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Changing Forecasts - Forecasting Change: The US market for savings deposits in econometric models and the market for econometric models among depository institutions, 1960s to 1980s

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Changing Forecasts – Forecasting Change

The US market for savings deposits in econometric models and the market for econometric models among depository institutions, 1960s to 1980s

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Abstract:

Since the late 1960s, the rising volatility of financial markets in the US has troubled econometricians and bank managers alike. Both professions have found it increasingly difficult to forecast savings deposit flows. This article explores these challenges by focusing on two developments. First, it explores the internal adjustment process among econometric models of the savings deposit market. To achieve this aim, I use the so-called FMP (MPS) macro model used by the Federal Reserve Board since 1970 and the deposit forecast model of the Philadelphia Saving Fund Society (PSFS), the oldest and largest savings bank in the US. I find that economists failed to find timeless determinants for the market for savings deposits, partly because the determinants of expectation formation of households kept changing. Instead, economists relied on a large number of time-dependent dummy variables. Second, the article shows how the conditions of the market for savings deposits shaped the demand for macroeconomic forecast models. Here, I again use PSFS as a case study. I show that the demand for econometric models in the banking industry skyrocketed in the 1970s but abated somewhat in the 1980s. While the rising volatility led bank managers to seek sophisticated tools to predict deposit flows, the deregulation of the banking industry and the accompanying change in customer behavior devalued macro models as a reliable forecast technique for individual banks. Instead, it became crucial for banks to predict the future behavior of competing institutions.

Keywords:

Savings; Deposits, Interest Expectations, Portfolio Choice, Financial History, Econometric Modeling, Stagflation Period

JEL Classification:

B23 – History of Economic Thought since 1925: Econometrics – Quantitative and Mathematical Studies

N22 – Economic History: Financial Markets and Institutions – US/Canada from 1913

1. Introduction

In the late 1960s, the economist Franco Modigliani was working on an econometric model of the entire US economy for the Federal Reserve Board – the FMP model – when he found a strong increase in the interest elasticity of savings deposits around the year 1962 in the data. He acknowledged this finding by including a dummy time variable that changed all major parameters of his model from that year until the end of the period. In a publication two years later, Modigliani's colleagues Edward Gramlich and Dwight Jaffee criticized his use of this statistical tool. Gramlich, who had designed a separate deposit model for the Fed, explained his refusal to include similar statistical methods from a rather fundamental standpoint:

> To the extent that the switch in interest elasticities really did occur, which question in some fundamental sense we can never answer, the Gramlich-Hulett version has been remiss in not capturing it. But precisely because we can never tell whether the switch really did occur, we cannot make accurate goodness-of-fit comparisons between the two sectors, for it is always possible to introduce constant and slope dummies in periods that would otherwise have large errors and make apparent improvements fit.[1]

In a strictly econometric sense, this criticism was valid. However, Modigliani did have a good explanation for the change in interest elasticity. In the early 1960s, commercial banks introduced certificates of deposits (CDs) as a new financial asset, thereby increasing the competition for funds. Thus, from a historical standpoint, Modigliani's decision was well justified. In a more general sense, this short dispute among the creators of the most important econometric model of the 1970s raises the question of whether the market for savings deposits featured some kind of underlying fundamental structure that allowed economists to prescind from the specific history of banking in the United States.

A few years later, in a different historical context, Charles Gibson was leading a team of economists at the Philadelphia Savings Fund Society (PSFS), at the time the oldest and largest savings bank in the United States. Here, he developed and administered the bank's econometric deposit forecast model. In 1981, he explained the rationale behind the use of macroeconomic modeling in retail banking:

> The old, stable world of banking is gone, and with it the once-comfortable world of bank decision making. In its place, we have exploding bank technology, regulatory uncertainty and economic instability. New problems demand new tools […].[2]

The bank had introduced their first full-scale model in 1978 in the midst of the stagflation period. It was not alone. Until the 1970s, deposit forecasts of retail banks in the United States were not unlike weather proverbs and usually confined to predict seasonal variations. Yet by 1979, most large commercial banks in the US had introduced some kind of formal economic forecasting technique.[3] This raises the question, what made econometric models superior to the old forecast techniques?

These two seemingly independent instances are connected by the overarching question of how to make economic forecasts of financial flows in the presence of fundamental change. Both instances point to the increasing volatility and unpredictability of deposit flows. Most scholars dealing with the post-war history of the American banking industry agree that in the mid-1960s, a period of rapid

[1] Gramlich, Edward M.; Jaffee, Dwight M., Savings Deposits, Mortgages and Housing. Studies for the Federal Reserve-MIT-Penn Economic Model, Lexington et. al. 1972, 246 FN 7.
[2] Gibson, Charles W., Using Models in Financial Planning, in: The Journal of Business Strategy, 2/1 (1981), 39-51, 39.
[3] Giroux, Gary Alan, Financial Forecasting in Commercial Banks: An Industry Survey, Diss. (Texas Tech University), 1979.

change and volatility began, which lasted at least until the early 1990s.[4] During this period, American banks entered a period of fundamental transformation that changed the entire industry almost beyond recognition. Allen Berger et al. interpret this fundamental change as the result of the transformation of a bank monopsony into a competitive market. While banks profited from artificially low cost of funds under the regime of Regulation Q, they had to start paying market prices after deregulation.[5] Other authors agree that it was not deregulation but competition and technological innovation that drove that change and forced the government to abandon Regulation Q in the early 1980s.[6]

This article aims at bringing together the above two instances in a historical analysis. First, I explore how the fundamental change in the US banking industry provoked changes in the macroeconomic models that simulated the market for savings deposits. These changes reflect a learning curve inside the economics departments of the Fed and retail banks. Both had to adjust their expectations of deposit flows to their changing experience. Second, I describe how the same changes in the market affect the utility of these models for their users. Naturally, retail banks had a different interest in the econometric modeling of deposit flows than the Fed. They used deposit forecasts primarily as a basis for their liquidity strategies, in the budgeting process and in long-term planning efforts on the company level. Conversely, the Fed used its model in the wider context of forecasting the future of the entire US economy and the impact of certain economic and monetary policies. It is not the aim of this article to assess the accuracy of the models. Instead, I will look at the contemporary assessment and critique of the quality of the forecast as a possible source for change.

To achieve this aim, I analyze actual econometric models in their historical appearance. The repeated revisions of the econometric models make them an excellent historical source for tracking the learning process of banks with regard to changes in the determinants of deposit flows. First, I introduce two models of the deposit market that were integrated into the original 1970 FMP model of the Federal Reserve Board. In a second step, I turn to the econometric forecasting methods of retail banks. In this context, I present the deposit-forecasting model of the Philadelphia Savings Fund Society (PSFS). This case study explains the changes to the PSFS model in the historical context of a large savings bank struggling to survive a period of extreme uncertainty. Moreover, PSFS is used as a case study to explore the changing utility of macroeconomic forecast models for retail bank managers. Finally, I look at the 1985 version of the FMP model in order to find out if the changes made to the original version reflect the experiences that are contained in the various versions of the PSFS model.

To the best of my knowledge, this article is the first attempt to use econometric models as a historical source to uncover changes in economic actors' perceptions of economic interrelations. Until recently, the history of the practical application of macroeconomic models was largely unknown. Research in this area was confined to articles of former practitioners or employees of central banks.[7] Only in the

[4] For commercial banking see: Hendrickson, Jill M., Regulation and Instability in US Commercial Banking. A History of Crises, Basingstoke; New York, 2011; Berger, Allen N.; Kashyap, Anil; Scalise, Joseph M., The Transformation of the US Banking Industry: What a long strange Trip it's been, Brookings Papers on Economic Activity, Vol. 1995, No. 2, 55-218. For the Savings&Loan industry see: Walker, Dustin R., Unleashing the Financial Sector. Home Loan Deregulation and the Savings and Loan Crisis, Diss., Santa Barbara, 2017; Mason, David, From Buildings and Loans to Bailouts. A History of the American Savings & Loan industry 1831-1995, Cambridge, MA 2004.
[5] Berger et.al., Transformation, 61.
[6] Nocera, Joseph, A Piece of the Action: How the Middle Class joined the Money Class, New York et. al., 1994.
[7] This is also true for the only major work in this area: Bodkin, Ronald G.; Klein, Lawrence R.; Marwah, Kanta, A History of Macroeconomic Model-Building, Aldershot 1991. See also: Brayton, Flint; Levin, Andrew; Tryon, Ralph; Williams, John, The Evolution of Macro Models at the Federal Reserve Board, in: Public Policy Vol. 47 (1997), 43-81; Webb, Roy H., Two Approaches to Macroeconomic Forecasting, in: Federal Reserve Bank of Richmond Economics Quarterly, 85/3 (1999), 23-40.

last years have scholars begun to engage in uncovering the history of the most prominent macro models.[8]

2. Portfolio theory and the development of deposit models in the 1960s

In the 1960s, several scientific institutions throughout the United States began to develop computer-based macroeconomic models aimed at simulating the entire US economy. Since the models were mostly named after the institutions where they were created, the names point to the prominence of their place of origin: the Brookings model, the Wharton model, the Saint Louis model and the FMP model (named after the Federal Reserve Board, the MIT and Penn State University). Many of these large models built on earlier attempts to create models of specific sectors of the economy. As for the financial sector, the two most important models, Brookings and FMP, used equations that had their origins in the early 1960s at the Social Science Research Council (SSRC).[9] Here, Frank de Leeuw had worked on a financial sector model since 1961. He was soon joined by Franco Modigliani (MIT) and Albert Ando (Penn State). Together with Stephen Goldberg, a PhD student of Albert Ando, de Leeuw created a financial sector model that laid particular emphasis on the banking sector. Thus, contrary to the take of standard histories of macroeconomics, the early models had a strong focus on the role of banks in the economy.[10]

Early on, de Leeuw found that he could not build on a worked-out economic theory that would explain the behavior of actors within the financial markets. Instead, he based his model on "preliminary empirical explorations of financial behavior."[11] He also formalized the interrelations that constituted this market in the process of creating the economy-wide models. Thus, the first formal models that emphasize the market for savings deposits stem from the mid-1960s.[12]

Fundamental to all attempts to construct a monetary sector of the US economy was the portfolio theory as proposed by Harry Markowitz and James Tobin. In 1952, Harry Markowitz introduced a new theory to solve the economic problem of portfolio selection.[13] The basic idea of this theory is that investors choose financial assets by maximizing utility using two parameters: expected return and risk. It is also called the mean-variance approach because it is based on the idea that both expected return and risk can be approximated by a probability distribution, where expected return is the weighted mean of possible returns and risk is the size of the variance in the return (as measured by standard deviation). Following from these assumptions, the portfolio theory postulates that asset choice is determined by the desire of investors to increase their overall expected return and/or reduce the overall risk. Since investors are assumed to be rational risk-averse economic actors, they will only accept an

[8] The first relevant contribution by historians is a special issue of "History of Political Economy". See: Boumans, Marcel; Duarte, Pedro Garcia (Eds.), The History of Macroeconomic Modeling, History of Political Economy, 51/3 (2019).

