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Business Cycles and Inflationary Expectation: Use of a Monetarist Model* for Korea

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Introduction

Since the first half of the 1970s, the Korean economy has maintained a high rate of economic growth based on the export promotion of manufactured goods and import substitution, recording a growth rate of 10 per cent in the 1970s and 7.5 per cent in the 1980s (up to 1988).

On the other hand, during the 1970s, the economy faced a persistent inflation that averaged 18.8 per cent in terms of GDP deflater growth rate,[1] and it is said that an "inflation mentality" settled into the economy. Under such circumstances it becomes useful to stress the role of price expectation and introduce it into price determination.

The Korean economy has experienced business cycles since the first half of the 1970s. One objective of this chapter is to examine the consistency between the business cycles generated by the monetarist model which contains inflationary expectation, and the cycles measured by the DI. Such a comparison stresses the importance of the price adjustment mechanism through inflationary expectation.

It is also important to investigate the mechanism of how inflationary expectation affects business cycles. Inflationary expectation, which is formed according to the past supply, demand, and price, influences the pattern of

* The model is cited from Mitsuru Toida, "A Monetarist Small Econometric Model for Singapore," *Econometric Link System for ASEAN, ELSA Final Report*, Vol. 1 (Tokyo: Institute of Developing Economies, 1985).

business cycles, depending on the magnitude of the adjustment speed of prices to inflationary expectation.

Two simulations were carried out to analyze the effects of a change in the speed with which prices adjust to inflationary expectation toward the pattern (the amplitude and cycle) of business cycles using a monetarist model. The results indicate that this type of analysis can facilitate the forecasting of business cycles.

In the second section the applicability of a monetarist model to the Korean economy is examined, then the structure of the monetarist model used in this paper is explained. The theoretical model is a replication of the Singapore model developed by Toida (1985). In the third section the results of the model estimations are shown. The specifications of this model also follow Toida (1985). Then in the fourth section the business cycles generated by the model are examined against the reference dates obtained from the DI compiled by IDE. The fifth section explains the simulation analyses, and the final section summarizes the results.

Analytical Model

In the Keynsian model, monetary and fiscal policies decrease the unemployment rate. Price is determined by the relationship between unemployment and price on the Philipps curve. As the labor market approaches full employment, a significant price hike takes place. However, the mechanism of price determination is still ambiguous in a theoretical sense. The stagflation which the Korean economy experienced in the past is impossible to explain by the trade-off between price and unemployment. Usually stagflation is explained by a cost-push theory. It attributes an acceleration of inflation to monopolistic wage determination conducted by labor unions and monopolistic pricing rules followed by firms. This approach has a shortcoming when explaining a simultaneous price hike on an international scale, because we have to assume analogous labor market structures in which labor unions have been strengthening negotiation powers independently in a number of different countries. Also, in the monetarist model, labor supply is assumed to be determined based on real wages. In the long run, the trade-off between price and unemployment disappears and the unemployment rate remains at the level of the natural unemployment rate. In other words, full-employment is assumed in this model (demand is restricted by supply). The Korean economy began to suffer from a labor shortage in the latter half of the 1970s; therefore it seems possible to assume the existence of a full-employment market structure for the Korean economy, and this reinforces the view that an "inflation mentality" became part of the economy, especially during the 1970s. Given these conditions in the economy, the application of a monetarist model becomes useful, and we can consider an adjustment mechanism as follows. Price expectation is formed based on demand, capacity of supply, and real price in the past, and it affects a price in the present. This present price adjusts demand toward supply.

The theoretical model used in this study can be characterized as a small monetarist model of an aggregate demand and supply. The main features are summarized by Toida.

> Fluctuations in nominal aggregate demand is explained by an external impulse as well as monetary and fiscal policy impulses. An inflation equation represents an aspect of aggregate supply. Dynamics of economic growth are fed into the model by specifying functions for investment and potential output.[2]

Inflationary expectation plays an important role in this model. (The framework of the Korean model is shown in Figure 14–1.)

