System Dynamics Simulations for the Management of a Commercial Bank

by

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Abstract

Bank institutions occupy a special position in the economy as they have to guarantee a frictionless money movement. Compared with industrial companies, banks do not produce concrete products but provide abstract services with money as their output object. These services - when they are included in balance sheet - are reflected in the accounts as sales relations. Therefore a balance sheet model is applied in order to reflect general decisions in banking and to show how these decisions affect banking business in terms of volume and profit.

The analysed bank is the London branch of a Continental bank. The branch acts on the markets as a commercial bank. These kind of representations are the most common ones in the financial center of London.

The branch offers four different kind of products: Traditional, specialized, contingent and treasury products. These products determine the statement of asset and liabilities and in addition are also the income earners of the branch.

The behaviour of the branch is determined by decision rules, market developments, the juristical position and internal restrictions. This behaviour is tested by adopting different scenarios.

The System Dynamics bank model is adaptable to individual circumstances of other banks and therefore it offers practical support for the management of financial institutions.

The model of the commercial bank

The model represents a commercial bank acting in the financial center of London. This bank deals with four products:

Product traditional (trad.). It includes products of the corporate banking (short and medium term loans, guarantees, tax-based and other products), the trade finance (short term export and import financing and forfeiting) and the commodities divisions (letters of credit, advances/acceptances and others) as long as they are non-specialised products or lease arrangements or non-standard products;

Product specialized (spec.). It reflects products of the Merchant Banking division (investing in non-listed developing companies, management buy-outs and arranging mergers and acquisitions) as long as assets are involved and specialized products offered by other Credit and Marketing divisions;

Product contingent. It represents all eventual assets and liabilities;

Product treasury. It includes trading of deposits with banks as well as deposits taken from banks, both traded in the interbank markets.

Fundamentally the model is divided into three sectors (see figure 1).

