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ICT in Cash Management: Explanatory Model

Leire San Jose
Financial Economic II Department
University of Basque Country, Bilbao, Spain
E-mail: leire.sanjose@ehu.es

Txomin Iturralde
Financial Economic II Department
University of Basque Country, Bilbao, Spain
E-mail: txomin.iturralde@ehu.es

Amaia Maseda
Financial Economic I Department
University of Basque Country, Bilbao, Spain
E-mail: amaia.maseda@ehu.es

Abstract

The aim of this paper is to develop a model that can determine and explain the use of ICT (Information and Communication Technologies) in treasury management. The results indicate that the ICT more utilized by firms to financial practices are financial software, Internet and electronic banking. Furthermore, these results have permitted us to develop an explanatory model of the use of ICT for the treasurer's functions. Three levels of use are established: *operational management technologies* (Basic ICT's or ICTB), *forecast management technologies* (Medium ICT's or ICTM), and *strategic treasury management technologies* (Advanced ICT's or ICTA). Our results indicate that ICT's embrace not only the most repetitive treasury functions (ICTB and ICTM) but also ICTA, since they are used in treasury management functions that depend largely on corporate decisions and are strategic rather than operational.

Keywords: Cash management, ICT, Factorial analysis, Explanatory model.
JEL Classifications: G21, G30

1. Introduction

Information and Communication Technologies (ICT's) are currently used in all areas of society, including cultural, social and business affairs. They have become an essential tool for enhancing links between individuals and organisations.

ICT's can be defined in several different ways as tools that comprise hardware, software and telecommunications equipment (Stark, 2002; Schlögl, 2005), including digital communication technologies that can reduce the cost of co-ordination, communication and information processes (Brynjolfsson & Hitt, 2000). From a broad perspective, ICT's embrace information technologies (websites, on-line databases, electronic documents, intranets, etc.), communication technologies (e-mail, electronic discussion groups, e-conferences and even mobile telephones) and hardware and

software technologies used in general to transmit information and communicate via computer, radio, TV or IT programs and tools. ICT's thus include both information and communication technologies that create, obtain, process, store, retrieve and transmit information.

In business ICT's, and more specifically financial software, e-banking and the Internet as core aspects of the various technologies used, have become driving forces behind the expansion of firms and the development of treasury management. New technologies are considered as one of the most attractive ways for businesses to increase revenue and achieve economies of scale that can reduce unit costs (Claessens *et al.*, 2000; Allen *et al*., 2001; Barajas & Villanueva, 2001; Mulligan & Gordon, 2002; Eije & Westerman, 2002).

Three different periods can be distinguished in the development of ICT's in treasury management (Williams *et al.*, 1997). In period one, prior to the 1970's, treasurers engaged in accounting and in managing the cash-flow of their companies, and did not use IT tools in their work. Period two, from the 1970's to the 1990's, is characterised by a vision based on corporate relations and integrated systems. In the late 80's firms began to use computers, and software products began to be adapted and incorporated into business platforms, operating systems and databases. Decisions by treasurers concerning company cash assets thus came to be made by grouping information from various areas of business, so that treasury management began to involve an overall vision. Since the 1990's we have moved into period three, the era of networking, in which the responsibilities of treasurers have come to include decisions concerning the identification and management of financial risks and the running of simulations of investment and financing projects, improving corporate information management solutions. In this last period the great advantages for business management entailed by the development of technology have come to be recognised: chief among them is the functionality of the Internet, which enables one to work with users outside one's own company unrestricted by actual distance. For the first time in history links between firms do not depend on the physical distance between them. This frees them from many limitations, since the Internet is a space that can be shared freely at zero expense (Bernal, 2001). However, the introduction of new technologies needs to be analysed thoroughly if business management efficiency is to be maximised (Levinsohn, 2001).

In that context, this article sets out to develop a model that can determine and explain the use of ICT's in treasury management. The idea is for the model to reflect all the treasury management functions assumed by financial managers and thus provide an up-to-date view of the use of technology in financial departments, and more specifically in treasury management.

The development of this model is an important contribution to the relevant literature, as there have been few papers that have analysed the use of ICT's in treasury management and none that has set out to draw up an explanatory model of the kind tackled here. This paper also presents a methodological contribution in the use of structural equations to analyse the factors linked to ICT use in treasury management. No previous paper has done this. The structural equations method can be used to construct unobserved variables that statistically validate and design the theoretical concepts studied, reasoned and explained by researchers (in this case concerning the use of ICT's in treasury management functions).