[9] Acosta, Juan; Rubin, Goulven, Bank Behavior in large-scale Macro-Econometric Models of the 1960s, in: Ibid., 471-491, 471f

[10] Ibid., 472.

[11] De Leeuw, Frank, A Model of Financial Behavior, in: Duesenberry, James et. al. (Eds.), The Brookings Quarterly Econometric Model of the United States, Chicago 1965, 464-530, 466. Quote taken from: Acosta/Rubin, Bank Behavior, 474.

[12] For the demand for deposits, see: De Leeuw, Frank, A Portfolio Model of Household Saving and Investment, Mimeographed 1966. For the supply-side, see: De Leeuw, A Model; Goldfeld, Stephen M., Commercial Bank Behavior and Economic Activity. A structural Study of Monetary Policy in Postwar United States, Amsterdam, 1966; Jaffee, Dwight M., The Determinants of Deposit-Rate Setting by Savings and Loan Associations, in: Journal of Finance, 70/3 (1970), 615-632.

[13] Markowitz, Harry, Portfolio Selection, in: The Journal of Finance, 7/1 (1952), 77-91.

increase in risk if they get overcompensated by increasing expected return. This need for overcompensation is called the risk premium. Following Markowitz, every investment has to be understood as a result of decisions by portfolio-optimizing rational investors.

James Tobin amended Markowitz's theory by integrating his own theory of money demand into the portfolio selection approach.[14] In 1963, Tobin integrated bank deposits into portfolio selection theory, thereby introducing the concept of imperfect substitution.[15] Thus, if the expected return of an asset would rise, an investor would readjust their portfolio by buying the higher yielding asset and selling some of the other assets in their portfolio. The amount of exchange is determined by the rate of substitution between the assets in question. The rate of substitution is determined in part by the covariance of returns and in part by other properties such as liquidity and risk. Tobin conceptualized deposits as close but imperfect substitutes for money holdings.

The great value of portfolio theory to creators of econometric models was that, in principle, it applied to all investors alike. At least in theory, financial institutions invested in a similar way as the state, corporations or households. However, the portfolio theory had some implications that complicated its practical application in macroeconomic models. In the absence of a consistent economic theory of imperfect substitution, the rates of substitution had to be determined empirically. Another major obstacle was the constraint that arose from balance sheet identities.[16] If – as Tobin assumed[17] – the amount of wealth was given, an increase in one asset had to be accompanied by an equivalent decrease in the holding of the other assets in a portfolio, thereby influencing the demand for those assets and eventually their return.

A more general problem with the portfolio theory was its inability to explain expectation formation. According to the theory, investors (banks or households) decided upon expected rates, not current rates. However, as both Markowitz and Tobin explained at the end of their foundational articles, the mean-variance approach did not replace theories of expectation formation but rather complemented them. Thus, the creators of the macro models had to find an expectation theory that would fit the reality of the financial markets. Two main approaches were discussed among model builders of the 1960s: Keynes's concept of the "normal rate" and Dusenberry's idea of trend extrapolation. Keynes postulated that investors could not know future interest rates due to fundamental uncertainty. Instead, investors formed a collective convention of a normal rate that was based on historical experience. In the long term, investors believed that the current rate would approach this normal rate. However, Dusenberry suggested that the expected interest rate was rather an extrapolation of the past trend. Thus, if interest rates had risen in the past, investors would expect it to rise further. Frank de Leeuw combined both approaches to find that in the short run, extrapolative expectations might dominate, while in the long run, the rate would approach the normal rate.[18]

However, this solution called for a complex distributed lag structure. Usually, adaptive expectations were formalized by a simple lag structure that informally accounted for the myopic nature of economic

[14] Tobin, James, The Interest Elasticity of the Transactions Demand for Cash, in: Review of Economics and Statistics, 38 (1956), 241-247; Ibid., Liquidity Preference as Behavior Towards Risk, in: Review of Economic Studies 25/2 (1958), 65-86.
[15] Tobin, James, Commercial Banks as Creators of 'Money'. Cowles Foundation Discussion Paper No. 159, 1963.
[16] Brainard, William C.; Tobin, James, Pitfalls in Financial Model Building, in: The American Economic Review, 58/2 (1968), 99-122.
[17] Tobin, James, A General Equilibrium Approach to Monetary Theory, in: Journal of Money, Credit and Banking, 1/1 (1969), 15-29.
[18] De Leeuw, Frank, A Model. For a formal discussion of the different forms of expectation formation, see: Modigliani, Franco; Sutch, Richard, Innovations in Interest Rate Policy, in: American Economic Review, 56/1&2 (1966), 1978-197, 185f.

actors. Thus, the impact of a change of the explanatory variable would decline linearly over time. De Leeuw's expectation theory, however, combined two different lag structures that had different time periods and properties. Here, the work of Shirley Almon helped.[19] Almon suggested that any lag structure could be approximated by a polynomial, whereas the degree of the polynomial is smaller than the number of lags.

Both Markowitz and Tobin's portfolio selection theory and de Leeuw's approach to expectation formation featured prominently in the emerging FMP model of the US financial sector. In the next section, I will highlight the particular importance of these theories for the creation of the model for savings deposit flows.

3. Savings deposits among the FMP model of the Federal Reserve, 1970

Savings deposits entered the FMP model rather late in the development process. They were introduced in 1969 as a restraint on housing starts. This is due to the fact that, at that time, houses were financed primarily by savings institutions, such as savings and loan associations and mutual savings banks. In the model, savings deposits represented the main proxy for credit rationing, because the relative availability of savings deposits determined the availability of mortgages.[20] As a restraint on housing starts, savings deposits represented one of only three transmission channels of monetary policy in the original model.

The integration of savings deposits into the model was complicated by the fact that two separate groups had worked on this task. On the one hand, Edward Gramlich and David Hulett created a comprehensive model of supply and demand for savings deposits. On the other hand, Franco Modigliani had worked on another deposit demand model with Myron Slovin, using his findings to create a model that could predict deposit rate settings.

Deposit demand

The following portrayal of both models is based on a publication of Edward Gramlich and Dwight Jaffee from 1972.[21] Both models differentiated between the supply side and the demand side of savings deposits. The quantity of savings deposits was determined by household demand. Both equations that constitute the deposit flow model are informed by the portfolio approach of Markowitz and Tobin.[22] Thus, the volume of savings deposit flows depends on the portfolio choice of households constrained by the overall volume of investable funds (i.e. wealth).

At the heart of both models is the premise that the demand for any asset is determined by its elasticity to rate differentials between its own rate and that of competing assets. Thus, a rise in return of the respective asset should increase demand, if the return of all other assets does not change. If the return on an asset does not change but the return on one or several competing assets rises, demand will decrease. The coefficients that determine the rate of substitution are determined empirically by determining the covariance of the return of the respective assets based on quarterly data from the US since the 1950s.

[19] Almon, Shirley, The Distributed Lag between Capital Appropriations and Expenditures, in: Econometrica, 33/1 (1965), 178-196.
[20] Acosta/Rubin, Bank behavior, 486f.
[21] Gramlich/Jaffee, Savings Deposits.
[22] See previous section.

The main dependent variables of the model constitute the deposit market: passbook savings deposits at commercial banks, savings and loan shares (passbooks) and mutual savings bank deposits.[23] For all other assets, both models use proxies. The opportunity costs of short-term assets were approximated by the three-month Treasury bill rate (T-bill rate). The corporate bond rate represented the opportunity costs of long-term assets. Common stock had no distinct proxy; instead, it is approximated by a combination of the bond rate and the expected rate of inflation. The latter enters the equation as a measurement for the opportunity cost of holding financial and real assets during inflationary periods.

While the theoretical models of deposit demand were centered on the portfolio selection theory and the theorem of imperfect substitution, the empirical tests of both models using quarterly data ranging from 1954 to 1969 found little evidence for this theory. Gramlich and Hulett especially struggled with the results of very low cross elasticities of the different types of savings deposits. These results imply that investors of one type of savings deposits do not react to changes in the price of other types of savings deposits. The authors suspected the regulation of interest rates to be responsible for this lack of elasticity, because it made all deposit rates almost perfectly collinear.[24] All other rate variables had only selective influences. The corporate bond rate had a significant influence on both commercial bank deposits and S&L deposits. The latter were also responsive to changes in the inflation rate, though this influence was small. The authors suggested that this effect may be due to a possible substitution effect from equities.

In the short term, Modigliani's findings were similar to those of Gramlich and Hulett. He even found that initially, savings deposits were inelastic not only to each other but also to other market rates. Instead, they seemed to increase steadily and proportionally with wealth. However, Modigliani found the long-term effect of changes in competing rates to be much stronger than Gramlich and Hulett suggested. The reason for this outcome was a fundamentally different lag structure that was caused by a different understanding of the expectation formation of investors.