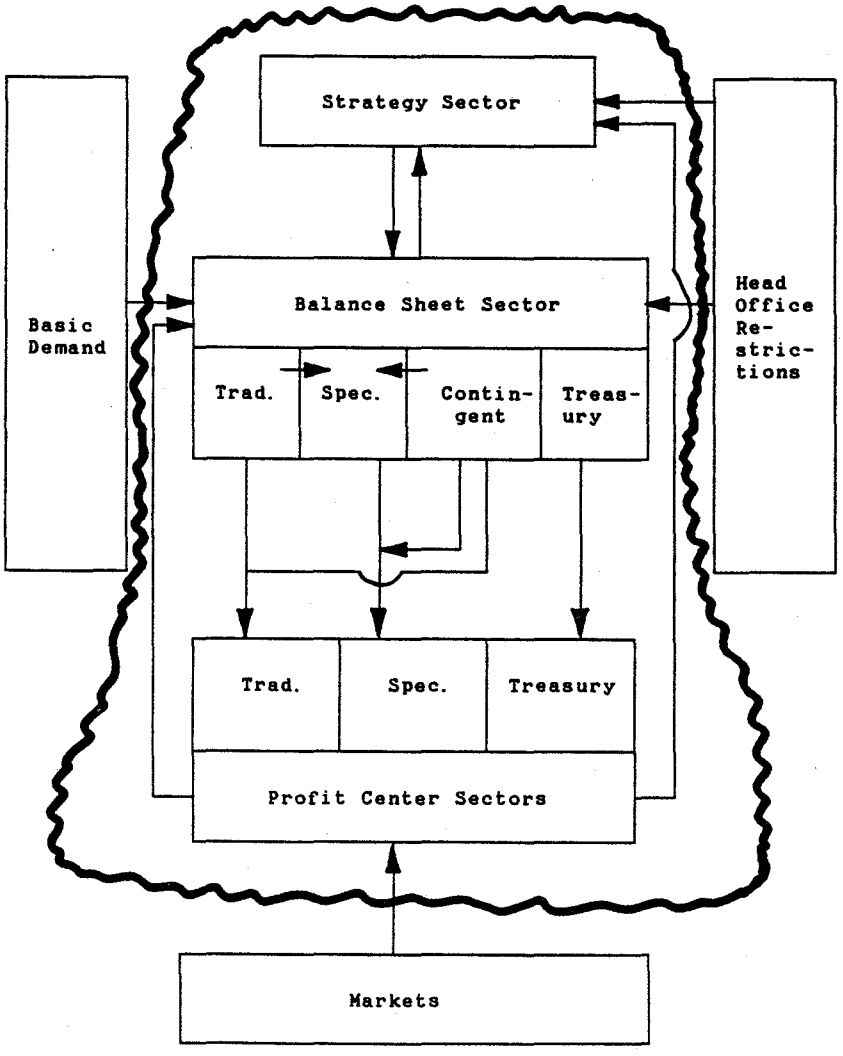

Fig. 1 : The simplified structure of the model

- Strategy Sector
  Within this sector decisions about desired volumes of the different products are made, taking into consideration risk readiness of the bank, substitution wishes and profitability. In addition staff planning decisions and employee costs are taken into consideration in this sector.

- Balance Sheet Sector
  This sector is subdivided into four business areas which are stated in the balance sheet of the examined bank (see figure 2).

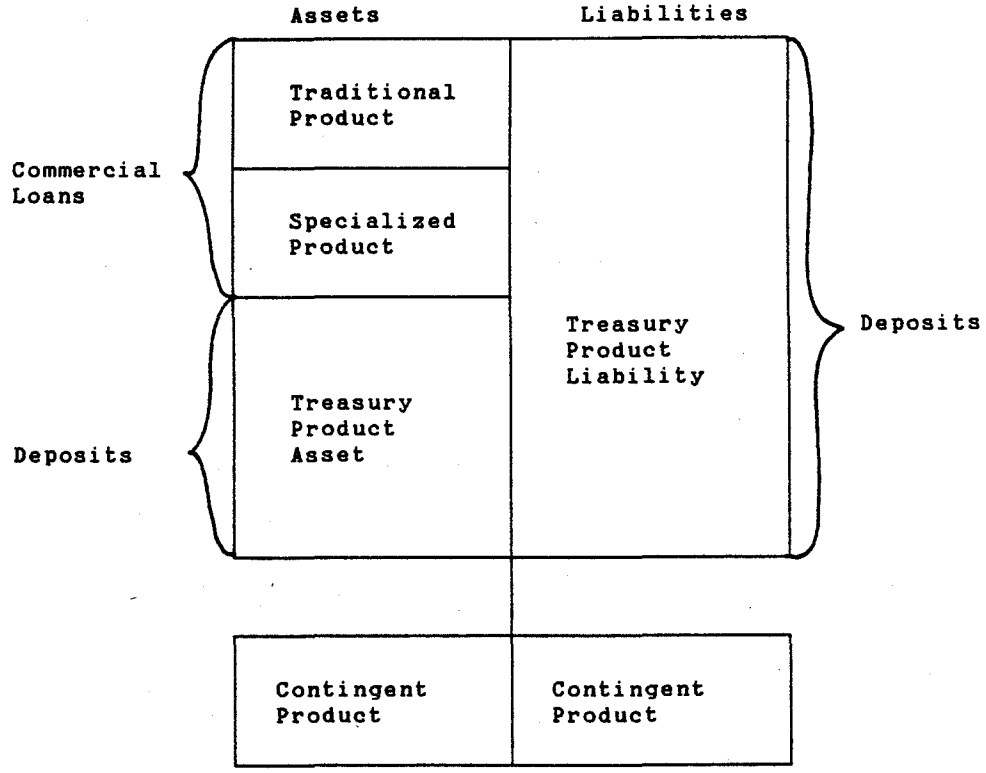

Fig. 2 : Model's balance sheet

As the bank refinances itself by deposits taken with banks and as this deposit business depends on asset business, liabilities are not included in the balance sheet sector. Nevertheless, deposits are included in the profit and loss accounts.

- Profit Center Sector
  There are three profit centers within the bank. They are profit center traditional product, specialized product and treasury product. In this sector emphasis is placed on profit generating of the mentioned products as well as on pricing policy of the bank management.

Another model assumptions is that the loan portfolio in its currency and area structure will not change during passing of time and that exchange rates are fixed.

The loop structure of the model

Traditional product loops. Volume of the traditional sector depends on the elements
- supply of traditional product;
- demand of the market for this product and
- maturity and selling off of traditional product.

