5% level and all other coefficients, except those of the dummy variable, are also significant at the 5% level.

Finally, since the devaluation dummy is not significant, we deleted it and re-estimated equations (4d) and (4e). While this did not make any difference to the estimates of these two equations, the CUSUM test for the equation with trend showed instability from 1998. However, the more powerful CUSUM SQUARES TEST showed no instability. In the equation without trend, given as equation (4f) in Table-2, neither stability test showed any instability. It is hard to determine which of these six equations is the best since they all have similar summary statistics and close SERs. The constrained equation (4e) has the lowest SEE of 0.081. However, we prefer equation (4d) because of the presence of the trend variable. The actual and predicted values of the change in the logarithm of real money of (4d) are plotted in Figure-3 below and it can be seen that the fit is fairly reasonable.[3]

[3] A regression between the actual and fitted values showed that the intercept is zero ($-0.91E^{-7}$) and the slope is unity. However, $\overline{R}^2 = 0.755$ and SER=0.072.

When 4d equations are subjected to the TIMVAR tests both the CUSUM and CUSUM SQARES tests indicated no temporal stability. These are given in Figures 2 and 3 below.

FIGURE 2

CUSUM TEST FOR EQUATION 4d

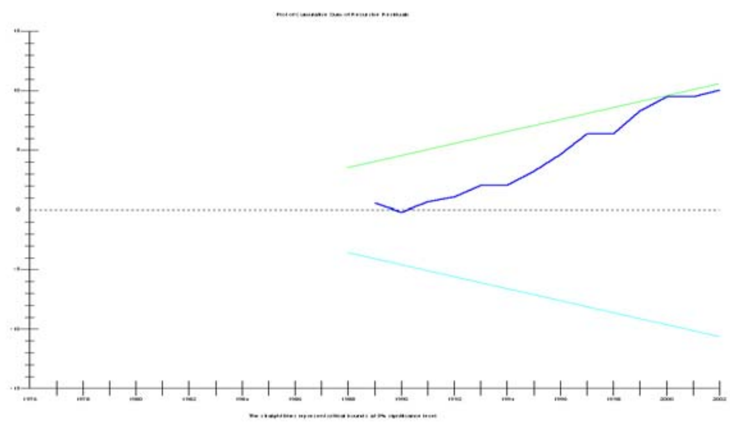
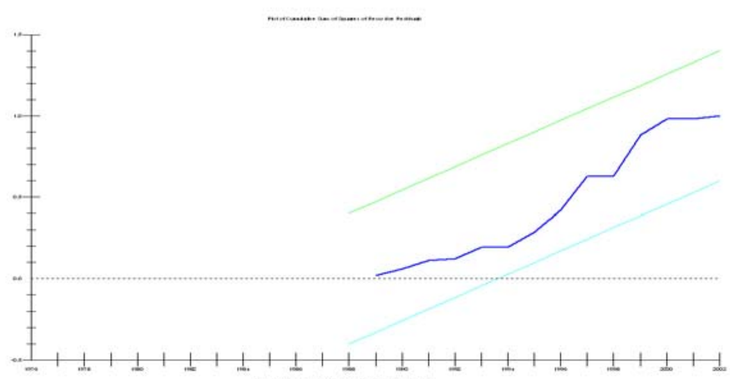


FIGURE 3

CUSUM SQUARES TEST FOR EQUATION 4d



5.3.2 THE JML APPROACH

We now report the results obtained with the JML procedure. We first tested for the optimum lag length of the VAR with a 4^{th} order model, by using the unrestricted VAR option. The I(0) variable selected are intercept, time trend and the two dummy variables used earlier COUP and DEVNBF. The AIC reached a maximum of 42.65 for VAR(2) but the SBC reached a maximum of 26.75 for VAR(1). Since our sample size is small, we have selected VAR(1). Furthermore, in our subsequent cointegrationtests we could not reject the null of no cointegratingvector with VAR(2). We postpone the Granger causality tests at this stage until we test for the number of the cointegratingvectors. We proceeded to test for the existence of the cointegratingvectors. These are conducted with unrestricted intercept and no trend option. The JML estimates implied that the null of no cointegration can be rejected for VAR(1) in which the null that the number of cointegrating vectors is zero, is rejected by the trace test statistic only at the 10% level. The computed value is 28.98 and the 10% critical value is 28.78. The null that there is one cointegrating vector is accepted by the eigenvalue and trace test statistics at the 95% level. The single cointegrating vector, normalized on money, obtained with JML is:

$$ln\left(\frac{M_t}{P_t}\right) = 1.133 ln\ Y_t - 0.037 RS_t \qquad (5)$$

We have conducted weak exogeneity tests for the null that money does not Granger cause income and the rate of interest. The computed $\chi^2(2)$ test statistic for the weak exogeneity test, with p value in the parenthesis, is 6.04 (0.049).Thus the null can be accepted only at the 1% but not at the 5% level. Subject to these limitations, it seems reasonable to interpret this single cointegrating vector as the demand for money, because no other sensible interpretation that the dependent variable is output or the rate of interest seems plausible. Therefore, in equation (5) the cointegrating vector is normalized on real money. The two crucial coefficients of income and rate of interest have the expected signs and magnitudes. The estimated income elasticity of demand for money is almost unity at 1.133, in comparison to an estimate of about 0.7 estimated by Katafono, using the JML procedure. This supplements the null of unit income elasticity in our GETS equation. The implied interest elasticity, at the mean interest rate of 6.97 is -0.286 is also plausible. These elasticities are comparable to similar recent estimates for India by Pradhan and Subramanian (2003) and Hafer and Kutan (2003) for Philippines.

In developing an appropriate VECM model, we adopted GETS in the second stage by including one period lagged residuals from the above cointegrating vector (ECM_{t-1}) as one of the dependent variables. We started with lags up to 4 periods and using the variable deletion tests in Microfit 4.1 arrived at the following parsimonious specifications.[4]

[4] In all the following equations t values are given below the coefficients in parentheses and p values are given in the parentheses for the χ^2 summary statistics. 5% and 10% significance is indicated with * and ** respectively.

$$\begin{aligned}\Delta ln\left(\frac{M_t}{P_t}\right) = &- 2.952 - 1.079\ ECM_{t-1} + 1.136\Delta lnY_t - 1.246\Delta lnY_{t-1} \\ &(-6.38)^{*} \quad (-6.22)^{*} \qquad (3.07)^{*} \qquad (-2.86)^{*} \\ &- 0.827\Delta lnY_{t-2} - 0.826\Delta lnY_{t-4} - 0.039\Delta RS_t - 0.002T \\ &(-2.18)^{*} \qquad (2.84)^{*} \qquad (2.62)^{*} \qquad (-0.47) \\ &+ 0.035\Delta RS_{t-1} + 0.269COUP - 0.119DEVNBF \\ &(3.08)^{*} \qquad (4.36)^{*} \qquad (1.76)^{**} \end{aligned} \tag{6}$$

$$\overline{R}^2 = 0.825, SEE = 0.061 \quad Period : 1976 - 2002$$

$$\chi^2_{sc1} = 0.411\ (0.52), \chi^2_{ff} = 5.68^{*}\ (0.02)$$

$$\chi^2_{n} = 0.684\ (0.71), \chi^2_{hs} = 0.780\ (0.38)$$

The summary statistics of this equation are good and a noteworthy feature of this equation is that it has a lower SEE of about 0.06 compared to 0.08 in all earlier estimates, including the estimates by Katafono. However, it may be noted that the functional form misspecification χ^2_{ff} test is significant at 5% but not at 1% level. This is not unusual for dynamic equations because it is hard to claim that the complex nature of dynamic adjustments can be adequately captured with linear specifications and limited data. All the coefficients are significant except that of the time trend. The combined devaluation and NBF dummy is significant at 10% level. When we tested separately for the significance of the two devaluations in 1988 and 1997 as well as the failure of the National Bank of Fiji, the second devaluation seems to have had a larger impact. Therefore, the above equation is re-estimated with a dummy variable only for the second devaluation and its coefficient is significant at the 10% level. The functional form misspecification test statistic deteriorated somewhat but still insignificant at the 1% level. These estimates are given below.

$$\begin{aligned}\Delta ln\left(\frac{M_t}{P_t}\right) = &- 2.952 - 1.079\ ECM_{t-1} + 1.136\Delta lnY_t - 1.125\Delta lnY_{t-1} \\ &(-6.38)^{*} \quad (-6.22)^{*} \qquad (3.07)^{*} \qquad (-2.86)^{*} \\ &- 0.827\Delta lnY_{t-2} + 0.827\Delta lnY_{t-4} - 0.038\Delta RS_t - 0.002T \\ &(-2.18)^{*} \qquad (2.84)^{*} \qquad (-2.62)^{*} \quad (-0.475) \\ &+ 0.035\Delta RS_{t-1} + 0.269COUP - 0.119DEV2 \\ &(3.08)^{*} \qquad (4.36)^{*} \qquad (-1.75)^{**} \end{aligned} \tag{7}$$

$$\overline{R}^2 = 0.825, SEE = 0.06 \quad Period : 1976 - 2002$$

$$\chi^2_{sc1} = 0.411\ (0.52), \chi^2_{ff} = 5.68\ (0.02)^*$$

$$\chi^2_{n} = 0.684\ (0.71), \chi^2_{hs} = 0.780\ (0.38)$$

It may be noted from these estimates in equations (6) and (7) that it is possible to reduce further the number of estimated coefficients to increase the degrees of freedom. The positive coefficient of ΔlnY_t is close in absolute values of the coefficient of ΔlnY_{t-1}. Furthermore, the coefficients of ΔRS_t and ΔRS_{t-1} are close and opposite in sign. Similarly the coefficients of ΔlnY_{t-2} and ΔlnY_{t-4} are close but opposite in sign as well. When these four restrictions are tested, all the nulls that their paired sum equals zero were easily accepted. The ultra parsimonious and our preferred equation based on these restrictions is:

$$\begin{aligned}
\Delta ln\left(\frac{M_t}{P_t}\right) = & -3.047 - 1.114\ ECM_{t-1} + 1.114(\Delta lnY_t - \Delta lnY_{t-1}) \\
& (-10.94)^* \quad (-11.05)^* \qquad (11.05)^* \\
& -0.820(\Delta lnY_{t-2} - \Delta lnY_{t-4}) - 0.039(\Delta RS_t - \Delta RS_{t-1}) \\
& (-3.59)^* \qquad\qquad\qquad\qquad (6.43)^* \\
& +0.279COUP - 0.114DEV2 - 0.002T \\
& (5.93)^* \qquad\qquad (1.93)^{**} \qquad (-0.706)
\end{aligned} \tag{8}$$

$$\overline{R}^2 = 0.857, SEE = 0.055 \quad Period: 1976-2002$$

$$\chi^2_{sc1} = 0.169\ (0.68), \chi^2_{ff} = 3.94\ (0.05)$$

$$\chi^2_{n} = 1.053\ (0.59), \chi^2_{hs} = 0.642\ (0.42)$$

The summary statistics of this equation are impressive and the estimated coefficients are similar to those in the previous two equations. There is a marginal reduction in the SER from 0.06 to 0.055. When this equation was tested for temporal stability neither the CUSUM nor CUSUM SQUARES test showed any instability. The plots from these two tests are given below in Figure-5 and Figure-6. The predicted and actual values from equation (8) are plotted in Figure-4.

Finally, both our most preferred equations, i.e, (4d) and (8) will subsequently be included in our complete macroeconometric model. The selection of the one to be retained in the model depends on their relative performance in the simulation exercise.

FIGURE 4

ACTUAL AND FITTED VALUES FROM EQUATION 11

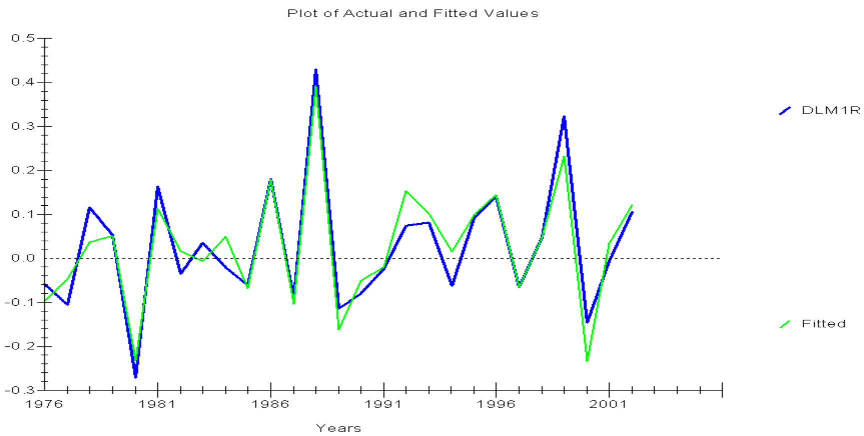


FIGURE 5

CUSUM TEST FOR EQUATION 11

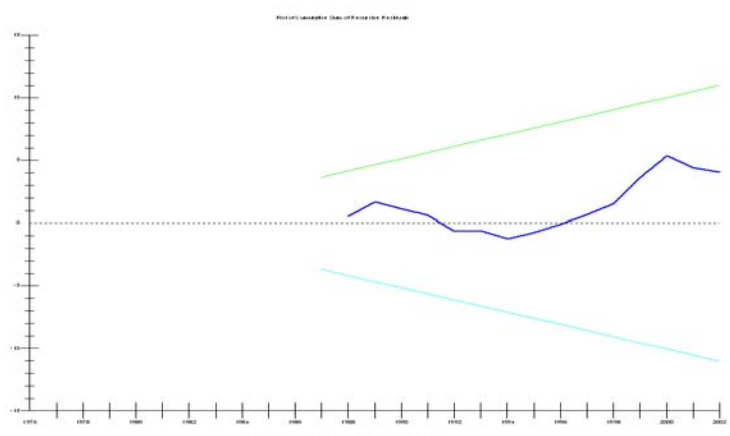


FIGURE 6

CUSUM SQUARES TEST FOR EQUATION 11

5.4. CONCLUSION

In this chapter, we have surveyed earlier works on the demand for money in Fiji. It is noted that Katafono's work has many merits and is a good starting point for further work. However, while hers is relatively free from some weaknesses compared to the other earlier works, it is also found to be in need of further improvements. Therefore, we have used two alternative time series methods to estimate demand for money in Fiji. Both the GETS and JML yielded similar cointegrating coefficients although their dynamic adjustment lags are somewhat different. The estimated income and interest rate elasticities are found to be well determined and their signs and magnitudes are consistent with *prior* expectations. Our results show that in Fiji the income elasticity of the demand for narrow money (M1) is unity and the interest rate elasticity is negative and about -0.35. Our second major finding is that the demand for money in Fiji is temporally stable. Therefore, our work raises doubts on the appropriateness of Reserve Bank of Fiji's monetary policy objective of targeting the rate of interest, instead of the stock of the real narrow money balances.

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6 THE TRADE EQUATIONS

6.1 INTRODUCTION

Trade plays a crucial role in growth process and there is a vast amount of empirical evidence on trade and growth. Therefore, the two important trade equations, viz the exports and imports are estimated in this chapter. The remarkable 9.8% growth for Fiji in the early 1990's has largely been attributed to export promotion policies implemented by the government following the political crisis of 1987. In Fiji, the average share of total trade (sum of exports and imports) on GDP over the last five years is around 75%. While traditional exports such as sugar, garments, gold, fisheries/marine products and other agricultural commodities dominate Fiji's exports, recently tourism has become the largest foreign exchange earner and contributes 20% to GDP. In terms of employment, directly or indirectly over 50,000 people depend on sugar and sugar cane production. However, most of these traditional exports have become highly incompetent in the world market as their productivity levels have declined. While reforms and other government initiatives are being implemented, international shocks such as the expiry of the trade agreements (LOME and SPARTECA) pose serious threats to sugar and garment industries. Imports make-up 44% of GDP and are largely for consumption purposes. However, raw materials and intermediate goods constitute a significant 20% of total imports. While exports performance is sluggish, imports have been increasing creating serious trade deficits which now stands at around 25% of GDP.

Although Fiji is an insignificant player in the world markets, exports play an important role in generating foreign exchange reserves to finance imports and to facilitate capital formation. Riedel (1984) (cited in Senhadji and Montenegro (1999)) suggests that developing countries have high relative price elasticities, and therefore, a real devaluation implies export promotion. This is in line with the Marshall-

Learner condition that a real devaluation leads to improvement in trade balance if the sum of the absolute value of relative price elasticities of exports and imports exceed unity. Further, if the income elasticity of exports is also high in developing countries, exports could be treated as the engine of growth. Therefore, proper estimation of price and income elasticities of trade equations are important. In particular, it is necessary to pay close attention to the specification of relative price. This is important because if the price variable is not properly specified, through the omitted variable effect, it may give biased estimates of the income and price elasticities. In some recent empirical studies, the relative price (in logs) is defined as: $ln\left[\frac{P_t}{P_F}\right]$ ignoring the effects of the exchange rate. Since the relevant relative price variable has three components viz. P_t, the price level in domestic country, P_F, the price level in the trading partner countries and E, the nominal exchange rate, defined as the price of a unit of foreign currency expressed in domestic currency, an increase in E implies a depreciation of domestic currency and a proportionate decrease in relative price. Therefore, if we assume that the only other explanatory variable is foreign income (YT), a log-linear exports equation could be specified as:

$$lnX_t = \alpha_0 + \alpha_1 ln\left[\frac{P_t}{E_t \times P_{Ft}}\right] + \alpha_2 lnYT_t \qquad (1)$$

It is clear from (1) that a 1% decline in the relative price could be due to a 1% decline in P_t or a 1% increase in E or P_F. However, in some influential empirical works including those of the IMF -see for example, Senhadji (1998) and Senhadji and Montenegro (1999), E is ignored in the relative price variable. We shall refer to this as the IMF specification. Nonetheless, this procedure seems to be widely used to quickly obtain empirical results with simple techniques like the FMOLS and the ARDL procedures since inclusion of E seems to produce implausible results. Further, some studies have used the relative price in "split-form" by separating the two prices P_t and P_F; see for example Narayan and Narayan (2004). Since there is likely to be high collinearity between the two prices, the estimated coefficients will be distorted. In our sample of 1970-2002, the correlation between Fiji's export prices and its trading partners' export price is 0.948 which implies that the split-form specification is inappropriate.

