CASH MANAGEMENT BEHAVIOR OF FIRMS AND ITS STRUCTURAL CHANGE IN AN EMERGING MONEY MARKET

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Abstract

Driven by fast evolution in the money market during the past two decades, financial and technological innovations, increasing competition, and internationalizing of businesses, cash and treasury management has become an increasingly important function in most firms. It is reasonable to expect that the role of financial transactions in the cash management process in adding to firm value has increased its importance and changed the cash management behavior of firms.

The main purpose of this study is to investigate this potential behavioral change in cash management by examining the cash management practices behind the models explaining the cash management behavior and to test the stability of some of these models. It is hypothesized that the environmental changes have been remarkable enough to change the cash management behavior, which can be seen as a structural change in the cash management function. The factors assumed to explain this phenomenon may concern organizational and technological arrangements in cash management, likewise professional skills in the area of financial transactions and incentives for these especially created by emerging money markets.

The examination was conducted using the survey method to map out the best cash management practices followed by Finnish listed manufacturing and service companies and by testing the stability of both static and dynamic models explaining cash management behavior. The empirical part of the study is based on three questionnaires in three separate years, namely 1988, 1994, and 2000, and the empirical estimation of the selected cash management models using financial statement data for the years 1972 to 2001.

The study concludes that during the research period firms have achieved a significant technological progress (improving systems and methods) and significant behavioral changes (increasing professionalism) concerning cash management practices, referring to opportunities for more effective cash management operations. The stability tests of cash management models indicated that a structural change in cash management behavior occurred after the deregulation years in the money market. These results were consistent with the surveys referring the development in the efficiency of the firms' cash management.

Keywords: cash management, demand for money by firms, short-term investing, treasury management

Acknowledgements

List of figures

List of tables

Contents

1 Introduction

1.1 Background

Cash management has attracted increasing attention among both academics and practitioners during last decades. In Finland, the increasing interest in this field is related to the liberalization of the money market, technological progress, and internationalization of businesses. These changes have forced management to critically review cash management strategy and, consequently, also cash management policies and responsibilities. These factors have created additional demand for various kinds of cash management services, either produced in-house or purchased from outside suppliers. In addition, Finnish banks have promoted new services for their corporate customers. Markets for money market instruments, derivatives and mutual funds have grown rapidly along with the new technology to provide greater scope for cash management.

In modern cash management, the emphasis is usually on the part of the cash management which is responsible for money market operations. A person responsible for the cash management function is primarily concerned with short-term financial activities. In a changing money market environment, it is more important than before to know how to further improve the company's cash position, including managing accounts receivable, improving cash flow, transferring funds, and controlling cash disbursements. In addition, one should understand the basic principles of short-term investment, including investment policies, available instruments, as well as investment strategies and techniques to minimize the cash management costs or to maximize profits.

In order to invest in the money market, a firm must know when the cash is needed. This is a difficult forecasting task even for large companies. To invest properly on an almost daily basis, a cash manager has to forecast the amount of funds that will be required to meet payments. He must maintain sufficient cash to handle immediate disbursements. In order to be effective, he should be aware on the various alternatives and relationships between interest rate yield curves for various investments and compare these with the existing market conditions prior to investing. He should also use modern techniques to improve overall returns on invested funds.

In Finland, the options for managing idle cash balances more effectively have evidently changed cash management behavior. Since the liberalization of the Finnish money market there have been numerous new financial and technological products available for short-term investing. This study investigates the cash management function and its stability in the changing environment. It considers especially the decisions focused on the limited segment of the financial transactions of the cash management process.

1.2 Classification of cash management research

There is increasing emphasis on describing cash management as an essential organizational function. Evidence in this field indicates that the role and responsibilities of cash managers are expanding beyond conventional boundaries. This has increased the research on cash management and related areas. Theoretically, the main research approaches are monetary theory, financial theory, and operations research approach, and the research of cash management practices. However, the borders of these areas are not clear-cut, and there are many interdisciplinary relationships between the areas. Areas in the cash management research are classified in Fig. 1.
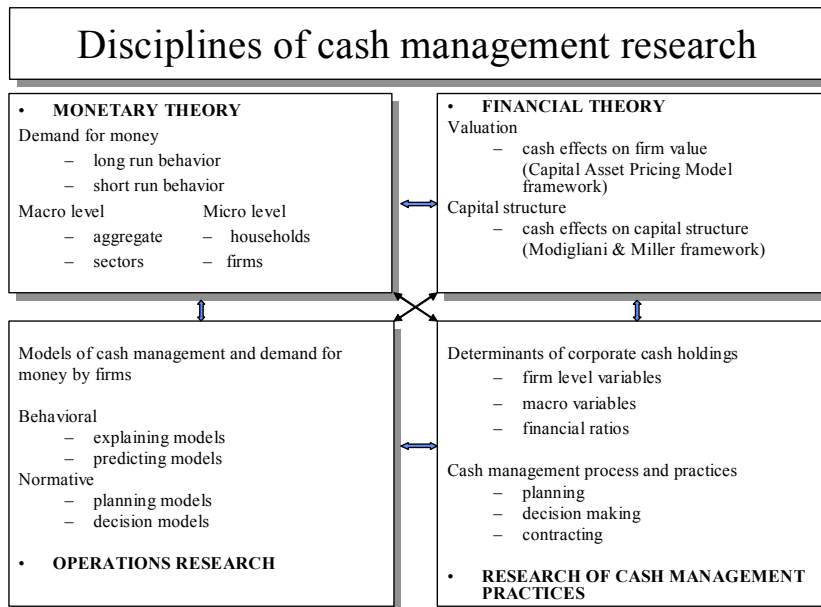
Fig. 1. Theoretical research on cash management.

In monetary theory, the demand for money is one of the most intensively investigated areas. Both long and short run behavior have been examined on the macro and micro

level. The research on the demand for money by firms concerns its special features compared with the other sectors of the economy. It investigates the decisions made in the cash management process. The basic theoretical results of monetary theory have been accepted in the areas of operations research and financial theory. Monetary theory, in turns utilizes many contributions reported, for example, in the theory of the firm, i.e. inventory theory, production theory, and agency theory.

Monetary theoretic approach to cash management: In the 1980s and 1990s there were many new developments in the area of the demand for money, which are not empirically examined on the firm level. These research areas include an attempt to account for forward-looking behavior in a buffer stock framework (Cuthbertson and Taylor 1987), to explain shifts in the demand for money as a result of financial innovations (Roley 1985, Hezel and Mehra 1989, and Marquis and Witte 1989), to find an appropriate scale variable for the demand for money relationship (Mankiw and Summers 1986), and to utilize the new estimation techniques, such as co-integration and error correction procedures (Melnik 1990, Arestis and Demetriades 1991, Hendry and Ericsson 1991, Hendry, Ericsson, Fleming, and Westphal 1991, Karfakis 1991, and Dutkowsky and Atesogly 2001). For the other theoretical and empirical research of monetary theory, see e.g. Harris (1981) and Cuthbertson (1988), Dixon (1997), and especially for stability research, Judd and Scadding (1982), Rasche (1987), Hoffman and Rasche 1989, and Muscatelli and Spinelli (2000). For example, the results for U.S. firms indicate that improvements in cash management techniques have significantly altered the cash management behavior of firms (see Marquis and Witte 1989).

Recent studies have concentrated on the effects of such issues as financial innovations, new transaction technologies, value of time or welfare cost of inflation on demand for money. Dutkowsky and Atesoglu (2001) investigated dynamic micro foundations for the conventional static money demand equation. Attanasio, Guiso, and Japelli (2002) used microeconomic data on households to estimate the parameter of the demand for currency derived from a generalized Baumol-Tobin model. They model the demand for currency accounting for the adoption of new transaction technologies and the decision to hold interest-bearing assets. For other recent studies, see Lucas 2000, and Mulligan and Sala-i-Martin 2000.

Numerous theoretical approaches to the demand for money by firms have been presented in the literature, including the inventory theoretic approach (see e.g. Baumol 1952, Tobin 1956, Miller and Orr 1966, 1968, and Marquis and Witte 1989), production theoretic approach (see Nadiri 1969 and Coates 1976), and wealth models (see Meltzer 1963a).

Empirical evidence of the demand for money by firms were presented in the 1960s by Meltzer (1963b), Frazer (1964), Whalen (1965), DeAlessi (1966), Vogel and Maddala (1967), Miller and Orr (1968), and Nadiri (1969), and in the 1970s by Coates (1976), Kanniainen (1976), and Hunter (1978), and in 1980s by Ungar and Zilberfarb (1980), Katzimbris and Miller (1982), Tuovila (1984), Kytönen (1986), Heinonen (1987) and Marquis and Witte (1989), and in the 1990s Kytönen (1990) and Mulligan (1997). Recent studies of this area include Natke (2001), Robles (2002) and Kytönen (2003). In addition, there are some experimental investigations of the basic cash management models (see Beckman and Foreman 1988, and Ansic 1991).

In the 1960s, most empirical studies on the demand for money by firms used cross-sectional data and concentrated on the question of economies of scale. In the 1970s and 1980s researchers used aggregated time series data sets of the whole economy or of household or firm sectors. The controversy over the opportunity cost of money was one of the most important issues studied. Instead, the studies of firm-specific data sets are quite few. However, at least five exceptions exist, i.e. DeAlessi (1966), Coates (1976), Ungar and Zilberfarb (1980), Natke (2001), and Kytönen (2003).

Operations research approach to cash management: Numerous operational models have been developed to optimize the split between cash and marketable securities based on the firm's needs for cash, the predictability of these needs, the interest rate on marketable securities, and the cost of a transfer to cash and vice versa.

The studies concentrating on developing the so-called cash flow models can be classified by the area of operations research. The background for these models is the Baumol-Tobin model and the Miller-Orr model. Although first presented as contributions in monetary theory, they were later accepted as corporate finance literature (see e.g. Cooley and Roden 1991, Brealey and Myers 1998, Ross, Westerfield, and Jordan 1999).

Linear programming models for short-term financial decisions have been developed, for example, by Robicheck, Teichroew, and Jones (1965), Archer (1966), Orgler (1974), Stone (1973), and Maier and Vander Weide (1982). Network based models have been created by Srinivasan (1974), Golden, Liberatore, and Lieberman (1979), and Glover and Kim (1991).

The earlier models approached only a limited segment of the cash balance management process and used procedures essentially based on an inventory control theory (see e.g. Gregory 1976). For a more recent development of cash management models, see Milbourne 1983, Bell and Parker (1985) Srinivasan and Kim (1986b), Smith (1989), Kamath, Khaksari, and Sharma (1991), Browne (1995), Milne and Robertson (1996), Tin (2000), Perry and Stadje (2000), Perry, Berg, and Posner (2001), and Hinderer and Waldmann (2001).

Financial theoretic approach to cash management: In financial theory, researchers have been interested in how cash and other liquid assets affect firm value and the optimal capital structure of a firm. Cash management is expected to play a key role in creating stockholder value. That is why it is important to find new evidence of cash management behavioral dimensions that cause the creation or destruction of shareholder value. Morris (1983) integrated operating cash flow activities into the risk and return framework. In this statement, the cash management policy of the firm was assumed to be of the Miller-Orr type. Sartoris and Hill (1983) integrated short-run cash inflows and outflows into the net present value model. They showed that the changes in cash management policies have a direct effect on the value of the firm.

Strategic reasons for holding cash balances have been studied, for example, by Jensen (1986), Ang (1991), Bhattacharya and Gallinger (1991), Opler, Pinkowitz, Stultz, and Williamson (1999), Dittmar, Mahrt-Smith and Servaes (2003). Shin and Shoenen (1998, 2001) investigated relationship between liquidity and profitability.

Research on cash management practices: Despite the copious research on the explaining models of cash management both on the theoretical and empirical level, very little is known about its practical issues. Only little survey evidence is available (see e.g. Gitman, Moses and White 1979, Kamath, Khaksari, Meier, and Winklepleck 1985,

Soenen and Aggarwal 1989, Tse, Buckley, and Westerman 1998a, 1998b, and Kytönen 2002). These are the surveys which try to increase awareness of actual corporate practices of cash management.

Soenen and Aggarwal (1989) surveyed and compared cash and foreign exchange management practices in large companies located in the UK, the Netherlands, and Belgium. There is also some evidence of cash and foreign exchange management practices in China (Soenen and Sun 1995). In their first paper, Tse, Buckley, and Westerman (1998a) focused on the results as they impact on the Dutch corporate sector in its cash management activities and bank relations. Their second paper presented the survey results on liquidity management, netting prices, bank relationship management and software systems used by the largest Dutch companies (Tse, Buckley, and Westerman (1998b). Cash management practices in Finland have been examined by Kytönen (2002).

1.3 Purpose, contribution and structure of the study

The main purpose of this study is to investigate the structural changes of the cash management behavior of firms in a changing environment. This will be done by examining the development of cash management practices and the stability of the cash management models in an environment of a deregulating and integrating money market. Using survey method, the best cash management practices used by the listed Finnish manufacturing and service companies, and their changes, will be examined. The behavioral changes in cash management will be investigated utilizing financial statement data in the stability tests of some cash management models.

The theoretical framework for the cash management as a part of corporate finance will be constructed. This will be done in two stages. The first stage is to review the cash management and demand for money studies in order to find proper models presented in the literature to describe cash management behavior. The second stage is to define the cash management concept and some important issues examined in the survey part of the study. The cash management practices followed by listed Finnish corporations will be verified through survey evidence. Additional evidence of the changes in cash management behavior will be searched from the estimates of some explaining cash management models. In addition to the stability tests of these models, the study examines the existence of the economies of scale in the cash management, the speed of adjustment of cash balances, and how sensitive a firm's cash management decisions are with respect to interest rate changes and inflation. For this purpose, the determinants of cash management models will be defined.

The study contributes to the literature in the following respects. It increases the awareness of the changes in the best cash management practices of firms in a liberalizing and integrating money market. This is a longitudinal study of cash management practices examining the impact of financial deregulation and innovations in cash management techniques on cash management behavior. This study surveys and compares for the first time cash management practices in listed companies located in Finland and tests cash management models using financial statement data.

The empirical data for the survey are based on three questionnaires completed in 1988, 1994, and 2000. As the survey was repeated three times, it makes it possible to test for changes in cash management practices over time. The financial statement data on individual firms cover the years before and after the deregulation years, i.e. from 1972 to 2001. The results are expected to reveal the stability or instability of the cash management behavior of firms in an environment of money market innovations and rapid technological changes. Some structural changes in cash management behavior are expected to be evident.

The structure of the study is as follows: The following two chapters create a theoretical framework of the study. Chapter 2 reviews the main research areas of cash management and the demand for money. The main theoretical approaches to the cash management problem and the basic determinants of the cash management models used in stability tests are also presented in Chapter 2. Chapter 3 defines some theoretical and practical issues in cash management decisions and processes relevant in the survey part of the study. The reasons for holding cash and other liquid assets are considered both from the perspective of financial theory and monetary theory. Chapter 4 presents the survey results of the cash management practices and Chapter 5 the empirical evidence of the stability of the cash management models and several other aspects characterizing the cash management behavior. Chapter 6 provides a summary of the study.

2 Cash management and related studies

This chapter considers various theoretical approaches to cash management and the demand for money by firms and reviews the main results reported in the empirical literature. The monetary theoretic approach is paid special attention because of the utilization of the models of the demand for money by firms as a description of cash management behavior in the empirical part of the study. However, financial theory and operations research have adopted many of the contributions presented in monetary theory and vice versa.

A tight cash management policy leads to a rise in the financial transaction costs of the firm. As suggested by Briggs and Singh (2000), if a firm decides to hold small amounts of cash, it has to have access to the money and capital markets or sell assets. The cost of both these options would induce a company to use these alternatives sparingly. On the other hand, if a firm holds more cash than necessary, it will incur the opportunity costs of money. The transaction models assume that a firm follows a cash management policy which tries to minimize these costs, or maximize the profits from cash management. In addition to this inventory theoretic approach, the other theories presented in the monetary theory are the production, wealth, and agency theories based on the theory of the firm. Financial theory considers the cash management problem in the framework of the valuation and capital structure of a firm.

As we will see, there have been many attempts to model the cash management problem. This is not an easy task on a theoretical level because of its complicated nature in practice, too. The management of cash flows requires careful analysis and coordination of many interacting factors. A cash manager must make interrelated decisions about the allocation of monetary assets while simultaneously keeping up with institutional financial constraints, such as those affecting average cash balances and cash management costs. Because of the complexity of the decision processes of cash management, the survey research tries to increase awareness of the practical issues of cash management.

The basic behavioral models presented in monetary theory can also be seen as a background for the many subsequent normative models which have been developed for cash management planning and decision-making purposes. Such normative models

generally try to optimize the split between cash and marketable securities based on the firm's needs for cash, the predictability of these needs, the interest rate on marketable securities, and the cost of a transfer to cash and vice versa.

2.1 Monetary theoretic approach to cash management

Monetary economists are interested in the cash management of firms. The objective has been to describe the mechanism of the demand for money by firms, because it differs from the behavior of other economic agents. Researchers have tried to find a stable relationship between the quantity of money and its determinants in order to forecast demand for money. A narrow definition of cash management consists of financial transactions, which means the purchasing or selling of financial securities or borrowing or repaying of capital. Many behavioral models describe especially the behavior of these operations.

2.1.1 Inventory theoretic approach to cash management

Numerous theories have been evinced to explain the cash management behavior of firms. Almost all of these theories can be generalized into a proposition of the existence of a stable relationship between a few important independent variables and the stock of money demanded (on the theoretical background of these relationships, see e.g. Harris 1981 and Cuthbertson 1988). The two basic transaction models most commonly accepted in the financial literature are the deterministic Baumol-Tobin and the stochastic Miller-Orr inventory models. These models are presented in monetary theory and are consistent with the theory of the firm. (Baumol 1952, Tobin 1956, and Miller and Orr 1966)

Baumol (1952) suggested that cash balances could be treated in the same way as inventories of goods. A stock of cash is its holder's inventory, and like an inventory of a commodity, cash is held because it can be given up at the appropriate moment, serving then as its processor's part of the bargain in an exchange. The firm is presumed to hold the amount of money, which minimizes the interest cost by holding money rather than investing it in short-term investments and the transaction costs associated with transferring between securities and cash.

In this framework the firm is assumed to finance its expenditures by selling securities or by borrowing and the firm has a steady stream of expenditures but has no receipts. In practice, the behavior is more complicated and the cash balances are the result of the imperfect synchronization of expenditures and receipts, which are often uncertain. This uncertainty is included in the stochastic cash management model derived by Miller and Orr (1966). This approach permits net cash flows to fluctuate in a completely stochastic way. Unfortunately, this feature is offset by the fact that the model is only capable of dealing with two types of assets – cash and marketable securities – and does not incorporate payables.

Both models referred to above imply that there are economies of scale in the use of money or, equivalently, that the elasticity of the demand for money with respect to

transactions is less than one. In these models the scale operator is transactions volume, mostly measured by sales. There are, however, also alternative measures presented in the demand for money literature, such as wealth, production, and market capitalization.

In their model, Attanasio *et al.* (2002) measured transaction costs with the time costs. The cash manager is assumed to need time to make transactions and that money is a way of saving on transaction time, and optimal money balances are chosen in order to trade off the time cost of transactions against the cost of holding money instead of an interest-bearing asset yielding a nominal return per period. The cash manager chooses money to minimize the sum of the cost of transaction time and forgone interest, subject to a transaction technology.

They present behavioral cash management models, such as deterministic and stochastic models as follows:

$$m = (\omega A \, \beta / R)^{1/(1+\beta)} \; c^{(\beta + \gamma)/(1 + \beta)} \tag{2.1}$$

where m is the real money balances, R is the nominal rate of return, A is a measure of technology improvements, c is the scale operator. The equation is based on an assumption that the cash manager behaves as $min \; \tau\omega + Rm$, subject to $\tau = Ac^{\gamma} (c/m)^{\beta}$ (where $\tau\omega$ = transaction time, τ = the time cost of transaction ω, and Rm = forgone interest).

This equation encompasses several models. By setting $\gamma = 0$ and $\beta = 1$, one obtains the Baumol-Tobin square root formula. If $\gamma = 0$ and $\beta = 2$, Equation (2.1) reduces to Miller-Orr solution (Attanasio *et al.* 2002).

The effects of the exogenous factors on the strategic cash management decisions can be examined by transforming Equation (2.1) to the estimation form and testing its stability.

In the empirical equation the variable A can be seen as error term as well as index of the state of financial sophistication in the firm (see Mulligan 1997). If transaction costs and the value of time of the cash manager are supposed to be constant, the long run model can be presented in its conventional form as presented for example by Coates (1976) as follows:

$$M^{*}_{t} = AT_{t}^{\alpha_1} \, i_{t}^{\alpha_2} \tag{2.2}$$

where M^{*} is the desired nominal cash balances, A is the fixed transaction cost; α_1 and α_2 are the elasticities of M^{*} with respect to the value of transactions (T = the scale operator), and the rate of interest (i). (Note the distinct meaning of the notation A in the models 2.1. and 2.2.)

2.1.2 *Production function approach to cash management*

Friedman (1959) stated that firms hold cash as a productive resource and that cash balances are analogous to fixed capital rather than to inventories. According to Nadiri (1969), real cash balances serve as productive inputs. Like any other capital investment,

an increase in cash balances results in a decrease in cash flow, and vice versa. They are part of the working capital of the firm facilitating its productive process, often by indirect means, such as hedging against changes in the prices of capital, labor and the interest rate. Holding adequate cash balances may reduce the uncertainty of meeting current payments, thus avoiding unnecessary and unprofitable liquidation of other assets. Given that management maximizes the present value of real cash flows, the basic determinants of a cash management function can be derived (see e.g. Nadiri 1969 and Coates 1976).

Nadiri (1969) presented his model in a multiplicative form as follows:

$$m_t^* = A_0 X_t^{* \ 1/\rho} v_t^\alpha (c/w)^\beta \tag{2.3}$$

where m^* is the desired level of real cash balances, A_0 is constant; ρ, α, and β are the elasticities of m^* with respect to the explanatory variables of the model, i.e. the expected level of output (X^*), the opportunity cost of money (v), and expected future relative prices (c/w).

Firms are assumed to minimize their expected total costs, which is hypothesized to be $C = wL + cK + vm$, where w, c, and v are the cost of labour L, capital K, and real money balances m. The cost of real balances (the opportunity cost of money), v, is defined to be $v = r + p'_b/p_b + p'/p$, where r is the interest rate, p_b, is the price of securities, p'_b, is the expected change in the price of securities, and p' is the expected change in the general price level.

Nadiri (1969) assumed the following reasonable a priori hypotheses: $\rho > 0$, $\alpha < 0$, and $\beta > 0$, i.e. the elasticities of output and expected future relative prices with respect to desired cash balances are positive and the elasticity of the opportunity cost negative.

Coates (1976) assumed that the management of a firm wishes to maximize the present real value of the firm. He derived the necessary conditions for such a maximum and resolved the marginal productivity conditions for labor, capital, and money. Changes in the cash balance are directly reflected as changes in the discounted stream of cash flows. These cash flows are equal to a firm's market value, and their maximization is the main goal of management as presented in financial theory.

In order to derive an explicit cash management function Coates (1976) assumed that the firm's production function could be defined by a Cobb-Douglas production function. The desired money stock was derived by combining the production function with the marginal productivity condition for real balances (i.e. the amount of real cash balances for which the marginal value product after taxes is equal to the tax adjusted cost of capital). The model took the following form

$$m^* = [(1 - \chi)\gamma\pi Q]/(r + dP/P) \tag{2.4}$$

where m^* is desired real cash balances, χ is the corporate tax rate, π is the real price of output Q, γ is the elasticity of production with respect to real balances, r is the cost of capital and dP/P is the percentage change in the price level.

For the estimation, Coates (1976) presented the model in nominal terms as follows (the tax rate was excluded for reasons of comparability with earlier studies and due to problems in determining it from accounting data of firms)

$$M_t^* = \gamma(\Pi Q)_t{}^{\alpha_1} i_t{}^{\alpha_2} \qquad\qquad\qquad (2.5)$$

Coates used the Treasury bill rate as the cost of real capital $i = r + dP/P$ (i.e. the real rate of interest plus the percentage change in the price level).

2.1.3 Wealth theoretic approach to cash management

In addition of the inventory theoretic and production theoretic models, the wealth theoretic approach is also widely accepted in literature. For example, Meltzer (1963b) hypothesizes that the amount of money held by firms is a function of the market rate of interest and wealth as follows:

$$M = k \, r^\alpha \, W^\beta \qquad\qquad\qquad (2.6)$$

where M is money, the sum of currency and demand deposits of the public, r is the market rate of interest and W is the net wealth of the public (Meltzer 1963b).

Meltzer defined wealth as the firm's total assets. He argued that the amount of money held is subject to a wealth constraint as well as being dependent upon the yield of a variety of alternative assets (r is a proxy for these returns). However, he used sales as a proxy for the firm's wealth. He assumed that the sales of the ith firm in the jth industry are equal to $S_{ij} = K_{ij} \, \rho_j \, W_{ij}$), where K is a measure of the capital/labor ratio and of the intensity of capital use and ρ_j is the internal rate of return. Both of these latter variables were assumed to be constant for all firms in the same industry. Wealth as a scale operator has been used for example by Nadiri (1969) and Ungar and Zilberfarb (1980).

In his cross-section study, DeAlessi (1966) used the Meltzer's model and examined the British business firms' demand for money and measured the wealth of each firm directly in the market place as the present value of the market-weighted net exposed income stream of that firm. The nominal wealth of each firm was estimated by multiplying the number of ordinary shares outstanding by their market price.

2.1.4 Stability of the cash management models

The main reason for the potential instability of the cash management functions has been alleged to be cash management innovations, both financial and technological. The evidence of Wilbratte's (1975) paper indicated a substantial contrast in the nature of the demand for money by households and firms. Under several definitions and over several time periods, the household demand was stable for the broader money definition. Wilbratte interpreted the instability of business demand as evidence that the division of liquid assets between the medium of exchange and its substitutes is simply not a meaningful partition in the case of firms, and alternatively, as evidence of financial innovations, as suggested by Vogel and Maddala (1967). Ungar and Zilberfarb's (1980) results for Israeli firms showed a stable relationship between the money holdings and the

explanatory variables suggested by monetary theory, which contradicted some of the earlier findings for the U.S.

To evaluate the effects of cash management innovations on the expected parameter estimates of the models presented above, the comparative static analysis to resolve the elasticities can be utilized. Marquis and Witte's (1989) solution of the long-term average cash balances was based on minimizing the expected cash management costs and the optimal values of risk of cash-out and the level of cash management services.

Marquis and Witte (1989) showed theoretically that the improvements in cash management techniques have significantly changed the cash management behavior of firms. The change in an exogenous variable can create an incentive to utilize more effective cash management services and to decrease the amount of desired cash balances. In addition, the elasticity of cash balances with respect to opportunity costs increases.

Their empirical results indicated that the firms are able to react more effectively than before to the changes in transaction needs of cash balances. Consequently, the scale elasticities predicted by the basic models should be decreased, which means that the cash management behavior is changed more effectively.

Natke (2001) found that all equations for the Brazilian and multinational firm sub-samples exhibit temporal stability but when the samples are combined the partial adjustment equations shift over time.

