IMPACT OF ECONOMIC REFORMS IN ALGERIA

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Résumé

In trying to assess the impact of economic reforms in Algeria, the author used a six-behavioural-equations model and tested the structural changes in its parameters. He observed that some factors, such as interest rates, exchange rate and prices have had a prompt impact whereas (production and labour) have not.

ملخص

حاول الكاتب قياس الآثار التي أحدثتها الإصلاحات الاقتصادية التي باشرتها السلطات الجزائرية سنة 1988. إذ أنشأ نموذجا من 6 معادلات سلوكية تمثل مختلف العوامل التي يمكن من خلالها معرفة التغير (الإيجابي أو السلبي) الذي طرأ على الاقتصاد الجزائري بعد تطبيق تلك الإصلاحات.

توصل إلى نتيجة مفادها أن تحسنا قد ظهر بعد الإصلاحات في 4 من 6 معادلات وهي نتائج شبيهة بتلك المسجلة في بر امج إصلاحات البلدان الأخرى. فعادة ما يكون لتحرير أسعار الفائدة، سعر صرف والأسعار، تأثير مباشر وسريع على الاقتصاد، أما فيما يتعلق بمستوى الإنتاج والعمالة فلم يظهر أي تحسن فيهما.

1 Introduction

It has been argued that Algeria's economic reform programme began in 1988 (see Joffe 1999). In evaluating the impact of these reforms a first approach might be to look at the rate of growth of GDP per head – the main determinant of long-run average living standards. This gives an unpromising view of the reforms, however, with GDP per head falling at –1.0 % per year for the 12 years 1988-1999. By comparison, for the 12 year period prior to this, 1976-1987, GDP per head rose at a rate of 1.8% a year,

Of course, the main external impact in the earlier period was the high level of world oil prices. For 1976-87, they were, on average, in real terms, seven times higher. The enormous inflow of resources that took place enabled Algeria to invest heavily (investment was 37% of GDP in 1976-87, but fell to 28% of GDP from 1988 on. Under such dramatic changes in external circumstances, the growth rate of GDP is a poor indicator of the efficiency of the economy.

The approach taken in this paper is to look at the structure of the economy to see if any improvements in efficiency, or growth enhancing

features, are discernable, in a comparison of the pre- and post-reform periods. This comparison draws on a 15 equation macroeconomic model (the technical details are consigned to Appendix I) constructed from data for the post reform period, 1988-97. The model has six estimated behavioural equations. This model is re-estimated for the period 1977-97, and tests are conducted for structural changes for the pre- and post-reform periods. These results are in Appendix II.

2 Analysis of Structural Changes

On improvement that might be expected is a reduction in the marginal propensity to consume in the consumption function. A reduction in financial repression and an increase in real interest rates might be expected to raise saving and reduce consumption. This is in fact observed. The Chow Breakpoint Test is significant at the 5% level, indicating that parameters have changed between the two periods, and equation 4B in Appendix II shows the slope dummy for the income term to be significant at the 5% level, with the marginal propensity to consume falling from 0.68 to 0.63.

A successful reform programme, by reducing financial repression, might be expected to increase the sensitivity of investment to the real rate of interest. That is, it would be expected that the negative coefficient on the interest rate would become more negative, and increase in significance. However, data on interest rates is only available for 1992 to 1996 inclusive, and this precludes structural change analysis for the investment function in the post-reform period model.

A alternative approach is to use the rate of inflation as a proxy for the real interest rate. The equation for the 1977-97 period shows no significant impact of the inflation rate, although the positive sign is as expected. The Chow Breakpoint Test is not significant. However, the introduction of a dummy slope variable in the post-reform period is significant, an the inflation variable also becomes significant. It seems that in the post-reform period, with a relaxation in financial repression, and the nominal interest rate adjusting with changes in the inflation rate, this effectively nullifies he impact of the inflation rate on investment (the coefficients of the dummy and the inflation rate variables are of roughly equal magnitude but opposite signs. Prior to the reforms, with a largely fixed nominal interest rate, variations in the interest rate effectively determined variation in the real interest rate.