The results indicate that the Internet, e-banking and financial software packages[1] are the most directly and widely used ICT's in treasury management functions. Specifically, they make the management of treasury positions faster, simpler and cheaper (Humphrey *et al*., 1996; Shon & Swatman, 1998). Treasury forecasts and planning can be made more accurate, and can be re-worked if greater-than-expected divergences emerge (Phillips, 1998). Banking management becomes an essential function in which information can be obtained electronically on market conditions, financial products, trends and financial services. Financing and investment of treasury deficit and surpluses is optimised by comparing the terms of the different financial products on the market and then contracting products

[1] There are other ICT's that also enhance or are beneficial to treasury management, including EDI (electronic data interchange) (Hill & Sartoris, 1995; Copeland & Hawang, 1997; Lee, S. et al., 2005), ERP, software integrated into companies (Thurston, 2000 and Mulligan & Gordon, 2002) and the XBRL business reporting language (Bonsón *et al.*, 2000).

on-line (Mooney & Pittman, 1996; Poynter, 1998; Welch, 1999; Vasarhely & Greenstein, 2003). Financial risks can be identified and monitored or hedged rapidly and systematically by means of purpose-built software, and simulations can even be run to compare the contracting of different hedging products. Treasury managers can thus opt for the financial products best suited to the needs and expectations of each firm (Loderer & Pichler, 2000).

The rest of the paper is structured as follows. Section 2 sets out the theoretical foundations on which the study is based. Section 3 presents the data and the analysis procedure used to conduct the empirical study. The main results of the investigation are shown in Section 4, and Section 5 presents conclusions. The paper ends with a list of bibliographical references.

2. Previous Research

In recent years the literature on business management has studied the consequences of the use of ICT's in the world of the economy and business, and has found evidence that ICT's have a positive effect on repetitive operations of all types and on organisational relationships in general, though there are barriers to their proper use. The conclusions of these studies reveal the importance of the use of ICT's and the need to consider them as an essential part of any organisational activity, primarily because of the benefits that they entail (Kantrow, 1980; McFarlan, 1984; Rockart & Scott, 1984; Porter & Millar, 1985; King, 1986 and Faulder, 2001).

The introduction of ICT's into the world of business has revolutionised the area of finance, where the use of electronic systems has become consolidated in all aspects (Bis, 2001). Increasingly widespread use of more and more advanced technology is changing the way in which treasury functions are managed, mainly by making them more competitive. ICT's, and particularly the Internet with its huge network of interconnected computers using rules to manage information and communication, have enabled numerous remote services to develop, including electronic treasury management (Large, 1997). This can be defined as a set of procedures and treasury management practices integrated into IT in a way that has been made possible by the development, evolution and monitoring of technology itself.

Previous research (San Jose, 2006) has suggested that a corporate culture has grown up around electronic treasury management functions to manage movements of available liquid funds efficiently. Analysis of the use and influence of technology tools leads to the assertion that the change of culture entailed by treasury management comes not only with a particular corporate culture with corporate beliefs and values, but also with a technological or innovative culture (Cameron & Quinn, 1999). Essentially, this technology brings with it up-to-date, accurate information, smooth, consistent relationships between economic operators and lower operating costs. It is these three contributions that have the most direct influence on treasury management responsibilities, so that:

- Liquidity management, the core of corporate treasury management, is conducted using the value date of treasury positions at all times. Management is also becoming increasingly efficient based on the obtaining of accurate, consistent internal and external information and good communication with economic operators (Graber, 2002).
- Payments and Collects can be managed systematically, and greater knowledge of unforeseen payments and collects enables adjustments to be made accordingly (Tse *et al*., 1998a, 1998b). The influence of these payments on treasury positions can also be managed easily and inexpensively.
- Treasury planning can approximate future situations more closely, mainly because of the accurate, up-to-date information available, and relationships and treasury movements can be managed anywhere at any time, and adjusted if divergences are larger than expected (Eby, 2003).
- Banking relationships become less personal, as there is no need actually to visit bank branches. However, information on firms is more specific, so there is a trend towards relational banking. This trend is consolidated with the issuing of detailed, up-to-date

information on any data required by firms, which decreases the asymmetry of information for firms and thus increases their negotiating power. In other words, firms obtain information on market conditions, financial products, trends and financial services that makes it possible to run comparisons (Markovic, 1998), which in turn enables them to take up better positions in negotiations for the contracting of financial products and services.

