ANEMONE, A MONETARY MODEL FOR BELGIUM

by

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Introduction

Monetary research has long remained an uncultivated field in Belgium. Recently however growing interest and contact with foreign research have led to the publication of a number of studies, bearing on some or all of the money flows in the economy[1].

These recent papers show an encouraging degree of convergence, both in their behavioural assumptions and in their interpretation of the institutional framework. They all in fact derive from the basic approach of Brunner-Metzler, where the money supply is determined by a basis-multiplier relation, as applied to an open economy where the basis partly depends on an exogenous balance of payments.

The present study , which is but an extension of F. Clavijo MIMI Model, belongs to that family ; many of its relation thus bear a marked degree of resemblance to some of its predecessors. We believe

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[1]- J. Vuchelen (1971), "Een ekonometrisch monetair model voor Belgie", Ph. D. Dissertation, Vrije Universiteit Brussel.

- P. Reding (1972-1973), "L'offre de monnaie en Belgique en 1960-1971 : une approche par l'analyse base multiplicateur", Recherches Economique de Louvain. Janvier 1975.

- D. Heremans, A. Sommariva, A. Verheirstraeten (1974), "A Money and Bank Credit Model for Belgium", Paper prepared for the Conference on Money, Bank Credit and Inflation in Open Economies, Leuven.

- F. Clavijo (1974), "Un modèle monétaire pour la Belgique, MIMI", Masters Dissertation, Université Catholique de Louvain.

however the differences to be significant enough to warrant publication, in the hope that debate will lead to further improvement in what is essentially work in progress.

The paper is divided in three parts. The first lays down the basic assumptions, and defines the scope and limitations of the model. The second describes in more detail the equations and their interplay. The third gives results on simulation.

I. Assumptions and Structure of the Model

The actors on the stage are the Central Bank, the deposit banks, other financial intermediaries, the Treasury, business and households. The rest of the world, off-stage, controls part of the play. The behaviour of each of these agents influences the total, through various links and feed-backs. As with all similar models, we may break into the circle at any one point. Let us start with the private credit market.

The model considers only credit demand by business (the mortgage and household construction are outside, while consumer credit is relatively unimportant in Belgium). The demand equation depends largely on real (as opposed to monetary) variables which are not explained by the model, since a link has not yet been archieved with a system accounting for the flows of goods and services. The supply depends on the basis and multiplier. The basis is however partly endogenous, as will be explained later, and adjusts to meet the demand.

Credit supply is not however completely flexible. The model assumes partly a quantitative adjustment to demand, and partly an adjustment through changes in interest rates, with a feed-back effect on demand. The mechanism is assumed flexible enough for credit data to be interpreted in terms of demand relations. This would in any case be inevitable in Belgium, because of the prevalence of open lines of credit, usually utilised at no more than 50 %. This deprives the banks

of the power of determining in the short run the amount of credit actually taken up (and incidentally has created difficulties for them when the Central Bank has imposed quantitative limits on credit expansion). Thus private credit depends on business behaviour.

Treasury borrowing is subject to rigid constraints : the budget deficit must be met. The purchase of bonds by households and non-bank intermediaries is not explained in the model, and thus total Treasury requirements for monetary financing appear as an exogenous variable. Households and business will meet part of this need through deposits with the Postal Checking system, deposits banks will decide their purchases of Treasury bills and bonds in the light of their liquidity position (as discussed below), and the burden of financing the remainder then falls on the Central Bank. Since direct borrowing has been limited under various agreements, the Treasury has usually met its requirements on the Euro-dollar market and sold the proceeds to the Central Bank against belgian francs. As these operations are equivalent in their monetary consequences to direct borrowing, the data have been adjusted to include them with the Central Bank advances to the Treasury. It will be noted that they also serve to adjust the basis to demand.

The exogenous balance of payments and credit demand from business and the Treasury thus determine the assets side of the balance sheet of the banking system, and therefore also its liabilities : money and quasi-money figures are interpreted from the supply side.

We have not included a money demand equation in the model. With interest rate governed by external constraints and the credit market, money demand and supply relations

could have been used to explain price changes. It is hoped however that further work on the lines of the "Scandinavian model" will help develop a system of price equations where changes in velocity form only one of the arguments. Meanwhile, price changes (we have used the consumption price index) remain exogenous.

Total money supply being fixed by credit demand, (and by the balance of payments), the behaviour of households and business will allocate it between various assets : currency, postal deposits, sight and term deposits in the banks. This allocation determines the value of the multiplier.

It has already been pointed out that in the short run, the banks have little control over the volume of their credits. It is assumed as well that for commercial reasons, they will, even in the longer run, attempt to satisfy by priority private credit demands. Thus, except where constrained by monetary policy, their holdings of Governement paper will vary, at a first approximation, with the relation between their deposits and private credit demand. This leaves however some degree of freedom for maximising behaviour : they can discount commercial bills or acceptances with the Central Bank, or borrow abroad, either to meet pressing business demands, or to buy Treasury bills, if they find the latter operation profitable. Their crucial behavioural variable is their liquidity : their reluctance to go to the Central Bank will increase as their holdings of discountable bills decline. Within the limits assigned by monetary policy, their short-run profit maximisation will thus be constrained by the need to satisfy their customers, and by a policy of retaining adequate liquidity in the form of a portfolio of readily discountable bills.

The behaviour of the Treasury and the banks accounts for the flexibility in the monetary basis, through the three mechanisms which have been alluded to :

- In the face of increasing credit demand, the banks will sell bills to the Central Bank, on their own initiative. They can also borrow abroad, and finance domestic credit either by using at home foreign deposits in belgian francs (rather than relending them on the Euro-franc market), or by taking up net liabilities in foreign currencies. In these two ways, they have at least partial means of accomodating changes in customer demand, or of offsetting exogenous changes in their liquidity.

- The system as described implies that any decrease in the basis, due for instance to a balance of payments deficit, will immediately be reflected in a decline of Treasury financing by the banks : the Treasury will then be compelled to borrow from the Central Bank (or on the Euro-dollar market), thus partly restoring the liquidity of the system. Conversely, if an external surplus increases the liquidity of banks and financial intermediaries, they will supply the Treasury with financing in excess of its requirements, and it will repay its foreign borrowings : this narrowing of the basis will tend to wipe out excess liquidity.

Thus, while the basic balance of payments (current account and long-term private capital) remains an essential, and highly variable, component of the basis, offsetting mechanisms exist within the system to ensure a considerable measure of flexibility in credit supply.[1]

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[1]Willms (1971) has analyzed a similar system for Germany. A previous research has applied his equations to belgian data, with comparable conclusions.

Turning now to the Central Bank, the discount rate has long remained almost the only instrument of its policy. Until 1962 however, the banks were compelled to hold up to 65 % of their assets in Trasury paper, while money market rates were rigidly linked to the official discount rate. From 1962 on, greater freedom was granted to the banks, and was reflected in a more rapid credit expansion. However, owing to the high rate of leakage into currency (or low value of the multiplier), the banks' autonomy in credit creation remained severely limited by the need to rediscount, and the Central Bank still felt it retained adequate control through the influence of its discount rate on credit demand. (There were also some occasional and rather minor changes in the definition of a discountable bill or acceptance ; as well as a short period where a monetary reserve was imposed, but at too low rate to be significant ; and periods of quantitative restrictions on credit growth, but again, not very effective).

There is of course a close relation between the official discount rate of the Central Bank and the short-term market rates. We present alternative interpretations of this relationship. On the first, the Bank pursues a completely autonomous policy, geared to economic objectives of external and internal balance (we take the latter to involve smoothing out the trade cycle and fighting inflation). The market rates then follow the lead of the discount rate, taking into account the liquidity of the financial intermediaries.

On the second interpretation, the short-term market rates play the leading role and the Bank rate must follow their lead. The Central Bank still pursues the same objectives, but with an additional constraint that limits its freedom of action. Under both interpretations, the short-term rate is an important determinant of the long-term rate.

Freedom of capital movements, and the growing importance of the Euro-dollar market imposed however increasingly narrow external constraints on the freedom of discount rate policy. At the same time, the rising value of the multiplier was allowing the banks more elbow room for credit expansion. Currency instability soon aggravated the problem of control. A first period of speculation against the belgian franc (mid 68 to october 69) showed the weakness of discount rate policy against a background of high Euro-dollar rates.

Speculation soon reversed itself however and the belgian market became increasingly liquid in 1970 and 71 with large-scale capital inflows, at a time of high and rising demand, when the Central Bank felt it had to "lean against the wind". It then introduced a whole spate of new instruments of credit control between 1971 and 73 :

- quantitative limits on credit expansion ;
- compulsory monetary reserves on domestic deposits, and, at penalty rates, on new credits exceeding the ceiling and on new foreign deposits ;
- a progressive lowering of discount facilities it was offering to the banks ;
- a proportion of assets to be maintained in the form of Treasury paper (though in a form less stringent than was the case before 1962) ;

- prohibitions on bank net borrowing in foreign exchange on the official market, and on paying interest on new foreign deposits in belgian francs[1].

Thus the whole philosophy has shifted, from a policy of controlling credit demand through its price, to a policy of controlling credit supply by regulating the liquidity of the banks and non-bank intermediaries (who were also imposed a monetary reserve).

This radical change in the instruments of monetary policy creates severe problems for a model that is built on the period 1960 to 73. Indeed, a first run covering the period 1960-71[2] often gave better fits than proved possible when the last years were included. In the earlier period, the only significant disturbances related to the sharp currency speculation of 1969, while the prevailing instability in exchange rates since 1971 has been reflected in unprecedented situations on the domestic market.

