The Reconstruction of a Macroeconomic Dataset for Uganda

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Abstract: This paper is an account of the re-construction of a macroeconomic dataset for Uganda. The sources of data, the splicing together of consumer price indices and interpolation of missing quarterly observations, the interpolation of quarterly GDP and the estimation of quarterly monetary GDY and GDE, are described. The resulting dataset (which is presented in an appendix) is then used to highlight the collapse in GDP, change in the structure of production and de-monetisation which resulted from insecurity, and more recent macroeconomic stability and re-monetisation. The final section of the paper discusses some of the time-series characteristics of the data.

1. Introduction

This paper[1] is an account of the re-construction of a quarterly macroeconomic dataset for Uganda from 1967 to 1996, no other complete dataset having existed as a result of institutional breakdown and economic collapse. The next section describes the sources for these data. In re-compiling data from disparate sources, three tasks required particular care and are, therefore, given a more detailed treatment in sections 3 to 5. These were the splicing of the consumer price index (cpi) and the interpolation of missing quarterly data for the cpi from 1977 to 1981; the interpolation of quarterly monetary GDP; the estimation of quarterly monetary GDY and monetary GDE. Section 6 highlights some features of the data which cover a period of insecurity and turmoil. Section 7 reports the results from unit root tests used to investigate the time-series properties of the data. The final dataset is listed in an appendix.

2. Sources

Until 1974 the Statistics Department[2] published an annual *Statistical Abstract*, and between 1968 and 1974 a *Quarterly Bulletin of Statistics*. Up until 1976, Uganda's statistics were also published by the East African Community in the *Economic and Statistical Review*. From the mid-1970s to 1989 Statistics Department data were only published in the annual *Background to the Budget* but it seems that none was published between 1974 and 1981[3]. The budget speech was published each year and some included limited statistical information for the 1970s which could be used in conjunction with other data, particularly the *Statistical Reports* from the Coffee Marketing Board (CMB). The Statistics Department has produced a comprehensive set of publications since 1988. Other sources were the *International Financial Statistics* (*IFS*), published by the IMF, the *World Tables* of the World Bank and *Pick's International Currency Yearbook*. In addition to published data there existed a collection of series of market exchange rates which were collated from various sources within the Macro-Planning Department of the MPED in 1988. Data on the volume of coffee delivered to the CMB in Kampala, the price farmers were paid for that coffee and the volume of shipments from the CMB were obtained from the successor to the CMB, the 'Coffee Marketing Board Ltd'. The rest of this section looks in more detail at the sources and quality of the main data series.

GDP

The sources for GDP data were the annual *Statistical Abstract*, issues of *Background to the Budget*, and the occasional *GDP Bulletin* of the Statistics Department. The series obtained were total and monetary

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[1] This paper is based, in part, on a chapter of my D.Phil thesis (Henstridge, 1995) which similarly re-constructed macroeconomic data for Uganda from 1967 to 1993. I am grateful to my supervisor Paul Collier for patience and encouragement and to Chris Adam for comments. Since 1993 some series have been revised, so this paper up-dates the earlier data, and extends the series through to the end of 1996.

[2] In 1992, the former Ministry of Finance and Ministry of Planning and Economic Development (MPED) were merged to form the Ministry of Finance and Economic Planning (MFEP). The Statistics Department thus changed parent ministry from MPED to MFEP. In 1996 this ministry was split, with the Ministry of Planning and Economic Development being separated from the Ministry of Finance. These two states can be considered interchangeable when referring to statistical publications, but here the title of the parent ministry is reported as it was at the time of publication of the statistics.

[3] That copies were produced for parliament, but not published for a wider audience is corroborated by the personal recollection of Henry Lutaaya (1995), who worked in the Statistics Department from the 1960s through to the early 1990s.

GDP (by factor cost in 1966 prices) from 1963 to 1987 and total and monetary GDP (by factor cost in 1991 prices) on a calendar and on a fiscal year basis from 1982 onwards.

The existence of survey data as well as the collection of price data during the 1960s suggests that the estimates of GDP for that decade were of good quality[4]. For the 1970s and 1980s, however, there are no further survey data. As a result, being based on estimates of changes in sectoral production implied a drop in both the quality and coverage of the GDP estimates. In 1989 the 'National Household Budget Survey' (HBS) provided survey information for the first time in nearly twenty years. The improvements in data on household production and consumption enabled the Statistics Department to make *ex post* revisions to the series for the 1980s, which raised the quality of the GDP estimates from 1982 onwards. The HBS was followed by a Census of Agriculture, a Census of Business Establishments, a National Population Census and the Integrated Household Survey of 1992, which provided additional information on household and small-scale, 'informal' production.

Price Data

Price data for Kampala were first collected regularly in the 1940s and used in a 'Kampala Cost of Living Index' based on weights taken from a survey conducted in Nairobi in 1947 with minor modifications. A second index was published monthly from June 1956[5] to measure 'the effect of price changes on the average expenditure pattern of African unskilled workers in Kampala'. The prices were collected from ten markets in Kampala. The weights for both these indices are shown in table 1, below. Revised indices, based at 100 for January 1961, were first published in 1962. These had weights based on surveys of expenditure patterns in Kampala, also shown in table 1[6].

Subsequent collection of price data allowed the publication of indices on a monthly and then a quarterly basis up to the end of 1976 but only annual estimates were available for the years 1977 to 1981(published in *Background to the Budget 1981/92* and the *IFS* and *World Tables*). In 1981, the monthly collection of price data re-commenced. The 1961 weights were used, with small modifications, which can be seen in table 1. The 'high- income index' was dropped, but the 'low-income index' continued with unchanged weights. The 'middle- income index' showed slight increases in the weights given to 'fuel', 'transport' and 'clothing', and a decrease in 'other consumer goods' and 'other goods and services'. This partly reflected changes in data coverage—there is no evidence of any collection of data on domestic servants' wages, for

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[4] Some of the sources of data probably used to compile estimates of GDP during the 1960s, which are referred to in other publications, or can still be traced, included:

- Survey of African Unskilled Workers in Kampala, February 1957 and February 1964.
- Survey of African Unskilled Workers in Mbale, February 1958.
- Survey of African Unskilled Workers in Fort Portal, February 1960.
- Survey of African Unskilled Workers in Gulu, February 1961.
- Enumeration of Employees, June 1961; 1962; 1963; 1964; 1966; 1967; 1968; 1970; 1971.
- The Patterns of Income and Expenditure of Coffee Growers in Buganda, 1962/63.
- Annual Surveys of Industrial Production Building and Commerce, 1963; 1964; 1965 and 66; 1968; 1969; 1971. Survey of African Unskilled Workers in Kampala, February 1964.
- Census of Distribution, 1966.
- Rural Food Consumption Survey, 1968: Ankole, Busoga, Masaka, West Nile.
- High Level Manpower Survey, 1967 and Analyses of Requirements, 1967-1981.

[5] See East African Statistics Unit (1957).

[6] The sources for the data were the *Statistical Abstract* and the *Quarterly Bulletin*.

example—and also reflected changes in patterns of consumption which resulted from insecurity. The organisation of data collection was changed, with the Research Department of the Bank of Uganda being given responsibility for the collection of data and compilation of the middle-income index. The Statistics Department, which was short of staff, equipment and financial resources, collected the data for and compiled the low-income index. Prices were collected for 46 items for the middle-income index, and for 39 items for the low-income index[7]. The resulting series were both published in *Background to the Budget*.

The preliminary results from the 1989/90 HBS provided new weights which were complemented by a widening of data collection to cover more products (89 items) in more markets and the inclusion of services, such as clinic and school fees and rent. The result was an increase in the amount of data encapsulated in each index number and a corresponding improvement in the quality of the index, published as the 'New cpi' in 1989. With the completion of the analysis of the HBS, a 'Revised New cpi' superseded the interim version in 1992. The additional revisions were minor: a slight change in weights, a change in the base of the index and a re-grouping of some items, reflecting more closely the categorisations used in the HBS and the increase in the number of items covered; the revised new cpi for Kampala (and Entebbe) included approximately 550 price observations for each month. Meanwhile, the collection of price data in other towns had started. The publication of the 'Revised New cpi' for Kampala had also presented data for Jinja and Mbale. In 1993, a 'Composite cpi', which also included data from Masaka and Mbarara, was published. The composite cpi weighted the data from each town by the relative numbers of urban households in each region, as recorded in the 1991 'Census of Population and Housing'. The composite cpi was calculated back to September 1989, though for some items data were not collected on a regular basis in all the towns until October 1991.

Exchange Rates

Until 1990 the official rates were administered by the Bank of Uganda and were published as monthly averages in Bank of Uganda reports and Statistics Department publications. They were also listed in the *IFS*. The market exchange rates were published by *Pick's International Currency Yearbook* on a monthly basis from mid-1970, but are also referred to in the text of *Pick*'s for earlier dates allowed the extension of data back to the beginning of 1967.

The other sources of data on the market exchange rate included a professor at Makerere University[8], the Kampala office of the US Agency for International Development (USAID), and a now defunct Kampala newspaper, the *Financial Times*. The information from these sources was patchy but not contradictory and had been collated within the Macro-Planning Department of the MPED in 1988[9]. The data from these sources ran from 1984 to 1988 and included the period of the currency reform in May 1987. These collated exchange rates were likely to be a stronger set of numbers than the *Pick's* numbers in that they probably reflected a larger number of actual transactions, or at least firm quotations. In any case, the series were mutually consistent. The only difference was that the *Pick's* data appeared to be a smoother monthly series, perhaps implying some interpolation, though this difference is not obvious when the data are transformed into quarterly averages.

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7 See Serunjogi (1990).

8 Professor E.O. Ochieng.

9 By Stephen Morris.

In June 1990 the holding and trading of foreign exchange was legalised, and the exchange rates from the Forex Bureaux were recorded by the Bank of Uganda, published in their reports and in the publications of the Statistics Department on a monthly basis. There was no particular incentive to conduct unreported transactions and no evidence of trade at prices much different from those reported in the market. Turnover has grown from between US$ 20 and 30 million per month in 1990 to an average of US$ 139 million per month in 1996.

The information content of parallel market exchange rates—in terms of their proxying the marginal price of foreign currency—partly depends on the size of the parallel market. Towards the end of the 1980s, the total value of licences issued for the import of goods with 'no foreign exchange required'—in other words, non-Bank of Uganda supplied foreign exchange—was approximately US$ 100m. a year[10]. Since a fee of 0.5 percent of the c.i.f. value of the import consignment was assessed at the time of application for the licence it seems unlikely that, once issued, a licence would not be used. Both the fee and other import taxation suggest that the actual value of imports financed by parallel market foreign exchange is likely to have been higher than the total value of licences issued, despite some of the licences having being used for externally-financed NGO imports. In addition to transactions for trade, foreign exchange would have been bought on the market for other uses, capital flight being an obvious example. In such a large market, when trade in currency was far from secretive—despite nominal illegality—the exchange rate would be well determined and therefore proxy the marginal price of foreign exchange reasonably well.

Money

M0 is defined as currency in circulation; M1 is M0 plus demand deposits; M2 is M1 plus time and savings deposits. The source used for the series on M0, M1 and M2 up to 1993 was the *IFS* because it was easier to use than the fragmented Bank of Uganda publications. The absence of continuously published monetary data in Uganda was a side-effect of difficulties experienced by the Bank of Uganda in compiling sound accounts over some of this period. For example, in 1990 no accounts (and no annual reports) had been published for the three years since 1986. An inability to produce its own balance sheet throws some doubt on the consistency and overall reliability of monetary data from a central bank. Corrupt accounting could have affected the accuracy and consistency of monetary data. These effects are likely to be smaller during the periods that agreements with the IMF meant some scrutiny—a sort of audit—of the monetary survey, even though such an exercise would not necessarily make a difference to levels of this sort of corruption. Agreements with the IMF were maintained between 1982 and 1984, and again from mid-1987. The absence of an IMF agreement between 1984 and 1987 coincided with what appeared to be a period of weak monetary data[11]. The quality of accounting at the Bank of Uganda improved with the completion and publication of accounts and reports for 1986-90 in 1991. It is reasonable to assume a corresponding improvement in the monetary data based on the balance sheet of the Bank of Uganda.

The Uganda Commercial Bank (UCB) is by far Uganda's largest commercial bank in terms of its share of the deposit base. However, UCB has not always been well managed and suffered from a high proportion of non-performing assets in the loan portfolio—one assessment showed that about 87 percent of loans were

[10] In 1987 the total value of 'no forex required' licences was US$ 97m. (Harvey, 1988) and was thought to have been higher in the following two years.

[11] See the analysis of the demand for money in Henstridge (1995) and (1997c).

non-performing[12], largely because of lending to relatively powerful figures in politics or the military[13]. As with the Bank of Uganda it is likely that the quality of accounting at UCB has at times been dismal. UCB's statistical returns to the Bank of Uganda have been inaccurate, as well as late, which could have compromised some of the monetary data.

Since 1990 a series on M3 has been compiled by the Bank of Uganda. In Uganda, M3 equals M2 plus the value of foreign exchange accounts held in commercial banks in Uganda. There is no equivalent to the M3 aggregate for Kenya, which equals M2 plus deposits in non-bank financial institutions. This is partly because non-bank financial institutions are generally small and insignificant over the period under consideration, and also because there are no systematic data available on their deposits.

Interest Rates

Domestic interest rates on 91-day treasury bills, demand deposits, time deposits and lending rates—which were distinguished by whether the activity was 'commercial' or 'developmental'—covering the late 1960s and 1970s, were assembled from a 1991 Bank of Uganda publication and were also available from 1981 in various issues of *Background to the Budget*. All interest rates were administered by the Bank of Uganda until the instigation of a regular 91-day treasury bill auction in 1992, at which point commercial banks were free to set their own interest rates within a limited range around a reference rate determined by the treasury bill auction. This restriction was lifted in June 1994. The domestic interest rate series used in the dataset is the six to twelve months deposit rate, but the 91-day treasury bill rate is also available from the beginning of 1993 when it began to be set by auction.

Three different interest rates were spliced together to derive a series intended as a proxy for international dollar interest rates. These were the UK one-month money market rate for the US dollar from 1967Q1 to 1973Q4, with a gap in the *IFS* reporting for the whole of 1971. This gap, and the period from 1974Q1 to 1981Q1, were filled by the three-month eurodollar rate in London. For the rest of the sample the LIBOR[14] for the three-month US dollar rate was used. The LIBOR series and the eurodollar series overlapped for the second half of 1981. The level of the eurodollar rate was increased by the ratio between the two rates for that period in an attempt to secure greater consistency between the components for the series on the international interest rate.

Trade Data

Over the 1970s and 1980s the customs service disintegrated. Alternative sources of trade data were either information related to the financing of imports or proceeds from export earnings, which were supposed to go through the Bank of Uganda, or the volumes of deliveries of coffee from processors to the CMB and the prices that farmers were paid, which were available from CMB Ltd on a monthly basis from 1966 to 1996. In addition, the volumes of coffee shipped from CMB were available from 1967 to 1996. Because these data inevitably miss smuggled or 'unofficial' trade, their coverage of actual trade narrowed through time. The data show that by the mid-1970s Uganda's official non-coffee exports had more or less stopped

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[12] Financial Sector Reform Review Mission Aide-Memoire, World Bank, 1994.

[13] A list of prominent defaulters on UCB loans was leaked to *The Monitor* newspaper in 1994 which did indeed feature relatively powerful people in politics and the military, and their relatives.

[14] The London InterBank Offer Rate.

and the available evidence suggests that much coffee production was smuggled between the mid-1970s and late 1980s[15]. Partner country data have been used to piece together an annual series on trade by the Statistics Department[16], giving annual data on imports and exports from 1981. The collapse of the international coffee price in 1989—and reduction in export earnings which were supposed to be remitted through the Bank of Uganda—combined with the liberalisation of the market in foreign exchange in 1990, initially led to a reduction in the imports financed by foreign exchange sold by the Bank of Uganda. This further reduced the coverage of actual trade by the official trade data. With the establishment of the Uganda Revenue Authority (URA) in 1992, the quality of data produced by the customs service started to improve and by 1996 was the main source of information on trade in the balance of payments tables produced by the Bank of Uganda.

The available data on imports and exports also gave a limited amount of information on the composition of trade (by volume) which was needed to weight the international prices imports and exports to produce import and export unit value indices. The prices of Uganda's exports, and of industrial country exports and petroleum products, were available from the *IFS*. As there were few data on the composition of imports it was assumed that imports were a combination of petroleum products and industrial country exports. The share of petroleum products in Uganda's imports was available on an annual basis from the *World Tables*, and for recent years from Statistics Department data. The composition of exports was found in various issues of the *IFS*, and Statistics Department data. The balance of payments tables from the Bank of Uganda have recently included data on the unit price and volume of most exports.

For some of the data discussed in this section there were complete runs of quarterly data from 1967 to 1993, specifically, the data on money, exchange rates, interest rates and on coffee prices and volumes. Other series, such as some of the trade data and the data used to calculate import and export unit values, required the work described in sections 3 to 5 before there were complete quarterly series for the whole period.

3. Prices

In order to produce a single quarterly cpi running from 1967 to 1996 it was first necessary to consolidate the available data for the 1980s. The various series covering the sample period then needed to be spliced and finally the annual observations for the late 1970s required interpolation into a quarterly series.

Consolidation of Price Data for the 1980s

The two consumer price indices published monthly for the 1980s were very similar, but neither had a full coverage, nor up-to-date weights. The first step was to re-base the sub-indices for both series to the average of 100 for 1982. The sub-indices were then averaged for each month. A ‘consolidated’ index was constructed by averaging the weights from the two series and applying them to the averaged sub-indices. A comparison of the weights of the low- and middle-income indices and the ‘consolidated’ index is shown in table 1. The most recent data from the official new and composite indices were then spliced on the consolidated data for the 1980s to give a quarterly index from 1981 to 1996.

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[15] The magnitude of smuggling and some counter-factuals are investigated in more depth in Henstridge (1997b).

[16] See Statistics Department (1993).

Table 1

Consumer Price Index Weights.