For the production function, we might expect the reform programme to show a asn improved, positive rate for technical progress and higher productivities for labour and capital. The signs on equation 8A in Appendix II suggest perhaps a an improvement in the impact of technical progress and in

labour productivity. However, it shows capital productivity as worsening. However, the evidence is not conclusive - the Chow Breakpoint Test is not significant and none of the slope dummy variables are significant, either.

With fewer administered prices it might be expected that the impact of the money supply (positive effect) and output (negative effect) might be expected to be greater. In addition, with liberalisation it might be expected that the impact of changes in the money supply and output on the price level would be take place more rapidly. The Chow Breakpoint Test is close to being significant at the 5% level. The slope dummies for the money supply and output are significant, and have the expected signs. The Nerlove lag coefficient is not significant, but does have a sign which is consistent with there being a speedier response to changes.

The exchange rate began to be adjusted with a steady depreciation after 1987, and the Chow breakpoint Test indicates a change in parameters. The most significant change is in the impact of relative prices with the slope parameter for this variable very significant (see equation 12A in Appendix II). This suggests that the exchange rate is increasingly determined by purchasing power parity.

In the labour market a more rapid response to changes in the gap between actual and potential GDP. To try to test this, the Okun's Law relationship between the level of unemployment and the closeness of actual GDP to potential GDP was reformulated to include a Nerlove lag (see equation 13A in Appendix II). The Chow Breakpoint Test shows no significant change, and neither of the slope dummies are significant.

3 Conclusions

Four of the six behavioural equations of the model show signs of either efficiency-enhancing of growth-supporting changes in the post-reforms period.

These results are are similar to what has been observed in other reform programmes , where liberalising key financial variables such as interest rates and the exchange rate and deregulating prices have a prompt and significant effect. The production process and the labour market, however, are typically more difficult to reform. The former requires privatisations which may take some year to bring about as preparations can be complex, and the privatisations face political opposition. Labour market reform often needs changes in attitudes to employment, revision of employment law and reform of social service provision, and to move too quickly in these areas runs the risk of social distress and political instability.

APPENDIX I
ALGERIA MACROMODEL

1 Introduction

The purpose of the modelling exercise is three fold. Firstly to provide a macroeconomic model that can be used for forecasting, incorporating various possible configurations of investment programmes and government policies with regard to financing. Secondly, it explores some of the main relationships in the economy, particularly the extent to which the reform process is transforming the Algerian economy on market economy lines. Finally, the model provides an aggregate background for detailed sectoral analysis of the macroeconomic framework.

The intention of the modelling exercise is to try to present a simple a set of relationships that is able to explain the main aggregates satisfactorily. The estimated model does not consider any sectoral detail on the production side — any changes in the composition of output will affect some of the the parameters of the aggregate relationships in the model. The forecasting configuration of the model, however, allows revised parameters to be introduced.

The design of the model is based on the flexible exchange rate, aggregate demand and lagged price-adjustment model developed by Hall and Taylor (1993) for the United States. Thus the starting point is a model for a market economy, with a well developed financial sector, a flexible labour market, relatively modest reliance (10% of GDP) on international trade, and price-adjustment which incorporates expectations, cost push influences and a Phillips curve relationship relating price changes to the closeness of the economy to full employment.

Algeria began its economic reform programme — as described by Joffé (1999) — in 1988. With a comprehensive data set only extending to 1997 (and then only with some bold assumptions to generate estimates), this is perilously little information on which to construct a model of the Algerian economy.

Certain features of the Hall and Taylor model were modified from the start. The external sector clearly required more attention than it receives for the US, where a portfolio balance approach is used to determine the real exchange rate, and only the balance between exports and imports is determined by the model. The Algeria model considers exports and foreign capital inflow as exogenous, and determines the exchange rate from a demand-for-imports balance of payments approach. Indirect taxes are significant in Algeria, and the model recognises this by distinguishing between GDP at factor cost and GDP at market prices.

The financial sector has only really introduced an interest rate structure from 1992 (see IMF 1997), and there is little experience on which to model the operation of the money market. Whereas Hall and Taylor allow the money supply to determine real interest rates from a demand-for-money equation, the Algeria model takes real interest rates as exogenous.

Finally, the Hall and Taylor price adjustment mechanism does not fit the facts well in Algeria, and the Algeria model uses a monetarist equation of exchange, with lags, to explain price changes.