2.1.5 Economies of scale in cash management

The results reported by Melzer (1963b) suggested strongly that the cross-section demand for money by firms is a function of sales, to a first approximation linear in the logarithms and unit elastic. A more detailed analysis, however, revealed that there are economies – and sometimes diseconomies – of scale in particular industries. Frazer (1964) concluded that the effect of increasing firm size is to reduce bank indebtedness as a percentage of assets, weaken the precautionary motive for holding cash relative to other assets, and transfer cash as a percentage of assets to securities. DeAlessi's (1966) analysis supported similar findings by Meltzer in the United States. The results of British firms suggested that money, defined as currency plus demand deposits, yields a meaningful demand function that is unit-elastic in wealth and is stable over time. Vogel and Maddala (1967) emphasized the difficulties in distinguishing between wealth and transaction models. Contrary to Meltzer's conclusions, a strong argument could be made for economies of scale in money demand. As manufacturing corporations increase in size, they appear to substitute short-term securities for cash. Vogel and Maddala (1967) attributed a downward trend in relative money balances to rising rates and innovations in financial management.

Nadiri's (1969) results indicated substantial economies of scale with respect to holding real cash balances. This result was independent of the choice of measure of the scale variable of the model. Coates (1976) stated that questions about economies of scale in cash holdings can be answered very differently depending upon one's conception of the inventory theoretic approach. Ungar and Zilberfarb (1980) made an empirical investigation of the cash management function of firms in a dramatically changing

money market environment in Israel. There appeared to be no economies of scale in the money holdings of individual firms. The sales elasticity was close to unity, while the wealth elasticity was less than one but not significantly so. Marquis and Witte (1989) concluded that the improvements in cash management techniques in recent years have significantly altered firms' demand for money. An exogenous change in a money demand variable that tends to increase transactions requirements or their variability also creates an incentive to utilize a higher level of cash management services, which will in turn reduce money demand. Their results suggested that understanding money demand requires separate consideration of firms' money demand. Natke's (2001) study of manufacturing firms in Brazil found that economies of scale in liquid asset holdings do exist for multinational subsidiaries but not for Brazilian firms.

2.1.6 Partial adjustment of cash balances

The models mentioned above supposed that the real cash balances are adjusted to a desired level immediately. However, there are possible lags in the adjustment of actual cash balances to their desired level. The lag could be due to uncertainty about the demand conditions, incomplete information about financial markets, etc. It may also reflect the disequilibrium in other assets of the firm. That is, adequate cash balances are needed to facilitate and lower the adjustment costs of other assets.

Several modifications can be made to the basic equation to introduce additional flexibility into the hypotheses. One of the most important of these is the specification of a partial adjustment mechanism by which actual holdings adjust to desired levels. The use of this model implies that cash manager find it optimal to adjust cash balances by only some fixed fraction of the desired adjustment in each period. He is assumed to behave this way because of the existence of adjustment costs which make change more costly on average the faster the adjustment. Since the desired cash balance variable is not directly observable, the adjustment process of actual to desired cash balance level should be specified (see e.g. Nadiri 1969, Coates 1976).

For example Nadiri (1969) postulated a Koyck distributed lag mechanism to depict the adjustment process from actual to desired cash balances, i.e.

$$m_t / m_{t-1} = (m^*_t / m_{t-1})^\lambda \qquad 0<\lambda<1 \tag{2.7}$$

The model hypothesizes that from the difference between the actual and desired cash balances is eliminated a fixed percentage during one period.

This simple partial adjustment mechanism is generally applied in most empirical studies on the demand for money by firms (Nadiri 1969, Coates 1976, Ungar and Zilberfarb 1980, Natke 2001, and Robles 2002.)

According to Nadiri (1969) the adjustment of actual real cash balances to their desired level seemed to be very rapid. Coates (1976) found that the *OLS* estimates indicated that firms adjust their cash balances slowly. The *DOLS* estimates indicated that adjustment is rapid with approximately 80 percent of the desired change in cash balances completed in one quarter. Ungar and Zilberfarb (1980) presented evidence that the dynamic equations

imply a quick adjustment process, and suggest that sales are a better scale variable than total assets. Natke's (2001) evidence also suggested that only partial adjustment of actual balances to desired balances is achieved in a one-year period. The results revealed that Brazilian firms adjust actual to desired balances faster than multinational firms. Robles (2002) specified that the gap between desired money holdings and last year's real money balances was closed fairly rapidly.

2.1.7 Models of expectational variables

The adjustment models presented above have an unfortunate characteristic of restricting the adjustment pattern in the dependent variable to be the same regardless of the source of the initial disturbance. There are several plausible theoretical reasons why this is not likely to be the case.

An alternative rationale for the presence of a significant lagged term in the cash balance function derives from the "adaptive expectations" model (see e.g. Cuthbertson 1988). In this formulation it is assumed that a firm does actually hold its desired level of money balances but that level itself is assumed to depend upon expected values of one or more of the independent variables rather than on current values.

Since independent variables are not observable, some hypothesis must be specified regarding how expectations are formulated. It may be postulated, for example, that current expectations are formed by modifying previous expectations in the light of current experience.

An alternative formulation avoiding this implicit assumption that independent variables are known in advance of formulating the expectation makes the revision of expectations dependent upon the most recent error in expectations, assuming data on current period values are not available. In this form expectations are revised by some fraction of the discrepancy between last period expectations and the actual values of lagged independent variables.

Either of these forms can be employed to derive an estimation equation specified solely in terms of observable values. For example, substituting the basic cash balance relation into the adaptive expectations model and applying a Koyck transformation yields a formulation where the adaptive expectations model is formally the same as the partial adjustment model, although the interpretation of the estimated coefficient on the lagged dependent variable and other variables is very different in the two equations.

Different expectational patterns may be specified for each of the independent variables in the equation or expectations of one or more of the variables may be allowed to adjust in different proportions to two or more of the previous expectations errors (for more detail on expectations models, see e.g. Cuthbertson 1988).

As a generalization of the conventional partial adjustment model a potential planning model can be proposed which enables differing reaction speeds to the various determinants of cash management and ensures that via the error correction mechanism the long-term goals will be achieved. The model includes the lagged value of the residuals from the cointegrating regression, and the lagged dependent variable. In addition there are, of course, variables included in the dynamic specification, which

appear in the long-run relationship but are designed to capture short-term dynamics, themselves determined by the data generation process. The estimation techniques, such as cointegration and error correction procedures have been utilized e.g. Melnik 1990, Arestis and Demetriades 1991, Hendry and Ericsson 1991, Hendry, Ericsson, Fleming, and Westphal 1991, Karfakis 1991, Kytönen 1993, and Dutkowsky and Atesogly 2001.

Theoretically this dynamic model belongs to the adjustment theory of cash balances of the Miller-Orr type (see Miller and Orr 1966 and Milbourne 1983). In that model the short-term factors determine the movements of money when the desired levels are given and the long run factors have an effect on these levels (see Smith 1986).

2.1.8 Opportunity cost of cash balances

In the 1960s the studies on the demand for money by firms were mainly cross-sectional and concentrated on the problem of economies of scale (Meltzer 1963b, Frazer 1964, Whalen 1965, DeAlessi 1966, and Vogel and Maddala 1967). Later studies generally using time series data also considered the opportunity cost of money.

As commented by Coates (1976) a wide variety of proxies, such as the short-term interest rate(s), the interest rates on the liabilities of financial intermediaries, the long-run interest rate(s) on bonds, the cost of capital, or some combination of these rates have been argued to be the opportunity cost of money.

Theoretically, Brunner and Meltzer (1964) partitioned their vector of relative asset yields into three components, i.e. the interest rate on financial assets, the relative yield on physical assets and the relative yield on human wealth. In the estimation, however, they use only long term bond yield. Maddala and Vogel (1969) employed both the bill rate and the bond rate in their empirical explanation of the demand for money. According to Miller and Orr (1968) the relevant interest measure is the long-term rate or cost of capital.

Nadiri (1969) related the demand for real cash balances by firms to the long-term rate of interest, the expected change in the long-term rate, and the expected change in the price level. He stated that the selection of short or long-term interest rates is an empirical question. In his specification, the opportunity cost of money has three components: an interest cost (the interest foregone by holding cash rather than short term securities), capital gains (losses) on the securities market (due to an anticipated change in the prices of securities), and a depreciation cost (a reduction in the purchasing power of money due to expected increase in the general price level). It was presented as $v = r + p'_b/p_b + p'/p,$ where v is the opportunity cost of money, r is the interest rate, p'_b is the expected change in the price of securities, p_b is the price of securities, p' is the expected change in the general price level, and p is the level of general prices. Assuming that a change in the expected rate of interest $(-r')$ is a good proxy for expected capital gains (losses), p'_b/p_b, $v = r - r' + p'/p.$

Coates (1976) argued that the change in nominal interest rate is obviously not a measure of future capital gains or losses. In his production theoretic model the cost of money services is the real rate of interest (cost of capital) plus the percentage change in the price level, which equals the expected change given perfect certainty;

$$i = (r + dP/P) \tag{2.8}$$

In the studies on the demand for money by firms the choice of the short-term rate is more general than the long-term one. Nadiri (1969) concludes that the appropriate interest rate is difficult to decide on a priori grounds, but the long-term rate performs somewhat better than short-term rate. The short-term rate has been used, e.g. by Coates (1976), Ungar and Zilberfarb (1980), Marquis and Witte (1989), Natke (2001), and Robles (2002).

The empirical counterparts used for the opportunity cost include the treasury bill rate (Coates 1976), the nominal interest on short-term bank loans (Ungar and Zilberfarb 1980), the three month T-bill rate (Marquis and Witte 1989), the interest on bills of exchange rate (Natke 2001) and the four to six month commercial paper rate (Robles 2002).

2.2 Operations research approach to cash management

Cash management models like the inventory theoretic models derived by Baumol (1952), Tobin (1956) and Miller and Orr (1966) cited before created the background for the later development of normative research of this area. Two review articles of cash flow model literature were presented by Gregory (1976) and more recently by Srinivasan and Kim (1986a).

The problem space of cash management research modified from Gentry's (1988) classification of financial management studies is presented in Table 1. The three dimensions are degrees of uncertainty, time dependence, and complexity of research problem. This classification may be useful when describing the development of the different types of cash management research, especially in the normative course of studies.

Table 1. Problem space of cash management research.

1. Information for a single variable that is deterministic and static.
(e.g. ratios of financial statement analysis such as current ratio and quick ratio)
2. A deterministic, single variable problem with a changing orientation.
(e.g. the calculation of future value or present value of a short-term investment)
3. A probabilistic, single variable set of information.
(e.g. the frequency distribution of a financial ratio or funds flow component)
4. The number of variables is increased, but the deterministic and static constraints are still present.
(e.g. the use of balance sheet or income statement information in developing direct measures of liquidity)
5. Uncertainty and dynamic dimensions for a single variable.
(e.g. the use of past daily cash flow information in an *ARIMA* model to predict firm's cash flow position)
6. A probabilistic, static, multivariable problem.
(e.g. the combination of cash management problem to capital asset pricing model, *CAPM*)
7. Several variables that are changing over time.
(e.g. a forecast of monthly cash budgets, and linear programming applications to cash management problems)
8. This class incorporates all three factors.
(e.g. the applications of control theory, dynamic programming, and simulation to cash management)

Many of the current cash flow models are based on the basic principles presented in monetary theory. There are two basic types of studies. One of them creates models for decision planning and the other for decision-making, i.e. for ongoing business operations. These models typically utilize such methods as linear programming or simulation in order to take into account uncertainty and to apply for forecasting. Based on these theoretical models there also exist many applications in the form of commercial softwares.

Hinderer and Waldmann (2001) studied cash management in a randomly varying environment. They found sufficient conditions for the optimality of a simple transfer rule, generalizing and partially improving the well-known results for the classic case with independent and identically distributed cash flows. The results they obtained for the cash balance prove to reduce the computational effort drastically in determining an optimal transfer rule.

They considered cash management in a randomly varying environment. The amount of money to be transferred at the beginning of period $n = 1,2,\ldots$ can be specified by a transfer rule

$$f(s_n) = \begin{cases} S^-, & s_n \leq S^- \\ s_n, & S^- < s_n < S^+ \\ S^+, & s_n \geq S^+ \end{cases} \tag{2.9}$$

for appropriate constants $S^\pm$. It means that the cash balance s_n at the beginning of period n is unchanged, if it is within the limits S^+ and S^-, and reset to S^+ and S^- respectively, otherwise. In a finite horizon approach the same holds with bounds $S^\pm$ depending n.

This direction of cash management research can be assigned to the area of operations research. Numerous operational models have been developed optimizing the split between cash and marketable securities based on the firm's needs for cash, the predictability of these needs, the interest rate on marketable securities, and the cost of a transfer to cash and vice versa.

Multi-period linear programming models have been formulated by Robicheck *et al.* (1965) to optimize short-term financing decisions by business firms, Archer (1966) for determining optimal cash balances, and Orgler (1974), whose model considers a wider range of constraints and handles uneven time periods. The types of constraints included in Orgler's model are: payment, short-term financing, marketable securities, minimal cash balance, and cash flow.

Stone's (1973) simulation approach utilized present relationships among the key decision variables to produce a schedule of credit requirements and short-term investments. Maier and Vander Weide (1982) presented an example of an user-oriented version of a linear programming model for managing a portfolio of marketable securities.

There are many restrictions on these models in practice. The model of Robicheck *et al.* (1965) was somewhat less applicable for cash management decisions, since it does not consider the two important decision areas of securities transactions and minimum cash balances. Archer's (1966) model likewise neglected securities transactions and in addition fails to handle payment schedules. The main disadvantage of Orgler's (1974)

model was the fact that it was somewhat cumbersome and difficult for a financial manager to interpret and analyze.

There are also models utilizing such methods as the network approach to the cash management problem, among them Srinivasan (1974), and Golden *et al.* (1979). Glover and Kim (1991) used a generalized-network approach. This latter approach to cash flow management is both convenient to use and efficient to solve. Using such a model, financial managers can effectively analyze the outcomes of many interlinking factors to achieve the objective of minimizing cash management costs.

Srinivasan's (1974) model for cash management assumed that the need for the conversion of cash into interest bearing instruments and vice versa occurs at predetermined intervals and that cash flows are known with certainty. The limitation of the approach is its ability to guarantee optimal solutions except by modification to incorporate the more general structure of generalized transportation problems. Golden, *et al.* (1979) also assumed that the supply of and demand for cash in each period are deterministic and known in advance. Unlike the Srinivasan model, their model recognized compounding of interest as well as reinvestment of returns. It also included a minimum-cash-balance requirement and a line of credit whenever needed.

Bell and Parker (1985) developed a visual interactive model to increase the involvement of the problem originators in the important problem formulation step. They did not identify a specific cash management formulation, but only described the process of obtaining inputs for the visual interactive system. Smith (1989) considered a stochastic, time varying interest rate in a continuous-time inventory theoretic model of the demand for money. His optimal cash management policy was of a familiar target-threshold form, or in the language of stochastic operations research, a control limit level.

Short-term investing problems especially have been considered by Kamath *et al.* (1991), who presented a technique that can consider both the quantitative as well as qualitative variables of a decision problem for investing excess cash in a portfolio of marketable securities, i.e. the analytic hierarchy process. Browne (1995) considered a firm facing an uncontrollable stochastic cash flow, and studied the optimal investment decision by taking into account the trade-off between holding a risky stock or cash.

Milne and Robertson (1996), and Perry *et al.* (2001) utilized the diffusion process for cash flows. Milne and Robertson studied the behavior of a firm whose cash flow is determined by a diffusion process which faces liquidation if the internal cash balance falls below some threshold value. They looked for an optimal trade-off between the desire to pay dividends and the need to retain cash as a barrier against possible liquidation. Their approach used a diffusion process to study the behavior of a firm facing liquidation if their internal cash balance falls below some threshold. They optimized a model under conflicting claims between the desire to pay dividends and the need to retain cash as a barrier against possible liquidation.

Perry *et al.* (2001) studied stochastic models for broker inventory in dealership markets with a cash management interpretation. In the first model, buyers and sellers arrive independently in accordance with price-dependent compound Poisson streams. The second and the third models were two variants of diffusion approximations.

In addition, Perry and Stadje (2000) presented a paper on risk analysis for a stochastic cash management model with two types of customers. They studied a model in which the cash flow is modeled by the superposition of a Brownian motion with drift and a

compound Poisson process with positive and negative jumps for "big" deposits and withdrawals respectively.

2.3 Financial theoretic approach to cash management

Both academic researchers and financial professionals have paid less attention to liquidity management that its importance would merit. Researchers of finance have focused on the relationships between firm value and capital structure. Financial policymaking is also mainly geared towards the firm's capital structure and its dividend policy. However, liquid assets present a substantial portion of the firm's assets financed with short-term debt, often at high rates. Thus efficient cash management is just as important as the other financial policy variables in creating shareholder value.

As a representative for the liquidity management, cash management can be linked to financial theory by considering its importance in an imperfect market. This can be done, by adding it to the financial theoretic models, such as the Capital Asset Pricing Model (*CAPM*) or the Modigliani-Miller (*M&M*) model. The effects of the inclusion of cash balances in these theoretical models show the importance of liquid assets for the value of a firm (through the systematic risk component) and for the optimal capital structure (through the liquidity slack concept).

In addition of the reasons for cash balances presented in monetary theory (and accepted in financial theory), financial theory considers some strategic reasons closely related to the Keynesian speculation motive of money. This literature considers the importance of liquidity slack and its effect, for example, on firm value and capital structure. (see for example Jensen 1986, Ang 1991, Bhattacharyan and Gallinger 1991, and Opler *et al.* 1999)

2.3.1 Effect of cash balances on the value of the firm

The valuation-capital structure discussion has generally ignored the impact of liquidity balances. Morris (1983) tried to connect cash management to the valuation framework of the *CAPM*. (see also Bierman and Copra 1975) He showed how cash balances affect the systematic risk of a firm's stock. He concluded that if a firm carries too little cash, the costs of cash management will have higher expected value and, because they are uncertain, they may add to the firm's systematic risk. The risk associated with the cash decisions is the covariance between the costs of cash management and the return on the market portfolio.

Increasing the cash balances may help decrease the uncertainty, but at the expense of unproductive investment. Both the initial cash balance and parameters of the cash management policy could be varied to reduce the systematic risk. Morris (1983) showed that the initial cash balance should be expanded to the point where the marginal value of the costs of cash management is equal to the value of the funds invested in productive capital assets. Sartoris and Hill (1983) integrated short-run cash inflows and outflows

into the net present value model. They showed that changes in cash management policies have a direct effect on the value of the firm.

Ang (1991) added the liquidity-slack controversy issue to the two other great controversies in corporate finance, both due to Miller-Modigliani; the dividend and capital structure problem. According to him, the liquidity slack refers to a firm's excess holding of liquid assets, or claims, and options for liquid assets above what it needs for the normal operation of its existing business. The relevant question is how the firm will employ the excess cash. Will it be value enhancing or value-reducing?

Bhattacharya and Gallinger (1991) examined the relationship between firm value, liquidity, and capital structure by the simulation of an extended version of the Modigliani and Miller (1958) valuation model. Their results indicated that an optimal level of liquidity exists for increasing firm value. Valuation is based on both capital structure decisions and liquidity decisions, which are influenced by the production and investment decisions of management. Their results suggested that the optimal capital structure for maximizing firm value is significantly related to the level of corporate liquidity. The corporate valuation theory could thus be enriched by more vigorously pursuing the idea that firm value is determined by the integration of several factors, with liquidity being an important influence.

More recently Titman (2002) applied the Modigliani and Miller theorem and studied the effect of financing and risk management on the firm value and impact of suppliers of capital on capital structure choices during capital market imperfection.

2.3.2 Liquidity slack

There is no general agreement on the value or role of liquidity slack. It can be assumed to be consistent with the definition of excess cash defined by Opler *et al.* (1999). They defined "excess cash" as the amount of cash held by a firm in excess of the amount predicted by their model, taking into consideration such variables as investment to date, cash flow from operations, and payments made for taxes, existing financial contracts and dividends. Alternative theoretical frameworks motivating companies to hold cash were presented and various cash holding models tested. They showed that excess cash is often held in anticipation of a business downturn or some shareholder wealth-enhancing projects. (see also Briggs and Singh 2000)

Jensen (1986) labeled this type of slack as "free cash flow". He suggested that to reduce this agency problem, the firm should

1. reduce the slack, e.g. through an immediate payout of extra cash in the form of share repurchase or dividends, and
2. reduce the possibility of being able to accumulate slack, e.g. by incurring a large debt with correspondingly large periodic obligations.

In addition to market imperfections that may provide reasons for holding liquidity slack, firms may hold slack for various strategic reasons. These are only some examples of the ways liquidity slack could expand the range of a firm's strategic choices. There are certainly other imaginative strategic uses of slack in practice. In the motivational

classification this concept is mostly consistent with the speculative motive of the demand for money by firms presented in the monetary theory literature by Keynes as a class of strategic use of slack (Keynes 1936).

Ang (1991) considered especially the effects of taxes and agency cost on liquidity slack. This was done in the context of two common types of agency problems. The first involves the conflict between the shareholders and other claimants of the firm, e.g. banks, bondholders, suppliers, and employees. The second concerns the conflict between managers and/or inside shareholders versus outside shareholders. The discussions in the agency literature are preoccupied with two major issues: how agency problems may arise and how they can be resolved.

Liquidity slack has the further advantage of enabling the firm to smooth its earnings, i.e. managers would reduce profit in good times by hiring extra staff and buying more assets, and increase profit in bad times by firing the extra staff and selling assets. (Ang 1991)

Opler, *et al.* (1999) test various cash holding models. In their theoretical framework they present motivations for holding cash as follows:

1. Frequent short-term borrowing costs can be reduced or minimized by holding cash.
2. Internal cash generation capability or external borrowing capacity is insufficient (especially during a period of mediocre performance).
3. Firms with no reserve borrowing capacity tend to hold an enhanced level of cash.
4. Firms with similar investment expenditures, but higher future investment opportunities will hold higher levels of cash to subvert the "under-investment problem".
5. Firms with low market-to-book ratios and higher levels of cash are characterized by the presence of "entrenched" management.

Opler, *et al.* (1999) found that

− larger firms hold smaller amounts of cash, relative to their size
− there exists a positive relationship between cash holdings and capital expenditures, indicating that firms with better growth opportunities hold higher levels of cash
− risk regulated firms held higher levels of cash than non-regulated firms
− net working capital and cash holdings were negatively correlated, supporting the logical conclusion that a positive net working capital is a close cash substitute
− a strong negative relationship between cash and leverage was observed
− insider ownership of the firm had a direct influence on the cash holdings of the firm, but only to a point
− firm volatility is positively correlated with company cash holdings
− a higher bond rating was related to lower cash level holdings
− there is no evidence that derivatives are cash substitutes

Using their theoretical framework, they examined the differences in the characteristics of high-cash firms as compared to low-cash firms. Generally they found evidence that firms with high levels of cash differed substantially from firms with lower levels of cash.

2.3.3 Cash management and the performance of a firm

The problem of the relationship between liquidity and profitability has been considered in some studies, such as Kytönen (1993) and Shin and Soenen (1998, 2000). Kytönen (1993) presented some preliminary evidence regarding relationships between cash management and a firm's performance. He investigated cash management behavior using the ratios of financial statement analysis as explanatory variables in the firms' demand for money function in addition to some macro-variables. The direction of the coefficient of the profitability variable indicated that the hypothesis of the increasing profitability as an explanation for more efficient cash management must be rejected.

In their earlier study Shin and Soenen (1998) investigated the relationship between the firm's efficiency of working capital management and its profitability. Although cash management is only a part of working capital management, the results concerning the latter could be valuable in analyzing cash management behavior. They used the *net trade cycle* (*NTC*) to measure the efficiency of managing the firm's working capital. *NTC* was used as a proxy for the *cash conversion cycle* (*CCC*) which measures the number of days funds are committed to inventories and receivables less the number of days payments are deferred to suppliers (see e.g. Richards and Laughlin 1980, and Kamath 1989).

According to the evidence of their study, Shin and Soenen (1998) found that

1. a strong negative association exists between the firm's *NTC* and its profitability, and
2. individual firms' stock returns are significantly negatively correlated with the length of the firm's *NTC*.

The results concerning *NTC* indicated that it is also closely related to the issue of firm valuation and the creation of shareholder value.

In their later study, Shin and Soenen (2000) found, that contrary to traditional belief, if a firm has larger sales with a generous credit policy, which extends the cash cycle, the longer *CCC* can result in higher profitability.

2.4 Research of cash management practices

As defined by Teigen (2001), cash management can be seen as a part of treasury management, which is a staff service function that supports many different areas of the organization. Cash management includes the control and care of the cash assets and liabilities of the organization. It means development and compliance with cash and investment policy and processes. All parts of cash management need to be coordinated and documented in a procedural manual in order to control the risk associated with cash.

Despite its central role in real business, very little is known about the practical issues of cash management. Only a little survey evidence is available (see e.g. Gitman *et al.* 1979, Kamath *et al.* 1985, and Soenen and Aggarwal 1989). These are the surveys which try to add to the knowledge of actual corporate practices of cash management.

Soenen and Aggarwal (1989) surveyed and compared cash and foreign exchange management practices in large companies located in the United Kingdom, the

Netherlands, and Belgium. There is also some evidence of cash and foreign exchange management practices in China (Soenen and Sun 1995).

The survey by Soenen and Aggawal (1989) focused on practices in manufacturing, trading, and service companies. They studied the following issues of cash and foreign exchange management:

1. Policy and responsibility
2. Centralization versus decentralization
3. Cash flow planning and foreign exchange forecasting
4. Use of banking relationships and cash management services
5. Hedging translation and transaction exposure
6. Conflicts with other departments
7. Computerization of cash and foreign exchange management

The results showed that there are significant international differences in the responsibility for cash and foreign exchange management. The position of the treasurer is recognized as a separate function in large companies and, where this function exists, the treasurer is involved both in policy formulation and in operations. In general, the sophistication of cash and foreign exchange management practices seems to depend on the country of location of the firm. Practices in the UK, which had the greatest number of large firms, were more sophisticated while in Belgium, where most firms were smaller they represent a lower level of sophistication. However, cash and foreign exchange management practices in all three countries seemed to be following a common evolutionary path and sophistication seemed to be increasing in all three countries.

The authors concluded that cash and foreign exchange management is an institutionally determined rational, value-maximizing response to variable demand under changing exchange rates and imperfect markets. Thus the evidence regarding institutional practices is important in understanding the process of treasury management among European firms.

Soenen and Sun (1995) presented corresponding results from the China. In most state enterprises the responsibility for cash management was assigned to senior executives. Almost eighty percent of the firms surveyed prepare a cash flow plan, most commonly in the form of a cash budget. A substantial number of respondents were in favor of quantitative cash balance models. On average, Chinese firms have very few bank relations, although eighty percent of them anticipate the number of banking relationships will increase in the next five years. Computers were used by less than forty percent of respondents, especially in the areas of cost analysis and projection, followed by accounts receivable and accounts payable management. The survey showed that the purchase department is the most likely to conflict with cash management, which conflicts are least likely to occur with the accounting and personnel departments.