The impact of omitting E on the estimated relative price and income elasticities are, *a priori,* not known. Maddala (1992) shows that the omitted variable bias could be computed by multiplying the coefficient of the excluded variable with the coefficient in a regression of the excluded variable on the included variable(s). Based on Maddala's approach, Rao and Singh (2005a) have shown that omitting E in the relative price leads to an over-estimation of the income elasticity by 40% to 60% using Fiji data. The under-estimation of the relative price elasticity is found to be small because the coefficient of E in the auxiliary regression is small. These misspecification have implications for growth policy based on trade promotions. If the income elasticity for example is over estimated, policy makers with the assumption that trade liberalization will bring fortunes to their economies, will not be wary of improving productivity and export competitiveness. Consequently, the deterioration of relative prices may overshadow the anticipated gains from trade leading to current account deficits.

In this chapter, apart from our conventional approaches of GETS and JML, we have also applied the FMOLS to estimate exports and imports equations for Fiji. However, although JML gave plausible point estimates of the two crucial elasticities for exports, they were not highly significant. In comparison, both GETS and FMOLS gave better and significant estimates of exports equation. The results, based on our specification of relative prices show that the long-run income elasticity of exports is around unity and the relative price elasticity is -1.25. For imports, all the three approach indicate that the implied long-run income elasticity is around 1.20 and the relative price elasticity is close to 0.5.

This chapter is organized as follows: Section 2 is a brief survey of empirical works on trade equations. In sections 3 and 4, we discuss our specification and empirical results, respectively and the conclusions are stated in Section 5.

6.2 A BRIEF SURVEY OF LITERATURE

There are numerous studies on exports and imports for both the developed and developing countries. In most of these studies two important variables are emphasized, viz, the activity variable and relative prices. In exports equations, trading partner GDP or some measure of foreign demand conditions play a major role and in imports functions, domestic income is the key explanatory variable. While trade patterns are dominated by global demand conditions, relative prices are also important. Our measure of relative prices (in logs) is: $ln\left[\frac{P_t}{E_t \times P_{Ft}}\right]$. A similar approach was taken by Oskooee and Brooks (2003) who modeled the US exports and imports using the JML approach. They found that the long-run income and price elasticities for US were 3.35 and 3.10 for imports and 2.07 and -0.99 for exports, respectively.[1]

Senhadji (1998) and Senhadji and Montenegro (1999) have estimated imports and exports equations for 77 and 75 countries, respectively. In both their studies, they have used OLS and FMOLS to estimate the short and long-run price and income elasticities. However, they have used the IMF specification of relative prices and the activity variables used in both the equations are proxied by respective GDP less exports. For example, in exports equation, trading partners' GDP less exports are used and for imports, domestic GDP less domestic exports are taken. The implied long-run mean estimates of income and price elasticities of both the equations with alternative approaches are summarized in Table-1.

Senhadji's results show that while there were large variations in price and income elasticities across countries, on average, the short-run price and income elasticities for imports were 0.26 (0.19) and 0.45 (0.34), respectively.[2] In the long-run, however, the average price and income elasticities were 1.07 (1.06) and 1.45 (1.32), respectively. They also tested the null of unit income and price elasticities and found that

[1] While their specification of the relative price variable is correct, they have used an ad hoc approach for selecting the order of the VAR, based purely on the goodness of fit criteria. However, this procedure is somewhat restrictive and time consuming. Furthermore, their selected order of 3 is not much different from an order of 2 implied by the standard SBC and AIC tests. Therefore, one wonders whether it is worth computing the goodness of fit statistics by estimating the cointegrating equation and the ARDL to determine an optimal order of the VAR.

[2] The standard deviation are reported in brackets.

Table-1: IMF Cross-Country Survey
Imports and Exports Equations- Alternative Estimates

	OLS	FMOLS	FMOLS*	OLS	FMOLS	FMOLS*
$ln\left[\frac{P_t}{P_{Ft}}\right]$	0.32	1.08	1.07	-0.27	-1.02	-1.07
	(0.21)	(1.08)	(1.06)	(0.20)	(0.97)	(1.04)
lnY_t	0.56	1.45	1.46			
	(0.39)	(0.93)	(0.93)			
$lnYT_t$				0.59	1.47	1.45
				(0.35)	(0.85)	(0.84)

Estimated mean values of the implied long-run elasticities for imports are in the first three columns followed by those for exports. Standard deviations are reported below the coefficients. Small sample bias corrected estimates are in FMOLS*.

around 23% of their sample countries rejected the null of unit price and 41% rejected unit income elasticity at 10% level. Their results also indicate that industrial countries have significantly higher income and lower relative price elasticities than developing countries. However, they did not report the estimates for developed and developing countries separately.

Subsequently, Senhadji and Montenegro (1999) applied similar methodology and showed that the average short-run relative price and income elasticities for exports were -0.21 (0.19) and 0.41 (0.31), respectively, for a sample of 66 different countries. The standard deviations are in brackets. In the long-run, the price and income elasticities were -1.07(1.04) and 1.45(0.84), respectively. Although Senhadji and Montenegro did not report the estimated values for different geographical regions, their results indicate that the Asian countries have a significantly higher price and income elasticities than developed or other developing countries. This implies that for the Asian economies, export promotion polices are highly effective and exports are the engine of growth. They also suggest that other developing counties have lower price and income elasticities than developed economies and the African countries, in particular, have the lowest.

Although the above two IMF studies are comprehensive, it may be noted that both samples constitute a mixture of developed and developing countries. However, it would be more interesting to review some cross country studies based on developing economies. In this respect, Reinhart (1995) found that for her sample of 12 developing countries the average price and income elasticities for imports were -0.66 and 1.31, respectively. For these countries, she found that the price and income elasticities for exports were -0.44 and 1.99, respectively. However, we are unable to obtain her paper for further review and our observations are based on Senhadji's (1998) survey.

Studies on trade equations for Fiji are only a handful. Murphy (1992) estimated imports and exports equations for Fiji in his macroeconometric model using annual data from 1974-1986. He dis-aggregated exports into three major categories, viz sugar, other goods and travel, but treated imports as a composite good. Essentially he has used the PAM framework with expectations that real imports would adjust to their equilibrium levels. The equilibrium levels of both for exports and imports are computed from an optimization output equation in his model. His estimated imports equation is:

$$\begin{array}{l} \Delta lnRM_t = 0.016 + 0.382\ lnRM^* + 0.618\ lnRM_{t-1} \\ \qquad\qquad\quad (1.06)\ (2.73)^* \qquad\qquad (--) \end{array} \tag{2}$$

$$Period : 1974 - 1986$$

$$\bar{R}^2 = --, SER = 0.055, DW = 2.89$$

RM_t= Real imports of goods and services

RM_t^* = Equilibrium value of real imports

$(--)$ indicates that the statistics were not reported in the original paper

The exports equations are modeled as both demand and supply functions. The first two (sugar and other goods) are estimated as supply functions with a pre-specified speed of adjustment of 40% each. However, travel is further dis-aggregated into tourism and other services. While Murphy assumes that other services depends on tourism activities, he takes the view that demand for tourism depends on relative prices. His estimated tourism export demand equation is as follows:

$$\Delta lnX_t^T = -1.50 + 0.023T - 0.650\ ln\Big[\frac{P_t}{E_t \times P_{Ft}}\Big]$$
$$(0.540) \quad (3.06)^* \quad (1.79)^{**}$$
$$+ 0.713\ lnX_{t-1}^T$$
$$(1.85)^{**} \qquad (3)$$

$$Period : 1974 - 1986$$

$$\bar{R}^2 = --, SER = 0.055, DW = 2.89$$

X_t^T= Real expenditure on travel

P_t = Price level in Fiji (GDP deflator)

P_{Ft} = Price level in Australia (CPI)

E_t = Nominal exchange rate

While equation (3) is refreshing, he failed to include a relative price or an activity variable in other trade equations. Further the time series issues regarding PAMs are well known and his sample size of around 10-12 observations is very small. Nonetheless, this is a pioneering attempt and noteworthy, particularly, Murphy's approach of dis-aggregating exports is insightful.

Rogers (2000) modeled Fiji's imports using the unrestricted ECM procedure for 1968-1998. Although there are some limitations (see discussions below) in her methodology, the overall results are reasonable. Her estimated imports equation is as follows:

$$\Delta lnRM_t = -6.64 + 0.41\ lnPM_{t-1} + 1.29\ lnY_{t-1} - 0.73\ lnRM_{t-1}$$
$$(-2.62)^*(3.80)^* \quad (2.69)^* \quad (-3.76)^*$$
$$+ 0.90\Delta lnY_t + 0.53\Delta lnPM_t + 0.76\Delta RER_t$$
$$(2.94)^* \quad (2.46)^* \quad (2.83)^*$$
$$- 0.02\Delta TF_{t-1}$$
$$(1.94)^{**} \qquad (4)$$

$$Period : 1968 - 1998$$

$$\bar{R}^2 = 0.749, SER = 0.062$$

RM_t= Real imports of goods and services

TF_t = Average tariff rate

RER_t= Real effective exchange rate index of the Fiji's dollar

Y_t = Real GDP in 1995 prices

PM_t = Import price index, proxied by trading partners' weighted average export unit value index.

All variables, except TF and RER are in logarithms. Significance at 5% and 10% are indicated by * and ** respectively. None of the diagnostic χ^2 summary statistics (not reported here) are significant at 5% level. It may be noted that with an improper specification of relative price, the income and price elasticities are around 1.80 and 0.60, respectively.

Prasad (2000) applied a similar approach and estimated an exports equation for Fiji with annual data from 1968 to 1998. Her results are as follows:

$$\begin{aligned} \Delta lnX_t = & -5.502 + 0.012SS_t + 0.007SS_{t-1} + 1.213\Delta lnYT_t \\ & (-4.72)^* \quad (4.77)^* \quad (1.86)^{**} \quad (1.22) \\ & + 2.037\Delta lnYT_{t-1} - 0.398\ lnX_{t-1} + 0.972\ lnYT_t \\ & (-2.28)^* \quad (-4.37)^* \quad (--) \end{aligned} \tag{5}$$

$$Period: 1968 - 1998$$

$$\bar{R}^2 = 0.638, SER = 0.084$$

X_t= Real exports of goods and services

SS = average productivity of sugar, taken as the supply side shock

YT_t = Weighted average real GDP of Fiji's trading partners

All variables, except SS are in logarithms and none of the diagnostic χ^2 summary statistics (not reported here) are significant at 5% level.

However, there are some limitations in both the studies. The unit root test results (see Table-1 in both papers) need further attention. Specifically, Roger's findings that the real GDP (in levels) is stationary at 5% level is doubtful. However, it is well known that real GDP and most other macroeconomic aggregates are unit root variables in many countries. Second, it is not clear how the cointegrating vectors were estimated since there are no lagged error correction terms in either of their equations.

In spite of these limitations, Roger's results point to a strong association of import demand to real domestic income and import prices. The dynamics are captured by the movements in exchange rate, growth in real income, import prices and average tariff rate. Prasad shows that the implied long-run income elasticity of exports is around 2.45 but she did not explain why Fiji's exports are luxury goods for trading partner countries.

More recently, Narayan and Narayan (2004 and 2005) have estimated income and price elasticities for both exports and imports, respectively, for Fiji using various time series methods, viz, the ARDL approach, Dynamic Least Squares (DOLS) and FMOLS. They have used annual data for the sample period 1970-2002 for exports and 1972-1999 for imports, respectively. Their results show that the long-run income elasticity for exports is around 0.80, while that for imports ranges from 1.05 to 1.90. However, like other studies, there are problems in the specification of relative prices in both their estimates. Nonetheless, both studies have good surveys of literature on trade equations.

Given the limitations in these earlier studies, we re-estimate both exports and imports equations for Fiji using JML, GETS and FMOLS methods for the sample period 1970-2002 with proper specification of relative prices. We also apply the IMF specification of relative prices only to compare our results.

6.3 OUR SPECIFICATION

Both our exports and imports equations are conventional demand equations, where real quantities of imports and exports of goods and services are related to relative price and income variables. We treat both exports and imports as two separate composite goods although further dis-aggregation along the lines of Murphy would be valuable. However, this is outside the scope of our present study. Total exports are expected to respond positively to an increase in foreign income and similarly, imports are expected to increase with domestic income. A raise in the relative prices would lead to a decline in the demand for exports and increase Fiji's demand for imports. Further, a devaluation of the domestic currency would lead to an increase in exports and depress domestic demand for imports.[3] Therefore, our basic specifications for exports and imports equations are as follows:

$$lnX_t = \alpha_0 + \alpha_1 ln\Big[\frac{P_t}{E_t \times P_{Ft}}\Big] + \alpha_2 lnYT_t + \epsilon_t \tag{6}$$

$$lnRM_t = \beta_0 + \beta_1 ln\Big[\frac{P_t}{E_t \times P_{Ft}}\Big] + \beta_2 lnY_t + \phi_t \tag{6$'$}$$

where:
α_1 and β_1 are expected to be negative and positive values, respectively.

X_t = Quantity of exports, determined by nominal (FOB) export deflated with domestic export unit value index.

P_t = Domestic export unit value index (1995 = 100).

E_t = Nominal exchange rate - the price of a unit of foreign currency in terms of domestic currency.

P_{Ft} = Import weighted export unit value index of major trading partner countries in 1995 prices.

YT_t = Trade weighted real GDP of trading partners expressed in 1995 prices.

RM_t = Quantity of imports of goods and services determined by nominal imports deflated with P_F.

Y_t = Fiji's real GDP expressed in 1995 prices.

ϵ_t and ϕ_t are the error terms with usual classical properties.

All variables in both equations (6 and 6$'$) are tested for unit roots and are found to be I(1) in levels and I(0) in first difference; see Appendix B for details on unit root tests. Later it was necessary to include SS - a measure of supply shock which is I(1) in levels and stationary in their first differences as well.[4] A detailed description

[3] Under the IMF specification, the impact of a devaluation cannot be directly computed.

[4] The supply shock is proxied with average sugar productivity per hectare (in 000's tonnes) in Fiji. This measure of SS is consistent with Prasad (2000). However, the SS variable is I(1) with a longer lag structure of six periods, compared to short lag structures of other variables in the ARDL.

of the variables and the data sources are given in Appendix A. We applied JML followed by GETS and JML procedures. The results for exports are discussed below followed by imports which are discussed in the subsequent section.

6.4 EMPIRICAL RESULTS

6.4.1 THE EXPORTS EQUATION

6.4.1.1 THE JML METHOD

In this section, we report our estimates of exports equation using the three aforesaid methods for both the specifications of relative prices. The variables, lnX_t, $ln\left[\frac{P_t}{E_t \times P_{Ft}}\right]$ and $lnYT_t$ are subjected to the Johansen cointegration test together with an intercept and a trend term included as exogenous variables in a VAR(4) framework. Both the SBC and AIC suggest that VAR(1) is adequate and we selected with a restricted intercept and no trend option. Both the eigenvalue and the trace statistics reject the null of no cointegration, but indicate that there exists at least one cointegrating vector. The eigenvalue and the trace statistics are, respectively, 19.163(19.860) and 32.697(31.930) for the null that there is no cointegration and 8.349(15.870) and 13.534(20.180) for at least one long-run relationship. The 95% critical values are given in parenthesis and we have selected using trace test. The cointegrating vector normalized on lnX_t is given in column (a) of Table-2. Although, the two crucial elasticities are correctly signed, the relative price elasticity is not significant at conventional levels. However, the income elasticity is significant and plausible.

For the IMF specification, the null of no cointegration is rejected in favor of at least one long-run relationship. The eigenvalue and trace statistics are, respectively, 23.949 (22.040) and 38.402(34.870) for no cointegrating vectors and 8.067(15.870) and 14.453 (20.180) the null of at least one long-run relationship. This is also estimated with a restricted intercept and no trend term in the VAR(1) framework as both the SBC and AIC indicate that VAR(1) is adequate. Note that both the elasticities given in column (b) of Table-2 are correctly signed

Table-2: Implied Long-run Elasticities for Exports Our Alternative Estimates

	(a)	(b)	(c)	(d)	(e)	(f)
$ln\left[\frac{P_t}{E_t \times P_{Ft}}\right]$	-2.578		-1.248		-1.018	
	(0.67)		(-1.58)		(-3.27)*	
$ln\left[\frac{P_t}{P_{Ft}}\right]$		-1.357		-1.971		-1.024
		(2.38)*		(-5.55)*		(-4.74)*
$lnYT_t$	1.147	1.641	1.066	1.663	0.995	1.379
	(2.29)*	(6.33)*	(4.76)*	(81.06)*	(8.88)*	(15.88)*
$Const.$	2.431	0.056	2.361		2.536	0.974
	(1.11)	(0.05)	(2.50)*		(4.37)*	(1.99)*
SS					-0.001	-0.001
					(-0.12)	(-0.16)

The t-ratios are reported below the coefficients. Significance at 5% and 10% are indicated by * and ** respectively. Microfit 4.1 of Pesaran and Pesaran (1997) is used for estimation.

and are significant at 5% level.

There are some caveats to our JML results. The exogeneity tests show that both the relative price variables are weakly exogenous and the lagged ECM term is significant only at 11.8% and 10% levels, respectively, in the selected VARs. Therefore, both the JML estimates reported in Table-2 should be interpreted with caution. However, it should be noted that they only indicate that ignoring the exchange rate in the relative price variable leads to a substantial under-estimation of the absolute value of relative price elasticity, -2.578 against -1.357 and to an over-estimation of the income elasticity, 1.147 against 1.641.

In estimating the dynamic adjustment VECM equations, we used the lagged residuals from the two cointegrating equations (separately) and applied GETS in the second stage. Starting with lags upto 4 periods and by sequentially deleting insignificant variables we obtained our parsimonious VECM equations reported in Table-3. The dependent variable is ΔlnX_t. The first two columns detail the dynamic adjustments equations for our specification of relative prices. The unconstraint VECM is reported as (5a). Note that the estimates are reasonable with the error correction term having the correct negative sign with near 15% adjustments completed within a year. None of the summary χ^2 statistics, except the $\chi^2_{(ff)}$ are significant at 5% level.