Modigliani assumed that the response to changes in competing rates was very slow. In his deposit demand model, he identified two main causes of the slow response. First, the *portfolio-rebalancing lag* was mainly caused by the transaction costs of adjustments. While Modigliani acknowledged the existence of this mechanism, he found it not nearly as important as the second cause of the lag structure: the *learning-expectational lag*. This lag has two sources. First, households show significant inertia in habits and thus do not change their investment patterns over longer periods, even though price changes would suggest a rebalancing to be efficient. Second, households hold interest rate expectations that are informed not just by the current rate of return, but also by past rates. Thus, their interest expectations are sticky. According to the model, the *learning-expectational lag* leads to a subjectively optimal portfolio selection that is significantly different from an objectively efficient portfolio choice, as informed by Markowitz' theory. Only in the long run do these two optima converge. While the subjective optimum is not observable, Modigliani approximated its value by assuming that the current portfolio is at least very close to the currently desired portfolio. Thus, he intentionally omitted the *portfolio-rebalancing lag*.[25] Modigliani estimated the rate of adjustment from the perceived to the actual optimal share of savings deposits with regard to wealth. In his favorite version, the rate was at roughly 4% per quarter. Thus, it took an investor many years to adjust the share of savings deposits to

[23] The model also includes insurance reserves. However, they will not be discussed here, in order to stay consistent with the discussions of the later revisions of the model.
[24] Gramlich, Edward M.; Hulett, David T., The Demand for and Supply of Savings Deposits, in: Gramlich/Jaffee, Savings Deposits, 13-62, 25 FN 11.
[25] Modigliani, Franco, The Dynamics of Portfolio Adjustment and the Flow of Savings through Financial Intermediaries, in: Ibid., 63-102, 64-66.

the optimum ratio.[26] By contrast, the Gramlich-Hulett model featured a simple lag structure for all interest rates that distributed the impact of a change in one rate evenly over six quarters. For the inflation rate and capital gains, Gramlich and Hulett used a linearly declining lag structure that also extended over six quarters. The relatively short lag structure of Gramlich and Hulett hints at the dominance of the *portfolio-rebalancing lag* in their model.[27]

Modigliani further improved his results by subdividing the period under consideration. While Gramlich-Hulett treated the entire postwar period in one block, Modigliani set a clear break in 1962. This was due to the introduction of certificates of deposits (CDs) by commercial banks in that year. By introducing this break, Modigliani was better able to explain the troubling result that differentials in the interest rates of savings deposits among the three banking groups had no significant impact on deposit flows. Modigliani demonstrated that the insignificance of competing deposit rates was in fact a feature of the early period. From 1962, the rates of competing depository institutions had a significant impact on deposit flows. Thus, the behavior of households in the deposit market had changed during the period. After 1962, they seemed to notice relative price differentials among the distinct banking groups. The increased competition among banking groups also increased the responsiveness of deposits at savings institutions to changes in the money market rate. Before 1962, deposits at savings institutions were only oriented towards the capital market. From 1962, the money market became a bit more influential to deposit flows at savings institutions.[28]

Both models contained non-rate variables that influenced portfolio choice through other channels than price. The first variable was the ratio of disposable income to wealth. Under the Gramlich-Hulett model, this variable was positively related to all savings deposits. Thus, a rise in the ratio of disposable income to wealth would increase the ratio of savings deposits at the expense of all other assets. The authors explain this effect by referring to the link between income and transaction volume. Thus, rising income leads to a higher demand for transaction purposes. Modigliani used this relationship to explain why he only found a positive effect of income on commercial bank passbooks, while deposits at savings institutions were negatively affected by rising income. He suggested that households use commercial bank passbooks at least in part as a short-term store of purchasing power. Therefore, commercial bank deposits profited from rising income. The negative correlation between income and deposits at savings institutions is due to the fact that during this period, savings institutions did not offer demand deposits and therefore were not used as liquidity buffers.

Another non-rate variable was capital gains. In the data period, capital gains actually contributed more to the rise in net wealth than savings. Thus, capital gains were quite important. However, since the gains were not realized among savings deposits, capital gains initially forced the share of savings deposits down. This effect applies to both models. The negative impact wanes over time due to the real location of these gains along portfolio lines. Modigliani found the proportion of capital gains that were reallocated in each quarter to be roughly 20%. Gramlich and Hulett introduce a linearly declining distributed lag over six quarters. However, increases in capital gains have a lasting effect in the Gramlich-Hulett model, while they disappear in Modigliani's model due to the latter's much longer lag period.

While the deposit supply side was an integrated part of the Gramlich-Hulett model, Modigliani did not create his own model. Instead, Myron Slovin created a model to account for deposit rate setting of depository institutions, largely relying on Modigliani's model of deposit demand.[29] However, Slovin

[26] Ibid., 80f.
[27] Gramlich/Hulett, Demand, 19-23.
[28] Modigliani, Dynamics, 73-75.
[29] Slovin, Myron, Deposit Rate Setting at Financial Institutions, in: Gramlich/Jaffee, Savings Deposits, 103-138.

also helped Gramlich and Hulett to complete their model. This is the main reason why both models have a lot in common.[30]

Table 1: Determinants of savings deposits according to the FMP Model of 1970

A. Gramlich-Hulett-model – dependent variables: savings deposits

Variable	Affected Deposits	Correlation	Long-term Impact
Commercial bank rate	Mutual savings banks	Negative	Medium
S&L rate	None	-	-
Mutual rate	None	-	-
Corporate bond rate	S&L	Negative	Medium
T-bill rate	Commercial banks	Negative	Medium
Inflation rate	S&L	Negative	Weak
Disposable income	All	Positive	Strong
Capital gains	All	Negative*	Medium
Time trend	S&L	Positive	Strong

Source: Gramlich/Hulett, Demand. * While capital gains have an overall positive effect on savings deposits, the Gramlich-Hulett model looks at the share of savings deposits in total wealth. Because capital gains are usually distributed across the portfolio with a considerable lag, they have a temporary negative impact on the share of savings deposits.

B. Modigliani model – dependent variables: savings deposits

Variable	Aff. Deposits	Correlation	Impact
Comm. bank rate (<1962)	None	-	-
Comm. bank rate (>1962)	S&L, mutuals	Negative	Strong
S&L rate (<1962)	Mutuals	Negative	Strong
S&L rate (>1962)	Comm., mutuals	Negative	Strong
Mutual rate (<1962)	S&L	Negative	Strong
Mutual rate (>1962)	Comm., S&L		
Corporate bond rate	S&L, mutuals	Negative	Medium
T-bill rate	All	Negative	Medium (comm.) Weak (S&L, mutuals)
Disposable income	All	Positive (comm.) negative (S&L, mutuals)	Strong
Time trend (<1966)	S&L	Positive	Strong
Time trend (>1966)	None	-	-

Source: Modigliani, Dynamics.

Deposit supply

Both models are centered on the question of how banks set deposit rates. While banks were able to set their deposit rates at their discretion, the individual bank could not change the overall quantity of deposits. Instead, banks competed for deposits. In both models, the setting of own rate mainly depended on a generic competitive rate that was composed of the weighted average of the yields of competing assets. As weights, both models used the cross elasticities that were calculated in the deposit demand models. While Gramlich and Hulett used their own estimates, Slovin used Modigliani's

[30] Gramlich/Hulett, Demand, 32, FN 16.

results. All three authors found a large variety of lag lengths and structures. Gramlich and Hulett used a mean lag for comparison that measured at what point half of the impact had been realized. I also adopted this measurement for Slovin's model. The detailed results are presented in Table 2.

The empirical tests of the Gramlich-Hulett model confirmed the significance of the competitive rate as a determinant of all deposit rates. Slovin confirmed, for deposit rates, Modigliani's finding of a strong increase in cross elasticities among different types of savings deposits. In contrast to Gramlich and Hulett, he found that the competitive rate was more significant for savings institutions than for commercial banks. Gramlich and Hulett found a diverse lag structure for the competitive rates, with the mean lag ranging from one quarter at mutual savings banks to a year for commercial banks. Slovin's mean lags on the competitive rate are shorter, ranging from less than one quarter to two quarters.

The influence of the banks' own assets on the deposit rate differed widely. Both models used the mortgage rate as the only relevant asset rate for savings institutions. Under the Gramlich-Hulett model, the mortgage rate had a strong influence on S&L associations and a medium impact on mutuals. Interestingly, the impact of the mortgage rate on the S&L deposit rate featured a nine-quarter lag structure, while mutuals adjusted to changes in the mortgage rate in just two quarters. Slovin found similar results, except for the lag structure that was similar among S&Ls and mutuals. Among commercial banks, Gramlich and Hulett found no evidence of an influence on asset rates. Slovin, by contrast, found a very strong effect of changes in the asset rates on the deposit rates at commercial banks. In order to measure this effect, Slovin created a composite rate of the various asset classes held by commercial banks, including commercial loans and corporate bonds. Another important influence on the deposit rate was the differential between asset and deposit flows. The rationale behind this variable was that if assets like mortgages grow faster than deposits, then intermediaries would have to raise the deposit rate in order to bring deposit growth in line with asset growth.

Table 2: Determinants of deposit rates according to the 1970 FMP model

A. Gramlich-Hulett-model

Variable	**Main impact variables**	**Correlation**	**Impact**	**Lag length (mean lag)**
Competitive Rate *(comm. Banks)*	Mutual Rate, T-Bill Rate	Positive	strong	9 qt (mean lag: 4,3 qt)
Competitive Rate *(S&L)*	Corporate Bond rate	positive	strong	4 qt (mean lag: 2,2 qt)
Competitive Rate *(Mutuals)*	Comm. Bank rate	positive	medium	5 qt (mean lag: 1,2 qt)
Asset rate (S&L)	Mortgage Rate	positive	strong	9 qt (mean lag: 5,2 qt)
Asset rate (Mutuals)	Mortgage Rate	positive	medium	2 qt (mean lag: 0,7 qt)
Difference Asset/Deposit (comm. Banks)	commercial loans/ Demand and time deposits	positive	strong	-
Difference Asset/Deposit (S&L)	Mortgages/Savings Deposits	positive	strong	9 qt (mean lag: 5,2)
FHLBB Advances (S&L) < 1962	-	positive	strong	-
Ceiling rate (comm. Banks)	-	positive	strong	-

Source: Gramlich/Hulett, Demand.