In the Korean model, an increase in nominal expenditure (*DGDP*) is determined by the following exogenous variables: an increase in exports, an increase in nominal government expenditure, and an increase in the money supply (M2). To specify this relationship, we first assume the stable equation of exchange ($PQ=MV$). In this equation, P indicates general price (GDP deflater), Q indicates real expenditure, M indicates money supply, and V indicates velocity (the speed at which money circulates). This equation insists that nominal expenditure is equal to money supply multiplied by constant velocity. We next assume a one-sided effect from money supply to nominal expenditure and a constant value of velocity. This enables us to consider nominal expenditure as determined by money supply. As a result, we can specify the equation in which an increase in nominal expenditure is determined by an increase in money supply. At the same time, because we allow a temporal effect of an increase in government expenditure to DGDP, the increase in nominal expenditure is not determined by the increase in M2 alone.

The growth rate of the GDP deflater is explained by the GDP deflater in period $t-1$, accumulated unrealized inflationary pressure in the past ($PRESAC(t-1)$), and inflationary pressure (*DPS*). Accumulated unrealized inflationary pressure in the period t is calculated in the following way. The growth rate of potential GDP and the growth rate of the GDP deflater are subtracted from the growth rate of nominal expenditure; then it is added to the accumulated unrealized inflationary pressure in the period $t-1$. In other words, the difference between the growth rate of nominal expenditure and the growth rate of potential GDP indicates a potential GDP deflater.