TABLE-3
Dynamic Exports Equations

	JML		GETS		FMOLS	
	5a	5b	6a	6b	7a	7b
Constant	0.448	0.46	3.656	2.361	0.324	0.311
	[2.11]*	[2.25]*	-1.54	[2.50]*	[5.73]*	[6.50]*
Trend	-0.003	-0.004				
	[-1.32]	[-1.98]**				
$\ln X_{t-1}$			-0.126	-0.245		
			[-1.13]	[-2.12]*		
$\ln YT_{t-1}$			0.776	1.066		
			-1.4	[4.76]*		
$\ln\left(\frac{PD_{t-1}}{E_{t-1} * PF_{t-1}}\right)$			-3.8	-1.248		
			[-1.07]	[-1.58]		
$\Delta \ln X_{t-2}$	-0.236	-0.172	-0.313		-0.146	-0.157
	[-1.98]**	[-3.41]*	[-2.39]*		[-1.56]	[-5.34]*
$\Delta \ln YT_{t-2}$					-0.293	-0.31
					[-2.41]*	[-11.76]*
$\Delta \ln\left(\frac{PD_t}{E_t * PF_t}\right)$	-0.719	-0.73	-0.951	-0.757	-0.766	-0.752
	[-4.59]*	[-5.07]*	[-4.97]*	[-4.32]*	[-15.36]*	[-13.79]*
COUP					-0.312	-0.31
					[-15.27]*	[-11.76]*
ECM_{t-1}	-0.149	-0.172				
	[-2.36]*	[-3.41]*				
$RES1_{t-1}$					-0.174	-0.157
					[-3.04]*	[-5.33]*
SS_{t-1}	-0.004	-0.004				
	[-1.55]	[-2.50]*				
SS_{t-2}	-0.004	-0.004			-0.004	-0.004
	[-2.02]**	[-2.50]*			[-4.91]*	[-5.51]*
$\bar{R}^2$	0.66	0.683	0.603	0.479	0.815	0.817
SEE	0.084	0.081	0.092	0.103	0.062	0.061
$\chi^2(sc)$	3.841	1.95	0.712	0.004	1.959	1.819
	[0.05]*	[0.16]	[0.40]	[0.95]	[0.16]	[0.18]
$\chi^2(ff)$	0.135	0.302	0.111	0.044	1.066	0.641
	[0.71]	[0.58]	[0.74]	[0.83]	[0.30]	[0.42]
$\chi^2(n)$	0.346	0.078	2.031	4.72	0.662	0.813
	[0.84]	[0.96]	[0.36]	[0.09]	[0.72]	[0.66]
$\chi^2(hs)$	1.2	1.041	0.858	0.725	3.972	3.454
	[0.27]	[0.31]	[0.35]	[0.39]	[0.05]*	[0.06]

The t-ratios are indicated below the coefficients, except for the

χ^2 summary statistics which are the p-values. Significance at 5% and 10% are indicated by * and ** respectively.

To further improve our results, we incorporated a few parameter restrictions. Note that the coefficients of ECM_{t-1} and ΔlnX_{t-2} are similar in magnitudes and signs. Similar conclusions are drawn for SS_{t-1} and SS_{t-2}. Therefore we tested the null that these paired variables are equal and both the nulls are accepted. This gives our preferred parsimonious VECM model in (5b). Note that the SER has marginally increased and the χ^2 summary statistics have improved. The ECM term is also significant. The TIMVAR stability tests results (not presented here to conserve space) indicates temporal stability of the preferred VECM parsimonious equation.[5]

In Table-4, we report the dynamic exports equations for the IMF specification of relative price in (5c). Note that with a few restrictions, the dynamic structure is reasonable and the VECM term is significant. The SER is slightly lower at 0.07 and none of the χ^2 summary statistics are significant at 5% level. The $\overline{R}^2$ is higher than our preferred VECM equation. It seems that empirical works mostly favor the IMF specification because it produces relatively better goodness of fit and therefore smaller SERs.

---

[5] An in-sample fit of actual vs. predicted values of growth of exports has an $\overline{R}^2$ of 0.768 and the SER is 0.069. The fitted equation has an intercept of zero and the slope is unity.

Table-4: IMF Based Dynamic Exports equations

	5c	6c	7c
$Const.$	0.313 (3.21)*		0.401 (3.72)*
lnX_{t-1}		-0.324 (-3.42)*	
$lnYT_{t-1}$		1.663 (81.06)*	
$ln\left[\frac{P_{t-1}}{P_{Ft-1}}\right]$		-1.971 (-5.55)*	
ΔlnX_{t-1}	-0.207 (-2.94)*	-0.298 (-2.47)*	-0.486 (-2.94)*
ΔlnX_{t-2}	-0.207 (-2.94)*	-0.229 (-3.22)*	
$\Delta ln\left[\frac{P_t}{P_{Ft}}\right]$	-0.722 (-6.52)*	-0.919 (-7.68)*	-0.686 (-5.83)*
$\Delta ln\left[\frac{P_{t-1}}{P_{Ft-1}}\right]$		-0.229 (-3.22)*	-0.340 (-2.20)*
$COUP$	-0.138 (-2.84)*		-0.170 (-2.89)*
ECM_{t-1}	-0.138 (-2.84)*		-0.170 (-2.89)*
SS_{t-2}	-0.005 (-2.88)*		-0.006 (-2.91)*
$\overline{R}^2$	0.794	0.797	0.788
SER	0.065	0.065	0.066
χ^2_{sc}	2.935 (0.09)	0.048 (0.83)	0.873 (0.35)
χ^2_{ff}	0.882 (0.35)	0.004 (0.95)	1.838 (0.18)
χ^2_n	0.640 (0.73)	1.206 (0.55)	1.343 (0.51)
χ^2_{hs}	1.852 (0.17)	0.760 (0.38)	2.668 (0.10)

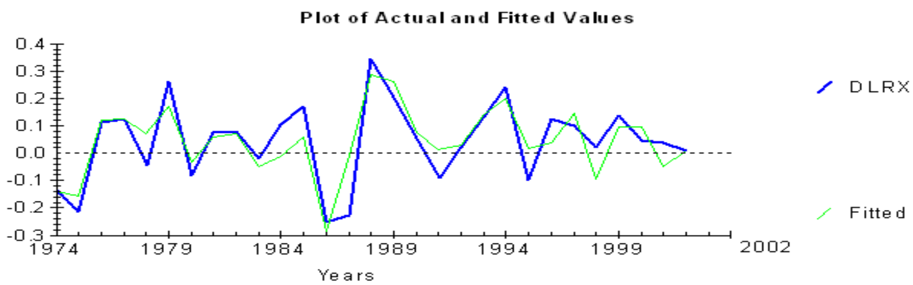
6.4.1.2 THE GETS APPROACH

In this section, we discuss our results obtained with GETS for exports. Note in the JML specification, the VARs were only meaningful with a restricted intercept and no trend option. Therefore, our GETS equation is estimated with the NLLS method in order to restrict the intercept terms for both the specifications of relative prices. Starting with lags up to 4 periods for the first difference variables and by sequential deleting the insignificant ones, we obtained the implied long-run income and relative price elasticities detailed in columns (c) and (d) of Table-2. Column (c) is for our specification of relative prices while (d) is that for the IMF version. Note that both the crucial elasticities of the two estimates are significant and have the expected signs. For our specification, the implied long-run income and relative price elasticities are around unity and -1.25, respectively.

The full GETS equations are reported in columns (6a) and (6b) of Table-3. In (6a), the SER is around 0.09 and the implied income and relative price elasticities are reasonable. However, they are significant at slightly higher than 10%. We noted that the inclusion of ΔlnX_{t-2} leads to the mild insignificance of the implied long-run elasticities and therefore it was excluded from the model. This gave (6b) which is our preferred GETS equation with better estimates of the two crucial implied long-run elasticities. For the IMF version, the estimates are in (6c), see Table-4 where the implied long-run income and price elasticities are -1.66 and 1.97, respectively. Note that GETS results also indicate that the IMF version gives biased estimates. The plot of actual vs. predicted values of our preferred equation are given in Figure-1 showing that the model predicts oscillations in exports reasonably well. The TIMVAR stability tests results given in Figures-2 and 3 indicate temporal stability of (6b).

FIGURE 1

Exports: Actual vs. Fitted (GETS)

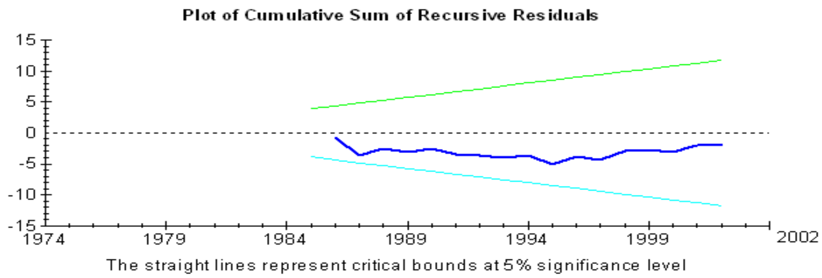


6.4.1.3 THE FMOLS ESTIMATES

We now report the FMOLS results. Both the specifications of relative prices are subjected to the Phillips-Hansen's procedures and the implied long-run elasticities are reported in the last two columns of Table-2. For our specification, see column (e) and the IMF's is in (f). However, unlike in the GETS and JML, we are unable to restrict the intercept term in the VAR. It was also necessary to include a supply dummy (SS) in FMOLS estimates to get meaningful results. However, when the SS variable was included in the Johansen procedure, the coefficient of income became negative. Nonetheless, the FMOLS results suggest that all the estimated long-run elasticities of both the equations, except that of SS, are significant and have the expected signs. It is noteworthy that, like in GETS but unlike in JML, there are only marginal differences in the estimated relative price elasticities of -1.018 against -1.248. Moreover, there are no significant differences

FIGURE 2:

CUSUM Test

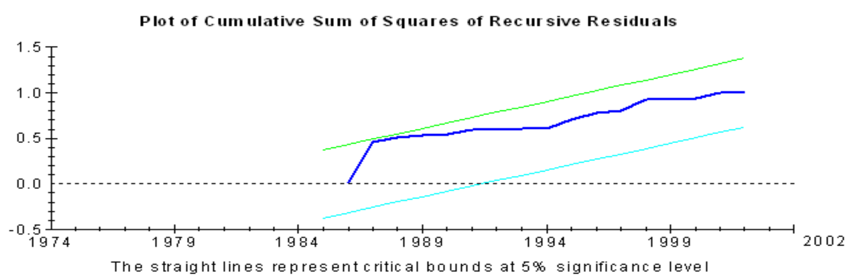


in the estimated income elasticities of 0.995 against 1.066 between GETS and FMOLS. For the IMF specification, see column (f), the income elasticity is higher at 1.379 and the relative price elasticity is -1.024.

The dynamic version of the FMOLS equations are obtained by applying GETS in the second stage, initially with a large lag structure of up to four periods. The one period lagged residuals from the long-run equations (e) and (f) are (separately) included in the respective dynamic equations. Following sequential deletion of insignificant variables, we obtained (7a) in Table-3, which is based on our specification of relative prices. The results are reasonable and none of the χ^2 summary statistics are significant at 5% level. However, to further improve our FMOLS dynamic equation, we adopted some parameter restrictions noting that $\Delta lnYT_{t-2}$ and COUP are similar in signs and magnitudes. The COUP dummy is computed as 1 since 1987 to 2000,

FIGURE 3:

CUSUM SQUARES Test



and zero in other periods. Similar conclusions are drawn RES_{t-1} and ΔlnX_{t-2}. Therefore, we tested if the paired coefficients are equal and both the nulls were accepted. Incorporating these restrictions, we obtained our preferred FMOLS dynamic equation given in (7b). Similarly, with a few restrictions (7c) was obtained for the IMF version, see Table-4. Note in our preferred equations, none of the χ^2 summary statistics are significant at 5% level. The SER is around 0.06 and comparable to (6b) of GETS. An in-sample plot of actual vs. predicted values of the exports are given in Figure-4. It can be said that the model predicts changes in exports reasonably well.[6]

The TIMVAR tests indicated temporal stability of our preferred equation and the tests results are reported in Figures-5 and 6.

[6] The fit of the actual vs. predicted values of growth of exports gives an $\overline{R}^2$ of 0.807 and the SER = 0.064. The fitted equation does not have an intercept, but the slope is unity.

FIGURE 4

Exports: Actual vs Fitted (FMOLS)

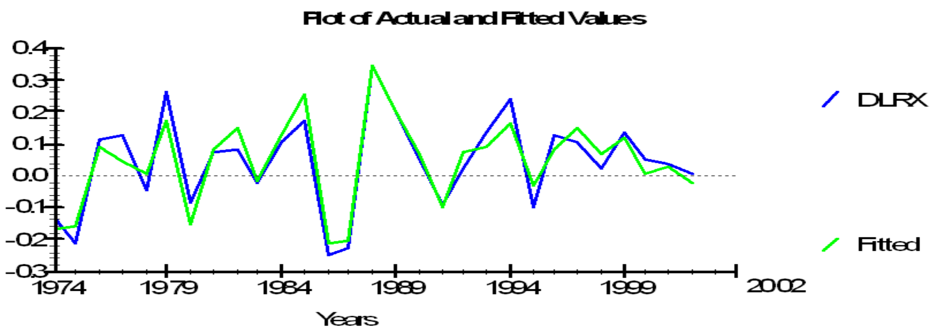
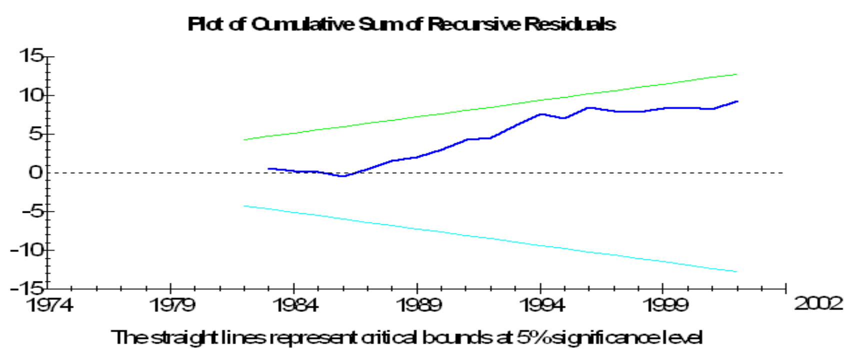


FIGURE 5

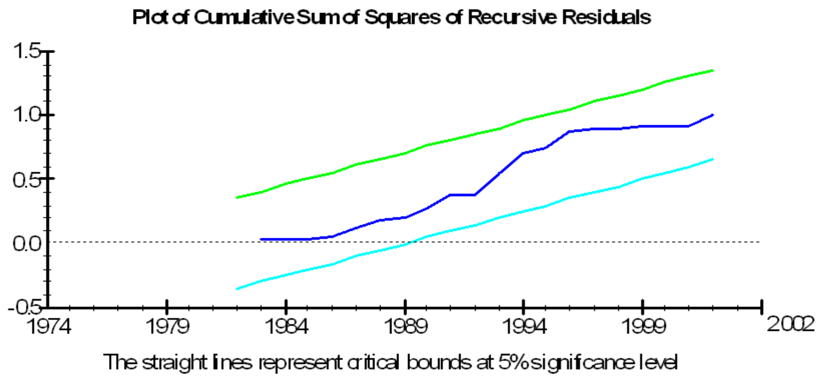
CUSUM Test



Since there are minor differences between our two preferred dynamic exports equations of GETS (6b) and FMOLS 7(b), we will include each of them in performing in-sample simulations in a complete macroeconometric model setup. The best equation to be finally adopted into the model depends on the simulation results. However,

FIGURE 6

CUSUM SQUARES Test



based on our preferred dynamics equations, it can be concluded that the implied long-run income and price elasticities of exports are around unity and -1.25, respectively, and in all our IMF based specifications, the income and price elasticities are biased.

6.4.2 THE IMPORTS EQUATION

In this section, we report the estimates of the imports equation using the aforesaid three approaches based on our specification of relative prices. We will discuss the long-run elasticities of imports for both the specifications, however, we shall ignore the dynamic adjustment equations for the IMF version. Further work on this would be useful, but is outside the scope of this thesis.

6.4.2.1 THE JML APPROACH

We applied the JML cointegration tests on $lnRM_t$, $ln\left[\frac{P_t}{E_t \times P_{Ft}}\right]$ and lnY_t with an intercept and a trend term in a VAR(3) framework. We allowed one period lagged supply shock (SS_{t-1}) and a COUP dummy as exogenous variables. The AIC suggests that VAR(2) is optimal, but the SBC implied that VAR(1) was adequate. Given our sample size, we selected VAR(1). The eigenvalue and the trace statistics rejected the null that there is no cointegrating vector, but accepted the alternative of at least one long-run relationship. The eigenvalue and trace statistics are, respectively, 26.780 (25.420) and 48.339(42.340) for the null that there are no cointegrating vectors and 12.874(19.220) and 21.559(25.770) for at least one long-run relationship.[7] The VAR(1) cointegrating relationship normalized on $lnRM_t$ is given in column (g) of Table-5 below. Both the crucial elasticities are well defined with correct signs and are statistically significant.

The weak exogeneity tests are conducted in line with Enders (2004), where three parsimonious VECM equations are estimated with the lagged residuals from the above cointegrating vector being included as one of the dependent variables in each of the three implied equations of imports, income and relative prices. The ECM_{t-1} term is significant when the dependent variables are $\Delta lnRM_t$ and ΔlnY_t. Thus,

[7] The 95% critical values are given in parenthesis. The null that r = 1 was also accepted for VAR(2) and the cointegrating vector is: $(-1.00\ lnRM_t + 0.813\ lnY_t + 0.576\ ln\left[\frac{P_t}{E_t \times P_{Ft}}\right] + 0.342T)$ which is also plausible. The absolute t-ratios for the independent variables are 2.12, 3.80 and 4.81, respectively. However, the implied income elasticity seems somewhat low given a high import penetration ratio for Fiji.

it is hard to say that income can be treated as a weakly exogenous variable in imports equation and therefore the single equation methods may give biased estimates. Nonetheless the bias depends on the degree of endogeneity. In this respect, JML, FMOLS and GETS with instrumental variables are useful. While we have not applied GETS with instrumental variables, the other two are given below. Further, the above signals for a two equation VAR model which is not only a tedious procedure but is more applicable for forecasting. Since our aim is more methodological, we shall ignore the VAR estimates and interpret the cointegrating vector as the implied long-run imports equation.

For the IMF specification, we found that although the eigenvalue did not reject no cointegration at 95%, it accepts the null that there exists one cointegrating vector at 90% level. However, the trace statistics implied one long-run relationship. The 95% eigenvalues and trace statistics are, respectively, 20.118 (21.120) and 36.299 (31.540) for the null of no cointegration and 10.924 (14.880) and 16.181 (17.860) for at least one long-run relationship. Based on the trace statistics the implied long-run relation normalized on $lnRM_t$ is given as (h) in Table-5. Note that while the signs of both the crucial elasticities are correct, the relative price variable is insignificant at conventional levels. However, the implied long-run elasticities in (g) are noteworthy.

In estimating the dynamic adjustment equations for our specification of relative prices, we used the one period lagged residuals from the cointegrating equation and applied GETS in the second stage. Starting with lags upto (4) periods and by sequentially deleting insignificant variables we obtained our parsimonious VECM equation reported in column 8a of Table-6. The estimates are reasonable and the error correction term has the correct negative sign with a near 70% adjustments completed within a year. Further, none of the summary χ^2 statistics are significant at the 5% level and the SER is around 0.06.