B. Slovin-model

Variable	Main impact variables	Correlation	Impact	Lag length (mean lag)
Competitive Rate *(Comm. Banks)* <1962	T-Bill rate	positive	medium	4 qt (mean lag: 1,5)
Competitive Rate *(Comm. Banks)* >1962	T-Bill rate, S&L rate, Mutual Rate	positive	medium	2 qt (mean lag: 0,7)
Competitive Rate *(S&L)* <1962	Corporate Bond rate; Mutual Rate	positive	strong	5 qt (mean lag: 2)
Competitive Rate *(S&L)* >1962	Comm. Bank rate; Corporate bond rate	positive	strong	4 qt (mean lag 1,5)
Competitive Rate *(Mutuals)* <1962	S&L rate; Corporate bond rate	positive	strong	5 qt (mean lag: 2)
Competitive Rate *(Mutuals)* >1962	Comm. Bank rate; Corporate bond rate	Positive	strong	4 qt (mean lag: 1,5)
Asset rate (comm. Banks)	Corporate loans; Mortgages; Municipal securities	Positive	strong	8 qt (mean lag: 6,4)
Asset Rate (S&L)	Mortgages	positive	strong	10 qt (mean lag: 3,6)
Asset Rate (Mutuals)	Mortgages	positive	strong	10 qt (mean lag: 3,8)
Diff. Asset/Deposit change (Comm. Banks) >1962	Commercial Loans; Mortgages / Demand Deposits; Time Deposits	Positive	strong	6 qt (mean lag: 2,7-3,5)
Diff. Asset/Deposit change (S&L)	Mortgages / Deposits	Positive	strong	9 qt (mean lag: 5,7)
Diff. Asset/Deposit change (Mutuals)	Mortgages / Deposits	Positive	Very strong	9 qt (mean lag: 5,2)
Ceiling rate (Comm. Banks)	Change of Rate Ceiling	constraint	-	10 qt (mean lag: 3,5)

Source: Slovin, Interest Rate Setting. *The effect of the savings and loan and mutual savings deposit rates has been combined. Only the combined rate has a strong effect on commercial banks, while the influence of the rates of the individual groups is unknown. However, since S&L and mutual rates are very closely interrelated, the combined rate is usually the same as the individual rates.

During the period under consideration, the interest rates of depository institutions were capped by mandatory ceilings under the mandate of Regulation Q. However, until 1966 only commercial banks were subject to interest rate regulations. Only in 1967 were ceilings on deposit rates extended to savings institutions. This is why in both models, ceiling variables only influenced commercial bank deposits. In the Gramlich-Hulett model, the ceiling rate influences the passbook deposit rate in two ways. First, the authors distinguish between the actual rate and a hypothetical desired rate that banks would have offered without the ceiling rate. Here, the ceiling works as a constraint. However, the Gramlich-Hulett model also assumes that the ceiling acts as a price leader in an oligopolistic market by also influencing the desired rate. Thus, the ceiling not only limits the options of commercial banks in the context of rate decisions but also alters what commercial banks view as the appropriate rate. Slovin denied this second influence and solely treated ceilings as constraints.

In the last chapter of their book, Gramlich and Jaffee compared the two models by looking at the performance of the models during simulation tests.[31] Here, the combined Modigliani-Slovin model proved to be superior in almost all aspects mainly because of the functional periodization.[32] This fact led to Gramlich and Jaffee's criticism of Modigliani as illustrated in the introduction. The argument between these famous economists was about the question of what a good forecast should accomplish. The Gramlich-Hulett model opted for theoretical clarity, while Modigliani chose empirical accuracy. As the next section will demonstrate, the latter strategy was preferred by a new group of users: retail banks.

4. The Deposit Forecast Model of the Philadelphia Savings Fund Society (PSFS), 1978–1985

The above questions were raised not only by the creators of sophisticated macro models at the Fed, but also by a fast-growing group of economists working in the retail banking industry. In the early 1970s, large retail banks began to introduce econometric models for forecasting purposes. By the end of the decade, the practice had become widespread at least for large and medium-sized banks. In 1979, a dissertation by Gary Giroux presented the results of a nationwide survey on forecasting techniques of commercial banks.[33] Giroux differentiated between "sophisticated" and "non-sophisticated" forecasting methods. Multiple regressions, econometric models and input-output analysis were among the "sophisticated" methods, while techniques such as expert panels, exponential smoothing of time series and individual judgement were considered "non-sophisticated.[34]

Among large banks (more than $500 million worth of deposits), sophisticated techniques were quite common. About two thirds used one of them for forecasting purposes. However, only a few medium-sized ($100–500 million) and almost no small banks (less than $100 million) used sophisticated techniques. Instead, the vast majority of small and medium-sized commercial banks relied solely on individual judgement as the forecasting method.[35] Thus, econometric methods had entered the retail banking sector by 1979, but they had not been rooted deep. Only the large banks had adopted these new techniques on a large scale. Interestingly, Giroux found no relationship between the use of sophisticated forecast techniques and bank performance.[36]

With regard to deposit forecasting, more than 20% of large banks used regression analysis and almost 20% full-scale econometric models to forecast time deposits.[37] Giroux explained the common utilization of these techniques in this area with the potentially strong correlation of deposits with specific economic variables such as personal income.[38] In another part of the dissertation, Giroux discussed several published analyses of deposit forecasting. Among them were forecast models developed by

[31] Gramlich, Edward M.; Jaffee, Dwight M., The Behavior of the three Sectors together, in: Ibid. (Eds.), Savings Deposits, 235-301.
[32] Ibid., 245f.
[33] Giroux, Financial Forecasting.
[34] Ibid., 61.
[35] Ibid., 72, 83, 89.
[36] Ibid, 112.
[37] Ibid., 79.
[38] Ibid., 78.

Dwight Crane and James Crotty for demand deposits and Kenneth Spong and Thomas Hoenig for demand and time deposits.[39] The latter had produced a time series regression that featured several independent variables. Among them was a permanent income variable within the individual banking market, the differential between the short-term Treasury bill rate and the average time deposit rate, and the change in the market share of savings and loans associations relative to commercial banks within the individual market of the bank. Thus, the forecast models designed for individual depository institutions shared many of the same variables that were used in the macro models.

The original PSFS model of 1978

In order to understand the dynamic relationship between model predictions, experience and model modification, I now turn to the case of the Philadelphia Savings Fund Society (PSFS), the oldest and largest savings bank in the US. Some general information about forecasting at PSFS has been published by Charles Gibson, who was in charge of the econometric model at the bank.[40] Accordingly, the bank started to develop the Deposit Forecast Model in 1976, mainly relying on the expertise and economic data of Data Resources Inc. (DRI), an economic research company co-founded by Harvard economics professor Otto Eckstein. In 1977, the first version of the model was ready for testing.[41] In April 1978, the financial planning unit that was responsible for the development of the model took an effort to explain to a largely ignorant board the nature of econometric forecasting:

> A model is not a crystal ball, but rather a tool which can order and analyze experience, and simulate a range of future occurrences. […] This model enables PSFS to look to the future with more assurance than has formerly been possible.[42]

A comparison between the FMP and the PSFS models is only possible in a broad qualitative way. One major obstacle is the scope of these models. The PSFS was not interested in the same questions as the Federal Reserve. It did not ask for the effectiveness of the transmission channels of monetary policy. Contrariwise, the Fed was not interested in the deposit flow to individual banks but only to entire groups of institutions. Many of the differences stem from this different scope rather than from the expertise of the involved people. Of course, it is hard to ignore the fact that the FMP model was created over the course of many years by economists who were among the most important scholars of their generation. Economists at retail banks had neither the same resources nor the same expertise. Thus, some of the differences stated below are due to these asymmetries. When compared to the FMP model, the PSFS model had a much simpler structure. There are no distributed lags or similar mechanisms that would provide for delayed responses by either banks or customers to changes in important variables. Instead, the model features a large number of dummy variables for seasonal and one-time variations of deposit flows.

All versions of the PSFS model measure savings deposit flows in absolute terms, while the FMP model looks for changes in the ratio of savings deposits to wealth. This difference is due to the different scope of the model. The PSFS was interested in deposit flows, not in the entire portfolio of households. The

[39] Crane, Dwight B.; Miller, Robert B., Development of a Deposit Forecasting Procedure for use in Bank Financial Management, in: Journal of Bank Research, Summer 1973, 122-138; Spong, Kenneth; Hoenig, Thomas, An Examination of individual Bank Growth. An empirical Analysis, in: Journal of Bank Research, Winter 1977, 303-310.
[40] Gibson, Using Models.
[41] Ibid., 41.
[42] PSFS Deposit and Cash Flow Model, Agenda of Board Meeting of April 14, 1978, in: Hagley Museum and Library, Accession 2062: Philadelphia Saving Fund Society Archive (PSFS Archive), Record Group I, Subgroup 2, Series B (RG I/2-B), Box 13.

original model used only four independent variables as predictors: The difference between the 90-day T-bill rate and the PSFS passbook rate, the level of personal income in Pennsylvania, the unemployment rate in Pennsylvania and the differential between the PSFS passbook rate and the rates at competing commercial banks.[43] The use of rate differentials to explain deposit flows is in line with both the theoretical and the empirical FMP models. In both models, income features as one of the main predictors of savings flows. Also in both models, the rate of commercial bank time deposits featured prominently as a predictor of deposit flows at mutual savings banks. The T-bill rate has not been an important predictor of mutual savings deposits under the original FMP model, while the unemployment rate did not occur at all. Under the PSFS model, however, these two variables were key to explain savings deposit flows at PSFS.

Table 3: Savings deposit flows at PSFS deposit forecast model, 1978 version

Variable	Correlation	Influence
Rate difference: 90-day T-bill rate minus PSFS passbook rate	Negative	Strong
Rate difference: passbook rate of competitors *minus* own rate	Negative	Weak
Unemployment rate	Positive	Strong
Personal income in Pennsylvania	Positive	Weak

Source: PSFS Deposit and Cash Flow Model, Agenda of Board Meeting of April 14, 1978, in: Hagley Museum and Library, Accession 2062: Philadelphia Saving Fund Society Archive (PSFS Archive), Record Group I, Subgroup 2, Series B (RG I/2-B), Box 13.