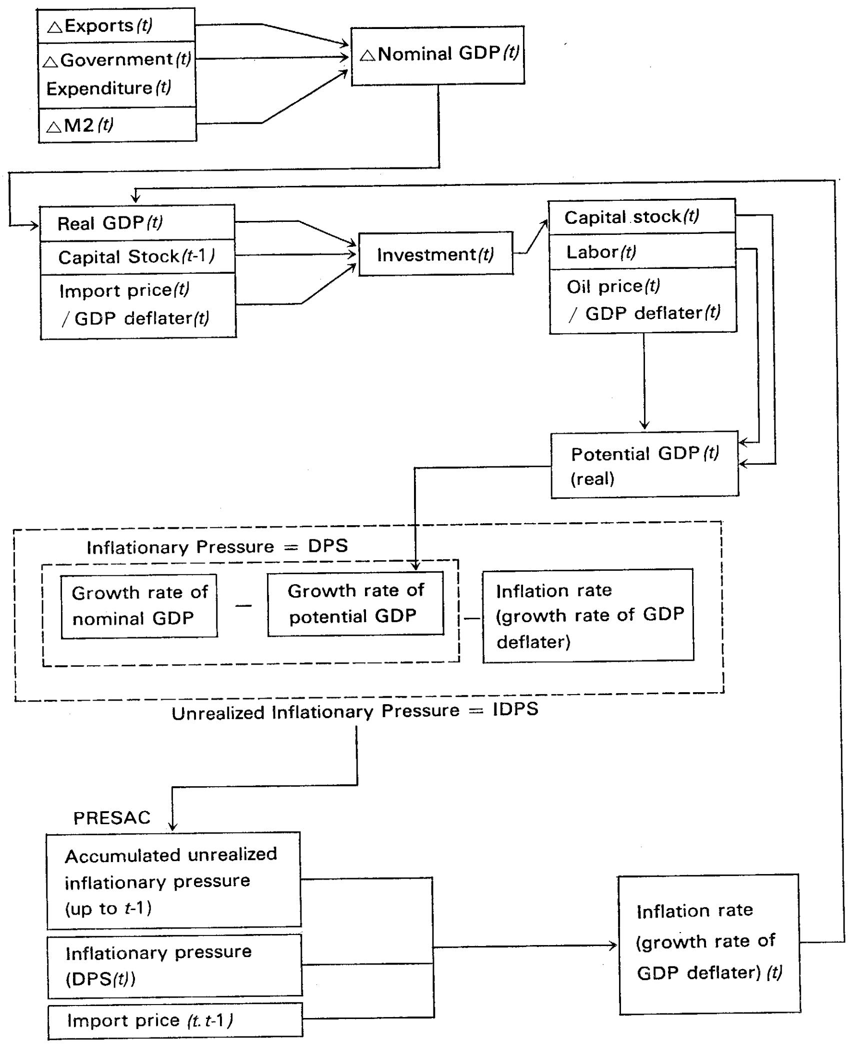

Fig. 14–1
Flow Chart of the Korean Model

If this does not match the real GDP deflater, the difference between the two creates a pressure to change the GDP deflater from the next period. In this model this variable (*PRESAC*($t-1$)) is defined as the inflationary expectation. Real GDP is obtained by dividing nominal expenditure (determined exogenously) by the GDP deflater. Therefore it can be said that real GDP is adjusted by inflationary expectation through this relationship toward potential GDP. As a result we can think of the coefficient of this inflationary expectation as controlling the speed of this adjustment, and it becomes possible to study the effect of change in the adjustment speed on the pattern of business cycles by changing this coefficient.

The model has an investment function which contains real GDP, capital stock in period $t-1$, and a ratio of import price ($DMF1$) to GDP deflater as explanatory variables. If GDP, which is determined as a ratio of nominal expenditure to GDP deflater, rises, investment increases. Because real GDP, which is temporarily affected by such variables as government expenditure, has a positive effect on investment, we can see that the temporal effect of the variables still affects the growth path of the potential GDP through capital accumulation and the potential production function.

Potential GDP per employee in the period t is a function of capital stock per employee in period $t-1$, the ratio of oil price to GDP deflater, and time. Because potential GDP is explained partly by the GDP deflater in a positive relationship, it is reasonable to postulate an aggregate supply curve with a positive slope.

Results of Estimation

In this section the main equations in the Korean model will be presented. The whole system of the model and the list of variables are shown in Appendix 14–1.

Price Formation Function

$$\begin{aligned} DP(t) = & \underset{(-2.0)}{-0.031} + \underset{(3.10)}{0.064}(DP(t-1)) + \underset{(2.29)}{0.149}(PRESAC(t-1) \\ & + \underset{(2.59)}{0.305}(DPS(t)) + \underset{(3.82)}{0.363}(DPM1(t)) - \underset{(-1.03)}{0.01}(DPM1(t-1)). \end{aligned}$$

$$DW = 2.66.$$
$$\bar{R}^2 = 0.94.$$

Figures in parentheses show t-value, Durbin-Watson value (DW), and adjusted coefficient of determination (R^2). In this equation, the growth rate of the GDP deflater (DP) in period t is determined by five variables. Initially DP in period $t-1$ is included as an explanatory variable. Then accumulated unrealized inflationary pressure in the past ($PRESAC(t-1)$) is added. The explanatory variable is defined as: $PRESACt = PRESACt-1 + IDPSt$. $IDPS$ (unrealized inflationary pressure) is defined as: $IDPS = (GDPV75t - POTGDPt) - DPt$.

DPS expresses the difference between the growth rate of nominal GDP and the growth rate of potential GDP. Because the coefficient of DPS is

0.305, the difference between the growth rate of nominal GDP and the growth rate of potential GDP is only partially absorbed in the growth rate of the GDP deflater. Because the import price is thought to have a rather large effect on the GDP deflater in the Korean economy, the growth rate of import prices ($DPM1$) is also included in this equation.

Nominal Expenditure Equation

$$DGDPV = \underset{(1.815)}{678.05} + \underset{\substack{(3.094)\\((0.212))}}{0.475}\, DDEV + \underset{\substack{(1.320)\\((0.151))}}{1.023}\, DGEV75 + \underset{\substack{(3.585)\\((0.458))}}{1.233}\, DM22 .$$

$$DW = 2.2877.$$
$$\bar{R}^2 = 0.9669.$$

Figures in double parentheses show elasticity. An increase in nominal expenditure is determined by an increase in nominal exports ($DDEV$), increase in nominal government expenditure ($DGEV75$), and an increase of M2 ($DM22$). External changes in explanatory variables activate $DGDPV$. $DGDPV(t)$ plus $GDPV75(t-1)$ (the nominal expenditure in period $t-1$) is defined as $GDPV75(t)$.