Tse, Buckley, and Westerman (1998a, 1998b) reported survey results on large Dutch companies' practices of cash management. The banking relationships and technological questions were the main theme in their survey. They found that the trend that emerges throughout corporate cash management is towards more effective cash management. Firms use more electronics and technology and move towards centralization of the treasury function.

The issues of cash management practices examined in the present study are based on the discussion presented in the theoretical and empirical literature reviewed above. The survey evidence presented in this study is mostly comparable with the results of Soenen and Aggarwal (1989) and Soenen and Sun (1995). However, the two surveys mentioned also consider the area of foreign exchange management omitted from this study.

The models used in the empirical estimation and stability tests are based on the monetary theoretic literature. This evidence is mostly comparable with the studies presented by Ungar and Zilberfarb (1980) and Natke (2001). The former study considers the research problems similar to those examined here in Israel, and the latter in Brasilia.

3 Cash management decisions

The purpose of this chapter is to present a framework for cash management practices relevant to the survey part of the study. Firstly, cash management is defined as a part of liquidity and treasury management. Then some organizational and technological concepts are considered related to cash management process. In addition, the decision-making principles relevant to the short-term financial decision process are described.

Today's business world cash management is more important than ever before. The review of the literature shows that much theoretical and empirical research has been conducted in the cash management area. However, very little is known about its practical issues. A survey method is used to identify the best practices followed by Finnish listed manufacturing and service companies in their cash management processes. Before turning to the survey evidence, based on the cash management literature, the practices and the management process from planning to decision-making and contracting, are described.

Cash management decisions can be divided into strategic decisions (long run behavior) and tactical decisions (short-run behavior). This study focuses particularly on the decisions related to the financial transactions of cash management. It can be expected that during the research period the changes in cash management were most significant in this area. Firms faced with liberalized money markets and volatile interest rates, were seeking to make the best possible use of their available funds.

3.1 Cash management as a part of liquidity management

Financial management is an extremely important area for a firm's success. Survey evidence has shown that financial planning and budgeting and working capital management are the activities on which chief financial officers spend most of their time (see Gitman and Maxwell 1985).

Cash management is a main area of working capital management. Other parts of it are inventory management, credit management and management of short-term liabilities.

According to Lee (2001), cash management involves the administration of liquid assets and liabilities, and the raising of funds to finance a business. Cash-flow control is therefore crucial to ensuring that a business remains liquid and able to meet payment obligations. This is carried out through the effective management of cash receipts and payments, cash balances and cash transfers between the different parts of a business.

At the organizational level the *responsibilities* of a chief financial officer can be presented as follows (Teigen 2001):

− capital management
− risk management
− strategic planning
− investor relations
− financial reporting

In large firms these responsibilities may be divided into two areas, i.e. accounting and treasury. The controller is the company's chief accounting executive and responsible for the first area, i.e. for accounting principles, auditing standards, and cash control and processing. Treasurer, on the other hand, is responsible for the second area, i.e. the receipt, custody, investment and disbursement of funds, and advice accounting of changes in the cash balance. As presented by Teigen (2001), the working relationship between the managers of these two financial functions must be very close and ethical.

Treasury can be regarded as a staff service function that supports many different areas of the organization. Its responsibilities and the advice it provides are (advice areas in parenthesis):

− capital management (cost of capital)
− risk management (risk analysis and mitigation)
− relationship management (the effects of the team's action on vendors, customers or investors)

The cash management problem is closely related to the concept of liquidity problem as discussed in the corporate finance literature (see, e.g. Cooley and Roden 1991, Brealey, Myers 1998, Scherr 1989, Maness and Zietlow 1998, and Ross, Westerfield, and Jordan 1999). In fact, depending upon the definition one chooses for cash management, the liquidity planning problem can be viewed more or less as general. As will later be shown, there exist several differing definitions of cash and treasury management in the financial management literature.

Teigen (2001) defined cash management as a part of treasury management, which is defined as a part of the main responsibilities of the central finance management team. The specific tasks of a typical treasury function include:

− cash management
− risk management
− hedging and insurance management
− accounts receivable management
− accounts payable management
− bank relations
− investor relations

This definition is consistent with the Srinivasan and Kim (1986a) classification of cash management areas as presented below (but risk management is not included). According to them the responsibilities of cash management can be divided into the five decision processes:

− cash balance management
− cash gathering
− cash mobilization and concentration
− cash disbursement
− banking system design

In their specification of the notion "cash balance management" includes

− management of cash position
− short-term borrowing
− short-term investing
− cash forecasting

In this context the management of the firm's cash position could include managing accounts receivable, improving cash flow, transferring funds, and controlling cash disbursements.

Teigen's (2001) "cash management" concept in turn includes the development and compliance with cash and investment policy and processes, and the control and care of the cash assets and liabilities of the organization, i.e. the selection of

− banks and bank accounts
− investment vehicles
− investment brokers
− methods of borrowing
− cash management information systems

It is noteworthy that in these classifications "cash management" (Teigen 2001) and "cash balance management" (Srinvasan and Kim 1986a) are closely-related concepts. In both specifications, the cash management concept includes so-called financial transactions as a part of the cash management process.

The early short-term financial management research of the 1960s focused on the specific activities of working capital management such as (see Gentry 1988):

− cash management
− accounts receivable management
− inventory management
− short-term borrowing
− cash budgeting

The early research in this area was conceptually based on balance sheet information (on the early evolution of short-run financial management research, see Smith 1973).

In the 1970s the short-run financial management research was developed in a more dynamic direction examining all of the components affecting the inflow and outflow of

cash through a firm (on the major directions of short-run financial management research in the1970s and 1980s, see Gentry 1988).

Compared with Teigen's definition, Kendal and Sheridan (1991) defined the treasury function somewhat differently including an additional area of international taxation as follows:

− financial risk management
− insurance risk
− undertake short-term investments
− inter-group borrowing and lending
− bank relations, credit facilities operations
− international taxation

The treasury function must work with all operations within the organization. The operational functions they work with should consider treasury as an internal consultant with expertise in risk and finance. (Teigen 2001)

In real business there may be many differing targets between cash management and other departments, such as marketing, purchasing, inventory management, production, and human resource management. It is therefore evident that there will be *conflicts* between these departments. Although financial executives know how important effective cash management can be to a company's bottom line, it is not so clear for other managers. Boer (1999) suggested that financial people could use such a simple concept as "*cash gap*" to convince operating managers to pay sufficient attention to cash flow. The cash gap is the number of days between a business's payment of cash for goods and services bought and the receipt of cash from its customers for goods or services sold. That interval must be financed. The longer the time lag, the more interest a company must pay. Even when interest rates are low, the cost of financing can add up quickly.

3.2 Cash management transactions and systems

Following Graber (2002), most of the daily transactions are enacted to complete an activity generated from internal units of the corporation; the payment of an invoice to a supplier, the receipt of a payment from a customer, the maturation of a security or the draw down on a bank line of credit.

In the present study the cash transactions are divided into two groups. The first group includes commercial cash flows (*operating transactions*), such as cash inflows from sales and cash outflows of purchases and the second financial cash flows (*financial transactions*), such as cash flows from money market operations. The latter flows are of special interest in this study.

Cash management is responsible for the cash flows through a firm. These flows can be described as presented in Fig. 2.
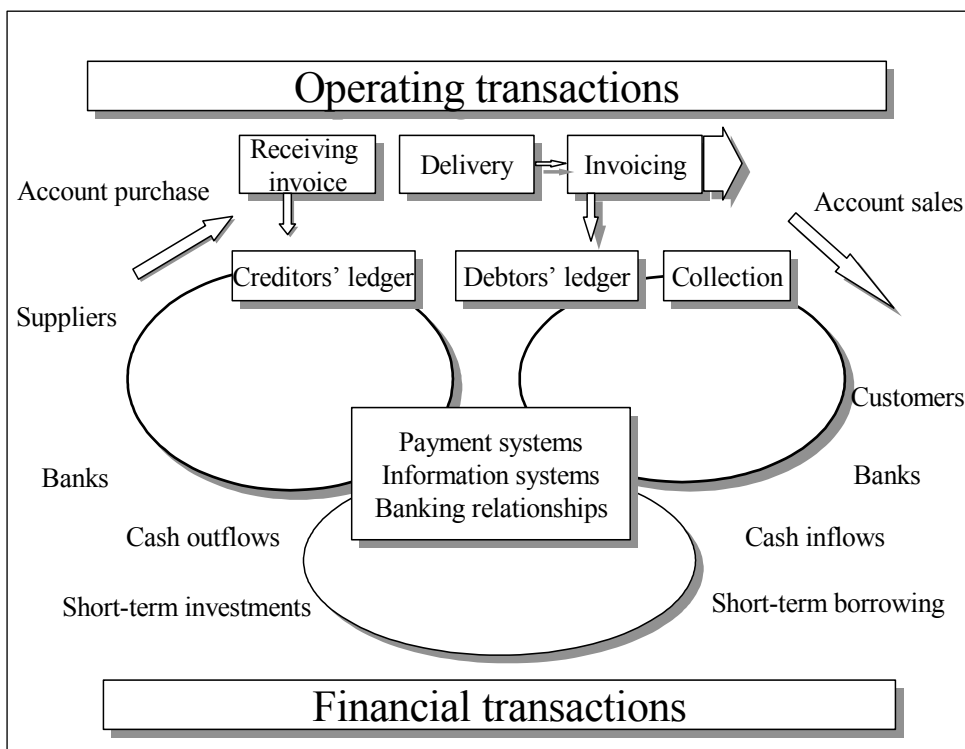
Fig. 2. Cash management transactions.

Operating transactions include accounts receivable management, which includes the control of cash receipt systems within the organization. This involves the management of customer disputes and deductions, collections, the system and processes for control of accounts receivable, and usually the establishment of credit card settlement systems.

On the other hand, operating transactions include accounts payable management, which includes the control of the cash disbursement process. This function consists of vendor relations, disputes and negotiation of the disputes, and the system and processes for control of accounts payable to conserve cash while maintaining positive vendor relationships.

In the effective management of these flows, technological and informational questions play a key role. Because cash management is becoming more sophisticated thanks to an increasingly complex world economy, *centralization* is a major theme and technology the main enabler and driving force (Lee 2001). By centralizing the use of available cash, the treasury operations are able to use the surplus funds of one division to meet the deficit position of another and thus avoid borrowing, or at least reduce the cost of borrowing. Alternatively, any surplus funds may be invested at higher returns in the money markets, adding to profitability.

Whether to centralize or decentralize a company's cash management operation is greatly dependent upon the type of corporate customer, whether or not it has multiple locations, the level of autonomy of the branch offices, and the breadth and scope of the

business. (see Graber 2002) When examining centralized versus decentralized approaches on organizational problems, Mulligan (2001) found evidence that centralization has an effect on firms' performance.

The minimum set-up for efficient liquidity management includes *a cash management system* with an interface to an electronic banking system. Ideally, the cash management software is part of the integrated treasury software. This allows the efficient linking of liquidity management with the process of settlement and accounting of transactions. A firm may develop cash management systems in-house or purchase a firmware system from a commercial supplier.

Scaglione and Pracheer (2002) contend that cash management systems have been a major force in driving the speed at which managers make investment, funding, strategic and risk management decisions. Many resources are expended on linking up the bank's proprietary systems to the company's *enterprise resource planning* (*ERP*), treasury or other internal system.

Significant advances in technology, coupled with access to timely data, have enabled treasurers and risk managers to develop value-added reports for senior management's medium- to long-term strategic objectives. With technology, treasurers are able to run simulated paths that can detect a risk to cash flow before it occurs, giving management the opportunity to take corrective action if warranted. They can also make corrective questions and the system should allow consolidation level control.

The necessary links between banks, treasury software and the accounting system can be realized via interfaces. Efficient cash management is the result of a mix of organizational and software skills. In the future, mobile-based solutions will further facilitate the concentration of liquidity. By mobilizing and developing an account structure for both local and foreign currency deposits using cross-border sweeps and pooling, companies can aggregate currencies and cash much more effectively and make a lot more money on cash balances and on pooling excess cash out of the netting system utilizing the so-called consolidated account system.

Increasingly corporations are seeking competitive advantage by fine-tuning their payments and collections processes and by improved integration and use of information data flows. A higher degree of professionalism within the treasury function and liberalization of exchange controls are two of the main drivers. The treasury area is likely to be involved in Internet-based cash management applications with their banks, as well as making Internet outsourcing decisions and choosing Internet application service providers for treasury-related functions.

Banking relationships is a function that is a delicate balancing act due to the normal practice of having more than one lender involved in most credit arrangements and meeting their needs for services and information from the organization. This responsibility is particularly important in order to maintain the support needed for the organization's cash flow requirements. A special task of cash management is bank selection, which can be based on geographical location, services provided, technology provided to customers, financial strength, and covenants in the credit agreement and customer service provided by the bank.

As an example of criteria for banks can be considered for example the Kobe Steel case (Ouzidane 2000). It presents criteria for the consolidation of its North American operation's cash management system and the development of a structure that would

enable the company to maximize the use of its liquidity. The following list includes the services Kobe expected from its partner bank in setting up its cash pooling system:

1. Ability to accommodate a complex account structuring across multiple legal entities in a fully automated electronic fashion.
2. Understanding of balance sheet netting and pooling requirements from a regulatory, tax and legal perspective.
3. Ability to pool funds among participating entities in a fully automated national manner.
4. Willingness to pass along benefits of balance sheet offset.
5. Ability to ensure that all accounts can be managed on a stand-alone basis by each group company's cash manager.
6. Capability to deliver sophisticated, fully integrated real-time reporting to ensure effective management of interest vs. expense.

Generally, the corporations' wishes include faster connections and execution, more reliable access to technology support, real-time information on cash balances, 24-hour operation, better security and more flexible reporting formats. Ideally, the treasurers would like to see direct feeds from the bank's systems to their internal systems. (see Graber 2002)

Companies continue to consolidate their banking relationships. As they move more business to fewer providers, they acquire better pricing leverage. Moreover, the larger the corporation, the more aggressive it is in seeking lower prices and the less loyal it is to its bank's cash management services. However, the effort to change cash management banks can be painful. Corporations may move a service or two to another bank, but moving the overall relationship, especially when there is a credit relationship with the bank, is cumbersome and can be disruptive to the organization. (Graber 2002)

Scaglione and Pracheer (2002) presented a variety of options that a treasurer can take to ensure that the company's current banking structure meets management's objectives efficiently. A company-wide treasury and cash management questionnaire that delves into current processes to manage cash is regarded as the best method of acquiring a full sense of a company's current cash and banking management and structure. This should include questions that elucidate the processes of the cash management function. The treasurer should also encourage divisions or subdivisions to provide insights and feedback on ways processes could be enhanced.

The next step in this developing process is the implementation of those items that can be controlled within the division (e.g. management reporting, daily processes and trades), and third the issuing of *a request for a proposal* (*RFP*) to enhance banking infrastructure through streamlining. By developing an *RFP* tailored to address the issues identified in the questionnaire, senior management will have the information necessary to modify the cash management process. The direct tangible benefit for the firm is to reduce banking and processing fees, gain a company-wide grasp of cash management and visibility, and develop a more accurate cash forecasting process.

Managing information flow is also a critical part of the cash management services offered by banks as adding value to the whole area of managing the information flow. This means the ability to collect information from the clearing systems, from their clients'

business partners as well as their vendors. Then they can pool this information into a format that is intelligible to their clients through integrated technology.

Treasurers want more updated information from Internet-based systems. On the Internet in general they can see the spontaneous responses to inquiries on the Web. In addition, they expect to be able to share access to the data with their colleagues, thereby reducing the level of communication required and saving time.

As Graber (2002) states, liquidity management is the lifeblood of corporate cash management and is the most important process to be supported through the use of the Internet. This is because good liquidity management is a matter of communication and exchange of information within the corporation, an excellent synergy with the attributes of the Internet.

As discussed before, utilization of such methods and systems in the development of the cash management may require external expertise to research and assist for renewing firms' treasury systems.

3.3 Framework for financial transactions

Some principal and definitional aspects need to be taken into account when planning short-term investments. As stated before, cash management is a key part of financial management, which in turn involves three functions: the management of long-term assets (capital budgeting), the management of long-term capital (management of capital structure), and the management of short-term assets and liabilities (working capital management). Cash management is concerned with the management of short-term assets and liabilities. Included here are assets such as cash, marketable securities, accounts receivable, prepaid expenses, and other current assets and liabilities such as accounts payable, notes payable, and accruals.

In Section 3.2, management of these issues was divided into operating and financial transactions. The areas of cash management defined above are presented in Fig. 3.
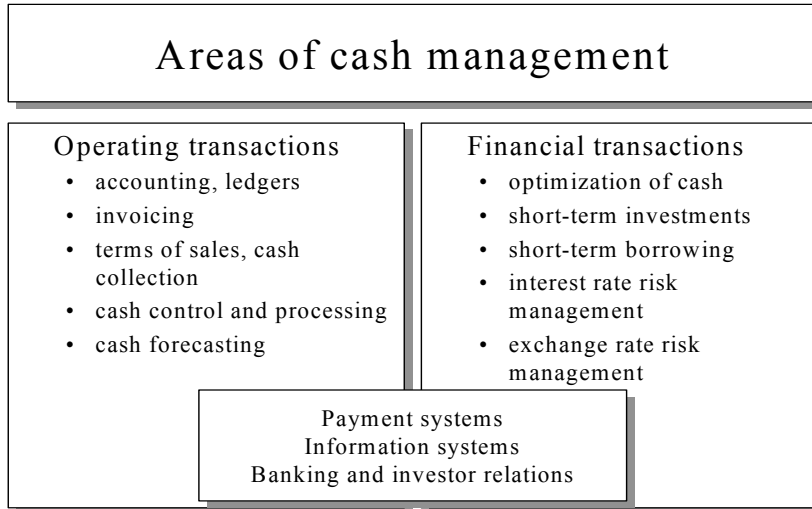
Fig. 3. Areas of cash management.

Cash management models, such as conventional Baumol and Miller-Orr models, are based on a very narrow definition of money and focused primarily on the financial transactions of cash management. They are based on an assumption of the cost minimizing behavior of cash managers. Thus a firm's cash control system consists of its cash position management and transfer system, its marketable securities portfolio and its short-term borrowing structure. The cash forecast is an essential part of the firm's cash control system and is one of the forecasts forming part of the firm's overall financial plan.

One main reason for holding cash in the form of non-interest-bearing currency and checking deposits is the *transaction motive*. Since debts are settled via the exchange of cash, the firm must hold some cash in the bank to pay suppliers and some currency to make change if it makes sales for cash.

Unfortunately, the firm's future cash needs for transactions purposes are often quite uncertain; emergencies may arise for which the firm needs immediate cash. The firm must hedge against the possibility of these unexpected needs. A motivational component explaining this additional need for cash is called a *precautionary motive*. The third component explaining cash need presented in the financial literature is the *speculation motive*. These additional cash holdings are based on a firm's goal to utilize the uncertainties of the money market for which it holds cash for exceptional events in the market.

The fourth potential reason for holding cash is the so-called *compensation motive*. "Compensating balances" are non-interest-bearing deposits made by firms with their banks as part of the banking arrangements. Historically, banks have required firms to make such deposits (which the banks then loaned out at interest) as repayment for the availability of reserve credit lines and other functions that banks perform for their clients.

All the motivational components mentioned above are valid reasons for holding cash balances in response to the needs and uncertainties faced by the firm, especially at the

operational level. This problem was mentioned in Chapter 2, when several strategic reasons for holding cash and short-term interest bearing assets were discussed.

When *planning short-term investments*, availability of cash flow forecasts is a key element. In today's world cash is not as readily available as it was before, so companies are looking into ways to gain better visibility into cash flow and to monitor it for better planning. There is a growing need for companies to forecast more accurately, because in addition to tightened cash flow, market conditions have become volatile. (see Gundavelli and Pacheco 2002)

Once confident that the data sets provide accurate and timely information, such as historical balance sheet data and information gained from ongoing communication with the operating divisions, the treasurer or cash manager has a variety of options in developing the forecast. The first step is to determine a time horizon for the forecast and then the next step is to determine the forecasting methodology.

The methods used for cash flow forecasting in the context of the budgeting process may vary significantly from company to company. Treasury systems have to integrate information from different sources and groups to develop the comprehensive forecast that the business requires. No matter what approach the company takes in developing and refining the forecast, management must ensure that consistent methodologies are applied and that their objectives are clearly communicated to the individuals responsible for the process.

There are two basic approaches to estimating uncertainty in cash forecasting. First, the effects of individual sources of uncertainty on important individual outcome variables could be assessed. Second, the effects of the uncertainty in the various estimated variables on all the important outcome variables could be assessed with uncertainties allowed to vary simultaneously. The first requires sensitivity analysis and the second simulation. The changing of input variables and the observation of the effects on output variables and procedures to assess risk can be performed routinely.

It should be noted that the ability to measure the likelihood of possible outlier events can be significantly improved by understanding the risks inherent in the inputs to the cash forecast and then quantifying the likelihood that they will occur. In addition, treasurers must be able to answer difference between forecasted and actual cash flows. According to Scaglione and Pracheer (2002), some companies have begun the process of deploying and implementing sophisticated financial tools that not only explain cash flow variances, but also produce results that can show the probability of future shortfalls. Having this information, management could take preemptive action if deemed necessary.

The primary impact of cheap computing capacity and user-friendly software has been highly enabled firms to assess risk in their cash flow forecasts. Microcomputer software useful for the analysis of cash management decisions includes spreadsheet (a modeling tool for cash budgeting and analysis), mathematical programming, and simulation packages (for optimization).

In addition, it is noteworthy that the human element in cash forecasting and collections will probably never be eliminated. Good customer relationship management cannot be ignored, and will always be an important part of collections and accurate forecasting, though it seems likely that technology will come more and more into the picture.

The usefulness of better forecasts has increased with the increasing importance of *short-term investment*. Ultimately, each company's unique set of investment skills, resources, liquidity needs and corporate culture will dictate its approach to cash investment.

As discussed before, short-term investment is a critical area of cash management. There are many reasonable grounds for its increasing importance. Many firms experience some seasonality in sales. There will be frequent periods during the year when such firms have excess cash that will be needed later in the year. Firms can temporarily invest the cash in interest-earning marketable securities from the time the cash is available until the time it is needed. Proper planning and investment selection for this strategy can yield a reasonable return on such temporary investments. Another alternative is to pay out the excess cash to security holders when this cash is available, and then issue new securities later in the year when funding is needed. However, the costs of issuing new securities usually make this a disadvantageous strategy.

Besides the basic and continuing reasons such as ensuring that a business remains liquid, several developments in the late 1980s and early 1990s led to increasing concern with the management of cash and short-term investments. One of these developments was the rapid evolution of deregulated money markets. This evolution provided financial managers with access to many new instruments for short-term finance and investment. A second development was a level of interest rates, which rose extremely high by historic standards, and increasing sensitivity to it. Higher money prices caused the financing of investments to become more costly. Together, these developments kept corporate treasurers seeking new and better ways of managing individual working capital accounts to balance the firm's overall liquidity position. Generally these events led to increasing concern with liquidity management.

When planning short-term investments a difficult problem is the trade-off between risk and return. Five ways to improve performance while minimizing risk presented by Winters (1999) are:

− Refine cash forecasting accuracy
− Become a student of the money markets
− Improve securities selection through in-house credit analysis
− Minimize risks with strict diversification and maturity limits
− Shift risk to others

The first issue includes such problems as forecasting accounts receivable and the definition of optimal cash position, and the second the selection of investment instruments (as also issue three) and the forecasting of interest rates.

Winters (1999) proposed that perhaps the most popular way to shift risk, and possibly improve performance, is to outsource the investment function either to a separate account manager or to a money-market mutual fund. While it is not guaranteed that performance will improve by using outside management, in almost all cases, it is evident that the risks will be better managed.

It has been contended that with perfect financial markets or with certain and level product demand there is no advantage to having liquid assets in a firm. However, under more realistic conditions, there may be a number of reasons why maintaining liquidity may add value to a firm.

In addition to its use as a means of handling uncertainty, the management of liquidity plays an important role in maintaining the financial health of the firm during the normal course of business. Too little liquidity and the firm is subject to bankruptcy risk if the inflow slows even slightly. Too much liquidity and profits are lower than necessary. A major function of decision-making for liquidity is the management of the various liquid accounts with regard to the firm's level of liquidity: not too much liquidity and not too little liquidity.

A firm facing variable demand can add value by maintaining liquidity to permit its operating flexibility, since changes in operating levels may be more expensive than changes in liquidity. Thus liquidity can enhance firm value by reducing the systematic component of its risk as it reduces the firm's sensitivity to economic fluctuations. In addition, the value of a firm may be changed by its liquidity because of its ability to act as a financial intermediary for its customers and suppliers because of imperfections in financial markets. Further, under asymmetric information, a highly liquid firm may be able to fund valuable projects that may be difficult or costly to fund on financial markets.

In the case of firms operating in multinational settings, maintaining liquidity may additionally allow firm opportunities for arbitrage between segmented national capital markets that have differing tax, regulatory, and institutional settings. Such firms also face additional opportunities and challenges in managing liquidity under currency and political risks. (More strategic reasons for cash were presented in Chapter 2.)

3.4 Principles of financial transactions

A firm can hold near-cash assets beyond what would be needed for transactions purposes. These are interest earning marketable assets with short maturities, and can thus be liquidated to provide funds at short notice with very little risk of loss. An alternative is to be able to borrow from a bank on short notice should funds suddenly be needed. Clearly, the more of this total hedging reserve held in near-cash assets and the less held in cash, the greater the interest earned. However, there is a trade-off between this interest revenue and the transactions costs involved in purchasing and selling such near-cash assets. Thus whether it is economical to invest part or all of the hedging reserve in near-cash assets depends on the amount of the reserve. Firms with smaller reserves (because their transactions needs are either smaller or more certain) are more likely to hold these reserves in cash, while firms with larger reserves keep them in near-cash assets. These behavioral aspects of cash management have been examined in many studies and were considered in the previous chapter.

The investment of idle cash balances and short-term borrowing for a cash flow shortfall are important dimensions related to cash balance management. The deregulation of the Finnish money market and a rapid increase in interest rates in the 1980s focused management's attention on these activities. Crucial to the desire to economize on transactions balances is the ability to invest these funds in short-term market instruments at relatively low costs. Otherwise there would be no reason to incur the costs involved in reducing the average level of these balances.

It is important that persons responsible for short-term investing be granted specific authority to handle investments. Certain parameters should be established, not only to protect the company, but also to protect these individuals. Generally, this authority will be documented as an *investment policy*, which should provide a framework to establish the goals and objectives of the investment function.

It is important to define the types of eligible investments. The selection of short-term investments is wide. Generally their maturities are shorter than one year. Other definitional aspects could be the limits on amounts of investments authorized and the reporting of investment transactions. Investment dealer selection will depend on the investment vehicles they offer, technology provided for customers, and service abilities. The treasury must develop an investment policy that specifies the level of risk taken through investments of excess cash.

In addition, it is important to decide the form of investments. In practice, the main types are *term investing* and *roll-over investing*. The former is appropriate as a cautious investment policy and the latter for a more risky policy.

Investors should also take into account the calculation of the absolute amount of investment yield in addition to the percentage yield and transaction costs. They should also follow the yield curve and changes in it.