The new instruments came into force towards the end of the period of observation. They were not created simultaneously, and most of them were progressively tightened, so that they became really effective some time after their establishment. To account for them, we have included a number of dummy variables in the model, but only from the dates when they became quantitatively significant.

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[1] Belgium has long had a two-tier exchange market. Central Bank reserves can be affected (in principle) only by operations on the commercial or official market. Thus while banks have always been forbidden from taking systematically net (uncovered) positions in foreign currencies, the more recent prohibition against covered borrowing relates to the official market only.

[2] See Clavijo (1974).

Finally, the non-bank financial intermediaries (which should include a number of para-statal credit institutions, private savings banks and insurance companies) present also an unsatisfactory compromise. A major difficulty arises because the model is a quarterly one (using end-of quarter figures), whereas quarterly data are scarce for that group of institutions. Total credits to business and households, as well as deposits with the Caisse Générale d'Epargne et de Retraite (the state savings bank), are however available on a quarterly basis. Since some of these institutions grant credits on terms competitive with the banks, we have included these data to estimate a total credit demand, and to build up a supply function from the deposit figures of the CGER and the intrapolated liabilities of the Société Nationale de Crédit à l'Industrie, the other important supplier of business credit. Other intermediaries have been left out (except insofar as they are included in the credit data). Thus no attempt is made to estimate the mortgage market. More regrettably for the functioning of the model, there can be no equation for the purchase of Treasury bills and bonds by these intermediaries (as mentioned earlier, a consequence is that only that part of the Treasury deficit requiring monetary financing appears in the model).

Also a substantial part of savings deposits cannot be included : the allocation equations for liquid assets do not include them, and the credit multiplier is defined in relation to bank deposits only (including time and savings deposits), but excluding similar deposits with other institutions. Because of their partial and composite character, liabilities of the CGER and the SNCI have been left exogenous.

Lacking an overall view of the liquidity of these intermediaries, we have also left exogenous their purchases of commercial bills and acceptances from the banks, on the assumption that this market also is essentially demand-determined.

An improvement in the data (or more courageous intrapolations than we have dared) will be needed before a quarterly model can be completed in these respects.

One final limitation should be noted. The model is simplified in not taking explicit account of two institutions : the Fonds des Rentes, which buys and sells Government bonds so as to regulate the market, and finances itself through the sale of short-term bills to the banks, and borrowing on the call-money market ; and the Institut de Réescompte et de Garantie, which acts as a broker on the bill market and finances some of them itself by borrowing call-money.

In the model, bills issued by the Fonds des Rentes are included with the residual term in the balance sheet of the banks. The rate on these bills has however been chosen to represent the short-term money rate, as reflecting best the liquidity of the banks (as the IRG commercial bill rate would best reflect the liquidity of the non-bank intermediaries).

Commercial paper discounted with the IRG is treated as sold outright to non-bank intermediaries, or discounted directly with the Central Bank. Apart from a minor inaccuracy, the main loss from this procedure is that the call-money

market is not explained. It is however subject to such wide day-to-day fluctuations that it appeared doubtful that end of quarter figures would prove of any significance.

The same reservation applies, to a much lesser degree however, to some of the other data. Because of the date of observation, they contain important systematic as well as random components, as they usually coincide with dates when a large volume of payments must be made. For the sake of consistency, we have however retained end of quarter figures even for those series where more frequent observations were available.

As it is, the model contains an account of the more important money flows and variables, sticking as closely as possible to the behaviour of the various agents, and a sadly incomplete version of some of the financial flows. Its predictive value is weak : it contains too many exogenous variables both from the rest of the world and from the goods and services markets, to operate on its own. Further links will have to be established before it becomes really useful in that respect.

At present, its main interest is explanatory. One might say that it explains how Belgium has managed to live under a fixed exchange rate system. In a small open economy, where the Central Bank cannot carry out open market operations because of market limitations, the monetary basis becomes essentially dependent on the external balance. And with fixed exchange rates, the monetary system would be subject to the automatic adjustments of the gold standard type. Since the last few years have produced wide swings, both in the basic

balance and in capital movements, their effects could produce great instability in credit availability and money supply. The model explains why this has not happened, and shows the built-in defense mechanisms against external shocks. They appear to have proved fairly adequate until 1972 when the pressure became too great and the dams finally broke. It remains to be seen how far the experience from the past can serve as a guide to the future.

We now turn to the presentation and discussion of the equations. The T-statistic has been written in brackets below the coefficients of the variables. Because of simultaneity, two-stages-least-squares have been used where necessary, that is where endogenous variables appear among the explanatory variables. The use of the Corchrane-Orcutt procedure has been noted whenever it was applied, and the value of RHO is given in the equations.

As a matter of notation, variables relating to the Central Bank carry the figure 1, deposit banks have the figure 2, other financial intermediaries, the figure 3. The letters L, D and PC preceding a variable denote a lagged value, a first difference and a percentage change respectively. (Also, LL denotes a 2-quarter lag, etc.).

II. Equations of the Model

1. Business behaviour : demand for credit

The credit data are interpreted in terms of a demand function, and we have used a set of figures which reflects business credit demand, excluding insofar as possible household demand to finance housing construction or purchases. The credit data do include short-term consumer credit granted by the banks, but the amounts are too small to affect the total (the construction of the series is explained in detail in the Appendix on sources and methods). The variable CRED denotes credits granted by both banks and other financial intermediairies, to the extent they are utilised : as explained above, the degree of utilisation of open lines of credit depends only on the borrower.

The variation in credits DCRED is chosen as the dependent variable : the main explanatory variables are investment, its rate of change and the rate of interest. Unfortunately, quarterly data on business investment alone were not available, so that our investment series relate to gross fixed capital formation, which gives it too high a level.

Investment shows a marked seasonal fluctuation (highest in the second and fourth quarters) as well as cyclical variations. It is likely that firms' own resources, or self financing, become available at a much steadier rate. Since it is the difference between investment and own resources that requires external financing, one would expect the ratio of credit creation to investment to be higher in periods of acceleration. Indeed, while a rise in fixed investment, other things being equal, causes a rise in credit of more than 60 %

of its value, an acceleration in investment calls for an additional amount of credit by approximately the same percentage.

No data are unfortunately available on seasonal stock movements : they probably account for the fact that the credit figures rise more than proportionately to fixed investment in the 4th quarter, and less than proportionately in the 2d. This systematic movement is taken care of by a seasonal dummy variable.

On the other side, the rate of interest exerts a powerful brake on credit demand. We have used the rate of discount, since banks' (and financial intermediaries') lending rates have traditionally been geared to the discount rate (usually by the addition of a fixed margin). The best fit was obtained with a one-quarter lag, to reflect reaction time : it must be stressed that in this equation, the influence of the rate of interest bears on the means of financing investment, and not on the decision to invest. The determinants of investment are outside this model.

We have also tried to include in the equation the rate of price increase, to test the sensitivity of credit demand to inflationary expectations. This variable however was never significant and, for most of the lags taken, showed the wrong sign. Leaving prices out, the equation for DCRED is as follows :

$$(1) \qquad \underset{}{DCRED} = \underset{(1.08)}{3.04} + \underset{(9.75)}{.647\ INV} + \underset{(5.8)}{.656\ DINV} - \underset{(4.27)}{2.637\ LTER} + \underset{(4.9)}{4.259\ DUMC}$$

$$R^2 = 0.841 \qquad DW = 2.20$$

Where LTER is the official discount rate, lagged once, expressed in % points (the mean of the variable is 4.95).

It could be expected that this demand equation would perform very poorly in 1972 and particularity is 1973, where measures to restrict supply were in force (in the form of a ceiling on credit expansion). In fact, we find that for the 4 quarters of 1973, the calculated values were on the average 2 billion francs above the actual value. Since however the mean value of the 1973 observations was 24 billion, a much higher figure than in any previous year, we did not feel justified in introducing a dummy variable to explain a restriction of credit supply which does not appear to have been really operative.

Having estimated credit changes, we also need the definitional equation :

(2) $\quad CRED = DCRED + LCRED.$

Part of this total credit demand is taken up by non-bank intermediaries : we estimate for them a credit supply function, leaving the balance of the demand to be satisfied by the banks, with their greater flexibility for foreign borrowing and discounting with the Central Bank.

This supply function depends on identified resources, a series which is unfortunately not homogenous with the credit data. It is based on the liabilities of the two main institutions, the CGER and the SNCI, but there are three others, who account between them for some 20 % of the credits of the group. We have implicitly assumed that their resources have the same trend as those of the two reporting institutions. In addition, the CGER has an important line in the financing of house building, and all institutions hold Government paper and meet their liquidity requirements by buying short-term commercial bills from the banks.

Identified resources (the variable MQ3C) account of course for the bulk of their credit operations. There is also a minor but significant cyclical swing in the use of their resources : like the banks, they attempt to satisfy by priority private credit demands (by reducing holdings of Treasury or commercial bills). We have expressed this demand pressure through the difference between the long and the short rates in interest (the variables CONJ), which is of course lowest (or even negative) in periods of high activity.

Finally, a system of monetary reserves was imposed on non-bank intermediaries as well as on the banks themselves at the end of 1972 : the resulting change in behaviour is represented by the variable DUMRES.

$$(3) \qquad EA3 = \underset{(-\ 9.44)}{-\ 32.748} + \underset{(69.03)}{.949\ MQ3} + \underset{(1.82)}{192.3\ LPCMQ3} - \underset{(7.02)}{7.256\ CONJ}$$

$$\underset{(-\ 3.70)}{-\ 14.778\ DUMRES} \quad ; \quad R^2 = .994 \qquad DW = 1.029$$

While the fit is excellent, there is a strong autocorrelation of the Residuals. The Corchrane-Orcutt procedure failed however, and the equation is presented in its original form.