Investment Function

$$I(t) = \underset{(1.795)}{1520.12} + \underset{\substack{(6.935)\\((1.435))}}{0.4612}\, GDP(t) - \underset{\substack{(-1.73)\\((-0.393))}}{0.0440}\, K75\,(t-1)$$
$$- \underset{\substack{(-3.112)\\((-0.383))}}{2452.16}\,(DMF1/PGDP) .$$

$$DW = 2.266.$$
$$\bar{R}^2 = 0.991.$$

To make this model dynamic, an investment function is introduced. In this equation, investment in period t is determined by real GDP in period t, capital stock ($K75$) in period $t-1$, and a ratio of import price ($DMF1$) to GDP deflater ($PGDP$). If the import price of raw materials or capital goods rises compared with general price (GDP deflater) and they can not be produced domestically, the cost of investment increases. This will curtail an adequate level of investment. For this reason a ratio of import price to GDP deflater is added as an explanatory variable in this equation.

Potential Production Function

$$(POTGDP/L75)t = \underset{(-4.131)}{-1.222} + \underset{\substack{(4.8)\\((0.415))}}{0.164}\,(K75\,(t-1)/L75)$$

$$-4.944E{-}6\,((POIL \cdot EXR)/PGDP)(t) + 0.0248T.$$
$$\underset{((-0.018))}{(-1.061)} \qquad \underset{((1.619))}{(4.755)}$$

$DW = 1.490.$
$\bar{R}^2 = 0.992.$

Potential GDP has been estimated by drawing lines connecting the peaks in real GDP. In this equation, potential GDP per employee in period t is determined by capital stock ($K75$) per employee ($L75$) in period $t-1$, time, and a ratio of oil price ($POIL$) to GDP deflater. By introducing a second variable, the effect of relative price change in oil can be expressed. If the import price of raw materials or fuels rises compared with general price (GDP deflater), and they can not be produced domestically, the cost of production increases. This will have a negative effect on production. For this reason a ratio of import price (in domestic currency) to GDP deflater is added as an explanatory variable in this equation.

The other equations in the model are contained in Appendix 14–1.

The fitness of the model was examined by in-sample simulation. The root mean squared percentage errors of GDP, potential GDP, and GAP are 7.8, 1.9, and 7.2. These figures show that the model is reliable and that it can be relied upon for performing simulations.

DGAP and the Business Cycle

The DGAP in this model has a close relationship with the business cycle. *DGAP* is defined as a growth rate of the ratio of GDP to potential GDP and is derived from the in-sample simulation without any shocks to the model (the base case). This DGAP and the peaks and troughs (reference dates) observed from the DIs are drawn in Figure 14–2. Theoretically the growth rate of the *DGAP* becomes negative and smallest when the business cycle is near its peak. In other words, the bottom of the *DGAP* oscillation roughly matches the peak in the business cycles, and conversely the growth rate of the *DGAP* become larger at the bottom of the business cycles. Prices present some difficulty, for although those for the first half of the 1970s and for the 1980s fit rather well, prices for the latter half of the 1970s do not. The model used here is based on annual data while the DI is based on monthly data. This difference makes it difficult for the model to capture small fluctuations in the variables. However, in general a rather close relationship can be found between the business cycles generated by this model and the cycles measured by the DI. The reason for drawing attention to the consistency between the business cycles formed by the monetarist model and those measured by the DI is to show the importance in business cycles