The goal in short-term liabilities management could be to develop a strategy, which, at a minimum cost, provides the desired funds and satisfies the firm's target level of aggregate liquidity. Short-term borrowing will include the selection of lenders and borrowing vehicles that best serves the business and the lenders. In addition to such common types of short-term financing as bankers' acceptances, accounts payable, and accruals, firms can raise money by issuing commercial paper. Banker's acceptances represent a bank borrower's obligation payable at a given date with payment guaranteed by the bank.

It is important to know the main interest rate relationships on the market. Monetary theory, and especially the theory of interest rates, explains their behavior. Because of money market uncertainties it is difficult to forecast interest rates. The longer the investment period the more difficult this task is.

The *yield curve* represents the required returns on securities of a given default risk for various times to maturity. That is, it defines the supply/demand intersections for securities of various maturities. These required returns may be influenced by various factors, such as the level of inflationary expectations, the relative levels of supply and demand for securities of different maturities, and differences in investors' perceptions of the interest rate risk of securities having different maturities. The most common theories regarding the determination of the term structure of interest rates are based on these differences in inflation, relative demand, and risk among securities with various maturities.

One important aspect of the yield curve with respect to the firm's investments in cash and near-cash assets is the risk-return trade-off caused by its usually positive slope. The longer the term to maturity of the investment, the higher the per-period yield. There is therefore an incentive for firms to invest in longer-term securities. Offsetting this is the greater interest rate risk for longer maturities; if the investing firm chooses a security with a longer maturity and is forced to sell that security before maturity and if interest rates have risen, the return achieved may be less than if the firm had invested in shorter-

term securities. Investments with longer maturity tend to have lower liquidity and the forecasting of interest rates is more difficult.

When utilizing yield curves in investment planning, it is notable that this requires special skills, relevant estimates of interest rates, and a decision if the risk/return ratio is relevant for such investments and if the return is high enough to compensate costs.

3.5 Financial transaction decisions

In the planning and decision-making process of financial transactions there are some important issues to consider. Especially during periods of high interest rates the cash manager should be aware of the increased value of seeking the best investment alternatives and that their returns may have a significant impact on firm's earnings.

In order to operate on the money market, the cash manager should be familiar with the investment vehicles available on the markets and select those appropriate for the investments. *Certificates of deposit* represent an investment in a financial institution, and they are written at face value. They represent a contractual arrangement for a set period of time, although they may be redeemed prior to their stated maturity. *Treasury bills* represent the direct obligations of the government. They are considered the safest investments available because they are backed by the full faith and credit of the government. They are sold on a discount basis and may be purchased through financial institutions.

The *Central bank's certificate* of deposit is a short-term paper issued by a central bank. *Commercial paper* represents an unsecured promissory note of a corporation with a limited maturity, and is issued on a discount basis. Many issuers obtain credit ratings through major rating companies, thereby helping the purchaser measure the relative risk of the investment. *Municipal securities* represent the obligations of local authorities. A *repurchase agreement* is an arrangement whereby a bank in essence sells one of its investment securities to a customer with an agreement to repurchase that same security at a specified date, at a specified price, and with a specified rate of interest for the period held. Other low risk possibilities for short-term investment are *fiduciary deposit* and *promissory note*. Money market funds representing a pool of interest-bearing investments represented by shares owned by fund investors are worth considering. Investors' returns consist of the weighted average of the fund less a management fee.

The selection of instruments takes time, and is a cost factor for the firm. Other time-consuming matters in making short-term investment decisions are for example such activities as setting goals and targets and the resolving of maturities for investments. Advanced computer technology provides easy access to daily cash receipt and disbursement information, resulting in a better understanding of the short-run cash flow processes. This information is important when defining investment amount. Moreover, short-term investing decisions require money market information.

Simultaneously with the money market deregulation, computer technology emerged that provided commercial banks with the tools to offer cash management services to corporate customers. (Information systems were discussed in Section 3.1.)

Establishing a personal relationship with a money market investment advisor of a bank, financial institution, brokerage, or advisory firm is an important responsibility of the cash manager. Time does not always permit him to continually study key market factors from commercial information systems or from economic newsletters. Thus the cash manager may need an advisor, who understands the firm's goals and objectives and provides appropriate investment advice.

Regardless of a company's size or ability, cash investing has been and always will be governed by three simple investment objectives, ranked in the following order: 1) principal preservation (the safety of the instrument), 2) liquidity and 3) performance (return). Failure to keep these priorities aligned can be costly. A cash investment manager needs to understand his role within the corporate risk continuum and avoid straying into a higher risk zone. (see Winters 1999)

In the context of the cash management definitions presented before, the short-term risk management was also included in the area of cash management. From the operating side of transactions it included customer credit management and means of financial analysis, credit limit establishment, and order control. The financial risks of short-term investing could be interest rate risk, credit risk, liquidity risk, inflation risk and exchange rate risk.

Investors' actual returns may differ from their expected returns as a result of unexpected changes in market interest rates. All securities are subject to varying amounts of interest rate risk. Other things being equal, the longer the maturity of an investment, the greater the interest rate risk will be. The longer the investment in a fixed rate investment, the greater the risk of principal should rates rise and early disposition be required.

In addition to yield curve effects, risks and returns among near-cash assets differ because of the credit risk. Some securities are extremely safe while others entail a nonzero probability of default, and carry higher interest rates to compensate buyers for this risk. It is important for the cash manager to look carefully at the institution behind the investment to ensure that principal and interest will be paid when due.

Generally, the liquidity of an investment will in part determine the return. The more liquid or marketable the security is, the lower the yield. This is due to a greater cost of liquidation, a more limited market, and an interest rate risk usually associated with a less-liquid investment. Because a major responsibility of the cash manager is to provide liquidity for the firm when necessary, overall marketability of the investment portfolio must be continually considered.

The return on an investment is also influenced by anticipated future rates. Because it is considered easier to predict the inflation rate in the short term, a premium is often attached to longer-term investments. Under the normal conditions the longer the maturity of an investment, the higher the rate of return. Often when the longer-term inflation rate is believed to be lower than the current short-term rate, a situation is created where short-term rates will yield a higher return than the longer term.

Hedging means to adopt a strategy that negates, in whole or in part, the risk associated with a decision. Hedging is quite different from risk pricing, which is a way of allowing for risk that is not hedged. Hedging as a method of controlling risk is very important in liquidity management. Two types of hedging strategies are hedging strategies that use derivatives and hedging strategies that do not.

Hedging strategies that do not involve derivatives may take several forms. The most common involves the arrangement of additional available financing or the investment in additional assets beyond what expected to be needed. Keeping a reserve of cash or of marketable securities to hedge cash flow risk is an example of this type of hedging.

Interest rate derivatives can be used in two ways to hedge risk in a cash forecast: (1) they can be used to hedge the interest rate risk on future borrowings and investments, or (2) they can be used to hedge the interest rate risk inherent in investing in longer-term instruments where an unexpected cash shortage may lead to selling these instruments before maturity.

When the firm uses these hedges, the prime variable it is attempting to hedge is the overall level of interest rates. Compared to changes in these general levels, changes in the basis are often rather small. Despite problems of thin markets and basis risk, the use of derivatives provides results that are significantly safer than un-hedged strategies.

When financial instruments are available, they can provide effective hedges against the uncertainties facing the firm. Financial hedging instruments include for example futures contracts, forward contracts, options, and swaps.

Interest rate futures present a contract to purchase or sell a financial instrument at a set price based on a future date. Once the contract is acquired, its value will depend on the open market rates for the instrument the contract presents. Under a *forward contract* a deposit of fixed maturity is agreed to at a fixed price for future delivery. The *interest rate option* is the right either to buy or to sell a specific money market security at a stated price during a specific period. An option is referred to as a call option if it gives the holder the right to buy, and as a put option if it gives the holder the right to sell. *Interest rate swap* is a contract wherein one part pays a fixed rate of interest based on a notional amount to a second party, who pays the first party a variable rate of interest based on the same notional amount.

3.6 Short-term financial planning and decision-making

The previous sections of this chapter presented a review of cash management issues focusing on financial transactions. Before turning to the survey evidence on the decision-making principles of these issues, it is reasonable to consider the management process both generally and especially in the case of cash management.

In the management process in general, planning plays a key role. The planning stage is followed by the decision making and contracting. According to Martin and Morgan (1991), the need to plan arises as a result of the same factors that have been used to explain the creation of firms. Therefore, the literature on the economic theory of the firm serves as a theoretical point of departure in developing a theory of financial planning.

The study of financial planning permits the following definition: "Projecting or estimating a firm's needs for funds and arranging for them before the time when those funds will be needed" (Martin and Morgan 1991). The key elements of this definition are 1) financial planning deals with the future, and 2) it involves present decisions and actions in response to the firm's assessment of its future financing needs.

It has been stated that all plans that deal with a period of one calendar year or less are short-term, while long-term planning is used to refer to the firm's very general plans or strategies for its future endeavors (Hussey 1971). Drucker (1974), on the other hand, uses short-range to refer to the time span over which the decision will be effective. Correspondingly he refers to a long-range decision as one whose effect will extend over a long time span.

In financial planning especially, there are differing classifications in the corporate finance literature. Financial planning is responsible for the financing of short- and long-term investments and can be defined as the treasury function of a firm.

The financial planning can be decomposed into four stages of activity as follows (Martin and Morgan 1991):

Stage 1:   Thinking out the firm's future financing needs.
Stage 2:   Prearranging the details associated with the acquisition of the funds requirement identified in stage 1. There are two possible consequences of this stage in the planning process: a) Raise no financial slack and b) Raise financial slack.
Stage 3:   Determining the optimal mix of financial contracts to be used to prearrange the details of the firm's future financing requirements.
Stage 4:   Managing the allocation of liquidity slack raised by issuing securities over the interim period until the funds are needed.

Financial planning is closely linked with the notion of cash management when the decision to raise liquidity slack via the sale of securities is being made. Raising liquidity slack in that form creates a direct link between financial planning and cash management. The discretion to allocate the resulting slack as excess liquidity to cash or marketable securities is created by the financial planning decisions of the firm.

Liquidity planning involves deciding what, if any, present action should be taken to prearrange the details of the financing of those projected needs. In terms of this notion of cash management policy, however, a theory of cash management must also include consideration for the determinants of the optimal mix of financial contracts that should be used to finance the projected mix of future asset investments and a decision as to what, if any, current actions should be taken to prearrange the details of that financing mix. Thus, this notion of liquidity planning can be viewed as a necessary first step toward the development of a comprehensive theory of cash management.

Fig. 4 presents some basic conditions for effective cash flow planning and how these plans could be carried out.

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│             Effective cash flow planning                    │
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┌──────────────────────────────┐  ┌──────────────────────────────┐
│ • Qualifications             │  │ • Activities                 │
│   – sophisticated systems for│  │   – management of cash flows │
│     • payments               │  │     • measurement of liquidity│
│     • information            │  │       and efficiency         │
│     • banking                │  │   – forecasts                │
│   – skilled personnel        │  │     • cash budgeting         │
│     • comprehensive view of  │  │     • financial statement    │
│       different activities   │  │       forecasts              │
│     • market knowledge       │  │   – adjustments              │
│     • awareness of risks     │  │     • transfer elasticity    │
│                              │  │     • money market operations│
└──────────────────────────────┘  └──────────────────────────────┘
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Fig. 4. Cash flow planning.

The conditions for effective cash flow planning include both organizational and technological issues as discussed in Section 3.2. Cash planning activities were the theme of Sections 3.3 to 3.5.

The term "strategic decision making" is generally used to refer to those planning activities involved in determining the goals and objectives of the firm, which, in turn determine the lines of business in which the firm will be engaged in the future, in contrast to tactical decision-making, which refers to those activities related to planning for the firm's ongoing operations. Table 2 presents a classification of the treasury issues presented by Kendal and Sheridan (1991). It is presented as a compromise situation where strategic issues should be the concern of corporate headquarters leaving tactical treasury issues to the business.

Table 2. Strategic and tactical issues (Kendal and Sheridan 1991:196).

Strategic issues	Tactical issues
Asset / liability structure	Local bank relations
Borrowings: maturity, amount, flexibility	Dividends to the centre
Credit lines	Cash management and all short-term investments
Interest risk	Ratios
Currency risk	Dealing with short-term surpluses
Economic risk	
Cost of capital	
Currency of borrowings	
Debt maturity	
Working capital, capital expenditure controls and evaluation	
Tax optimisation	
Guarantees, and any pledging of group assets	

The decisions on financial transactions in cash management can be divided into strategic and tactical as shown in Fig. 5. Corporate strategy will focus on using capital resources to improve the decision support systems and the management of information in order to gain a competitive advantage and improve operating performance. In the case of cash management, strategic decisions are focused on cash management investments, such as new cash management systems and human resources, which create opportunities for effective cash planning and decision-making. Incentives for these investments could be, for example, structural changes in the money market or the changes in the firm's performance. From the financial transactions perspective, strategic decisions affecting cash management policy are the preferences concerning the risk, return, and liquidity of short-term investments. Instead, operational decisions are related to policy issues concerning cash forecasting, short-term investment, borrowing, and cash position management.
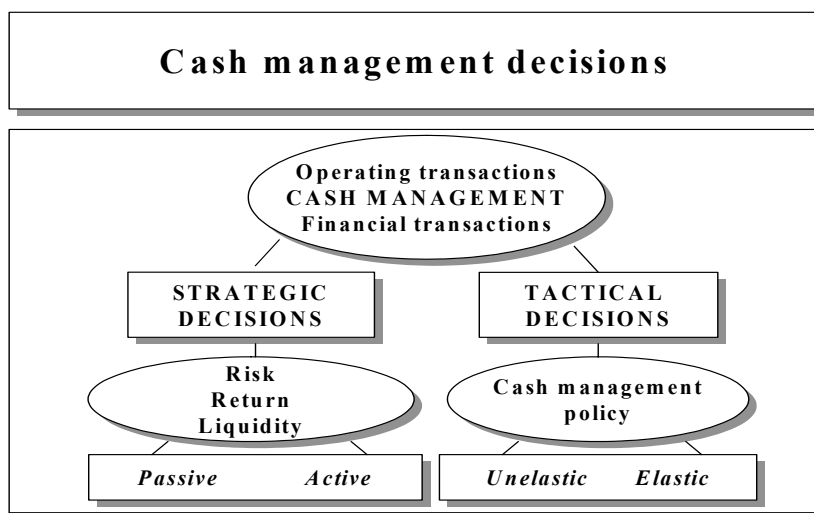
Fig. 5. Cash management decisions.

Cash management policy can be defined in a more general context, which encompasses the formulation of policies regarding the firm's current assets needs both in total and by specific category, in addition to the determination of how those asset needs will be financed.

If the firm pursues a passive strategy with respect to financial investments it takes no risk and emphasizes liquidity before return. In a case of active strategy a firm follows principles as do money market dealers. These strategic decisions create the basis for tactical cash management decisions and policy issues. In circumstances of passive strategy, cash management follows elastic policy and vice versa.

A key element for the financial decision-making process is contracting. When examining financial planning and the associated activities of the firm directed at arranging for the firm's future financing needs, the question as to how buyers and sellers structure and enforce their agreements must be addressed.

Some of the early literature on the theory of the firm (e.g. Coase 1937) referred to the use of short and long-term contracts used by entrepreneurs to acquire the use of resources. Long-term contracts were used in a manner analogous to Williamson's (1979) notion of a neoclassical contract, where the key element appears to be the firm's discretionary powers concerning the use of resources acquired through the agreement. Other two types of contracts defined by Williamson were classical contracts and relational contracts.

Hart's (2001) paper concerns the factors affecting financial contracting among capitalists, entrepreneurs and businessmen. It considers the establishment of a corporate financial structure through the Modigliani-Miller theorem and especially the trade-off between debt and equity finance on incentive agency problems.

Holmström and Tirole (2000) present a contract-theoretic framework integrating three dimensions of corporate financing and prudential regulation, i.e. liquidity management,

risk management, and capital structure. They state that firms and financial institutions are best viewed as ongoing entities, whose project competition may require renewed injections of liquidity.

Commercial banks create new financial instruments to meet specialized corporate needs and extend the rate of return effects on the short-run portfolio. These new instruments provide new sources of cash balances as well as opportunities to meet cash management investment and borrowing needs. Emerging financial strategies create new financial contracts that shift the firm's risk exposure to the marketplace. The internationalizing of firms and the integration of money market also introduces new instruments available for short-term investing. The long-run impacts of financial and organizational restructuring will introduce significant changes in cash management.

The short review of cash management activities presented in this chapter forms a framework for the following survey analysis. The issues researched will be defined in the first section of the next chapter.

4 Survey results of cash management practices

This chapter presents survey results of the cash management practices of Finnish firms. The importance of these results is evident because there is little information available on the practices behind the models of cash management and firms' demand for money. Cash and treasury management and some organizational issues such as responsibilities and the centralization of cash management are defined. The next step is to describe the main cash management practices and to gather evidence from the real business world on these. An examination is made of the responses of the representatives of cash management in Finnish firms, all listed on the Helsinki Stock Exchange.

Modern cash management emphasizes that part of cash management which is responsible for money market operations. The cash manager is primarily responsible for short-term financial activities. In an emerging money market, it is important to know how to further enhance the company's cash position, including managing accounts receivable, improving cash flow, transferring funds, and controlling cash disbursements. In addition, one should understand the principles of short-term investment, including investment policies, instruments available, and investment strategies and techniques of minimizing cash management costs.

In order to invest in the money market effectively, a firm must know when the cash is needed. This is a difficult forecasting task, even for larger companies. To invest properly on an almost daily basis, a cash manager has to forecast the funds that will be required to meet payments, and to maintain sufficient cash to cover immediate disbursements. In order to be effective, he should be aware of various alternatives and relationships between interest rates yield curves for various investments and compare these with the market conditions prior to investing.

Coinciding with many requirements there are also additional opportunities for effective cash management. The Finnish banks have promoted new services for corporate customers. The markets for money market instruments, derivatives and mutual funds, have grown rapidly along with the new technology to provide more opportunities.

The empirical evidence presented here is mostly comparable with the survey results presented by Soenen and Aggarwal (1989) and Soenen and Sun (1995). The former study

examines cash and foreign exchange management practices in three European countries, i.e. the UK, the Netherlands, and Belgium, and the latter corresponding practices in China. The evidence from this study will be compared with the results of these studies where appropriate. When assessing the relevancy of the comparison, it is worth noting the very different and fast changing political and economic environment in China. When considering the timing of the separate studies, it is noticeable that the results of Soenen and Aggarwal (1989) are mostly comparable with the first survey (1988) and results of Soenen and Sun (1995) with the second survey (1994) presented here. There are also similarities with the survey carried out by Tse, Buckley, and Westerman (1998a, 1998b) in the Netherlands. Especially, this holds for banking relationships and technologies.

This part of the study presents the results of the three surveys conducted in 1988, 1994 and 2000. This is a longitudinal study of cash management practices investigating the impact of financial deregulation and innovations in cash management techniques on cash management behavior. Before turning to the survey evidence the contents of the questions are presented in the next section.

The rest of this chapter is organized as follows: Section 4.1 includes the issues researched. Section 4.2 consists of a survey design including a description of the data and the methodological questions. The survey results are presented in Section 4.3. Section 4.4 provides the conclusions of the survey part of the study.

4.1 Cash management practices: issues researched

Research in cash management must inevitably be linked to certain organizational questions such as responsibilities and centralization of cash management, cash management systems, banking relationships, utilization of information technology, and the management of short-term investments. By recognizing of these interrelationships, this study addresses some specific issues of cash management.

As Scaglione and Pracheer (2002) point out, with emphasis on cash generation and preservation, treasurers of firms will be called upon to ensure that the company's financial objectives are being met efficiently. As a result, they should implement best practices in treasury and financial risk management to maximize cash flow and transparency effectively. Initially, key areas that treasurers should focus on to meet this objective include bank management and structure, cash forecasting, financial tools, and technology.

This study focuses on the short-term operations of the areas mentioned above. Some potential theoretical factors relevant to the decision making process of cash management issues are considered first.

The issues of cash management to be investigated are divided into four groups. The first consists of some organizational and technological questions. The second group includes selected issues in cash management and the third one forms the framework for financial transactions decisions. The last group of issues considers these transactions more specifically.

4.1.1 Organizational and technological issues

The first group of issues to be examined consists of some organizational and technological questions already considered in more detailed in Chapter 3, and are defined as:

1. Responsibility for cash management
2. Conflicts with other departments
3. Centralization of cash management
4. Utilization of cash management systems
5. Banking relationships
6. Information systems in use

Responsibility for cash management: As presented before, cash management is a part of treasury management, which in turn forms the main area of corporate finance. It can therefore be assumed that cash management constitutes a major financial function in the firm and consequently the responsibility for it within the firm should reside with senior management. This study investigates the position of a person responsible for cash management and gender distribution of respondents. Generally, females have got more responsibility in the business world in Finland. Evidently, the same should also occur in the area of cash and treasury management.

Conflicts of cash management with other departments: Effective cash management requires information from the other departments of a firm and active cooperation with them. Although financial executives know how important effective cash management can be to a company's profitability, they sometimes have difficulties convincing operating managers to pay sufficient attention to cash flow. Even those who might otherwise be very good at managing sales, production, inventory or materials, may need some persuading. Obviously, corporate goals (such as liquidity, profitability and risk management) can result in opposing interests for different departments within the same firm.

This survey tries to determine which departments are most likely to be in conflict with those responsible for cash management. Potential candidates are as follows:

a) purchasing
b) inventory management
c) production
d) marketing
e) human resource management

Centralization of cash management: With the increasing options to use common balances to meet needs in various parts of a company, and the increasing availability of technological innovations, it is reasonable to assume that there has been an increase in the degree of centralization of the cash management function. This assumption is consistent with some roundtable discussions among cash management professionals (see e.g. Asiamoney 2001, 84-90, Corporate Finance 2001, 205-225, and Corporate Finance 2002, 208-225). This study tries to find evidence for the progress of the centralization of cash management and also in the case of treasury management.

Utilization of cash management systems: There are many areas where computerized decision support systems have been developed to help those who are responsible for cash management, i.e. for example electronic and mobile funds transfers, quotation money market and foreign exchange rates, balance reporting, and cash flow and interest rates forecasting. This study investigates the extent to which companies use of the new systems in cash management decisions, when the systems have been purchased, what features they have, and what methods they enable. It is hypothesized that the development of these systems has increased.

New methods can be utilized by using software programs both made in-house and bought from outside suppliers. It is reasonable to suppose that in-house systems have given way to firmware systems.

It is probable that at the same time as the availability of firmware systems has increased their features have become more sophisticated. The new systems should clearly be integrated into other financial accounting systems, and they should be applied for consolidation control and the utilization of the netting system. This development of systems makes it possible to make questions for differing criteria and enable simulation.

Banking relationships: As those responsible for cash management and appropriate organizational arrangements are defined, effective cash management operations require the creation of functioning banking relationships. Banking services continue to be an important part of the cash management system. A firm needs a partner bank in order to arrange its cash flows properly.

The discussions (see e.g. Asiamoney 2001, 84-90, Corporate Finance 2001, 205-225, and Corporate Finance 2002, 208-225) show that foreign (either U.S. or European) companies have shown an increasing tendency to concentrate their banking activities among fewer banks. It is thus reasonable to assume that Finnish firms have also reduced the number of banking relationships, and a firm may have only one or two lead-banks.

Information systems in use: In order to manage financial transactions effectively, a manager needs online information on the firm's internal accounting systems and the money market. In addition to the information services offered by banks, there are many alternative commercial systems available on the market, for example *Reuters, Telerate* and *Startel*. It is obvious that with the increasing importance of cash management operations the demand for such systems has increased.

When making cash management systems more effective, it is usually reasonable for a firm to use expert consultants. The demand for these services has clearly increased. This study examines how widely firms have used cash management consultants in order to develop cash management processes.

4.1.2 Concepts and definitional aspects of cash management

The next group of issues to be investigated concentrates on selected definitions and concepts of cash management. Generally, several factors affect cash management, based on theoretical and practical discussion. The issues are classified as follows:

1. Areas of cash management
2. Motives of firms' demand for money

3. Cash planning
4. Increasing importance of short-term investment
5. Problems in short-term investment
6. Importance of firm's liquidity

Areas of cash management: In the above discussion, the term "cash management" referred to the management of cash from the time it starts its transit to the firm until it leaves the firm in payments. Cash management encompasses the design of collection and disbursement systems for cash and the temporary investment of cash while it resides with the firm. In this definition operating transactions are also included in the definition of cash management.

This study concentrates on the part of firms' cash control system which includes financial transactions of cash management, a definition consistent with Srinivasan and Kim's (1986a) and Teigen's (2001) specifications of cash balance management. The survey part of the study examines how the cash management professionals rank these factors at different times. The areas of cash management considered are:

a) cash position management
b) short-term investment
c) short-term borrowing
d) forecasting cash balances

Motives of the demand for money: Despite their seemingly low returns, there are several good reasons for firms to hold cash assets. It is useful to think about the firm's cash balances as comprising of four parts, each part of which has a particular reason for holding these assets.

The transaction motive explains the amount of money necessary for running daily business operations assuming deterministic cash flows. Additional money is needed because of daily cash flow uncertainties (precautionary motive) and if a firm holds cash for some speculative reasons (speculative motive).

If a bank requires a firm to make a deposit as repayment for the availability of reserve credit lines and other functions the bank performs for its clients, these non-interest-bearing deposits form the compensation motive for cash. However, it is supposed that recent developments in the banking industry have seemingly rendered this approach increasingly less common relative to fee-based systems of banking compensation.

Although the priority order of these four factors may be quite obvious, a potential change in their priorities is researched. The motivation components examined here are:

a) transaction motive
b) precautionary motive
c) speculative motive
d) compensation motive

Cash planning: An important instrument used in cash planning is the cash budget. This is an estimation of the flows in and out of the firm's cash account over a particular period of time, usually a quarter, month, week, or day. It is primarily intended to provide an estimate of the firm's borrowing and lending needs and to forecast these needs during various future periods. An unplanned surplus of cash causes a firm almost as many

problems as an unplanned deficit. Without a cash budget, the firm has no way of knowing how long the surplus will persist, that is, if and when the cash will be needed for expenses.

Thus it is concluded that the preparation of formal cash flow forecasts is a fundamental cash management activity. Additionally, this study examines the extent to which formal quantitative models are used for cash and short-term investment planning and what their position is with respect to cash budgeting.

The alternative methods researched are as follows:

a) cash budgeting
b) linear programming
c) simulation
d) optimizing model
e) rules of thumb

Increasing importance of short-term investing: Section 2.3 presented numerous reasons for the increasing importance of short term investment. Money market liberalization increased the volatility of interest rates and therefore the opportunity costs of money. At the same time, many money market innovations were created by the banks. This evolution path of the money market provided financial managers with access to many new instruments for short-term financing and investments. Together with these developments, corporate cash managers seek new and better ways of managing cash flows to balance the firm's overall cash position. As proposed before, there are many additional reasons for the increasing importance of liquidity. Evidently, the importance of short-term investment has increased in parallel with the increasing importance of liquidity.