The important negative constant in the equation suggests that a growing proportion of resources have been devoted to direct business credits. One should however bear in mind the reservations regarding the quality of the data.

From CRED and EA3, we define credits originally supplied by the banks :

$$(4) \qquad CRE2 = CRED - EA3.$$

Because of the importance of discounting with the Central Bank, we would like a separate estimate of credits which meet the official acceptability conditions, and are therefore liquid from the point of view of the banks. Unfortunately, such data are not published, and we had to fall back upon the much broader category of commercial bills and bankers acceptances : only part of these can be sold to the Central Bank (probably around a third of the amount outstanding, carrying three signatures and having less than four months to run) but others can also be sold to financial intermediaries on the bill market.

We assume that banks prefer to extend credit in that form wherever possible (because of its higher liquidity), but that they will make special efforts to persuade their customers when they themselves feel illiquid. Thus we have included in the equation the variable GAMA (to be formally defined later) as a measure of bank illiquidity. The same assumption suggests on the other hand that periods of rapid credit expansion would result in a decreasing proportion of bills and acceptances.

(5) $$\begin{array}{lllll} DER = & .452\ DCRE2 & -\ 28.10\ LPCCRE2 & +\ 8.827\ LGAMA \\ & (10.22) & (-\ 2.25) & (1.35) \end{array}$$

$R^2 = .731$ $\qquad$ $DW = 1.94$

The last assumption is well justified : the marginal coefficient DER/DCRE2 is negatively influenced by an acceleration in the growth of credits. On the other hand, the variable GAMA is barely significant, indicating that the possibility for banks to increase the share of bills and acceptances in total credits when they most need it, remains rather limited.

As with CRED, we need the definitional equation :

(6) $$ER = DER + LER.$$

2. Households and firms : allocation of monetary assets

Total money supply depends on the basis-multiplier relation. Within that total, decisions by households and business determine the form under which monetary assets will be held, or the leakage into currency from the credit operations of the banking system. Since compulsory reserves with the Central Bank became operative only from 1972, and cash in the banks is a small item, fairly stable around 4 % of deposits (except for seasonal variations) the multiplier is taken to depend only on household and firms behaviour.

Since our main interest lies in the credit mechanism, the best definition of money for our purpose would include money proper et quasi-money with the banking system and other financial intermediaries. However, as explained above, we lack essential quarterly data for the latter, and have had to fall back on a narrower definition : currency, deposits with the Post Office and the banks (both sight and term) held by the public. We have also excluded deposits held by local authorities and some Government agencies, mainly with the Credit Communal, but also with the postal checking system. This definition comes close to the standard concept of M2.

The four components of total money supply (MT) are :

$$MT = MC + MP + MD + MQ2$$

with :

MC : currency outside banks (including coins) ;

MP : postal deposits of households and firms ;

MD : sight deposits with the banks (in belgian francs) ;

MQ2 : term and savings deposits with the banks, in belgian francs and belonging to belgian firms and households.

Since MT is calculated elsewhere, we can estimate only 3 allocation coefficients. If they are taken in relation to MT (a coefficient being for instance MC/MT), the last of them, obtained by difference (they must add up to one), will cumulate all errors in the three estimates. For this reason, we have preferred to carry out the estimates in relation to one of the components of MT, and have chosen MD[1].

This makes the coefficients independent from one another (there is no additive constraint on them). They are defined as follows :

$$K1 = \frac{MC}{MD} \quad ; \quad K2 = \frac{MP}{MD} \quad ; \quad K3 = \frac{MQ2}{MD}$$

and the addition of the components to the total is written :

$$(7) \qquad MT = MD\ (K1 + K2 + 1 + K3)$$

With MT given by equation (21) below, equation (7) is an identity used to obtain the value of MD.

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[1]This procedure was suggested by Professor G. VILA.

K1, the relation of currency in circulation to sight deposits, is affected by a significant seasonal variation : it is higher in the summer months, usually reaching its annual peak in August ; our June and September observations are affected, though to a lesser degree. The explanation appears to lie with the holiday period, when deposits are turned into currency, more liquid when travelling. A dummy variable (DUMK1) is therefore included in the equation.

The main influence upon K1 however is a declining trend. The share of currency in money supply had in the post-war years been abnormally high in Belgium, following the pattern of a developing rather than of an industrialised country. The falling trend is thus largely a catching-up phenomenon : 50 years after everybody else, the Belgians are discovering the banking habit, helped no doubt by the rapid increase in bank offices.

This gradual change in the public's habits is expressed through the lag of the variable. The GNP is also introduced (with a negative coefficient) to explain part of the decline, as well as part of the seasonal movement. The dummy has been chosen to transform the seasonal variation of GNP into the different fluctuation of K1. Since the last has not been regular, there remains a negative auto-correlation of residuals.

(8) $$K1 = \underset{}{.33} - \underset{(1.50)}{.0005\ GNP} + \underset{(-1.63)}{.86\ LK1} + \underset{(10.24)}{.031\ DUMK1} \quad \underset{(3.38)}{}$$

$$R^2 = .983 \qquad DW = 2.49$$

The relation of postal deposits to bank deposits shows a much weaker trend, also negative. It also has some seasonal movement, being more sensitive than bank deposits to moments of strong activity (the second and fourth quarters), which we have picked up through the quarterly variations in GNP (the variable DGNP). The fit has been improved by inclusion of the lagged variable, yielding the equation :

(9) $$K2 = \underset{}{.167} + \underset{(3.2)}{.0006}\ DGNP - \underset{(3.74)}{.0015}\ TIME + \underset{(-3.65)}{.651}\ LK2 \quad \underset{(5.99)}{}$$

$$R^2 = .953 \qquad DW = 2.04$$

K3, the last of the allocation coefficients, is subject to much more complex influence. Since it is affected by cyclical variations in business activity, we start by defining the variable GAP (which will reappear later) : it expresses the percentage deviation of GNP from potential GNP. For the purpose, the quarterly data have been expressed at constant prices, and the seasonal variation eliminated. Potential GNP is then a peak to peak intrapolation.

$$GAP = \frac{GNPP - GNPCS}{GNPP}\ 100$$

K3 increases in periods of lower business activity, when the need for immediate means of payments declines and firms experience excess liquidity.

For the same reason, K3 increases seasonally with moments of lower activity (the winter months and the summer holidays) and DUMK3 is introduced to account for this variation.

Term and savings deposits also show a rising trend in relation to sight deposits (which themselves were rising faster than currency or postal deposits), which suggests that total money supply was rising faster than the demand for immediate means of payments (a similar trend is however observed in almost all european countries in the same period). This trend is accounted for by the variable GNP. Finally, K3 is of course influenced by the rate of interest, since the opportunity cost of holding money rather than quasi-money increases with the yield of the latter : for this purpose we have used the long-term rate of interest (TIL), less volatile than the short rate, giving :

$$(10) \qquad K3 = \underset{(2.24)}{0.091} + \underset{(10.66)}{0.097\ TIL} + \underset{(12.60)}{0.0012\ GNP} + \underset{(7.03)}{0.028\ LGAP} + \underset{(6.48)}{0.030\ DUMK3}$$

$$R^2 = .976 \qquad DW = 2.01$$

These coefficients allow us to define the money multiplier. It should be noticed that our variable MC is not the total issue of currency, but only that part held outside the banks. The same applies to postal deposits, MP. Thus the multiplier derived from the previous relations does not take into account a leakage of currency into bank reserves : this has remained through the period close to the legal minimum of 4 %, except on the dates when the main banks present their balance sheets, when window-dressing

operations cause it to rise sharply. Since this excess liquidity probably lasts only a couple of days, its inclusion in the equations is likely to distort the picture rather than improve it, and we have therefore decided to neglect it. It must simply be remembered that our multiplier is a little higher than would be shown by the conventional calculation.

Since the treasury has been in quasi-permanent deficit, we may consider that money lent to it, through postal deposits, is promptly spent again, and therefore constitutes no leakage out of the system. We therefore define the multiplier as MT/MC. Because of the way the allocation coefficients have been defined, however, the equation comes out as :

$$(11) \qquad K = \frac{K1 + K2 + K3 + 1}{K1} \quad \left(= \frac{MT}{MC}\right)$$

Considered together, the three allocation coefficients imply that the multiplier for bank credit has shown over the period a strongly rising value, while the Treasury has benefitted to a far lesser degree from the decreased share of currency in money demand.

As defined here, the multiplier has risen from an average value of 2 in 1960 to nearly 3.6 in 73. The rise in the bank credit multiplier would be somewhat less sharp : considering leakages both into currency and into postal deposits, its value rises from less than 1.7 in 1960 to more than 2.8 in 1973.

3. Deposit Bank's Behaviour

We may start with the balance sheet of the banks. It can be written :

(12) $$CRE2 + ET2 + EA23 - ER1 - ER3 = MD + MQ2 + MF2 + U2$$

with :

- CRE2 : total credit to business and households originating with the banks ;
- ET2 : Treasury bills and bonds held by the banks ;
- EA23 : bank credit to financial intermediaries ;
- ER1 : bills and acceptances discounted with the Central Bank ;
- ER3 : bills and acceptances discounted with (or sold to) financial intermediaries ;
- MD : sight deposits ;
- MQ2 : term and savings deposits with the banks ;
- MF2 : net liabilities in foreign currencies and belgian francs liabilities to foreigners ;
- U2 : balancing item in the balance sheet : real assets, capital accounts, currency held by the banks, and minor items.