	Food	Drink and Tobacco	Fuel and Lighting (Rent & Utils.)	Trans-port (&Com.)	Clothing and Footwear	Other Consumer Goods	Other Goods & Services
Cost of Living (excluding rent)-Kampala[7]	46[2]			8	10	12	24[3]
Index of Retail Prices in African Markets-Kampala[7]	70	15	3[4]		10	2	
High-Income Index - Kampala[7] (1960s)	25	7		35	7	14	12[5]
Middle-Income Index - Kampala[7] (1960s)	42	17	4	8	11	14	4[6]
Low-Income Index - Kampala[7] (1960s)	70	11	8		9	2	
Middle-Income Index - Kampala[7] (1980s)	41	17	6	10	14	10	2
Low-Income Index - Kampala (1980s)	70	11	8		9	2	
Consolidated Index[7]	55.5	14	7	5	11.5	6	1
Composite Index	50.1	10	10.8	4.3	6.6	10.7	7.6

Notes:

1. Apart from the composite index and the consolidation of the indices for the 1980s, all weights have been rounded with the column 'Other Goods and Services' absorbing the rounding error. In addition, the headings are for the composite index and do not apply uniformly to the other indices.
2. This is the weight for Food and for Drink and Tobacco.
3. This includes a weight of 13 for wages of domestic servants.
4. This is the weight for Fuel and Soap.
5. This includes a weight of 7.5 for the wages of domestic servants.
6. This includes a weight of 3.8 for the wages of domestic servants or other labour.
7. All the indices for the 1950s, 1960s and 1980s, and therefore the consolidation of the indices for the 1980s, excluded rent, which is included in the composite index.

Splicing the Price Data

The rest of the available data was also re-based to an average of 1982=100. The annual observations from the MPED Statistics Department data for the years 1977 to 1981 were assumed to be authoritative, though slightly higher than the numbers in *World Tables*. The price changes for this period are looked at in more detail in section 6. The exception was the observation for 1979, for which a weighted average of the Statistics Department observation (weighted 0.5) and the two numbers from the *World Tables* on the cpi and an agricultural GDP deflator (each weighted 0.25), was taken.

Table 2
Splicing the Price Data.

		Agriculture GDP Deflator (1982 = 100) World Tables	CPI (1982 = 100) World Tables	Average Low-income Price Index (1982 = 100) MPED Stats	Low-Income Price Index (1982 = 100) EAC/MPED Stats	Consolidated Price Index (1982 = 100)
1976	Qtr1				5.51	5.51
1976	Qtr2	6.52	4.78	5.30	6.07	6.07
1976	Qtr3				7.95	7.95
1976	Qtr4				7.59	7.59
1977	Qtr1					
1977	Qtr2	13.21	9.66	10.00	10.00	10.00
1977	Qtr3					
1977	Qtr4					
1978	Qtr1					
1978	Qtr2	14.86	11.52	13.64	13.64	13.64
1978	Qtr3					
1978	Qtr4					
1979	Qtr1					
1979	Qtr2	23.56	20.76	43.19	43.19	32.67
1979	Qtr3					
1979	Qtr4					
1980	Qtr1					
1980	Qtr2	40.27	32.09	48.31	48.31	48.31
1980	Qtr3					
1980	Qtr4					
1981	Qtr1					
1981	Qtr2	57.11	66.98			74.15
1981	Qtr3					85.95
1981	Qtr4			84.88		83.53
1982	Qtr1			87.83		89.23
1982	Qtr2	100.00	100.00			100.77
1982	Qtr3					105.02
1982	Qtr4					117.10

The reason for this somewhat arbitrary decision was that the Statistics Department number was significantly higher than either of the other two and higher than trend. A linear interpolation of the Statistics Department data would generate a run of quarterly numbers in 1980 which showed negative annual inflation. While this may actually have been the true path of the cpi, anecdotal evidence and a comment in *The Background to the Budget, 1982/83* suggesting that the price increase in 1980 was higher than that shown by the data, implied that a period of negative inflation would not be even a rough approximation of what actually happened. The splicing of the data is shown in table 2. The spliced series is in the right-hand column ('Consolidated Price Index').

Quarterly Interpolation for the late 1970s

The quarterly price index now ran from 1967 to 1996, with the exception of the annual observations between 1977 and 1981. Because food crop prices accounted for one third of the cpi in the late 1980s and

1990s, it was unlikely that a simple linear interpolation, ignoring seasonal movements in prices, would provide a satisfactory interpolation of late 1970s data. The significance of the deterministic seasonal dummies in table 3 bore out this assertion.

The interpolation method of Friedman (1962)—described for the interpolation of GDP below—involves the use of a correlated series which is available both annually and quarterly. Unfortunately, no suitable series related to the cpi was available. Possible candidates such as the stock of money or the market exchange rate might be used as part of the modelling of this dataset—time series modelling being one of the reasons for compiling the data in the first place—which could be invalidated by the use of these series in interpolation of prices. Therefore the constant seasonal component of the quarterly data running from 1982Q3 to 1996Q2 was extracted using dummies as a seasonal filter[17] and added to the linear interpolation between the annual observations. Each year's quarterly observations were then scaled to match the average level of the cpi as represented by the original annual observations.

Table 3

Unit Root Tests and a Seasonal Filter for the Consumer Price Index.

Unit root tests[1] *1981 (3) to 1996 (2)*

Variable	With Constant t-ADF	lag	With Constant and Trend t-ADF	lag	With Constant and Seasonals t-ADF	lag	Sargan-Bhargava DW
Lcpi	-2.38	0	-1.29	0	-2.40	0	0.004
DLcpi	-3.16*	0	-3.46	0	-2.91	0	0.61
DDLcpi	-3.80**	5	-3.85**	5	-3.53**	5	2.32

Applying the Seasonal Filter

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The present sample is:  1981 (3) to 1996 (2)

 Variable     Coefficient    Std.Error  t-value  t-prob  PartR²
 Constant        0.036764     0.022645    1.623  0.1101  0.0449
 Seasonal       -0.020664     0.032025   -0.645  0.5214  0.0074
 Seasonal_1     -0.061513     0.032025   -1.921  0.0599  0.0618
 Seasonal_2     -0.073365     0.032025   -2.291  0.0258  0.0857

 R² = 0.10988  F(3, 56) = 2.3043 [0.0867]  Õ = 0.0877048  DW = 2.35
 RSS = 0.4307591294 for 4 variables and 60 observations
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[1.] If the result of the unit root test is that there is significant evidence of stationarity for a variable, then the result of the Augmented Dickey-Fuller test at the longest significant lag of the first difference of the variable being tested is shown. This usually means that there was a stronger result, in terms of significance, at shorter lags. If there is no significant stationarity, then the result for the contemporaneous observation is shown.

Before regressing the cpi on a constant and three seasonal dummies, the data were differenced and subjected to Augmented Dickey-Fuller tests[18] and Sargan-Bhargava Durbin-Watson tests, which are shown

[17] Two methods were potentially feasible. An exercise to model this data using time-series methods to characterise the data using an ARIMA model was tried, with some success. But the ARIMA results were not obviously superior to the simple application of a seasonal filter.

[18] The Dickey-Fuller test is against an equivalent null: H_0: $\$_1 = (1 - D) = 0$ in the regression:
$\Delta y_t = \$_0 + \$_1 y_{t-1} + ,_t$.
This, however, implicitly assumes that the process generating the data is an AR(1) process under the null. If this

in table 3. Despite the low power of these tests in short samples, this was to try toensure that the regression used stationary data. The results of the unit root tests implied that the cpi for the 1980s and early 1990s was I(2), hence the data in the regression were twice-differenced[19].

In the first column of table 4 the available quarterly and annual data are shown in logs. The coefficients from the seasonal dummies in the bottom part of table 3 were added to the twice-differenced interpolated cpi. This was then 'un-differenced' twice to give the column headed 'linear plus seasonal Lcpi' The means of the levels of each year were compared to the actual means, with the observations for each quarter being adjusted by the difference between the two. This gave the final 'adjusted' column on the left-hand side of the table.

Table 4

Interpolation by Applying the Seasonal Filter to a Linear Interpolation.

	ln(cpi)	Simple Linear Interpolation	Dln(cpi)	DDln(cpi)	Seasonality	Linear plus Seasonal DDln(cpi)	Linear plus Seasonal Dln(cpi)	Linear plus Seasonal ln(cpi)	Interpolated Annual Means	Annual Observations	Adjusted Dln(cpi)	Adjusted ln(cpi)
1976-3	-3.387	-3.387	0.268	0.170	-0.037	0.133	0.268	-3.387			0.268	-3.387
1976-4	-3.432	-3.432	-0.045	-0.313	0.037	-0.277	-0.045	-3.432			-0.045	-3.432
1977-1		-3.294	0.137	0.183	0.016	0.199	0.154	-3.278			0.157	-3.275
1977-2	-3.157	-3.157	0.137	0.000	-0.025	-0.025	0.113	-3.16	-3.145	-3.157	0.116	-3.159
1977-3		-3.079	0.078	-0.060	-0.037	-0.096	0.041	-3.125			0.044	-3.115
1977-4		-3.002	0.078	0.000	0.037	0.037	0.115	-3.010			0.118	-2.998
1978-1		-2.924	0.078	0.000	0.016	0.016	0.094	-2.916			0.125	-2.873
1978-2	-2.846	-2.846	0.078	0.000	-0.025	-0.025	0.053	-2.863	-2.722	-2.846	0.084	-2.789
1978-3		-2.628	0.218	0.141	-0.037	0.104	0.182	-2.681			0.213	-2.576
1978-4		-2.410	0.218	0.000	0.037	0.037	0.255	-2.426			0.286	-2.290
1979-1		-2.191	0.218	0.000	0.016	0.016	0.234	-2.192			0.232	-2.058
1979-2	-1.973	-1.973	0.218	0.000	-0.025	-0.025	0.194	-1.999	-1.983	-1.973	0.191	-1.867
1979-3		-1.875	0.098	-0.121	-0.037	-0.157	0.061	-1.937			0.059	-1.808
1979-4		-1.778	0.098	0.000	0.037	0.037	0.135	-1.803			0.132	-1.676
1980-1		-1.680	0.098	0.000	0.016	0.016	0.114	-1.689			0.119	-1.558
1980-2	-1.582	-1.582	0.098	0.000	-0.025	-0.025	0.073	-1.616	-1.563	-1.582	0.078	-1.480
1980-3		-1.475	0.107	0.009	-0.037	-0.027	0.071	-1.546			0.075	-1.405
1980-4		-1.368	0.107	0.000	0.037	0.037	0.144	-1.402			0.149	-1.256
1981-1		-1.260	0.107	0.000	0.016	0.016	0.123	-1.278			0.123	-1.133
1981-2	-1.153	-1.153	0.107	0.000	-0.025	-0.025	0.107	-1.153			0.107	-1.153
1981-3	-1.002	-1.002	0.151	0.044	-0.037	0.007	0.151	-1.002			0.151	-1.002
1981-4	-1.015	-1.015	-0.013	-0.164	0.037	-0.128	-0.013	-1.015			-0.013	-1.015

The actual data and the interpolated observations are shown in figure 1. The resulting series are shown in figure 2 both in fourth differences (annual inflation) and first differences (quarterly inflation). A feature of both the plots in figure 2 is the jump in inflation at the beginning of 1975 and the end of 1984. Similarly both show the decline in inflation from the end of 1989 and the resurgence and defeat of inflation in 1992. Apart from the burst of annual inflation in the late 1970s, this period does not stand out from the rest of the data and the use of 1980s within-year movements for the late 1970s appears reasonable.

is not the case, then there will be serial correlation in the residuals of this regression, which will bias the results. The Augmented Dickey-Fuller test embeds the standard Dickey-Fuller test within a regression of the form:

$$\Delta y_t = \$_0 + \$_1 y_{t-1} + \Sigma(_j \Delta y_{t-j} + ,_t .$$

The lag length, *j*, is set to enure that autocorrelation in Δy_t is absorbed and the error term distributed as white noise.

[19] In table 3, and the rest of this paper, the log of the cpi is denoted 'Lcpi'. The prefix 'D' indicates the difference of the log of the cpi; hence 'DD' means twice-differenced, 'D4' means the fourth (which for quarterly data means annual) difference, and 'DD4' means the first difference of the fourth difference.

Figure 1

The Actual Data and the Interpolated Observations of the Log of the Consumer Price Index.

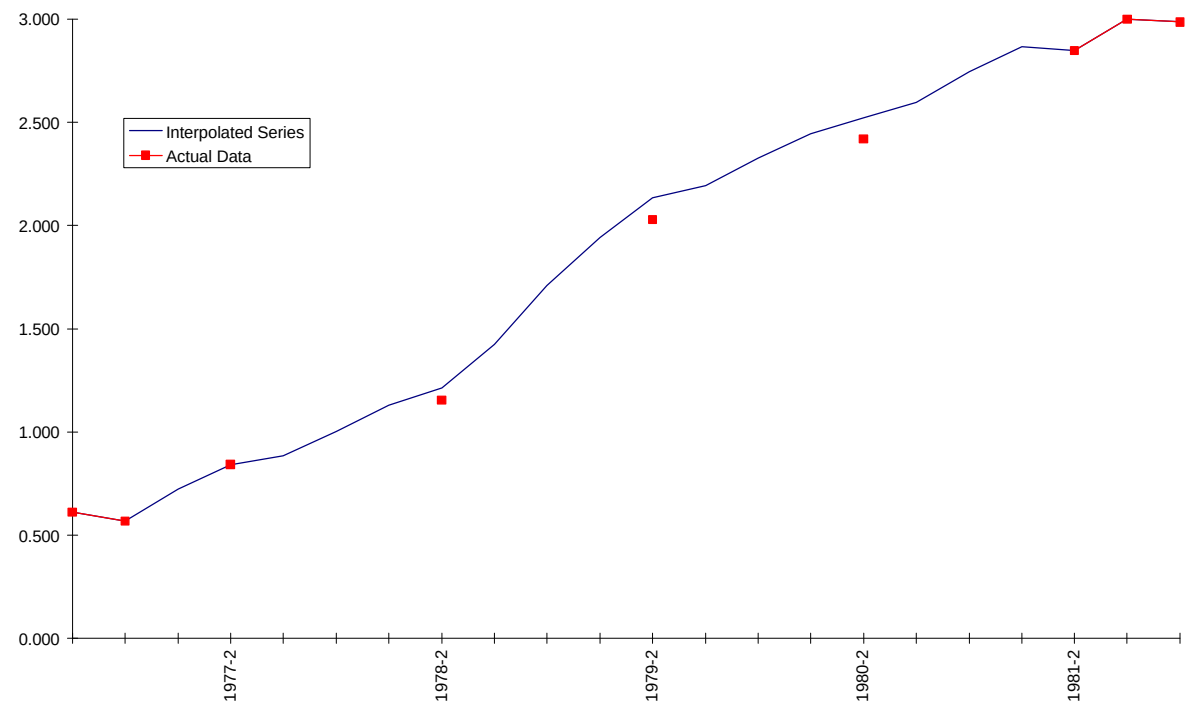


Figure 2

Quarterly Inflation (Dlcpi) and Annual Inflation (D4Lcpi).

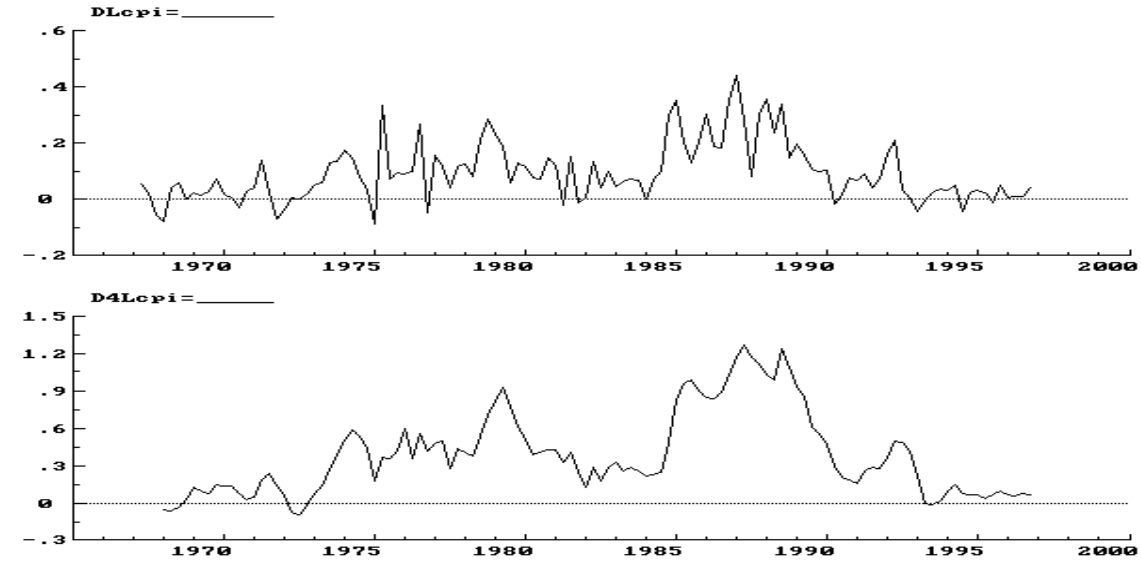
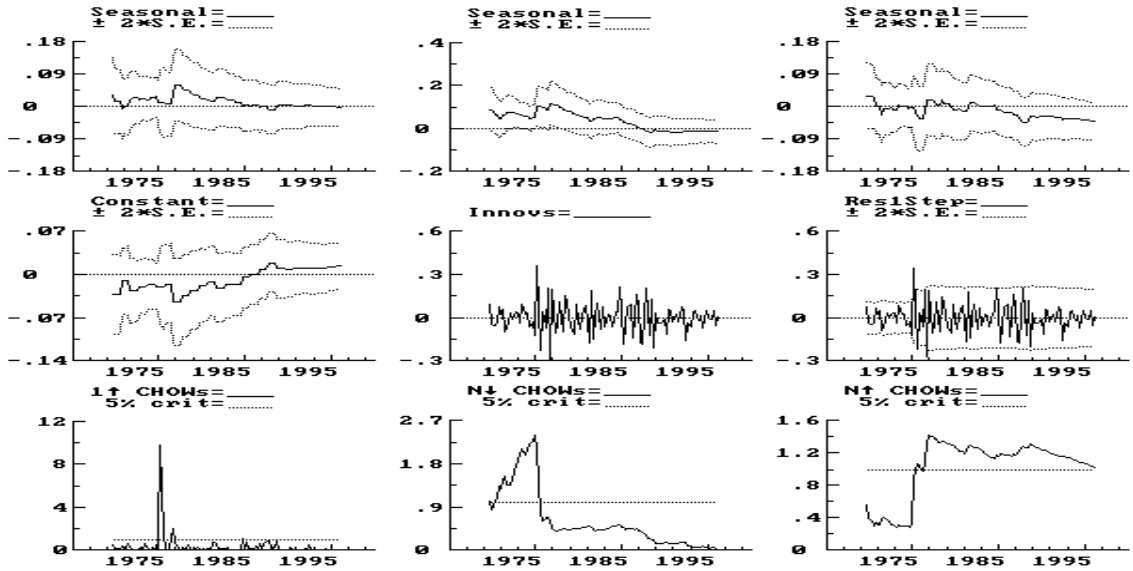


Figure 3

The Recursive Graphics from the Regression of a Constant and Three Seasonal Dummies on the Twice-Differenced Log of the Consumer Price Index.