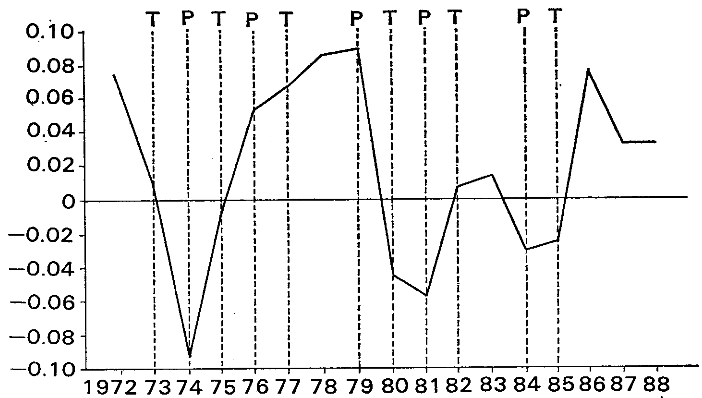

Fig. 14–2
Computed DGAP and Reference Dates
Note: T and P denotes trough and peak respectively.

of the price adjustment mechanism operating through inflationary expectation.

Simulation Analysis

The following simulation analysis looks at different levels of speed with which prices adjust to inflationary expectation and the impact this has on the pattern of business cycles. In order to see the cyclical pattern over the long term, the results of simulations from 1980 to 1997 were investigated. For the period 1980–1988, the actual values were used for exogenous variables. From 1989 until 1997, exogenous variables were extrapolated beforehand and applied.

Table 14–1 shows the results of the base case simulation, which did not apply any external shocks to the coefficient of inflationary expectation. In this case, the growth rate difference (*DGAP*) between the potential GDP and the actual GDP tended to approach zero due to the adjustment mechanism through prices.

Two other cases were also simulated. In case 1, the adjustment speed, which is the coefficient of inflationary expectation, was increased. In case 2, it was decreased to zero. The results of each case are summarized in Table 14–1.

Case 1

The coefficient of inflationary expectation ($PRESAC(t-1)$) was changed from 0.1491 to 0.7457, indicating that the model now depended more on

Table 14–1
Simulation Results

	DP			*IDPS*			*DGAP*		
	Base Case	Case 1	Case 2	Base Case	Case 1	Case 2	Base Case	Case 1	Case 2
1980	0.244	0.370	0.157	−0.048	−0.173	−0.010	−0.046	−0.133	−0.016
1981	0.149	0.155	0.211	−0.057	−0.055	−0.007	−0.058	−0.057	−0.016
1982	0.890	−0.010	0.103	0.014	0.122	0.062	0.006	0.117	0.053
1983	0.830	0.008	0.044	0.021	0.101	0.071	0.014	0.095	0.063
1984	0.072	0.083	0.036	−0.030	0.041	0.022	−0.032	−0.041	0.018
1985	0.048	0.084	0.020	−0.027	−0.063	0.023	−0.027	−0.060	0.022
1986	0.027	0.035	−0.003	0.082	0.075	0.125	0.075	0.068	0.123
1987	0.042	0.078	−0.021	0.038	0.004	0.090	0.031	−0.002	0.086
1988	0.050	0.100	−0.016	0.037	−0.010	0.099	0.030	−0.014	0.095
1989	0.077	0.123	−0.020	−0.011	−0.052	0.063	−0.014	−0.050	0.059
1990	0.088	0.095	−0.008	−0.016	−0.016	0.062	−0.019	−0.019	0.058
1991	0.094	0.067	−0.005	−0.016	0.016	0.061	−0.019	0.011	0.057
1992	0.096	0.064	−0.003	−0.014	0.023	0.061	−0.017	0.017	0.056
1993	0.097	0.080	−0.002	−0.010	0.010	0.060	−0.014	0.004	0.055
1994	0.098	0.098	−0.001	−0.006	−0.005	0.060	−0.010	−0.009	0.055
1995	0.098	0.107	0.000	−0.003	−0.010	0.059	−0.007	−0.014	0.054
1996	0.099	0.106	0.001	0.000	−0.005	0.059	−0.005	−0.010	0.053
1997	0.101	0.103	0.001	0.002	0.002	0.058	−0.004	−0.004	0.053