The strong negative relationship between the T-bill rate and PSFS passbook flows is compatible with the portfolio theory and draws directly on the experience of *disintermediation*. This term was invented in the late 1960s to describe the phenomenon of strong outflows of deposits into the money and capital markets.[44] The flows were caused by large interest spreads between money market and deposit rates. Among scholars of US banking, the phenomenon of disintermediation is not without controversy. While all scholars agree that it had a transformative effect on depository institutions and regulative authorities, the exact timing of disintermediation as a transformative force is open for debate. While many contemporary accounts and a part of the literature point to 1969 as the first occurrence of disintermediation, recent publications understand the credit crunch of 1966 as its first showing.[45] A similar disagreement exists with regard to the question of when the transformative influence of disintermediation ended. Until recently, most scholars focused on the last period of disintermediation that was caused by the emergence of money market mutual funds (MMMFs) and the eventual introduction of the money market deposit account (MMDA) via the Garn-St Germain Act of 1982.[46] In a recent article, Drechsler et al. challenge this view and instead point to the introduction of market rate certificates in 1978/79 as the defining development.[47]

[43] See PSFS Business Plan 1979-1981, 6, in: Hagley, 2062: PSFS Archive, RG V/2-B, Box 68.
[44] See Woelfel, Charles, J., Encyclopedia of Banking and Finance, 10th edition, Chicago et. al. 1994, 306.
[45] See for the older tradition: Gilbert, Alton R.; Lovati, Jean M.; Disintermediation: An Old Disorder with a new Remedy?, in: Federal Reserve Bank of St. Louis Review, January 1979, 10-16; Erdevig, Eleanor, Disintermediation again?, in: Economic Perspectives, May/June 1978, 10-14; Mason, From Buildings and Loans to Bailouts, 159-186. For the more recent view, see: Walker, Unleashing the financial sector, 33-44.
[46] Berger et. al., Transformation, 61; Hendrickson, Regulation and Instability, 181; Walker, Unleashing the Financial Sector, 238.
[47] See Drechsler, Itamar; Savov, Alexi; Schnabl, Philipp, The Financial Origins of the Rise and Fall of American Inflation, NYU Stern School of Business Working Paper, February 2020, 43.

From the perspective of the econometric models, the question of when the impact of disintermediation started is difficult to answer. The original FMP model of 1970 did not account for this phenomenon, since it happened too recently to have a major influence over the entire data period. The authors of the model only verbally hinted at the effects of disintermediation in their articles.[48] In contrast, disintermediation was the prime cause of the introduction of the PSFS deposit forecast model. The main purpose of the original model was to optimize the liquidity management system of PSFS that was put in place after the 1966 period of disintermediation.[49] Prior to the introduction of the deposit forecast model, the goal of PSFS was to hold enough liquidity to endure an outflow of 6% of overall deposits within one year. Thus, the bank always had to maintain significant amounts of liquid assets to prepare for sudden deposit outflows during periods of disintermediation.[50] However, these liquidity ratios were only rule-of-thumb estimates that had no formal or econometric background. The deposit forecast model was introduced to help develop a more efficient liquidity strategy:

> Deposit forecasts of some considerable accuracy are possible, thus enabling a more rational assessment of liquidity policy as it relates to deposits.[51]

The linear negative relationship between the 90-day T-bill rate and deposit flows was the prime vehicle to formalize the experience of disintermediation in the deposit forecast model.

While disintermediation was a well-established reality by the mid-70s, the positive relationship between the unemployment rate and deposit flows was a new insight. In fact, in 1978 the financial planning unit felt the need to explain to the board why unemployment correlated positively with deposit flows.[52] In an interview for an employee newsletter in 1983, Gibson later claimed that he personally found the positive correlation between deposits and the unemployment rate while working on the PSFS model:

> You wouldn't think that a rising unemployment rate is good for anybody. Actually, it's fairly good for savings banks. When unemployment statistics start going up […] you have to realize that there are a lot of people still out there working. At times like these, people are very nervous and tend to save their money in case they are laid off. We found that out when we were building our first deposit model seven years ago.[53]

It is not clear if Gibson and his team had actually been the first to integrate the unemployment rate into a deposit model. The original FMP model did not feature this variable. This is not surprising, since unemployment had been low throughout the entire postwar period. Only in 1974 did the unemployment rate rise above 7% for the first time since the war, peaking at 9% in 1975.[54] Thus, while the unemployment rate did vary in the postwar period, it did not seem to have an effect on portfolio selection, or at least the creators of the FMP model did not find it to be significant. The notion that unemployment explained to a good part the flows of savings deposits at PSFS hints at the fact that rising unemployment changed the income-risk perception of households and therefore increased demand for liquid assets such as savings deposits.

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[48] Gramlich/Hulett, Savings Deposits, 34; Slovin, Deposit Rate Setting, 122f.
[49] Report of the liquidity task force, June 14, 1980, p. 14, in: Hagley, 2062: PSFS Archive, RG XX/3, Box 137.
[50] Ibid, p. 16.
[51] Ibid, p. 17.
[52] Ibid.
[53] Model for Success. PSFS and Economic Models, in: On-Line Extra, published by the Philadelphia Savings Fund Society, Vol. 2/4, August/September 1983, p. 2, in: Hagley, 2062: PSFS Archive, RG V/1-C, Box 65.
[54] Monthly unemployment rates are taken from the US Bureau of Labor Statistics online Database, Series LNS14000000, Online-Ressource, URL: https://data.bls.gov/pdq/SurveyOutputServlet

In sum, the initial model integrated two relatively recent findings concerning the main influences on deposit flows: the experience of disintermediation and the return of income uncertainty that followed the recession of 1974/75.

The impact of the money market certificate (MMC) and the revision of the PSFS model, 1978–80

From 1978, short-term interest rates in the US started to rise substantially. This was mainly a consequence of renewed attempts of the Federal Reserve to fight a persistently high inflation rate. This fight was reinforced by a significant change in monetary policy under the newly appointed Fed chairman Paul Volcker. The Fed Fund Rate reached 15% in October 1979 and 20% in early 1980. It remained in double digits for several years, with money market rates closely following the fund rate.[55] The large spreads between the money markets and the still regulated interest rates on bank deposits led to a widespread fear among the banking community of a recurrence of disintermediation.[56]

This fear is key to understanding the rationale behind the nationwide introduction of the money market certificate (MMC) in June 1978.[57] The MMC was a savings certificate with a six-month maturity and a fixed interest rate that was tied to the prevailing interest rate of six-month Treasury bills. Thus, the rate on MMCs was still regulated. As with passbooks MMCs sold by savings institutions had a fixed-rate advantage over those sold by commercial banks. In June 1978, this rate was at about 8%, but rose to double digits by the end of the year – far above any other retail deposit rate. Hence, banks offered a relatively liquid financial asset that had a yield double that of a passbook and much higher than conventional savings certificates with maturities of up to eight years. From the customer's point of view, it was a very attractive asset.

The impact of the MMC on the deposit market depended mainly on the duration of the high-interest rate period. By intention of its creators, the MMC was a temporary device to bridge short-term peaks in the money market. It was not designed for the sustained period of high interest levels that started in 1978.[58] In this high-interest environment, the MMC became a dangerous instrument for banks. While largely preventing disintermediation, the MMC cannibalized large parts of the deposit base of the banking system.

The MMC was such a fundamental force among deposit flows that it caused a structural change to the deposit forecast model at PSFS in 1980. Charles Gibson stressed its importance amid the introduction of the revised model: "The influence of the Money Market Certificate (MMC) cannot be overstated."[59] In the previous version of the model, internal transfers from passbooks to certificates were set as a constant factor of savings flows. In the 1980 revision, there were two separate equations. First, there was the equation for regular savings deposit flows without transfers. Second, there was the equation for transfers. The combination of both equations resulted in the net savings deposit flow. The two equations were not just separated; they featured different explanatory variables.

[55] For the now classical take on the "Volcker revolution" see: Clarida, Richard; Gali, Jordi; Gertler, Mark, The Science of Monetary Policy. A New Keynesian Perspective, in: Journal of Economic Literature, 37/4 (1999), 1661-1707. For a critical view, see: Goodfriend, Marvin; King, Robert G., The incredible Volcker Disinflation, in: Journal of Monetary Economics, 52/5, (2005), 981-1015.

[56] See for a contemporary view: Godfrey, John M., Disintermediation?, in: Economic Review (Federal Reserve Bank of Atlanta), May/June 1978, 52-54.

[57] Gilbert/Lovati, Disintermediation, 10f.

[58] Savings & Loan News, June 1978, 16f.

[59] PSFS Deposit Forecast Model – 1980 Version, Attachment to the Report of the Liquidity Task Force of the PSFS as of July 14, 1980, in: Hagley, 2062: PSFS Archive, RG XX/3, Box 137.

Table 4: Savings deposit flows (before internal transfers) in the PSFS deposit forecast model, 1980 version

Variable	Correlation	Influence
Rate difference: 90-day T-bill rate *minus* PSFS passbook rate	Negative	Strong
Unemployment rate	Positive	Strong
Gasoline prices (Inflation proxy)	Positive	Weak
Equity position of households	Positive	Weak
Income tax payments	Negative	Weak

Source: PSFS Deposit Forecast Model, 1980 Version, Attachment to the Report of the Liquidity Task Force of PSFS as of July 14, 1980, in: Hagley, 2062: PSFS Archive, RG XX/3, Box 137.

The equation for savings account flows had become more sophisticated compared to the original model. The spread between the 90-day T-bill rate and the passbook rate as well as the unemployment rate remained the main variables. Additionally, inflation entered the equation via a variable for gasoline prices. Contrary to the 1970 FMP model, this inflation proxy was positively correlated to passbook flows. Similar to the unemployment variable, the creators of the model explained this positive correlation between inflation and savings deposit flows as an "uncertainty response" that manifested itself in a rise in customer liquidity demand.[60] Other new variables were changes in the equity position of households and changes in income tax payments. Changes in the equity position of households were positively correlated to savings deposit flows. This is generally compatible with the 1970 FMP model, since the latter only stated that the ratio of savings deposits in total wealth would fall in the case of rising equity values. PSFS only measured total savings deposit flows, and therefore it captured the effect of rising equity values on total wealth, which through the portfolio adjustment process would also benefit savings deposits. Changes in income taxes were negatively correlated, because rising taxes reduced disposable income and thus savings.