While the interpolation of a trend between annual data points was relatively straightforward, the imposition of seasonality from one period of the data onto another was less so. Some seasonality exhibits non-constant patterns over time[20]. To investigate the validity of the assumption of a constant seasonal pattern, the twice-differenced cpi was regressed on a constant and three deterministic seasonal dummies. Figure 3 shows the recursive coefficients from that regression and the output from recursive Chow tests for parameter stability. These plots show a test for the constancy of the seasonal coefficients and therefore test the extent that the pattern of seasonal variation in the cpi across the whole sample changed, including the period upon which the within-year movement was imposed.

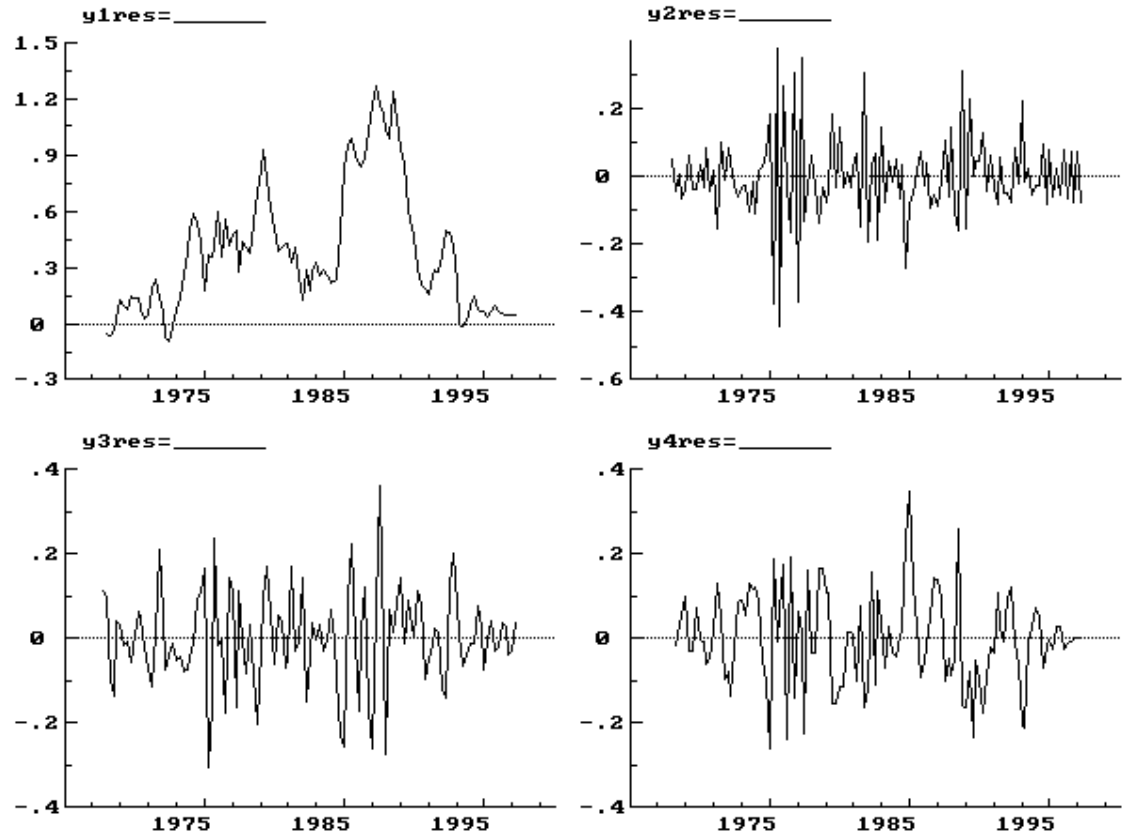
The graphs in figure 3 show that the coefficients on the seasonals and the constant term are not constant through time and that there appears to be more volatility in the data between 1975 and 1987. This corresponds to a period after which data collection decayed—which is why there were no quarterly data after the end of 1976—and before comprehensive data collection for the cpi was resurrected in 1988. But what is of particular interest is the extent to which the imposed within-year movements between 1977 and 1981 are responsible for this non-constancy. The widening of the standard-error bands for the plot of the one-step residuals in the top left-hand quadrant of figure 3 starts in 1975. Similarly, the instability shown in the two right-hand graphs also starts from 1975, rather than 1977, implying that the use of the constant component of seasonality from the 1980s in the interpolation of missing data for the late 1970s was not unreasonable.

The graphs in figure 4 show a decomposition of quarterly inflation and provide some backing for this conclusion. In the top-left hand graph is a four-period sum of quarterly inflation; the bottom-right graph shows the long-run component of the series and the other two graphs show the semi-annual components. The regular, seasonal, components of these within-year movements are those which were plucked out of the data for the 1980s and early 1990s and imposed on that for the late 1970s. These show that the period

[20] See Hylleberg (1992).

onto which seasonality was grafted—1977 to 1981 inclusive—does not stand out from the rest of the sample.

Figure 4
The Seasonal Decomposition of Quarterly Inflation.



In the examination of the time series characteristics of the data presented in section 7, quarterly inflation is expressed as both the first difference of the log of the cpi and as 'pi' which is defined as $pi = \pi/(1+\pi)$, where $\pi = (p_t - p_{t-1})/p_{t-1}$, which correctly measures the capital loss on a financial asset due to inflation in discrete time data (see Calvo and Liederman, 1992).

4. Interpolating from Annual to Quarterly Monetary GDP

In this section a series for quarterly monetary GDP is constructed. Data on total GDP and its components, at factor cost in 1966 prices, were available for calendar years from 1966 to 1987. A more recent series[21] in 1991 prices existed for the calendar years since 1984 and for the fiscal years since 1984/85. Earlier revisions to the estimates of GDP had gone back to 1982 and to the fiscal year 1982/83. There were two reasons for focusing on monetary, as opposed to total, GDP. First, because there were some quarterly data which related to monetary GDP and none which related to non-monetary GDP, a more efficient

[21] *Gross Domestic Product, Uganda (1984-1993/94)*, Statistics Department, January 1994.

interpolation than a simple linear interpolation could be made. In addition, the estimates of non-monetary activity were only good for the 1960s, 1989/90 and 1992 when data from surveys of non-monetary production and consumption were available. The bulk of the data in the series on non-monetary GDP was based on limited evidence of on-going rates of population growth. Second, one of the intended uses of this dataset was the modelling of the demand for money for which the appropriate scale variable would be monetary, not total, GDP, GDY or GDE. At the end of the next section an exercise to make a similar linear interpolation of non-monetary GDP, which is then added to the results from this and the next section to give a series on quarterly total GDP, total GDY and total GDE is summarised.

The growth rates of monetary GDP from the constant price series in 1966 prices for the years 1967 to 1982 were applied to the constant price series on monetary GDP in 1991 prices to make a backwards-projection of real monetary GDP, in 1966 relative prices, but expressed at the 1991 price level. This gave an annual monetary GDP series for the whole of the period under consideration. Two main tasks remained: first, to make a quarterly interpolation of the data on monetary GDP, which is described in this section; second, to estimate GDY and GDE, which is described in section 5. The combination of calendar year estimates and fiscal years estimated from 1982 onwards gave, through simple averaging, six-monthly estimates of the level of monetary GDP for the last eleven years of our sample, with annual estimates for the rest. A log-linear interpolation was inserted between these data points and is shown in the final dataset.

A second interpolation was made using Friedman's (1962) method. This involved adjusting a linear interpolation of the series, for which there were only annual data, with the weighted percentage errors between actual data and the linear interpolations of related series for which quarterly data were available. The eligibility of suitable related series was limited by the availability of related quarterly data and was determined by the significance of each series in a regression on real GDP. The aim of the regression was to maximise the correlation of the annual series on the grounds that such a correlation would also apply to quarterly data. Although this was crude, it may have given rise to a different and possibly more informative quarterly series than the simple linear interpolation. Friedman (1962) specifies the use of a static regression, such that the coefficients of the regression are used to give relative weight to the related series, which are also scaled by some appropriate factor (*e.g.* their means). There are, however, two reasons for considering the use of lagged variables. First, because a more flexible specification would allow the data a greater say in determining which variables appeared to have a correlation with monetary GDP. Second, because the log of monetary GDP showed a high degree of serial correlation, which implied that omitting a lagged dependent variable would lead to biases in the estimates of the coefficients on each related series and thus to biases in the quarterly interpolation for which those coefficients would be used. These issues were resolved by finding a congruent model of the annual observations for monetary GDP and deciding that if this involved lagged variables, then the long-run static solution from the model would be taken. This was consistent with the aim of securing a correlation between the series as part of the production of a possibly more informative quarterly series than would have been achieved with a linear interpolation.

One of the candidates for the regression included data on coffee. The available series included the volume of coffee deliveries to the CMB ('LCofDel') the real value of coffee deliveries (defined as the volume of deliveries multiplied by the prevailing nominal producer price, deflated by the cpi, 'LCofVal') and the real producer price itself ('LCofP'). The other series considered were based on trade data. One was the 'capacity to import' ('LCapM'), defined as exports deflated by the import unit price index; the other two were 'real exports' ('LRealX') which were exports deflated by the export unit price index and 'real imports' ('LrealM') which were imports deflated by the import unit price index.

Table 5
Unit Root Tests.

Unit Root Tests 1973-1996

Variable	With Constant t-ADF	lag	With Constant and Trend t-ADF	lag	Sargan-Bhargava DW test	Order of Integration
LGDP	2.12	0	-0.61	0	0.069	1 or 2
DLGDP	-2.42	0	-3.98*	1	0.854	0 or 1
DDLGDP	-5.21**	1	-5.10**	1	2.338	0
LcofDel	-2.93	0	-2.78	0	1.007	1
DLCofDel	-4.82**	1	-4.85**	1	2.445	0
LCofVal	-2.95	0	-2.80	0	1.027	1
DLCofVal	-4.74**	1	-4.76**	1	2.462	0
LCofP	-1.71	0	-2.07	0	0.488	1
DLCofP	-3.37*	1	-3.75*	0	1.55	0 or 1
DDLCofP	-5.16**	1	-5.01**	1	2.4 91	0
LCapM	-3.07*	0	-3.08	0	1.062	1
DLCapM	-4.55**	1	-4.83**	1	2.677	0
LRealX	-2.91	0	-2.54	0	0.801	1
DLRealX	-5.54**	0	-5.85**	0	2.171	0
LRealM	-2.04	0	-2.78	0	0.726	1
DLRealM	-4.72**	1	-5.49**	1	2.699	0

The data series used in a regression should each be of the same order of integration for that regression to be consistent[22]. The results of two sets of Augmented Dickey-Fuller tests (which included a constant, and a constant and a trend) all conducted with three lags, and the Sargan-Bhargava Durbin Watson tests are shown in table 5. These have to be treated with caution because of the low power of these tests in short samples, meaning that no precise inference can be drawn. The results implied that the first difference of the log of monetary GDP (DLGDP: the 'D' signifies a difference—see footnote 19) was borderline stationary. This was consistent with the log of GDP being I(1), but with a trend break—some change in the 'Data Generation Process' for GDP in the late 1980s—giving the appearance of an I(2) series in these test results. I choose to treat it as being I(1); I return to this issue when discussing the results, below. The levels of all the other variables appear to be I(1) and their differences I(0). The minor exceptions were the first difference of the real coffee price which could have been I(1) rather than I(0), and the level of the capacity to import, which seemed to be borderline stationary.

[22] See, *inter alia*, Banerjee *et al.* (1993) and Adam (1995).

Table 6

Modelling the Annual Data on Monetary GDP.

Modelling LGDP by OLS

```
The present sample is:  1968 to 1996

 Variable     Coefficient    Std.Error  t-value  t-prob  PartR² Instab
 Constant          1.1938      0.82281    1.451  0.1598  0.0806   0.07
 LGDP_1           0.85436     0.068663   12.443  0.0000  0.8658   0.07
 LCofP           0.043957     0.017392    2.527  0.0185  0.2102   0.07
 LRealM          0.087989     0.038066    2.311  0.0297  0.1821   0.07
 Trend          0.0049940    0.0015080    3.312  0.0029  0.3136   0.11

 R² = 0.970209  F(4, 24) = 195.4 [0.0000]  F = 0.0480271  DW = 1.80
 RSS = 0.05535842514 for 5 variables and 29 observations

 Variance instability test: 0.142952  ;  Joint instability test: 0.875914
```

Solved Static Long Run equation

```
        LGDP =    +8.197              +0.3018 LCofP        +0.6042 LRealM
(SE)          (    2.074)          (   0.1464)          (   0.2919)
                +0.03429 Trend
              (  0.01227)
```

```
 WALD test Chi²(3) = 10.068 [0.0180] *
```

Test Summary

```
 AR 1- 2F( 2, 22) =    0.31359 [0.7340]
 ARCH 1 F( 1, 22) =     1.1144 [0.3026]
 Normality Chi²(2)=     8.7246 [0.0127] *
 Xi²    F( 8, 15) =    0.47877 [0.8527]
 Xi*Xj  F(14,  9) =     1.9341 [0.1609]
 RESET  F( 1, 23) =    0.19534 [0.6626]
```

LM test for Omitted Variables

```
 Add    F( 1, 23) =     5.7023 [0.0255] *
 Added variables:
 DLCapM
```

The I(1) variables were assessed on their significance when regressed on the log of GDP. Because the value of coffee deliveries is a linear combination of the volume of deliveries and the price, they could not be used all at once, but neither the volume nor the value of deliveries had any strong significance[23]. The most efficient model to emerge had lagged GDP, the level of the real producer price of coffee, the first difference in the capacity to import, real imports and a trend term as explanatory variables.

While the role of the first difference in capacity to import could have been of interest in an exploration of the growth process in Uganda, in the context of making an interpolation of GDP it was unhelpful. This is because it was a stationary variable and hence not amenable to a linear interpolation of annual observations. As a result, taking the deviation of actual observations from a linear interpolation was

[23] This is in contrast to the results reported in Henstridge (1995), where the real value of coffee deliveries and the real producer price were the only regressors on the grounds that the GDP series, which ran only until 1993, appeared more strongly I(2) than the slightly revised series which now runs through until 1996. The changes in the series meant that those results could not be reproduced with adequate significance for the value of coffee deliveries over a sample up to 1993. Also that commencing modelling over the full sample using just the real producer price and the real value of coffee deliveries gave rise to a model which had the real coffee price, the first difference of the real value of coffee deliveries and a step dummy, which took the value 1 from 1990 onwards, as the explanatory variables, but which was encompassed in non-nested tests by the model shown in table 6.

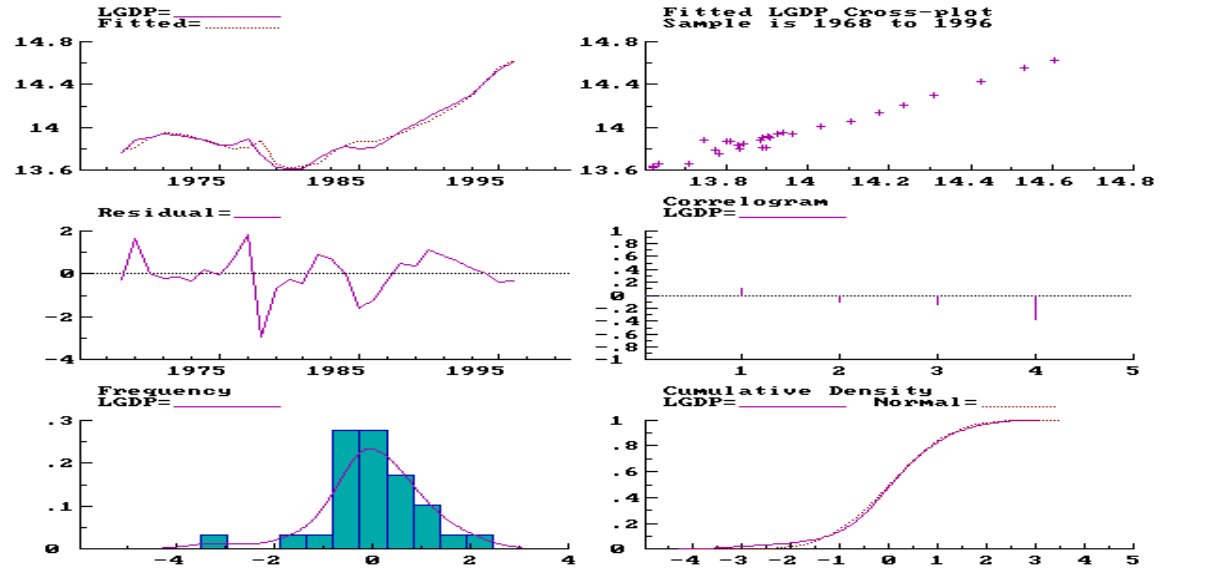
possibly meaningless at best, and mis-leading at worst. The results shown in table 6 are therefore those with the change in the capacity to import omitted.

The correlation of the producer price of coffee to monetary GDP reflects the fact that coffee production was a significant proportion of rural monetary GDP for a large area of Uganda, though a small proportion of total monetary GDP. For the early and late years of the sample, when domestically produced or imported consumer goods were generally available, increases in the real producer price of coffee would have led to an increase in supply. One of the characteristics of the middle years of this sample is a decline in official coffee deliveries[24] which is correlated with a decline in monetary GDP.

For the few years in the sample which follow the liberalisation of the coffee sector in the early 1990s, the real producer price for coffee is a loose proxy for the terms of trade, which are also reflected in the capacity to import. The positive relationship between a change in the capacity to import and production is in line with cross country experience, which suggests that openness and export success leads to increased growth rates.

Figure 5

Diagnostic Graphics from the Regression on GDP.