inflationary expectation in determining the GDP deflater. If we check the growth rate of the GDP deflater (*DP*), we find larger values up to 1981 and smaller values from 1982 to 1983 compared with the base case. This is due to an interaction between the two relationships. One is that the larger coefficient of inflationary expectation (*PRESAC*($t-1$)) emphasizes the effect of *PRESAC*($t-1$), and another is that increased or decreased *DP* (compared with the base case) affects inflationary expectation (*PRESAC*(t)) conversely through unrealized inflationary pressure (*IDPS*=*GDPV*75−*POTGDP*−*DP*). *DP* has larger values in some periods and smaller values in others. At the same time, *DP* shows larger fluctuation in this case than in the base case. This movement of *DP* is reflected in movements of GDP and potential GDP. *DGAP* (growth rate of *GDP*/*POTGDP*) shows larger fluctuation during the whole period compared with the base case. It is assumed that the *DGAP* indicates the business cycle, thereby indicating that the cycle becomes shorter in this case.

Case 2

The coefficient of inflationary expectation (*PRESAC*($t-1$)) was changed from 0.1491 to zero, indicating that the model no longer depended on inflationary expectation.

At first, when looking at the growth rate of the GDP deflater (*DP*), we see that it simply continues to decrease. This indicates that the GDP deflater (*PGDP*) is remaining stable. This movement of *DP* is reflected in movements of GDP and potential GDP. The *DGAP* (growth rate of *GDP/POTGDP*) shows smaller fluctuation, especially after 1983, compared with the base case. Assuming that the *DGAP* indicates the business cycle, it can be seen that the cycle becomes longer in this case.

Summary and Conclusion

One objective of this study has been to examine the consistency between the business cycle formed by the monetarist model, which contains inflationary expectation, and the cycle measured by the DI.

In order to do this, in the second section the applicability of a monetarist model to the Korean economy was examined. It was noted that an "inflation mentality" developed in the Korean economy, especially during the 1970s. In such a situation it becomes appropriate to introduce a price adjustment mechanism through inflationary expectation. The monetarist model was therefore introduced.

In the fourth section, the consistency between the business cycle generated by the monetarist model and the one measured by the DI was checked. We were able to obtain a quite close relationship between the two, thereby confirming the usefulness of the price adjustment mechanism in forecasting the business cycles in the future.

Another objective of this paper was to investigate the mechanism of how inflationary expectation affects business cycles. Because inflationary expectation affects the business cycles, depending on the magnitude of adjustment speed which is the coefficient of inflationary expectation, this magnitude of speed seems to play an important role in generating business cycles. This adjustment speed is thought to increase as industrialization progresses.

To clarify this point, two simulation cases were conducted in which the magnitude of the speed with which prices adjust to inflationary expectation was changed. When the growth rate of *GAP*(*GDP/POTGDP*) was assumed to indicate the business cycle, it was concluded that a larger coefficient of inflationary expectation brings about a larger fluctuation and shorter cycle. Therefore it is possible to conclude that the magnitude of the speed with which prices adjust to inflationary expectation controls the amplitude and cycle of business cycles.

Notes

1 This came down during the 1980s, especially after 1983, slowing to 8.7 per cent. During the same two decades, import prices increased by 16.5 per cent and 4.5 per cent, and the money supply (M2) by 30.7 per cent and 19.7 per cent. The large figures for the GDP deflater and the growth in money supply reflected the persistent inflation, especially in the 1970s.

2 Cited from the introduction (p. xiv) of *Econometric Link System for ASEAN, ELSA Final Report*, vol. I (Tokyo: Institute of Developing Economies, 1985), p. 271.

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Appendix 14–1
List of Variables and the Estimated Model

A. List of Variables

Code	Variable Names
DP	Growth rate of *GDP* deflater
PRESAC	Accumulated unrealized inflationary pressure
DPS	Inflationary pressure
*DPM*1	Growth rate of import price
DGDPV	Increase of nominal *GDP*
DDEV	Increase of nominal exports
*DGEV*75	Increase of government expenditure
DM 22	Increase of money supply
I	Investment (real)
GDP	*GDP* (real)
*K*75	Capital stock (real)
*DMF*1	Import price
PGDP	*GDP* deflater
POTGDP	Potential *GDP* (real)
*L*75	Number of employees
POIL	Oil price
EXR	Exchange rate
T	Time
*GDPV*75	Nominal *GDP*
IDPS	Unrealized inflationary pressure
GAP	*GDP*/*POTGDP*
DGAP	Growth rate of *GAP*
M 22	Money supply (*M*2)
*GEV*75	Nominal government expenditure
*EV*75	Nominal exports