The model determines 15 main endogenous variables, including GDP, investment, capital stock, full employment output, the price level, imports, the exchange rate and unemployment. On the basis of these it also generates the inflation rate, the growth rate for GDP, and the growth rate of GDP per head.

2 Algeria macromodel

Aggregate demand

(1) YM = CO + IN + GO + EX - IM

(2) YF = YM / (1 + T1/100)

(3) YD = (1 - TD/100) * YF

(4) CO = -3.645 + 0.6864*YD

(5) IN = 89.88 + IA - 2.481*IR

Aggregate Supply

(6) LP = LF * (1 - UN/100)

(7) KA = (1 - DE/100)*KA(-1) + IN

(8) YP = EXP(-0.481 - 0.0115*TM + 0.318*LN(LP) + 0.483*LN(KA(-1))

Prices and Inflation

(9) CP = EXP (0.970*LN(M1) - 0.516*LN(YM) + 0.507*LN(CP(-1))

(10) IF = ((CP-CP(-1)) / CP(-1))*100

Balance of Payments & Exchange Rate

(11) IM = EX + FI

(12) ER = EXP(-0.368*LN(IM*PC/PM) + 0.965*LN(PC/PM) + 0.642*LN(YF*PC/PM))

Labour Market & Population

(13) UE = UN-0.256*((YF-YP) / YP)*100

(14) LF = LF(-1)*(1 + LG/100)

(15) PO = PO(-1)*(1 + PG/100)

Endogenous variables

CO = Private consumption, AD bn, 1987 prices
CP = Consumer price index, 1987=100
ER = Exchange Rate, AD per $US
IF = Inflation rate, % per year
IM = Imports, AD bn, 1987 prices
IN = Investment, AD bn, 1987 prices
KA = Capital stock, AD bn, 1987 prices
LF = Labour Force, thousands
LP = Potential labour force, thousands
PO = Population, thousands
UE = Unemployment, %
YD = Personal disposable income, AD bn, 1987 prices
YF = GDP at factor cost, AD bn, 1987 prices
YM = GDP at market prices, AD bn, 1987 prices
YP = Potential output, AD bn, 1987 prices

Exogenous variables

DE = Depreciation rate, % per year
EX = Exports, AD bn, 1987 prices
FI = Foreign capital inflow, AD bn, 1987 prices
GO = Government consumption expenditure, AD bn, 1987 prices
IA = Autonomous investment, AD bn, 1987 prices
IR = Real interest rate, % per year
LG = Labour force growth rate, % per year
M1 = Money supply, AD bn
PG = Population growth rate, % per year
PM = Import price index, 1987=100
TD = Direct tax rate, %
TI = Indirect tax rate, %
TM = Time trend, 1977=1
UN = Natural rate of unemployment, %

3 Structure of the model

3.1 Aggregate demand

Equations (1) to (5) determine the main expenditure, output and income aggregates. Private consumption, investment, government consumption, exports and imports comprise aggregate expenditure, which equals GDP at market prices (equation 1). Export volumes (predominately oil) are decided by the state-owned oil sector, and export prices are set by the world oil market, and thus exports are considered exogenous. Government consumption spending, is also exogenous.

GDP at factor cost is derived in equation (2) by reducing GDP at market prices by the amount of indirect taxes. Personal disposable income is obtained from GDP at factor cost in equation (3) by subtracting direct taxes. Consumption is a linear function of personal disposable income in equation (4). Investment is a linear function of real interest rates, in equation (5). There is provision for modelling the effects of the increases in investment by inclusion of an autonomous investment term (AI) in the investment equation.

3.2 Aggregate supply

Three factors are considered to determine aggregate supply, namely technical progress, employed labour, and capital. The labour force is determined, in equation (14), by using the exogenously given rate of growth of the labour force with the level of the labour force in the previous period. Potential employment, in equation (6), is obtained by subtracting the natural level of unemployment (taken as exogenous) from the labour force.

The capital stock from equation (7) is obtained by subtracting depreciation (exogenously given) from the capital stock of the previous period, and then adding investment.