- Financing of treasury deficit and investment of surpluses are optimised because financial products can be contracted on line (Petersen & Rajan, 2002): firms can compare the terms of the various financial products available on the market (Claessens *et al*., 2000 & Pennathur, 2001) and can opt for whichever are best suited to their needs. Treasurers can even run simulations of operations to help them improve their decision-making, though decisions must also be based on their experience and intuition and on market trends (which can also be analysed using IT tools).
- Financial, interest rate and exchange rate risks can be identified quickly, and the relevant trends can be analysed on an ongoing basis using purpose-made software. Financial risks can be measured (Skerritt, 1999) and hedges can even be executed if trends or risks turn out to extend beyond the levels that firms wish to bear. Hedging is simple and can be formalised immediately, financial hedging products can be compared and simulations can be run to check for differences between contracting one or another (Markovic, 1998; Allen *et al*., 2001; Schaechter, 2002). This means that treasury managers can again opt for the products that best suit the needs and expectations of their firms.

In short, financial services based on new technologies use the Internet as a single communication standard and thus obtain economies of scale (Mishkin & Strahan, 1999; Barajas & Villanueva, 2001; Eije & Westerman, 2002) and positive synergies at treasury departments which were formerly difficult to achieve.

3. Data & Research Method

Sample

This study was conducted on Spanish firms with more than 10 employees in 2005. The sample was chosen by proportional allocation according to criteria of company size (defined by the number of employees) and sector of activity. We strove to obtain at least 30 observations in each segment so that the comparative tests could be made with the minimum required level of guarantee. The total number of firms used was 501.

The Questionnaire

The questionnaire comprises two blocks of questions: “Level of Use of ICT’s in Treasury Management” and “Use of ICT’s in Treasury Management Functions”. The first block is intended to analyse the technological factors used for financial operations and elicit information to enable a descriptive analysis to be drawn up of the level of use of technology tools in finance so that attention can subsequently be focused on determining the technological level of each treasury management function.

Level of ICT use in treasury management	Use of ICT's in treasury management functions
Financial Software Internet E-banking (Internet Banking)	Management of payments and collects Monitoring of liquidity of banking operations Short-term treasury forecasts Management of account balances at value dates Negotiation with banks Management of treasury deficit funding Management of treasury peaks Management of interest & exchange rate risks

The questionnaire contains specific questions about the points under study that require equally specific answers. The questions are presented via a Likert type scale so that the qualitative opinions of employers can be quantified and the relevant empirical comparisons can be made.

The scale of agreement/ disagreement used in these questions is as follows: 1 = Never and of little or no importance; 2 = Sometimes but with little significance; 3 = Several times and with some significance; 4 = Many times and with considerable significance; and 5 = Habitually and of great significance.

Methodology

To draw up the explanatory model of ICT use in treasury management we used confirmatory factorial analysis of structural equations. First of all an exploratory factorial analysis was performed to reduce the number of items proposed for the assessment of the different constructs of ICT's by grouping variables together, thus ensuring minimum information loss. Secondly, a cluster analysis of variables was performed to ensure maximum consistency in the groups of variables drawn up in the exploratory factorial analysis. And thirdly a confirmatory factorial analysis was carried out to estimate the relationships between the items to be measured and the indicators used for measurement, and thus confirm the scale of measurement of the specific constructs under analysis from a convergent perspective.

Version 12.0 of the SPSS program was used to perform the exploratory factorial analysis and the cluster analysis. For the confirmatory factorial analysis and the validation of both the measurement model and the structural model, Version 5.0 of AMOS was used (attached to the SPSS statistical package).