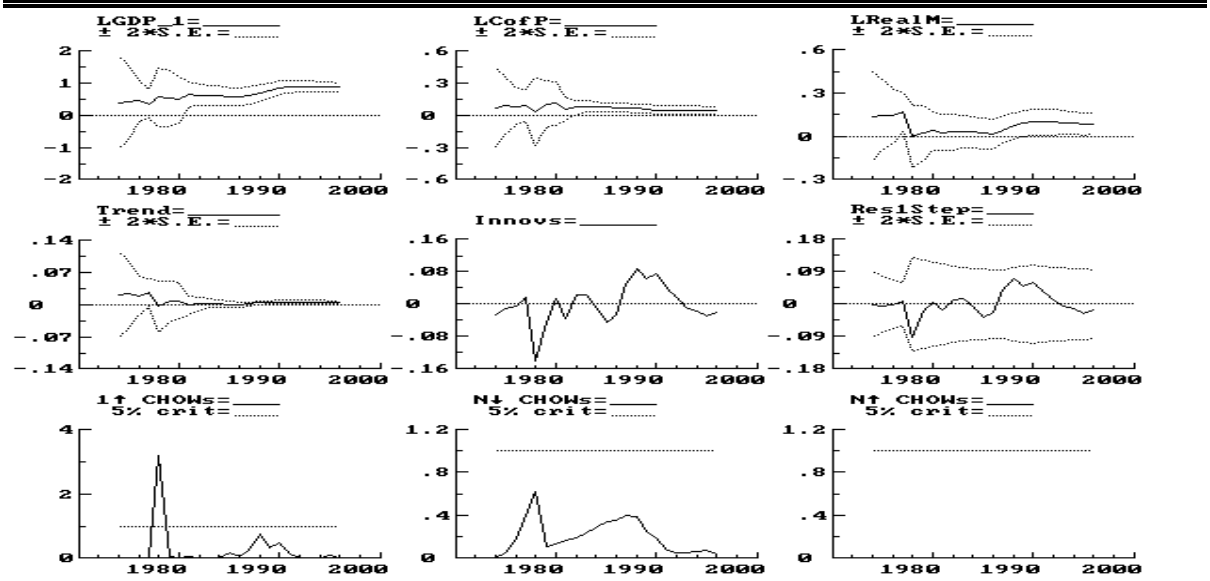


[24] The decline in coffee deliveries is almost certainly a consequence of smuggling, which means that the use of the official deliveries data in the national accounts led to an underestimation of production and hence of GDP (see Henstridge, 1997b). Since the constant price national accounts are in 1991 prices when the price of coffee was very low, the consequence of adding the estimates of smuggled coffee production to GDP is also low, especially when compared to the magnitude of possible errors in the rest of the national accounts (and in the estimates of smuggling themselves).

The rest of the top block of table 6 shows a static long-run solution to the model and a summary of diagnostic tests, which are all satisfactorily passed[25]. A set of graphs showing the actual and fitted values, plotted through time and cross-plotted, and four plots of the residuals through time, their correlogram, and the distribution and density functions of the residuals are shown in figure 5; figure 6 shows recursive graphics from the regression on GDP.

Figure 6

Recursive Graphics from the Regression on GDP.



There is a distinct shift in the coefficient on the one period lag of GDP in the top-left graph in figure 6. This increase in the coefficient of last period's GDP in explaining this period's GDP is mirrored by the increase,

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[25] The test for serial correlation in the *Test Summary* section of the results is labeled: `AR 1-2 F( 2, 19)` and is the F version of the Lagrange Multiplier test for r^{th} order serial correlation. The other summary diagnostic tests are as follows:

`ARCH 1 F ( 1, 19)` A test for 'AutoRegressive Conditional Heteroscedasticity' (Engle, 1982), which tests the hypothesis $\phi = 0$ in the model:

$$E[u_t^2 \mid u_{t-1},..., u_{t-r}] = c_0 + \sum_{i=1}^{r} \phi_i u_{t-i}^2,$$

where $\phi = (\phi_1,...,\phi_r)'$. The 'ARCH' test is asymptotically distributed as $P^2(r)$ on H_0: $\phi = 0$. In the results shown, the F-form of the test is presented, which is slightly better in small samples.

`Normality Chi² (2)` A test for normality of the residuals. Tests whether the skewness and kurtosis of the residuals correspond to those of a normal distribution.

`Xi²  F( 7, 13)` A test for heteroscedasticity, based on White (1980), involving an auxilliary regression of $\{\hat{u}_t^2\}$ on the original regressors (x_{it}) and all their squares (s_{it}^2). The null is unconditional homoscedasticity and the alternative is that the variance of the $\{u_t\}$ process depends on $\mathbf{x}_t$ and on the s_{it}^2.

`Xi*Xj  F(13, 7)` A test for heteroscedasticity and functional form, reported if there is a large number of observations relative to variables. It is based on an auxilliary regression of the squared residuals ($\hat{u}_t^2$) on all squares and cross products of the original regressors. H_0 is that the errors are homoscedastic or, if heteroscedasticity is present it is unrelated to the original regressors.

`RESET  F( 1, 20)` A test of the null of correct specification of the original model against the alternative that powers of $\hat{\imath}_t$ such as ($\hat{\imath}_t^2$, $\hat{\imath}_t^3$ ...) have been omitted. Due to Ramsey (1969).

into significance, of the trend term at around the same time. This implies that there was a change in the 'Data Generation Process' for GDP in Uganda which was not captured by this model and possibly reflected in the burst of instability which can be seen in the innovations, residuals and Chow tests in the bottom part of figure 6. This helps explain the apparent borderline I(1)—I(2) nature of GDP—as discussed it seems more likely from figure 6 to be an I(1) series with a break than an I(2) series[26].

The results from this simple short sample modelling exercise are adequate. The fit and equation standard error are respectable and the diagnostic tests and graphics show good performance. These results are next employed in the interpolation of monetary GDP.

A set of linear interpolations was made between the logs of the available observations for monetary GDP, in constant 1991 prices (the series mGDPl in the dataset). These were then adjusted so as to ensure that the quarterly interpolations summed to match the actual annual observations. The same was done for the annual observations on the real producer price of coffee. The differences between the actual quarterly observations on the real producer price of coffee and their linear interpolations were multiplied by the long run coefficient in the top of table 6, scaled by the ratio of the mean of the log of the real producer price to the mean of the log of GDP and then added to the linear interpolation of GDP. This produced the line 'GDP-Friedman' shown in figure 8, below. An alternative to scaling by the ratio of the means of the real producer price to the mean of monetary GDP was to scale using the ratio of the value of real deliveries of coffee to monetary GDP. This produced a line which was largely indistinguishable from the simple linear interpolation—which is also shown in figure 8—and so was discarded. Both series were used for the construction of alternative series for GDY and GDE so that if the results from the Friedman method are considered inappropriately noisy, those from the simple linear interpolation are an adequate and more transparent alternative.

5. GDY and GDE

While GDP is a quantity index, GDY reflects the changing value of traded production by taking into account changes in terms of trade. This 'terms of trade adjustment' is defined as the 'capacity to export' (exports deflated by the import unit price index) less 'real exports' (exports deflated by the export unit price index). The difference between GDY and GDE is the difference between income and expenditure and is calculated as GDY less the current account balance (here I use the trade balance because full current account data is not available). The basic data requirements are for the quarterly values of imports and exports and the unit values of imports and exports. Specifically:

$$GDP + [(X/IUV) - (X/XUV)] = GDY - [(X-M)/IUV] = GDE.$$

Trade data for Uganda were published on a quarterly basis in US dollars in the *IFS*, from which it was possible to construct a series on imports, but not exports. Additional data were taken from the *Direction of Trade Statistics* (*DOTS*) from the Statistics Department and from the coffee data available from the CMB discussed in section 2. For most of the 1980s and early 1990s, there are data on annual imports and exports. These enabled quarterly estimates to be constructed so as to be consistent with reasonably sound annual totals for official trade.

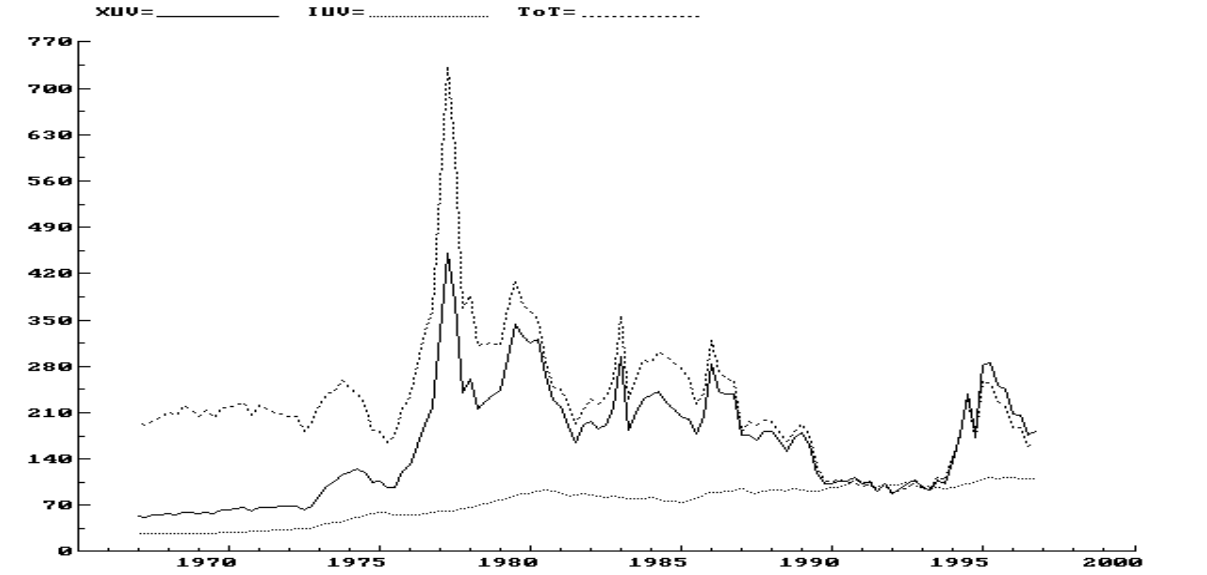
[26] And explains the failure to reproduce the results for the modeling of GDP—which was also for the interpolation of GDP—in Henstridge (1995).

Import and Export Unit Values

The import unit value index was an average of a petroleum price index and the unit price of exports from industrialised countries weighted by the share of petroleum products in total imports. The export unit value index up until 1993 took international prices for coffee, cotton, tea and tobacco and used a series on African export unit values for the periods it was available in the *IFS*. Since coffee dominated the official trade statistics, the international price of coffee dominates the index from the mid-1970s until the early 1990s. More recently, the more comprehensive tables under-pinning the construction of the balance of payments in the Bank of Uganda have allowed the unit prices of fish and fish products, hides and skins, simsim (sesame seed), maize and beans to be included. Unit prices are combined into an index by weighting them by their share in export volumes in each period[27].

Figure 7

The Import Unit Price Index, Export Unit Price Index and Terms of Trade for Uganda (1991=100).



The unit value indices and the terms of trade index are shown in figure 7. The three coffee booms of 1977, 1986 and 1995 are prominent. The order of magnitude of the changes in the terms of trade are impressive by the standard of most countries—Uganda is clearly as shock-prone as any other African country. From an index level of about 200 in the early 1970s, a peak of 600 was hit during the 1977 coffee boom. The level during the early 1980s was around 180 before a peak of 250 in the 1986 coffee boom. The slump in coffee prices which followed the collapse of the International Coffee Agreement replacement talks in 1989 was then followed by a recovery almost to 1986 levels in 1995.

GDY and GDE

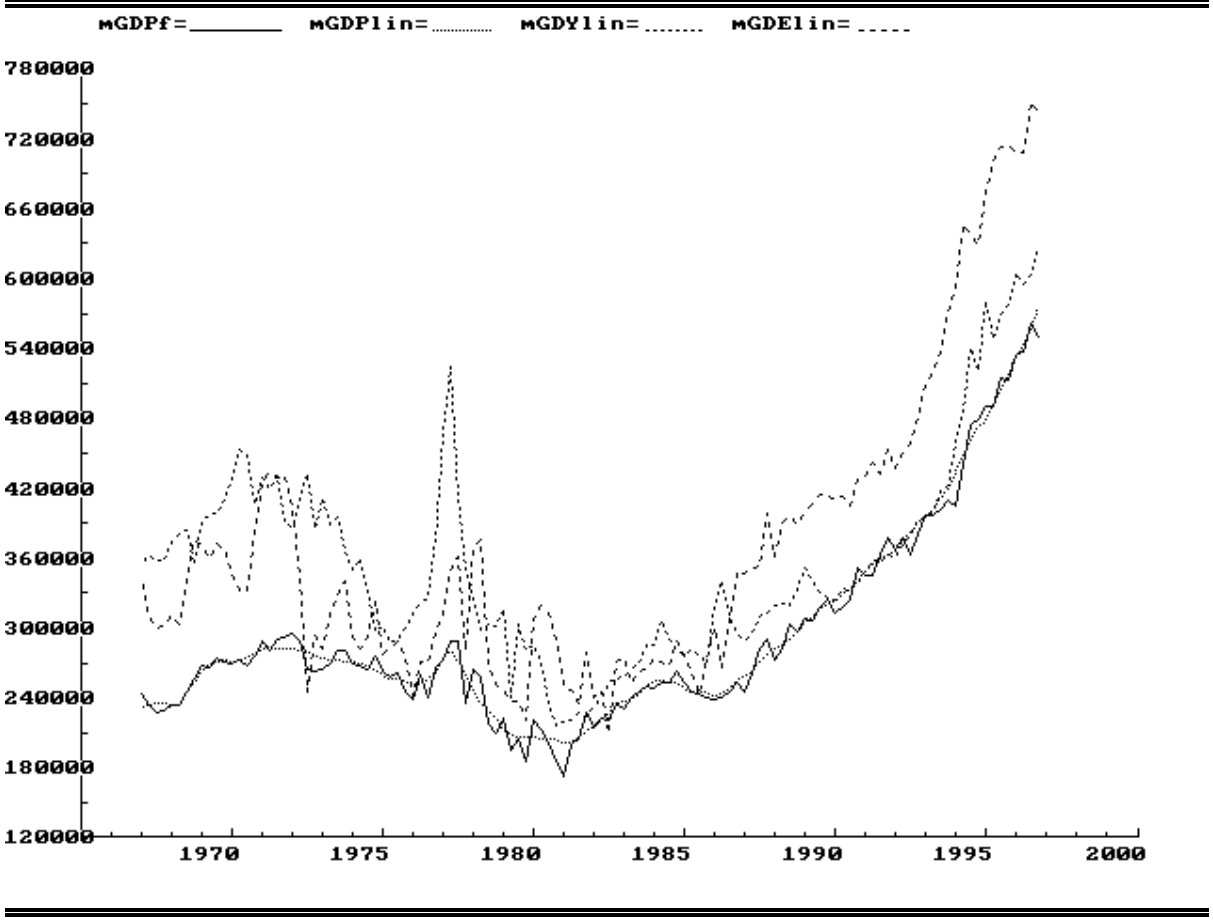
Figure 8 shows quarterly monetary GDP, GDY and GDE in 1991 Uganda Shillings, based on a linear interpolation of monetary GDP as well as the interpolated series for monetary GDP based upon the Friedman method. The base year for the terms of trade adjustment, which links monetary GDP and GDY, is 1991. This was a low point for the terms of trade which is why GDY looks higher than GDP for much

[27] More detail on the assembly of these series is provided in Henstridge (1995).

of the sample. The difference between GDY and GDE is the trade balance, which is heavily negative from the late 1980s as a result of increases in aid-financed imports.

Figure 8

Monetary GDP, both linearly interpolated (mGDPl) and interpolated using Friedman (1962), (mGDPf) and monetary GDY and monetary GDE based on linearly interpolated monetary GDP.



Finally, a log-linear interpolation of non-monetary GDP was made and added to the quarterly series on monetary GDP, GDY and GDE to give total GDP, GDY and GDE, with both the linear and Friedman interpolations, on a quarterly frequency.

6. The Data and Uganda's Recent Economic History

In this section I briefly review the data both as a record of a period of turbulence in Uganda's history and, in the next section, as raw time-series data. The final dataset is shown in appendix II.

Production and the Composition of Production

The series on monetary GDP, GDY and GDE are shown in figure 8 and show a collapse in production from the mid-1970s through to the mid-1980s with a subsequent recovery. In 1996, real GDP overtook the previous peak but GDP *per capita* was still lower than it had been at the beginning of the 1970s. A second main feature of the GDP series—though not reflected in figure 8—is the change in the composition of production.

Table 7

Structural Change in the Ugandan Economy.

	1970	1986	1996
Total GDP (index: 1970=100):	100	93.9	175.7
GDP per capita (index: 1970=100):	100	57.5	80.4
Shares in GDP (percent)			
Agriculture:	48	57.9	45.5
o/w Monetary Agriculture:	24	24.0	24.9
o/w Non-monetary Agriculture:	24	34.0	20.6
Manufacturing:	7	5.4	7.7
Volumes of Exports ('000s tonnes)			
Coffee:	191.2	140.8	278.7
Cotton:	78.1	4.9	9.8
Tea:	14.9	2.8	14.6
	1969/70	**1986/87**	**1996/97**
Total Recurrent Revenue (percent of GDP):	14.6	4.2	12.3
Taxes on Domestic Activity:	9.0	1.5	5.9
Taxes on International Trade:	5.6	2.7	6.4
o/w Export Tax:	2.5	1.7	0.0
Total Govt Expenditure (percent of GDP):	20.2	10.1	19.3
	June 1970	**June 1986**	**June 1997**
Cash as a percent of Broad Money:	34	43.7	31.0
Broad Money (M2) as a percent of GDP:	17	7.2	11.1
Claims on Government as a percentage of Total Domestic Credit:	23	44.2	-28.3

Sources: *Statistical Abstract*, 1973.
Background to the Budget, 1990/91 and 1997/98.
Macro-Planning Department, MoF, data.

Table 7 shows some indicators of structural change for 1970, 1980 and 1996. Through the 1970s and early 1980s there was a shift out of the monetised economy into a more predominantly subsistence, agricultural economy. There was also a shift within the monetised agricultural economy from tradable production to food production. Export volumes fell, there was a fiscal collapse and de-monetisation. Between 1986 and 1996 some of these changes were reversed, notably in the structure of GDP. The volumes of coffee exports surpassed previous peaks in 1996. However, fiscal revenue and monetisation remained significantly lower than in 1970.

Collier (1995) argues that 'disorder has two economic effects: it raises the cost of transactions and it makes visible and mobile assets more vulnerable'. Those sectors where production was relatively more intense in monetary transactions and easily expropriated assets, such as manufacturing and monetary agriculture, therefore suffered more from insecurity than less vulnerable sectors, such as subsistence agriculture. In addition, part of the reason for the rise in transactions costs and the reduction in holdings of visible and mobile assets was the loss of what Putnam (1993) terms 'social capital'. Disorder gives rise to a greater risk of violence against person and property and a dissolution of many of the organisations of civil society and the state. These insecurities lead to agents shortening time, or planning, horizons and hence to reduced incentives to build and maintain reputation. In the same way, insecurity can also lead to the under-mining of such institutions as the civil legal system or standardised weights and measures—also part of social capital—which, together with the shortening of time horizons, can switch the most profitable form of behaviour from honesty to opportunism[28]. With the restoration of peace, there is a recovery in production in sectors which are vulnerable to insecurity, but the restoration of social capital takes longer. This helps explain the low level of total GDP—despite the relatively strong growth of vulnerable sectors having led to a restoration of the structure of production—and the relatively slow recovery in fiscal revenue and monetisation.