In addition, it can be expected that the priority order of these factors may be quite sensitive to environmental changes. The main factors affecting the importance of short-term investment are supposed to be:

a) increase in interest rate sensitivity
b) new money market instruments
c) increasing importance of liquidity
d) rise in the price of money

Problems of short-term investment: When considering the process of short-term investment, uncertainties are likely in most problems both in the case of operating and financial transactions. Reliable estimates of cash flows are essential for these decisions. In addition to the forecasts of the surpluses and deficits of cash balances, the amount of cash and short-term investments must be resolved. In an open market environment the cash manager should be familiar with the money market instruments available. In order to resolve the period for investments, the interest rate forecasts should also be available. Evidently, interest rate forecasting is a fundamental financial transactions management activity as was formal cash flow forecast for operating transactions management. The main problems of short-term investment are assumed to be as follows:

a) forecasting accounts receivable
b) defining optimal cash balances

c) choosing the investment instrument
d) forecasting interest rates

Importance of the liquidity of a firm: As presented before, liquidity can increase the firm's value by reducing the systematic component of its risk as it reduces the firm's sensitivity to economic fluctuations. In addition, under asymmetric information, a highly liquid firm may be able to fund valuable projects that may be difficult or costly to fund in financial markets. Further, the value of a firm may be enhanced by its liquidity because of its ability to act as a financial intermediary for its customers and suppliers. In multinational settings, maintaining of liquidity may additionally allow opportunities for arbitrage between segmented national capital markets. Such firms also have additional opportunities and challenges in managing liquidity under exchange and political risks.

The above discussion suggests the potential reasons for holding liquid assets to be:

a) it increases elasticity of production
b) it is possible to finance projects with own money
c) it creates opportunities to act as a source of financing
d) it is possible to utilize arbitrage
e) it eases management of exchange and political risks

4.1.3 Framework for financial transactions decisions

The following issues form the framework for the decisions concerning financial transactions and are specified as follows:

1. Short-term investment policy
2. Form of short-term investments
3. Selected principles in short-term investment decisions
4. Borrowing by issuing commercial papers
5. Importance of interest rates in short-term investment
6. Utilization of yield curves

Short-term investment policy: For effective money market operations, a company should have a formal investment policy for the management of its cash and short-term investments. It is very reasonable to expect that at the same time as activities in the area of short-term investment increase, more and more companies have constructed a more detailed formal investment policy for short-term investments.

The generality of short-term investment policies and the factors included in them is examined. The following factors should obviously be included:

− types of eligible investments
− limits on amounts of investments
− who is authorized to transact
− reporting of investment transactions
− dealers with whom to transact

Forms of short-term investments: When planning short-term investments a cash manager should estimate the future interest rates. If such estimates are available, the two commonly used investment principles are either term investing (the investment is made for the whole investment period) or roll-over investing (the investment is renewed during the investment period). It is supposed that the behaviour of cash managers depends on the money market circumstances as well as their risk preferences. Generally, a risk taker manager is assumed to follow an active cash management policy and a risk-averse manager more conservative policy. It is hypothesized that cash managers' have turn to follow more active policy.

Selected principles in short-term investment decisions: There are some investment principles which characterize the investing behaviour of cash managers. Some of them calculate the absolute value of the yield on investment, in addition of the percentage yield. There may be differences in preferences with respect to transaction costs. Utilization of yield curves and changes therein in the context of short-term investing decisions is supposed to refer to sophisticated decision processes.

Borrowing by issuing commercial papers: Money market operations include such actions as short-term investing and short-term borrowing. On the international money markets, one widely used instrument is the commercial paper issued by firms. In the case of Finnish listed firms, it is reasonable to assume that some of them have also issued such papers on the money market in Finland or in some other countries and that the importance of this function has increased.

Importance of interest rates in short-term investment: After the money market liberalization, the opportunities for effective money market operations have increased significantly. Parallel with this evolution process the importance of money market information, especially reliable estimates of interest rates are expected to increase. The availability of online information from both the Internet-based banking systems, and from other commercial information systems has increased.

Term structure of interest rates: It is important to understand the yield curve effect when resolving investing time for short-term investments. This curve describes the yields of investments in differing time periods. Required returns on investments may be influenced by various factors, such as the level of inflationary expectations, the relative levels of supply and demand for securities of different maturities, and differences in investors' perceptions of the interest rate and other risks of securities of different maturities.

Hence it is evident that financial professionals' considerations differ concerning the factors affecting the slope of the yield curve. Required return is assumed to be higher with longer maturities because of

a) higher interest rate risk
b) lower liquidity
c) higher credit risk
d) difficult to forecast interest rates

In addition, it is evident that activity in utilizing yield curves varies between cash managers. Perhaps some decision-makers do not utilize the yield curves at all. Reasons for this behavior likely to include:

a) it needs special skills
b) it needs relevant estimates of interest rates
c) risk/return ratio is not relevant for this kind of investments
d) the return is not high enough to compensate costs

4.1.4 Selected activities of financial transactions

The next group of issues considers the activities of financial transactions, all of which are worth notice and important to resolve when developing the cash management decision-making process. The following activities will be examined:

1. Short-term investment instruments
2. Distribution of time used in short-term investing
3. Money market information sources
4. Criteria for short-term investments
5. Risks of short-term investment
6. Derivatives used to cover interest rate risks

Short-term investment instruments: After the liberalization of the Finnish money market, innovations such as new money market instruments increased quickly. Currently, a cash manager should be familiar with these instruments. While all the instruments traded on the money market are quite safe relative to many other investments (for example common stock), they differ somewhat with respect to the risk and return. One difference in per-period investment return is the above mentioned yield curve effect.

The volumes of the instruments traded on the market show that certificates of deposits issued by banks are most commonly used, but changes in the relative importance of instruments are likely. In addition, it is reasonable to assume that after the money market liberalization the utilization of market instruments has increased.

The following list of typical money market instruments is available for firms for short-term investment purposes. Five of these instruments are so-called discount-based papers, which are sold at a discount and redeemed at their principal value at maturity (i.e. papers a-e) and the other four are papers without street markets (i.e. papers f-i).

a) certificate of deposit
b) treasury bill
c) Finland Bank's certificate of deposit
d) commercial paper
e) municipal paper
f) repurchase agreement
g) time deposit
h) fiduciary deposit
i) promissory note

Distribution of time used in different tasks of short-term investing: Despite sophisticated technological solutions, planning and decision-making takes more time than before because of more uncertain markets. As seen before, it is a complicated task to plan and

resolve the problems of the short-term investment process. Due to the increasing uncertainty, the time needed to resolve these problems will clearly be longer than before. However, the development of technological systems should be an opposite effect. In addition, it is assumed that there are some changes in the distribution of time used, especially on money market operations. The following tasks are regarded to be most relevant in short-term investment planning:

a) setting goals and targets
b) choosing the investment instruments
c) defining the amount of money to be invested
d) resolving of maturities

Money market information sources: In the past two decades information technology has made tremendous advances. Information is much cheaper and available online via electronic and mobile technology. In addition, there has been a great revolution in banking connections via Internet.

It is reasonable to assume that commercial systems, including utilization of banking systems have increased their importance as information sources. Potential information sources which cash managers are supposed to utilize in their decision-making could be for example

a) banks
b) commercial information systems
c) personal relationships
d) economic newsletters
e) economic reviews
f) economic newspapers

Criteria for short-term investments: Because of the yield curve effect, there is an incentive for firms to invest in longer-term securities. Offsetting this is the greater interest rate risk for longer maturities; if the investing firm chooses a security with a longer maturity and is forced to sell that security before maturity and if interest rates have risen, the return achieved may be less than if the firm had invested in shorter-term securities.

It was suggested before that near-cash, interest-bearing assets could be substituted for cash when the motivation for holding these assets is based on precautionary and speculation purposes. Because the money will eventually be needed for the operations of the firm, a primary concern of the cash manager is supposed to be the safety and liquidity of the investment instrument used.

Although the priority order of these factors seems to be fairly obvious it is reasonable to assume that because of the environmental changes, changes in their relative importance are likely. The criteria for short-term investments are as follows:

a) safety of instrument
b) liquidity
c) maturity
d) return

Risks of short-term investments: The primary impact of cheap computing capacity and user-friendly software has been the enhanced ability of managers to assess risk. In dealing with risks, the first step is to estimate the amount and types of risk in some way (assessed). The second step is to account for the assessed risk in the decision-making process (addressed). Addressing risk takes two forms: the risk may be either priced within the financial decision process and/or a hedging strategy may be formulated to remove all or part of the risk.

The risks of short-term finance exist both in the operating and financial transactions. The most important risk on the operating side is the risk of bad debts. However, the primary focus of this study is on the priority order of financial risks. Interest rate risk is the probability of the interest rate change before maturity. In addition, risks and returns among near-cash assets differ because of the credit risk characteristics of their issuers. Some securities are extremely safe while others entail a nonzero probability of default, and carry higher interest rates to compensate buyers for this risk. Liquidity risk refers to the ease of liquidating assets and inflation risk is the uncertainty of purchasing power changes.

Priority orders of financial risks are assumed to change due to environmental changes. The importance of interest rate risk is expected to increase especially just after the liberalizing period. The risks of short-term investments are:

a) interest rate risk
b) credit risk
c) liquidity risk
d) inflation risk

Derivatives used to cover interest rate risks: Hedging as a method for controlling risk is an important task in cash management. It is useful to think of hedging strategies as being of two types: hedging strategies that do not use financial instruments (by using precautionary balances) and hedging strategies that use financial instruments (derivatives). Hedging means adopting a strategy that negates, in whole or in part, the risk associated with a decision. Risk pricing is a way of allowing for risk that is not hedged.

This study focuses on the latter strategy, which uses financial instruments to hedge risk. When these are available, they can provide effective and low-cost hedges against the uncertainties facing the firm. These instruments can be used in two ways to hedge risk in a cash forecast: (1) they can be used to hedge the interest rate risk on future borrowings and investments, or (2) they can be used to hedge the interest rate risk inherent in investing in longer-term instruments where an unexpected cash shortage may require the sale of these instruments before maturity.

It is reasonable to assume that simultaneously with the increase in short-term investments the utilization of such hedging instruments has increased during the research period. The generality of the following interest rate derivatives is researched:

a) forwards
b) futures
c) swaps
d) options

The practical issues of cash management presented above will be examined using the survey method. In order to ascertain the potential changes in cash management behaviour, the surveys were conducted in three separate years. The survey evidence will be presented after survey design in Section 4.3.

4.2 Survey design

4.2.1 Data

A questionnaire dealing with different aspects of cash management was sent to Finnish listed manufacturing and service companies and addressed to a person responsible for cash management. It included the following three sections:

1. Cash management systems in use (11 questions)
2. Cash management operations of a firm (13 questions)
3. Short-term investment decisions (25 questions)

These sections contained questions in which respondents were asked to rank the alternatives according to their importance. In addition, the questions gave the respondent a chance to specify alternatives other than those provided. For the analysis the questions were rearranged and divided in to four groups. Contents of the questions were presented in Section 4.1.

The questionnaire was repeated in 1988, 1994 and 2000. The first two surveys were accomplished by sending ten sites questionnaire by mail and the last one via Internet-sites. Utilization of the Internet may cause some difficulties regarding comparability of results.

Table 3 presents the number of participant companies. The response rates were relatively high in all three questionnaires. Despite the small size of the database compared to the population of Finnish corporations, it is believed that the inferences derived from the available data are very informative.

Table 3. Response rates of the questionnaires.

	1988	1994	2000
Number of responses (*N*)	28	29	34
Response rate *(%)*	70.0	71.0	65.3

The responding firms operate in the following industries: diversified companies, forest industry, metal and engineering, information technology, other services and other industries (for more details see Table 4).

Table 4. Business branches of companies surveyed.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
A Diversified companies	6	21.4	4	13.8	2	5.9
B Forest industry	5	17.9	0	0.0	0	0.0
C Metal and engineering	3	10.7	6	20.7	7	20.6
D Other industries	7	25.0	4	13.8	12	35.3
E Other services	7	25.0	9	31.0	3	8.8
F Information technology	0	0.0	0	0.0	5	14.7
Data missing	0	0.0	6	29.7	5	14.7
Total	28	100.0	29	100.0	34	100.0

When comparing a company's branch of industry it can be concluded that the number of responses varied between surveys. In the last survey, most of the answers were from "other industries" and "metal and engineering" industries. Six of the firms in 1994 and five in 2000 did not divulge the name or industry of the firm. In 2000 there were five information technology firms among the respondents, a branch that was not represented in the first two surveys.

4.2.2 Methodology

In addition to direct questions, there were several questions where respondents were asked to put various factors in order of priority. To analyze the answers to such questions, so-called preference matrices are first formed to find out what position different factors achieved in relation to each other. These matrices are used to rank the factors by importance. The matrices contain two elements for the pair of factors i and j (i, j = 1,2,...,h). The element preceded by the sign '+' gives the number of respondents preferring factor i to j and conversely in the case of sign '-' (for more detail see Laitinen 1984).

In addition, relative frequency distributions are formed to calculate the so-called *Gini* coefficients in order to evaluate the degree of consensus between respondents. This is done for different factors as well as for different questions. Furthermore, the results of the questionnaires in 1988, 1994 and 2000 are compared.

The *Gini* coefficient is calculated as follows (see Kendal and Stuart 1962, and Laitinen 1984):

$$G(s) = 1/(k\text{-}1) \sum_{i=1}^{k\text{-}1} \sum_{j=i+1}^{k} |p_{is} - p_{js}| \qquad (4.1)$$

where

s = group of respondents
k = number of digits on the integer scale
p_{is} = percentage of the respondents in the group s weighting the object with i

The maximum and minimum values of the coefficient are defined as follows:

max $G(s) = 1$ if $p_{is} = 1$ for any $i = 1,2,...,k$
min $G(s) = 0$ if $p_{is} = p_{js}$ for all $i,j = 1,2,..., k$

The maximum value is reached if all the respondents in the group give the same weight to the factor (perfect agreement). The minimum value is reached if the distribution of weights is uniform (perfect disagreement).

The significance of the behavioral differences between survey years (row variable) and the cash management issue examined (column variable) is tested by *Chi*-Squares. The null hypothesis states that the variables are independently related. The values of these and their significance levels of 10%, 5%, and 1% are presented by one, two, and three asterisks respectively.

4.3 Survey results

As presented in Chapter 2, cash management affects firms' profitability and value. Thus the evidence regarding corporate practices presented in this chapter is important in understanding the process of cash management among firms. It surveys for the first time cash management practices in listed companies located in the Finland in 1988, 1994 and 2000. Next a short summary of the implications of the three surveys is presented.

4.3.1 Organizational and technological solutions

Responsibility for cash and treasury management: The titles of the executives responsible for cash management are summarized in Table 5. As this table shows, there are significant differences between surveys in the responsibility for cash management. However, two company executives, financial manager and cash manager, seem to be the designated executives for dealing with the firm's cash management. The category "other" contains about 14%, 17%, and 9% of the respondents in the surveys in 1988, 1994, and 2000 respectively.

Table 5. Position of person responsible for cash management.

	1988		1994		2000	
	f	%	f	%	f	%
1 Financial Manager	13	46.4	12	41.4	19	55.9
2 Cash Manager	9	32.1	7	24.1	5	14.7
3 Business Controller	1	3.6	1	3.4	2	5.9
4 Other	4	14.3	4	17.2	3	8.8
Data missing	1	3.6	5	13.8	5	14.7
Total	28	100.0	29	100.0	34	100.0
χ^2			33.135^{***} (df = 6)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

As presented above, cash management responsibility in most companies in Finland is assigned mostly to senior executives. This result is consistent with the results from the Netherlands and the UK, while it does not seem to be the case in Belgium (see Soenen and Aggarwal 1989).

Soenen and Sun (1995) found that in China three company executives, the controller, the treasurer and the VP/Director Finance, seem to be designated executives for dealing with the enterprises' short-term financial management.

The results presented in Table 6 indicate that there is a small increase in the proportion of female as financial managers. As a whole, there are significant differences between the three surveys. In all three surveys there are more female cash managers than males.

Table 6. Gender distribution of respondents (F = female, M = male).

	1988				1994				2000			
	F		M		F		M		F		M	
	f	%	f	%	f	%	f	%	f	%	f	%
1 Financial Manager	1	22.2	12	56.3	4	57.1	8	43.8	9	52.6	10	70.0
2 Cash Manager	5	44.5	4	18.7	3	42.9	3	18.7	3	26.3	2	20.0
3 Other	2	33.3	2	25.0	0	0.0	6	37.5	5	21.1	1	10.0
Total	8	100	19	100	7	100	16	100	17	100	12	100
χ^2					6.242^{***} (df = 4)							

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

Conflicts with other departments: Decisions made by other departments may have an impact on cash management, thus conflicts of interest between departments may frequently arise. The departments most likely be involved in such conflicts are summarized in Table 7. As this table indicates, conflicts between cash management and other departments are very general. Most evidently these conflicts arise between cash management and the purchasing and marketing departments, whereas the departments least likely to create conflicts are production and human research management. The survey also reveals that the awareness of the possibility of conflicts between cash management and other departments has increased.

The evidence of the present survey is partly consistent with evidence found by Soenen and Sun (1995) on China. The department most likely to come into conflict with cash management was purchasing, whereas those least likely to create conflicts were accounting and personnel.

Table 7. Priority order (po) of the conflicts between cash management and other departments of a firm and Gini coefficient.

	1988 (N=28)			1994 (N=29)			2000 (N=34)			χ^2
	Gini	f	po	Gini	f	po	Gini	f	po	
a	-	-	-	0.775	12	1	0.418	27	1	6.172
b	-	-	-	0.400	6	3	0.319	21	4	6.621
c	-	-	-	0.267	6	5	0.204	23	3	8.039
d	-	-	-	0.635	12	2	0.319	25	2	9.490[*]
e	-	-	-	0.217	5	4	0.404	18	5	10.265[**]

a = purchasing. b = inventory management. c = production. d = marketing. e = human resource management.
H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

As Soenen and Aggarwal (1989) proposed, this finding of the generality of conflicts can be seen as a confirmation of the belief that the cash management area is closely interrelated with other managerial functions in a firm and, therefore, any department that can influence the company's cash flows may be in conflict with the cash management department.

Soenen and Aggarwal found that the situation is quite different with respect to foreign exchange management. Purchasing and sales are the departments with whom conflicts are most likely to occur. These are the departments found in the present study concerning conflicts with respect to cash management.

Centralization of cash management: According to the results the centralization of cash management is evident. As shown in Table 8, the centralization of cash management increased significantly during the period of the three surveys and has continuously been at a very high level. This finding is consistent with Collins and Frankle (1985), who reported that for U.S. domestic operations, 91 percent of the companies surveyed centralize cash management at the corporate level.

Table 8. Centralization of cash management.

Cash Management	1988		1994		2000	
	f	$\%$	f	$\%$	f	$\%$
Centralized						
Yes	25	89.3	26	89.7	33	97.1
No	3	10.7	3	10.3	1	2.9
Data missing	0	0.0	0	0.0	0	0.0
Total	28	100.0	29	100.0	34	100.0
χ^2			1.413^{**} (df = 2)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

The centralization of the whole treasury management area is as high as in the limited segment of cash management (see Table 9). Almost without exceptions cash management, risk management, and foreign exchange management are centralized in the finance department in all three samples. The reasons for the centralization are evident. As Tse *et al.* (1998b) concluded a move towards centralization of the treasury function aimed at streaming operations and making cash management more effective. In addition, Mulligan (2001), found some evidence that in two out of three time periods examined, the financial health of firms with a centralized cash management structure is better compared with a decentralized structure.

Table 9. Centralization of treasury management.

Treasury management	1988		1994		2000	
	f	$\%$	f	$\%$	f	$\%$
Centralized						
Yes	27	96.4	27	93.1	32	94.1
No	1	3.6	1	3.5	1	2.9
Data missing	0	0.0	1	3.5	1	2.9
Total	28	100.0	29	100.0	34	100.0
χ^2			0.266 (df = 2)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

If the results presented above are compared with those of Soenen and Aggarwal (1989), the centralization is higher in the sample companies than it was in the Netherlands (70%) or the UK (69%) and much higher than in Belgium (40%). Consistent with this study, there is a definite trend towards increasing centralization of the cash management function in all three countries.

The results from China showed that 44% of the sample firms centralize their cash management operations at the headquarter level, a result mostly comparable with Belgium (Soenen and Sun 1995).

Cash management systems: Firmware systems have significantly increased their popularity. Table 10 shows that among the companies using computer-based systems, the computer software used in cash management was developed in-house by 67.8%, 31.0%,

and 31.6% of the companies in 1988, 1994, and 2000 respectively, and 7.2%, 41.4%, and 63.1% of the companies had bought it from software vendors in 1988, 1994, and 2000 respectively. Thus the rate of in-house software systems has decreased and firmware systems increased significantly.

Table 10. Cash management systems in use; firmware or in-house system.

	1988		1994		2000		χ^2
	f	*%*	*f*	*%*	*f*	*%*	
Firmware system	2	7.2	12	41.4	24	63.1	17.168[***]
In-house system	19	67.8	9	31.0	12	31.6	8.704[*]
Data missing	7	25.0	8	27.6	2	5.3	
Total	28	100.0	29	100.0	38	100.0	

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

In Soenen and Aggarwal's (1989) investigation the rate of in-house software systems was 80% and the firmware systems 20%. The percentage of firmware systems was therefore higher compared with the 1988 study. However, the latter two surveys yield much higher numbers.

In addition, the results of Soenen and Aggarwal showed that nearly one-fifth (18%) of the UK based companies claimed they do not make use of computers in their cash management. This percentage was much lower in the Netherlands and Belgium, being 10% and 12% respectively.

If the missing data (in Table 10) are interpreted as an implication of no use of this kind of systems, the representative percentages are 25% in 1988, 27.6% in 1994, and 5.3% in 2000, referring to a quick computerizing of cash management, especially from 1994 to 2000. During the same time period there was a considerable increase in the percentage of firmware systems.

Table 11 shows the progress of computerizing concretely. It lists the enabling years of the software systems. In the first survey there were only two firmware systems but nineteen systems had been produced in-house. In the second survey the situation is about fifty-fifty, but in the last survey the number of firmware systems is almost twice as high as in-house systems.

Table 11. Cash management systems in use; years of the software enablement.

Year	Firmware system			In-house system		
	1988	1994	2000	1988	1994	2000
1981				1		
1982				2		
1983				1		
1984				2		
1985			1	2		
1986			1	8		1
1987	2			3		
1988		3			2	2
1989			2		1	
1990		3	3		2	1
1991		1	1		3	
1992		1	1		1	
1993						1
1994		4				2
1995			1			
1996			2			
1997						
1998						
1999			2			2
2000			4			1
Total	2	12	18	19	9	10
χ^2		38.753* (df = 34)			58.598** (df = 38)	

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

At the same time as the number of firmware systems has increased, likewise their sophistication. As seen in Table 12, there is a significant increase in the integration of cash management systems and the utilization of netting systems.

The integration of systems seems to be a common phenomenon in financial management. For example, Soenen and Aggarwal (1989) found a significant trend of increasing integration of the various elements of working capital management.

Table 12. Characteristics of cash management systems.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
Integration of cash management systems						
Yes	10	35,7	12	41,4	24	70,6
No	18	64,3	17	58,6	4	11,8
Data missing	0	0,0	0	0,0	6	17,6
Total	28	100,0	29	100,0	34	100,0
χ^2			16.162^{***} (df = 2)			
Application for consolidation control						
Yes	19	67.9	25	86.2	30	88.2
No	9	32.1	4	13.8	1	2.9
Data missing	0	0.0	0	0.0	3	8.8
Total	28	100.0	29	100.0	34	100.0
χ^2			3.226 (df = 2)			
Allows questions for differing criteria						
Yes	12	57.1	16	55.2	21	61.8
No	9	42.9	13	44.8	11	32.3
Data missing	0	0.0	0	0.0	2	5.9
Total	21	100.0	29	100.0	34	100.0
χ^2			1.178 (df = 2)			
Allows simulation						
Yes	10	35.7	7	24.1	9	26.5
No	11	39.3	20	68.0	22	64.7
Data missing	7	25.0	2	6.9	3	8.8
Total	28	100.0	29	100.0	34	100.0
χ^2			3.099 (df = 2)			
Firm utilizes the consolidation accounts system						
Yes	-	-	24	82.8	26	76.5
No	-	-	5	17.2	6	17.6
Data missing	-	-	0	0.0	2	5.9
Total	-	-	29	100.0	34	100.0
χ^2			0.023 (df = 1)			
Firm utilizes netting system						
Yes	-	-	5	17.2	13	38.2
No	-	-	24	82.8	17	50.0
Data missing	-	-	0	0.0	4	11.8
Total	-	-	29	100.0	34	100.0
χ^2			4.735^{**} (df = 1)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

It is interesting to note that the percentage of netting systems presented here (17% in 1994 survey) is the same that found by Soenen and Sun for Chinese firms. The two other

cash management services mentioned in their survey were concentration banking and direct depositing. The last survey refers to higher utilization of netting (38%), but it is still lower than reported by Tse *et al.* (1998b) for largest Dutch companies. They found that netting is used by about half the companies surveyed.

In addition, more and more of the systems allow the questions for differing criteria and systems application for consolidation control has also increased. Instead, the characteristic of simulation is quite rare, and the utilization of consolidation accounts system is at about the same level as before. Generally, the tendency in cash management systems seems to be similar as presented by Tse *et al.* (1998b) who found the trend that emerges throughout corporate cash management towards more use of electronics and technology.

As Table 13 shows, the *Analyste* company is a clear market leader in the firmware markets for cash management systems in Finland. As seen before, with the increasing supply of such programs the maintaining of in house programs has decreased.

Table 13. Supplier of the cash management system in use.

	1988 (*N*=28)		1994 (*N*=29)		2000 (*N*=34)	
	f	*%*	*f*	*%*	*f*	*%*
Analyste	0	0.0	5	17.2	21	61.8
Opus Capita	0	0.0	4	13.8	11	32.3
Some other system	2	0.7	3	10.3	4	11.8
χ^2			48.760[**] (df = 4)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

In order to develop its cash management skills and practices a firm may turn to an external consultant. About 40% of the firms surveyed bought such services. (see Table 14)

Table 14. Cash management research accomplished.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
Yes	-	-	12	41.4	13	38.2
No	-	-	17	58.6	19	55.9
Data missing	-	-	0	0.0	2	5.9
Total	-	-	29	100.0	34	100.0
χ^2			0.004 (df = 1)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

The results of Soenen and Aggarwal (1989) are not directly comparable with this issue, but they found that among the companies that use computer-based systems, approximately 45% of them in the UK, 40% in the Netherlands, and 35% in Belgium maintain in-house data processing expertise specifically for cash management.

Banking relationships: Generally, banks and financial institutions play an important role with respect to corporate cash management. The results presented in Table 15 indicate that the number of banking relationships maintained by firms varies widely between firms and samples. As expected, there are fewer banking relationships in the last sample than in the previous one. Eight (in 1994) and six (in 2000) of the companies have over twenty banking relationships each. Forty-four percent (in 1994) and about sixty-two percent (in 2000) of the Finnish respondents have fewer than ten banking relationships each.