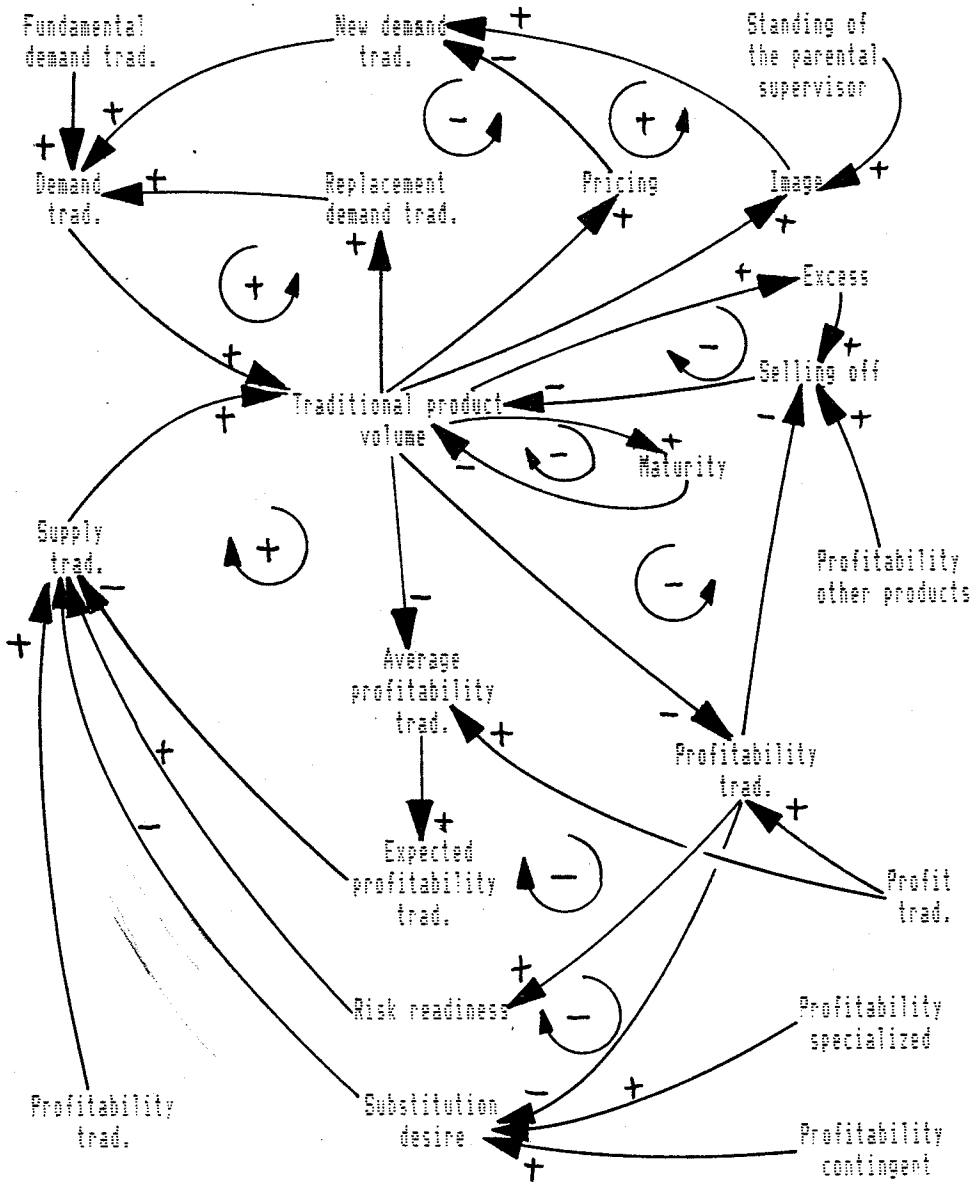

Fig. 3 : Traditional product volume loops

Specialized product loops. Volume of the specialized product also depends on supply, demand and maturity and selling off of specialized product. While demand, maturity and selling off loops in the specialized product sector are the same as the demand loops mentioned above, supply loops are different.