In this list, three items are taken as exogenous : the balancing item, U2, and the two variables describing the relations with non-bank intermediaries : loans to them, EA23, because they depend on institutional arrangements, and bills sold to them, ER3, as they are taken to reflect demand on the part of the intermediaries, which cannot be adequately explain within the model for reasons already given. U2 includes in the last few quarters monetary reserves with the Central Bank.

Since we have assumed that banks attempt by priority to satisfy customer demands, the variable CRE2 was defined in equation (4) as outside the control of the banks. Similarly, deposits, both sight and term, depend on total money supply and the allocation behaviour of business and households (equations (8), (10) and (21)).

Three variables in the equation thus remain under the control of the banks : their sales of bills to the Central Bank (ER1), their borrowing abroad (MF2), and their holdings of Treasury paper (ET2) (in certain periods, their holdings beyond the minimum imposed by the Central Bank). Together with the "budget constraint" of equation (12) we need two behavioural equations, the third policy variable of the banks being then derived from equation (12).

We have elected to treat holdings of Government paper as the residual, and to estimate discounts with the Central Bank and foreign borrowing. The choice is partly arbitrary, but it appears to correspond most closely to actual practice.

Maximising behaviour may be expected from the banks, subject to a liquidity constraint. Since banks are assumed to satisfy the demand of financial intermediaries for bills, their main liquidity reserve is made up of bills still in their portfolio, but discountable with the Central Bank. These can be turned into currency promptly to meet any unforseen contingency. Treasury bills, on the other hand, for which there exists no market, can be chosen so that their maturity date coincide with foreseen liquidity needs, arising for instance from seasonal switches into currency or large-scale tax payments. Discountable bills therefore constitute the main hedge against uncertainty and a desirable liquidity reserve. Being too liquid on the other hand, usually involves a sacrifice of earning opportunities. Theory thus suggests an optimum level of liquidity or discounting.

It is however difficult to define with any degree of precision : first, banks have usually been more liquid than appears necessary, and when conditions tightened, they have on occasion sacrificed their liquidity to the overriding objective of satisfying their customers.

In the second place, there are no direct data on discountable bills in their portfolio. We shall attempt to measure liquidity indirectly, through a variable GAMA, defined as the proportion of total bills and acceptances discounted with the Central Bank :

(13) GAMA = ER1 / ER

The higher GAMA, the less liquid are the banks. Since some discountable bills are sold to financial intermediaries, and a fairly high proportion of the remainder are not acceptable at the Central Bank, a maximum value for GAMA would appear to lie between 20 and 25 %. It was even less at the end of our period, when the Central Bank lowered gradually its rediscount facilities, from a ceiling of 12 % of liabilities in 69 to 5.5 % at the end of 73.

When banks are liquid, they have the option of discounting more with the Central Bank in order to buy Treasury bills with the proceeds. Maximising behaviour implies that they will exercise this option when the earning relations are right. The option closes when the banks get less liquid. Thus, as will be seen later, GAMA is a main explanatory variable for the difference between the Treasury bill rate and the official discount rate.

Now discounting with the Central Bank is the first means available to the banks to adjust their liquidity position : one would therefore expect the level of these discounts to reflect exogenous (from the banks' point of view) changes in liquidity : these would

result from the basic foreign balance (current account and long term capital) and from Treasury financing by the Central Bank. The other two elements entering the money basis are the banks' sales to the Central Bank and their own capital movements, the main factors in their liquidity adjustment.

To express this exogenous impact on liquidity, we have taken the sum over the three previous quarters of changes in the basic balance and in Treasury financing by the Central Bank : this is the variable COLMO :

$$(14) \qquad COLMO_t = FORI_t - FORI_{t-3} + ETI_t - ETI_{t-3}$$

with : FOR : Foreign reserves of the Central Bank, excluding the effects of the net foreign position of the banks and of the Treasury.

ETI : Central Bank lending to the Treasury, including Treasury borrowing abroad.

The main alternative source of liquidity, outside the discount window, is foreign borrowing : the volume of discounts is sensitive to the covered difference between the costs of domestic and foreign borrowing.

On the other hand, we found that the difference between the discount and the short-term rates was not significant : as indicated above, the causality appears to run the other way.

If maximising behaviour accounts for part of the discount policy of the banks, straightforward quantitative adjustments to liquidity needs explain the rest : discounts are sensitive both to changes in the amount of credit taken up, and, negatively, to the amount of bills purchased by non-financial intermediaries. This is as expected.

In the last two years, the new measures of monetary control have forced on the banks a new pattern of behaviour : they have reacted to the instauration of a monetary reserve by increasing their discount with the Central Bank. This result is all the more interesting because of the limits on discount facilities offered to the banks : it would appear that the latter measure was ineffective (up to the end of 1973), and that the banks were partly able to circumvent the first through increased recourse to the discount window.

In addition, in the last quarter on 73, there occured a sudden shift in the foreign currency position of the banks either because of official restrictions on their borrowing operations, or because of a change in expectations with respect to dollar futures : the resulting change in discounting with the Central Bank has also been caught by a dummy expressing the lack of response to a sharp rise in the discount rate while the Euro-dollar rate was weakening.

Discounts with the Central Bank ER1 are then estimated as follows :

(15) $$ER1 = \underset{(4.13)}{9.439} - \underset{(-3.95)}{.399}\ COLMO + \underset{(11.99)}{3.059}\ TENSIOC + \underset{(1.53)}{.197}\ DCRE2 - \underset{(-1.99)}{.230}\ ER3 + \underset{(7.91)}{16.203}\ DUMRES + \underset{(3.26)}{12.227}\ DUMFOR$$

$$R^2 = .874 \qquad DW = 2.001$$

with : TENSIOC : covered differential between the 3-month eurodollar rate and the official discount rate ;

ER3 : sales of commercial paper to financial intermediaries ;

DUMRES : dummy corresponding to the imposition of monetary reserves (from July 1972 on) ;

DUMFOR : dummy corresponding to the change in foreign currency position (Dec. 73).

Two points in this equation warrant some further comment. First, the remarkably high value of DUMRES, which is in fact greater than the average value of compulsory reserves for the 6 relevant observations. The same had been true in equation (3) above where the variable DUMRES had shifted downward the credit supplied by non-bank intermediaries by more than the amount of their compulsory reserves. Thus, credit demand seems in that period to have shifted towards the banks : the increase in their discounts would then reflect not only their imposed reserves, but also those of non-bank intermediaries.

The second observation relates to the variable TENSIOC. Where capital movements are free and motivated only by interest rate differentials, TENSIOC should be zero (or a small constant) ; in other words, the Interest Parity Theorem suggests that the difference in interest rates (if appropriately chosen) should match the difference between the spot and the forward rate on the exchange market. Thus, from one point of view, TENSIOC is a measure of the existence of so-called speculative movements, or of the expectation of relative parity changes. From another point of view, which is that of equation (15), TENSIOC measures the opportunity cost of foreign versus domestic financing.

The other policy variable of the banks, MF2, is made up of three separate items : net foreign currency liabilities to foreigners, belgian deposits in foreign currencies, and net foreign deposits in belgian francs (net deposits meaning deposits less credits). The sum of the first two items define the net foreign currency position of the banks on their own account. MF2 would be zero if the banks re-lent on the Euro-dollar market all their dollar deposits (or borrowing), and if they re-lent on the Euro-franc market all their foreign deposits in belgian francs. MF2 thus corresponds to a net conversion of "foreign" resources into domestic lending. It is in that sense that we may interpret it as a policy

variable for the banks. Some reservations however will be noted below, concerning foreign deposits in belgian francs which are not decided by the banks.

The other component of MF2, the banks net foreign currency position, is however of their own choosing, subject to the regulations of the exchange office, which as indicated above have not proved constrictive, except at the end of 1973.

We have estimated MF2 globally, and also separately its two main components, which we label FDBF (foreign deposits in belgian francs) and DOL2 (net foreign currency liabilities).

Foreign deposits in belgian francs have shown a rapidly rising trend, which has accelerated since the end of 1969. While the rise from 7 milliards fr. in 1960 to 20 in 1968 could be accounted for by the increase in belgian foreign trade, the new trend, from 15 milliards at the end of 69 to more than 80 at the end of 73 cannot be explained within the model : it is clearly dependent on excess liquidity abroad and currency speculation. There is also some ambiguity about the interpretation of the figures. Our banking statistics relate to Belgium, while our balance of payments data cover the Belgo-Luxembourg Union. Thus when Belgians, for fiscal reasons, deposit money in Luxembourg, and the Luxembourg banks, with limited credit demands, relend the money to belgian banks ,, this will appear in the statistics as foreign deposits in belgian francs, or a net borrowing abroad by the banking system. In fact, it is neither, and has no influence on the foreign reserves of the Central Bank. (Its statistics duly note a discrepancy between the balance of payments data and the net changes in foreign assets of the belgian banks ; there are however other reasons as well for this).[1]

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[1]For the 4 years 1970-73, the cumulative value of the discrepancy is 33 billions BFr, as against a net increase in FDBF of 68 billions in the same period.

Correction for this factor is not possible on the basis of the published data, and we have no choice but to estimate FDBF globally (and to substract it globally from Central Bank reserves). It will not be surprising that the "explanation" of FDBF is largely a statistical rather than an economic one. The lag of the variable is the main argument in the equation, to be modified only by REPORT, which measures the forward discount of the belgian france against the dollar. As expected, the increase in REPORT in 1969, the period of speculation against the belgian franc, accounts for the temporary drop in FDBF.

(16) $$FDBF = \underset{(.52)}{.33} + \underset{(39.58)}{1.02}\ LFDBF - \underset{(-5.03)}{1.22}\ REPORT$$

$$R^2 = .984 \qquad DW = 2.178$$

It will be noted that the coefficient of the lagged variable is greater than one, indicating, other things being equal, an exponential trend of 2 % per quarter.