To further improve our results, we imposed parameter restrictions on $\Delta ln\left[\frac{P_t}{E\times P_F}\right]$ and ΔlnY_{t-4} since they were similar in signs and magnitudes. We tested if they are equal and the null was easily accepted. The results are given in equation (8b) which is our preferred VECM model. Note that the SER has dropped marginally and the individual variables have become more significant. Further, none of the χ^2 statistics are significant at 5% level. The plot of actual vs. fitted values

Table-5: Implied Long-run Elasticities for Imports
Our Alternative Estimates

	(g)	(h)	(i)	(j)	(k)	(l)
$ln\left[\frac{P_t}{E_t \times P_{Ft}}\right]$	0.504 (3.17)*		0.436 (1.56)		0.383 (6.07)*	
$ln\left[\frac{P_t}{P_{Ft}}\right]$		0.437 (1.41)		0.674 (1.44)		0.174 (1.95)*
lnY_{Ft}	1.153 (2.38)*	2.512 (11.60)*	0.837 (109.15)*	1.932 (4.40)*	1.162 (5.12)*	1.431 (5.36)*
$Const.$					-2.462 (-1.47)	-4.720 (-2.42)*
$Trend$	0.030 (3.61)*		0.023 (4.40)*		0.027 (6.81)*	
SS						0.005 (3.23)*

The t-ratios are reported below the coefficients. Significance at 5% and 10% are indicated by * and ** respectively. Microfit 4.1 of Pesaran and Pesaran (1997) is used for estimation. The CVs are normalised on $lnRM_t$.

of growth of imports is given in Figure (7) and it can be concluded that the in-sample predictions are reasonable.[8] The TIMVAR stability tests results are shown as Figures (8) and (9) and it can be said that the preferred VECM model is structurally stable.

6.4.2.2 THE GETS APPROACH

We now report our GETS results for imports which are estimated using the NLLS. We tried both the restricted and unrestricted intercept and trend or no trend options. However, except for the unrestricted

[8] A fit of the actual vs. predicted values of the growth of imports has zero intercept and 1.00 as the slope. The $\overline{R}^2 = 0.830$ and the SER is 0.049.

TABLE-6
Dynamic Imports Equations

	JML		GETS		FMOLS	
	8a	8b	9a	9b	10a	10b
Constant	-1.412	-1.425				
	[-4.04]*	[-4.50]*				
Trend			0.02	0.023		
			[3.71]*	[4.40]*		
$\ln M_{t-1}$			-0.624	-0.685		
			[-4.15]*	[-4.89]*		
$\ln Y_{t-1}$			0.834	0.837		
			[100.97]*	[109.15]*		
$\ln\left(\frac{PD_{t-1}}{E_{t-1} * PF_{t-1}}\right)$			0.254	0.436		
			[0.86]	[1.56]		
$\Delta \ln M_{t-1}$					0.347	0.353
					[3.22]*	[3.48]*
$\Delta \ln Y_t$	0.787	0.785	0.623		1.623	1.586
	(2.47)*	(2.52)*	(1.90)**		(5.81)*	(6.68)*
$\Delta \ln Y_{t-2}$			-0.864	-0.694	-0.673	-0.656
			[-3.36]*	[-2.52]*	[-2.80]*	[-3.15]*
$\Delta \ln Y_{t-4}$	0.439	0.416	0.621		0.925	0.925
	(1.73)**	(4.26)*	(2.22)*		(4.14)*	(4.38)*
$\Delta \ln\left(\frac{PD_t}{E_t * PF_t}\right)$	0.411	0.416	0.328	0.419	0.209	0.184
	(3.67)*	(4.26)*	(2.49)*	(5.23)*	(1.95)**	(4.05)*
$\Delta \ln\left(\frac{PD_{t-1}}{E_{t-1} * PF_{t-1}}\right)$					-0.245	-0.254
					[-2.87]*	[-4.51]*
$\Delta \ln\left(\frac{PD_{t-4}}{E_{t-4} PF_{t-4}}\right)$					-0.259	-0.254
					(-2.83)*	(-4.51)*
SS_{t-1}	-0.005	-0.005				
	[-3.82]*	[-3.92]*				
COUP	-0.287	-0.288	-0.339	-0.419	-0.175	-0.184
	[-3.99]*	[-4.16]*	[-3.64]*	[-5.23]*	[-2.91]*	[-4.05]*
ECM_{t-1}	-0.711	-0.716				
	[-4.94]*	[-5.55]*				
$RES2_{t-1}$					-0.805	-0.792
					[-4.66]*	[-5.01]*
$\bar{R}^2$	0.789	0.799	0.774	0.723	0.825	0.841
SEE	0.055	0.053	0.057	0.063	0.05	0.047
$\chi^2(sc)$	0.116	0.072	1.458	2.405	1.522	1.751
	[0.73]	[0.79]	[0.23]	[0.12]	[0.22]	[0.19]
$\chi^2(ff)$	1.657	1.668	0.267	1.123	0.119	0.033
	[0.20]	[0.20]	[0.61]	[0.27]	[0.73]	[0.86]
$\chi^2(n)$	2.533	2.476	0.15	0.084	0.698	0.717
	[0.28]	[0.29]	[0.93]	[0.96]	[0.71]	[0.70]
$\chi^2(hs)$	0.174	0.179	1.14	1.016	1.782	1.775
	[0.68]	[0.67]	[0.29]	[0.31]	[0.18]	[0.18]

trend and no intercept option, none of the others gave meaningful re-

FIGURE 7

Imports: Actual vs. Fitted (JML)

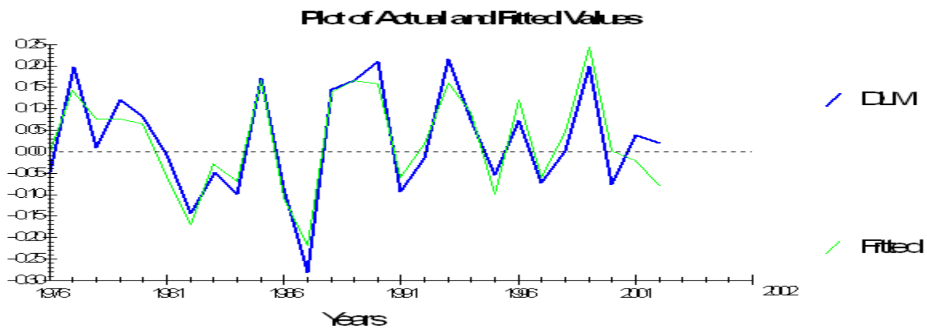
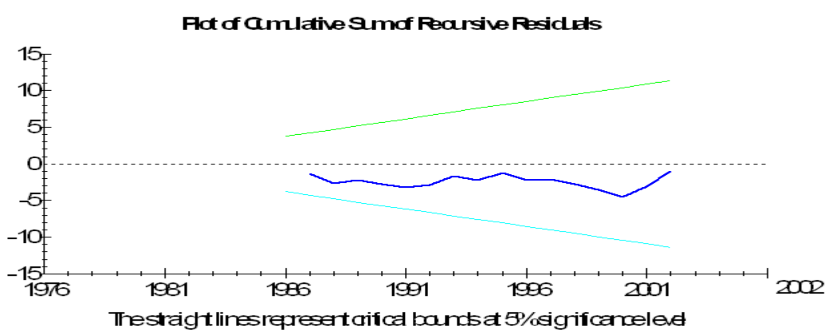


FIGURE 8

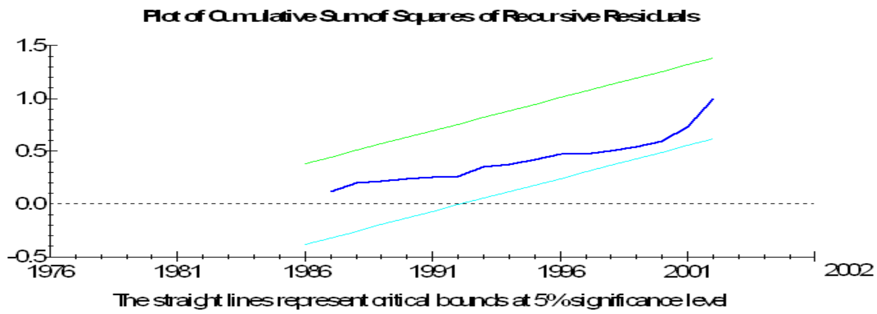
CUSUM Test



sults. The implied long-run income and relative price elasticities are given in columns (i) in Table-5 for ours and in (j) for the IMF specification. The implied income elasticity is around 0.84 and the elasticity with respect to relative price is 0.44. Both the crucial coefficients are significant and have the expected signs. The implied long-run income

FIGURE 9

CUSUM SQUARES Test



elasticity for the *IMF* specification is relatively larger and the price elasticity is only significant above 10%.

The full GETS equation with the dynamics are in column (9a) of Table-6. Note that although the SER is low at around 0.06, the implied relative price elasticity is significant only above 10% level. However, the implied long income elasticity is strongly significant and none of the χ^2 summary statistics are significant at 5% level. To further improve our results, it was necessary to exclude ΔlnY_t and ΔlnY_{t-4} from the equation. Our final GETS results are given as (9b). Note that none of the χ^2 summary statistics are significant at 5% level. The SER is around 0.05 and the implied long-run income and relative price elasticities are plausible and significant. An in-sample plot of actual vs. predicted values of the growth of imports is given in Figure 10. It can be said that the model predicts changes in imports, within the sample reasonably well.[9]

We tested for stability of (9b) using the TIMVAR tests. The test results are reported in Figures 11 and 12 below. Based on the tests, may be concluded that our preferred equation is temporally stable.

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[9] The fit of the actual vs. predicted values of growth of imports gives $\overline{R}^2$ of 0.772 and the SER = 0.042. The fitted equation has an intercept of zero and the slope is unity.

FIGURE 10

Imports: Actual vs Fitted (GETS)

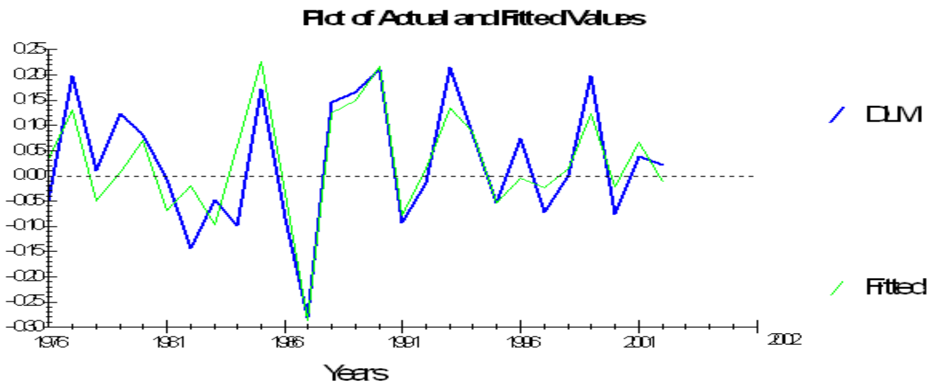


FIGURE 11

CUSUM Test

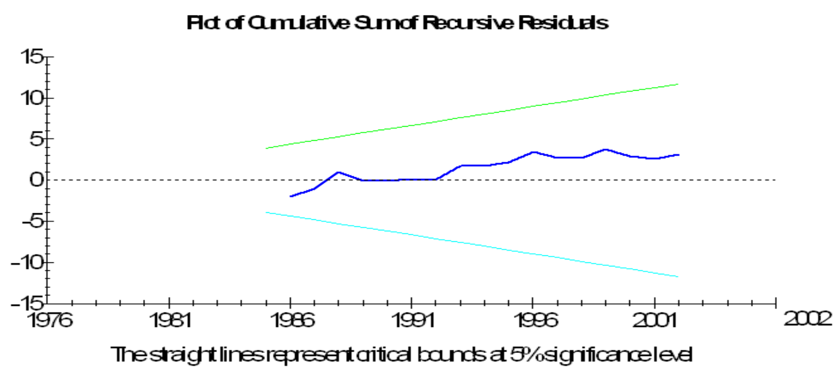
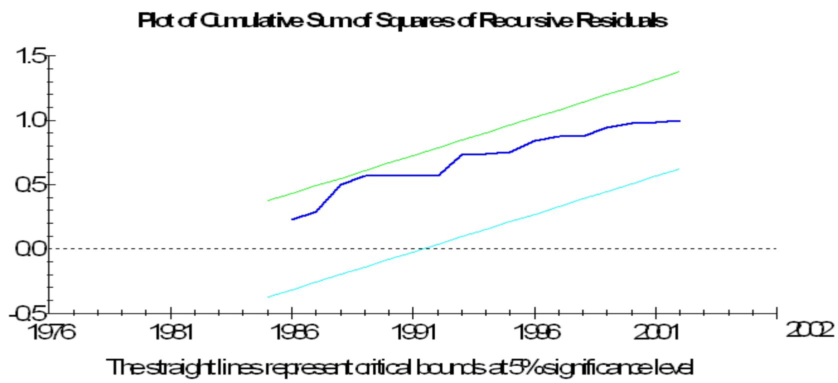


FIGURE 12

CUSUM SQUARES Test



6.4.2.3 PHILLIP-HANSEN FMOLS ESTIMATES

Both the specifications of relative prices are subjected to the FMOLS procedures and the implied long-run elasticities are reported in last two columns of Table-5. Since FMOLS does not allow parameter restrictions, the intercept term could not be restricted.[10] It was also necessary to include SS to get meaningful estimates for the IMF specification, however it was not required for our specification of relative price. For the IMF specification, see column (l) in Table-5, all the estimated coefficients are significant and have the expected signs. It is noteworthy that, like in JML, the income elasticity in our specification, see column (h), is not significantly different from a value of 1.20 and the relative price elasticity is similar to our GETS estimates.

The dynamic structure of (h) is obtained by applying GETS in the second stage initially with a lag structure of up to four periods and by including the one period lagged residuals from the long-run equation. Following sequential deletion of insignificant variables, we obtained equation (10a) reported in Table-6. Note that the results are

[10] We observed that since the trend term was significant in all other methods, it was included in the VAR.

reasonable and none of the χ^2 summary statistics are significant at 5% level. The SER is low at 0.05. The dynamic estimate is further improved by adopting a few restrictions. We noted that $\Delta ln\left[\frac{P_{t-1}}{E_{t-1}\times P_{Ft-1}}\right]$ and $\Delta ln\left[\frac{P_{t-4}}{E_{t-4}\times P_{Ft-4}}\right]$ are similar in signs and magnitudes. However, COUP and $\Delta ln\left[\frac{P_t}{E_t\times P_{Ft}}\right]$ have similar magnitudes but opposite signs. We tested these restrictions and both the nulls were accepted. Incorporating these restrictions, we obtained (10b) which is our preferred FMOLS dynamic equation.

Note that none of the χ^2 summary statistics are significant at 5% level. The SER has dropped marginally. All the included variables are highly significant and around 80% of the adjustments are completed in the next period. An in-sample plot of actual vs. predicted values of the FMOLS estimates indicated that the model predicts changes in imports reasonably well. We also tested for temporal stability using the TIMVAR tests and none of the tests indicated any instability in our prefered equation.[11] Note that as indicated by other procedures, the FMOLS also suggests that the implied long-run elasticities in IMF version is biased.

Comparing the most preferred dynamic equations for imports, the VECM and FMOLS estimates are quite close and both have smaller SERs of around 0.05. However, FMOLS seems to be better because of some allowance for endogeneity. The GETS results are also reasonable and GETS with instrumental variable estimates may be more appropriate. However, we have not gone into such details in this thesis. It is only after simulating the complete model, we may be able to comment which of the three is best. Nonetheless, based on our estimates, we conclude that the implied long-run income elasticity for imports is as high as 1.20 and the relative price elasticity is around 0.50.

[11] The fit of the actual vs. predicted values of growth of imports gives an $\overline{R}^2$ of 0.873 and the SER = 0.042. The fitted equation has an intercept is zero and the slope is close to unity. The stability tests results and the in sample plot of FMOLS are not reported to conserve space but is available upon request.

6.5 CONCLUSIONS

In this chapter, we have surveyed previous works on trade equations and have noted their results. It is found that the relative price variable is poorly specified in many empirical works, both in Fiji and elsewhere. Our results, based on various time series methods with proper specification of relative prices, indicate that this leads to biased estimates of crucial elasticities. Similar conclusions are made by Rao and Singh (2005a). It is shown that the long-run income elasticity for exports is around unity and the relative price elasticity is around -1.25 for Fiji. For imports, the implied long-run income and price elasticities are around 1.20 and 0.50, respectively. These results indicate that while exports is an engine of growth for Fiji, reliance on sheer good fortunes of the trading partners may not aid economic growth. As noted earlier the two income elasticities are almost equal. Therefore to improve the current account balance, Fiji needs to improve international competitiveness. Since the absolute value of the sum of the two relative price elasticities exceeds unity, it may be concluded that managing relative prices would help reduce the trade deficits. For Fiji, the options are, to reduce the costs of exportable -perhaps through improving productivity or to lower the value of the domestic currency - devaluation. However, the merits and de-merits of devaluation would have to be evaluated by simulating a complete macroeconometric model. We have also noted that the political instability have had negative impact on trade through trade embargo or exclusions. Therefore, having a stable macroeconomic environment is also important for trade based growth in Fiji.

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7 PRICE EQUATIONS

7.1 INTRODUCTION

In the Keynesian approach, aggregate output is demand determined and output fluctuations are caused by cyclical upswings and downswings of effective demand. Therefore, many prominent macroeconomic textbooks such as Dornbusch et.al (2003) and Romer (2001) do not include output equations in their expositions of ADAS model in which goods prices are flexible. Rao (2001) and Nevile and Rao (1996) argued that such an exposition of the ADAS where AD is derived from the ISLM framework is inconsistent because the price flexibility implied in the ADAS model is inappropriate since the labor and goods markets are fixed price markets in the ISLM. This calls for an ADAS model based on the assumption that these are disequilibrium markets. A simpler alternative is to close the ISLM by augmenting with the Phillips curve type price adjustment equation or both price and quantity adjustment equations. Therefore, some Keynesian economists augment the ISLM model with the Phillips curve, but use the inverted Phillips curve as aggregate supply. Goods prices are determined as a mark-up on the wage costs augmented with a demand pressure variable. This is a pragmatic compromise and we shall follow this approach by developing wage and price equations in our model. Therefore, in this chapter we explain the various price equations viz, the GDP deflator, CPI and the wage rate.