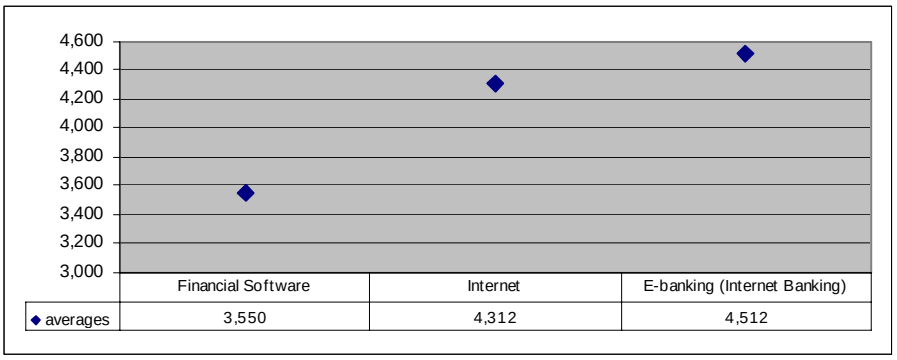
Structural equations have not previously been used in research to analyse factors linked to the use of ICT's in treasury management, so this is a methodological contribution of our study to the relevant literature. The structural equations method can be used to construct unobserved variables that define and statistically validate the theoretical concepts studied, reasoned and explained by researchers: in this case the use of ICT's in treasury management responsibilities.

4. Results

Preliminary Results

The ICT's most widely used in financial operations and more specifically in treasury management are financial software, the Internet and e-banking, though it is the introduction of the Internet into all areas of corporate life that has been the major revolution of the past ten years. All these technologies entail benefits for financial management, so the next step is to analyse their average levels of use and determine which ICT's are most widely used in this area (see Grafhic 1).

Graphic 1: The level of utilization of ICT in cash management: averages.

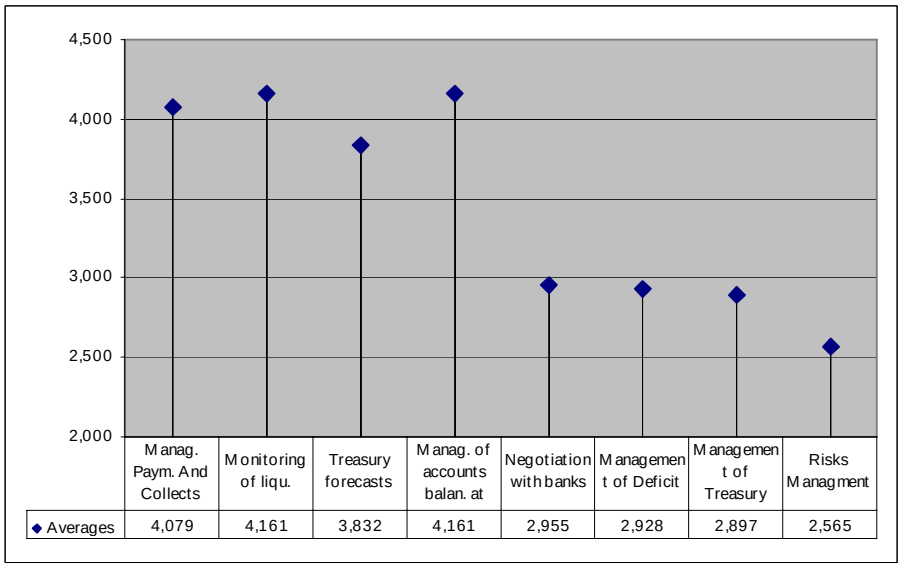


This analysis shows that e-banking (Internet banking) is the most widely used tool in treasury operations, with treasury managers awarding it an average score of 4.512 out of 5. The second highest score is that of the Internet, with 4.312, followed by financial software with an average of less than 4. Specifically, e-banking is used habitually by 73.1% of the firms analysed, the Internet by 65.5% and financial software by 44.6%.

In short, ICT's are widely used in treasury management tasks, with e-banking being the most widely used of all. The boost provided by the Internet in terms of relationships between firms and their banks and in terms of contracting and analysing different financial instruments needs to be considered.

The grafhic below analyses the technological level attained in each area of responsibility of treasury managers so as to determine the tasks in which technology is used most. The figures given are averages.

Graphic 2: Utilization of ICT in responsibilities of cash management: averages.