Output, in equation (8), is determined by a Cobb-Douglas production function relating output to labour and capital with exogenous technical progress picked up by a time trend. The capital stock used in the production function is that of the previous period — as well as being plausible, this has the useful side effect that the non-linear nature of the production function does not complicate the solution of the model when generating projections.

3.3 Prices and Inflation

The Hall and Taylor model generates expected inflation as a function of past inflation rates, and then determines actual inflation as a function of expected inflation and the gap between actual and potential GDP. The price level is then generated by adjusting the price level of the previous period by the inflation rate. Exogenous influences on the inflation rate, such as changes in

the levels of indirect taxes and changes in import prices can be included in the inflation equation.

Such a formulation does not fit the facts in Algeria. The main problem is that when the GDP gap is high, inflation is also high, and conversely, the opposite of what is expected on theoretical grounds.

A monetarist explanation explains price behaviour in Algeria rather better. A double-log relationship, equation (9), determines the price-level as a function the money supply and the level of expenditure as represented by GDP at market prices. The money supply is thus the main determinant of the price level, with a delay modelled by including the price level lagged as an explanatory variable. The inflation rate is then found from the change in the price level in equation (10).

3.4 Balance of Payments and the Exchange Rate

The level of exports, and the net inflow of foreign capital, both exogenous, determine the level of imports in equation (11).

Essentially a double log import demand equation relates imports to the level of GDP at factor cost and the domestic relative price of imports. This latter is the import price, multiplied by the exchange rate and divided by the domestic price level. Equation (12) inverts the import demand function to give the exchange rate as a function of imports, domestic consumer prices, import prices and GDP at factor cost.

3.5 Labour Market and Population

The rate of unemployment is obtained from Okun's law adapted to Algeria. In equation (13), the unemployment rate is given by the natural rate of unemployment (exogenous) and the gap between actual and potential GDP.

The labour force, equation (14), and the population, equation (15), are obtained by taking the levels in the previous period and adjusting by the exogenously given growth rates.

4 Estimation of the model

The 6 behavioural equations of the model below were estimated by ordinary least squares, except for those with AR(1) to the right of the equations, which indicates a first-order autoregressive correction used in the presence of evidence of serial correlation. The figures in parentheses under the coefficients are t values.

The data was assembled from IMF (Annual), World Bank (Annual) and Ighilahriz (1999). Annual data for the period 1977-97 is included at the end of this Appendix, but for the estimated equations below, only the observations for

the years 1988-97 were used. For the investment equation (5) there were only 5 observations, 1992-96. For the other equations the sample size is 10, but when lags are introduced, or autoregressive correction is used in the presence of evidence of serial correlation, further observations are lost.

(4)CO = - 3.65 + 0.686YD
(-0.15) (6.22)
$R^2 = 0.83$ DW = 2.64

(5)IN = 89.88 - 2.481 IR
AR(1)
(17.36) (-5.40)
$R^2 = 0.93$ DW = 2.66

(8)LN(YF) = - 0.481 - 0.0115 TM + 0.318 LN(LP) + 0.4832 LN((KA(-1)))
(- 0.11) (-0.77) (1.254) (0.85)
$R^2 = 0.66$ DW = 2.13

(9)LN(CP) = 0.9700 LN(M1) - 0.5156 LN(YM) + 0.5065LN((PC(-1)))
(3.05) (-2.91) (2.94)
$R^2 = 0.99$ DW = 2.19

(12) LN(ER) = -0.369 LN(IM*PC/PM) + 0.9653LN(PC/PM)
+0.6423LN(YF*PC/PM) AR(1)
(- 0.72) (3.08) (1.88)
$R^2 = 0.98$ DW = 2.30

(13) UE - UN = - 0.256 ((YP - YF)/YP) AR(1) (- 0.73)
$R^2 = 0.46$ DW = 2.23

As the model has a simultaneous structure, some of the equations would, in principle, be better estimated (that is, have less bias) with the use of some simultaneous equation estimating method such as instrumental variables. However, the sample size is so small, with 10 exogenous and two predetermined variables the reduced form equations would run out of degrees of freedom.

The consumption function, equation (4), is quite well estimated. The investment equation, despite a vey small sample period, exhibits a significant effect of the real interest rate on investment.