To compute a demand pressure variable such as the well known output gap (GAP), it is important to estimate the level of capacity output. One approach is to estimate an aggregate production function (APF). A simple Cobb-Douglas constant returns to scale (CRS) framework may be sufficient due to its simplicity. However, unreliable data on capital stock limits the use of the APF approach. Nonetheless, Gounder and Morling (2000) have estimated the GAP by constructing a capital stock series using the perpetual method for Fiji. They first estimated the factor shares by computing the ratios of wages and salaries and capital profits, respectively, on GDP. Their computed labor share is 0.53 and with CRS, this gives a capital share of 0.47

which is somewhat high for Fiji. Using these ratios, they estimated potential output and computed the GAP. Our estimates of the CRS Cobb-Douglas production function with Gounder and Morling's modified dataset gives 0.22 and 0.78 as the long run elasticity of capital and labor, respectively, which are not too far from the norm for developing countries.

A more common approaches of estimating potential output is the Hodrick-Prescott Filter (HPF) de-trending method. Using the HPF, one can estimate smooth trend of variables based on a user-specified smoothing factor (λ), which reflects the frequency of the business cycle.[1] The HPF is widely used in empirical works due to simplicity. Using the HPF method, we estimated the output gap for Fiji. However, the conventional unit root tests indicate that the GAP is stationary both in levels and in first difference. Therefore, due to econometric reasons, we did not include GAP in the cointergating parts of GETS for the price equations. Nonetheless, GAP can be included as an I(0) variable in the JML procedure. Since we obtained good results with GETS, we did not apply the JML approach.

Nonetheless, changes in GAP does explain price movements in Fiji. These observations are consistent with Morling et. al (1999). Other causes of inflation are the growth of world oil price, Fiji's import prices and past growth of inflation rates. It is noted that political coups and the first devaluation dummies have had positive, but temporary effect on inflation. The two crucial variables, viz, the consumer price inflation and the growth in average productivity of labor lead to higher wage inflation in Fiji.

This chapter is organized as follows: Sections 2 is a brief survey of existing empirical works on Fiji. Sections 3 and 4 discuss our specification and empirical results, respectively, and the conclusions are stated in Section 5.

[1] Pesaran and Pesaran (1997) suggest that $\lambda = 7$ is appropriate for annual data.

7.2 EMPIRICAL STUDIES IN FIJI

There are only a few studies on price equations in Fiji. Murphy (1992) estimated three price equations viz, the GDP deflator, CPI and the wage rate in his macroeconometric model. The GDP deflator is the core measure of prices and is estimated using OLS with expectations that it adjusts to its equilibrium value in the long-run. The equilibrium price level, which represents the marginal cost of domestic production, is computed by Murphy using an optimization model. The GDP deflator is estimated as a function of the current and previous period's equilibrium prices and a time trend. His deflator equation is given below:

$$\begin{aligned} lnP_t = 0.109 - 0.014\ T + 0.281\ lnP_t^* + 0.719\ lnP_{t-1}^* \\ (4.73)^* \quad (-4.77)^* (4.09)^* \qquad (4.09)^* \\ Period: 1976 - 1986, DW = 2.13, SEE = 0.02 \end{aligned} \quad (1)$$

where:

P_t= GDP deflator

P_t^* = Equilibrium value of GDP deflator

T = Time trend

The CPI (expressed as a ratio of GDP deflator) has a significant role in wage equation as wage awards are partially based on cost of living adjustments. Murphy also uses the CPI to capture the impact of consumption tax on consumer expenditure. His estimated CPI equation is:

$$\begin{aligned} lnCPI_t^{'} = -0.034 + 0.004\ T + 0.295\ lnCPI_{t-1}^{'} \\ (-2.70)^* \qquad (2.12)^* \quad (1.48) \\ Period: 1974 - 1986, DW = 2.23, SEE = 0.03 \end{aligned} \quad (2)$$

where:

$CPI_t^{'}$= Tax adjusted CPI ratio computed as: $\left[\frac{CPI_t}{(1+Tx^c)\times P_t}\right]$

Tx^c = Tax on consumption

Although his attempts are reasonable, Murphy should have included other important variables such as the past and expected inflation rates, productivity and GAP. For wages, Murphy relates the growth of nominal wage rate to one period lagged growth of CPI, the level and the lagged growth of labor market pressure variables proxied by the ratio of formal employment to working age population. His estimated wage rate equation is:

$$
\begin{aligned}
ln(W_t/W_{t-1}) = & -0.360 + 1.00\Delta lnCPI_{t-1} + 1.85\ ln(L/POP)_{t-1} \\
& (-0.66)\ (--) \qquad\qquad\qquad (0.70) \\
& + 2.01\Delta ln(L/POP)_t + 5.28\Delta ln(L/POP)_{t-1} \\
& (0.51) \qquad\qquad\qquad (1.18)
\end{aligned} \qquad (3)
$$

$$Period: 1974 - 1988, DW = 2.76, SEE = 0.085$$

where:

W_t= Average wage rate

L_t = Labor force in formal sector

POP_t = Total working age population

While the estimates (1) and (2) are significant, none of the variables in (3) are significant at conventional levels. Moreover the SER is high at 0.09 and the sample size of 10-12 observations is very small. Nonetheless, his work provides useful insights in estimating the price equations for Fiji.

Morling et. al (1999) seems to have estimated a CPI equation using a variant of the GETS approach for the period 1966-1998. Their estimates are as follows:

$$
\begin{aligned}
\Delta lnP_t = & \ 0.049 - 0.165\ lnP_{t-1} + 0.130\ lnPM_{t-1} + 0.022\ lnLC_{t-1} \\
& (2.12)^* \quad (-3.78)^* \quad (---) \quad (---) \\
& + 0.207\Delta lnP_{t-1} + 0.205\Delta lnPM_t + 0.176\Delta(\ lnY - lnY^*)_{t-1} \\
& (1.64)^{**} \quad (10.14)^* \quad (2.66)^* \\
& + 0.087\Delta lnLC_{t-1} \\
& (2.19)^*
\end{aligned} \qquad (4)
$$

$$Period: 1966 - 1998, \bar{R}^2 = 0.75, SEE = 0.02$$

where:
P_t= Consumer price index (1990 = 100)

PM_t = A weighted average import price index, 1990 base

$(lnY_t - lnY_t^*)$ = GAP, where Y_t^* is estimated with HPF

LC_t = Unit labor cost index (1990 = 100)

$(---)$ = Not reported in the original study.

All variables, except the GAP are in logarithms and the significance at 5% and 10% levels are indicated by * and **, respectively. None of the $\chi^2_{hs}(1)$ summary statistics (not reported here) are significant, except that there seems to be a typographical error in $\chi^2_{hs}(1)$, which implies some heteroscedasticity. Nonetheless, the over roll results are noteworthy. Morling et. al claim that in long run, import price and unit labor cost determine movements in consumer prices. The dynamics are captured by changes in these variables together with changes in GAP and previous period's inflation rates.

These studies highlight some important issues in modeling inflation in Fiji. However, in what follows, we report our estimates of the three price equations using these earlier works.

7.3 OUR SPECIFICATION AND RESULTS

In equation (5) we relate the GDP deflator to Fiji's import price and a time trend. The dynamics are captured by lagged differences of import and world oil prices together with past inflation rates and their growth rates. The CPI is assumed to be highly influenced by the GDP deflator and the dynamics of consumer inflation are captured by changes in the deflator, import prices and the GAP. We assume that wages rate responds to CPI and average productivity of labor, which is computed as the ratio of output to employment. The dynamics are captured by the lagged changes in these variables. Our three basic specifications in order of GDP deflator, CPI and wage rate are given in (5-7) below:

$$\begin{aligned}\Delta\, lnP_t =& \lambda_1\Big[lnP_{t-1} - (\alpha_0 + \alpha_2 lnPM_{t-1} + \alpha_3 T)\Big] \\ &+ \sum_{i=0}^{j} \kappa_i \Delta lnPM_{t-i} + \sum_{i=0}^{k} \gamma_i \Delta^2 lnP_{t-i} \\ &+ \sum_{i=0}^{l} \eta_i \Delta lnPOIL_{t-i} + \sum_{i=1}^{m} \omega_i \Delta lnP_{t-i} + \xi_t \end{aligned} \tag{5}$$

$$\begin{aligned}\Delta\, lnCPI_t =& \lambda_2\Big[lnCPI_{t-1} - (\beta_0 + \beta_2 lnP_{t-1})\Big] + \sum_{i=0}^{n} \tau_i \Delta lnP_{t-i} \\ &+ \sum_{i=0}^{p} \rho_i \Delta lnPM_{t-i} + \sum_{i=1}^{q} \sigma_i \Delta lnCPI_{t-i} \\ &+ \sum_{i=0}^{t} \upsilon_i \Delta(lnY - lnY^*)_{t-i} + \epsilon_t \end{aligned} \tag{6}$$

$$\begin{aligned}\Delta\ lnW_t =&\lambda_3\Big[lnW_{t-1}-(\pi_0+\pi_2 lnCPI_{t-1})\Big]\\&+\sum_{i=0}^{u}\phi_i\Delta^2 lnW_{t-i}+\sum_{i=0}^{v}\psi_i\Delta ln(Y/LL)_{t-i}\\&+\sum_{i=0}^{w}\iota_i\Delta lnCPI_{t-i}\ +\sum_{i=1}^{x}\theta_i\Delta lnW_{t-i}+\mu_t \qquad (7)\end{aligned}$$

where:

P_t = GDP deflator (1995 = 100)

PM_t = Import Price Index 1995 base

CPI_t = Consumer Price Index (1995 = 100)

$(lnY_t - lnY_t^*)$ = GAP, where Y_t^* is computed with HPF

$POIL_t$ = Brent crude oil prices Index (1995 = 100)

W_t = Average wage rate

(Y_t/L_t) = Average productivity of labor

ξ_t, ϵ_t and μ_t are the respective error terms with usual classical properties.

All variables except the GAP, are in logarithms. Using the standard unit root tests, we found that all, except the GAP is I(1) in levels and I(0) in first difference. Later it was necessary to include some dummy variables, COUP1, VAT1, DEV and DUM8991. A detailed description of data, including these dummy variables are in Appendix A and the unit root tests results are given in Appendix B.

7.3.1 THE GDP DEFLATOR EQUATION

The following results are obtained with GETS in which lags up to four periods for the first differences of the variables are specified together with a coup dummy. Following sequential deletion of insignificant variables, we obtained (8):

$$\begin{aligned}\Delta lnP_t =& 0.777 - 0.287\Big[lnP_{t-1} - (0.244\ lnPM_{t-1} + 0.028T)\Big] \\ & (6.70)^{*}\ (-4.27)^{*} \qquad (-2.08)^{*} \qquad (5.06)^{*} \\ & + 0.362\Delta^2 lnP_t \ + 0.188\Delta^2 lnP_{t-1} + 0.054COUP1 \\ & \quad (4.45)^{*} \qquad (2.55)* \qquad (3.60)^{*} \\ & + 0.025\Delta lnPOIL_{t-1} \\ & \quad (1.88)^{**} \end{aligned} \tag{8}$$

$$\overline{R}^2 = 0.901, DW = 1.56, SEE = 0.020, Period : 1974 - 2002$$
$$\chi^2_{sc1} = 2.253(0.13), \quad \chi^2_{ff} = 0.911(0.34)$$
$$\chi^2_{n} = 1.126(0.57), \quad \chi^2_{hs} = 0.139(0.71)$$

The import price and time trend have correct signs and are significant. The dynamics are captured by current and lagged inflation and oil price growths. COUP1 indicates sudden upswings in prices due to precautionary demand during the crisis and none of the χ^2 summary statistics are significant at 5% level. Figures-1, 2 and 3, respectively, are the graph of actual vs. predicted values and stability tests indicating no major problems in equation (8).

FIGURE 1: Actual vs. Fitted (GETS)

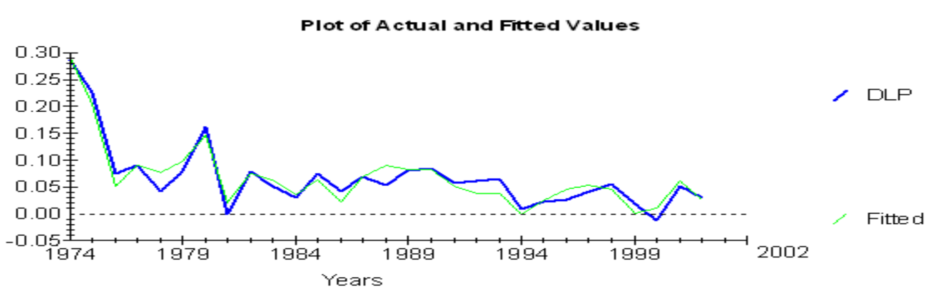


FIGURE 2: CUSUM Test

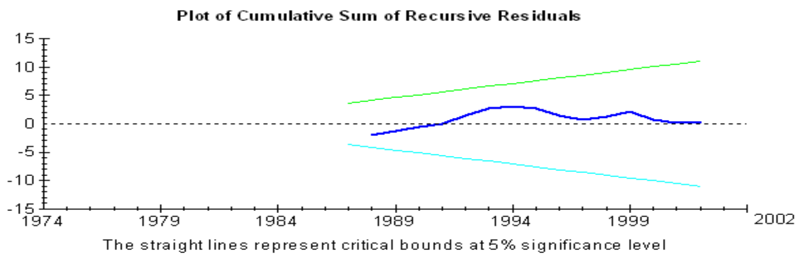
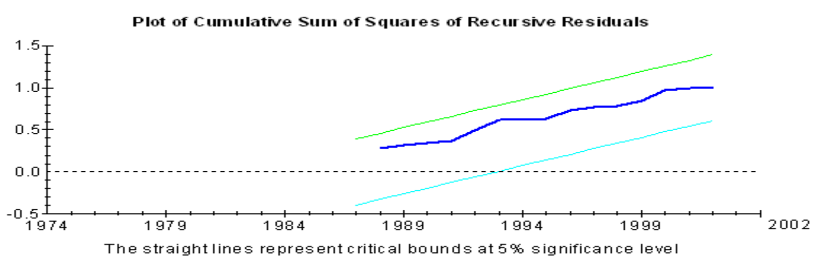


FIGURE 3: CUSUM SQUARES Test



7.3.2 THE CONSUMER PRICE EQUATION

Our GETS estimates of the CPI equation is as follows:

$$\begin{aligned}
\Delta lnCPI_t = & -0.263\Big[\ lnCPI_{t-1} - (1.015\ lnP_{t-1})\Big] + 0.096\Delta lnPM_{t-1} \\
& \quad (3.21)^{*} \qquad\qquad (134.81)^{*} \qquad\qquad (1.93)^{**} \\
& + 0.103\Delta lnPM_{t-2}\ + 0.317\Delta lnP_t + 0.036DEV \\
& \quad (1.82)^{**} \qquad\qquad (3.63)^{*} \qquad\qquad (2.67)^{*} \\
& + 0.220\Delta lnCPI_{t-2}\ + 0.099\Delta(\ lnY - lnY^{*})_{t-2} \\
& \quad (2.51)^{*} \qquad\qquad (1.28)^{*}
\end{aligned} \tag{9}$$

$$\overline{R}^2 = 0.811, DW = 1.62, SEE = 0.016, Period : 1974 - 2002$$

$$\chi^2_{sc1} = 1.210(0.27), \quad \chi^2_{ff} = 0.005(0.95)$$

$$\chi^2_{n} = 1.137(0.57), \quad \chi^2_{hs} = 0.106(0.75)$$

Note that the GDP deflator has a strong positive effect on CPI and has an implied long-run unit elasticity. All other variables are correctly signed and the change in GAP seems to have positive impact on CPI. The lagged growth of import prices are significant and the devaluations seem to have increased consumer prices. The VAT dummy, both temporary and permanent were insignificant at conventional levels. To further improve our results, we introduced a few restrictions. Note that $\Delta lnPM_{t-1}$, $\Delta lnPM_{t-2}$ and $\Delta(lnY - lnY^{*})_{t-2}$ are similar in signs and magnitudes. Thus we tested the null that they are equal and it was easily accepted. Therefore, with these restrictions, we obtained (10), which is our preferred CPI equation given below:

$$\Delta lnCPI_t = -\,0.264\Big[lnCPI_{t-1} - (1.015\ lnP_{t-1})\Big] + 0.036DEV$$
$$(-3.49)^* \qquad\qquad (145.70)^* \qquad\qquad (3.04)^*$$
$$+\,0.100\Big[\Delta lnPM_{t-1} + \Delta lnPM_{t-2} + \Delta(lnY - lnY^*)_{t-2}\Big]$$
$$(4.08)^*$$
$$+\,0.220\Delta lnCPI_{t-2} + 0.317\Delta lnP_t$$
$$(2.66)^* \qquad\qquad (3.98)^* \qquad\qquad (10)$$

$$\overline{R}^2 = 0.828, DW = 1.61, SEE = 0.015, Period: 1974 - 2002$$
$$\chi^2_{sc1} = 1.255(0.26), \quad \chi^2_{ff} = 0.007(0.93)$$
$$\chi^2_n = 1.135(0.57), \quad \chi^2_{hs} = 0.074(0.79)$$

There are no major changes in estimates of (9) and (10) and all the coefficients are highly significant. None of the χ^2 summary statistics are significant at 5% and SER is 0.015. The graph of actual vs. predicted values is given as Figure-4 and it seems that the model predicts inflation reasonably well. The TIMVAR stability test results are given in Figures-5 & 6 indicating that equation (10) is temporarily stable.