Recovery is partly a consequence of increased confidence which lengthens agents' time horizons and reduces returns to opportunistic behaviour. A key source of confidence is macroeconomic stability. Table 8 reproduces an up-date of a table contained in the *Background to the Budget 1996/97* which makes a crude comparison of the years of NRM government rule prior to the establishment of macroeconomic stability in June 1992 with subsequent years through an averaging of some indicators of macroeconomic performance. The top block of table 8 indicates that since June 1992 fiscal savings through the good aggregate management of the budget[29] led to a slow-down in the rate of growth of the money supply to 32 percent a year, while the average end-period inflation rate was only 5.6 percent a year. This was because once the Shilling stopped losing value the private sector demand for money increased, allowing the supply of money to increase at the same time, without causing inflation. As a result, it was with the restoration of macroeconomic stability that the economy started to re-monetise: M2 as a percent of GDP is shown at the bottom of table 8 as having increased from an average of 6.3 percent of GDP to an average of 9.0 percent of (a much higher) GDP.

That macroeconomic stability has contributed to an increase in confidence is also implied by increased private investment and increased growth in GDP. Increased investment was reflected in the investment financed by private transfers to Uganda. There was an increase in the growth of GDP from an average of 5.2 percent prior to the attainment of stability to 8.1 percent (and 10.5 percent in monetary GDP) between 1992/93 and 1995/96.

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[28] Tirole (1992) gives a full discussion of the dynamics of trust.

[29] See Henstridge (1997a).

Table 8

A Comparison of Macroeconomic Indicators Before and After Stabilisation.

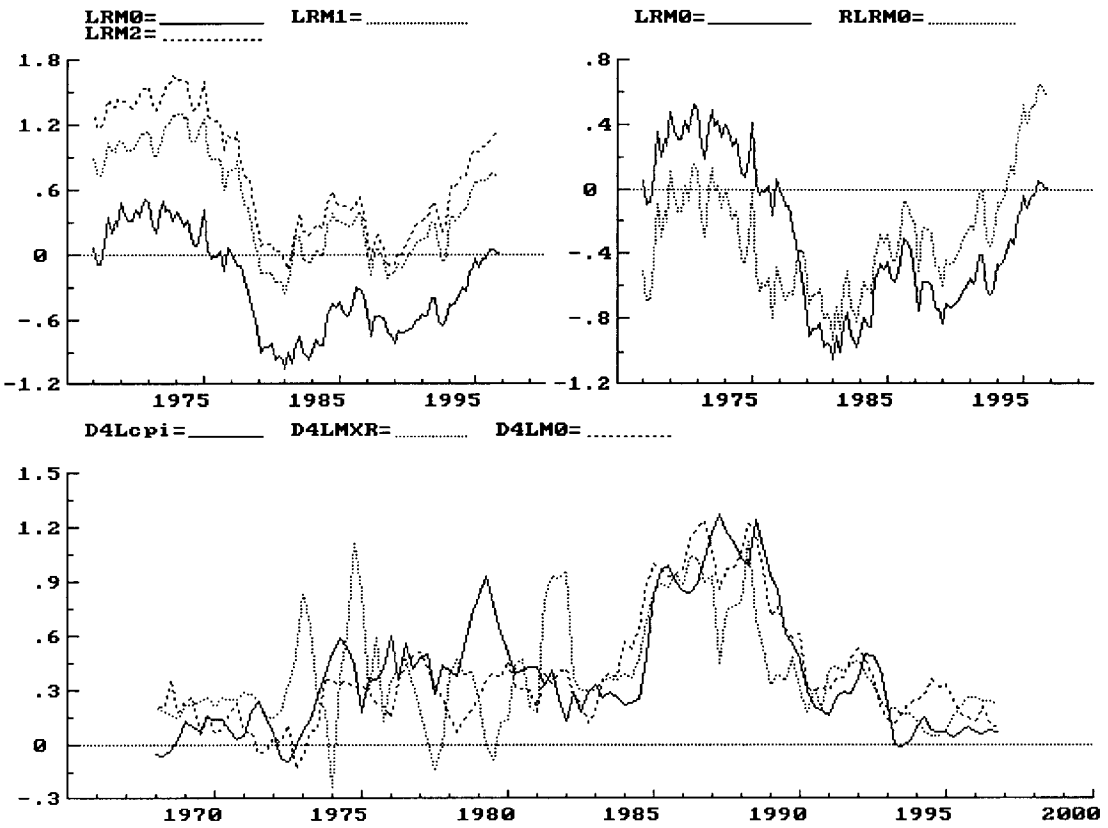
	Average 1986/87-1991/92	Average 1992/93-1995/96
Domestic Financing (% GDP)	1.2	-1.5
Growth in Average Level of M2 (% per year)	105.5	31.8
Average end-period Inflation (% per year)	107.6	5.6
Private Investment (% constant price GDP)	6.6	10.0
Private Investment in Structures (%GDP)	4.7	6.7
Private Investment in Equipment (%GDP)	1.9	3.3
Growth in Total GDP (% per year)	5.2	8.1
Growth in Monetary GDP (% per year)	6.7	10.5
Growth in Industrial Production (% per year)	11.8	16.2
Shares in Total GDP:		
Agriculture	53.0	48.2
o/w non-monetary Agriculture	29.0	23.8
Industry	5.7	7.5
Money, M2 (% GDP)	6.3	9.0

Sources: *Background to the Budget, 1996/97*, up-dated with data from:
Macro-Policy Department, Ministry of Finance
Research Department, Bank of Uganda
Statistics Department, Minstry of Planning and Economic Development.

Monetisation: real M0, real M1 and real M2

One of the features of table 7 and of the period of stabilisation shown in table 8 was the re-monetisation of the economy. The top left-hand graph in figure 9 shows the log of real M0, M1 and M2, illustrating the magnitude of the de-monetization of the late 1970s and early 1980s. Money is particularly vulnerable to insecurity, being, by definition, both a highly mobile asset and fundamental to monetary transactions. Given the insecurity of the late 1970s and parts of the 1980s as well as high inflation and the decay of controls over foreign exchange holdings, the collapse in monetization is not surprising. Since real money is nominal money deflated by the cpi if the cpi overstates the increase in prices, then the de-monetization between the 1970s and 1980s is also exaggerated. Whether the drop in real balances at the end of 1970s was a result of a break in the data or a structural break in private sector demand for real money balances, the break can be proxied. Perron (1989) uses intercept and slope dummies to model sharp breaks in US GDP. Leybourne *et al.* (1995) suggest smoothing the modelling of a break using a logistic function, rather than an instant change. In both cases the timing of the break is at the discretion of the researcher. When a smoothing function is fixed to the data, the duration of the transition has to be decided too. The top right-hand graph of figure 9 shows the same real M0 series as the left-hand graph together with a series for real M0 (with the same mean and range) and with the break removed. This was done using a dummy variable which took the value 0 up to 1976Q4 and the value 1 from 1980Q1 with a logistic function smoothing the transition symmetrically across the intervening period, and the value 0.5 in 1978Q2 marking the mid-point.

Figure 9



One way to assess the extent to which the apparent break in real money balances is due to errors in the cpi series is to compare the nominal money series, the cpi and the market exchange rate. The fourth differences of the log of each (approximating to annual growth) are shown in the bottom graph of figure 9 (with means and ranges adjusted to maximise visual correlation). Of note is the spike in the cpi series ('D4Lcpi') in 1978 and 1979 which corresponds to the period of rapid de-monetization in real money balances. This surge in the price level is a consequence of the splicing of the annual observations on prices available for that period (discussed in section 3), rather than a result of the interpolation of quarterly data for this period presented in section 4. It could be that those price data were inaccurate.

The relationship between money, price and the market exchange rate were also looked at more closely with a set of Granger non-causality tests. These were run between the log levels of each series on money and the cpi and market exchange rate, shown in the top block of table 9, and between the first differences of each series, shown in the bottom block of table 9. In effect the Granger non-causality test seeks to explain the current observation of a variable—x—using past observations of that variable and tests for the significance of the history of another variable—y—in explaining the current value of x. If the history of y is significant in explaining the current value of x, when the history of x is present, then the null hypothesis that y does not 'Granger-cause' x is rejected. 'Granger non-causality' is a statistical concept rather than a claim over causality, but is nonetheless important in econometric modelling when one wishes to be clear about the relative exogeneity of two series.

Table 9

Granger (non-)Causality Tests between Money, Prices and the Exchange Rate.

Granger (non-) Causality Tests
(F-Statistic probabilities in brackets, 4 lags, 115 observations)

To test if ↓ does not Granger-cause→	LM0	LM1	LM2	LMXR	Lcpi
LM0	X	X	X	2.46 (.05)	5.56 (0.00)
LM1	X	X	X	0.37 (0.83)	3.17 (0.02)
LM2	X	X	X	0.16 (.96)	4.36 (0.00)
LMXR	0.91 (.45)	0.23 (0.92)	0.23 (0.92)	X	.31 (.87)
Lcpi	4.80 (0.00)	5.81 (0.00)	5.24 (0.00)	0.2 (.99)	X

To test if ↓ does not Granger-cause→	DLM0	DLM1	DLM2	DLMXR	DLcpi
DLM0	X	X	X	3.47 (0.01)	4.82 (0.0)
DLM1	X	X	X	0.53 (0.71)	2.54 (0.04)
DLM2	X	X	X	0.35 (0.83)	2.40 (0.05)
DLMXR	0.27 (0.89)	0.06 (.99)	0.07 (0.99)	X	0.33 (0.85
Dlcpi	1.15 (0.33)	3.27 (0.01)	2.94 (0.02)	0.27 (.90)	X

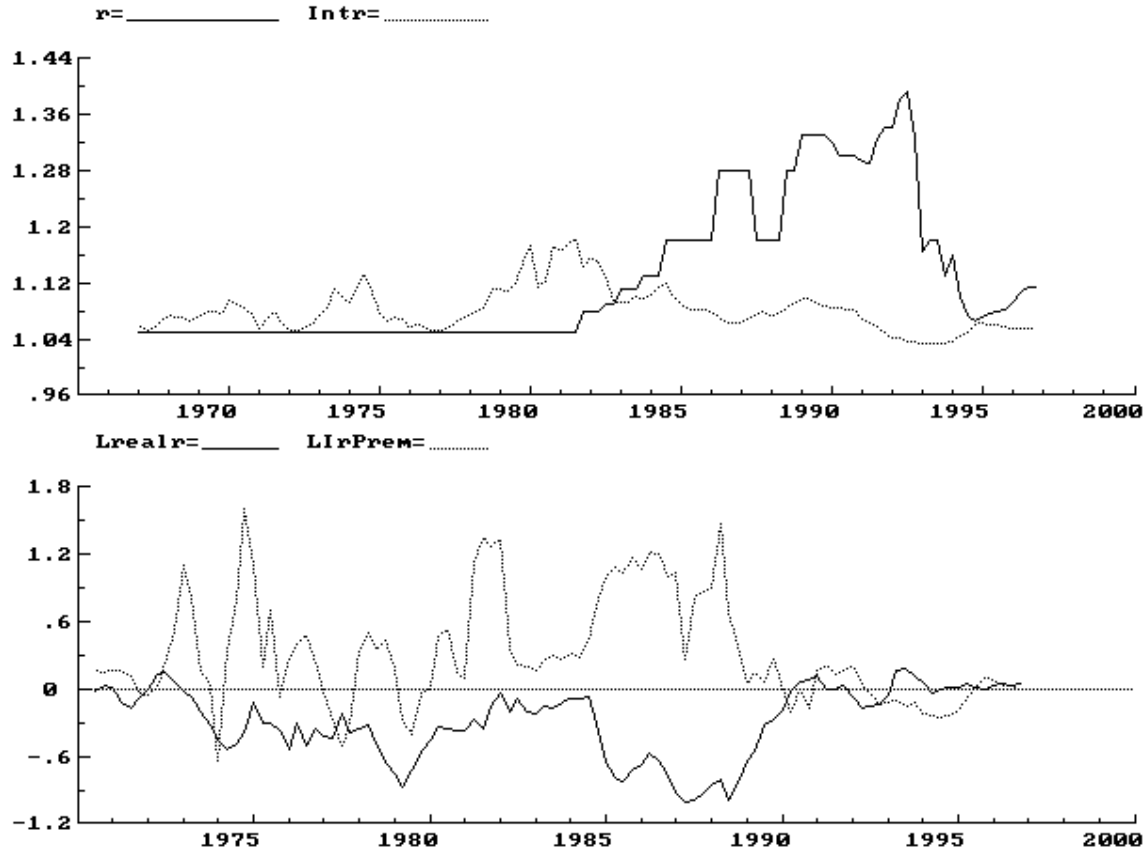
The results shown in table 9 are F-statistics from Granger non-causality tests, with the associated probabilities shown in brackets under each result. In the top block of the table, non-causality is rejected both for money and for prices: the non-Granger causality of money on prices *and* for prices on money are both rejected. In other words, the history of each is significant in the determination of current observations of the other. The market exchange rate does not Granger-cause money or prices, but the non-causality of money M0 on the exchange rate is just rejected. Looking at the first differences in the bottom block of table 9, the non-causality of money on the exchange rate is again rejected. This implies that the history of money is of some significance in explaining the market exchange rate. The only other non-symmetric result in the bottom block of the table is for money and prices: the non-causality of M0 on the cpi is rejected, but the non-causality of the change in the cpi on the change in M0 is not rejected.

Interest Rates and Financial Repression

The top graph in figure 10 shows the six month deposit rate and the three month eurodollar LIBOR, both of which were described earlier. The graph shows them as 1 + the annual percentage interest rate. Under the Bank of Uganda's administration nominal deposit rates were constant into the 1980s. Rates were then changed at intervals until 1992 when the first stage of liberalisation required bank interest rates to be within a specified interval around the 91-day Treasury Bill rate, which was determined in a primary auction. Full

liberalisation in June 1994 removed the link with the Treasury Bill rate. The sharp reduction in deposit rates upon liberalisation was not matched by a reduction in lending rates. The spread represented a tax on deposits implicitly levied to finance the inefficiencies of the banking system. Liberalisation has not entirely relieved financial repression, rather it seems to have re-directed the proceeds.

Figure 10



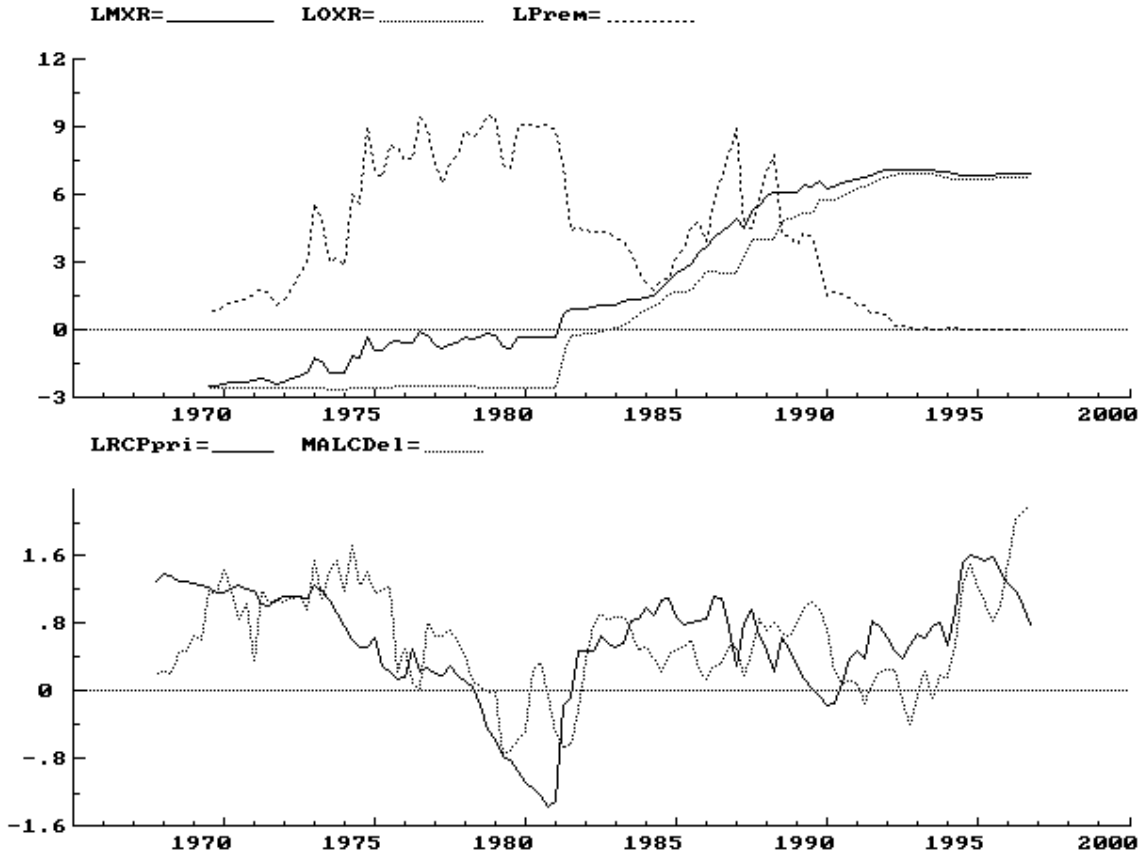
The bottom graph of figure 10 shows the domestic rate deflated by the annual inflation rate and the international rate deflated by the annual rate of depreciation of the market exchange rate. The extent to which real domestic rates were negative for most of the 1970s and 1980s is clear. Equally clear is the financial premium on foreign deposits, which does not include any component for the risk of appropriation of Uganda Shilling assets. The 1990s saw a return to positive real interest rates and a premium for Shilling assets over dollar assets.

The Exchange Rates, Exchange Rate Premium and Coffee Smuggling

The top graph in figure 11 shows the log of both the market and the official exchange rate and the premium of the market rate over the official rate. The official rate was held close to the original rate at which the East African Shilling had been fixed and which the Uganda Shilling inherited in 1966, for most of the 1970s, while the premium grew. The adjustment programme of the early 1980s almost achieved the unification of the exchange rates before it broke down in 1984. One of the early decisions of the NRM government in 1986 was to appreciate the official exchange rate, though when the consequences of this

were clear the decision was reversed. In 1990 the government accepted that a competitive exchange rate was essential for export promotion[30] and the parallel market was legalised in June 1990. The devaluation of the official exchange rate, and the move from a fixed rate via an auction to an inter-bank market rate achieved full unification of the exchange rates in November 1993.