Table 15. Number of banking relationships.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
$X < 5$	-	-	6	24.0	10	29.4
$5 \leq X < 10$	-	-	5	20.0	11	32.3
$10 \leq X < 20$	-	-	6	24.0	7	20.6
$20 \leq X$	-	-	8	32.0	6	17.6
Total	-	-	25	100.0	34	100.0
χ^2			103.367^{***} (df = 3)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

The result is inconsistent with the Netherlands and Belgium, where the number of banking relationships was lower. In these countries half of the companies do regular business with at most four or five banks, while three-quarters of them have at most eight banking relationships each. However, the more recent evidence from the Netherlands refers to fewer banking relationships. Tse *et al.* (1998b) found that most Dutch companies maintain more than one but fewer than five banks for domestic cash management purposes. Instead, the result of the present study is mostly consistent with the UK, where companies tend to have a much higher number of banking relationships than in the Netherlands and Belgium, i.e. 50% of the firms have under 15 and three-quarters under 30 banking relationships. (see Soenen and Aggarwal 1989)

The results presented here as well as Soenen and Aggarwal's are inconsistent with China. Of the sample firms, about 50% maintained only one or two banking relationships. Ninety percent of the firms had relationships with less than five banks.

The decreasing number of banking relationships in Finland is also in contrast to the increasing number of banking relationships in China. Soenen and Sun (1995) found that only seven percent of the respondents expected that in the future the number of banking relationships will remain the same, while 81% anticipated an increase in the number of banks they will do business with.

Most generally one to three banks are regarded as lead banks. However, there are still quite a large number of lead banks in some corporations. As seen in Table 16, all of the responding firms have at least one lead bank with about 30% in 1994 and 44% in 2000 of the companies restricting themselves to no more than two lead banks.

When comparing these results with Soenen and Aggarwal's survey, it can be seen that the firms in the UK, the Netherlands, and Belgium also had at least one lead bank but the

percentage of no more than two lead banks was about 50%. This number is higher than presented in Table 16.

Table 16. Number of lead banks.

	1988		1994		2000	
	f	%	f	%	f	%
1	-	-	6	26.1	4	12.5
2	-	-	1	4.3	10	31.2
3	-	-	8	34.8	8	25.0
4	-	-	2	8.7	4	12.5
5	-	-	2	8.7	4	12.5
> 5	-	-	4	17.4	2	6.2
Total	-	-	23	100.0	32	100.0
χ^2			87.708*** (df = 5)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

Information systems: Effective financial transactions require continuous monitoring of markets. For this job commercial information systems are available. The most common system is *Reuters*, but *Startel* also increased its popularity in the late 1990's. Instead of these systems or in addition to them, currently many firms also utilize some Internet-based information sources offered by banks. This phenomenon can be seen in the rise of the category "some other system" in Table 17.

Table 17. Information systems in use.

	1988 (N=28)		1994 (N=29)		2000 (N=34)		χ^2
	f	%	f	%	f	%	
Reuters	18	64.3	15	51.7	21	61.8	5.625**
Startel	4	14.3	4	13.8	11	32.0	4.971**
Telerate	0	0.0	6	20.7	4	11.8	14.114***
Some other system	0	0.0	1	3.4	8	23.5	1.173

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

It was found that the direction of the technological development was as expected. In addition, in most cases differences between surveys were significant indicating a structural change in cash management. This holds especially for responsibilities, as well as for centralization of cash management, and the utilization of banking and information systems.

4.3.2 Development of cash management practices

Next the evidence on how Finnish cash management professionals weight some essential questions in cash management decision-making is considered. As seen in Table 18 (Issue

1), the most important area of cash management was reported to be cash position management (with highest priority and a relatively high consensus levels).

This result is comparable with Soenen and Aggarwal (1989), who researched the frequencies with which the major components of the firm's cash flow are updated (i.e. accounts receivable, accounts payable, and cash position). The results indicated that the cash position (bank balance information) is updated most frequently, mostly on a daily basis.

The priority orders are exactly the same in all three surveys. However, the consensus levels vary between surveys being highest in the case of the second survey. In addition, there are significant differences between surveys in managers' opinions of financial transactions, which are the factors mostly affected by the environmental changes in money market.

There is fairly wide consensus about the motives for the demand for money in all three surveys (Issue 2). As expected, the transaction motive is regarded as most important. Next is the precautionary motive, which defines the additional cash needed because of cash flow uncertainties. The highest *Gini* value is in the first position of the transaction motive. According to this result, a large part of firms' demand for money could be explained by the transaction models. There are significant differences between surveys with respect to speculative and compensation motives. Generally, these motives are linked to the strategic reasons for holding cash.

The efficiency of cash management can be significantly improved if managers can make more accurate forecasts. As Issue 3 shows, the main instrument utilized to prepare the cash balance forecasts is the cash budget. This is consistent with Soenen and Aggarwal (1989), who found that almost without exception firms made regular forecasts of cash flows for planning purposes, and generally these forecasts are consolidated in the form of a cash budget. In addition, the results from China showed that the forecasts of incoming and outgoing cash flows are generally (58%) considered in the form of a cash budget.

The utilization of other methods is very rare. This is consistent with Soenen and Aggarwal (1989), who reported that the majority of the responding companies (over 80%) reported that they were not familiar with any of the mathematical models developed to optimize cash management decisions. Also Tse *et al.* (1998b) found that Dutch companies make use of simple tools to identify liquidity needs.

Soenen and Sun (1995) found that about 40% of the Chinese firms disagreed with the statement that quantitative models of cash management are unlikely to be successful while 71% agreed with that statement. This finding confirms the impression that Chinese managers have strong faith in a quantitative approach to managerial issues.

As Issue 4 in Table 18 indicates, there seem to be significant differences between surveys concerning managers' views of increasing importance of short-term investing. The greatest consensus concerns the first place of 'new money market instruments', 'increase of interest rate sensitivity', and 'increasing importance of liquidity' in 1988, 1994, and 2000 respectively.

Table 18. Consensus on the cash management issues; priority orders and Gini coefficients.

	1988		1994		2000		χ^2
	po	*Gini*	*po*	*Gini*	*po*	*Gini*	
1 Areas of cash management							
Cash position management	1	0.547	1	0.816	1	0.609	3.424
Short term investment	3	0.453	3	0.610	3	0.236	11.371[*]
Short-term borrowing	4	0.643	4	0.771	4	0.245	19.183[***]
Forecasting cash balances	2	0.107	2	0.448	2	0.510	9.842
2 Motives of the demand for money by firms							
Transaction motive	1	0.833	1	0.879	1	0.912	2.003
Precautionary motive	2	0.703	2	0.828	2	0.544	8.747
Speculative motive	3	0.717	3	0.828	3	0.456	19.057[***]
Compensation motive	4	0.714	4	0.673	4	0.455	22.507[***]
3 Methods of cash planning							
Cash budgeting	1	0.922	1	0.752	1	0.867	9.354
Linear programming	4	0.093	4	0.035	3	0.255	2.701
Simulation	3	0.129	3	0.055	4	0.218	11.687[***]
Rule of thumbs	2	0.186	2	0.225	2	0.546	13.763
4 Increasing importance of short term investing							
Increase in interest rate sensitivity	2	0.393	1	0.686	2	0.394	11.122[*]
New money market instruments	1	0.536	3	0.386	3	0.425	21.448[***]
Importance of liquidity	3	0.339	2	0.449	1	0.727	22.091[***]
Rise in the price of money	4	0.446	4	0.453	4	0.303	12.327
5 Problems in short-term investing							
Forecasting accounts receivable	3	0.375	2	0.569	1	0.691	38.123[***]
Defining of optimal cash balances	2	0.321	3	0.405	2	0.412	12.223
Choosing the investing instrument	4	0.523	4	0.793	4	0.324	21.337[***]
Forecasting interest rates	1	0.679	1	0.655	3	0.442	34.782[***]
6 Importance of the liquidity of a firm							
It increases flexibility of production	-	-	1	0.631	2	0.379	5.385
Project financing with own money	-	-	2	0.370	1	0.458	6.390
It is possible to act as a source of financing	-	-	4	0.424	4	0.259	10.155[*]
Exchange and political risk management	-	-	3	0.392	3	0.313	7.120

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

This result is interesting given the environmental changes in the money market. In the case of the first survey the money markets had just been liberated and there were many innovations on the money market. When the second survey was conducted, the interest rates levels and volatilities were quite high and were regarded as the most important factor in short-term investment decisions. In the money market of lower rates and volatilities, after the money market integration in Europe, the most important task in cash flow management seems to be the satisfaction of the liquidity needs of a firm.

Table 18 (Issue 5) also shows significant changes in cash managers' views between surveys. Again, this issue of cash management, i.e. the problems in short-term investing, and its factors were expected to be sensitive to the money market changes. The evidence refers to the decreasing importance of interest rates and the increasing significance of operating cash flows.

The last issue (Issue 6) in Table 18 indicates that the respondents regard the possibility of financing projects with the firm's own money and the increase in the flexibility of production as the most important factors of liquidity. The greatest consensus prevails in the first place of these factors. The change in the priority order can be interpreted as a result of changes in the availability of money from the stock market, especially in the late 1990's.

When considering the results presented in Table 18, there were only two components where the priority order of the factors remains exactly the same in all surveys. These questions were 'Areas of cash management' and 'Motives of the demand for money by firms'. In addition, all the issues include factors which change significantly between surveys. This holds especially for issues linked to financial transactions. Thus the behavioral changes in cash management are evident.

4.3.3 Practices in financial transactions

Cash management policy: Effective cash management decision-making requires a formal cash management policy, including a policy for short-term investments. The results presented in Table 19 indicate that the situation in this respect is much better according to the results of the last two surveys than in the first one. However, while there was a significant increase from 1988 to 2000, a number of companies were still without a formal policy. In 2000 over eighty percent of the Finnish companies had a formal cash management policy (72.4% in 1994 and 35.7% in 1988).

Table 19. Formal short-term investment policy.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
Yes	10	35.7	21	72.4	28	82.4
No	18	64.3	8	27.6	6	17.6
Data missing	0	0.0	0	0.0	0	0.0
Total	28	100.0	29	100.0	34	100.0
χ^2			15.823*** (df = 2)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

When comparing this result with Soenen and Aggarval (1989), the evidence of the 1988 survey is mostly consistent with the results from the Belgian firms, i.e. about fifty percent of the firms had a formal cash management policy. In the latter two surveys this rate was much higher, and so more consistent with the Netherlands (67%) and the UK (80%).

Obviously since Soenen and Aggarwal's (1989) study there have been developments in cash management policies in these countries, too.

As Table 20 indicates, the contents of short-term investment policies developed regarding more detailed rules for decision-making. The most common considerations are the instruments available for investing, the decision maker for transactions, and the reporting of the transactions. It is noteworthy that the category "some other things" increased, indicating an increase in the sophistication of cash management policies.

Table 20. Formal investment policy; factors included.

	1988		1994		2000		χ^2
	f	*%*	*f*	*%*	*f*	*%*	
Types of eligible investments	10	100.0	20	95.2	27	96.4	4.426[*]
Restrict to one investment	3	30.0	6	28.6	15	53.6	4.431[*]
Who decides on transactions	10	100.0	17	81.0	24	85.7	2.308
Reporting	9	90.0	17	81.0	21	75.0	3.040
Dealers	4	40.0	10	47.6	17	60.7	2.509
Some other things	0	0.0	4	19.0	8	28.6	2.571

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

Principles of short-term investing: When planning the investment time the managers tended to resolve this problem in the 'term-investing' manner. Although according to the last two surveys such behaviour has become more popular, the principle of 'roll-over' investing is also widely used. (see Table 21)

Table 21. Form of short-term investments.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
Term investing	15	53.6	15	51.7	22	64.7
Roll-over investing	13	46.4	14	48.3	10	29.4
Data missing	0	0.0	0	0.0	2	5.9
Total	28	100.0	29	100.0	34	100.0
χ^2			18.377[***] (df = 2)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

When considering other investment principles presented in Table 22, most often the absolute amounts of return and transaction costs are calculated. Instead, less consideration is given to the use of yield curve and the risk of changes in it. The results differed insignificantly between the three surveys referring relatively stable behaviour.

Table 22. Selected principles in short-term investing.

	1988 (N=28)		1994 (N=29)		2000 (N=34)		χ^2
	f	*%*	*f*	*%*	*f*	*%*	
Absolute amount of return	26	92.9	25	86.2	29	85.3	1.166
Transaction costs	23	82.1	23	85.2	21	61.8	4.276
Use of yield curve	15	53.6	19	67.9	15	44.1	2.682
The risk of change in yield curve	11	39.3	17	63.0	12	35.3	3.878

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

Short-term borrowing includes the selection of lenders and borrowing vehicles that best serve the business and the lenders. An alternative is the utilization of commercial paper markets. Quite many of the survey firms have issued commercial paper in Finland, and some of them also in foreign countries. However, the number of the issues of the latter papers has lowered from eight (27.6%) in 1994 to four (11,8%) in 2000. (see Table 23)

Table 23. Issue of commercial paper.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
In Finland						
Yes	-	-	19	65.5	20	58.8
No	-	-	7	24.1	13	38.2
Data missing	-	-	3	10.3	1	2.9
Total	-	-	29	100.0	34	100.0
χ^2			2.976 (df = 1)			
In foreign country						
Yes	-	-	8	27.6	4	11.8
No	-	-	18	62.1	23	67.6
Data missing	-	-	3	10.3	7	20.6
Total	-	-	29	100.0	34	100.0
χ^2			1.497[**] (df = 1)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

Importance of interest rates: Interest rates imply the conditions of the money market, being one of the main macro variables followed by managers. When the results of the three surveys are compared in Table 24, it shows that the importance of interest rates increases from the first survey to the second but decreases again in the last one. These changes are evident if they are compared with the integration development of money market. In the late 1990's especially, the levels and volatilities of interest rates were quite low. This result is consistent with the results of short-term investment shown in the context of Table 18.

Table 24. Importance of interest rate progress in short term investing.

	1988		1994		2000	
	f	*%*	*f*	*%*	*f*	*%*
Very important	12	42.9	16	55.2	9	26.5
Quite important	13	46.4	13	44.8	21	61.8
Not forecasted	3	10.7	0	0.0	2	5.9
Data missing	0	0.0	0	0.0	2	5.9
Total	28	100.0	29	100.0	34	100.0
χ^2			6.143 (df = 4)			

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

As expected, the main reason for the higher yield for the papers with longer maturity is considered to be their higher interest rate risk (see Table 25). Consensus on its position as the most important factor is quite high in all three surveys and increased over time. Another important factor is the lower liquidity of the paper with longer maturities.

Table 25. Priority order (po) of the factors defining the shape of the yield curve and Gini coefficient.

	1988 (*N*=28)			1994 (*N*=29)			2000 (*N*=34)			χ^2
	Gini	*f*	*po*	*Gini*	*f*	*po*	*Gini*	*f*	*po*	
a	0.535	24	1	0.673	27	1	0.735	32	1	4.517
b	0.482	24	4	0.586	28	2	0.375	31	2	8.112
c	0.549	23	2	0.431	28	4	0.390	31	4	6.977
d	0.483	23	3	0.362	27	3	0.376	29	3	13.850[*]

a = higher interest rate risk. b = lower liquidity. c = higher credit risk. d = difficult to forecast interest rates. H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

As Table 26 shows, the main reasons why managers do not use the yield curves also differ between surveys. Firstly, the managers reported that the risk/return ratio is not a relevant measure for short-term investment (in 1988), secondly, the utilization of yield curves presuppose special skills (in 1994), and thirdly, the return is not high enough to offset usage costs (in 2000). Again, the results are very reasonable given the changes of the conditions of the money market.

Table 26. Priority order (po) of the reasons why the respondents do not utilize yield curves and Gini coefficient.

	1988 (*N*=28)			1994 (*N*=29)			2000 (*N*=34)			χ^2
	Gini	*f*	*po*	*Gini*	*f*	*po*	*Gini*	*f*	*po*	
a	0.143	6	2	0.300	5	1	0.125	8	2	8.548
b	0.079	7	4	0.250	2	3	0.175	8	4	8.435
c	0.155	7	1	0.100	3	4	0.225	10	3	9.885
d	0.036	3	3	0.250	2	2	0.453	12	1	4.871

a = needs special skills. b = needs relevant estimates of interest rates. c = risk/return ratio not relevant for this kind of investments. d = return not high enough to offset costs. H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. [*], [**], and [***] indicate significance at 10%, 5%, and 1% level respectively.

The discussion of this section shows that significant development holds for behavioral developments considered. Evidently, cash management activities are elastic for environmental as well as technological changes and the possibilities for effective cash management have increased.

4.3.4 Development of short-term investment

When considering the activities of short-term investment in Table 27, it can be seen that in all three surveys there is fairly wide consensus on the position of banks certificates of deposit as the most commonly used short-term instrument. Furthermore, there are significant differences between surveys in the use of commercial paper (see Issue 1).

As Issue 2 in Table 27 shows, in the planning of short-term investments most time is needed for setting goals and targets (in 1989) and resolving the amount of cash for investing (in 1994 and 2000). The importance of setting goals and targets is evident because of the money market operations, which were quite a new phenomenon in the late 1980's. Despite the methodological developments, the forecasting of cash for investment purposes was reported to be quite difficult. As seen before in Table 18, the main decision instrument was the cash budget.

The sources of information used in the preparation of short-term investment plans are also summarized in Table 27 (Issue 3). Commercial information systems and banks are regarded as the main sources. There are significant differences between the surveys in the case of commercial information systems and personal relationships. The greatest consensus prevails on the position of the alternatives regarded as the most important information sources. The increase in the importance of the banks may refer to the use of Internet-based banking services. This result is consistent with that presented in Table 17 showing the increase in systems other than those offered by commercial suppliers.

Soenen and Aggarwal (1989) examined the sources of information used in the case of exchange rate forecasts. They found that while the most common procedure was to use a combination of information provided by banks and financial publications, about one third of the companies claim that they used only intuitive approaches.

Table 27. Consensus on financial transactions; priority orders and Gini coefficient.

	1988		1994		2000		χ^2
	po	Gini	po	Gini	po	Gini	
1 Investment instruments in use							
Certificates of deposit	1	0.754	1	0.801	1	0.778	7.371
Treasury bills	4	0.224	3	0.461	3	0.259	22.190
Commercial papers	2	0.608	2	0.658	2	0.741	18.933**
Time deposits	3	0.059	4	0.303	4	0.265	20.439
2 Distribution of time used to plan short-term investments							
Setting goals and targets	1	0.482	2	0.432	2	0.280	10.082
Choosing the investment instrument	3	0.402	4	0.570	4	0.412	11.578
Defining cash for investing	4	0.340	1	0.604	1	0.559	16.158**
Resolving of maturities	2	0.393	3	0.431	3	0.526	7.124
3 Money market information sources							
Direct from banks	-	-	2	0.701	1	0.745	5.652
Commercial information systems	-	-	1	0.690	2	0.569	10.294*
Personal relationships	-	-	4	0.368	4	0.363	36.548***
Economic newsletters	-	-	3	0.621	3	0.667	10.684
4 Criteria of short term investing							
Safety of instrument	1	0.333	1	0.897	1	0.698	9.390
Liquidity	2	0.489	2	0.880	3	0.561	9.836
Maturity	4	0.798	4	0.931	4	0.470	26.719***
Return	3	0.345	3	0.656	2	0.682	16.528**
5 Risks of short-term investing							
Interest rate risk	-	-	1	0.621	1	0.576	7.497
Credit risk	-	-	3	0.551	3	0.501	9.391
Liquidity risk	-	-	2	0.689	2	0.501	2.756
Inflation risk	-	-	4	0.759	4	0.621	2.708
6 Utilization of derivatives							
Forwards	2	0.321	2	0.546	1	0.501	7.268
Futures	3	0.036	3	0.382	3	0.154	9.261
Swaps	1	0.452	1	0.735	2	0.500	2.162
Options	4	0.071	4	0.412	4	0.231	3.995

H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

Cash management should develop an investment strategy that considers the level of risk taken through investments of excess cash. As seen in Table 27 (Issue 4), respondents emphasize safety and liquidity of the instruments in short-term investing. In the case of the return on investments and their maturity, opinions differ significantly between surveys.

How managers emphasize the risks of the short-term investments is shown in Table 27 (Issue 5). As expected, the most important risk seems to be the interest rate risk. In second place is the liquidity risk followed by credit risk. The greatest consensus prevails

on the lowest effect of inflation risk. In the case of this issue, there are no changes in priorities and no significant differences between surveys.

Issue 6 in Table 27 lists the instruments used to cover interest rate risks. The most common are interest rate swaps and forwards. The consensus about the position of the derivatives increased in the second survey but then decreased in the last survey. Only part of the Finnish firms surveyed were actively involved in the management of short-term interest rate risks with derivatives, although all of them were involved in money market operations. Thus the responses reveal that short-term risk management is not a priority at the firm level.

In Table 27 only the priority order of the factors of the issue 'risk of short-term investing', which was included only in the last two surveys, remained the same. This result as well as that presented in Table 18, refers to behavioral changes in cash management. Moreover, four of the six issues included factors which differ significantly between surveys.

4.3.5 Evolution of the money market

The behavioral changes in cash management have occurred parallel with the organizational and technological developments. It was assumed that the incentive for these changes was based on the money market evolution. The discussion of this section concerns the liberalization progress of the money market and creates a background also for the next chapter, where some evidence concerning the stability of cash balance functions in emerging money markets will be presented. The liberalization period primarily spanned the years from 1982 to 1987. In the last year of this period bank certificates were exempted from cash balance duty. Other factors which supposed to have an influence on money market evolution were the lifting of the stamp tax of money market instruments, the increasing awareness of new instruments with the internationalizing of businesses, technological progress, increasing professionalism, and positive atmosphere towards securization.

To ascertain the priority order of the factors and the actions completed during the liberalization period the respondents were asked to assess their importance. As seen in Table 28, the most important thing is regarded to be the increasing awareness of new instruments in the first survey and the lifting of the stamp tax on money market instruments and the lifting of the cash balance duty of bank certificates in the last two surveys. Generally, the consensus levels are highest in the case of the highest priorities.

Table 28. Priority order (po) of the evolutional factors of money market and Gini coefficient.

	1988 (*N*=28)			1994 (*N*=29)			2000 (*N*=34)			χ^2
	Gini	*f*	*po*	*Gini*	*f*	*po*	*Gini*	*f*	*po*	
a	0.441	28	3	0.482	24	1	0.417	13	2	12.226
b	0.238	27	5	0.528	24	2	0.714	13	1	14.631**
c	0.511	28	1	0.348	25	3	0.191	12	4	14.208*
d	0.405	26	2	0.439	25	5	0.310	13	5	13.140*
e	0.250	28	6	0.359	25	4	0.405	13	3	12.409
f	0.357	25	4	0.482	25	6	0.436	14	6	12.371

a = lifting of the stamp tax of money market instruments. b = lifting of the cash balance duty on bank certificates. c = awareness of new instruments increased with the internationalizing of businesses. d = development of computer technology. e = operational skills increased. f = positive attitude towards securization. H_0: variables are independently related. Row variable: year. Column variable: cash management factor examined. *, **, and *** indicate significance at 10%, 5%, and 1% level respectively.

According to the survey results the changes in the cash management practices are evident. The next chapter tries to find additional evidence how strong the effect of market liberalization was on cash management behavior, i.e. if there were any structural changes in the cash management function of firms. Some conventional demand for money equations to describe the cash management behavior of firms will be used.

4.4 Conclusions

The purpose of this part of the study was to increase the awareness of firms' cash management practices and their development. Three questionnaires were conducted in separate years, namely 1988, 1994 and 2000.

When analyzing the survey data, preference matrices were utilized in order to define the priority orders of the factors relevant to the cash management decisions. In addition, so-called *Gini* coefficients were calculated as measures for the consensus levels of respondents. The *Chi*-square was used as a test for the significance of the behavioral differences between surveys.

As expected, responsibility for cash management has shifted more to senior management and to financial professionals. Thus the cash management can be seen as a more serious function and strategic issue in a firm, commanding more consideration and resources. Awareness of potential conflicts between cash management and other departments increased. This is important when resolving these problems and taking into account the interests of different departments. Purchasing and marketing were the departments with which the conflicts are most evident. The centralization of cash management has increased significantly, as expected. Centralized cash flow management makes it possible to utilize several sophisticated methodologies developed in recent years. As expected, the utilization of firmware systems increased parallel in with their increasing availability. The last survey showed that about 63% of the systems are firmware. More and more of these systems include the features necessary for effective

cash management. There were significant differences between surveys regarding integration of systems and the utilization of netting as a cash management method. As supposed, the number of banking relationships decreased. This progress often runs parallel with the centralization of cash management. Information systems offered by banks and other suppliers were utilized more widely than before. These are clearly necessary for effective money market operations, which form an important part of modern cash management activities. In general, the computerizing of cash management operations increased rapidly in the late 1990's.

The conclusion concerning the shifting of responsibility for the cash management was consistent with the results from the Netherlands and UK. The increasing of the centralization was consistent with the findings on the U.S. but it refers to higher centralization than that found in the Netherlands, the UK, Belgium, or China. The number of banking relationships in Finnish firms was at the same level as that found in the UK but higher than that in the Netherlands, Belgium or in China.

The survey results revealed that cash management professionals regard cash position management as the most important area of cash balance management, confirming the previous findings on other countries. The holding of cash balances was primarily motivated by transaction and precautionary needs. Instead, in the case of other motives, i.e. speculation and compensation motives, significant differences appeared between surveys. When planning cash operations the most important instrument utilized was the cash budget, which is a consistent finding with the other studies. Cash managers' views differed between surveys concerning the evaluation of the increasing importance of short-term investment referring to environmental effects. The first survey showed that money market instruments could be the most important factor. In the second survey the representative factor was sensitivity to increasing interest rates and in the last survey respondents weighted especially the importance of liquidity. Cash managers' views clearly depend on money market conditions. In the first two surveys the most important problem of short-term investment reported to be the forecasting of interest rates, but the last survey emphasized the importance of the forecasting of accounts receivable. This result refers to the decrease in the importance of interest rates and the increasing importance of operating cash flows in parallel with money market developments. In the 1994 survey the most important reason for changes in the importance of liquidity was its effect on the flexibility of production and in 2000 on the financial flexibility. These behavioral changes can be linked with the financial market conditions.

As expected, more and more firms construct a formal investment policy for short-term investment. In the last survey over 80% of the firms had a formal policy, which is a quite high number in international comparison. In addition, the policies were constructed in greater detail indicating their increasing sophistication. This is a key element for active and effective money market operations. The evidence showed that cash managers' investment style was primarily 'term investing'. It was expected that this would lead to more passive cash management behavior than 'roll-over investing'. In addition, an increase was expected in some selected principles, such as the calculation of absolute yield on investments and transactions costs as well as the utilization of yield curve and its change. However, the differences in these between surveys were mostly insignificant. Thus the results were only indicative. Short-term borrowing from Finnish and foreign money markets lowered referring firms' good general liquidity level and good

availability of money from the stock market in the late 1990s. Interest rates were not regarded as such an important factor in decision-making as before. Managers' views on the importance of interest rates seemed to change parallel with the money market changes. Consensus on the most important factor affecting the shape of term structure of interest rates has increased during the research period. This was regarded as the higher interest rate risk. The utilization of yield curves as well as the reasons why managers did not use them in decision-making was supposed to vary with money market conditions.