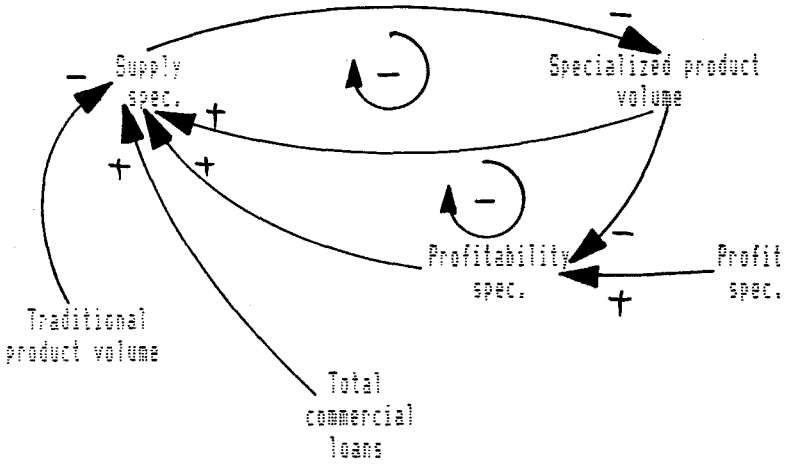

Fig. 4 : Supply specialized product volume loops

Contingent product loops. Contingent product volume has to be viewed in conjunction with expected profitability of the whole bank. The higher the expected profitability the higher the contingent product volume. Contingent product is viewed by the management as a substitution possibility of traditional and specialized product. The reason for that is that contingent product is not asset binding and therefore total profitability of the bank is rising if contingent product volume increases as contingent product is generating income.

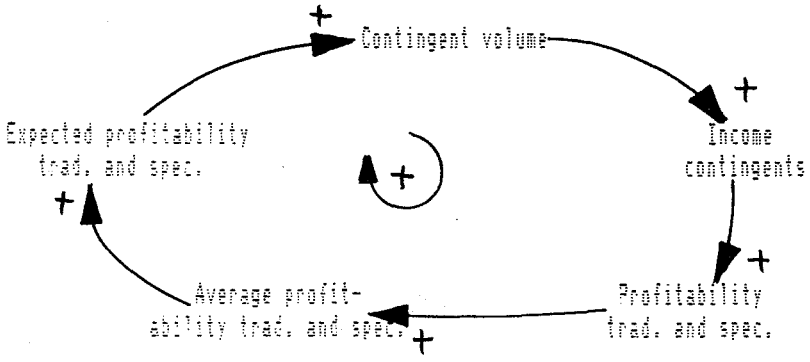

Fig. 5 : Contingent product loop I

A second loop is implemented instead of the one mentioned above from the start of 1987 as a result of law changes which from then on effect the business of the bank. These law changes (new bank act) claim that 50% of contingent product volume has to be included in the balance sheet as assets.

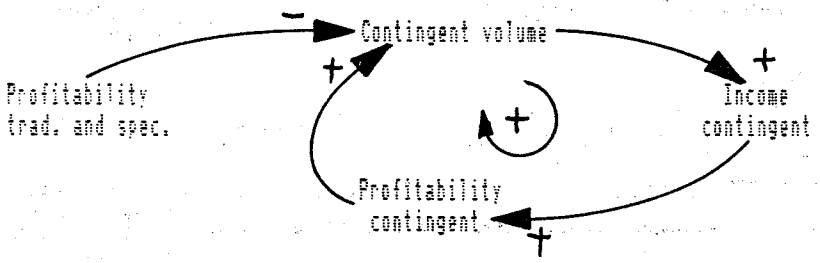

Fig. 6 : Contingent product loop II (after law changes come into force)

Treasury product loop. Deposits are influenced by profitability comparison. The higher the profitability of the treasury product compared to commercial loans profitability the greater is the desire of the management to increase deposit volume.

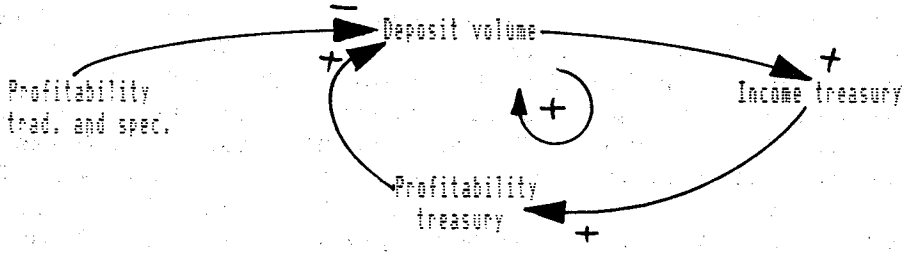

Fig. 7 : Treasury product volume loop

Figure 8 shows the simulated behaviour of the balance sheet elements and of out of balance sheet business (accumulated values).