The treasury management functions in which ICT's are most widely used are Management of Bank Balances at Value Date and Liquidity Monitoring, with average scores of 4.161 out of 5. This is because ICT's make it possible to obtain direct information from banks on movements at the value date, which is a great improvement. In combination with the use of a suitable IT tool, knowing account balances at all times enables firms to monitor their liquidity simply and efficiently. High scores are also obtained by Management of Payments and Collects (4.079) and Treasury Forecasts (3.832): the big advantage of ICT's here is that they provide more and more detailed information, which firms can acquire and manage using new technologies. The use of ICT's is lower for other treasury functions,

mainly because although more up to date information is a help, management depends largely on the conditions of the money market and the economy.

It can thus be asserted that the use of ICT's (financial software, the Internet and e-banking) is becoming more widespread in the treasury management tasks of Management of Payments and Collects, Treasury Forecasts and Management Of Bank Balances At Value Date.

In three of the four remaining areas of responsibility – Negotiation With Banks, Management of Deficit and Management of Surpluses – the use of ICT's is also relatively widespread among the firms questioned, but it depends more on the economic situation at any given time, on the terms and conditions offered by banks, on the negotiation power of firms and on the financial products available. Significant positive scores were not obtained for the use of ICT's in interest rate and exchange rate risk management.

An Explanatory Model

To give a valid, reliable scale for measuring the use of ICT's in treasury management, an exploratory factorial analysis is applied, followed by a cluster analysis of variables and, finally, a confirmatory factorial analysis to confirm the level of reliability and convergent validity of the scale of measurement.

Exploratory Factorial Analysis

The basic assumptions underlying factorial analysis – linearity, normality and homoskedasticity – are conceptual rather than statistical. Therefore, from a statistical point of view these assumptions can be obviated, in the awareness that their nonfulfilment causes a drop in the correlations observed (Hair *et al*., 1999). However, these correlations are still sufficient if it is determined that factorial analysis is appropriate. This can be done by analysing the Kaiser-Meyer & Olkin (KMO) measurement and examining the whole correlation matrix, contrasting it with Bartlett's sphericity test.

Table 1: Determining factor of the correlation matrix, KMO and Bartlett´s test.

Kaiser-Meyer-Olkin simple suitability measure		**794**
Bartlett´s sphericity test	Chi-square	761,264
	fd	28
	p-value	,000

The results shown in Table 1 are satisfactory for both tests, so an exploratory factorial analysis can be performed for ICT's.

Table 2: Principal component analysis. Final statistics with three components of rotate variables.

	Communality	**Comp.**	**Eigen-value**	**% of Var.**	**%Var. Accum.**
Management of payments and collects	,754	1	3,246	40,571	40,571
Monitoring of liquidity of banking operations	,707	2	1,480	18,499	59,069
Short-term treasury forecasts	,655	3	753	9,418	**68,487**
Management of account balances at value dates	,699				
Negotiation with banks	,649				
Management of treasury deficit funding	,664				
Management of treasury peaks	,711				
Management of interest & exchange rate risks	,639				

These results show that the eight variables for the use of ICT's in treasury management can be grouped into three components with minimal information loss. The first component explains 40.571%

of the variance, the second 18.499% and the third 9.418%. In all, this grouping into three factors explains 68.487%[2] of the overall variability of the sample.

Table 3: Rotated component matrix. Varimax normalization with Kaiser.

	COMP. 1	COMP. 2	COMP. 3
Management of payments and collects		834	
Monitoring of liquidity of banking operations		803	
Short-term treasury forecasts			684
Management of account balances at value dates			799
Negotiation with banks	,670		
Management of treasury deficit funding	,766		
Management of treasury peaks	,808		
Management of interest & exchange rate risks	,785		

Saturations lower than 0.4 in absolute value have been eliminated.

An analysis of the sensitivities in the above table shows that for the first component, *Negotiation With Banks, Management of Treasury Deficit Funding, Management of Placement of Treasury Peaks and Management of Interest & Exchange Rate Risks* have high, positive values. Considering the significance of these variables this component seems to be reflecting aspects concerned with ***strategic treasury management technologies***.