DOL2, the other component of net foreign liabilities, the banks' own position, is more interesting. It is also subject to a margin of error, as the original data have had to be corrected for Treasury borrowings on the Euro-dollar market through the banks. Since these operations are not reported directly, they had to be calculated by difference and an error term may have been introduced that way (see Appendix on sources and methods).

At the beginning of the period, the banks had net foreign assets (impying that they used domestic resources for foreign lending). As domestic credit demand became more pressing, they gradually shifted to a net liability position, which then rose progressively, until the middle of 1973, when official instructions (and/or changes in expectations) practically wiped out their net position.

In our equation, these trend factors are accounted for by the volume of domestic credit and an important negative constant. A dummy is introduced for the last two quarters of 1973.

Since the volume of credit (or its change) appears in both the Central Bank discount equation and in DOL2, the implication is that banks had recourse simultaneously to both means of financing : to that extent they were complementary.

In the short run, they however appear rather as substitutes : the variable TENSIOC would appear in the equation for DOL2 with the reverse sign it had in explaining ER1. We have however chosen to break it down in its component parts TENSIO and REPORT, in the (perhaps futile) attempt to discriminate between opportunity costs and speculative elements. For the distinction to be valid, one has to assume that in quiet periods on the exchange markets, there is no need for forward cover. Then the uncovered difference in interest rates (TENSIO) is relevant, while REPORT comes into its own in periods of greater uncertainty : until the end of 1967, there occurs only one observation where REPORT is greater, in absolute value, than 1 %. From then one, such values become the rule rather than the exception, with peaks of + 7.2 % in the 3d quarter of 69, and of - 6.6 % in the first quarter of 73.

Both variables are significant in the equation :

(17) $$\begin{aligned} DOL2 = &- 10.09 - 1.028\ TENSIO - 8.13\ REPORT \\ &(-8.76)\quad (-2.52)\qquad\quad (-12.40) \\ &+ .075\ CRE2 - 12.56\ DUMF2 \\ &(2.95)\qquad (4.97) \end{aligned}$$

$R^2 = .85$ DW = 1.85

The fit is no better than adequate. The most important errors occur in the last quarter of 68 and in 69. They lend themselves to a rather significant economic interpretation. When at the end of 68, the belgian franc came under attack, the banks moved faster than their normal behaviour pattern (as reflected in the equation) : they shifted from net liabilities of 4.1 billion francs in the 3d quarter of 68 to net assets of 1.2 in the 1st quarter of 69 : their shift to domestic financing raised their GAMA to the then unprecedented value of 17.6 %. With continuing pressing credit demands (partly, one suspects, for capital exports), they found their GAMA rising to what they must have considered the danger level of over 20 % in the 2d quarter. Rather than disappoint their customers, they went back to borrowing abroad, so that at the height of the speculation against the belgian franc, in the 3d quarter, their net foreign liabilities had risen back to 4.4 billions. This behaviour pattern is too complex to be caught by our simple equation, and of course worsens its fit.

The aggregation of FDBF and DOL2 into the single variable MF2 was carried out essentially because FDBF with its exponential trend appeared dangerous to use for simulation purposes.

(18) $$MF2 = \underset{}{-8.59} \underset{(-8.76)}{-1.78\ TENSIO} \underset{(-1.87)}{-2.24\ REPORT} \underset{(4.36)}{+.165\ CRE2} \underset{(2.95)}{+25.68\ DUMRES} \underset{(4.97)}{+.494\ RHO} \underset{(3.89)}{}$$

$$R^2 = .964 \qquad DW = 1.58$$

The fit is surprisingly good for a composite variable : that the errors of the component parts tend to cancel out reflects of course the fact that one form of foreign borrowing is a substitute for the other. The Durbin-Watson however remains poor, even after the Corchrane-Orcutt procedure has been applied.

The trend in FDBF is mostly caught by the CRE2 variable, while the other arguments come more from DOL2. DUMRES which is used here, and applies to the last 6 observations when monetary reserves were in force, may offer what is essentially a spurious correlation : it was essentially FDBF which rose spectacularly (from 43 to 83 billion francs in this period) and this may have been no more than a windfall, not reusable abroad. One may argue on the other side that, failing this, the banks would have increased their net liabilities in foreign currencies.

Be that as it may, the dummies in equations (15) for ER1 and (18) for MF2 explain why we were able to interpret the credit data for the last couple of years in terms of demand functions.

4. Treasury behaviour

Financial requirements of the Treasury are exogenous in the model. They are covered in four different ways, which can be illustrated from the 1972 figures, which correspond both to the last figures available and to the maximum Treasury deficit :

Increase in liabilities to :	(Billion frs)
- Households and firms	14.0
- Non-bank intermediaries	31.7
- Banking sector	34.2
- Rest of the world	-8.5
Total gross liabilities	71.4
Increase in financial assets	7.7
Net financial requirements	63.7

No quarterly data are available for the first 2 groups, households and business, and financial intermediaries : they cannot therefore be estimated even as a residual. We are thus reduced to taking as exogenous the total demands adressed by the Treasury to the last 2 groups (Treasury monetary financing, TMF).

In turn, these are subbdivised in three categories :

1. Households and firms lend to the Treasury by increasing their depostis with the postal checking system (and their holdings of coins, but this is insignificant and neglected).
2. Deposit banks buy Treasury bills and Government bonds.
3. The Treasury must meet the balance of its requirements from the Central Bank and the Euro-dollar market : since the latter operations involve obtaining belgian francs from the Central Bank also, we lump the last two together as Central Bank financing.

The Treasury financial constraint can then be written :

(19) $TMF = MP + ET2 + ET1$

where :

MP : deposits with the postal checking system ;
ET2 : Government paper in the banks ;
ET1 : direct and indirect lending to the Treasury by the Central Bank.

With TMF exogenous, MP and ET2 estimated elsewhere, equation (19) determines ET1.

MP results from the allocation behaviour of firms and households, discussed above. However since it was expressed before in relation to sight deposits, it must be written here :

(20) $$MP = \frac{K2 \cdot MT}{K \cdot K1} = \frac{MP}{MD} \cdot MT \Big/ \frac{MT}{MC} \cdot \frac{MC}{MD}$$

with :

MC : currency
MD : sight depostis
MT : Total money stock.

ET2 has been discussed above (13), as resulting from deposits, private credit demand and the maximising behaviour of the banks.

5. Central Bank Behaviour

We take up first the problem of the basis, to turn next to the discount rate policy.

The basis is usually taken to be equivalent to Central Bank liabilities, essentially currency issued, plus monetary reserves. To be consistent with our definition of the multiplier, we shall however use here a slightly narrower concept : here, currency in circulation with the public (excluding that held by by the banks) defines the basis :

(21) $BASIS = ET1 + MF1 + ER1 + U1$

with : ET1 : credit to the Treasury, including foreign currencies purchased from the Treasury ;

MF1 : net foreign assets (excluding currencies purchased from the Treasury) ;

ER1 : commercial bills and acceptances discounted by the Central Bank, including those financing exports.

U1 : balancing item in the balance sheet of the Central Bank (exogenous).

Because of the definitions used, bank claims on the Central Bank (currency and monetary reserves) are included (with a minus sign) in U1. Thus, under this set of definitions, reserves reduce the basis rather than the multiplier. No attempt was made to estimate them independantly : they result from a complicated formula (partly on domestic, partly on foreign deposits ; and partly on excess credits), and only 6 observations are available. Here they remain exogenous, while elsewhere their effect has been estimated through the dummy DUMERS (equations 3, 15 and

18). To some extent, UI has become a policy variable for the Central Bank.

Of the three endogenous variables, ERI is decided by the banks with some influence from the Central Bank's discount rate. ETI and MFI depend essentially on exogenous factors (Treasury requirements for monetary financing and balance of payments), but also on bank behaviour (purchases of Treasury bills and short-term capital movements) which are also indirectly affected by the discount rate.

Thus, until 1972, the basis, like the multiplier lay largely outside the control of the Central Bank : its influence through the discount rate was indirect and worked through the reactions of the banks. On the other hand, the three main components of the basis adjusted partly or completely, to the liquidity requirements of the banks and the Treasury. The Central Bank was of necessity "accomodating" to this built-in flexibility. The adjustment mechanism has absorbed without undue strain balance of payements surpluses or deficits in the past. The current account surpluses and capital inflows of the past three years have however proved too much for it : these exogenous increases in the basis permitted the financing of record Treasury deficits and of an exceptional rate of credit expansion without strain on the liquidity of the system, until 1973, when the new instruments of credit control became effective.

The basis as defined above, and the multiplier (equation 11), resulting from household and business allocation decisions, give total money supply (defined to include term deposits in the banks, but not elsewhere, a concept frequently referred to as M2).

(22) $MT = K. BASIS$

Until 1971, the main policy instrument of the Central Bank has been its discount rate. The degree of autonomy of the Bank in the use of this instrument is however open to question. There clearly exists an external constraint, the Euro-dollar rate in recent years. Beyond this, it is not clear whether the Bank "makes the market" or follows the market. The data used here can be interpreted in either way. This partly results from the use of quarterly figures (taken at the end or towards the end of the quarter) : they do not define turning points with any precision, and create an appearance of simultaneity, which may be partly spurious, between changes in short-term rates and in the discount rate.

Moreover, the discount rate is sometimes stable over fairly long periods, cutting off both troughs and peaks in short-term rates. To take the example of a peak, the discount rate will stop going up before the short-term rates, and will thus lead them ; but it will also start going down after them, and will then lag behind them.