Securities issued by banks (the certificates of deposits) and issued by firms (commercial paper) were the major money market instruments used in short-term investing. When planning short-term investments, the most time-consuming task was to resolve proper cash balances and to set goals for them. Managers' most important information sources were the banks and commercial information systems. Respondents reported the safety of the instrument as the most important criterion for investment and regarded interest rate risk as a crucial problem. Hedging should be used as a tool to manage risks. In case of interest rate risks the most common instruments seemed to be forwards and swaps. However, other derivatives were accorded minor importance.

This chapter presented survey evidence of cash managers' views on some fundamental issues of organizational, technological, and financial aspects of cash management function. It was concluded that cash management systems developed significantly, as expected. The direction of the technological development was as expected. In addition, in most cases differences between surveys were significant. This holds especially for responsibilities, as well as for centralization of cash management, and the utilization of banking and information systems. Significant development also holds for behavioral developments, especially cash management practices. It is therefore evident that cash management activities are elastic for environmental as well as technological changes and that the possibilities for effective cash management have increased.

In the case of selected cash management issues, in two out of the six the priority orders remained unchanged. All the issues included one or more such factors which changed significantly between surveys. Moreover, generally the consensus levels were highest in the case of the issue regarded as most important. As expected, there were significant differences concerning many practices in the area of financial transactions.

Issues of financial transactions were expected to change more than was found. The systems were used mostly with operative transactions. This is true when comparing 1988 and 2000. But as expected there was progress between 1988 and 1994. This implies that cash management behavior adjusts to changes in money market conditions. In addition to interest rate changes, it was concluded that cash management behavior depends on such elementary factors as stock market climate and a firm's general performance.

The differences in consensus levels on issues studied revealed that the principles of cash management decisions are based on differing arguments. Because of this differing behavior forecasting problems with the behavioral cash management models are evident. Generally, when the changes of consensus levels were compared between the surveys 1988 to 1994 and 1994 to 2000, it was found that the degree of consensus increased from 1988 to 1994. Consequently, there was a decrease from 1994 to 2000, which, however, was smaller than the former increase, so the trend was still increasing.

When the results of the three surveys were compared with results from some other countries, in addition of many similarities in cash management practices, several

differences between countries were found. This holds both for organizational, technological and behavioral issues in cash management. It seems, however, that in many respects the development of the processes of cash management of Finnish listed firms is comparable with that of firms in other countries.

5 Cash management behavior: empirical evidence

This chapter presents empirical evidence on the stability of the cash management function and on several other issues of the cash management behavior of firms in a changing money market environment, utilizing the demand for money functions as a description of cash management behavior. The survey results presented in the previous chapter indicate that a structural change in cash management behavior is evident. Cash management behavior is expected to change in Finnish firms, because of the money market liberalization and financial and technological innovations.

Cash management aroused interest because of its increasingly important role in today's business world. The need to economize on the holdings of cash balances has always been important. However, in the 1990s, changing money market conditions altered the profitability of the use of the new methods of managing transaction balances. After the liberalization of the money markets, new financial innovations and improved cash management techniques occurring throughout the 1980s and 1990s had a major impact the cash management behavior. Given these conditions on the money market, Finnish firms faced different relative rates of return and wealth constraints in different time periods. These changes may well be significant enough to alter cash management behavior, so that a structural change in the cash management function is perceptible.

Deregulation of the money markets encourages firms to alter portfolio choices in response to substantial developments in money market instruments and expected rates of return on assets. Behavioral knowledge of the business sector's cash management can help in modeling and decision-making processes. The literature on this behavioral area of cash management research provides conflicting answers at least to the following six fundamental questions:

1. Is the cash management function stable over time?
2. Do economies of scale exist in cash management?
3. How quickly do firms adjust cash balances to the desired level?
4. Are the cash balances sensitive to changes in interest rates?
5. How sensitive are cash balances to changes in inflation?
6. Is the cash demand homogeneous of degree one with respect to prices?

The confusion is partly caused by the fact that many earlier studies ignore one or more of these questions while answering the others. (Ungar and Zilberfarb 1980, Dotsey 1984, Marquis and Witte 1989, Natke 2001, and Robles 2002)

The literature in this area does agree that there are two major approaches to modeling cash balances of firms. *Transactions models* argue that cash holdings are related to the costs and level of transactions carried out by firms and they predict the existence of economies of scale in these demand functions. *Wealth models* view cash balances as one of many potential assets that a firm may hold in its portfolio. The amount of cash balances held is determined by the wealth budget constraint and the rates of return on other assets.

Empirically it has been difficult to distinguish between these models, since most studies include sales as an indicator for both the level of transactions and a proxy for wealth. In addition, they are mostly based on aggregate data sets of the whole economy or of household or firm sectors. However, firm-specific data sets are quite rare. In a recent study Robles (2002) used annual data to examine the behavior of two manufacturing sectors, i.e. non-durable and durable sectors with respect to adjustment speed of money and loans. Natke (2001) considered several issues of the cash management function for Brazilian firms and multinationals in a very inflationary environment. He found that the cash management function was stable for the entire sample and for static models and unstable for dynamic ones. Separately the models were stable, when dynamic models for Brazilian firms were an exception. Marguis and Witte (1989) utilized a micro model to examine the effects of the improvements in cash management techniques on cash management and the demand for money. Ungar and Zilberbarb (1980) examined selected issues of cash management behaviour of Israeli listed firms in an inflationary environment and found a stable relationship between money balance and its determinants.

The present study focuses on the stability question, i.e. whether environmental changes are significant enough to alter cash management behavior, which can be regarded as a structural change in the cash balance function. The stability issue will be examined over two substantially different periods in the money market environment. In addition to the stability tests, economies of scale, adjustment speed of cash balances, interest elasticity, and price homogeneity will be calculated and compared with the results from some other countries, especially from Israel (Ungar and Zilberfarb 1980) and Brazil (Natke 2001). These studies were selected for the comparison because they use firm level data and similar estimation techniques as is used in this study. However, it is worth notice that they consider cash management issues in a very inflationary environment. In addition, Natke (2001) used wider cash concept including, in addition to cash and deposits, short-term securities.

Pooled time series, cross-section data on Finnish listed firms over a 30-year period characterized by liberalization and integration of the money market will be used to examine the different issues concerning the cash management behavior of firms.

The remainder of the chapter is organized as follows: The next section considers the functional forms of cash management models presented in Chapter 2. Section 5.2 consists of a description of the data, regression models, and some methodological questions. Empirical results are presented in Section 5.3. Section 5.4 provides conclusions for this part of the study.

5.1 Cash management models

This study focuses especially on the financial transactions of the cash management function. These are the changes in cash balances due to the sales or purchases of financial securities or the borrowing or repaying of capital. On the other hand, cash balance changes due to the firm's operations, such as sales of a firm's products or purchases of factor inputs, are defined as operating transactions.

The models of the demand for money by firms are used as a description of financial transactions side of cash management. Four static cash management models and their dynamic counterparts are selected for the empirical estimation.

5.1.1 Static cash management models

In order to describe the long run behavior of cash management, the four models presented in Chapter 2 are selected (i.e. the models 2.2, 2.5, and two forms of the model 2.6). Some standardizations of the expressions of the elasticities are made. The first model is the inventory theoretic transaction model defined for empirical estimations in a multiplicative form as follows:

$$m_t^* = A \, s_t^{\alpha_1} \, R_t^{\alpha_2} \, (dp/p)_t^{\alpha_3} \tag{5.1}$$

where A is constant and α_1, α_2, and α_3 are the elasticities of desired level of real cash balances (m^*) with respect to the explanatory variables of the model, i.e. the level of real value of sales (s), and the opportunity cost of money (R). The real interest rate is replaced by nominal rate and, following Natke (2001) and several other researchers, an additional variable for price level change (dp/p) is included. It is assumed that the percentage change in the price level, which equals the expected change given perfect certainty, influences the cash management behaviour independently of the opportunity cost of money, and therefore should enter the function as a separate variable.

This model represents a version of the inventory theoretic transactions model (2.2) where $\gamma = 0$ and $\beta = 1$, and the expected elasticities $\alpha_1 = 0,5$ and $\alpha_2 = -0,5$. For the α_3 a priori hypothesis is $\alpha_3 > 0$.

The cash management model (2.5) based on the production function approach is defined in real terms as follows:

$$m^* = \gamma \, q_t^{\beta_1} \, R_t^{\beta_2} (dp/p)_t^{\beta_3} \tag{5.2}$$

where γ is constant and β_1, β_2, and β_3 are the elasticities of desired level of real cash balances (m^*) with respect to the real value of production (q), opportunity cost of cash (R), and price level changes. Again the real interest rate is replaced by nominal rate and the variable of price level change (dp/p) is added.

As in the case of the previous models, the wealth model (2.6) is presented in real terms, as follows:

$$m^* = k \, w_t^{\delta_1} \, R_t^{\delta_2} \, (dp/p)_t^{\delta_3} \tag{5.3}$$

where k is constant and δ_1, δ_2, and δ_3 are the elasticities of desired real cash balances (m^*) with respect to the explanatory variables of the model, i.e. the real value of wealth (w), the opportunity cost of money (R), and price level change (dp/p).

Following DeAlessi (1966), the wealth model is also estimated in the form where the wealth variable is defined as the market value of a firm. Thus, the fourth cash management function to be used in the estimations is

$$m_t^* = h \, (mc)_t^{\phi_1} \, R_t^{\phi_2} \, (dp/p)_t^{\phi_3} \tag{5.4}$$

where h is constant and ϕ_1, ϕ_2, and ϕ_3 are the elasticities of desired real balances (m^*) with respect to the market value (mc), the opportunity cost of money (R), and price level change (dp/p).

5.1.2 Dynamic cash management models

The long run cash management models as presented above, suppose that the cash balances would be adjusted to a desired level immediately. Generally there is a time lag between the actual and desired real cash balances of the firm. The lag could be due to e.g. uncertainty and incomplete information about financial markets. It may also reflect the disequilibrium in other assets of the firm. Evidently, adequate cash balances are needed to facilitate and lower the adjustment costs of other assets.

In Chapter 2, a partial adjustment mechanism by which actual holdings adjust to desired levels was presented. Following Nadiri (1969), a Koyck distributed lag mechanism was used to depict the adjustment process of actual to desired cash balances. Equation (2.7) can be expressed logarithmically as follows (see e.g. Laumas and Mehra 1976, Carr and Darby 1981, and Fair 1987):

$$ln \, m_t - ln \, m_{t-1} = \lambda(ln \, m_t^* - ln \, m_{t-1}) \tag{5.5}$$

In this form, the adjustment coefficient, λ, measures the rate at which adjustments are made to bring actual money holdings in line with the current desired level.

5.2 Research design

5.2.1 Data

The data used in the analysis consist of annual observations from two data sets. The first data set includes 23 and the second one 22 industrial firms, which were continually listed on the Helsinki Stock Exchange during the years 1972–1987 (first data set) and 1988–

2001 (second data set), and for which financial statements were available. There are 16 firms which are included in both samples.

The financial statement data used in the study is not very exposed to the 'window dressing' techniques. However, because of the changes in the accounting legislation during the research period, there may have some differences in the content of the accounts between sub-periods.

All measures are expressed in real Finnish currency using the wholesale price index with 1972 as the base year. The interest rate is measured by the nominal 5-year bond rate. This series was obtained from the Bank of Finland. The inflation rate is computed on the basis of the wholesale price index. The empirical counterparts for the theoretical variables are presented in Appendix 1.

5.2.2 Regression models

If the long-run development of cash management is based on rational behavior, meaning minimizing cash management costs (as a part of maximizing the expected net present value of firm's cash flow), the average long-run cash balances can be defined.

In this study, four static cash management models and their dynamic counterparts are estimated using financial statement data from Finnish listed manufacturing firms. When estimating the models presented in Section 5.1, a logarithmic transformation is used making the equations linear in the logarithms of the variables and linear in the parameters to be estimated. Taking the natural logs of both sides of the equations 5.1 – 5.4, yields the following models:

Inventory theoretic model (Model 1)

$$ln\ m_{it}^{*} = \alpha_0 + \alpha_1\ ln\ s_{it} + \alpha_2\ ln\ R_{it} + \alpha_3\ ln\ (dp/p)_{it} + \varepsilon_{1it} \tag{5.6}$$

Production theoretic model (Model 2)

$$ln\ m_{it}^{*} = \beta_0 + \beta_1\ ln\ q_{it} + \beta_2\ ln\ R_{it} + \beta_3\ ln\ (dp/p)_{it} + \varepsilon_{2it} \tag{5.7}$$

Wealth model A (Model 3)

$$ln\ m_{it}^{*} = \delta_0 + \delta_1\ ln\ w_{it} + \delta_2\ ln\ R_{it} + \delta_3\ ln\ (dp/p)_{it} + \varepsilon_{3it} \tag{5.8}$$

Wealth model B (Model 4)

$$ln\ m_{it}^{*} = \phi_0 + \phi_1\ ln\ (mc)_{it} + \phi_2\ ln\ R_{it} + \phi_3\ ln\ (dp/p)_{it} + \varepsilon_{4it} \tag{5.9}$$

where α_0, β_0, δ_0, and ϕ_0 are constants and the coefficients of the explanatory variables are the elasticities of real cash balances, with respect to these, and ε_{1it}, ε_{2it}, ε_{3it}, and ε_{4it} are random error terms.

The following reasonable a priori hypotheses of the estimated parameters of the models are assumed:

$$\alpha_l, \beta_l, \delta_l, \text{ and } \phi_l > 0; \quad \alpha_2, \beta_2, \delta_2 \text{ and } \phi_2 < 0; \quad \alpha_3, \beta_3, \delta_3 \text{ and } \phi_3 < 0 \qquad (5.10)$$

The elasticity of desired real cash balances, m^*, with respect to the scale variables is certainly positive. The relation between m^* and R, the opportunity cost of holding cash balances, is negative. A negative sign for the relation of m^* and dp/p suggests that firms will find it worthwhile to improve their cash management practices in the face of rising inflation.

The first model (*Model 1*) implies that there are economies of scale in the use of cash balances or, equivalently, that the elasticity of the cash balances with respect to transactions is less than one. The other three models expect unit elastic behavior. Many theoretical studies have considered the effects of the relaxation of the restrictions of these models on the elasticities of the basic models (see e.g. Sprenkle 1966, 1968, Sastry 1970, 1971, and Frenkel and Javanovic 1980).

In the empirical estimations of the static cash management models, two additional assumptions are made:

1. The money market is always in equilibrium so that desired cash balances equal the actual cash balances reported ($m_{it}^* = m_{it}$).
2. There are exact empirical counterparts to the theoretical variables specified.

Because of the market imperfections generally there is a time lag between the actual and desired balances. The above-mentioned adjustment process allows the derivation of an estimation equation with solely observable quantities. Substituting separately the static equations (5.6–5.9) into the adjustment equation (5.5) and rearranging, the representative dynamic cash balance functions can be presented as follows:

Inventory theoretic model (Model 5)

$$ln\ m_{it} = \lambda ln\ \alpha_0 + \lambda\alpha_l\ ln\ s_{it} + \lambda\alpha_2\ lnR_{it} + \lambda\alpha_3\ ln\ (dp/p)_{it} + (1-\lambda)ln\ m_{it-1} + \lambda\varpi_{1it} \qquad (5.11)$$

Production theoretic model (Model 6)

$$ln\ m_{it} = \lambda ln\ \beta_0 + \lambda\beta_l\ ln\ q_{it} + \lambda\beta_2\ lnR_{it} + \lambda\beta_3\ ln\ (dp/p)_{it} + (1-\lambda)ln\ m_{it-1} + \lambda\varpi_{2it} \qquad (5.12)$$

Wealth model A (Model 7)

$$ln\ m_{it} = \lambda ln\ \delta_0 + \lambda\delta_l\ ln\ w_{it} + \lambda\delta_2\ ln\ R_{it} + \lambda\delta_3\ ln\ (dp/p)_{it} + (1-\lambda)ln\ m_{it-1} + \lambda\omega_{3it} \qquad (5.13)$$

Wealth model B (Model 8)

$$ln\ m_{it} = \lambda ln\ \phi_0 + \lambda\phi_l\ ln\ (mc)_{it} + \lambda\phi_2\ ln\ R_{it} + \lambda\phi_3\ ln\ (dp/p)_{it} + (1-\lambda)ln\ m_{it-1} + \lambda\omega_{4it} \qquad (5.14)$$

In these formulas, λ can be calculated from the coefficient estimate of the lagged dependent variable. The long-run cash management functions can be obtained if the above equations are divided by the λ of a representative dynamic function and exclude the term *ln m_{it-1}*.

In the models the dependent variable is real cash balances (m_{it} = *cash on hand and in banks of the ith firm at the end of the tth year*). In addition to sales (s_{it} = *net sales*) as a scale variable c_{it}, one other proxy for transactions and two proxies for wealth are used. Production ($q_{it} = s_{it} - inventories_{it} + inventories_{it-1}$) is used as another measure of transactions volume, and total assets (w_{it} = *the sum of assets in the fiscal year-end balance sheet*) and market capitalization (mc_{it} = *the mean quotation of share multiplied by the number of shares*) as two measures of wealth. The nominal interest rate (R_{it} = *the 5-year bond rate*) is included in the cash management function as a proxy for opportunity cost of money. In addition, measures of inflation or the price level are added (and estimated separately) to the standard models of cash management. *The wholesale price index (p_{it})* is used to measure the price level and to calculate the inflation rate.

5.2.3 Estimation technique

The models presented above are estimated by using the fixed effects generalized least squares (*FGLS*) procedure, which allows the intercept term to differ across firms by estimating different constants for each cross-section. This procedure is similar to that used by Ungar and Zilberfarb (1980) and Natke (2001), i.e. the least squares dummy variable (*LSDV*) model. However, this study utilizes the *GLS* procedure using the estimated cross-section residual variances as weights (i.e. *FGLS*). The results are virtually the same, if all observations are given equal weight.

Individual shift variables are introduced explicitly into the equations to account for firm specific differences. The rationale of this procedure is that the data contain "other factors" which are specific to the individual firm. A firm's behavior is expected to be influenced by the nature of its economic environment. How a firm's cash management practices change in the face of the utilization of the money market and technological innovations depends on a comparison of marginal benefits and costs.

Following Natke (2001), random-effects generalized least squares (*REGLS*) regressions were also tried. This model assumes that the intercept is the sum of a common constant and a time-invariant cross-section specific random variable that is uncorrelated with the residual. However, the coefficients differed only slightly from those found by using the *FGLS* procedure. Consequently only the *FGLS* estimates are reported here.

Natke (2001) concluded that the *LSDV* model is appropriate to control for potential heteroscedasticity and autocorrelation associated with pooled time series and cross-sectional data. This is also suggested by Ungar and Zilberfarb (1980) in their study of Israeli firms.

This study assumes that the cash management behavior of firms underwent substantial changes after the money market liberalization. The previous survey evidence on Finnish firms supports this assumption. The results showed that in the 1990s there was a

significant development in cash management practices in Finnish listed firms. These concerned the following areas of cash management:

1. Responsibilities in cash management
2. Centralization of cash management
3. Sophistication of technological methods
4. Utilization of money market instruments
5. Consensus on cash management issues between representatives of cash management

The development of cash management practices can be seen as an indication of a structural change in cash management function. During the latter period firms may hold less cash balances, other things being equal, because they have greater access to domestic and foreign financial markets after the liberalization and integration of these markets. In addition they have access to sophisticated cash management techniques. This would cause a parallel shift in the cash balance function. To examine this issue, separate regression models are estimated for two periods, so that during different periods firms are allowed to respond differently to each independent variable in the models.

Based on the survey results mentioned above and the *CUSUM* test (which is based on the cumulative sum of the recursive residuals), the breakpoint for the two sub-periods was determined (for the *CUSUM* test, see e.g. Brown, Durbin, and Evans 1975 and Johnston and DiNardo 1997). The first was the period of governmentally controlled money markets and the liberalizing years during the latter part of the period (1972-1987) and the second included the years after the deregulation and during the integration of the money market (1988–2001). To measure the statistical significance of the difference between periods, the Chow test is performed (Chow 1960).

Then the appropriate test is

$$F_{Chow} = \frac{(sse_{ab} - sse_a - sse_b)/k}{(sse_a + sse_b)/(n + m - 2k)} \tag{5.15}$$

where

sse = sum of squared errors of the regression
a, b, and ab = first, second, and combined data sets
k = number of parameters
n = number of observations in the separate sets of data

Alternatively the periodic dummies are also used. The overall conclusions derived from the both the tests are the same. (Two dummies for the entire period and one dummy for both sub-periods are used. In the first stage the whole period is divided into three equal sections and in the second stage the two sub-periods are divided into two equal sections.)

5.3 Empirical results

The main results regarding the temporal stability of the cash balance function, economies of scale in cash management, adjustment speed of cash balances, interest rate sensitivity, the role of inflation, and price homogeneity are reported in Tables 29–34.

The estimated coefficients of the independent variables together with their *t*-values are reported in the tables. In Appendices 2–3, following these coefficients, are the *R*-squared statistic (adjusted for degrees of freedom), the standard error of the regression (*S.E.)*, Durbin-Watson statistic (*D-W*), *F*-statistic, and F_{Chow}-statistic. The *D-W* statistic is not appropriate as a test for serial correlation if there is a lagged dependent variable on the right-hand side of the equation. In these cases *Durbin's h* statistic is computed.

Stability of cash management functions: The outcome of the stability tests reported in Table 29 reveals that for the entire period the instantaneous adjustment models as well as the partial adjustment models are temporally unstable. The calculated F_{Chow} statistics are considerable higher than the tabulated values of 1.67, 1.96, and 2.62 at the 10%, 5%, and 1% of significance, respectively. Therefore, the null hypothesis of no structural change in the cash balance function before and after 1987 can be rejected. However, the results are somewhat different between the two sub-periods. The behavior of cash management defined by the dynamic models seems to be quite stable during both sub-periods (*Model 8* for the first sub-period is an exception). The significance of the periodic dummies included for the sub-periods also refers to the major changes in the economic environment in both periods (see Tables 1 and 2 in Appendix 2).

Table 29. Stability of the cash balance functions; F_{Chow} statistics.

Period	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1972–2001	3.938[c]	4.908[c]	5.639[c]	6.163[c]	1.962[b]	1.852[a]	2.097[b]	2.083[b]
Sub-period I 1972–1987	4.907[c]	4.765[c]	5.856[c]	6.116[c]	1.262	1.324	0.808	2.423[b]
Sub-period II 1988–2001	3.202[c]	3.144[c]	3.609[c]	0.587	0.832	1.040	1.256	1.331

Static models 1, 2, 3, and 4; Dynamic models 5, 6, 7, and 8. Breakpoint for the entire period is 1987 and for the sub-periods I and II, 1979 and 1994 respectively. a, b, and c indicate significance at 10%, 5% and 1% level respectively.

The temporal instability of the cash management functions in the 1970's, 1980's, and 1990's may reflect the changing behavior during the first and second periods (before and after money market changes), because during these periods firms may have responded differently to economic conditions. The increase in opportunities to utilize the money market and technological innovations may have changed. If this interpretation is correct, then separate regressions should be estimated for each period of time. The results from the separate regressions are reported in Appendix 3).

The results are partly consistent with Natke (2001). By analyzing Brazilian firms, he found a stable relationship for static models, but an unstable relationship for dynamic models. However, Ungar-Zilberfarb (1980) showed that all the models (including the dynamic ones) were stable in Israel. Dotsey (1984) used several proxies to capture the

cash management effects of technological development which decreased the instability of the cash management function. However, the purpose of the present study is not to search stable relationships but to detect the potential structural changes in the cash management behavior.

Next the cash management function is investigated in detail. Estimates for the entire period are considered and compared with the separate results for the two sub-periods. Economies of scale, adjustment speed of cash balances, interest elasticity, and price homogeneity, are of particular interest.

Economies of scale in cash management: Despite the differing theoretical grounds, the other main determinants of the cash management models are the same, except for the scale variable as a measure of firm size. In the case of transaction models the most generally used measures are sales or production. Instead, in the wealth models the scale operator is mostly total assets or sometimes market capitalization.

As in the case of other independent variables of the models, the log-per-firm transformations yield constant elasticities without any additional calculations. The scale elasticity less than unity is interpreted to refer to increasing efficiency of cash management processes, i.e. to economies of scale.

Based on the estimates of the entire sample, in the models of Table 30 without a lagged cash balance term, the scale elasticity differs significantly from unity only in the case of wealth model 4. This is consistent with the theoretical hypothesis which expects unitary elasticity. Instead, in the case of transactions models and the other wealth model (*Model 3*) the scale elasticity is insignificantly different from unity. The result is inconsistent with the inventory theoretic approach which expects economies of scale for cash balances.

The specification of models 1, 2, 3 and 4 assumes an instantaneous adjustment of actual cash holdings to its desired level. Alternatively, a partial adjustment mechanism may be assumed. This leads to models 5, 6, 7, and 8 with a lagged value of the dependent variable as an additional explanatory variable.

The results of investigating the scale elasticities reported in Table 30 indicate that when the lagged cash balance term is included in the model of an error adjustment process, the scale elasticities decrease essentially. This is a general finding also reported in previous studies on firm level data. These estimates indicate substantial economies of scale for cash holdings, which contradicts the results reported in many studies on aggregated data, i.e. there are no economies of scale.

Table 30. Elasticities of scale variables; FGLS estimates.

Period	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1972–2001	1.053	1.110	1.008	0.294[c]	0.447[c]	0.469[c]	0.331[c]	0.057[c]
	(-0.696)	(-1.425)	(-0.089)	(18.338)	(8.178)	(7.671)	(9.110)	(31.228)
Sub-period I	1.150	1.217	0.689[a]	0.177[c]	0.599[c]	0.624[c]	0.465[c]	0.049[c]
1972–1987	(-0.962)	(-1.378)	(1.706)	(14.763)	(2.701)	(2.511)	(2.801)	(17.945)
Sub-period II	0.657[c]	0.683[c]	0.618[c]	-0.116[c]	0.471[c]	0.490[c]	0.399[c]	-0.145[c]
1988–2001	(3.598)	(3.544)	(3.635)	(12.255)	(6.522)	(5.420)	(5.994)	(13.944)

Static models 1, 2, 3, and 4; Dynamic models 5, 6, 7, and 8. Scale variable $ln\ x_{it}$. Model 1 and 5; $x = net\ sales$.
Model 3 and 7; $x = total\ assets$. Model 2 and 6; $x = production$. Model 4 and 8; $x = market\ capitalization$. t-
statistic in parentheses ($H_0 = 1$). a, b, and c indicate significance at 10%, 5% and 1% level respectively.

The results of the regressions for separate periods are also reported in Table 30. The magnitudes of the scale coefficients suggest economies of scale, especially for the latter period, and they are more prominent when a partial adjustment process is modeled. When these coefficients are tested against one, economies of scale exist for both periods.

Assuming an instantaneous adjustment process, the estimated coefficients of the scale variables for first sub-period, range from 1.217 to 0.177, while those for the second period range from 0.683 to -0.116. During the first period, the static transaction models indicate unitary scale elasticities and the wealth models economies of scale. In addition, the elasticities for wealth models 4 and 8 are very low. These models include market value as a scale variable and the coefficient estimates differ essentially from those of other models. During the latter sub-period, market values increased greatly, which has a decreasing effect on the elasticities.