Traditional product volume decreases during the whole simulation by 83% and at the end of the simulation in 1991 represents 2% of total balance sheet sum (22% at January 1983). This decrease is a result of both, lower extension of loans than matured ones and heavy selling off of traditional product volume in the first month of 1987.

Up to the end of 1986 specialized product volume is gaining more and more importance in terms of contribution to total assets but as this product is sold heavily in 1987 at the end of the simulation specialized volume represents only 10% of total assets (8% at January 1983). The development of specialized product volume is determined during the simulation by supply which fluctuated during the whole simulation.

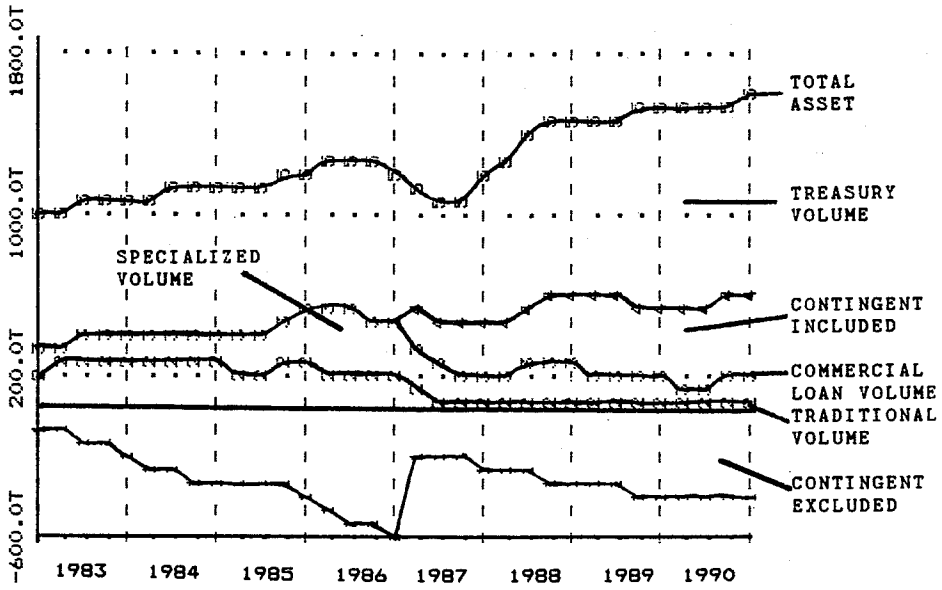

Fig. 8 : Balances sheet structure - base run

Contingent product volume which is not included as asset increases in the simulation up to January 1987, when it reaches its maximum level of 584 million Pounds. Then, in the first three months of 1987, it decreases due to law changes coming into force at the start of 1987 as half of contingent product volume is to be included in the balance sheet. Nevertheless from then onwards it increases and at the end of the simulation non asset contingent product has a volume of 390 million Pounds. The part of contingents, which are included in the balance sheet as assets in 1987, also increases and at the end of the simulation contingent product volume declared as asset is 390 million Pounds. The increase of contingent product business is mainly the result of the fact that this area generates the highest profitability. Therefore supply of this product exceeds demand by far so that the development of contingent product is determined by demand.

Treasury product volume stays relatively stable during the simulation. An exception of this development is the negative trading of treasury product in 1987. These trading activities are the result of deteriorating market conditions leading to low profitability. At the end of the simulation treasury's contribution to balance sheet sum is 63% (71% in January 1983).

The result of the explained asset movements reflects the development of the balance sheet sum. Balance sheet sum increases in the first three years of simulation.

Due to the heavy selling off of traditional, specialized and contingent volume and the negative trading of treasury product, which exceed contingent product volume declared as assets, balance sheet sum decreases in 1987. Nevertheless, the inclusion of contingent as assets and the increase of treasury product volume lead to an increase of the balance sheet sum in the following years. At the end of the simulation in 1991 balance sheet sum is 1,594 million Pounds (1,024 million Pounds at January 1983).