FIGURE 4

CPI : Actual vs. Fitted (GETS)

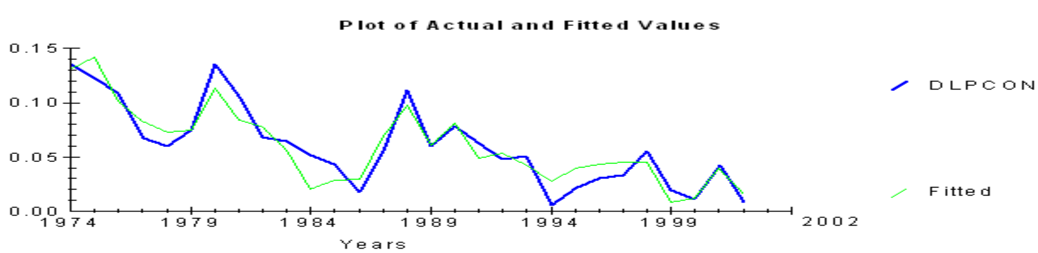


FIGURE 5

CUSUM Test

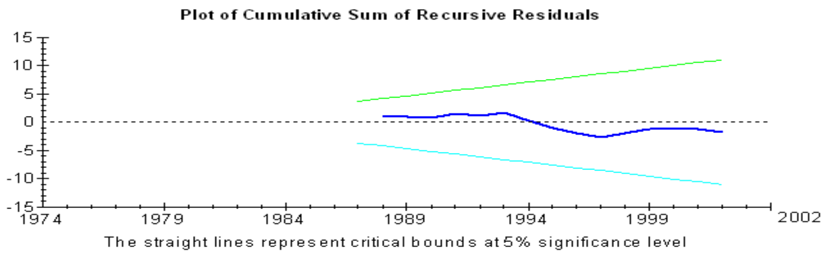
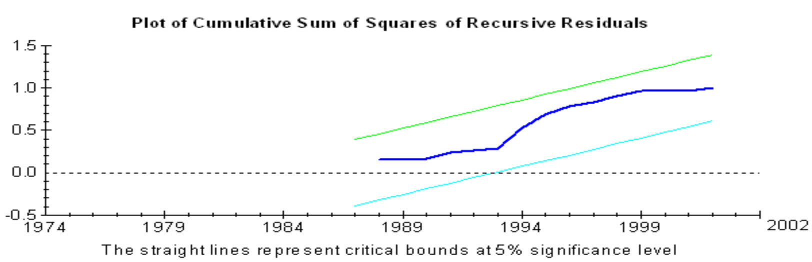


FIGURE 6

CUSUM SQUARES Test



7.3.3 THE WAGE RATE EQUATION

Using GETS we estimated the following wage rate equation.

$$\begin{aligned}
\Delta lnW_t = &- \underset{(9.44)^*}{0.183}\Big[lnW_{t-1} - \underset{(9.96)^*}{0.135}\ lnCPI_{t-1}\Big] + \underset{(4.10)^*}{0.273}\Delta^2 lnW_{t-1} \\
&+ \underset{(6.36)^*}{0.448}\Delta^2 lnW_t \ + \underset{(1.52)}{0.136}\Delta ln(Y/LL)_{t-1} \\
&+ \underset{(2.10)^*}{0.189}\Delta ln(Y/LL)_{t-2} + \underset{(3.65)*}{0.057}\ VAT1
\end{aligned} \quad (11)$$

$$\overline{R}^2 = 0.855, DW = 1.55, SEE = 0.028, Period : 1974 - 2002$$
$$\chi^2_{sc1} = 2.230(0.14), \quad \chi^2_{ff} = 0.645(0.42)$$
$$\chi^2_{n} = 0.666(0.72), \quad \chi^2_{hs} = 1.102(0.29)$$

The implied long run CPI elasticity is significant and the dynamic factors are the lagged changes in GAP, wage rates, average productivity of labor and a temporary VAT dummy. However, the SER is relatively higher than our other two estimates (8) and (10). Therefore, to improve our results, we added a dummy variable (DUM8991), which is 1 in 1989-1991 and zero otherwise. The 1989-91 period marks government's massive tax free programs which gave incentives to producers, therefore demand for labor. Also note that $\Delta ln(Y/LL)_{t-1}$ and $\Delta ln(Y/LL)_{t-2}$ are similar in signs and magnitudes. Thus we tested the restriction that these two variables are equal and the null was easily accepted. With these changes, we obtained our preferred wage rate equation (12) below:

$$\Delta lnW_t = -\underset{(9.46)^{*}}{0.175}\Big[lnW_{t-1} - \underset{(9.54)^{*}}{0.147}\ lnCPI_{t-1}\Big] + \underset{(4.65)^{*}}{0.283}\Delta^2 lnW_{t-1}$$
$$+ \underset{(6.36)^{*}}{0.424}\Delta^2 lnW_t \ + \underset{(1.78)^{**}}{0.130}\Big[\Delta ln(Y/LL)_{t-1} + \Delta ln(Y/LL)_{t-2}\Big]$$
$$+ \underset{(3.07)^{*}}{0.047}\ VAT2 - \underset{(-1.96)^{**}}{0.043}DUM8991 \quad (12)$$

$$\overline{R}^2 = 0.875, DW = 1.59, SEE = 0.026, Period: 1974-2002$$
$$\chi^2_{sc1} = 1.154(0.21), \quad \chi^2_{ff} = 0.008(0.93)$$
$$\chi^2_{n} = 0.386(0.83), \quad \chi^2_{hs} = 2.003(0.16)$$

Note that none of the χ^2 summary statistics are significant at 5% level and the SER has declined marginally. The speed of adjustment is around 20%. The graph of actual vs. predicted values of the wage inflation are given in Figure-7 and it seems that the model predicts changes in wage rate reasonably well.[2] The TIMVAR stability test results are given in Figures-8 and 9. based on the more robust test - CUSUM SQUARES - it can be concluded that equation (12) is temporarily stable.

[2] A fit of the actual vs. predicted values of the two gives $\bar{R}^2$ of 0.898 and the SEE of 0.023. It has a slope of unity and the constant term is zero.

FIGURE 7

Wage Rate: Actual vs. Fitted values (GETS)

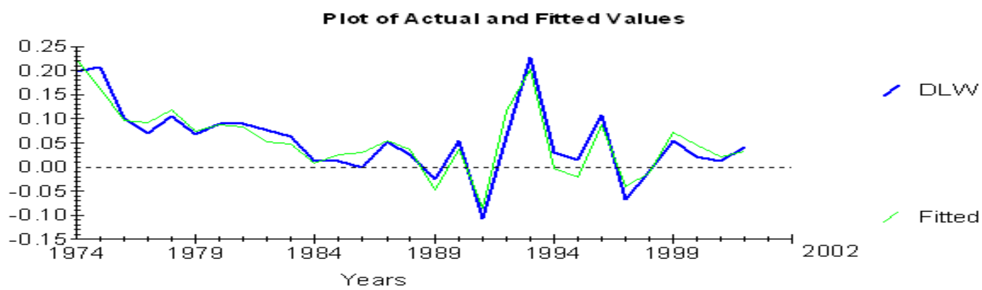


FIGURE 8

CUSUM Test

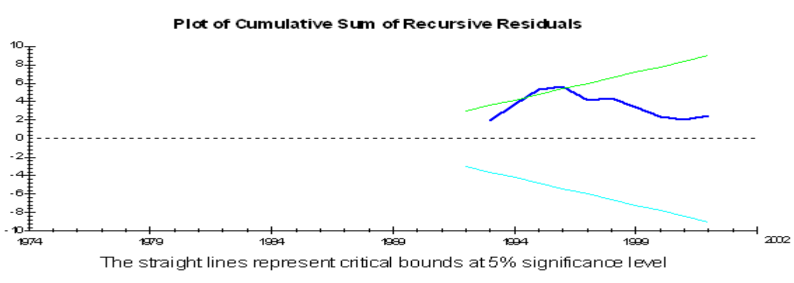
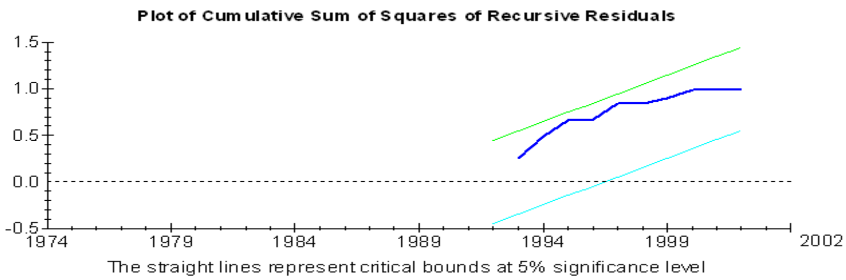


FIGURE 9

CUSUM SQUARES Test



7.4 CONCLUSION

In this chapter, we have conducted a brief survey of existing works on price and wage equations in Fiji and noted that the RBF study is most useful. The others are also important since they provide insights for further works on price equations. We have applied the GETS approach and estimated three price equations, viz the GDP deflator, CPI and the wage rate. The long run equilibrium relationships are reasonable and we have found that import and world oil prices and changes in GAP are important determinants of inflation in Fiji. The dummy variables for the coup and devaluation seem to cause a temporary but significant effect on inflation in Fiji. The CPI and the average productivity of labor determine the wage growth and the use of DUM8991 and VAT dummies have improved our estimates. Note equations (8), (10) and (12) are well determined and therefore are included in our macroeconometric model.

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8 SIMULATION RESULTS

8.1 INTRODUCTION

This chapter brings together our preferred equations from the preceeding chapters to form a macroeconometric model. The model is then simulated over the historical period of 1970-2002 and the standard simulation evaluations are performed. The historical simulation permits to test how well the model performs as a complete system. The selection of the equations is based on the SER of each equation and their respective simulation outcomes. In Chapters 3-7, we have noted that individual equations fit historical data reasonably well and satisfy other important summary statistics. However, when combined as a system, the whole model may not replicate the actual data accurately. This problem arises due to our single equation methods of estimation which may contain some biases in the estimated coefficients. However, since we have used improved methods of estimation of the dynamic adjustments, these single equations may work well as a system. Systems estimation methods are difficult to implement with small samples of about 30 observations. Therefore, we belive that our approach is a pragmatic alternative. While some model builders make slope and intercept adjustments in their simulations, we found that small adjustments to the intercepts of our consumption function, which did not fit the data well, adversely effected the simulation results for other variables. Therefore, we had to experiment with alternative estimates of the consumption equation. Nonetheless, in spite of some weaknesses, our simulation results satisfy various criteria used to judge the quality of simulation results..

Given some limitations in our specifications and the exploratory nature of our estimation techniques, we do not claim that our model is satisfactory for policy analysis and/or forecasting. Our main objective is methodological i.e., explore the use of time series methods of estimation to capture the underlying dynamics with a more flexible lag structure than the traditional partial adjustment process. It is now well known that this traditional approach, based on partial adjustment, has ignored the non-stationarity of the variables and therefore gives spurious regression results and unreliable summary statistics. From these perspectives, we only claim that our results based on single equation methods, with time series techniques such as GETS, are promising and give plausible and more reliable estimates. Needless to say further refinements in specification and estimation are necessary before our model and approach are used for policy analysis and forecasting.

We have encountered two major problems in simulating the model. First, all equations were specified in logarithms and their re-conversion to levels, at best, is an approximation. We found it difficult to balance the national accounting identity. This was further aggravated by the lack of consistent data for the full sample on capital consumption and other important components of the national accounts. Therefore, instead of linking the national income and disposable income with identities, we have assumed that the disposable income is a proportion of GDP, determined by the tax rate. This approach was also taken by Murphy (1992). Further the aggregate demand (Y^d), obtained by adding the levels of expenditures, can be said to be only a proxy to Y^d. Therefore, we assumed that actual output adjusts to this proxy aggregate demand and aggregate supply, which is estimated with a production function. Unlike in many models where aggregate supply is ignored, we have used a Cobb-Douglas production function (unadjusted for capacity utilization) for Fiji estimated by Rao (2005). Rao computed the capital stock using the perpetual inventory method and a 4% depreciation rate. The initial capital stock for 1970 assumed by him is about twice the GDP. In spite of the preliminary nature of his estimates, his production function gave good results in the growth accounting equations; see Rao and Rao (2005). In his production function the two inputs are labor and capital and a time trend has been added to capture the impact of the Hicks neutral technical progress. In our simulations output, in the short-run, is assumed to adjust to both demand and supply conditions. In a way this adjustment process captures the missing quantity adjustment equation in the disequilibrium models.

This chapter is organized as follows: Section 2 is an exposition of the basic structure of our macroeconometric model. Section 3 is a brief discussion of the simulation process. Simulation results and evaluations based on various simulation criteria are in section 4. Conclusions and limitations are stated in Section 5.

8.2 THE BASIC STRUCTURE OF OUR MODEL

The hypothesized basic structure of the macroeconometric model, abstracted from its dynamics is as follows:

$$ln\ C_t = \alpha_0 + \alpha_1 lnYD_t + \alpha_2 R_t + \epsilon_{1t} \tag{1}$$

$$ln\left(\frac{I_t}{Y_t}\right) = \beta_0 + \beta_1 ln\ Y_t + \beta_2 RRL_t + \epsilon_{2t} \tag{2}$$

$$ln\left(\frac{M1_t}{P_t}\right) = \lambda_0 + \lambda_1 ln\ Y_t + \lambda_2 RS_t + \epsilon_{3t} \tag{3}$$

$$ln\ P_t = \pi_0 + \pi_1 ln\ PM_t + \pi_2 T + \epsilon_{4t} \tag{4}$$

$$ln\ X_t = \gamma_0 + \gamma_1 ln\ YT_t + \gamma_2\ ln\left[\frac{P_t}{E_t \times P_{Ft}}\right] + \epsilon_{5t} \tag{5}$$

$$ln\ RM_t = \tau_0 + \tau_1 ln\ Y_t + \tau_2\ ln\left[\frac{P_t}{E_t \times P_{Ft}}\right] + \epsilon_{6t} \tag{6}$$

$$ln\ W_t = \omega_0 + \omega_1 ln\ CPI_t + \epsilon_{7t} \tag{7}$$

$$ln\ CPI_t = \phi_0 + \phi_1 ln\ P_t + \epsilon_{8t} \tag{8}$$

$$Y_t^d = C_t + I_t + \overline{G}_t + X_t - RM_t \tag{9}$$

$$ln\ Y_t^s = \theta_0 T + \theta_1 ln\ K_t + (1-\theta_1) ln\ LL_t + \epsilon_{10t} \tag{10}$$

$$Y_t = \eta_1 Y_t^d + \eta_2 Y_t^s \tag{11}$$

Definition of variables and sources of data are in appendix A. The equations of the above model, except Y^s, are estimated with GETS and JML approaches, see chapters 3-7. Our aggregate supply is the production function estimated in Rao (2005) in which it was estimated using GETS.[1] Our model, using the estimated equations from the previous chapters, is as follows. Note equation numbers, for example, 3.6d means equation (6d) in chapter 3.

8.2.2 THE DYNAMIC MODEL FOR SIMULATION

Consumption Function

$$\begin{aligned}\Delta lnC_t = & -0.105\Big[lnC_{t-1} - (0.811 lnYD_{t-1} + 0.408R_{t-1})\Big] \\ & \quad (-1.43) \qquad\qquad (8.16)^{*} \qquad\qquad (1.44) \\ & - 0.699\Delta lnC_{t-1} - 0.451\Delta lnC_{t-2} - 0.258\Delta lnC_{t-3} \\ & (-4.30)^{*} \qquad\quad (-4.10)^{*} \qquad\quad (-2.54)^{*} \\ & - 0.285\Delta lnYD_{t-1} - 0.019\Delta R_{t-1} \\ & (-1.84)^{**} \qquad\qquad (-3.38)^{*} \end{aligned} \qquad (3.6c')$$

$$\overline{R}^2 = 0.675, SER = 0.035 \quad Period: 1975 - 2002$$

$$\chi^2_{sc1} = 0.047, \chi^2_{ff} = 2.855, \chi^2_{n} = 0.732, \chi^2_{hs} = 0.371$$

Investment Equation

$$\begin{aligned}\Delta ln\left(\frac{I_t}{Y_t}\right) = & -6.693 - 0.119(\Delta RRL_t + COUP) - 13.374\Delta^2 lnP_{t-1} \\ & (-7.81)^{*} \quad (-7.75)^{*} \qquad\qquad\qquad (-6.40)^{*} \\ & - 0.261[\Delta ln(I/Y)_{t-2} + \Delta ln(I/Y)_{t-4}] + 0.038\,T \\ & (-2.88)^{*} \qquad\qquad\qquad\qquad\qquad (7.00)^{*} \\ & - 7.898[\Delta^2 lnP_t + \Delta^2 lnP_{t-2}] - 2.589\Delta lnY_t \\ & (-5.00)^{*} \qquad\qquad\qquad (-4.81)^{*} \\ & + 0.050\Delta RRL_{t-4} - 0.688ECM_{t-1} \\ & \quad (2.93)^{*} \qquad\quad (-4.12)^{*} \end{aligned} \qquad (4.8b)$$

[1] Rao used the GETS approach to tackle the unit roots in the variables of the production function.

$$\overline{R}^2 = 0.761, SER = 0.127 \quad Period : 1976 - 2002$$
$$\chi^2_{sc1} = 2.590, \chi^2_{ff} = 0.202, \chi^2_{n} = 1.154, \chi^2_{hs} = 0.161$$

Demand for Money

$$\begin{aligned}\Delta ln\Big(\frac{M_t}{P_t}\Big) =& -3.047 - 1.114ECM_{t-1} - 0.039(\Delta RS_t - \Delta RS_{t-1})\\ & (-10.94)^* \quad (-11.05)^* \qquad (11.05)^*\\ & - 0.820(\Delta lnY_{t-2} - \Delta lnY_{t-4}) + 1.114\Delta^2 lnY_t\\ & (-3.59)^* \qquad\qquad\qquad (6.43)^*\\ & + 0.279COUP - 0.114DEV2 - 0.002T\\ & (5.93)^* \qquad (1.93)^{**} \qquad (-0.71) \qquad\qquad (5.8)\end{aligned}$$

$$\overline{R}^2 = 0.857, SEE = 0.055 \quad Period : 1976 - 2002$$
$$\chi^2_{sc1} = 0.169, \chi^2_{ff} = 3.94, \chi^2_{n} = 1.053, \chi^2_{hs} = 0.642$$

Exports Equation

$$\begin{aligned}\Delta lnX_t =& 0.311 - 0.157(\Delta lnX_{t-2} + RES_{t-1}) + 0.0004SS_{t-2}\\ & (6.50)^* \qquad (-5.33)^* \qquad\qquad\qquad (3.78)^*\\ & - 0.752\Delta ln\Big[\frac{P_{Dt}}{E_t \times P_{Ft}}\Big] - 0.310(\Delta lnYT_{t-2} + COUP)\\ & (11.76)^* \qquad\qquad\qquad (-13.79)^* \qquad\qquad (6.7b)\end{aligned}$$

$$Period : 1974 - 2002$$
$$\bar{R}^2 = 0.817, SER = 0.061, Period : 1973 - 2002$$
$$\chi^2_{sc}(1) = 1.819, \chi^2_{ff}(1) = 0.641, \chi^2_{nn}(2) = 0.813, \chi^2_{hs}(1) = 3.454$$

Import Equation

$$\begin{aligned}\Delta lnRM_t =& -1.425 + 0.416\Delta ln\Big[\frac{P_{Dt}}{E_t \times P_{Ft}}\Big] + 0.416\Delta ln\ Y_{t-4}\\ & (-4.49)^* \; (4.26)^* \qquad\qquad\qquad (3.17)^*\\ & + 0.785\Delta lnYT_t - 0.716ECM_{t-1} + 0.021T\end{aligned}$$

$$(2.52)^* \quad (-5.55)^* \quad (3.61)^*$$
$$- 0.288COUP - 0.005SS_{t-2}$$
$$(-4.16)^* \quad (3.92)^* \qquad (6.8b)$$

$$\bar{R}^2 = 0.80, DW = 2.00, SER = 0.05, Period : 1975 - 2002$$
$$\chi^2_{sc}(1) = 0.072, \chi^2_{ff}(1) = 1.668, \chi^2_{nn}(2) = 2.476, \chi^2_{hs}(1) = 0.179$$