The production function is not strongly established, with none of the coefficients strictly significantly different from zero at the 5% level. The labour and capital variables have the expected sign, but the time variable has a negative coefficient, suggesting declining total factor productivity — a

reflection of the declining efficiency of the productive sector in this period, despite the economic reform programme.

The equation of exchange explaining the price level is altogether more successful with all the variables have the appropriate sign, and with significant coefficients.

The demand for imports equation, which serves to set the exchange rate is reasonable — all the variables have the expected sign, although only one variable has a significant coefficient.

The unemployment equation shows the expected sign for the variable measuring the gap between potential and actual output, but it is not strictly significant.

5 Forecasting with the model

The model is relatively easy to solve, with only 5 of the equations of the model needing to be solved simultaneously, and this is fairly straightforward as the 5 equations are all linear. The five aggregate demand equations that need to be solved give the two GDP measures, personal disposable income and the two endogenous components of aggregate expenditure, consumption and private investment.

The supply side depends only on exogenous or lagged endogenous variables in determining potential output. GDP with the exogenous money supply determines the price level. and thus inflation. Imports are determined by two exogenous variables. Imports are then used to determine the exchange rate with the price level, GDP, and exogenously determined import prices. Finally, the unemployment rate is determined by the exogenously given natural rate, and the determined rates of potential and actual GDP.

The solution to the model is set up in a spread sheet which allows the specification different policy options. These options include fiscal policy (through the level of government consumption expenditure, direct and indirect tax rates), and monetary policy (through changes in the the money supply). The effect of initiatives which raise investment can also be explored, as well as the impact of changes in net foreign investment.

6 Future development of the model

An area where the model might be improved is by including extra equations to model government finances in a more comprehensive manner so that the budget out-turn can de determined by the model. A second area is to make the interest rate endogenous through a demand for money equation - this really hinges on obtaining a longer data series on interest rates. Finally work needs to

be done in estimating the natural rate of unemployment, rather than just assuming a plausible value.

References

Hall, R. and J. Taylor (1993) *Macroeconomics.* (4th Edition) New York: Norton.

Ighilahriz, I. (1999) *New Deal Initiative: Macroeconomic Frame.* (Mimeo) Paper for MENAS Workshop on Algeria, March 1999.

IMF (Annual) *International Financial Statistics Yearbook.* Washington DC.

Joffé, G. (1999) *Patterns of Devleopment: Algeria and its Precursors..* (Mimeo) Paper for MENAS Workshop on Algeria, March 1999.

World Bank (Annual) *World Tables.* Washington DC.

Table 1 NATIONAL ACCOUNTS

YEAR	Y '87	FY '87	MY '87	DC '87	OI '87	NG '87	OE '87	XIM '87
	AD bn	AD bn	AD bn	AD bn	AD bn	AD bn	AD bn	AD bn
1977	162.84	205.6	142.3	100.43	102.1	31.2	34.4	53.3
1978	177.63	224.5	155.2	100.31	112.5	32.4	36.5	52.6
1979	192.08	241.1	167.9	110.08	113.8	42.0	39.1	52.7
1980	191.65	243.2	167.5	121.48	116.4	40.9	34.1	54.5
1981	195.55	250.6	170.9	131.66	120.7	43.6	34.2	63.4
1982	208.99	266.7	182.7	135.22	121.1	46.7	37.7	62.3
1983	222.95	281.0	194.9	143.60	128.6	49.2	40.0	66.2
1984	233.81	297.5	204.3	151.36	131.2	52.3	42.3	67.9
1985	250.73	314.2	219.1	159.53	134.7	55.2	43.4	71.7
1986	253.34	313.1	221.4	160.17	114.5	57.5	43.2	55.9
1987	253.58	312.7	221.6	154.88	93.9	58.0	45.8	39.9
1988	249.11	308.0	217.7	143.42	98.4	61.7	46.0	41.2
1989	259.31	324.6	226.6	153.32	107.5	62.7	49.7	48.2
1990	251.06	321.3	219.4	149.48	101.6	64.6	51.4	43.5
1991	245.90	317.8	214.9	143.81	87.2	71.0	50.9	35.7
1992	253.51	322.4	221.6	151.57	82.3	77.6	52.9	37.3
1993	254.10	318.3	222.1	147.02	74.5	77.3	52.0	34.8
1994	251.30	314.8	219.6	147.85	99.4	74.7	49.6	42.0
1995	261.11	327.1	228.2	147.64	102.0	70.9	51.7	44.1
1996	271.03	339.5	236.9	160.92	85.1	79.2	54.4	38.9
1997	274.55	343.9	240.0	160.92	83.4	74.7	60.3	34.2