Profitability loop. The profitability loops apply to both, the traditional as well as to the specialized product sector. Profitability depends on volume and profit which the involved assets generate. Higher profits result in higher profitability, but an increase of volume leads to profitability decrease. Profit is measured in net income before operating expenses. There are three sources of income:

- interest and fee income, both generated by traditional and specialized product;
- fee income generated by contingents and
- interest income from treasury.

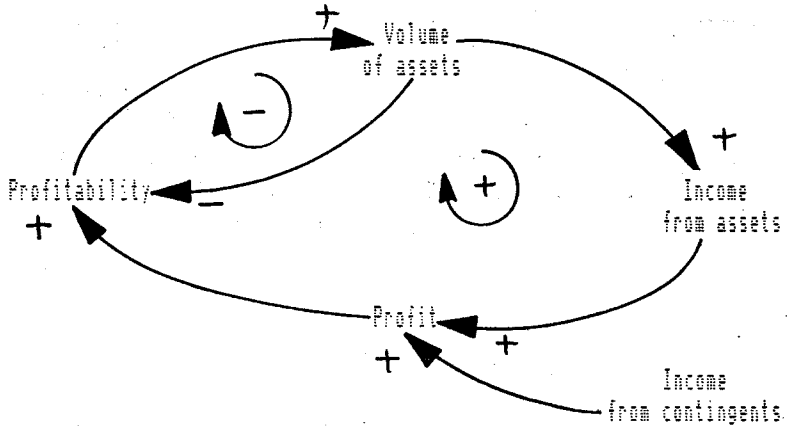

Fig. 9 : Profitability loop

Figure 10 shows the development of the total income the bank generates during the passage of time as well as the development of the different sources of income (accumulated values). At the beginning of the simulation income generated by traditional product represents 21% of total income (124,570 Pounds per month). It decreases slightly and at the end of the simulation income of traditional product represents about 1% of total income (15,730 Pounds per month). This decrease reflects the decrease of traditional product volume.

Income generated by the specialized product reflects 9% of total monthly income at January 1983. Up to the first months of 1986 it becomes more and more important especially as total income decreases heavily between the middle of 1985 and the first months of 1987 (32% of total income at January 1986). Later on its importance decreases and at the end of the simulation income of specialized product represents 6% of total income (71,610 Pounds per month). The development of income generated by specialized product partly reflects deteriorating market conditions during 1987 to 1989 and the decrease of specialized product volume especially in 1987 and 1989.

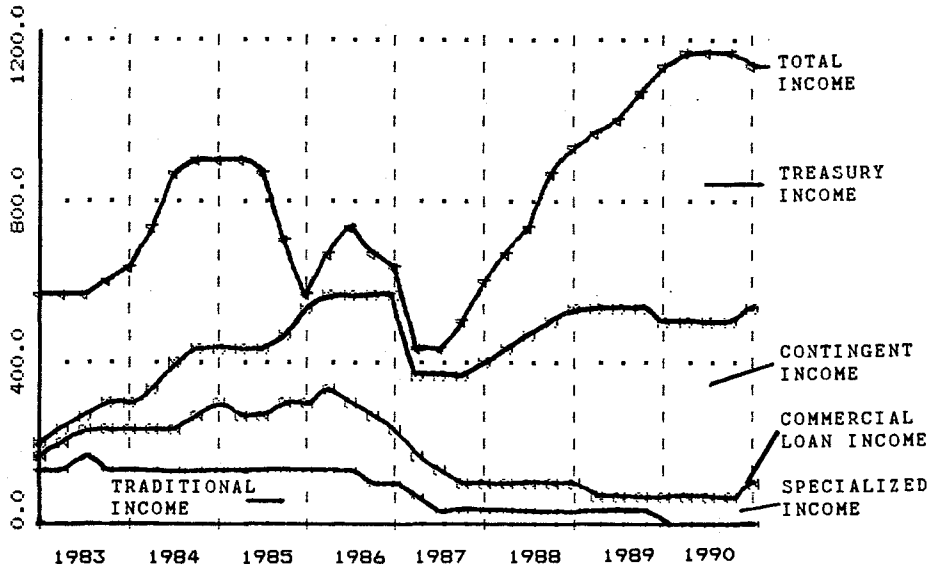

Fig. 10 : Income structure - base run

Income generated by contingents is only of little importance at the beginning of the simulation representing 13,600 Pounds per month reflecting 2% of total income. During the passage of time it becomes of ever increasing importance in terms of the proportion of total income contribution and at the end of the simulation income generated by contingent product stands at 429,360 Pounds per month (37% of total income). The development of income earned by contingent product represents increasing fee margins and volume during the simulation.