Thus, two interpretations are possible (and equations reflecting both will be presented here) : under the first, the behaviour of the Central Bank is constrained by foreign interest rates, but within the freedom allowed it, uses the discount rate to pursue objectives of economic policy, three of which are identified in the equations :

- stabilising the trade cycle, represented here by the gap between potential and actual GNP (the variable GAP) ;
- fighting against capital movements, induced by parity change expectations, represented here by the forward discount of the BFranc against the dollar (REPORT) ;
- fighting against inflation, expressed here by the rate of increase in the consumption price index (over a 6-month period, PC2CP).

These assumptions account fairly well for the behaviour of the Central Bank, except for the year 1970 and the first

half of 71, when the discount rate was maintained more than 1 1/4 % higher than can be explained in terms of our equation. It is suggested that great caution was exercised after the traumatic experience of 1969, and the Central Bank followed the downward plunge of the Euro-dollar rate, with delays and reluctance. This temporary change in behaviour patterns is caught by a dummy (DUMD), covering the 4 observations of 1970 and the first 2 of 71. (By the middle of 71 it was clear that it was not the belgian franc that was in trouble).

With the discount rate catching the external influences, the short-term Treasury-bill rate reflects domestic liquidity : its movements are influenced by the liquidity of the banks (the variable GAMA), as well as by general market liquidity : this is expressed through the rate of growth of money supply, PCMT : velocity of circulation which was tried as an alternative proved not to be significant or to have the wrong sign. The level of the short-term rate depends in the first place on its own past. This can be interpreted as reflecting delayed adjustments to the discount rate and the liquidity variables : thus an increase in the discount rate by 1 % would have an immediate effect of less than .4 % on the short-term rate, and a long-term effect of more than .8 % ; alternatively the variable LTIC may be taken to express the expected rate of interest, as based on previous experience. In the last analysis, both interpretations come to the same, since they are but two ways of accounting for some inertia in the market.

Expressing all rates in percentage points (the mean for TER is 5), the equations are as follows (with the Corchrane-Orcutt :

(23) $$\begin{array}{l} TER = 2.03 + .422\ TFC + .189\ REPORT - .156\ LGAP \\ \qquad\quad (7.76)\ \ (11.87)\ \ \ (5.15)\ \ \ \ (-2.64 \\ \\ \qquad + 24.68\ PC2CP + 1.28\ DUMD + .27\ RHO \\ \qquad\quad (2.86)\ \ \ \ \ (5.78)\ \ \ \ \ (1.92) \\ \\ R^2 = .913 \qquad\qquad DW = 1.74 \end{array}$$

(24) $$\begin{array}{l} TIC = -.703 + 7.480\ GAMA + .391\ TER - 4.426\ PCMT \\ \qquad\quad (-2.80)\ \ (5.64)\ \ \ \ \ (3.33)\ \ \ \ \ (-1.04) \\ \\ \qquad + .677\ LTIC \\ \qquad\quad (7.02) \\ \\ R^2 = .956 \qquad\qquad DW = 2.15 \end{array}$$

with : TER : the discount rate of the Central Bank ;
TIC : the rate on 3-months Treasury bills issued by the Fonds des Rentes ;
TFC : the 3-months Euro-dollar rate in London ;
PCMT : percentage change in money supply (quarterly ; mean : .02)
PL2CP : percentage change in consumption price (half-yearly : mean : .02)
and other variables as previously defined.

Equation (23) suggests that the most powerful factors influencing Central Bank policy are external : other things being equal, a 1 % change in the Euro-dollar rate would cause a change of .4 % in the discount rate, while changes in the forward foreign exchange market are equally significant. Among the policy objectives noted above, only the GNP gap has a rather weak influence.

Turning now to the other interpretation, where the Central Bank follows the market, the short-term rate becomes the leading factor and accounts for most of the changes in the discount rate. The policy objectives of the Bank have been retained in the

equation, but their impact is much weaker, and the Euro-$ rate looses all significance. (The Corchrane-Orcutt procedure has been applied).

With the leading position now given to the short-term rate, it is unfortunate that most variables in its equation explain so little : bank liquidity retains its importance, and the growth rate in money supply increases in significance, but the influence of the euro-dollar market is weak and other variables which have been tried contribute little. In fact, the lag of the variable "explains" almost everything. The explanation in terms of delayed reactions becomes unbelievable : the coefficient of LTIC implies a long-term multiplier more than 5 times the value of the impact multiplier for the other variables, and this is not reconcilable with the rather volatile character of the short-term rate. And in the other interpretation, the level of the rate is left hanging by its own bootstraps (or by its own unexplained expectations).

(23*) $$\begin{aligned} TER = {} & .495 + .663\ TIC + .108\ TFC + .094\ REPORT \\ & (1.08)\ (5.66)\ \ (1.60)\ \ (2.86) \\ & - .092\ LGAP + 24.47\ PC2CP + .677\ RHO \\ & (-1.60)\ \ (3.17)\ \ (6.31) \end{aligned}$$

$R^2 = .954$ DW = 2.05

(24*) $$\begin{aligned} TIC = {} & - .220 + 6.387\ GAMA - 8.276\ PCMT + .126\ TCF \\ & (-.78)\ \ (3.76)\ \ (-1.78)\ \ (2.87) \\ & + .841\ LTIC \\ & (14.09) \end{aligned}$$

$R^2 = .95$ DW = 1.89

As can be seen, both sets of equations are about equally good, and there is no technical reason to give preference to one set over the other. On the level of economic interpretation,

the lack of real explanation in the last equation for the short-term rate would give some edge to the first set where TIC appears in a more subordinate position. Further work is clearly called for. It may suggest, for instance, that the Bank "makes the market" in certain cases, but has to follow it when the market is not "in the Bank". Meanwhile we must leave the reader to his own interpretation.

The long-term rate, the variable TIL, has the same explanation whatever view is taken of the relation between the discount rate and the short-term rate. Its trend is determined by the liquidity of the economy, which we have represented by the velocity of circulation (GNP divided by money supply, without term deposits). Variations around this trend are accounted for by the influence of the short-term rate.

There is no price variable in the equation : when it was introduced, it gave either a significant negative, or a weak and non significant positive, correlation, depending on the way the price variable was lagged. (This may result from the fact that our calculated value are systematically too low in 1968 which is a period of slack in the economy and slow price increases). Inflationary expectations thus appear to have played little role in the formation of the long-term rate, at least over the period of observation. It is only in the last few years however that the rate of price increase has exceeded 3 % per year, so that a weak price effect could be picked up through the indirect influence of the discount rate, where the price variable is significant.

(25) $$\underset{\quad}{TIL} = \underset{(-2.5)}{-1.89} + \underset{(7.91)}{.30\ TIC} + \underset{(7.79)}{8.84\ LVELO} + \underset{(2.63)}{.358\ RHO}$$

$$R^2 = .958 \qquad DW = 2.25$$

with : TIL : rate of interest on public bonds of more than 5 years' maturity.

LVELO : velocity of circulation (GNP over money supply), lagged one quarter.

In the last couple of years, the discount rate has ceased being the main policy instrument. The new measures that have replaced it, have already been discussed at length in their impact on bank behaviour. At the risk of some repetition we may briefly summarise here the conclusions of that discussion, which is based, of course, on our behavioral equations : the implications we draw from them are no better than they are. On the figures, as our equations interpret them, the conclusions are :

1. The quantitative limitation on credit expansion does not appear to have been operative : our demand equation shows but a weak systematic error for total credit in 73 (it is of course possible that it has prevented a marked change in business behaviour from being reflected in the credit figures).

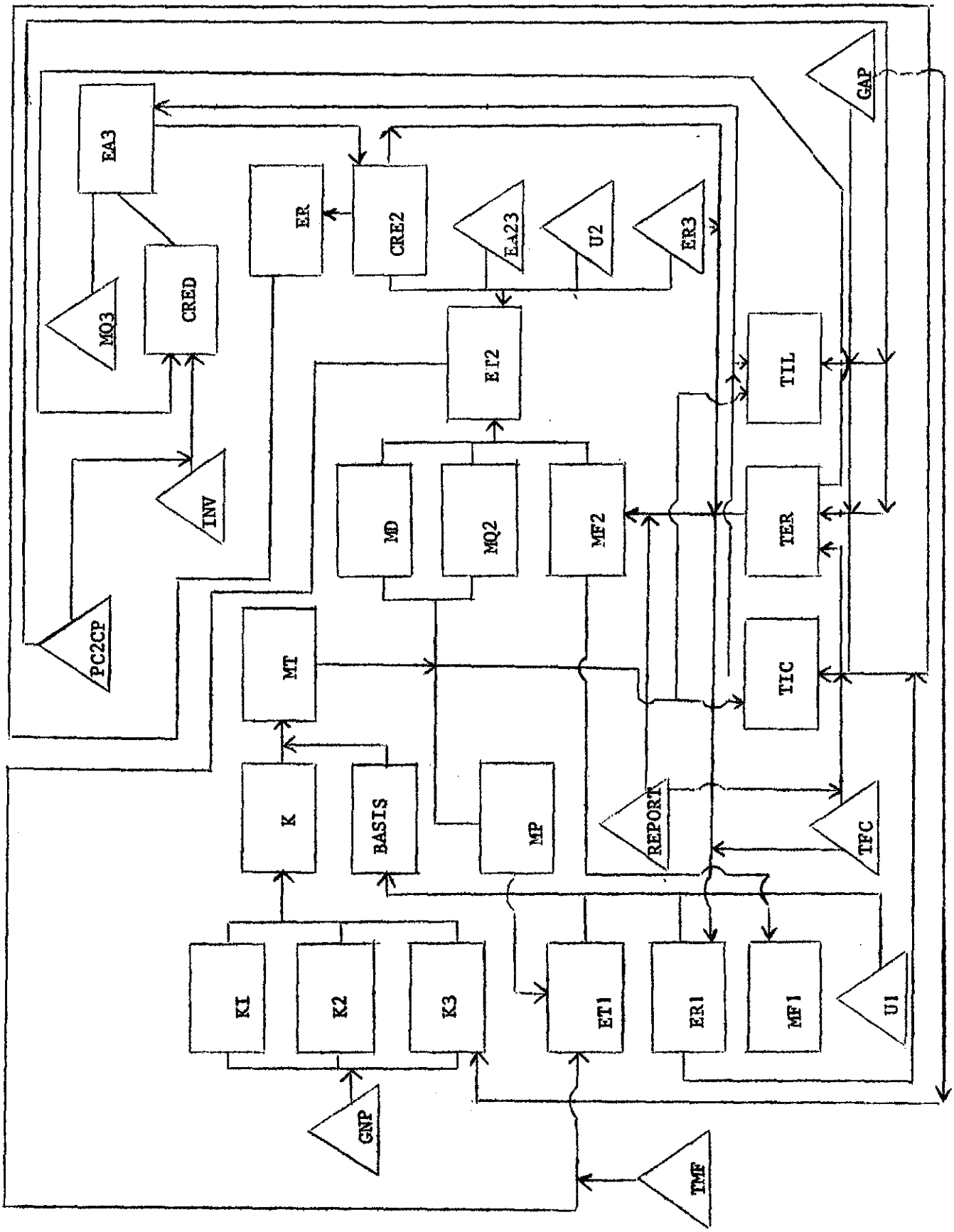
2. The creation of monetary reserves (compulsory deposits with the Central Bank) was certainly effective in increasing the volume of discounts of the banks, with the Central Bank, and probably in increasing their net foreign borrowing (up to the middle of 1973).