Table 5: Internal transfers from passbooks to certificates in the PSFS deposit forecast model, 1980 version

Variable	Correlation	Influence
Rate difference: max. PSFS certificate rate *minus* PSFS passbook rate	Positive	Strong
Expected rate of inflation	Positive	Medium
Transfers in preceding quarter	Positive	Strong

Source: See Table 4.

The additional equation that measured transfers from savings accounts to certificates contained only three regular variables. Similar to the equation for savings deposit flows, the main variable was a rate differential. In this case, it was the differential between the maximum rate on certificates and the passbook rate. The second variable was the expected rate of inflation. The third variable represented the volume of transfers in the preceding quarter. All of them are positively correlated with transfers from passbooks to certificates. Hence, they are negatively correlated to net savings deposits. Additionally, there were several dummy variables that accounted for specific events during the 1970s. Among them was the "wild card" experiment in 1973, where for a short period of time the interest rate regulation on certificates with four-year maturities was lifted. This decision triggered an unprecedented

[60] Ibid.

boom in these new certificates that could be recognized in the data even four years later, when they became due. For both the original experiment and the reinvestment period, the model featured separate dummy variables. The most recent event that demanded a dummy variable was of course the introduction of the MMC.

The third part of the model measured flows to certificates in general. It was much more complicated than the passbook equations because it had to capture sales and redemptions of certificates. The team that was responsible for the model especially struggled with the practice of premature redemptions and the ratio of mature certificates that would be rolled over. Since they did not find a good solution, they treated both variables exogenously.

Table 6: Flows of new money into PSFS certificates

Variable	Correlation	Influence
Change in household disposable income in Pennsylvania	Positive	Strong
Rate Difference: max. rate on PSFS certificates *minus* three to five-year government bond rate	Positive	Medium
Volume of transfers from passbooks to certificates	Positive	Medium

Source: See Table 4.

The most interesting equation is the "new money sales" equation: the part of certificate sales that represents new sources of funds for the bank. Strikingly, certificate sales involving new money had been almost constant over the years. The main variable is the change in disposable income. The equation also features a rate differential – the difference between the maximum rate of certificates and the three to five-year government bond rate. Another influence is the transfer volume between passbooks and certificates. Hence, transfers from savings deposits stimulate the inflow of new money. The creators of the model explained this feature with the minimum investment requirement of certificates and especially the MMC. In order to fulfil this requirement, investors supplemented their savings money with external funds.[61]

Taken together, the three equations reveal how the introduction of the MMC changed the way that high market rates affected deposit flows. First, high money market rates reduced the flow into passbooks. Second, high rates widened the spread between the passbook rate and that of the highest yielding certificate (the MMC), thereby increasing the transfers from passbooks to certificates. Since high money market interest rates are usually a response to high inflation rates, it is interesting to see how inflation influences savings deposits in the model. Increasing price levels (here, gasoline prices) increases savings deposit flows, albeit not to the same degree that high money market rates decrease flows. Conversely, rising inflation expectations increase transfers from savings deposits to certificates, thereby reducing savings deposits. In practice, the positive impact of rising gasoline prices outweighed the negative impact of rising inflation. According to the model, the overall impact of inflation on PSFS savings deposits seems to have been positive. This implies that savings deposits were reduced not by inflation itself, but by the fight against inflation via rising short-term interest rates.

[61] Ibid., 3.

By looking at the market for certificates, the MMC brought in money from passbooks and additional new money whose volume was tied to the transfer volume. In so-called "inverse" interest rate environments, where money market rates went above capital market rates, the MMC could even generate new money flows via the rate differential to government bonds. Overall, the MMC reduced the impact of high market rates on deposit flows, but it accelerated the substitution of savings deposits for high-yielding certificates.

The structural change in the deposit forecast model had far-reaching consequences for the PSFS liquidity strategy. It effectively ended the bank's focus on disintermediation:

> Liquidity policy has, for some years, viewed as its primary objective provision for disintermediation. This focus must now change in light of the market rate certificates which we already offer and in view of the removal of all ceilings within six years. We must be able to pay current rates when these ceilings are removed. […] It is evident that, in the coming world of no rate ceilings, a liquidity policy based on disintermediation would be in error. Econometric forecasting will be able to assess the potential consequences of any particular rate structure before it is implemented by management. This ability suggests that a doomsday approach to liquidity will no longer be necessary.[62]

The MMC diminished the threat of a liquidity squeeze and turned the attention of bank executives to the problem of profitability. Thanks to the introduction of the MMC and similar market-based certificates, PSFS is now able to compete with money market assets and prevent disintermediation. However, this came at a price. In order to prevent liquidity squeezes, the bank had to pay market prices on its deposits.

This consequence became clear in the 1981–1983 PSFS business plan, which was the first plan to use the revised model. A new forecast predicted the ratio of money market certificates to all deposits. In the control scenario, the ratio would rise from 46% to 71.6% in 1985. In a separate recession scenario, the ratio would rise to 65.8%%. These estimates were surprisingly accurate, since the actual ratio in 1983 was 69.6%. Thus, the revised model accurately predicted the rise of the market for money market certificates. The model also retained its accuracy regarding the passbook market by correctly forecasting its decline. However, the model was ill-equipped to simulate the market for certificates. Given the future dominance of money market certificates, this was the market that mattered.

The return of competition and the failure of the PSFS deposit forecast model in the 1980s

In 1984, Charles Gibson and other executives at PSFS were asked to analyze the reasons for the sustained negative deposit flows that started in 1979. The numbers are staggering. From 1979 to 1983, PSFS lost $1.8 billion in retail deposits from a deposit base of $5.2 billion in 1979, if interest payments are subtracted.[63] Neither the long-term forecasts in the business plans nor the yearly budget forecasts had predicted these large outflows.

[62] Report of the Liquidity Task Force of the PSFS as of July 14, 1980, 17f, in: Hagley, 2062: PSFS Archive, RG XX/3, Box 137.

[63] At the same time, total retail deposits grew from $5.2 billion to eight billion Dollars. This growth came entirely from only two sources. First, interest paid on deposits more than offset net withdrawals. Second, the merger of PSFS with Western Savings – a competing savings bank in Pennsylvania – in 1982 increased the deposit base instantly by almost two billion Dollars. PSFS Annual Report for the Year 1982, p. 11, in: Hagley, 2062: PSFS Archive, RG I/2-A, Box 5.

Why did PSFS lose so many deposits? In trying to answer this question, Charles Gibson pointed to the long-term trends of deposit flows. He found that the structure of the PSFS deposit base had fundamentally changed. The decline of the passbook was probably the most striking feature of that change. In June 1978, the month when the MMC was introduced, more than half of all deposits at PSFS were still on passbooks. By the end of 1983, it was 17%. Thus, the passbook market became almost irrelevant for the market for retail deposits. As Gibson explained in 1982, the decline of the passbook was accompanied by a fundamental change in the relationship between savings and deposits:

> The structural change is hard to put a finger on. It may well be that the psychological link between financial savings and banks (especially thrifts) has been severed for good. Not too many years ago, if one wanted to open a savings account the institution of choice was a thrift. Why? Because that's where you saved money; commercial banks were for checking. The financial services market consisted of nearly hermetically sealed compartments. Those compartments have long since disappeared and with them has gone the link between savings and the thrift industry. […] The implications of the break in this link are profound. We can no longer count on automatic reintermediation when rates fall.[64]

One of the fundamental changes in the deposit market was the shortening of maturities. Led by the MMC, maturities of deposits decreased substantially. Before 1979, the ratio of redemptions – the amount of deposits due within one year – to total liabilities was about 15%; in 1982, it was 96%. Gibson came to the conclusion that "[c]ustomers are presented with a reinvestment choice every year, which means that the chances for removal of the deposit are greater than they were in the past."[65]

The almost universal annual reinvestment opportunity increased competition for funds and reinforced another trend that was dangerous for the banking industry: the return of disintermediation via competition from money market mutual funds (MMMFs). Apart from the MMC, MMMFs were the main cause of the fundamental change in the deposit market. These funds pooled money market assets such as certificates of deposits and Treasury bills and offered retail customers fund shares that they could buy and sell any time at the current market value.[66] Starting in 1978, MMMFs grew in phenomenal pace from $10 billion at the beginning of that year to more than $200 billion in 1982.[67] During the same time, deposits at savings institutions had largely stagnated, implying that most of the growth in savings assets had gone to MMMFs. A survey showed that as much as 20% of customers of depository institutions also held MMMF shares.[68] Thus, bank customers substituted deposits for MMMF shares on a large scale. At PSFS, the MMMFs were found mainly responsible for the mismatch between forecasted and realized deposits and the stagnation of deposit flows in general.[69]

In November 1982, depository institutions took a large step to regain competitiveness vis-à-vis MMMFs with the introduction of the money market deposit account (MMDA). The MMDA was expected by virtually the entire banking industry to be a real game changer.[70] It was a savings account

[64] Deposit Trends for the third Quarter 1982, Attachment to a Memorandum by Charles Gibson to the Policy and Asset/Liability Committee from October 26, 1982, Policy Committee: Minutes 1980 - May1984, in: Hagley, 2062: PSFS Archive, RG I/2-B, Box 29.
[65] Deposit Flow Analysis, April 1984, Policy Committee: Minutes 1980 - May1984, in: Hagley, 2062: PSFS Archive, RG I/2-B, Box 29.
[66] See for a good summary of the advantages of MMMFs: Savings & Loan News, November 1979, 32-35.
[67] Mutual Fund Fact Bookyear 1983, ed. by the Investment Company Institute (ICI), Washington 1983, 17.
[68] "Thrifts take aim at Money Funds," in: Savings & Loan News, August 1982, 32-34.
[69] 1981 Deposit Forecast 7/1 Review, July 21, 1981, Policy Committee: Minutes 1980 – May 1984, Hagley, 2062: PSFS Archive, RG I/2-B, Box 29.
[70] "Banks prepare for new market rate deposit account", in: American Banking Journal, November 1982, 35-39; "The Money Market Fight: Associations put on new Gloves", Savings & Loan News, December 1982, 38-43.

whose interest rate was at the discretion of the individual bank. The banks were allowed to change the rate on a daily basis. The minimum deposit for MMDAs was $2,500, far below the $10,000 threshold of the MMC. The MMDA was designed by the DIDC explicitly to enable banks to compete with money market mutual funds (MMMFs). Thus, the hope was that money would flow from the money market back into the banking system.