Table 2 MONEY, PRICES, INFLATION, INTEREST RATES, EXCHANGE RATE, TAXES

YEAR	M1	CP	PM	IF	IR	ER	TD	TI
	AD bn	'87=100	'87=100	% pa	% pa	AD/$	%	%
1977	48.6	37.4	66.3	12.0		4.2	12.6	26.3
1978	62.6	43.8	75.2	17.2		4.0	12.6	26.4
1979	72.7	48.9	88.1	11.5		3.9	12.6	25.5
1980	84.8	53.5	99.0	9.6		3.8	12.6	26.9
1981	97.9	61.3	93.1	14.6		4.3	12.6	28.1
1982	125.3	65.4	89.1	6.7		4.6	12.6	27.6
1983	152.8	69.3	87.5	6.0		4.6	12.6	26.0
1984	180.4	75.0	85.1	8.1		5.0	12.6	27.2
1985	202.2	82.8	86.1	10.5		5.0	12.6	25.3
1986	204.8	93.1	94.1	12.4		4.7	12.6	23.6
1987	223.9	100.0	100.0	7.4		4.9	12.6	23.3
1988	252.2	105.9	107.9	5.9		5.9	12.6	23.6
1989	250.0	115.8	110.9	9.3		7.6	12.6	25.2
1990	270.4	135.0	116.8	16.6		9.0	12.6	28.0
1991	324.5	170.0	116.8	25.9		18.5	12.6	29.2
1992	377.0	223.8	119.8	31.7	-15.0	21.8	12.6	27.2
1993	450.3	269.7	123.1	20.5	-4.0	23.4	12.6	25.3
1994	485.7	384.0	126.0	42.4	-8.0	35.1	12.6	25.3
1995	520.3	460.1	129.1	19.8	-7.0	47.7	12.6	25.3
1996	590.0	559.7	132.0	21.7	2.0	54.8	12.6	25.3
1997	638.9	591.6	134.7	5.7		57.5	12.6	25.3

Table 3 POPULATION, LABOUR, UNEMPLOYMENT

YEAR	PO	LF	UE	UN
	K	k	%	%
1977	17.06	3007	22	6.0
1978	17.60	3355	17	6.0
1979	18.16	3703	19	6.0
1980	18.74	4051	22	6.0
1981	19.33	4197	22	6.0
1982	19.94	4348	20	6.0
1983	20.57	4505	19	6.0
1984	21.22	4667	19	6.0
1985	21.89	4835	20	6.0
1986	22.47	5017	20	6.0
1987	23.06	5207	21	6.0
1988	23.67	5403	21	6.0
1989	24.29	5607	17	6.0
1990	24.94	5819	20	6.0
1991	25.51	5799	22	6.0
1992	26.10	6078	24	6.0
1993	26.77	6396	24	6.0
1994	27.50	6715	25	6.0
1995	28.10	7033	30	6.0
1996	28.60	7395	27	6.0
1997	29.10	7757	26	6.0

Table 4 PRODUCTION, RESOURCES

YEAR	YP AD bn '87	TIME '77 = 1	LP k	KA AD bn '87
1977	166.7	1	2827	617.3
1978	180.7	2	3154	690.1
1979	194.8	3	3481	759.5
1980	207.8	4	3808	809.1
1981	213.9	5	3945	894.6
1982	224.6	6	4087	976.9
1983	234.2	7	4235	1063.1
1984	243.8	8	4387	1148.1
1985	252.8	9	4545	1233.0
1986	261.4	10	4716	1294.0
1987	267.1	11	4895	1331.7
1988	270.1	12	5079	1372.3
1989	273.3	13	5271	1420.3
1990	277.1	14	5470	1460.2
1991	276.2	15	5451	1426.3
1992	272.6	16	5713	1464.4
1993	276.6	17	6013	1498.8
1994	279.9	18	6312	1551.7
1995	284.9	19	6611	1604.5
1996	290.0	20	6951	1641.7
1997	293.4	21	7292	1677.5

APPENDIX II
STRUCTURAL CHANGE IN ALGERIA

All equations estimated from the dataset in Appendix I, with 21 annual observations for the period 1977-1997 inclusive. D is a dummy variable with value 0 for the years 1977-87 inclusive, and 1 otherwise.