GDP Deflator Equation

$$\Delta lnP_t = 0.777 - 0.287[lnP_{t-1} - (0.244\ lnPM_{t-1} + 0.028T)]$$
$$(6.70)^* \ (-4.27)^* \quad (-2.08)^* \quad (5.06)^*$$
$$+ 0.362\Delta^2 lnP_t \ + 0.188\Delta^2 lnP_{t-1} + 0.025\Delta lnPOIL_{t-1}$$
$$(4.45)^* \quad (2.55)^* \quad (1.88)^{**}$$
$$+ 0.054COUP1$$
$$(3.60)^* \qquad (7.8)$$

$$\overline{R}^2 = 0.901, DW = 1.56, SEE = 0.020, Period : 1974 - 2002$$
$$\chi^2_{sc1} = 2.253(0.13), \chi^2_{ff} = 0.911, \chi^2_n = 1.126, \chi^2_{hs} = 0.139$$

CPI Equation

$$\Delta lnCPI_t = -0.264[lnCPI_{t-1} - (1.015\ lnP_{t-1})] + 0.036DEV$$
$$(-3.49)^* \quad (145.70)^* \quad (3.04)^*$$
$$+ 0.100[\Delta lnPM_{t-1} + \Delta lnPM_{t-2} \ + \Delta(lnY - lnY^*)_{t-2}]$$
$$(4.08)^*$$
$$+ 0.220\Delta lnCPI_{t-2} \ + 0.317\Delta lnP_t$$
$$(2.66)^* \quad (3.98)^* \qquad (7.10)$$

$$\overline{R}^2 = 0.828, DW = 1.61, SEE = 0.015, Period : 1974 - 2002$$
$$\chi^2_{sc1} = 1.255, \chi^2_{ff} = 0.007, \chi^2_n = 1.135, \chi^2_{hs} = 0.074$$

Wage Rate Equation

$$\Delta lnW_t = -0.175[lnW_{t-1} - 0.147\ lnCPI_{t-1}] + 0.283\Delta^2 lnW_{t-1}$$
$$(9.46)^* \quad (9.54)^* \quad (4.65)^*$$

$$+\,0.424\Delta^2 lnW_t \;+ 0.130[\Delta ln(Y/LL)_{t-1} + \Delta ln(Y/LL)_{t-2}]$$
$$(6.36)^* \qquad\qquad (1.78)^{**}$$
$$+\,0.047VAT2 - 0.043DUM8991$$
$$(3.07)^* \qquad (-1.96)^* \qquad\qquad (7.12)$$

$$\overline{R}^2 = 0.875, DW = 1.59, SEE = 0.026, Period: 1974 - 2002$$
$$\chi^2_{sc1} = 1.154, \chi^2_{ff} = 0.008, \chi^2_n = 0.386, \chi^2_{hs} = 2.003$$

The Production Function

$$\Delta lnY^s_t = -3.900 - 1.195\ lnY^s_{t-1} + 0.264\ lnK_{t-1} + 0.736\ lnLL_{t-1}$$
$$(-7.05)^* \quad (-6.94)^* \qquad (8.53)^* \qquad\qquad (8.53)^*$$
$$+\,0.737\Delta lnLL_t + 1.005\Delta lnK_t + 0.028DUM8995 + 0.013T$$
$$(5.93)^* \qquad (3.50)^* \qquad (1.94)^{**} \qquad\qquad (12.20)^*$$

$$\bar{R}^2 = 0.987, DW = 2.29, SER = 0.028, Period: 1971 - 2002$$
$$\chi^2_{sc}(1) = 1.41, \chi^2_{ff}(1) = 2.00, \chi^2_{nn}(2) = 0.37, \chi^2_{hs}(1) = 0.00$$

Aggregate Output

$$Y_t = 3.261 + 0.298Y^s_t + 0.280Y^d_t$$
$$(9.17)^* \quad (2.74)^* \quad (1.99)^*$$

$$\bar{R}^2 = 0.911, DW = 1.598, SER = 0.040, Period: 1977 - 2002$$
$$\chi^2_{sc}(1) = 0.87, \chi^2_{ff}(1) = 1.46, \chi^2_{nn}(2) = 0.47, \chi^2_{hs}(1) = 0.79$$

Note that an alternative consumption equation (3.6c') is used in simulations. Although the SER of this equation is higher than the most preferred equation obtained in chapter 3, the alternative equation gives better simulation outcomes and therefore is retained in the model. The production function is based on constant returns to scale and it may be noted that the share of profits on output is on the low side. This may be due to limitations in data on capital stock. Further, it is hard to obtain data on employment in the informal sector. Nonetheless, the equation is well defined and as shall be seen later, predicts real output reasonably well.

Given the estimated parameter values of these equations, if the actual values of the 13 exogenous variables which are:$\overline{G}$, YD, R, RL, E, PM, PF, YT, K, L, POIL, PM and Y* and for the 9 dummy variables, (COUP, COUP1 SS, DEV, DEV2, VAT1, VAT2, DUM8991 and DUM8996) are provided, the models gives time paths for the 11 endogenous variable (C, I, X, RM, M1, P, CPI, W, Y^d, Y^s and Y). The two types of simulation results are close, but we report static simulation results because they are marginally better. Before discussing the simulation results, we shall provide a brief discussion on simulation process.

8.3 A NOTE ON SIMULATIONS

Generally, model simulations are performed for a variety of reasons including model testing and evaluation, policy analysis and forecasting. However, for the purposes of our study, we have only performed historical simulation and evaluated the results based on some standard model evaluation criteria. Various evaluation statistics such as the root mean squared errors ($RMSE$), root-mean-squared percentage errors ($RMSPE$), the Theil's inequality measure (U) and their decompositions (Us, Um and Uc) are computed. Generally, the RMSE should be compared with the actual size of the variables, say proxied by its sample mean. However, in practice, the RMSEs are often high, since they penalize large individual errors more heavily. Low RMSPE are only one desirable measure of simulation fit. A model's evaluation should depend on the purpose for which it was built. Since our main objective is to develop a small scale macroeconometric model using recent developments in time series methods, it is important to check if the equations are well specified, together with the correctness of the signs and the magnitudes of parameter estimates, which we have shown to be appropriate and consistent with the economic theory and our expectations.

A statistic related to RMSE is the Theils's inequality coefficient (U). The values of U close to zero means a perfect fit. This inequality can then be defined in proportions as Um, Us and Uc, which are called the bias, variance and covariance proportions. These are useful breakdowns of simulation errors into its characteristics sources. The Um is an indication of systematic error, thus a large value of Um would signal systematic bias and implies the need for revision of the model. The variance proportion, Us indicates the model's ability to replicate the degree of variability in the variables. Large values of Us would signal either the actual or the simulated series have more fluctuations than the other. This would also signal model revision. Finally, the Uc measures unsystematic errors which is less worrisome. Another important criterion is to check if the model tracks turning points well in data. This indicates if there are specifications bias.

Even if a model tracked oscillations well and has small root mean square errors, one would want to test whether the model responds well to large changes in exogenous variables in a manner which is consistent with economic theory. This is called the dynamic response of the model. For example a major increase in government expenditure is supposed to increase GDP in a decreasing manner. Thus one can compute the dynamic multipliers associated with changes in the exogenous variables. Sometimes, a model may perform well in one or two of these criteria, but may fail in others. Unfortunately as yet, the econometric techniques do not offer a unified statistic which gives model's performance consistent with all these criteria. Thus one has to apply judgment and understand the trade-offs between alternative criteria in evaluating a model. It should be noted that the evaluation criteria is much more complicated for a multi-equation model than a single equation. However, a model as a whole, will have a dynamic structure which is much richer than any one of its equations. In light of these issues, we have simulated the complete model and the results together with the computed evaluation measures are given below.

8.4 SIMULATION RESULTS

We now turn to simulation results and conduct standard simulation evaluation tests. We compute various summary statistics to examine how well the model captures the dynamics of output, its disaggregated components, inflation and wages during the sample period.

In Figures 1-8 below, time series plots of actual and simulated values of the endogenous variables are given. These are based on statics simulations. All quantity variables are in real terms given in their logarithms. The predicted series are indexed with z.

FIGURE 1

ACTUAL AND SIMULATED VALUES OF CONSUMPTION

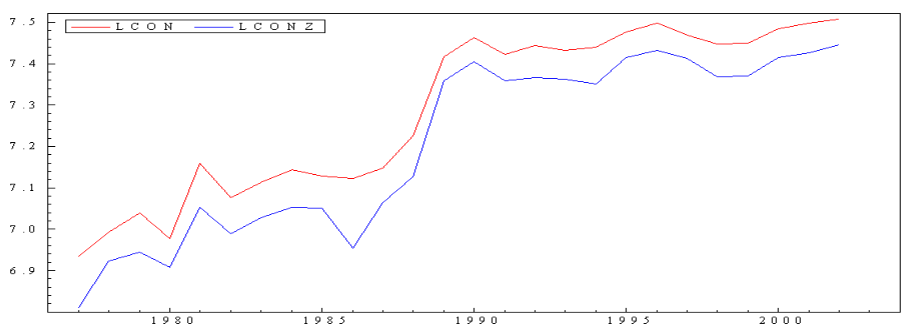


Figure-1 shows the dynamic time path of consumption. Although the simulation results are not impressive, it is noted that the model replicates turning points reasonably well. Often model builders adjust the slope and intercept in such as situation. Our attempts to do the same worsened simulation results for other variables. Therefore, we had to fit an OLS equation between the actual and predicted values of consumption and the results are given in Figure-2. It may be noted that there exist a near perfect fit between the two.

FIGURE 2

ACTUAL AND SIMULATED VALUES OF CONSUMPTION (adjusted

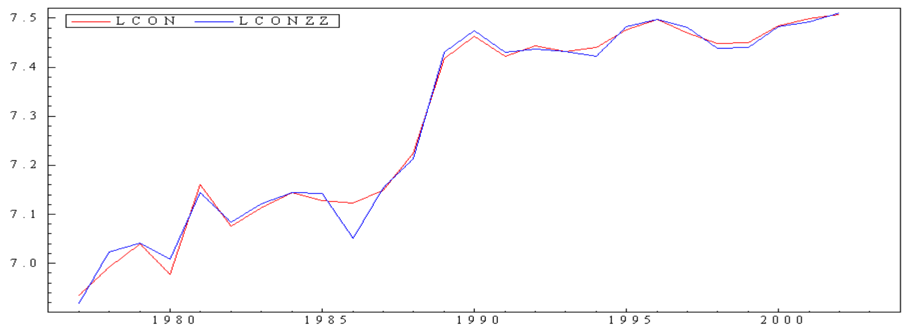
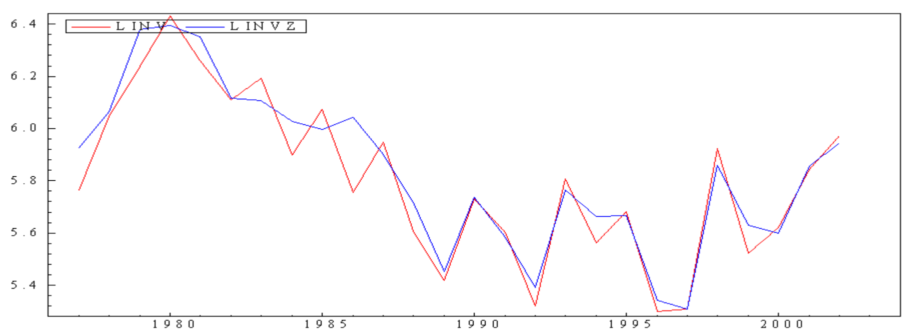


FIGURE 3

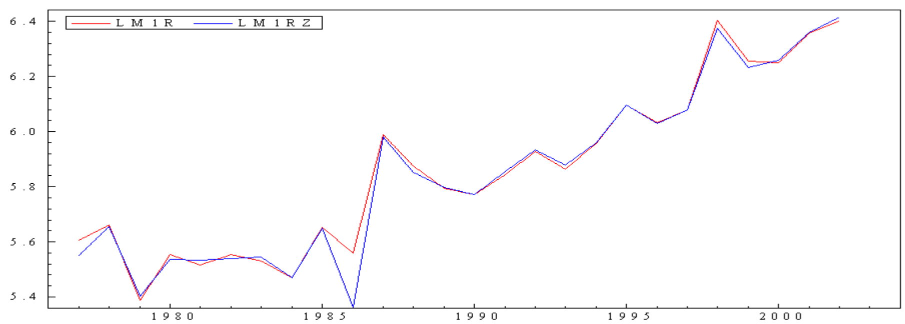
ACTUAL AND SIMULATED VALUES OF PRIVATE INVESTMENT



In Figure-3, we have plotted private investment against its simulated values. It may be noted that investment is the most volatile component of aggregate demand. Except for the mid 1980's, the model gives a good prediction for changes in private investment.

FIGURE 4

ACTUAL AND SIMULATED VALUES OF MONEY DEMAND

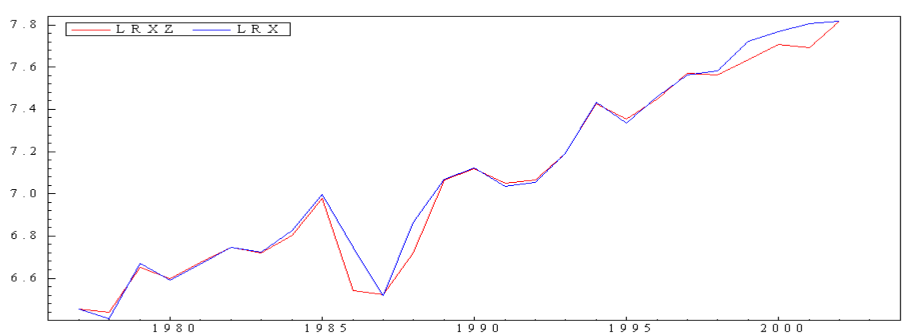


The money demand is shown in Figure-4. Apart from the unexplained deviations in 1986, the predictions are impressive.

Real exports and imports are given in Figures-5 & 6, respectively.

FIGURE 5

ACTUAL AND SIMULATED VALUES OF EXPORTS



The predictions are not perfect only in 1986-87 and in late 2000. These may be due to the two political coups during these periods. However, the overall simulation results for both the variables are reasonable.

FIGURE 6

ACTUAL AND SIMULATED VALUES OF IMPORTS

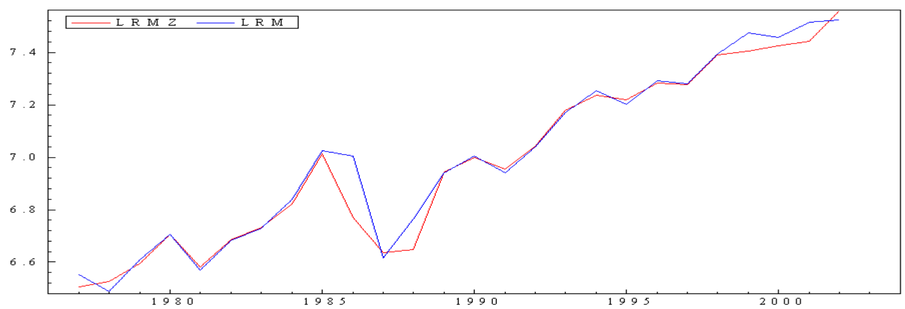
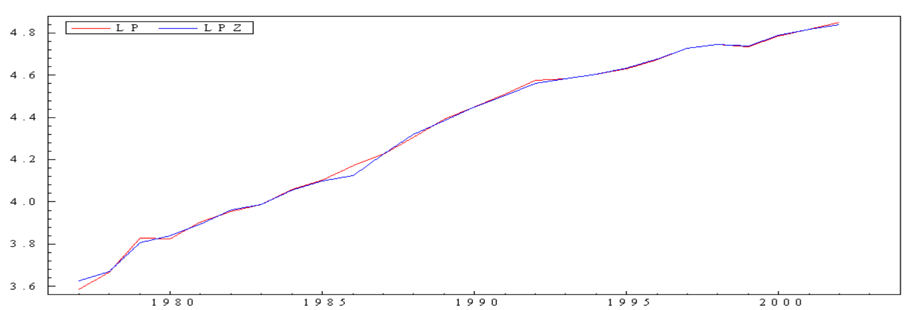


FIGURE 7

ACTUAL AND SIMULATED VALUES OF GDP DEFLATOR



Figures 7-9 show simulation results of price equations. All the variables, viz, the GDP deflator, CPI and the nominal wage rate have perfect fit.

FIGURE 8

ACTUAL AND SIMULATED VALUES OF CPI

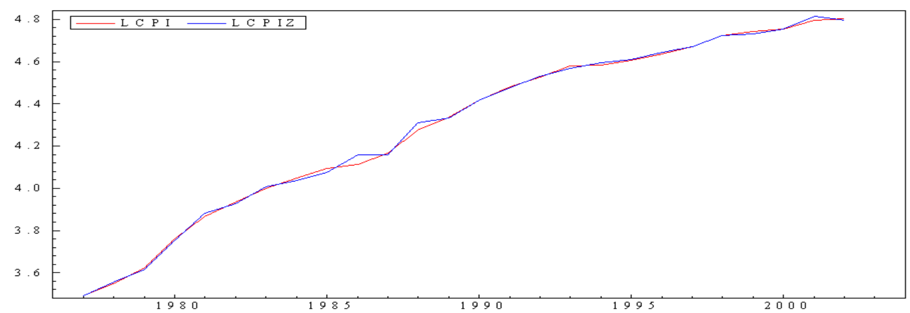


FIGURE 9

ACTUAL AND SIMULATED VALUES OF WAGES

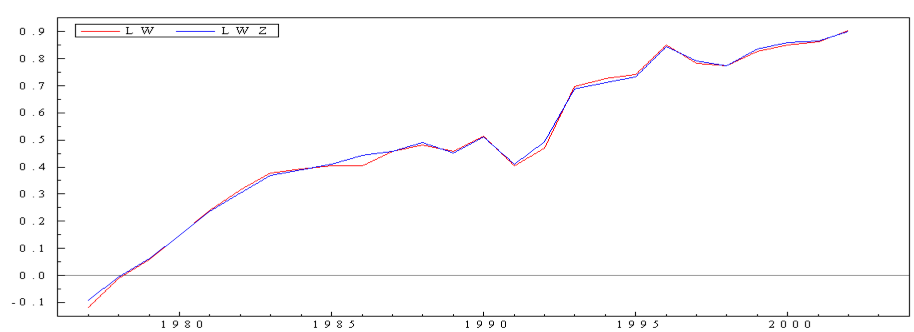
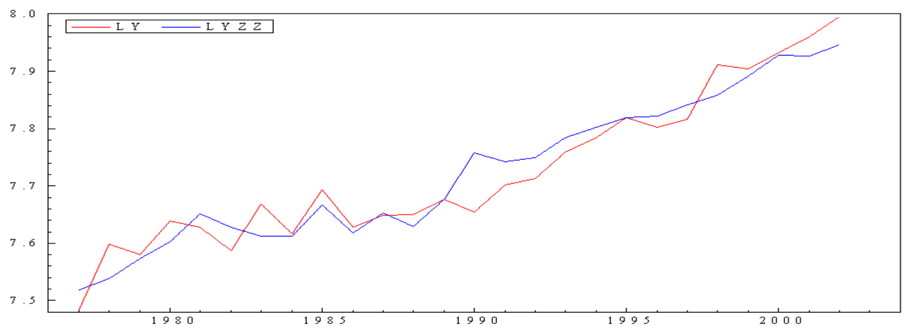


Figure-10 shows predictions of real GDP which is derived using the output equation. Note there is a close association between the actual and predicted values, although the fit is not perfect. However, it is reasonable given the size and limitations of our model and data.