Figure 11



The bottom graph of figure 11 illustrates one of the consequences of the control regime on foreign transactions. The official coffee producer price and a four-period moving average of the deliveries of coffee to the CMB are shown, with the graph adjusted to maximise visual correlation. The nominal producer price was held constant for much of the 1970s and 1980s, and a combination of inflation and the over-valuation of the official exchange rate led to farmers being offered next to nothing for their coffee. The two main features of the graph are the decline in both the real producer price and deliveries, their recovery in the late 1970s and early 1980s, and the increase in deliveries which follows the increase in the real producer price from around 1993. The data on official deliveries do not necessarily show production and from the mid-1970s to the late 1980s much coffee was smuggled[31]—hence the poor coverage of official trade data discussed in section 2.

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[30] See *The Way Forward I* (1990), and for the analysis which under-pinned the decision to liberalise, Morris (1995).

[31] See Henstridge (1997b).

7. Time Series Characteristics

In this final section, we review the results of unit root tests on the main series in the dataset. The test results are shown in tables 10 and 11, below. Most series conform to prior expectations: those in levels show a unit root, their differences appear stationary. However, nominal money could be I(2) in levels with the first difference not being clearly stationary according to the Durbin-Watson test. Similarly unclear is the order of integration of the price level ('Lcpi') and the inflation variable ('pi'), with the Durbin-Watson test for quarterly inflation inconclusive and the fourth difference—annual inflation—being non-stationary in all tests. These contrasting results for quarterly and annual inflation are characteristic of series which exhibit short-term volatility in levels such that changes over the annual frequency smooth over such volatility and appear to be I(1), while shorter frequency changes reflect the volatility and appear more I(0). Both money and prices are used in the derivation of the series on real money, which appeared to be I(1) in levels and I(0) in differences. Tests on the series for real money with the apparent structural break for the late 1970s removed did not alter these results.

The extent to which the inflation series exhibits memory can be illustrated in a correlogram across its lags, which is shown in figure 12 for both the 'pi' inflation variable and the first difference of the log of the cpi, along with the correlogram from the fourth difference of the cpi ('D4Lcpi'). The correlograms for the first difference of the log of the market exchange rate ('DLMXR') and the fourth difference of the market exchange rate ('D4LMXR') are also shown in figure 12. The final graph is the correlogram for the log of the premium of international interest rates over domestic interest rates which in the top of table 11 was perhaps borderline I(1) and I(0) as well.

The correlograms in figure 12 suggest that all these series, with the exception of the first difference of the market exchange rate ('DLMXR'), have close to a unit root, exhibiting enough series memory to be considered borderline I(1) and I(0). This is of particular relevance when inflation is to be used as a measure of the opportunity cost of holding money in a model of the demand for real money balances. Being borderline I(1) it may lead to the assessment of the number of cointegrating relationships within the Johansen procedure being biassed upwards. In addition, its near stationarity could loosen the power of tests of restrictions on the cointegrating vector.

The final source of any lack of clarity in the results of these unit root tests is for the series on the deliveries of coffee to the CMB. The test results differ considerably from those shown in table 11 if a constant is not included. This is because the absolute variation of the series about its mean is limited—though significant, as shown by the moving average of deliveries in figure 11—but within that variation there is considerable movement. Put in other words, the variance is low but the variability is high. As a result, if the mean is stripped out through the inclusion of a constant in the unit root tests, the series appears more stationary than it actually is. The additional grounds for this assertion are in the nature of the data generation process. The robusta coffee which makes up the vast bulk of the deliveries of coffee shown in the data is a tough, hardy tree crop. It is unlikely that many trees received optimal attention in the form of weeding, pruning fertilisers or pesticides over most of the data sample, yet the coffee will have continued to appear each year. With a fairly constant stock of trees—not until the 1990s was there much evidence of up-rooting or planting— it is in the nature of this data generation process that there is a long memory to the data, despite the apparent noisy and close to non-stationary appearance of the series in the unit root tests.

Table 10

Unit Root Tests: Money, Prices and Exchange Rates.

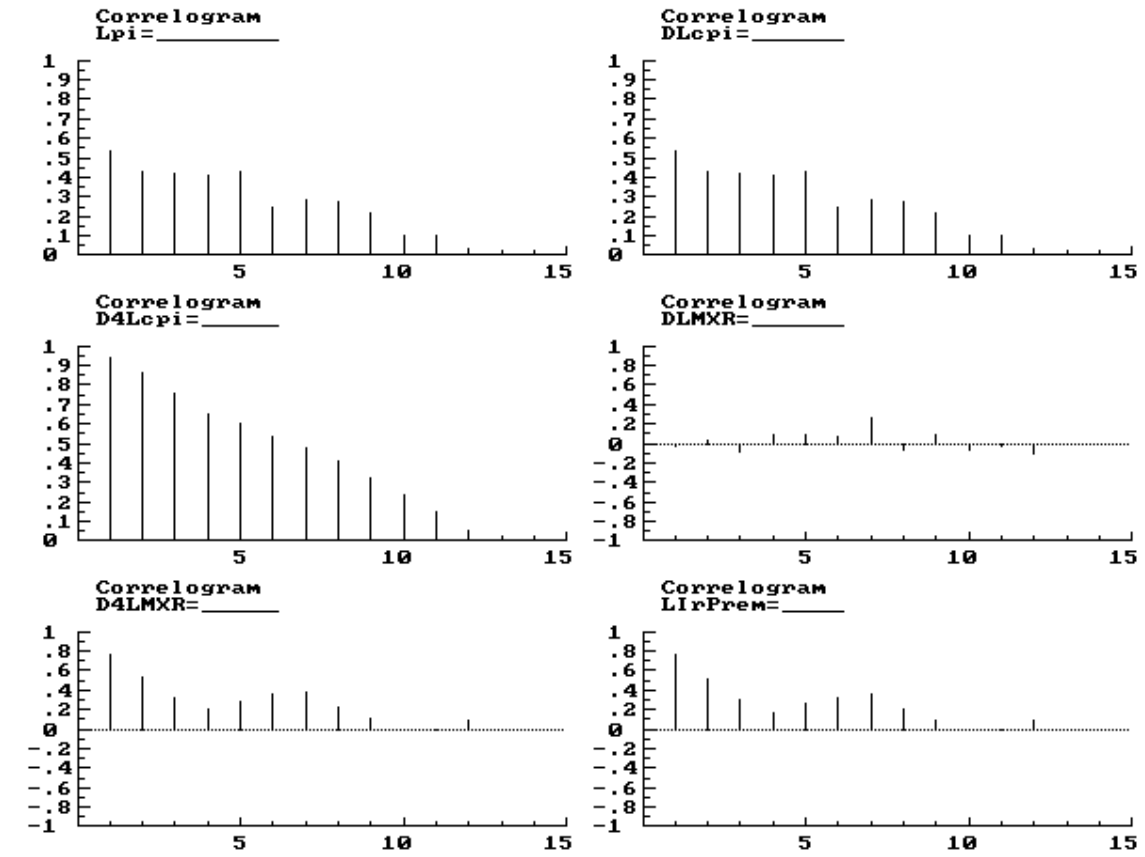
	ADF with Constant	Lag	ADF with Trend	Lag	Phillips Perron with Constant	Phillips Perron with Trend	Durbin-Watson Stat.	Order of Integration
Money								
LM0	0.47	0	-1.34	0	1.20	-1.96	0.001	1 or 2
DLM0	-4.89**	1	-4.82**	1	-8.05**	-8.25**	1.09	0 or 1
LM1	0.47	0	-1.68	0	1.37	-2.18	0.001	1 or 2
DLM1	-3.80**	2	-5.31**	1	-6.36**	-6.51**	1.02	0 or 1
LM2	1.00	0	-1.68	0	1.76	-2.21	0.001	1 or 2
DLM2	-3.52**	2	-4.98**	1	-6.31**	-6.66**	1.03	0 or 1
LRM0	-1.88	0	-1.32	0	-1.27	-0.84	0.06	1
DLRM0	-1.77	0	-4.32**	5	-11.26**	-11.27**	1.96	0
LRDD	-1.54	0	-1.33	0	-1.62	-1.37	0.08	1
DLRDD	-3.88**	5	-0.44	0	-8.99**	-8.97**	1.66	0
LRM1	-1.77	0	-1.19	0	-1.39	-0.98	0.06	1
DLRM1	-5.22**	3	-5.63**	3	-8.72**	-8.71**	1.57	0
LRTS	-1.32	0	-4.17**	0	-1.26	-0.39	0.04	1
DLRTS	-4.22**	5	-4.58**	5	-9.75**	-9.87**	1.81	0
LRM2	-1.64	0	-0.70	0	-1.21	-0.41	0.04	1
DLRM2	-4.66**	0	-5.31**	3	-8.69**	-8.73	1.56	0
Prices								
Lcpi	-1.25	0	0.40	0	0.46	-2.09	0.001	1 or 2
Dlcpi	-3.96	1	-5.60**	0	-5.64**	-5.69**	0.93	0 or 1
DDLcpi	-5.63**	5	-5.76**	5	-20.29**	-20.30**	2.75	0
D4Lcpi	-1.93	0	-2.01	0	-2.18	-2.00	0.12	1
pi	-4.13**	1	-4.10**	1	-5.64**	-5.69**	0.89	0 or 1
Dpi	-5.98**	5	-6.03**	5	-20.29**	-20.30**	2.71	0
Exchange Rates								
LMXR	0.80	0	-1.04	0	-0.42	-1.41	0.006	1
DLMXR	-3.77**	4	-4.66**	3	-10.49**	-10.44**	2.05	0
D4LMXR	-3.91**	2	-3.60*	0	-3.64**	-3.61**	0.48	0 or 1
LOXR	0.25	0	-1.77	0	0.64	-1.91	0.004	1
DLOXR	-4.22**	3	-4.22**	5	-7.31**	-7.39**	1.32	0
D4LOXR	-2.88	0	-2.84	0	-3.15*	-3.19	0.30	1
Lprem	-1.62	0	-3.18	0	-1.47	-2.21	0.12	1
DLPrem	-4.04**	5	-4.33**	5	-10.64**	-10.81**	2.03	0
D4LPrem	-4.34**	5	-4.68**	3	-4.42**	-4.56**	0.67	0

Table 11

Unit Root Tests: Interest Rates, GDP, GDY, GDE, Coffee and Trade.

	ADF with Cons-tant	Lag	ADF with Trend	Lag	Phillips Perron with Cons-tant	Phillips Perron with Trend	Durbin-Watson Stat.	Order of Integ-ration
Interest Rates								
Lr	-1.42	0	-1.20	0	-1.56	-1.67	0.06	1
Lrealr	-1.92	0	-2.29	0	-2.27	-2.22	0.13	1
Lerealr	-1.89	0	-1.96	0	-2.41	-2.31	0.15	1
Intr	-1.98	0	-2.52	0	-2.26	-2.39	0.15	1
LirPrem	-4.10**	2	-3.90*	0	-3.86**	-3.87*	0.50	1 or 0
LeirPrem	-3.55**	3	-3.91*	0	-3.96**	-3.94*	0.53	1 or 0
GDP, GDY and GDE								
LmGDPf	0.32	0	-1.71	0	0.80	-0.52	0.04	1
LmGDPl*	4.69	0	-0.16	0	2.13	0.59	0.006	1
LtGDPf	0.75	0	-1.48	0	0.87	-0.59	0.03	1
LtGDPl*	4.63	0	-0.09	0	1.76	0.22	0.005	1
DLmGDPf	-3.55**	5	-4.61**	5	-12.74**	-13.71**	2.43	0
DlmGDPl	-3.82**	1	-4.48**	3	-3.77**	-4.28**	0.47	0
DltGDPf	-3.65**	5	-4.99**	3	-12.49**	-12.71**	2.31	0
DltGDPl	-3.59**	1	-4.25**	1	-3.62**	-3.97*	0.43	0
D4LmGDPf	-4.50**	3	-6.04**	3	-4.84**	-5.12**	0.69	0
D4LtGDPf	-3.94**	0	-4.64**	0	-4.31**	-4.49**	0.56	0
LmGDYf	-1.20	0	-2.04	0	-1.11	-1.23	0.13	1
LmGDYl	-0.50	0	-1.50	0	-0.69	-0.83	0.08	1
LmGDEf	-1.45	0	-3.54*	0	-1.17	-2.28	0.16	1
LmGDEl	-0.66	0	-2.71	0	-0.52	1.63	0.09	1
DLmGDYf	-4.03**	5	-4.58**	5	-12.74**	-12.91**	2.30	0
DLmGDYl	-3.87**	5	-4.51**	5	-10.75**	-10.91**	1.96	0
Coffee and Trade								
LCPpri	-0.16*	0	-1.58	0	0.64	-2.17	0.003	1
DLCPpri	-4.01**	3	-4.95**	2	-8.67**	-8.73**	1.56	0
LRCPpri	-1.83	0	-2.18	0	-2.11	-2.05	0.12	1
DLRCPpri	-4.09	5	-4.72	3	-9.23**	-9.21**	1.70	0
LCDel	-4.92**	2	-4.90**	2	-10.97**	-10.93**	1.85	0 or 1
LX	-4.05**	0	-4.01*	0	-4.22**	-4.28**	0.62	0 or 1
DLX	-5.32**	5	-5.32**	5	-16.19**	-16.14**	2.60	0
LM	-1.80	0	-4.81	0	-1.20	-4.99**	0.17	0 or 1
DLM	-6.13**	5	-6.15**	5	-14.41**	-14.39**	2.51	0
LXUV	-2.49	0	-2.48	0	-2.05	-1.95	0.12	
LIUV	-4.07**	0	-3.30	0	-1.76	-1.03	0.01	
LToT	-1.73	0	-2.33	0	-2.12	-2.49	0.13	

Figure 12
Correlograms



8. Conclusion

This paper has sought to provide a full account of the compilation of the data which is shown in appendix II. The bulk of the paper has described the major tasks involved in the completion of the data. These were the splicing and interpolation of the cpi, the interpolation of the GDP series and the derivation of GDY and GDE. The rest of the paper has taken an initial look at some of the features of the data in the light of the period which they cover in Uganda's recent history and has briefly reviewed the time-series characteristics of the data. The main purpose of these data is to provide a resource for research into the macroeconomic experience of Uganda in a form amenable to time series modelling. Some of the caveats which should accompany these data into an econometric exercise have been mentioned in the text; others are obvious from even a fleeting consideration of the circumstances surrounding the coverage and compilation of the original data.

May 1997.

Appendix I: The Variables

M0	Currency in circulation in billions of new Uganda Shillings. Source: the monetary survey of the Bank of Uganda
M1	Currency in circulation plus demand deposits in billions of new Uganda Shillings. Source: the monetary survey of the Bank of Uganda.
M2	M1 plus time and savings deposits in billions of new Uganda Shillings. Source: the monetary survey of the Bank of Uganda.
cpi	The consumer price index, 1991=100. Source: data from the cpi published by the East African Statistics Bureau up to 1976Q4; from 1977 to 1981 annual observations from the low-income cpi published in *Background to the Budget, 1982/83* augmented by data from the World Bank's *World Tables* for 1979, and interpolated in the text. From 1981 to 1989 data from the low-income index of the Statistics Department and the middle-income index of the Bank of Uganda. From 1989 the 'New cpi' is used, re-based to 1991=100.
pi	Quarterly inflation defined as: pi = $\pi/(1+\pi)$, where $\pi = (p_t - p_{t-1})/p_{t-1}$.
OXR	The 'official' exchange rate, expressed as new Uganda Shillings per US$. Source: the Bank of Uganda official rate until November 1993 after which the mid-rate in the interbank market is used.
MXR	The market exchange rate, expressed as new Uganda Shillings per US$. Source: *Picks Currency Yearbook* and data compiled in the Macro-Analysis Department of the MPED for the years before June 1990, after which the bureaux market mid-rate is used, as reported by the Bank of Uganda.
mGDPf	The prefix for the GDP, GDY and GDE series (derived in the text) signifies that it is monetary GDP, GDY or GDE only, while the prefix 't' signifies total GDP, GDY and GDE. The suffix 'f' signifies that the series has been interpolated using the Friedman (1962) method as described in the text. The suffix 'l' signifies a log-linear interpolation. Hence mGDYl is monetary GDY based upon the linearly interpolated GDP series. Source: the Statistics Department's estimates of national accounts with derivations as described in the text.
Cdel	The volume of coffee delivered to the CMB, or registered with the Uganda Coffee Development Authority (UCDA), in metric tonnes. Source: UCDA.
Cppri	The average producer price of coffee in new Uganda Shillings per kilo. Source: UCDA.
RvalDel	The real value of coffee deliveries in 1991 new Uganda Shillings, derived from the volume of deliveries, the average producer price and the cpi.
Exports	Exports in US$. Source: data from the Bank of Uganda balance of payments, the Statistics Department, the *IFS*, and the *Direction of Trade Statistics*.
Imports	Imports in US$. Source: data from the Bank of Uganda balance of payments, the Statistics Department, the *IFS*, and the *Direction of Trade Statistics*.
XUV	The Export Unit Value index, 1991=100, as reported in the text.
IUV	The Import Unit Value index, 1991=100, as reported in the text.
r	The 6-12 month deposit rate in Uganda. Source: the Bank of Uganda.
Tbillr	The interest rate on 91-day treasury bills (since 1992).
Intr	The international interest rate as proxied by the 3 month dollar LIBOR rate. Source: the *IFS*.
KMXR	The Kenyan market exchange rate in KSh/US$. Source: *Pick's Currency Yearbook* and the *IFS*.
Kppri	The Kenyan producer price of coffee in KSh per kilo. Source: Statistics Bureau *Quarterly Digest* and the *IFS*.
i8486p	Dummy variable taking the value 1 between 1984Q1 and 1986Q4 inclusive and the value 0 elsewhere.