3. The limitation of discounting facilities clearly must have created a very tight liquidity position at the end of 73, when combined with monetary reserves and limitations on foreign borrowing. They did not prevent discounts from reaching an all time high in Dec. 73, but it is possible that without that restriction, they would have gone even higher.

4. The limitation on the net foreign currency position of the banks proved effective only in the last quarter of 73, when its reduction was no longer offset by an increase in foreign deposits in belgian francs.

5. Since we did not estimate directly bank holdings of Government paper, we can offer no comment on the last measure which imposed a minimum on them. The logic of the model implies however that such a restriction (if effective) would prevent Treasury requirements from increasing the basis.

FLOW CHART



A triangle denotes an exogenous variable

A rectangle denotes an endogenous variable

Principal feedback circuits in the model :

The preceding flow chart provides a convenient summary of the main links in the model. Since it is already fairly complicated, we have left out some of the intermediary or composite variables such as GAMA, TENSIO, etc.

The main feed-back mechanism can be described fairly simply. Total money supply (MT), with the help of household decisions (the K_i variables), and credit demand (CRED), determines (together with bank decisions) the three central variables of the system : the banks' discounts with the Central Bank, their borrowings abroad and their purchases of Treasury paper. The first two directly, and the third indirectly, feed back into the basis, and thus (together with the K_i variables) determine money supply.

We may illustrate in more detail with the Treasury position. Money supply and K2 give household financing. Money supply and the K's on the one hand, credit demand on the other, determine bank liquidity, and their supply of credit to the Treasury. These two supply factors, together with Treasury requirements, determine its borrowings from the Central Bank which feeds directly into the basis, and therefore back to money supply.

To take now the bottom of the chart, the group of domestic interest rates influences :

- total credit demand and its allocation between banks and other intermediaries ;
- allocation of assets between money and quasi-money, and thus the multiplier and total bank liabilities ;

- total borrowing by the banks, and thus their purchases of Treasury paper and the basis (as above) ;

- the allocation of bank borrowing between the Central Bank and the rest of the world and thus bank liquidity.

Money supply and bank liquidity in turn feed back into the determination of interest rates. It will be seen that the rates of interest play a considerable role in the model, but are mainly determined from outside it, by the foreign rates, currency speculation , the rate of price increase and the trade cycle. Similarily, the major determinant of credit demand is investment, closely tied to the trade cycle and GNP growth. These essential links stress the need for integration into a fully developed model.

III. Simulation and Results

While the individual equations presented above appear fairly satisfactory, both in a statistical and an economic sense, this is not enough to judge the performance of a model containing a number of simultaneous equations and strong feed-back links. Simulation provides this test of overall behaviour.

Two types of simulations are presented. Static simulation uses observed values for exogenous and lagged variables, and calculates from them the value of endogenous variables. This is a step by step, one period at a time, exercise. It would correspond to a forecast looking only one quarter ahead.

Dynamic simulation provides the acid test : it uses observed values only for the exogenous variables and for the initial values of the lagged endogenous variables. From then on, the model generates itself all endogenous variables, and is thus liable to cumulate errors.

Unfortunately, computer limitations have prevented us from running simulations over the whole period. We have then chosen to simulate the last ten quarters, as being the most interesting to the reader. Unfortunately, this corresponds, in the monetary area, to a period of troubles, as well as of changes in the institutional framework and in the instruments of monetary policy. Some of our estimating equations, with excellent fits up to 1970, show fairly large residuals for the last three years, and these are of course carried over to the simulation exercise. This reduces the quality of the results without impairing the significance of the structure.

Two behavioural constraints have been included in the equations. The first is that the banks cannot discount with the Central Bank more than 20 % of the total volume of bills and acceptances (GAMA cannot exceed 20 %) ; nor can GAMA fall below zero. Since about 20 % of total bills are normally discounted outside the Central Bank, to other financial institutions, this limit is less stringent than the discount ceilings which have been in force since 1969, and progressively tightened thereafter.

The other constraint prevents the banks from reducing their holdings of Government paper by more than 5 billion francs in any quarter, reflecting in weakened form the legal obligation to invest in that way a fixed proportion of the increase in deposits. Statistically, this constraint was imposed to bring about a more rapid convergence of the Gauss-Seidel iterations, and to prevent a "hunting" process from developing.

The following table presents, for the main variables, the results of 4 simulations, static and dynamic for the two sets of equations relating to the formation of interest rates.

SIMULATIONS RESULTS

(Root of the mean squared percentage deviation)
Period from 1971/3 to 1973/4

Variable	With equations 23 & 24		With equations 23* & 24*	
	Static	Dynamic	Static	Dynamic
CRED	.83	.91	.83	1.20
CRE2	2.23	2.62	2.36	4.09
ER	3.26	5.44	3.34	6.95
EA3	2.19	2.17	2.37	3.17
ER1	41.26	43.91	37.51	64.64
MF2	12.15	12.60	12.77	12.70
K	3.95	4.89	3.93	4.46
MT	4.51	4.94	3.78	6.35
MP	4.19	7.23	3.94	8.28
MQ2	3.81	5.43	3.31	5.84
MD	5.17	7.07	4.69	8.92
ET2	7.65	7.24	7.32	6.88
ET1	121.4	119.4	124.3	110.1
TIC	10.60	12.03	13.40	16.94
TIL	3.36	3.97	3.18	7.41
TER	7.65	7.65	10.37	12.87

While the static simulations are of about equivalent quality with both sets of equations, the dynamic simulations are better with the first, when the discount rate depends only on exogenous variables. This is as expected, since a possibility of cumulating errors is thereby avoided : with all rates depending on endogenous variables, the second set of equations tends to generate too high a money supply (and too low a set of interest rates).

Particularly with the first set of equations, the dynamic simulations are not much worse than the static ones. This suggests that a high percentage of the errors arises from the estimating equations, rather than from the behaviour of the model itself, in other words, the system tends to be self-correcting. This can be illustrated by an exemple : suppose an error arises from too high a capital inflow (MF2) : the dollars are sold to the Central Bank, which increases the basis, the money supply and the deposits of the banks. After they have satisfied the demand for credit, the banks will increase their lending to the Treasury. The Treasury, receiving too much money from postal deposits and from the banks, will reduce its borrowing from the Central Bank, thus causing an offsetting reduction in the monetary basis. Incidentally, since with quarterly observations we are using a simultaneous money multiplier, this process can give rise to non convergent iterations ("hunting"), with increasingly wide swings in money supply as the basis is expanded then contracted from one iteration to the next. Hence the need to cut off the process through a limit to the reduction of bank lending to the Treasury.

Turning now to individual results, the credit variables are satisfactory. Total credit (CRED) depends on the real variables outside the model and on the lagged rate of discount : in a static simulation it depends only on exogenous variables, and is therefore the same with both sets of equations.

The results for the amount discounted (ER1) with the Central Bank are poor. For the 10 quarters under observation, the observed values range from zero to 36 billion, with wide variations from one quarter to the next. The mean percentage error is thus bound to be high. In addition, the calculation involves a division, and when either the observed or the calculated value is nil (and both cases occur), the percentage deviation is a meaningless figure.

MF2, the foreign borrowings of the banks, is clearly not satisfactory. The comparison of the four simulations show however that the error arises from the estimating equation. Although it has an R^2 of .964, this is calculated on the period as a whole, and 9 of the last ten observations have errors in excess of the standard error. Here is clearly a case where institutional changes call for a reappraisal of the estimation.