When a partial adjustment process was estimated, the scale elasticities decreased as much as 0.624–0.049 for the first and 0.490– -0.145 for the second period. Therefore, it seems that pooling data hides substantial variation across sub-periods with respect to economies of scale.

To summarize, the results reported in Table 30 indicate that the economies of scale in cash management are a result of environmental changes. For the entire sample and for the first sub-period the sales and production elasticities are close to unity in the case of static models, but differ significantly from unity for the latter sub-period. The larger the firm, the better are its chances of operating on the money market. These possibilities have clearly increased during the second sub-period, indicating more effective cash operations.

The long run elasticities of independent variables are virtually the same that as presented in the context of static models. The significance of the sales and production variables suggests that these are better scale variables than proxies for wealth (see Appendices 2–3).

Considering Ungar and Zilberfarb (1980) and Natke (2001), the former found no evidence for economies of scale but the latter did. Generally their results were at the same level as those presented here, while the latter wealth model was an exception. The results from Finland and also from Brazil suggest that the use of the error-adjustment model leads to lower estimated scale elasticities and a greater probability of concluding that economies of scale exist in cash management.

Partial adjustment of cash balances: In the dynamic cash management functions 5.12–5.15, the adjustment coefficient, λ, can be calculated from the coefficient estimate of the lagged dependent variable (i.e. from $1 - \lambda$). The estimated adjustment coefficient in Table 31 reveals the adjustment speed of cash balances from actual to desired level. The coefficients of the lagged dependent variables take positive and significant values. These coefficients suggest that during the entire period, about 35%–41% of the adjustment of actual cash balances to the desired level is accomplished within a year.

The results for the two sub-periods in Table 31 indicate that the adjustment speed differs between periods. During the second sub-period firms adjusted cash balances faster that in the first one (*Model 8* is an exception). Approximately 48%–53% and 44%–57% of the gap between the desired cash balances and the actual level was closed within a year during the first and second periods respectively. This result indicates more effective cash management during the latter period and is consistent with the decrease in scale elasticities discussed before.

Deregulation of the money markets has made it possible for firms to adjust actual holdings of cash balances to their desired level more quickly during the latter period. The magnitudes of the coefficients vary across models. The transaction models refer to the highest adjustment speed.

Table 31. Speed of adjustment of cash balances; FGLS estimates.

Period	Model 5		Model 6		Model 7		Model 8	
	$1 - \lambda$	λ	$1 - \lambda$	λ	$1 - \lambda$	λ	$1 - \lambda$	λ
1972–2001	0.592[c]	0.408	0.585[c]	0.415	0.631[c]	0.369	0.652[c]	0.348
	(18.375)		(17.999)		(19.795)		(20.511)	
Sub-period I	0.468[c]	0.532	0.465[c]	0.535	0.516[c]	0.484	0.516[c]	0.484
1972–1987	(10.235)		(10.134)		(11.492)		(11.393)	
Sub-period II	0.432[c]	0.568	0.426[c]	0.574	0.468[c]	0.532	0.557[c]	0.443
1988–2001	(7.280)		(6.452)		(7.618)		(8.389)	

Dynamic models 5, 6, 7, and 8. Independent variable $ln\ m_{it-1}$. t-statistic in parentheses ($H_0 = 0$). a, b, and c indicate significance at 10%, 5% and 1% level respectively.

Robles (2002) used annual U.S. data for selected durable and non-durable manufacturing industries. He found that non-durable industries adjust their cash balances faster that durables. Approximately 65% of the gap between desired and actual cash balances was closed within a year (ranging from 48% to 74%). Natke (2001) found that Brazilian firms adjusted their portfolios at lower rate as that found here, i.e. about 45% of the gap between desired and actual liquid assets. The study by Ungar and Zilberfarb (1980) reported faster adjustment process. About 75% of the gap between the desired money balances and the actual level was closed within a year.

Interest rate elasticity of cash balances: The interest rate elasticities are reported in Table 32. For the entire period, the estimated interest rate elasticities are positive and generally significant. Dynamic wealth models are the exceptions (i.e. Models 7 and 8). As in the case of scale variables, the levels of the coefficient are higher for the static than for dynamic models. A positive coefficient suggests that an increase in the nominal interest rate, holding the inflation rate constant, increases cash holdings. An explanation

for the positive elasticities suggested in the literature is the high own rate of return on cash balances of the firm with respect to the opportunity cost of money. On the other hand, the use of long-term interest rate as a proxy for opportunity cost may affect the results.

In addition, Table 32 indicates that the interest rate sensitivity of Finnish firms' cash asset demand is also positive for the sub-periods, but significant only for the second one (except in *Models 4* and *8*). The magnitudes of the interest rate elasticities for second sub-period differed somewhat from those estimated for the entire period, but are substantially lower and insignificant for the first sub-period.

Evidently, this result is consistent with the expectations regarding the effects of money market changes on cash management behavior. In the first sub-period the money markets were constrained and the interest rates governmentally controlled. Under the controlled markets the volatility of interest rates was very low which can partly explain the insignificant coefficients for the first sub-period.

Table 32. Interest rate elasticities; FGLS estimates.

Period	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1972–2001	0.970 [c]	0.998 [c]	0.598 [c]	0.554 [c]	0.379 [c]	0.391 [c]	0.178	0.108
	(5.235)	(5.426)	(3.239)	(2.756)	(2.595)	(2.673)	(1.254)	(0.733)
Sub-period I	0.299	0.169	0.392	0.521	0.251	0.191	0.261	0.355
1972–1987	(0.811)	(0.458)	(0.991)	(1.283)	(0.781)	(0.601)	(0.782)	(1.035)
Sub-period II	0.788 [c]	0.828 [c]	0.591 [c]	0.229	0.558 [c]	0.580 [c]	0.330 [b]	-0.001
1988–2001	(4.298)	(4.972)	(3.776)	(1.148)	(3.607)	(3.341)	(2.168)	(-0.007)

Static models 1, 2, 3, and 4; Dynamic models 5, 6, 7, and 8. Independent variable $ln\ R_{it}$. t-statistic in parentheses ($H_0 = 0$). a, b, and c indicate significance at 10%, 5% and 1% level respectively.

It is noteworthy that the interest rate elasticity depends also on the model specification. Natke (2001) found that when inflation was included in the equation in its level form, interest elasticities took highly significant positive values. When the measure of the price level was omitted from the model the interest rate variable was insignificant. Otherwise Natke's elasticities were negative and significant, and high relative to the existing literature on the firm demand for cash balances. In Ungar and Zilberfarb's study too, interest elasticities were generally significant and negative. Annual U.S. data referred substantially lower interest rate elasticities than the studies mentioned above (Dotsey 1984).

Inflation elasticity of cash balances: Results of investigating the elasticity reported in Table 33 indicate that over the entire period and in the first sub-period, the inflation rate seems to have an inverse impact on the cash balances. In every case the coefficients are negative and significant as expected.

A higher inflation rate encourages firms to adopt better procedures for cash management practices which lower cash balances regardless of the nominal interest rate. This suggests that firms change the portfolio of short-term assets and payments-handling practices when the inflation rate is rising to economize on holdings of cash balances.

During the 1980s, the inflation rate had a negative and significant effect on cash management in Finland. The insignificant values for the latter period can be explained by fairly low and stable inflation in the 1990s.

Table 33. Inflation elasticities; FGLS estimates.

Period	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1972–2001	-0.219 [c]	-0.198 [c]	-0.162 [c]	-0.153 [c]	-0.119 [c]	-0.112 [c]	-0.095 [c]	-0.105 [c]
	(-4.219)	(-4.099)	(-3.190)	(-2.816)	(-3.147)	(-2.970)	(-2.457)	(-2.671)
Sub-period I	-0.602 [c]	-0.535 [c]	-0.621 [c]	-0.644 [c]	-0.394 [c]	-0.366 [c]	-0.407 [c]	-0.403 [c]
1972–1987	(-7.220)	(-6.254)	(-6.619)	(-6.814)	(-5.361)	(-4.912)	(-5.126)	(-5.076)
Sub-period II	0.032	0.028	0.058	0.078	-0.002	-0.003	0.016	0.011
1988–2001	(0.673)	(0.635)	(1.266)	(1.595)	(-0.046)	(-0.053)	(0.384)	(0.238)

Static models 1, 2, 3, and 4; Dynamic models 5, 6, 7, and 8. Independent variable $ln\ (dp/p)_{it}$. t-statistic in parentheses ($H_0 = 0$). a, b, and c indicate significance at 10%, 5% and 1% level, respectively.

Natke (2001) found that the inflation rate seemed to have a direct impact on firms' demand for liquid assets. Whenever the inflation rate or the nominal interest rate was entered into the demand equation by itself, it had an insignificant influence on cash balances. Ungar and Zilberfarb (1980) suggest that the lack of a direct effect of inflation in the equations may be attributed to the problem of using the actual inflation rate as a proxy for inflationary expectations and to the problem of multicollinearity between inflation and interest rate.

Homogeneity of cash demand: A common assumption in studies investigating the demand for money is that the demand for money is homogeneous with respect to prices. To test this assumption, Models (1)–(8) were re-estimated with *the log of the price level* as an additional explanatory variable instead of inflation. Only for the entire period and for first sub-period in the case of *Model 8*, do the results for static models meet the homogeneity assumption. When the price level was introduced into the model, the estimated parameter of price level variable in the case of static models is 0.890, 0.830, 0.987, and 1.223 respectively. The coefficients are positive and insignificantly different from unity, indicating that cash management is homogenous of degree one with respect to the price level.

Table 34 also indicates that during the two sub-periods firms' behavior differs greatly in their responses to price level changes. During both sub-periods, cash asset demand is not homogeneous of degree one with respect to prices since the coefficients are positive and greater than unity for the first period and negative for the second period and significant in both cases.

Table 34. Homogeneity of cash balances with respect to price level changes; FGLS estimates.

Period	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
1972–2001	0.890	0.830	0.987	1.223	0.293 [c]	0.283 [c]	0.310 [c]	0.356 [c]
	(0.542)	(0.842)	(0.065)	(-1.052)	(4.604)	(4.677)	(4.472)	(4.133)
Sub-period I	1.382 [c]	1.329 [c]	1.483 [c]	1.778 [c]	0.701[c]	0.690 [c]	0.714 [c]	0.849
1972–1987	(-10.782)	(-2.788)	(-3.908)	(-7.021)	(2.718)	(2.829)	(2.524)	(1.309)
Sub-period II	-3.848 [c]	-3.893 [c]	-2.804 [c]	-2.592 [a]	-3.144 [c]	-3.152 [c]	-2.891 [b]	-2.825 [b]
1988–2001	(-3.237)	(-3.267)	(-2.508)	(-1.498)	(-2.687)	(-2.700)	(-2.345)	(-2.079)

Static models 1, 2, 3, and 4; Dynamic models 5, 6, 7, and 8. Independent variable *ln p_{it}*. *t*-statistic in parentheses ($H_0 = 1$). a, b, and c indicate significance at 10%, 5% and 1% level respectively.

Thus for the first period, the result is consistent with Natke (2001). He found a significant positive relationship significantly higher than unity. On the other hand, Ungar and Zilberfarb (1980) found that in all the equations this coefficient was insignificantly different from unity, so that one cannot reject the hypothesis of unitary price elasticity in the demand for money by firms. The result is consistent with the present study for the entire period in the case of static models.

5.4 Conclusions

Cash management behavior is exposed to structural changes if there are significant changes in money market environment. This can create incentives for strategic decisions which affect operational behavior. The purpose of this part of the study was to examine if these effects are significant enough to reject the hypothesis of the stability of the cash management function. Four cash management models based on three theoretical approaches were estimated. The strategic cash management decisions were expected to appear as instability of the parameter estimates of these models.

Cash management behavior was examined over two substantially different time periods, i.e. before and after the money market liberalization in Finland. The first time period covered the years from 1972 to 1987 and the second from 1988 to 2001. In order to examine the direction of the change in the cash management behavior of firms during the last three decades, the parameters of all equations, both static and dynamic, were estimated for these periods. During the first sub-period the money market innovations for the cash management were believed to be unimportant. The null hypothesis that the coefficients of the demand for money relationship have not changed over the entire period was tested by computing the F_{Chow} statistic.

The calculated F_{Chow} statistics were very high, especially in the case of static models. Therefore, the null hypothesis that the coefficients of the regressions for the different periods of time are the same was rejected. The results showed that both static and dynamic cash management models exhibit temporal instability in a markedly changing money market environment.

It was found that although the inter-firm variation in cash holdings was eliminated for the entire period, there appeared no economies of scale in the cash holdings of individual

firms. This holds especially for the static models. The elasticity of cash management with respect to scale variables was about one. Instead, the empirical evidence suggested the rejection of the null hypothesis of the existence of the economies of scale in firms' cash balances only in the case of the first sub-period. Thus the economies of scale in cash balances were more evident in the latter period of more developed money market conditions. Correspondingly, the behavior of firms' cash management seemed to approach the inventory theoretic expectations that they behave rationally in the sense of minimizing cash management costs.

The result for scale elasticity significantly less than one was consistent with the inventory theoretic model but inconsistent with the production and wealth theoretic models. In addition, there were no significant differences in the explanatory power between models. However, empirical evidence indicated that the scale elasticities of the wealth theoretic models were lower than the elasticities of transaction models. The former elasticities were more indicative of the existence of the economies of scale in cash management.

The evidence also suggested that only partial adjustment from actual to desired balances was achieved within a year. For the entire period the adjustment coefficient indicated that 35 to 41 percent of the desired adjustment of cash balances appears to be completed in one year. Finnish firms seemed to adjust cash balances faster during the second period than during the first period. This may indicate fundamentally different partial adjustment processes for the two differing periods. This result was consistent with the lower scale elasticities for the latter period, indicating more effective cash management. Economic agents tend to invest more time and resources in improving their payment techniques or in finding alternative investment media, thereby reducing the need and desire to hold cash balances.

Although there are potential problems in assessing the sensitivity of cash management decisions to changes in nominal interest rates, the evidence suggested elasticities that have much higher positive values than those generally found elsewhere in the empirical literature. The strength of this sensitivity appeared to be affected by periods being more significant during the latter period.

The coefficient of the inflation rate had the expected sign in all equations but significant only for the entire and first sub-period. Thus the inflation rate does seem to have a direct, although not always significant, effect on the cash management behavior of firms. Results referred more effective cash management practices in an inflationary environment.

In the case of the static models and for the entire period, cash asset demand was homogeneous of degree one with respect to the price level. Instead, for the sub-periods the hypothesis of the price homogeneity was rejected.

This study concludes that according to the empirical evidence from the stability tests, the hypothesis about no changes in cash management behavior was rejected. The Chow statistic indicated a shift in the cash management function between two sub-periods, i.e. from 1972 to 1987 and from 1988 to 2001, most likely under the influence of structural changes in the money market environment. After the deregulation of the Finnish money market, the development of cash management behavior has been as expected. Larger firms can use the new opportunities of the money market more effectively than can smaller ones. In addition, the utilization of the new technologies has increased the

effectiveness of money market operations especially in large firms. This was seen in the lower scale elasticities and in the higher adjustment speed of cash balances for the latter period.

These conclusions differ partly from those found for samples in Israeli and Brazilian firms by Ungar and Zilberfarb (1980) and Natke (2001) including temporal stability, economies of scale, interest rate sensitivity, and homogeneity with respect to price level. Further research is needed to determine which conclusions might be general ones and which are specific to the money market experience in Finland during the research period.

6 Summary and further research

Driven by the increasing importance of the cash management function in the environment of the emerging money market, it has attracted the attention of both academics and practitioners in recent times. It is reasonable to expect that especially the role of financial transactions in cash management process in adding to firm value should be more important than before.

Cash management is an issue researched in many research disciplines, such as in monetary theory, financial theory, and operations research. Theoretically, most studies try to model the behavior of cash managers or to derive normative decision or planning models. The behavioral results have mainly been presented in the monetary and financial theoretic literature and the normative models correspondingly in the area of operations research. However, there is little information about cash management practices and their development in emerging money market. It is supposed that the environmental changes have been remarkable enough to change the cash management behavior, which can be seen as a structural change in the cash management function, i.e. in the progress of cash management practices likewise in the instability of the behavioral cash management models.

The main purpose of this study was to examine if evidence of a structural change can be detected from the decision-making practices of cash management and/or from the financial statement data. Through survey evidence an attempt was made to identify the best practices followed by Finnish listed manufacturing and service companies and their developments during the research period. The factors assumed to change were the organizational and technological arrangements in cash management as well as professional skills in the area of financial transactions. The most important incentive for these developments was expected to be the liberalization of the Finnish money markets and the innovations in financial transactions and related areas. In addition, the behavioral changes in cash management were examined by testing both static and dynamic cash management models and their potential structural change before and after the deregulation years of the money market.

The results of the survey part of the study revealed that cash management practices changed significantly during the research period. The organizational and technological changes especially concerned the responsibilities of cash management, the centralization

of cash management operations, and the development of cash management systems and banking relationships. Concerning the decision-making principles, estimated by the priorities and consensus levels, most of them revealed significant changes during the research period.

Generally the survey evidence showed that firms have achieved significant technological progress (improving systems and methods) and significant behavioral changes (increasing professionalism) concerning cash management practices during the research period, referring to increasing opportunities for more effective cash management operations.

When the survey results were compared to the stability tests of cash management models they indicated a consistent structural change in cash management behavior. The hypothesis of no changes in cash management behavior after the liberalization of the Finnish money market was rejected. The development of cash management behavior was as expected; larger firms can exploit the new opportunities of the money market and new technologies more effectively than can smaller ones.

The development of cash management practices verified through the survey analysis can be seen as an indication of more effective behavior during the latter part of the research period. The survey results was confirmed by the estimation evidence, i.e. the lower scale elasticities, the higher speed of adjustment of cash balances, and more sensitive reactions with respect to market variables. As in the case of the survey results the estimation evidence differed partly from those presented in certain previous foreign studies.

This study surveyed and compared for the first time cash management practices in listed companies located in Finland and tested cash management models using financial statement data. Cash management practices in firms seemed to follow a common evolutionary path and sophistication seemed to be increasing during the research period. The instability of the cash management models referred consistent evidence with survey results.

The final conclusion is that both parts of this analysis, i.e. the fist part based on the survey data likewise the second part based on financial statement data, implied a structural change in cash management behavior in an emerging money market.

For further research, it would seem reasonable to investigate cash management behavior in greater detail using the ratios of financial statement analysis as explanatory variables in the firms' demand for money function in addition to some macro-variables. With the utilization of financial statement data, some preliminary evidence has been presented in literature regarding relationship between cash management and a firm's performance. This interesting relationship needs further research. In future more attention should be devoted to developing positive theories of cash management. This study presents some aspects which may help to explain the current behavior of cash management decision makers.

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Appendix 1 Empirical counterparts to the theoretical variables.

The individual financial statement data for the listed Finnish manufacturing companies are used (N = 23, years 1972–1987 and N = 22, years 1988–2001).

Dependent variable:

    Cash balances of a firm

    M_t = *Cash and bank receivables*$_t$

Scale variables:

    Sales

    S_t = *Net sales*$_t$

    Production

    PRO_t = *S_t - Inventories*$_t$ *+ Inventories*$_{t-1}$

    Wealth

    W_t = *Total assets*$_t$

    Market capitalization

    MC_t = *Mean quotation of shares*$_t$ ** Number of shares*$_t$

Opportunity cost of money:

    Long term interest rate

    R_t = *5-year bond rate*$_t$

Price level:

    P_t = *Wholesale price index*$_t$

Appendix 2 Estimates of the cash management models (for the entire time period).

Table1. Static cash management models; FGLS estimates. (Time period: 1972-2001)

	Model 1	Model 2	Model 3	Model4
$ln\ x_{it}$	1.053^c	1.110^c	1.008^c	0.294^c
	(13.757)	(14.374)	(10.995)	(7.462)
$ln\ R_{it}$	0,970^c	0.998^c	0.598^c	0.554^c
	(5.235)	(5.426)	(3.239)	(2.756)
$ln\ (dp/p)_{it}$	-0.219^c	-0.198^c	-0.162^c	-0.153^c
	(-4.219)	(-4.099)	(-3.190)	(-2.816)
Dum1	1.162^c	1.112^c	1.129^c	1.490^c
	(10.932)	(10.494)	(9.938)	(13.327)
Dum2	0.923^c	0.839^c	0.780^c	1.593^c
	(5.156)	(4.711)	(3.914)	(8.393)
Adj. R^2	0.882	0.887	0.851	0.870
S.E.	1.011	1.101	1.018	1.107
D-W	1.621	1.631	1.510	1.494
F	147.157^c	154.155^c	112.242^c	124.274^c
F_{Chow}	3.938^c	4.908^c	5.639^c	6.163^c

t-statistics in parentheses under coefficients estimates. a, b, and c indicate significance at 10%, 5%, and 1% level respectively. *Model 1; x = net sales. Model 3; x = total assets. Model 2; x = production. Model 4; x = market capitalization.*

Table 2. Dynamic cash management models; FGLS estimates. (Time period: 1972-2001)

	Model 5	Model 6	Model 7	Model 8
ln x_{it}	0.447[c]	0.469[c]	0.331[c]	0.057[a]
	(6.612)	(6.776)	(4.512)	(1.880)
ln R_{it}	0.379[c]	0.391[c]	0.178	0.108
	(2.595)	(2.673)	(1.254)	(0.733)
ln $(dp/p)_{it}$	-0.119[c]	-0.112[c]	-0.095[b]	-0.105[c]
	(-3.147)	(-2.970)	(-2.457)	(-2.671)
Dum1	0.493[c]	0.486[c]	0.480[c]	0.632[c]
	(5.401)	(5.335)	(5.048)	(6.846)
Dum2	0.213	0.196	0.199	0.498[c]
	(1.469)	(1.336)	(1.276)	(3.349)
ln m_{it-1}	0.592[c]	0.585[c]	0.631[c]	0.652[c]
	(18.375)	(17.999)	(19.795)	(20.511)
Adj. R^2	0.941	0.943	0.933	0.940
S.E.	0.868	0.864	0.887	0.911
Durbin's h	-0.378	-0.334	-0.443	-0.434
F	301.589[c]	309.798[c]	261.960[c]	280.181[c]
F_{Chow}	1.962[b]	1.852[c]	2.097[b]	2.083[b]

t-statistics in parentheses under coefficients estimates. a, b, and c indicate significance at 10%, 5%, and 1% level respectively. *Model 5; x = net sales. Model 7; x = total assets. Model 7; x = production. Model 8; x = market capitalization.*

Appendix 3 Estimates of the cash management models (for the two sub-periods).

Table 1. Static cash management models; FGLS estimates. (Time period I: 1972-1987, Time period II: 1988-2001)

	Model 1	Model 2	Model 3	Model4
Period I				
ln x_{it}	1.150^c	1.217^c	0.689^c	0.177^c
	(7.356)	(7.717)	(3.773)	(2.964)
ln R_{it}	0.299	0.169	0.392	0.521
	(0.811)	(0.458)	(0.991)	(1.283)
ln $(dp/p)_{it}$	-0.602^c	-0.535^c	-0.621^c	-0.644^c
	(-7.220)	(-6.254)	(6.619)	(-6.814)
Dum1	-0.627^c	-0.614^c	-0.820^c	-1.038^c
	(-5.383)	(-5.292)	(-6.684)	(-9.214)
Adj. R^2	0.910	0.916	0.881	0.869
S.E.	0.996	0.990	1.021	1.027
D-W	1.726	1.688	1.483	1.369
F	126.531^c	135.795^c	92.489^c	80.889^c
F$_{Chow}$	4.907^c	4.765^c	5.856^c	6.116^c
Period II				
ln x_{it}	0.657^c	0.683^c	0.618^c	-0.116
	(6.895)	(7.646)	(5.879)	(-1.278)
ln R_{it}	0.788^c	0.828^c	0.591^c	0.229
	(4.298)	(4.972)	(3.776)	(1.148)
ln $(dp/p)_{it}$	0.032	0.028	0.058	0.078
	(0.673)	(0.635)	(1.266)	(1.595)
Dum2	0.233^a	0.235^a	0.314^b	0.087
	(1.656)	(1.872)	(2.426)	(0.611)
Adj. R^2	0.997	0.998	0.999	0.998
S.E.	0.825	0.739	0.788	0.833
D-W	1.611	1.609	1.448	1.364
F	301.007^c	308.210^c	377.441^c	351.113^c
F$_{Chow}$	3.202^c	3.144^c	3.609^c	0.587

t-statistics in parentheses under coefficients estimates. a, b, and c indicate significance at 10%, 5%, and 1% level respectively. *Model 1; x = net sales. Model 3; x = total assets. Model 2; x = production. Model 4; x = market capitalization.*

Table 2. Dynamic cash management models; FGLS estimates. (Time period I: 1972-1987, Time period II: 1988-2001)

	Model 5	*Model 6*	*Model 7*	*Model 8*
Period I				
ln x_{it}	0.599[c]	0.624[c]	0.465 [c]	0.049
	(4.083)	(4.166)	(4.052)	(0.921)
ln R_{it}	0.251	0.191	0.261	0.355
	(0.781)	(0.601)	(0.782)	(1.035)
ln $(dp/p)_{it}$	-0.394[c]	-0.366[c]	-0.407[c]	-0.403[c]
	(-5.361)	(-4.912)	(-5.126)	(-5.076)
Dum1	-0.380[c]	-0.383[c]	-0.504[c]	-0.562[c]
	(-3.594)	(-3.649)	(-4.619)	(-5.455)
ln m_{it-1}	0.468[c]	0.465[c]	0.516[c]	0.516[c]
	(10.235)	(10.134)	(11.492)	(11.393)
Adj. R^2	0.939	0.943	0.928	0.925
S.E.	0.925	0.921	0.933	0.939
Durbin's h	-0.307	-0.324	-0.398	-0.399
F	185.391[c]	196.579[c]	154.650[c]	142.934[c]
F_{Chow}	1.262	1.324	0.808	2.423[b]
Period II				
ln x_{it}	0.471[c]	0.490[c]	0.399[c]	-0.145[a]
	(5.804)	(5.205)	(3.975)	(-1.763)
ln R_{it}	0.558[c]	0.580[c]	0.330[b]	-0.001
	(3.607)	(3.341)	(2.168)	(-0.007)
ln $(dp/p)_{it}$	-0.002	-0.003	0.016	0.011
	(-0.046)	(-0.053)	(0.384)	(0.238)
Dum2	0.153	0.161	0.261	0.091
	(1.347)	(1.289)	(1.445)	(0.706)
ln m_{it-1}	0.432[c]	0.426[c]	0.468[c]	0.557[c]
	(7.280)	(6.452)	(7.618)	(8.389)
Adj. R^2	0.954	0.995	0.999	0.999
S.E.	0.686	0.759	0.717	0.751
Durbin's h	0.239	1.160	0.190	0.318
F	157.238[c]	247.730[c]	325.379[c]	362.233[c]
F_{Chow}	0.832	1.040	1.256	1.331

t-statistics in parentheses under coefficients estimates. a, b, and c indicate significance at 10%, 5%, and 1% level respectively. *Model 5; x = net sales. Model 7; x = total assets. Model 6; x = production. Model 8; x = market capitalization.*