Appendix II: The Dataset

	M0	M1	M2	cpi	pi	MXR	OXR	mGDPf	mGDYf	mGDEf	mGDPlin	mGDYlin	mGDElin	tGDPf	tGDYf	tGDEf
1967-1	0.00301	0.007	0.01037	0.002855	-9999.99	0.0847	0.071429	242804	366127	352407	232055	355378	341658	337689	461011	447291
1967-2	0.002767	0.0064	0.0098	0.003024	1.059322	0.085867	0.071429	234322	363294	310416	233493	362466	309587	330081	459054	406175
1967-3	0.002847	0.00635	0.00987	0.003097	1.024	0.087033	0.071429	227964	351587	292741	234826	358449	299603	324501	448124	389277
1967-4	0.003183	0.006737	0.010337	0.002927	0.945313	0.0882	0.071429	229021	350521	294940	236167	357666	302086	326334	447834	392253
1968-1	0.003827	0.007577	0.011287	0.00271	0.92562	0.0869	0.071429	234054	375074	312318	233204	374223	311467	332144	473163	410407
1968-2	0.003427	0.007327	0.010993	0.002831	1.044643	0.0856	0.071429	233300	379943	301212	234560	381202	302471	332167	478809	400078
1968-3	0.00406	0.0077	0.011697	0.003	1.059829	0.08405	0.071429	245561	383435	337531	246501	384376	338471	346510	484385	438481
1968-4	0.003877	0.008327	0.01245	0.003	1	0.0825	0.071429	255758	356843	378105	253693	354778	376040	358791	459876	481138
1969-1	0.00493	0.008707	0.01282	0.003073	1.024194	0.0905	0.071429	267409	397981	375751	262017	392589	370359	372525	503098	480867
1969-2	0.0045	0.00834	0.01274	0.003121	1.015748	0.089	0.071429	265456	392296	355698	269634	396474	359876	372656	499496	462898
1969-3	0.004367	0.0083	0.0127	0.003218	1.031008	0.0905	0.071429	273880	401803	375497	270942	398866	372560	381240	509163	482857
1969-4	0.00468	0.008983	0.013327	0.00346	1.075188	0.092	0.071429	270380	407409	366123	272257	409286	367999	377900	514930	473643
1970-1	0.00535	0.009837	0.014513	0.003532	1.020979	0.0935	0.071429	268947	426201	342084	271418	428672	344556	376627	533881	449765
1970-2	0.00503	0.01045	0.015307	0.003556	1.006849	0.099973	0.071429	272611	453408	331895	272745	453543	332029	380452	561249	439736
1970-3	0.00531	0.010727	0.01574	0.00346	0.972789	0.0993	0.071429	267834	442110	324999	274832	449108	331997	376390	550666	433555
1970-4	0.00595	0.010827	0.016317	0.003556	1.027972	0.1007	0.071429	276331	406551	379273	276934	407155	379876	385602	515822	488543
1971-1	0.005963	0.01136	0.017153	0.003702	1.040816	0.109	0.071429	287833	435773	432153	281350	429290	425670	397818	545759	542138
1971-2	0.005523	0.010877	0.016757	0.004258	1.150327	0.1147	0.071429	281216	416374	431066	283485	418643	433335	391917	527075	541767
1971-3	0.005237	0.010597	0.016487	0.004355	1.022727	0.1077	0.071429	289642	436883	435125	282783	430024	428265	401538	548780	547021
1971-4	0.00598	0.011217	0.016743	0.004065	0.933333	0.0953	0.071429	292537	400083	440652	282083	389629	430198	405629	513176	553744
1972-1	0.00639	0.012217	0.017523	0.003919	0.964286	0.1022	0.071429	295835	401994	416760	281492	387651	402417	410123	516282	531048
1972-2	0.005803	0.012743	0.018593	0.003944	1.006173	0.1148	0.071429	289258	421247	351561	280796	412785	343099	404742	536731	467045
1972-3	0.00595	0.013167	0.01916	0.003944	1	0.1345	0.071429	264620	417891	230985	279004	432275	245369	381164	534435	347529
1972-4	0.005507	0.014633	0.020787	0.004016	1.018405	0.1567	0.071429	262350	370441	278529	277224	385314	293403	379954	488045	396133
1973-1	0.00627	0.015033	0.020727	0.004234	1.054217	0.3	0.071429	263988	400627	271527	274700	411338	282239	382652	519291	390192
1973-2	0.006363	0.016783	0.02261	0.0045	1.062857	0.25	0.071429	268899	385382	306414	272942	389425	310457	388623	505106	426138
1973-3	0.00668	0.01774	0.025617	0.005129	1.139785	0.1488	0.069	280299	404085	338047	271806	395592	329553	401219	525005	458967
1973-4	0.00796	0.02063	0.028417	0.005879	1.146226	0.1548	0.069	280290	376060	350139	270674	366444	340523	402406	498176	472255
1974-1	0.0089	0.02041	0.0292	0.006992	1.1893	0.1495	0.071126	268953	347712	290556	271061	349821	292664	392264	471024	413867
1974-2	0.00895	0.02273	0.03032	0.008105	1.15917	0.3333	0.071439	267461	356830	279879	269939	359308	282357	391969	481338	404386
1974-3	0.00946	0.02549	0.03373	0.008782	1.083582	0.3	0.071439	264900	330500	289292	266987	332587	291379	390196	455796	414588
1974-4	0.01092	0.02998	0.03851	0.009073	1.033058	0.7167	0.071439	276221	308065	334704	264067	295911	322550	402306	434150	460789
1975-1	0.01244	0.02953	0.04097	0.008323	0.917333	0.433	0.071439	263180	305860	281766	258843	301523	277428	390055	432735	408640
1975-2	0.01202	0.02964	0.04147	0.011635	1.398008	0.4	0.071439	257308	288786	283209	255987	287466	281889	384971	416450	410873
1975-3	0.01205	0.03018	0.04369	0.012524	1.076367	0.583	0.071439	261245	296644	293977	255583	290983	288315	389943	425343	422676
1975-4	0.01367	0.03239	0.04665	0.013784	1.100671	0.65	0.082173	244541	288966	263108	255179	299604	273746	374276	418701	392842
1976-1	0.01478	0.03617	0.0518	0.015093	1.094948	0.5667	0.082983	238564	300074	228839	251931	313440	242206	369334	430844	359609
1976-2	0.01702	0.03986	0.05601	0.016654	1.103421	0.5867	0.084246	260179	328808	279102	251529	320158	270452	391984	460613	410907
1976-3	0.01861	0.0388	0.05564	0.021781	1.307859	0.9333	0.083875	239692	309578	254141	255713	325599	270162	372693	442579	387143
1976-4	0.02205	0.04447	0.0619	0.020821	0.955899	0.8167	0.083604	266602	382141	303707	259966	375505	297071	400799	516338	437904
1977-1	0.02428	0.05254	0.06984	0.024351	1.169577	0.55	0.083572	273050	462499	307873	276274	465722	311097	408443	597891	443266
1977-2	0.02579	0.06083	0.07905	0.027341	1.122763	0.44	0.08308	289345	532632	359152	280668	523955	350475	425933	669221	495740
1977-3	0.02569	0.06778	0.08749	0.028577	1.045237	0.55	0.082958	288376	431151	379201	270364	413139	361189	425926	568701	516751
1977-4	0.02889	0.05772	0.07385	0.032144	1.124804	0.59	0.081013	235202	325499	254628	260450	350747	279875	373714	464011	393139
1978-1	0.02881	0.05737	0.07527	0.03642	1.133033	0.75	0.078819	264914	344875	390172	244636	324597	369893	404387	484348	529645
1978-2	0.02831	0.06042	0.08083	0.039614	1.087682	0.7	0.078637	257241	319650	396911	235459	297868	375130	397676	460084	537346
1978-3	0.03019	0.06368	0.08661	0.049003	1.23701	0.75	0.076256	217577	291980	258281	229071	303475	269775	353142	427546	393846
1978-4	0.03531	0.06978	0.09272	0.065231	1.331175	0.85	0.073955	209208	288597	237240	222858	302247	250890	339904	419293	367936
1979-1	0.03756	0.076053	0.10003	0.082256	1.260996	0.84	0.075005	222226	325017	254743	213449	316241	245966	348052	450844	380569
1979-2	0.040473	0.081853	0.107463	0.099573	1.210523	0.5	0.075559	195137	228335	223836	207572	240771	236272	316094	349292	344793
1979-3	0.044777	0.090327	0.11742	0.105593	1.060458	0.47	0.074004	204958	301448	235120	206829	303319	236992	323942	420433	354105
1979-4	0.051007	0.100993	0.1329	0.120501	1.141183	0.75	0.074178	185289	259847	199842	206088	280647	220641	302301	376860	316854
1980-1	0.059063	0.11434	0.14865	0.135671	1.125896	0.765	0.074714	220206	298898	321974	206079	284770	307846	335246	413938	437014
1980-2	0.055687	0.11152	0.1467	0.146638	1.080831	0.75	0.073667	212707	278008	326969	205343	270644	319606	325775	391075	440037
1980-3	0.061447	0.124843	0.16319	0.158107	1.078213	0.74	0.073384	201782	232186	308710	205343	235747	312271	317759	348163	424687
1980-4	0.069037	0.13571	0.178813	0.18345	1.16029	0.77	0.075202	184679	195416	269671	205343	216080	290336	303565	314302	388557
1981-1	0.072427	0.14362	0.192197	0.207518	1.131198	0.75	0.077633	172636	189839	220091	202117	219319	249571	294432	311634	341886
1981-2	0.081933	0.160507	0.177277	0.203272	0.979538	2.05	0.309667	199668	218640	244345	202117	221089	246794	324373	343345	369050
1981-3	0.08642	0.22145	0.240857	0.236452	1.163231	2.517164	0.805333	205480	225911	233301	206631	227062	234452	332342	352773	360164
1981-4	0.102208	0.278207	0.299021	0.233339	0.986837	2.576369	0.81	226963	239835	294800	211244	224116	279081	355982	368854	423819
1982-1	0.109961	0.274572	0.344059	0.234957	1.006932	2.651247	0.859333	214080	230168	238739	215660	231748	240319	345257	361345	369915
1982-2	0.108315	0.253827	0.332626	0.269181	1.145661	2.738919	0.891667	223069	243247	248939	220478	240656	246348	356403	376581	382273
1982-3	0.109711	0.264132	0.346936	0.281319	1.045092	3	0.99	221409	246966	204494	226967	252523	210052	356630	382187	339715
1982-4	0.117394	0.283763	0.371372	0.310779	1.104722	3.085714	1.020667	235254	257763	272768	233643	256151	271156	372363	394872	409877
1983-1	0.133243	0.310347	0.400201	0.325066	1.04597	3.171429	1.118533	229847	252147	268509	236226	258525	274887	368954	391253	407616
1983-2	0.156723	0.360082	0.460817	0.347402	1.068712	3.533333	1.289167	239425	265198	254547	238613	264385	253735	380529	406302	395652
1983-3	0.161986	0.377187	0.48605	0.374279	1.077368	4.033333	1.659633	245481	270914	264992	244021	269455	263532	384854	410288	404366
1983-4	0.171392	0.397755	0.508272	0.400395	1.069775	4.077778	2.0871	249134	284683	264291	249550	285099	264707	386778	422326	401934
1984-1	0.23093	0.526697	0.643713	0.402074	1.004195	4.426667	2.5629	248244	279084	268884	254154	284994	274794	381918	412757	402557
1984-2	0.261389	0.591253	0.726763	0.433147	1.077282	4.713333	2.971833	252955	304584	269620	254523	306153	271189	382658	434288	399324
1984-3	0.302996	0.699782	0.848421	0.478784	1.105361	6.466667	3.706667	253824	290651	267909	253649	290476	267734	384527	421353	398611
1984-4	0.393717	0.868088	1.034668	0.647097	1.351543	9.187222	5.145367	263150	291252	299426	252778	280880	289055	394851	422953	431128
1985-1	0.589008	1.247314	1.440433	0.921897	1.424665	12.895	5.583	253039	282329	282534	248077	277367	277572	386621	415911	416116
1985-2	0.650971	1.517134	1.748787	1.12766	1.223195	15.04667	5.9787	245115	280782	260942	245151	280818	260979	380577	416244	396405
1985-3	0.72578	1.702717	1.993987	1.285442	1.13992	19.7125	6	243728	275746	242121	245502	277520	243895	380248	412266	378642
1985-4	0.95248	2.04772	2.395717	1.582787	1.231317	31.8625	9.416667	240404	263721	267905	245853	269170	273354	377983	401300	405484
1986-1	1.46783	2.84834	3.290477	2.145467	1.355499	40.63333	14.79667	238609	313265	295874	242544	317200	299809	376744	451400	434010
1986-2	1.90206	3.642163	4.21544	2.586259	1.205453	60.67292	14.26667	239998	337498	262528	243368	340868	265898	378690	476189	401220
1986-3	2.232033	4.584397	5.261153	3.108165	1.201799	78.33102	14	245770	306183	300049	248795	309208	303075	385487	445900	439766
1986-4	3.021633	5.519887	6.394423	4.427315	1.424414	103.3084	14	252585	293823	346606	254341	295579	348362	393328	434565	487349
1987-1	3.993303	6.887577	8.105443	6.899073	1.558297	137.3361	14	245060	274839	333358	258662	288442	346960	387520	417299	475818
1987-2	4.29674	7.503287	8.67578	9.135343	1.324141	92.86714	29.33333	261969	295671	348771	263391	297093	350193	406147	439848	492949
1987-3	5.585817	10.04512	11.18975	9.921702	1.086079	192.8567	60	281560	321474	364114	270282	310195	352835	427624	467538	510178
1987-4	7.592043	14.29492	16.06689	13.46189	1.356812	262.0135	60	290096	326169	410907	277348	313422	398160	438046	474119	558857
1988-1	10.82536	19.30252	21.42442	19.23906	1.42915	371.2527	60	272120	310058	351032	281703	319641	360616	422199	460138	501112
1988-2	13.47404	23.09733	25.55816	24.35889	1.266117	440.8333	60	282342	318219	386640	285318	321195	389616	434551	470428	538849
1988-3	16.49132	27.44083	30.11125	34.23946	1.405625	444.5	150	302783	332271	409157	290563	320051	396937	456963	486450	563337
1988-4	18.91069	33.3876	36.64341	39.66703	1.158518	457	155	296146	334207	388281	295903	333964	388038	452295	490356	544430
1989-1	21.20875	40.30668	44.29373	48.28512	1.217261	466.25	176.6667	307465	353602	401745	305217	351355	399498	465752	511890	560033
1989-2	27.79875	51.78354	57.24231	56.57238	1.171632	612	200	305773	336180	401954	309937	340344	406118	466199	496607	562381
1989-3	30.42823	55.34301	62.51821	62.94885	1.112713	575	200	317172	332560	416198	315446	330834	414471	478361	493749	577386
1989-4	33.50569	62.83561	72.0324	69.43267	1.103001	740	360	324825	329715	417707	321052	325942	413934	486777	491666	579659
1990-1	38.13359	74.5494	86.62427	76.94702	1.108225	560	377.6667	312867	314755	400016	322455	324342	409603	475339	477226	562488
1990-2	38.17389	77.91378	91.00331	75.61591	0.982701	600	387.6667	318464	323996	402146	328638	334170	412320	481456	486988	565139
1990-3	41.43109	84.72129	100.7714	77.2476	1.021579	690.6	456.6667	324925	323462	396267	334223	332759	405565	488141	486677	559483
1990-4	45.87667	93.20667	112.2567	83.64554	1.082824	746.9233	513.3333	351983	350017	438753	339901	337936	426672	515422	513456	602192
1991-1	51.505	103.19	122.82	89.59261	1.071099	797.6667	596.6667	344632	344116	426925	348477	347961	430770	508186	507670	590479
1991-2	54.80667	113.5233	136	97.96576	1.093458	891.6667	670	344993	347538	431896	355392	357936	442294	508662	511206	595565
1991-3	59.67667	121.9933	145.0167	102.367	1.044927	970.3333	816.6667	362779	359983	435420	358903	356108	431544	523787	520991	596428
1991-4	73	148.2267	176.44	110.0746	1.075294	1122.933	915	377657	377765	468168	362450	362557	452960	536004	536112	626515
1992-1	86.43	170.5133	205.6967	129.5905	1.177297	1250.037	1038.52	367858	362211	438848	366345	360698	437335	529762	524115	600752
1992-2	86.32667	176.2967	218.8767	160.0558	1.235089	1216.227	1163.32	376590	373168	454717	373789	370367	451916	542050	538628	620177
1992-3	86.29667	154.56	204.5967	165.6594	1.03501	1245.837	1182.767	363221	361426	439336	381800	380006	457915	531595	529800	607710
1992-4	91.28333	163.69	222.9433	166.8187	1.006998	1237.323	1197.113	380129	382564	471459	389981	392416	481310	551418	553852	642747
1993-1	100.92	213.57	274.8433	160.0773	0.959588	1241.387	1217.243	396461	396139	510125	395842	395519	509505	567490	567167	681153
1993-2	99.65333	228.8233	301.44	159.9485	0.999195	1238.49	1210.15	397083	395056	514133	402395	400367	519444	567851	565824	684901
1993-3	104.4667	222.4833	307.86	163.9848	1.025235	1205.84	1192.07	401465	407586	526684	411169	417290	536389	572278	578399	697498
1993-4	116.42	239.9533	335.5933	170.1251	1.037444	1182.997	1160.617	409970	412939	560691	420131	423100	570852	580830	583799	731551
1994-1	130.0533	262.3133	361.0933	176.0292	1.034705	1116.117	1079.717	404787	428601	563268	433903	457718	592385	579588	603403	738070
1994-2	131.7667	278.1667	384.5333	185.0035	1.050982	1016.72	978.4433	440498	475838	637034	450691	486031	647228	619241	654582	815778
1994-3	150.2	312.3	428.1	177.3174	0.958454	952.47	936.34	473852	552417	649967	461286	539850	637401	653056	731620	829171