The multiplier (K) and money supply variables (MT, MP, MQ2 and MD) are much more satisfactory. It is noteworthy that the errors in total money are hardly larger than those in K, the mul-plier, while the errors on the individual endogenous components of the basis (ER1, discounts ; MF2, banks' borrowings abroad ; and ET1, Central Bank lending to the Treasury) are very much lar-ger. Errors in some components of the basis must thus be offset in others. In fact, the construction of the model implies that all other errors cumulate in ET1, Treasury financing by the Cent-ral Bank : it is the difference between Treasury requirements and the supply offered by the banks and postal depostis. Since 1971-73 was a period of liquidity, direct advances were sometimes nil, and the short term foreign debt was being completely repaid ; thus the values of ET1 are small and the percentage deviations correspondingly large.

The last group, the rates of interest, are fairly satisfac-tory, at least with the first set of equations, where the Central Bank reacts autonomously : in this case, the discount rate (TER) depends only on exogenous variables (and is therefore the same in both static and dynamic simulations). This implies that the 7.65 % error arises entirely from the estimating equation. Again, this has an R^2 of .913 with a concentration of errors in the last few years. The rather poor determination of TER of course effects also the short-term rate, TIC, at least in the first set of equations.

CONCLUSION

As was stated in the beginning, this paper offers for criticism the present stage of work in progress. While the results presented are fairly satisfactory as concerns the structure of the model, we have stressed the need for reestimating some of the key equations when new observations become available on the changed structure of monetary relations. It is only to be hoped that behaviour does not change too fast or too often to make econometric work impossible. Meanwhile, it is also proposed to complete the model, by bringing into it the non-bank financial intermediaries, and by linking it to the goods and labour markets.

This interim report is published largely in the hope that it may evoke responses that will permit improvement of the model. We believe its approach to be fruitful both for interpretation, and at a later stage, for policy purposes. By remaining close to the actual behaviour of the monetary institutions, it attempts to account for the process of money creation, and the interplay of the balance of payments, endogenous capital movements, credit demand and Treasury requirements.

LIST OF VARIABLES

(Endogenous variables are starred)

		Equation numbers
*BASIS	: monetary basis, currency in circulation with the public ;	21
*COLMO	: cumulative change in the basis due to the balance of payments and Central Bank lending to the Treasury ;	14
*CONJ	: difference between the long and the short term rates of interest ;	24 & 25
*CRED	: total short and medium term credit demand of business and households ;	1 & 2
*CRE2	: part of CRED satisfied by deposit banks ;	4
CP	: quarterly increase in the cost of living or consumption price index ;	
*DOL2	: net foreign currency liabilities of the deposit banks ;	17
*EA3	: part of CRED satisfied by non-bank financial intermediaries ;	3
EA23	: deposit bank credit to other financial intermediaries ;	
*ER	: commercial bills and bankers acceptances, credit originally supplied by deposit banks ;	5 & 6
*ER1	: commercial bills and acceptances discounted with the Central Bank ;	15
ER3	: commercial bills and acceptances sold to non-bank intermediaries ;	

*ET1	: Central Bank direct and indirect credit to the Treasury ;	19
*ET2	: Deposit banks holdings of Government bonds and Treasury bills (in belgian francs) ;	12
*FDBF	: Foreign deposits in belgian francs ;	16
FOR1	: Net foreign reserves of the Central Bank, excluding items resulting from Treasury or bank operations ;	
*GAMA	: ratio of bills discounted with the Central Bank to the total outstanding ;	13
GAP	: percentage deviation of GNPC from potential GNPC ;	
GNPCP	: potential GNPC ;	
GNPCS	: GNP at constant prices after elimination of seasonal variation ;	
INV	: gross fixed capital formation ;	
*K	: credit multiplier ;	12
*K1	: ratio of currency to sight deposits ;	8
*K2	: ratio of postal deposits to sights deposits ;	9
*K3	: ratio of term and savings deposits in the banks to sight deposits ;	10
*MC	: currency and coins held by the public ;	12 & 21
*MD	: sight deposits in the banks ;	8, 12 & 21
*MP	: sight deposits in the postal system ;	20
MF1	: foreign reserves of the Central Bank : FOR1 + MF2 ;	15
*MF2	: DOL2 + FDBF	18
*MQ2	: term and savings deposits in the banks ;	8, 9, 12, 21

MQ3	: liabilities to the public of non-bank intermediaries ;	
*MT	: money supply (including savings and term deposits with banks, but not with other intermediaries) ;	22
REPORT	: forward discount of the belgian franc against the dollar ;	
*TENSIO	: interest rate on 3-months euro-dollars less belgian Central Bank discount rate ;	23
*TENSIOC	: TENSIO + REPORT ;	
*TER	: Central Bank official discount rate ;	23
TFC	: interest rate on 3-months euro-dollars in London ;	
*TIC	: rate on 3-months Treasury bills issued by the Fonds des Rentes ;	24
*TIL	: long term rate (public bonds, 5-10 years) ;	25
TMF	: Treasury demand for financing by monetary intermediaries ;	
U1	: balancing item in the balance sheet of the Central Bank ;	
U2	: balancing item in the balance of the deposit banks ;	

Dummy variables		Equations where used
DUMC	: seasonal variation : 0 -1 0 +1	1
DUMD	: the 4 quarters of 1970 and the first 2 of 1971 ;	22
DUMF2	: 4th quarter of 1973 ;	17
DUMFOR	: 3d and 4th quarters of 1973 ;	15
DUMK1	: seasonal variation : 0 0 1 0 ;	8
DUMK3	: seasonal variation : 1 -1 1 -1 ;	11
DUMRES	: the last 2 quarters of 1972 and the 4 quarters of 1973.	3, 15 & 18

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APPENDIX : Sources and Methods

All domestic monetary and financial data are taken from the published figures of the Banque Nationale de Belgique, either in the statistical part of the monthly Bulletin, or from the volume : "Statistiques Economiques Belges, 1960-70", B.N.B., 1974.

We start by reviewing these and note explicitly the references to table numbers in the Bulletin de la Banque Nationale de Belgique, where alternative definitions are available or where the original data have been combined or transformed.

CP : Consumption price index : table VII-4, (prior to 1966, cost of living index).

CRED : Total credits to business originating with banks and other intermediaries : CRE2 + EA3.

CRE2 : Credits originating with banks : table XIII-2 c), lines c), d) & e) plus XIII-7, C, col. (1) & (2).

DOL2 : Net foreign currency liabilities of the banks : Table XIII-2 c) : Passif, lines A.4.a) + C.3.a) 3 less : Actif, lines A.3. & 7.a) less : Dollar liabilities incurred on behalf of the Treasury (see below under ET2).

EA3 : business credit originating with non-bank intermediaries : Table XVII-6, cols. 4 & 6. We have however excluded the CGER mortgage and house building credits, from XIV-5b.

EA23 : Net bank lending to non-bank intermediaries : 1960-71, Table XIII-1, col (12). This series no longer being valid after monetary reserves were imposed, from 1972 on : Table XIII-2 c), line 5 b) Actif - Passif.

ER : commercial bills and acceptances originating with the banks : XIII-7, C, col. (1) & (2).

ER1 : part of ER discounted with the Central Bank : XIII-8, C, col. 6.

ER3 : part of ER discounted with non-bank intermediaries : XIII-7, C, col. 7, less : XIII-8, C, col. 6.

ET1 : Central Bank total lending to the Treasury : XIII-2 a), lines C.1. plus : foreign debt of the Treasury. The latter stock series was built up from the flow series, XI-3, col. (10), and the stock figure for Dec. 73 in XVI-3a.

ET2 : Bank lending to the Treasury : XIII-2 c), lines C.1., less : Treasury bills arising from euro-dollar operations on behalf of the Treasury. The latter are estimated by the difference between two flow series : total Treasury borrowing abroad, XI-3, col. (10), less : direct Treasury borrowing abroad, IX-3, lines 3.11., and a stock figure assumed nil in Dec. 73.

FDBF : net foreign deposits in belgian francs : XIII-2 c), Passif line A.4. b) less : Actif, line A.7. b).

MC : currency and coins outside banks : XIII-4, col. (3).

MD : deposit money in the banks : XIII-2 c), line C.2. a). (The figure differs from XIII-4, col. (7) by a small amount representing sight deposits with parastatal credit institutions.(See also MT).

MF1 : Net foreign assets of the Banque Nationale, XIII-5, col. (1), adjusted to exclude export bills, XIII-2 a), line A.4 ; (included in ER1), and Treasury foreign debt, included in ET1. From 1969 on the stock data have been built up from the flow data of XIII-5, col. 4, which are adjusted to exclude writing up or down the value of foreign assets following various devaluations and revaluations, and to exclude SDRs.

MF2 : external liabilities of the banks : DOL2 + FDBF.

MP : postal deposits : XIII-4, col. (6).

MQ2 : quasi-money in the banks : XIII-2 c), lines C.3. a) 1 & 2 plus C.4.

MQ3 : deposits with the CGER and liabilities of the SNCI : XIV-5a, col. (4) & (5) plus XIV-6, Passif, lines 1 & 2.

MT : money supply : XIII-4, cols. (3) plus (6), plus MD, plus MQ2.

TER : official discount rate : XIX-I, col. 1.

TIC : 3-months Treasury bill rate (Certificats B), XIX-3, col. 5, (average of the last month of the quarter).

TIL : rate of interest on bonds of more than 5 years' maturity XIX-6, col. 4 (last month of the quarter).

Other sources were used for the following series :

GNP, GNPC : Quarterly data for GNP, GNP at constant prices and GNP deflator from : DULBEA, Cahiers Economiques de Bruxelles, University of Brussels. Series originally calculated by Ginsburg.

INV : Gross capital formation : same source.

TFC : maximum interest rate on 3-months Euro-dollars in London, Wednesday averages, from IRES databank, University of Louvain.

REPORT : 3-months $/BFr rate as percentage deviation from the spot rate (on an annual basis) on the official market ; from IRES databank, University of Louvain.