FIGURE 10

ACTUAL AND SIMULATED VALUES OF OUTPUT



Finally, we computed various simulation evaluation statistics presented in Table-1 below. All the summary statistics are impressive except for the original consumption equation which has been improved upon in the third row. Both RMSPE and Theil's U are low for all variables. The highest RMSPE is 0.118 for the wage variable but is lowest for the alternative consumption and GDP deflator at 0.003. The U is 0.010 for the wages but this is still low. The Um and Us decompositions of U are small which indicate that there are no serious errors in specification and that the variations in dependent variables are adequately captured. While Um is around 0.15 for investment and exports equations, they are not a cause of concern given our sample size and data limitations. Further, Pindyck and Rubinfeld (1991) suggest that Um above 0.2 may be troublesome, which is not the case in ours. The last three columns in Table-1 give the basic statistics based on OLS fit of the actual and the simulated values of respective variables. It may be said that there exists close to perfect fit between the actual and simulated values for all the endogenous variables. The

Table-1
EX-post Simulations: Summary Statistics

	RMSE	RMSPE	U	Um	Us	Uc	α	β	$\bar{R}^2$
lnC_t	0.085	0.012	0.006	**0.921**	0.026	0.053	0.990	0.583	0.930
lnC'_t	0.019	0.003	0.001	0.001	0.000	0.999	0.033	0.996	0.990
lnI_t	0.092	0.016	0.008	0.135	0.002	0.863	0.121	0.918	0.974
$lnM1_t$	0.042	0.008	0.004	0.061	0.052	0.888	0.238	0.961	0.983
lnX_t	0.059	0.008	0.004	0.161	0.008	0.831	-0.008	1.004	0.984
$lnRM_t$	0.058	0.008	0.004	0.107	0.000	0.893	0.099	0.989	0.970
lnP_t	0.014	0.004	0.002	0.009	0.025	0.966	-0.021	1.005	0.999
$lnCPI_t$	0.015	0.003	0.002	0.025	0.000	0.975	0.003	0.999	0.975
lnW_t	0.042	0.118	0.010	0.043	0.067	0.890	-0.008	1.010	0.998
lnY_t	0.037	0.005	0.002	0.000	0.021	0.979	0.000	1.000	0.918

lnC'_t represents the alternative consumption function used in simulations. The α and β are, respectively, the intercept and slope of the fit between the actual and simuated values. The $\bar{R}^2$ measures the goodness of fit.

$\bar{R}^2s$ are high, slope coefficients are close to unity and the intercepts are around zero.

8.5 CONCLUSION

In this chapter, we have simulated the complete macroeconometric model and evaluated the in sample predictions. Based on the two important model evaluation criterion, viz, RMSPE and U (including its decompositions), it can be concluded that the model predicts historical data reasonably well. Thus our results indicate that simple time series approaches such as GETS may be useful for developing structural models. While it would be valuable to estimate the entire model with systems based estimation methods, it is not practical when the data points are limited, compared to the number of coefficients in the model. Furthermore, as yet it is not known how these time series methods of estimation can be modified to estimate models consisting of more than two are three equations. In conclusion, we only claim that time series estimation methods, such as GETS, seem to be more promising in capturing the underlying dynamics of the equations and also give more reliable summary statistics than those based on the standard classical methods of estimation. It is hoped that our preliminary work would be useful for future works on model building.

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9 CONCLUSIONS AND LIMITATIONS

9.1 CONCLUSIONS

In this thesis, we have briefly surveyed the literature on macroeconomic relationships and analyzed various empirical works for both single equation estimation and macroeconometric model building. While there is a good number of works on single equations, to date, only two studies on macroeconomic models are published in Fiji. However, an up-to-date structural model that may be used for forecasting or policy does not exists in Fiji. Thus we have used alternative time series techniques (GETS and JML) to estimate important macroeconomic relationships that comprise our macroeconometric model. Our single equation approach for macro modeling is not new because systems methods are not only complicated but are also non-pragmatic given the quality and frequency of data in developing countries compared to the number of coefficients of the model. Further, it is not yet known how these time series methods can be modified to estimate models consisting of more than two or three equations.

The complete model is then simulated over the historical period and standard model evaluation tests are conducted. Based on the simulation results and evaluation tests, it can be concluded that our approach has yielded respectable results. The in- sample predictions are reasonable with small RMSPE and impressive Theils inequality coefficients. The decomposed Theils indicies indicate that there are no serious systematic or specification errors. While the overall results are noteworthy, we have made at least two observations. First, both GETS and JML produced equally good and comparable parameter estimates and it is hard to claim which is better. However, we noted that most of the final equations comprising our model are based on GETS. Based on these observations, we only claim that simple time series estimation methods seem to be promising in capturing the underlying dynamics of the equations and also give reliable summary statistics than those based on classical methods. Therefore, these may be used to estimate structural macroeconometric models.

9.2 LIMITATIONS

There are a few limitations of our model. First, given the scope of this thesis, we are unable to extend our work in lines of forecasting and policy analysis. However these require further revision of our model. Second, we have ignored structural breaks and their implications on unit root tests as implied by Perron (1989), who argued that if there is a one time change in the intercept and/or trend in a variable, the power of the standard unit root test statistics becomes weaker. Consequently, the null that the variable is non-stationary may not be rejected even if it is stationary. Perron's work stimulated several interesting developments because a major limitation in his work is that the date of the break should be known *a priori*; for a comprehensive survey see Maddala and Kim (1998). However, we argue that there are practical problems in utilizing the break point tests when there are only a limited number of annual observations for developing countries. That is, suppose the structural break tests show that there is a single or double break in the series, it would be necessary then to partition the data into two or three smaller sub-samples and estimate the cointegrating vectors for each. Such a partition is not practical for a small sample such as ours. Nonetheless, we do not argue that structural change methodology is not useful at all, but in our view, this literature has only a limited use for developing countries. Thus, we have not applied the beak point tests in our estimates but have conducted the usual TIMVAR stability tests which suggest that all the estimated equations are stable.

With these controversial methodological debates, our findings should be treated as preliminary until they are refuted by other works. Nonetheless, we are hopeful that our work will be a useful starting point for further works and may encourage other researchers to develop large scale forecasting or policy models for Fiji and for the other PICs.

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APPENDICES

APPENDIX A: DATA AND DEFINITIONS

C_t = Nominal private consumption expenditure including durables and non-durables deflated by GDP deflator. Source: Current Economic Statistics, Bureau of Statistics (various years).

P_t = Real GDP deflator. Source: International Financial Statistics CD-ROM, (December 2003).

YD_t = Real private sector disposable income. Since data on disposable income is not published, YD_t is computed as: $Y_t * (1 - Tx) + RGNT_t$, where Tx is the average (direct) tax rate and $RGNT_t$ is the sum of grants and current transfers received by the private sector deflated by GDP deflator. The tax rate is computed as a ratio of direct tax levied on wages and profits as a proportion of gross disposable income accrued to labor and capital. Source: Current Economic Statistics, Bureau of Statistics (various years).

Y_t = Nominal GDP at factor cost deflated by GDP deflator. Sources: Reserve Bank of Fiji, Quarterly Reviews (various years) and International Financial Statistics CD-ROM, (December 2003).

R_t = Credit availability proxy computed as the spread between the nominal short term - RBF 91-day bond or treasury bill rate, which ever is available - and the long term interest rates - 5yr government bond yields. Annual average yields of corporate bonds of similar maturity in the pre-1979 period is taken as long term interest rate for those years. Sources: International Financial Statistics CD-ROM, (December 2003) and Reserve Bank of Fiji, Quarterly Reviews (various years).

I_t = Nominal private sector investment deflated by GDP deflator. It also includes investment expenditure of statutory bodies. Source: Reserve Bank of Fiji, Quarterly Review, (December 2003).

Y_t^* = Real potential GDP, de-trended values of real GDP using HPF method in Microfit 4.1.

RRL_t = Real long term interest rate, computed as the difference between nominal long term interest rate and GDP deflator inflation rate.

SS_t = Average Sugar production per hecter used as a proxy for the supply side dummy. Source: Current Economic Statistics, Bureau of Statistics, (December 2003).

CPI_t = Annual average index of the consumer prices. Sources: Current Economic Statistics (December 2003) and Reserve Bank of Fiji, Quarterly Reviews (various years).

GAP_t = Is computed as the difference between lnY_t and lnY_t^* in Microfit 4.1.

W_t = Is the nominal annual average daily wage rate in all productive sectors classified by the FSIC categories. Source: Current Economic Statistics and Fiji Employment Survey, both of Bureau of Statistics, (various years).

LL_t = Labor force in paid employment. Sources: Reserve Bank of Fiji and Fiji Employment Survey, (various years).

K_t = Real capital stock data is derived by adjusting the capital stock series used by Gounder and Morling (2000). Sources: Reserve Bank of Fiji's Quarterly Review, (December 2003) and Gounder and Morling (2000).

RS = Nominal simple average of 1-3 years savings deposit rates. Sources: Reserve Bank of Fiji Quarterly Review (various years) and International Financial Statistics CD-ROM, (December 2003).

M1 = Narrow money balance consisting of currency in circulation, demand deposits and bills payable. Source: Reserve Bank of Fiji Quarterly Review (various years) and the International Financial Statistics, (December 2003).

X_t = Quantity of exports determined by nominal (FOB) export value deflated with domestic export unit value index. Sources: Current Economic Statistics, Bureau of Statistics (various years) and International Financial Statistics CD-ROM, (December 2003).

E_t = Nominal exchange rate - the price of a unit of foreign currency in terms of domestic currency. Sources: International Financial

Statistics CD-ROM, (December 2003) and Reserve Bank of Fiji, Quarterly Reviews (various years).

P_{Ft} = Foreign prices computed as trade-weighted average of GDP deflator (1995 = 100) of Fiji's major trading partner countries. The trading partner countries are Australia, New Zealand, USA, EU/England and Japan. Trade weights are computed as respective trade shares of these economies on Fiji's total trade with them. Sources: International Financial Statistics CD-ROM, (December 2003) and Reserve Bank of Fiji, Quarterly Reviews (various years).

PM_t = Import prices computed as import-weighted average export unit value indices (1995 = 100) of Fiji's major trading partner countries. Import weights are computed as respective shares of import from these economies on Fiji's total imports from them. Sources: International Financial Statistics CD-ROM, (December 2003) and Reserve Bank of Fiji Quarterly Reviews (various years).

Y_F = Trade weighted real GDP Index of trading partner countries expressed in 1995 prices.

RM_t = Quantity of imports of goods and services, determined by nominal imports deflated with P_M. Sources: Current Economic Statistics and Reserve Bank of Fiji Quarterly Reviews, (various years).

$POIL_t$ = Brent crude oil prices Index (1995 = 100). Source: International Financial Statistics CD-ROM, (December 2003).

COUP = Dummy variable for the two political coups in Fiji. Data constructed as 1 since the first coup in 1987 to 2002 and 0 in all other periods.

COUP1 = Dummy variable to capture the temporary impact of the two coups. Data constructed as 1 in 1986 to 1988 & 2000 and zero in all other periods.

NBF = Dummy variable for the collapse of the National Bank of Fiji. Data constructed as 1 for 1996 to 1998 and 0 for all other periods.

DEV = Dummy variable for the two devaluations of the Fiji dollar. Data constructed as 1 for 1987-88 & 1997-98 and 0 for all other periods.

DEV2 = Dummy variable for the second devaluation. Data constructed as 1 for 1997 to 98 and 0 for all other periods.

VAT = A permanent dummy for the introduction of VAT in 1992. Data constructed as 1 from 1992 onwards and zero for other periods.

$VAT2$ = Temporary VAT dummy for the introduction of Value Added Tax in Fiji. Data constructed as 1 for 1992-1994 and zero in all other periods.

DUM8991 and DUM8995 = are dummy variables to proxy, separately, the post 1989 to 1991/95 period of high private sector confidence following the major tax incentives in tax free zones and export promotion policies.

T = is the time trend.

APPENDIX B: UNIT ROOT TEST RESULTS

Variable	ADF	PP	Variable	ADF	PP	m
RL_t	2.65	1.71	ΔRL_t	4.43	4.29	
	0.11	0.42		0.00	0.00	[1,1,3,3]
$\ln\left(\frac{I_t}{Y_t}\right)$	0.90	1.65	$\Delta\ln\left(\frac{I_t}{Y_t}\right)$	6.40	8.27	
	0.31	0.53		0.00	0.00	[1,3,1,1]
$\ln(Y_t - Y_t^*)$	5.40	8.14	$\Delta\ln(Y_t - Y_t^*)$	5.90	15.85	
	0.00	0.00		0.00	0.00	[4,4,4,4]
$\ln C_t$	2.44	2.58	$\Delta\ln C_t$	4.14	6.58	
	0.23	0.11		0.01	0.00	[1,1,1,1]
$\ln YD_t$	2.33	2.88	$\Delta\ln YD_t$	5.27	6.24	
	0.33	0.23		0.00	0.00	[1,1,1,1]
R_t	2.05	1.15	ΔR_t	6.28	10.08	
	0.27	0.22		0.00	0.00	[2,1,1,1]
$\ln P_t$	3.39	3.34	$\Delta\ln P_t$	4.08	4.08	
	0.07	0.08		0.02	0.02	[0,1,0,0]
$\ln Y_t$	1.33	1.48	$\Delta\ln Y_t$	4.46	7.89	
	0.15	0.53		0.00	0.00	[1,2,1,1]
$\ln P_t^F$	1.69	0.72	$\Delta\ln P_t^F$	4.61	3.08	
	0.97	0.98		0.01	0.00	[1,1,2,2]
$\ln M1_t$	2.73	0.02	$\Delta\ln M1_t$	5.46	7.94	
	0.44	0.43		0.00	0.00	[1,1,1,1]
RS_t	1.79	2.26	ΔRS_t	4.49	32.15	
	0.61	0.96		0.00	0.00	[2,5,1,1]
$\ln X_t$	2.74	2.42	$\Delta\ln X_t$	6.57	5.91	
	0.23	0.24		0.00	0.00	[0,0,1,1]
$\ln YT_t$	2.93	2.00	$\Delta\ln YT_t$	3.51	4.59	
	0.33	0.58		0.01	0.00	[1,1,1,1]
$\ln\left(\frac{P_t}{E_t * PF_t}\right)$	2.71	2.68	$\Delta\ln\left(\frac{P_t}{E_t * PF_t}\right)$	6.38	6.08	
	0.06	0.08		0.00	0.00	[1,1,1,1]
$\ln RM_t$	2.26	3.64	$\Delta\ln RM_t$	6.08	13.21	
	0.43	0.71		0.00	0.00	[2,2,1,1]
$\ln PM_t$	2.27	1.37	$\Delta\ln PM_t$	2.97	3.02	
	0.44	0.85		0.04	0.04	[1,1,1,1]
$\ln POIL_t$	2.34	2.47	$\Delta\ln POIL_t$	3.89	6.10	
	0.17	0.13		0.01	0.00	[1,1,1,1]
$\ln CPI_t$	2.79	1.86	$\Delta\ln CPI_t$	4.00	5.15	
	0.28	0.75		0.03	0.03	[1,1,1,1]
$\ln XP_t$	2.54	1.96	$\Delta\ln XP_t$	4.67	5.31	
	0.13	0.60		0.00	0.00	[4,4,1,1]
$\ln W_t$	1.97	1.98	$\Delta\ln W_t$	3.61	4.86	
	0.59	0.59		0.04	0.00	[0,2,3,3]
$\ln APL_t$	2.46	3.10	$\Delta\ln APL_t$	4.64	8.25	
	0.13	0.12		0.00	0.00	[1,0,1,1]
$\ln Lb_t$	2.70	1.79	$\Delta\ln Lb_t$	4.85	6.98	
	0.34	0.37		0.00	0.00	[1,0,1,0]
$\ln K_t$	2.84	1.79	$\Delta\ln K_t$	3.19	3.03	
	0.27	0.27		0.10	0.14	[1,1,0,1]
SS	1.45	1.33	$\Delta\ SS$	3.48	14.98	
	0.54	0.20		0.02	0.00	[6,6,6,6]

Notes on Unit Root Tests

1. ADF is the standard augmented Dicky-Fuller F-test and the PP is the Phillips-Perron test. For both the tests the p-values are given in parenthesis.

2. m is the lag length of the first differences of variables included, for example, [1,1,2,2] means that one lagged first difference is found to be adequate in each test in levels and two lags are optimal for their first differences.

3. The sample chosen for the tests are 1972-2002 for levels and 1973-2002 for first the differences of variables.

4. A time trend (T) is included for levels but only for the first difference if it is significant. Microfit 4.1 and E-Views 5.0 are used to compute the test statistics.

5. The unit root test results indicate that all variables except the output gap ($lnY_t - lnY_t^*$) are I(1) in levels but are stationary in first difference at 5%.

6. We also conducted an alternative test - KPSS test - for lnP_t, $ln\left[\frac{P_D}{E_t \times P_F}\right]$ and ΔlnK_t since the ADF and PP did not give conclusive results for these variables at 5% level. Based on the KPSS tests, the null of stationarity is rejected for lnP_t and $ln\left[\frac{P_D}{E_t \times P_F}\right]$ at 5%. The KPSS statistics in order of lnP_t, $ln\left[\frac{P_D}{E_t \times P_F}\right]$ are 10.529 and 0.954 against the critical value of 0.146. For ΔlnK_t the null was accepted since the KPSS statistic was 0.441 against 0.463 at 5% level. The 1% critical value for KPSS is 0.739. Thus we accepted that the two price variables are I(1) in levels and ΔlnK_t is stationary.