1994-4	161.1667	346.6	472.7667	181.3537	1.022763	928.29	923.2233	478795	528107	636126	472126	521437	629457	658458	707770	815789
1995-1	180.7	368.1667	490.3333	187.1934	1.032201	930.6633	925.8667	491119	594173	685926	478210	581264	673016	673078	776132	867885
1995-2	169.7667	368.9	492.8	191.6376	1.023741	956.51	954.0267	489779	546212	698057	492805	549237	701082	674034	730466	882311
1995-3	180.2667	379.0333	512.5	189.3618	0.988125	981.7467	972.22	514219	577817	722580	505279	568877	713640	697253	760851	905614
1995-4	190.7667	393.7333	537.7	199.2164	1.052041	1040.79	1033.233	513175	573350	710059	518058	578234	714942	694989	755164	891872
1996-1	210.83	418.9	579.16	200.6784	1.007339	1032.5	1021.657	533219	605401	708740	533138	605321	708659	712936	785119	888457
1996-2	211.9	428.2	603	202.8039	1.010592	1033.79	1024.3	537514	591882	703804	541492	595860	707781	715135	769504	881425
1996-3	205.3	423.1	624.3	204.6718	1.00921	1069.08	1065.95	561405	606492	755077	558116	603203	751788	738486	783573	932158
1996-4	214.7	440.7	645.8	213.3026	1.042169	1081.61	1072.29	550322	602610	717526	575241	627529	742444	726863	779151	894067

	tGDPlin	tGDYlin	tGDElin	CDel	CPpri	RValDel	Exports	Imports	XUV	IUV	r	Tbillr	Intr	KMXR	KPpri	i8486p
1967-1	326940	450262	436542	53409	0.01038	19419	56.84	53	53.66307	27.56	1.050	-9999.99	1.060	-9999.99	-9999.99	0
1967-2	329253	458226	405347	28273	0.01038	9704	59.94	47	52.70225	27.45	1.050	-9999.99	1.053	-9999.99	-9999.99	0
1967-3	331363	454986	396139	19284	0.01074	6688	55.81	41	54.88301	27.51	1.050	-9999.99	1.054	-9999.99	-9999.99	0
1967-4	333480	454979	399399	34259	0.01074	12569	53.74	40	55.42581	27.28	1.050	-9999.99	1.066	-9999.99	-9999.99	0
1968-1	331294	472313	409557	58070	0.01082	23188	59.94	44	57.24307	26.99	1.050	-9999.99	1.074	-9999.99	-9999.99	0
1968-2	333426	480069	401338	26913	0.01098	10439	64.07	44	56.06379	27.22	1.050	-9999.99	1.072	-9999.99	-9999.99	0
1968-3	347451	485325	439421	27513	0.01098	10070	56.84	45	59.52766	26.93	1.050	-9999.99	1.070	-9999.99	-9999.99	0
1968-4	356726	457811	479073	35830	0.01098	13114	43.41	49	58.92114	27.56	1.050	-9999.99	1.067	-9999.99	-9999.99	0
1969-1	367133	497706	475475	73410	0.01098	26233	57.87	52	56.53001	27.61	1.050	-9999.99	1.072	-9999.99	-9999.99	0
1969-2	376834	503674	467076	25771	0.01098	9067	54.77	45	59.44607	27.79	1.050	-9999.99	1.078	-9999.99	-9999.99	0
1969-3	378302	506226	479920	63249	0.01098	21583	57.87	51	56.89773	28.06	1.050	-9999.99	1.078	-9999.99	-9999.99	0
1969-4	379777	516806	475520	34549	0.011047	11031	60.97	50	63.20317	29.15	1.050	-9999.99	1.077	-9999.99	-9999.99	0
1970-1	379099	536353	452236	106423	0.011403	34357	70.28	48	63.71168	29.33	1.050	-9999.99	1.094	7.666036	784.04	0
1970-2	380586	561383	439870	18719	0.01205	6342	80.61	48	65.36758	29.60	1.050	-9999.99	1.089	7.666036	797.28	0
1970-3	383388	557664	440553	37290	0.01205	12988	77.51	45	67.57756	29.96	1.050	-9999.99	1.083	7.666036	793.66	0
1970-4	386205	516425	489147	45047	0.01205	15263	62.01	54	61.94449	30.14	1.050	-9999.99	1.075	7.666036	720.84	0
1971-1	391336	539276	535656	39668	0.01205	12913	70.28	69	67.53174	30.51	1.050	-9999.99	1.056	7.666036	608.62	0
1971-2	394185	529344	544036	62642	0.01205	17727	66.14	70	66.37595	30.87	1.050	-9999.99	1.068	7.666036	608.62	0
1971-3	394679	541921	540162	30867	0.01205	8541	75.44	75	67.42646	32.04	1.050	-9999.99	1.078	7.666036	608.62	0
1971-4	395175	502722	543290	46328	0.01205	13735	56.84	69	68.57597	32.95	1.050	-9999.99	1.064	7.666036	746	0
1972-1	395780	501939	516705	38515	0.01205	11841	58.91	64	69.19094	33.76	1.050	-9999.99	1.053	7.666036	744.3	0
1972-2	396279	528269	458583	66594	0.01205	20349	74.41	52	69.22294	34.04	1.050	-9999.99	1.051	7.666036	744.3	0
1972-3	395548	548819	361913	32274	0.01205	9862	95.08	35	62.67601	34.40	1.050	-9999.99	1.055	7.666036	744.3	0
1972-4	394828	502918	411007	36540	0.01205	10963	64.07	34	68.7925	35.12	1.050	-9999.99	1.059	7.666036	908.84	0
1973-1	393364	530003	400903	88942	0.01491	31322	81.64	35	85.54465	38.83	1.050	-9999.99	1.074	7.666036	908.84	0
1973-2	392667	509149	430181	34353	0.01491	11382	71.31	41	98.46918	41.46	1.050	-9999.99	1.085	7.405242	908.84	0
1973-3	392726	516512	450473	53855	0.01491	15656	80.61	53	106.6113	44.17	1.050	-9999.99	1.110	7.405242	908.84	0
1973-4	392790	488560	462639	42261	0.01491	10718	67.18	56	115.6323	44.72	1.050	-9999.99	1.101	7.405242	1010.77	0
1974-1	394373	473133	415976	52121	0.01493	11130	85.78	52	120.4879	48.79	1.050	-9999.99	1.091	7.666036	1010.77	0
1974-2	394446	483815	406864	77233	0.01493	14227	104.38	57	124.4867	52.41	1.050	-9999.99	1.115	7.666037	1010.77	0
1974-3	392283	457883	416675	26958	0.01493	4583	82.68	57	118.7521	53.32	1.050	-9999.99	1.132	7.666041	1010.77	0
1974-4	390152	421996	448635	54150	0.01529	9126	53.74	72	104.3412	57.03	1.050	-9999.99	1.105	7.666059	982.8	0
1975-1	385717	428397	404303	36342	0.01565	6834	74.41	58	106.8385	59.11	1.050	-9999.99	1.076	7.666119	970.7	0
1975-2	383651	415129	409552	79637	0.01565	10712	65.11	61	96.51808	58.75	1.050	-9999.99	1.065	7.666248	970.7	0
1975-3	384282	419681	417014	28328	0.01565	3540	63.04	61	97.73048	55.31	1.050	-9999.99	1.072	7.665907	970.7	0
1975-4	384914	429339	403481	13110	0.0161	1531	64.07	47	121.0245	56.03	1.050	-9999.99	1.068	8.846386	1596.02	0
1976-1	382701	444210	372976	54209	0.01775	6375	91.98	41	130.4494	55.76	1.050	-9999.99	1.056	8.9	2283.74	0
1976-2	383334	451963	402258	43617	0.02765	7242	82.68	48	160.2762	56.39	1.050	-9999.99	1.059	9.45	2283.74	0
1976-3	388714	458600	403164	26128	0.02765	3317	80.61	40	193.3466	58.02	1.050	-9999.99	1.057	9.3	2283.74	0
1976-4	394163	509702	431268	39662	0.02765	5267	117.81	62	217.1222	59.65	1.050	-9999.99	1.053	9.25	3919.56	0
1977-1	411667	601115	446489	43104	0.02985	5284	173.62	61	331.2977	60.38	1.050	-9999.99	1.051	8.95	4060.88	0
1977-2	417256	660544	487063	43925	0.03285	5278	204.63	81	450.8692	61.46	1.050	-9999.99	1.056	8.6	4060.88	0
1977-3	407914	550689	498739	29211	0.03885	3971	126.08	89	376.1918	62.10	1.050	-9999.99	1.063	8.55	4060.88	0
1977-4	398961	489258	418387	32602	0.03885	3940	105.41	49	239.1098	64.99	1.050	-9999.99	1.072	8.15	3386.42	0
1978-1	384109	464070	509367	32831	0.0415	3741	83.71	118	259.9677	67.35	1.050	-9999.99	1.073	8.1	2815.64	0
1978-2	375894	438303	515564	29077	0.0415	3046	72.34	132	215.164	68.89	1.050	-9999.99	1.079	8.8	2815.64	0
1978-3	364636	439040	405341	26725	0.0415	2263	95.08	67	227.0669	72.24	1.050	-9999.99	1.088	8.35	2815.64	0
1978-4	353554	432943	381586	29358	0.0415	1868	104.38	60	235.899	74.59	1.050	-9999.99	1.112	8.1	2830.38	0
1979-1	339276	442068	371793	34601	0.0465	1956	136.42	75	242.9769	77.94	1.050	-9999.99	1.109	8.4	2839.84	0
1979-2	328530	361728	357229	9450	0.0465	441	47.54	43	292.672	79.66	1.050	-9999.99	1.107	8.55	2839.84	0
1979-3	325814	422304	355977	29636	0.0465	1305	133.32	67	342.651	83.73	1.050	-9999.99	1.117	8.55	2839.84	0
1979-4	323101	397659	337654	35466	0.0465	1369	124.02	57	325.0199	87.44	1.050	-9999.99	1.148	8.3	2728.26	0
1980-1	321119	399810	422886	39247	0.0465	1345	124.00	149	315.6421	87.08	1.050	-9999.99	1.172	7.5	2639.84	0
1980-2	318411	383712	432673	26786	0.0465	849	108.74	163	321.4496	91.61	1.050	-9999.99	1.112	8.6	2639.84	0
1980-3	321320	351724	428248	33696	0.0465	991	59.96	149	266.2483	93.15	1.050	-9999.99	1.122	8.3	2639.84	0
1980-4	324229	334966	409222	19832	0.0465	503	26.41	117	228.5119	91.70	1.050	-9999.99	1.172	8.3	2358.42	0
1981-1	323912	341115	371367	21340	0.057	586	53.81	94	218.5457	89.07	1.050	-9999.99	1.164	9.6	2258.42	0
1981-2	326822	345794	371499	20238	0.170467	1697	65.81	99	190.038	84.46	1.050	-9999.99	1.176	10.5	2258.42	0
1981-3	333493	353924	361314	36141	0.2174	3323	93.68	103	165.0913	85.45	1.050	-9999.99	1.184	12	2258.42	0
1981-4	340263	353135	408100	35090	0.38045	5721	44.80	115	190.8639	88.17	1.080	-9999.99	1.143	12.5	2258.42	0
1982-1	346837	362925	371495	50167	0.38045	8123	72.68	85	196.7613	85.27	1.080	-9999.99	1.155	14	2780	0
1982-2	353812	373990	379682	37751	0.434633	6095	87.20	95	186.0642	83.19	1.080	-9999.99	1.151	14.65	2780	0
1982-3	362188	387745	345273	43602	0.543	8416	137.24	75	191.0463	81.83	1.090	-9999.99	1.126	15.45	2780	0
1982-4	370752	393260	408265	30345	0.543	5302	74.57	95	216.5923	83.46	1.090	-9999.99	1.095	16.5	2780	0
1983-1	375332	397632	413994	54622	0.543	9124	61.13	85	293.9629	82.37	1.110	-9999.99	1.093	15.55	3488	0
1983-2	379717	405490	394839	37231	0.6092	6529	109.13	95	183.3431	80.47	1.110	-9999.99	1.093	18.5	3488	0
1983-3	383395	408828	402906	35184	0.86	8084	93.13	85	209.0658	79.39	1.110	-9999.99	1.100	16.6	3488	0
1983-4	387194	422742	402350	21145	0.931867	4921	113.13	85	230.7396	79.75	1.130	-9999.99	1.098	16.2	3488	0
1984-1	387828	418667	408467	58278	1.0756	15590	91.43	78	235.5246	82.28	1.130	-9999.99	1.102	15.5	3842	1
1984-2	384226	435856	400892	31345	1.0756	7784	132.43	88	242.1751	80.11	1.130	-9999.99	1.114	17.25	3852	1
1984-3	384352	421178	398436	27972	1.4	8179	107.43	78	225.043	76.49	1.180	-9999.99	1.120	16.66	3852	1
1984-4	384480	412582	420756	28378	1.96	8595	77.43	88	215.4188	75.68	1.180	-9999.99	1.100	18.53	3826	1
1985-1	381659	410949	411154	61893	2.24	15039	85.32	86	204.8218	73.59	1.180	-9999.99	1.090	17.5	3934	1
1985-2	380613	416281	396441	33313	2.456667	7257	110.59	86	200.9515	76.94	1.180	-9999.99	1.083	18.5	3974	1
1985-3	382023	414040	380416	31417	2.89	7063	128.69	86	178.0638	79.84	1.180	-9999.99	1.081	16.25	3938	1
1985-4	383432	406749	410933	17372	3.613333	3966	80.04	86	203.3872	85.00	1.180	-9999.99	1.082	15.96	4034	1
1986-1	380680	455336	437945	52285	5.06	12331	106.75	90	282.5679	88.62	1.180	-9999.99	1.079	15.3	5776	1
1986-2	382060	479560	404590	41372	7.914667	12661	152.71	80	241.4893	88.62	1.280	-9999.99	1.071	15.3	6072	1
1986-3	388512	448925	442792	32189	9.342	9675	95.90	90	238.216	91.43	1.280	-9999.99	1.063	15.75	5672	1
1986-4	395083	436321	489104	24244	9.342	5116	67.50	120	238.964	92.15	1.280	-9999.99	1.061	17.1	5506	1
1987-1	401122	430902	489420	50887	9.342	6891	79.88	144	176.9672	97.13	1.280	-9999.99	1.064	18.95	4244	0
1987-2	407569	441270	494371	24670	20.42467	5516	79.19	134	176.2604	89.43	1.280	-9999.99	1.072	19.75	3954	0
1987-3	416345	456259	498899	50494	25.966	13215	95.86	139	167.8412	87.71	1.180	-9999.99	1.072	22	3816	0
1987-4	425298	461372	546110	41787	25.966	8060	78.11	164	181.7237	91.61	1.180	-9999.99	1.080	20	3792	0
1988-1	431783	469721	510695	41360	31.1	6686	79.66	121	181.8755	92.33	1.180	-9999.99	1.070	20.75	4128	0
1988-2	437528	473405	541825	28502	31.1	3639	77.86	145	168.8007	93.40	1.180	-9999.99	1.075	23	4486	0
1988-3	444743	474230	551117	42161	65	8004	66.28	138	151.7109	90.65	1.280	-9999.99	1.084	23	4556	0
1988-4	452052	490113	544187	39134	65	6413	76.28	128	172.1646	94.55	1.280	-9999.99	1.090	21	4550	0
1989-1	463505	509642	557786	50236	65	6763	93.69	141	179.8868	93.34	1.330	-9999.99	1.098	22	4370	0
1989-2	470363	500770	566544	38002	65	4366	69.34	133	160.78	91.12	1.330	-9999.99	1.098	24.5	4358	0
1989-3	476634	492023	575660	46636	65	4816	66.10	147	117.8678	91.06	1.330	-9999.99	1.089	22.1	3015.741	0
1989-4	483004	487893	575886	34170	65	3199	69.00	157	101.7882	93.67	1.330	-9999.99	1.086	22.5	2584.491	0
1990-1	484927	486814	572075	36658	65	3097	47.26	136	102.1674	97.30	1.320	-9999.99	1.084	23.95	2579.322	0
1990-2	491630	497162	575312	18273	65	1571	49.81	128	106.6643	97.16	1.300	-9999.99	1.085	24.75	2664.44	0
1990-3	497438	495975	568780	39381	85.5	4359	42.75	128	105.9751	102.46	1.300	-9999.99	1.082	24.25	2683.091	0
1990-4	503340	501374	590110	34435	123.8333	5098	50.30	160	111.3298	107.50	1.300	-9999.99	1.082	25.5	2817.246	0
1991-1	512030	511515	594324	35521	143	5670	43.84	136	103.4799	106.02	1.293	-9999.99	1.069	32	2597.5	0
1991-2	519060	521604	605963	12817	143	1871	42.61	130	103.9742	98.24	1.290	-9999.99	1.062	32	2420.87	0
1991-3	519911	517116	592552	57492	236.1	13260	38.71	116	90.70995	96.56	1.323	-9999.99	1.058	30	2314.352	0
1991-4	520797	520904	611307	41558	236.1	8914	43.86	141	101.8359	100.79	1.340	-9999.99	1.051	30.5	2469.414	0
1992-1	528248	522602	599239	35903	244.0667	6762	41.97	123	87.45822	100.85	1.340	-9999.99	1.043	34	2224.942	0
1992-2	539249	535827	617376	13016	260	2114	44.98	133	94.62066	101.66	1.380	-9999.99	1.041	34.2	1953.498	0
1992-3	550175	548380	626290	33744	243.5333	4961	40.79	129	102.317	107.03	1.390	-9999.99	1.035	50	1998.429	0
1992-4	561270	563704	652599	27632	286.6	4747	43.61	139	107.8323	100.99	1.323	-9999.99	1.036	75	2404.109	0
1993-1	566870	566547	680533	60005	315.5333	11828	38.63	156	96.29054	97.26	1.164	1.21	1.033	80	2348.814	0
1993-2	573163	571135	690212	19801	304.6333	3771	44.09	168	93.58459	98.17	1.179	1.23	1.032	100	2297.14	0
1993-3	581982	588104	707202	21029	356.1	4567	49.18	169	108.9951	96.15	1.179	1.23	1.033	100	2839.264	0
1993-4	590990	593959	741712	40242	378.9333	8963	42.48	192	102.8249	95.75	1.130	1.18	1.034	90	3043.692	0
1994-1	608705	632519	767186	57548	304.3	9948	79.08	214	135.9384	96.05	1.159	1.21	1.036	88.25669	3149.846	0
1994-2	629435	664775	825971	34877	478.5603	9022	83.14	251	176.2647	98.78	1.101	1.15	1.045	77.56807	3998.122	0
1994-3	640490	719054	816604	59417	813.0005	27243	146.53	251	238.8563	101.91	1.074	1.08	1.050	71.52039	6625.961	0
1994-4	651789	701101	809120	55343	905.8333	27643	129.02	247	177.7091	104.13	1.066	1.06	1.060	57.45296	4585.627	0
1995-1	660169	763223	854975	39220	919.1667	19258	191.03	296	280.7137	108.46	1.070	1.07	1.063	58.37326	4416.431	0
1995-2	677059	733491	885337	25914	900.8333	12181	110.76	291	285.5327	112.80	1.075	1.09	1.061	65.47271	4711.453	0
1995-3	688313	751911	896674	45414	927.3333	22240	131.15	299	251.8884	110.99	1.078	1.09	1.059	73.49246	4573.48	0

1995-4	699872	760047	896756	70797.4	808.7333	28741	127.07	286	245.6581	111.69	1.081	1.10	1.059	73.09805	3755.26	0
1996-1	712856	785038	888377	82331.6	720	29539	178.98	300	208.394	111.39	1.092	1.11	1.054	75	3778.415	0
1996-2	719113	773481	885402	52984.5	669.1667	17483	134.99	265	205.6806	109.98	1.106	1.12	1.055	75	4132.502	0
1996-3	735197	780284	928869	51237.4	564.1667	14123	143.46	317	175.2807	110.42	1.114	1.12	1.056	75	3966.354	0
1996-4	751782	804069	918985	81811.5	470	18027	161.38	298	182.0388	110.86	1.113	1.13	1.055	75	4014.735	0

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