Inside PSFS, the MMDA was first discussed in late October 1982. The first step was to determine the expected financial implications of introducing the new account.[71] This task was assigned to the financial planning unit, among them Charles Gibson.[72] The financial review of the impact of the MMDA finally came in late December, after the roll-out of the new product had already taken place. Concerning deposit flows, the expected impact of the MMDA was huge. In the first year, the MMDA was expected to attract investments in the volume of more than $1 billion.[73] Since the numbers were not available before the authorization of the final PSFS budget for 1983, they could not influence the decisions on the initial offering of the MMDA by the PSFS. neither decision. Hence, in the budget the expected volume for MMDAs was set at $1.5 billion. As late as February 1983, the marketing department at PSFS even set the goal to sell $2.2 billion worth of MMDAs.[74] The actual numbers for the MMDA in 1983 was $764 million, significantly less than the financial review had forecasted and only a third of the marketing goal.

The most important factor in the disappointing performance was fierce competition from commercial banks. In an internal report in early 1984, bank officials demonstrated that several commercial banks saw their savings deposits increase by up to 200% between June 1982 and March 1983. These banks had committed to an aggressive pricing strategy that significantly outbid money market mutual funds.[75] However, from March 1983, the inflows into the MMDA stopped among the entire banking industry. This was because the banks could not sustain the initial interest rates over longer periods.[76]

PSFS had expected a completely different development. The aforementioned financial review estimated that the share of new money from non-PSFS owners of MMMF shares would be small in the first year, but become more significant over the following years. Here, the underlying assumption was that, in principle, household investors would prefer insured bank deposits to MMMF accounts, once interest rates were competitive.[77] However, this assumption was wrong, as Charles Gibson admitted in 1984:

> The money which had been going to money market mutual funds did not all come back to banks. Consumers had been introduced to a good thing which they did not want to give up.[78]

[71] Minutes of the Products & Projects Committee, October 27, 1982, in: Hagley, 2062: PSFS Archive, RG V/1-C/i, Box 69.
[72] Minutes of the Products & Projects Committee, November 24, 1982, in: Ibid.
[73] Financial Review of Money Market Investment Accounts (MMIA), Memorandum to the Chairman of Products & Projects Committee by J.P. Nugent, December 21, 1982, Exhibit IV, in: Ibid.
[74] 1983 PSFS Communications and Marketing Plan, , February 1983 34, in: Hagley, 2062: PSFS Archive, RG V/1-B/ii, Box 68.
[75] Ibid., 4.
[76] Deposit Flow Analysis, April 1984, 7, Policy Committee: Minutes 1980 - May1984, in: Hagley, 2062: PSFS Archive, RG I/2-B, Box 29.
[77] Financial Review of Money Market Investment Account (MMIA), Memorandum to the Chariman of Products & Projects Committee by J.P. Nugent, December 21, 1982, Exhibit I-III, in: Hagley, 2062: PSFS Archive, RG V/1-C/i, Box 69.
[78] Deposit Flow Analysis, April 1984, 7, Policy Committee: Minutes 1980 - May1984, in: Hagley, 2062: PSFS Archive, RG I/2-B, Box 29.

Thus, instead of a gradually growing appeal for MMDAs, there was only a small window of opportunity for banks to pull back money from the MMMFs. The experience of PSFS's competitors in 1983 demonstrated that the aggressive pricing of MMDAs resulted in immediate and significant flows of new money into the banking system. However, PSFS did not offer competitive rates on the MMDA and therefore missed out on the opportunity to win back money from the money funds.

The roots of this decision can be traced back to the bank's MMC experience of the late 1970s. PSFS was reluctant to price the MMDA aggressively, because they feared that it would only lead to increased transfers from passbooks and certificates to MMDAs without attracting significant amounts of new money. Using the revised deposit forecast model, the financial planning committee had estimated beforehand that 80% of new MMDA deposits would come from PSFS passbooks or certificates. These transfers would generate so-called roll-up costs. These roll-up costs were estimated as being so high that they would overcompensate any profit from investing additional funds. Thus, no matter what the bank did, according to the deposit forecast model, the bank would always lose money on the MMDA.[79] PSFS estimated that the MMDA would generate a cumulative net loss for PSFS of about $25 million in the first three years after introduction. Since the transfer estimations originated from the specifications of the econometric model, the model was principally responsible for the pessimistic earnings outlook and therefore informed the cautious approach to MMDAs by PSFS. PSFS's disappointing performance regarding MMDAs was an important factor in the bank's failure to attract new money. The lack of inflows of new money was in turn mainly responsible for the large deposit losses in the early 1980s.[80]

A look at the 1980 version of the deposit forecast model reveals the sources of the failure to account for the importance of competition. In contrast to the original 1978 model, the 1980 version did not have one single variable that would measure the effect of changes in deposit rates among direct competitors. This was straightforward because the 1980 revision captured the consequences of the introduction of the money market certificate. The MMC and subsequent market rate certificates were designed to prevent disintermediation, not to enhance competition among depository institutions. Thus, the rate of the MMC was still regulated. The prominence of money market rates in the revised model even ensured that the emergence of money market funds was at least partly captured by the model. The MMDA, however, was introduced without any rate regulation, so competition among depository institutions did matter. Banks would be able to compete freely for funds.

The PSFS deposit forecast model was not built to deal with this unregulated form of competition. It was based on the general assumption that general economic indicators, such as income, unemployment and the money market rate, dominated savings and deposit flows. The experience with the MMDA, however, demonstrated that in a deregulated environment, general economic indicators did not matter as much, whereas competition became the prime factor for deposit flows. Hence, it became more important to anticipate the actions of rival financial institutions than the development of the economy at large. Since the deposit forecast model was a macro model, it was structurally not capable of forecasting microeconomic decision-making. Thus, as macroeconomic indicators declined as predictors of deposit flows, so did the tool that simulated this very environment.

From 1984, the deposit forecast model became less and less relevant for long-term strategic planning at PSFS. The most important change took place around 1985. Before that year, the deposit forecast

[79] Financial Review of money Market Investment Accounts (MMIA), Memorandum to the Chariman of Products & Projects Committee by J.P. Nugent, December 21, 1982, Exhibit I-III, in: Hagley, 2062: PSFS Archive, RG V/1-C/i, Box 69.

[80] 1984 Small Savers Rollover Plan, November 14, 1983, in: Policy Committee: Minutes 1980 - May1984, in: Hagley, 2062: PSFS Archive, RG I/2-B, Box 29.

was independent from business goals. It was conceptualized as part of the business environment – an independent variable and a pre-condition of business strategy.[81] The 1986–1990 PSFS business plan redefined retail deposits as business goals.[82] Instead of trying to forecast deposit flows, the bank set specific goals for retail deposits. Retail banking liabilities were set to grow by 8.1% annually from 1986 to 1990. Instead of a company-based forecast, the planning unit used deposit flow estimates from DRI for individual banking groups. The 1987–1991 PSFS business plan did not even contain exact numbers of deposit forecast anymore.[83]

5. The 1985 version of the FMP model: What lessons were learned?

The fundamental change in the market for savings deposits also led to significant changes in the FMP model used by the Federal Reserve Board. The first published version of the model after its original introduction is from 1985.

The decline of the passbook is reflected in the revision. It is not easy to even find savings deposits in the model. While in the 1970s an entire model was built exclusively around the market for savings deposits, in the 1980s the same asset was part of an abstract aggregate that encompassed all major non-transaction parts of the money aggregate M2 (e.g. M2 minus M1). Apart from savings deposits, this aggregate includes small-time deposits, money market deposit accounts (MMDAs) and money market mutual funds (MMMFs). In accordance with the portfolio approach, the aggregate is not set in absolute terms but as a ratio of household wealth.

Table 7: Determinants of flows of non-transaction M2 money aggregate, FMP model 1985 version

Variable	Correlation	Influence
Rate differential: average (90d T-bill or 90d large CDs) *minus* max (Small-time deposits or yield on MMMFs)	Negative	Strong
Rate differential: average (90d T-bill or 90d large CDs) *minus* passbook rate	Negative	Strong
Value of common stock	Positive	Medium
Personal savings	Positive	Medium
Time variable	Positive	Medium

Source: Brayton/Mauskopf, Federal Reserve Board MPS quarterly econometric model.

The equation for the aggregate shows striking similarities to the PSFS model. First and foremost, the 90-day T-bill rate features prominently in both models. In the FMP model, this rate is used in two rate differentials, one against the passbook rate and one against the maximum of either the average rate among MMMFs or small-time deposits. The first differential resembles classical disintermediation. The second difference acknowledges the fact that there were now deposits that yielded rates that were competitive in the money market. The FMP model counted money market mutual funds (MMMFs) as part of M2, adding $200 billion to this money aggregate. Here, the FMP reflected the Fed decision to define shares in MMMFs as close substitutes for money. Both differentials have a negative impact on the volume of the aggregate. Since the differential between the money market rates and the passbook

[81] 1984-1987 PSFS Business Plan, December 1983, ii-iv, in: Hagley, 2062: PSFS Archive, RG V/2-B/i, Box 68.
[82] 1986-1990 PSFS Business Plan, April 1985, 29c, 38, in: Hagley, 2062: PSFS Archive, RG V/2-B/i, Box 68.
[83] 1987-1991 PSFS Business Plan, July 1986, "Objectives"; "Account Trends", in: Hagley, 2062: PSFS Archive, RG V/2-B/i, Box 68.

rate has been much higher in the years preceding 1985, the latter differential has a stronger impact than the former.[84] The passbook differential has a four-quarter lag structure, while the impact of the other differential is realized instantaneously.