B. Estimated Model

$DP=$	-0.032	$+0.6043$ (1 lag DP)	$+0.1491$ (1 lag $PRESAC$)		
t-val.:	-1.962	3.103	2.287		
Elast.:		0.6327	0.0394		
	$+0.305$ (DPS)	$+0.3629$ ($DPM1$)	-0.096 (1 lag $DPM1$)		
	2.588	3.824	-1.034		
	0.3672	0.2873	-0.0802		
	-0.072 ($D81$)	-0.0647 ($D79$)	$+0.0437$ ($D80$)	$+0.045$ ($D72$).	
	-1.916	-1.858	1.410	1.889	
	-0.029	-0.0262	0.0177	0.0182	

$SE=0.0195.$ $DW=2.6607.$ R^2 (adj) $=0.9423.$
F stat. $=31.87.$

$$DGDPV=678.0487+0.4746\,(DDEV)+1.0234\,(DGEV\,75)+1.2329\,(DM22)$$

t-val.:	1.815	3.094	1.32	3.585
Elast.:		0.2123	0.1506	0.458

$$+1854.3481\,(D79)+2961.8868\,(D84)+1376.0781\,(D78)$$

2.17	2.819	1.637
0.0164	0.0261	0.0121

$$+1909.4479\,(D88).$$

1.676
0.0168

$SE=797.8442.$ $DW=2.2877.$ R^2 (adj) $=0.9669.$
F stat. $=71.84.$

$$I=1520.12+0.4612\,(GDP)-0.0440\,(1\text{ lag }K75)$$

t-val.:	1.785	6.935	−1.73
Elast.:		1.4345	−0.3929

$$-2452.1607\,(DFM1/PGDP)+385.6851\,(D69)+645.3208\,(D79).$$

−3.112	1.423	2.293
−0.3836	0.0042	0.007

$SE=243.8991.$ $DW=2.2657.$ R^2 (adj) $=0.9907.$
F stat. $=407.02$

$$(POTGDP/L75)=-1.2218+0.1644\,((1\text{ lag }K\,75)/L75)$$

t-val.:	−4.131	4.8
Elast.:		0.4145

$$-4.934\cdot 10^{-6}\,(POIL\cdot EXR/PGDP)+0.0248\,(T)$$

−1.061	4.755
−0.0181	1.6187

$$+0.0306\,(D74)+0.0592\,(D84)+0.0528\,(D85)$$

1.085	1.997	1.831
0.0013	0.0025	0.0023

$$-0.0552\,(D79)-0.0610\,(D80).$$

−1.923	−2.135
−0.0023	−0.0025

$SE=0.0258.$ $DW=1.4898.$ R^2 (adj) $=0.9917.$
F stat. $=285.09.$

$DPS=[(PCG\ GDPV75)-(PCG\ POTGDP)]/100.$
$IDPS=DPS-DP$
$PRESAC=(1\text{ lag }PRESAC)+IDPS.$
$GDPV75=(1\text{ lag }GDPV75)+DGDPV.$
$GDP=GDPV75/PGDP.$
$PGDP=(1+DP)\cdot(1\text{ lag }PGDP)$

$GAP = GDP/POTGDP.$
$DGAP = (PCG\ GAP)/100.$
$K75 = [(1\ \text{lag}\ K\ 75) + (0.7 \cdot I)].$
$DPM1 = (PCG\ DMF1)/100.$
$DM22 = M\ 22 - (1\ \text{lag}\ M22).$
$DGEV75 = (GEV75) - (1\ \text{lag}\ GEV75).$
$DDEV = EV\ 75 - (1\ \text{lag}\ EV75).$

Note: PCG shows percentage growth.