In January 1983 treasury product income represents 68% of total income. Between 1985 and 1986 it looses significance in terms of total income contribution. The reason for this is the fact that market conditions are very difficult and therefore fee margins are extremely low. Nevertheless, in the following years interest income generated by treasury area again becomes important by contributing to total profit and in January 1991 treasury product income represents 55% of total income.

Interest income generated by the treasury product is essential for the development of total income during the passage of time. The high fluctuations of treasury product income result in fluctuations of total income.

Summary of the results of the model experiments

Three model experiments are applied.

Model experiment I represents the model's behaviour after a juristical change, i.e all contingents have to be declared as assets from 1987 onwards.

Model experiment II reflects the model's behaviour due to market changes by assuming that due to higher competition the market conditions for contingent product deteriorate, i.e. fee margin for contingent product is lower than in the base run.

Model experiment III states the behaviour of the model by changing the policy of head office, i.e. the credit availability amount for one customer is increased.

The following summary in tabular form (see table 1) reflects the comparison of figures of the base run with figures of each of the three scenarios. Here it is distinguished between the first four years of the simulation ("1st"= 1983-1986) and the following years ("2nd"= 1987-1991).

Model experiment	I		II		III	
Elements	1st	2nd	1st	2nd	1st	2nd
Traditional volume	=	=	<	<	<	=
Specialized volume	=	<<	<	>>	>	>>
Contingent volume	=	<<	>	<<	<<	=
Treasury volume	=	=	<	<	=	>
Balance sheet sum	=	>	<	<	=	>
Traditional income	=	=	=	<	>	>
Specialized income	=	<	=	>	>>	>>
Contingent income	=	<<	<	<<	<	>
Treasury income	=	=	=	<	=	=
Total income	=	<<	<	<<	>	>>
Total ROA	=	<<	<	<<	>	>

>> remarkably higher than the figures in the base run
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Tab. 1 : Tabulated summary of the results of the model experiments

Final observation

The base run and the model experiments show that the profit of the branch depends on the development of market conditions. The managements adaptability towards changing market conditions is not fast enough, in either, to compensate quickly a potential resulting decrease of income and to use improved conditions to increase profitability. This inadequate adaptability is not only the result of management decisions but of strong reglementations set by head office.

An improvement of the mentioned adaptability would be to increase flexibility of management by:

(1) **Shortening official channels** (especially the existing ones with head office) in terms of time required to obtain the approval for a deal.
Increasing lending volume per customer.

(2) **Increasing the percentage of possible maximum contingent product volume in budgeted business volume.** There is no reason for the fact that management restricts contingent product volume to a maximum of 50% of budgeted business volume.
(3) **No constant increase of budgeted business volume.** The possiblity of a lower budget than in the last period could generally lead to a shrinking of bussiness towards higher profitability and to a specialication.

The managements main aim is maximizing proceeds. The question has to be asked if the strive after this aim is sufficient to guarantee profitability especially as expenses are not taken into consideration by management. A result of the non attention towards expenses could be a substance consumption of the branches (parent supervisors) equity if losses are made. In this respect it seems to be richer in meaning for the management to adopt the aim of net profit maximizing in its decision process especially as then the expense sinking potential would be considered.

To guarantee higher profitability certain changes have to be made:

(1) **Establishing an effective cost accounting center.** The higher the precision of cost accounting is, the more accurate is the profit contribution figure of each product or customer resulting in higher efficiency of the branch as products or customers which generate the highest net operating income can be advanced.
(2) **Strengthening the treasury division.** Income of commercial loans including contingent income covers only in the first four years of the simulation expenses while in the following years this income stagnates and is exceeded by steadily increasing operating expenses. Therefore in the long term it is necessary to smooth income fluctuations of the market with which treasury operates. This can be achieved by bringing up to date the electronical equipment of treasury and by recruiting highly capable people with experience in money and capital markets experience.
(3) **Development of a customer group orientated organisation structure.** This structure enables the branch to cooperate better with customers as only one or two employees advise a customer (instead of five or even more).