When lags are introduced in the equations, or corrections for serial correlation are employed, observations are lost depending on the length of the lags and the order of the autocorrelation assumed. The equations are estimated by ordinary least squares, (except where an autoregressive structure has been assumed).and the figures in parentheses are t values.

Consumption Function

(4A) CO = 26.90 + 0.565YD
AR(1)
(0.80) (3.69)
R^2 = 0.91 DW = 1.70
Chow Breakpoint Test: 1988 F = 3.80

(4B) CO = 9.28 + 0.67YD - 0.04D*YD AR(1) AR(2)
(0.46) (6.78) (-3.07)
R^2 = 0.93 DW = 2.65

Investment Function

(5A) IN = 97.49 + 0.27IF AR(1) AR(2)
(7.52) (1.11)
R^2 = 0.69 DW = 1.77
Chow Breakpoint Test: 1988 F = 1.27

(5B) IN = 95.82 + 2.13IF - -2.20D*IF AR(1) AR(2)
(15.83) (2.91) (-3.43)
R^2 = 0.71 DW = 1.93

Production Function

(8A) YF = -0.93 - 0.016TIME + 0.34LN(LP) + 0.53 LN(KA(-1)) AR(1)
(-0.50) (-2.06) (1.44) (4.77)
R^2 = 0.96 DW = 1.92
Chow Breakpoint Test: 1988 F = 1.16

(8B) YF = 12.91 - 0.045TIME - 0.76LN(LP) + 1.45 LN(KA(-1))
(0.64) (-1.00) (-0.82) (1.54)
+ 0.042D*TIME – 1.01D*LN(LP) - 1.23D* LN(KA(-1))
(0.920) (1.12) (-1.12)
R^2 = 0.97 DW = 1.69

Price Level

(9A) LN(PC) = 0.250 LN(M1) - 0.10 LN(YM) + 0.86 LN(PC(-1))
(1.012) (-0.97) (4.75)
$R^2 = 0.99$ DW = 2.21
Chow Breakpoint Test: 1988 F = 3.27

(9B) LN(PC) = -0.019 LN(M1) - 0.08 LN(YM) + 0.93 LN(PC(-1))
(-0.106) (0.85) (2.80)
+ 0.990 D*LN(M1) - 0.600D* LN(YM) - 0.43 D*LN(PC(-1))
(3.22) (-3.568) (-1.19)
$R^2 = 0.996$ DW = 2.30

Exchange Rate

(12A) LN(ER) = -0.156 LN(IM*PC/PM) – 1.071 LN(PC/PM)
(-0.560) (- 5.952)
+ 0.457 LN(YF*PC/PM)
AR(1)
(2.355)
$R^2 = 0.98$ DW = 1.57
Chow Breakpoint Test: 1988 F = 3.97

(12B) LN(ER) = 0.141 LN(IM*PC/PM) - 0.069 LN(PC/PM)
(0.604) (- 0.470)
+ 0.187 LN(YF*PC/PM) - 0.668 D* LN(IM*PC/PM)
(1.081) (-1.447)
+ 1.210 D*LN(PC/PM) + 0.539 D*LN(YF*PC/PM)
(2.355) (1.684)
$R^2 = 0.99$ DW = 1.64

Unemployment

(13A) UE-UN = -0.450 ((YP-YF)/YP) + 0.826 (UE-UN)(-1)
(-2.59) (11.074)
$R^2 = 0.62$ DW = 2.09
Chow Breakpoint Test: 1988 F = 0.35

(13B) UE-UN = -0.264 ((YP-YF)/YP) + 0.849 (UE-UN)(-1)
(-0.942) (10.561)

-0.380 D* ((YP-YF)/YP) - 0.119 D*(UE-UN)(-1)
(-1.021) (-1.100)

$R^2 = 0.64$ DW = 2.02