The other variables can also be found in the original FMP and the PSFS model. In an interesting U-turn, the value of common stock appears as a positive factor for the share of the aggregate among total wealth. Brayton/Mauskopf have no explanation for this new relationship. It just seems that a rise in the stock market causes households to reallocate their portfolio in a way that favors investments in money-like assets .[85] Since the PSFS model does not use ratios of wealth as dependent variables, it is not clear if PSFS had already captured this turnaround. Instead of disposable income, a new variable directly measures the impact of personal savings on the aggregate. The positive correlation indicates that new savings also tend to benefit the aggregate disproportionally compared to other assets. This reflects the tendency to invest new savings in liquid assets first and to reallocate them later. The inclusion of personal savings does not contradict Charles Gibson's assessment that the link between savings and savings deposit has been broken, since it refers to the broad aggregate that includes money funds.

Table 8: Ratio of savings deposits to the non-transaction M2 aggregate, FMP model 1985 version

Variable	Affected Institutions	Correlation	Influence
Rate differential: max (Small-time deposits or yield on MMMFs) minus passbook rate	All	Negative	Strong
Unemployment	All	Positive	Strong

Source: See Table 7.

Savings deposits, in the classical definition of the original 1970 model (passbooks and statement savings deposits), have technically disappeared as an independent variable. Instead, they are lumped together with MMDAs in a separate equation. However, the simulation for the 1985 model ended in 1982, while MMDAs were introduced at the end of that year. Thus, MMDAs do not matter in the empirical model. In practice, classical savings deposits were still part of the model. Similar to the first equation, savings deposits are not measured in absolute terms but as a ratio of the above-mentioned aggregate (M2 minus M1). In striking contrast to the original model, the 1985 version uses exogenous variables to determine the ratio of savings deposits at each of the groups of depository institutions. The only exception is a separate equation to determine the growth of deposits at S&Ls, which is a simple extrapolation of the past trend, adjusted for inflation. Thus, the competition among banking groups has no influence on the overall demand for savings deposits.

The main explanatory variable for savings deposits is an interest rate differential between the maximum of either small-time deposits or the yield on MMMFs on the one hand and the commercial bank passbook rate on the other hand. The greater the difference, the smaller the share of savings deposits in the M2-M1 aggregate. This variable closely resembles the internal transfer equation in the PSFS model. It has a seven-quarter lag, which is longer than the differentials in the equation for the aggregate. Since the term includes MMDAs as well as savings deposits, the rate differential has presumably lost much of its significance in the following years. The second important variable is unemployment, which is positively correlated to the ratio of savings deposits to the aggregate. As explained above,

[84] Brayton, Flint; Mauskopf, Eileen, The Federal Reserve Board MPS Quarterly Econometric Model of the US economy, in: Economic Modelling, 2 (1985), 170-292, 209.
[85] Ibid.

Charles Gibson of PSFS claimed to be among the first to have found this close link. It is unclear, however, when this variable entered the FMP model. It might just be that both teams of econometricians found this link independently.

As stated above, the deposit market share of banking groups has been determined by exogenous variables. Thus, the deposit rates that featured so prominently in the original model have lost their influence on determining market share. The only rates that were influential in the deposit market were the rates on commercial bank passbooks and the rates of time deposits at commercial banks and S&Ls. The passbook rate is a function the T-bill rate, constrained by the ceiling on passbook rates. Instead of the current value of the T-bill rate, the mean of its values over the past 15 quarters is used.

The equations for small-time deposits encompass the entire market for savings certificates. Those of commercial banks and S&Ls closely resemble each other and have a structure similar to that of the passbook rate. There are important differences, though. Instead of the mean of the T-bill rate, both equations feature a linearly declining distributed lag of the current rate that extends over 12 quarters. This means that the highest rates on time deposits adjust somewhat faster to the market rate than does the passbook rate. Furthermore, both equations feature a complex set of equations that determine the highest ceiling rate on time deposits. These equations are important because they encompass the impact of the MMC on the model. Both equations are split into two separate equations by a time dummy that changes value in 1978. Before the introduction of the MMC, the ceiling was measured by a weighted average of the ceilings of the various savings certificates. Afterwards, it depended on the T-bill rate.

The newly introduced rate on MMMFs was a function of various money market rates. The MMMF rates adjust almost instantaneously, thus making it much faster than the rates on deposits.

Table 9: Determinants of interest rates on deposits, FMP model, 1985 version

Dependent Variable	Explanatory Variables	Correlation	Influence	Lag length
Passbook rate (comm. banks)	T-bill rate; Ceiling rate	Positive	Strong	15 qt (T-bill rate)
Highest rate on small-time deposits (maturity adjusted)	T-bill rate; Ceiling rate	Positive	Strong	12 qt (T-bill rate)
MMMF yield	Rate on large CDs; Commercial paper rate	Positive	Strong	1 qt (Large CD rate)

Source: See Table 7.

In sum, the 1985 version of the FMP model incorporated many of the features of the PSFS model. This is true for unemployment as a major explanatory variable, but even more for the prominence of money market rates. Like the PSFS model, the FMP model incorporated both a mechanism for classic disintermediation and transfers from savings to time deposits. The FMP mechanism for both kinds of disintermediation is enhanced by the introduction of MMMFs as part of the M2-M1 aggregate. The newly found dependence of savings deposits on the money market is probably the most striking development in the monetary sector of the FMP model until the 1990s. Simulation runs of the model demonstrated that the M2-M1 aggregate showed a significantly higher elasticity to changes in money market rates than M1.[86] At least according to the model, there was no doubt that bank customers had become much

[86] Brayton/Mauskopf, Federal Reserve Board MPS, 209f.

more interest rate sensitive. According to the authors of the model, this revision reflected the disruptive experience of the banking business in the United States in the late 1970s and early 1980s as described above.[87] The reason for the long lags in the adjustment equations for deposit rates were thus not due to demand-side issues, but to institutional constraints such as the still-existing ceilings on passbooks. Once these constraints were lifted, the market for deposits would become almost frictionless according to the model.

Conversely, the FMP model, very much like the PSFS model, downgraded the importance of interbank competition. The ratio of savings deposits held by either group was meaningless for the model of the deposit market. Differentials between the deposit rates of the respective groups did not matter either. The differentiation of different groups of depository institutions only existed because of reasons outside the deposit market, mainly the market for loans and mortgages. It was not essential to the deposit market anymore. In sum, the 1985 FMP model did not offer any solutions for the problems that occurred at the financial planning unit at PSFS.

6. Conclusion

The turmoil in the market for bank deposits that pervaded the stagflation period is reflected by fundamental changes in the econometric models that simulated this market. I could identify four major changes.

First, savings deposits were redefined as part of the money market. In the original 1970 FMP model, one of the most striking results was the relative independence of savings deposit flows from changes in the rates of competing assets. Whether this was due to the effective use of ceiling rates as suggested by Gramlich and Hulett or the result of a very slow adjustment process regarding the expected future rates as explained by Modigliani, deposit rates seemed to be inelastic to changes in the competitive rate, at least in the short term. Instead, deposits seemed to increase steadily with wealth. In the 1985 version of the FMP model, the logic of the deposit market had changed fundamentally. It had become very elastic to changes in the money market rate.

The analysis of the PSFS deposit forecast model points to the historical developments that were responsible for this change. The original PSFS model was created as a response to *disintermediation* – the withdrawal and reinvestment of deposits into the money market. Consequently, the benchmark money market rate played an important role in the model. However, the actual integration of savings deposits into the money market only started with the introduction of the money market certificate (MMC) in 1978, which caused a fundamental revision of the PSFS model. The emergence of money market mutual funds (MMMF) and the eventual introduction of the money market deposit account in 1983 merely completed the integration of savings deposits and money markets.

Second, during the stagflation period, both the PSFS and the FMP models integrated several variables that hint at the rising importance of precautionary saving. The finding of a positive connection between the unemployment rate and savings flows seems to have surprised the practitioners at the banks as well as the economists responsible for the large macroeconomic models. There is not enough evidence to confirm Charles Gibson's claim that he personally discovered this close link. In any case, the unemployment rate entered the PSFS model in 1978 and was part of the 1985 version of the FMP model. Gibson explained this link as an increase in uncertainty that clouded customer expectations and led to a higher liquidity preference among customers. This increased liquidity demand of the still employed

[87] Brayton, Flint; Levin, Andrew; Tryon, Ralph; Williams, John, The Evolution of macro models at the Federal Reserve Board, in: Public Policy, 47 (1997), 43-81, 48f.

far outweighed the deposit losses derived from income losses of the unemployed. A similar mechanism was at the heart of the positive connection between savings deposit flows and inflation. Here again, rising inflation rates increased uncertainty and, thereby, liquidity demand. The finding of a positive link between the two major economic forces of the stagflation period and savings deposits via household liquidity demands reaffirmed the redefinition of savings deposits as part of the money market.

Third, in the process of adapting to these new macroeconomic conditions, both models eliminated variables that accounted for interbank competition. For the FMP model, this had few consequences, largely because the Federal Reserve Board simultaneously expanded the definition of the M2 money aggregate to incorporate money market mutual funds. This way, they could partly withdraw from the competition for deposits. By contrast, PSFS struggled with the strong increase of competition for funds in the early 1980s. In this situation, their deposit forecast model was of little use. Since it was macroeconomic by design, it was designed for a time when largely external economic forces determined deposit flows. On the macroeconomic level, these factors still explained the overall flow into monetary assets in the 1980s. However, in the new and increasingly deregulated and competitive environment of this decade, external factors worked less and less well in forecasting deposit flows to individual banks. From their perspective, flows were now determined by business strategies rather than macroeconomic variables. Consequently, the deposit forecast model moved to the fringe of decision-making at PSFS.

On a more general note, the analysis of different econometric models of the market for savings deposits during the stagflation period reinforced the fundamental importance of historical context in the study of financial markets. The market for savings deposits in the 1960s was fundamentally different from that of the 1980s. This was not just due to changing regulations or innovation. The behavior of investors had changed. In the earlier market, they either did not adjust to changes in the market at all or took years to restructure their portfolio. In the 1980s, Modigliani's expectational-learning lag had disappeared, at least if measured by the elasticity of the demand for savings deposits to changes on the money market. The remaining lags can be explained by portfolio rebalancing procedures or institutional constraints. As the analysis of the PSFS model highlighted, this was not merely a result of secular economic development but the consequence of specific changes in the supply of deposit-like assets. Or, to rephrase Charles Gibson, customers had been introduced to a good thing – and thereby fundamentally changed their expectations of deposit returns!

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