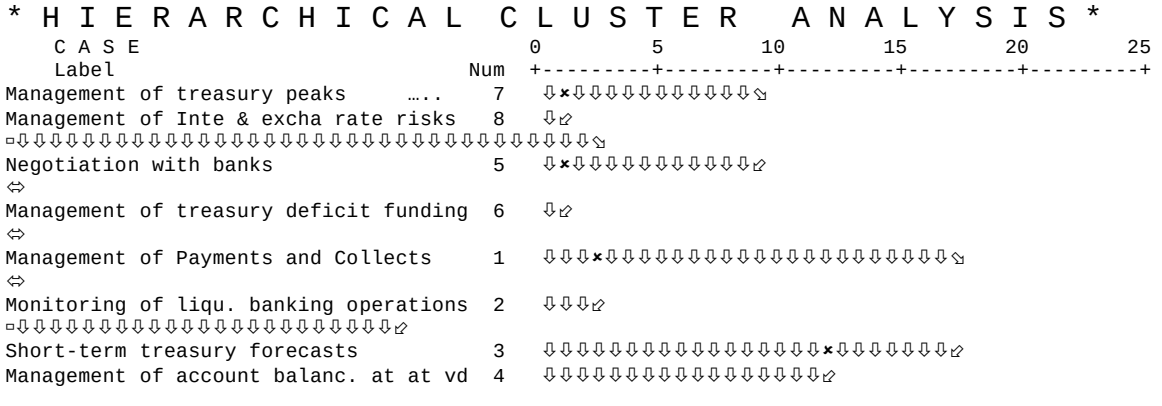
Use of ICT's in *Management of Payments and Collects and Monitoring Liquidity in Banking Operations* can be grouped around the second factor as ***operational management technologies***.

The third component, defined by the variables for ICT use in *Short-Term Treasury Forecasts* and *Management of Bank Balances* at Value Date can be taken as ***forecast management technologies***.

Cluster Analysis

A cluster analysis of variables was then conducted using the hierarchical method to arrive at homogenous groups. The result of the cluster analysis was compared with the result of the exploratory factorial analysis performed in order to give greater consistency to the results obtained. The criterion used in the clustering process was the average inter-group link and the measure of similarity between elements in the analysis was the absolute value of the correlation coefficient.

Graphic 3: Dendogram for variables of "Information and Communication Technologies"



After this cluster analysis it was determined that variables could be classed in three sub-sets in terms of ICT use in treasury management: the same ones as obtained by factorial analysis. This gives the desired consistency to the grouping.

[2] The number of factors extracted was determined by prioritising the "percentage of variance" criterion over the "latent root" criterion so that with commonalities above the set minimum of 0.5 it was decided to select the number of factors necessary to explain at least 60% of the variance.

Table 4: Reliability with Cronbach´s Alpha.

CRONBACH ALPHA	
COMPONENT 1	0,788
COMPONENT 2	0,684
COMPONENT 3	0,606
GLOBAL SCALE	0,789

As can be seen from the table above, the Cronbach's Alpha coefficients of the second and third components fail to reach the set minimum of 0.7. This made it necessary to purify the scale of measurement of ICT's. This was done by drawing up a confirmatory model of structural equations that enabled the link between indicators to be estimated and determined which item(s) should be eliminated to obtain a more parsimonious scale.

Confirmatory Factorial Analysis

To estimate the convergent validity of the model, the standard weights of the model proposed were observed and the percentage of variance explained by observed variables was determined. Once the significance of the weights was studied, the next step was the sequential unit removal of items in line with their explanatory capability with the latent variable. In other words, confirmatory factorial analysis was used to obtain a valid scale of measurement. This meant carrying out various fitting processes to eliminate unreliable items and factorial weights. These fits are shown below.

Table 5: Debugging process of the scale "Information and Communication Technologies".

LATENT VARIABLE - INFORMATION AND COMMUNICATION TECHNOLOGIES							
Adjusted process	**Items**	**Charges in F1****	**Charges in F2****	**Charges in F3****	**Reliability (R2)**	**C.R.**	**p**
1	Management of payments and collects		1*		,610	-	-
	Monitoring of liquidity of banking operations		0,886		,558	10,426	***
	Short-term treasury forecasts			1*	,660	-	-
	Management of account balances at value dates			0,692	,339	8,000	***
	Negotiation with banks	0,859			,489	12,730	***
	Management of treasury deficit funding	1*			,637	-	-
	Management of treasury peaks	0,944			,537	12,781	***
	Management of interest & exchange rate risks	0,897			,492	11,768	***
2	Management of payments and collects		1*		,622	-	-
	Monitoring of liquidity of banking operations		0,836		,515	9,183	***
	Short-term treasury forecasts			1*	,957	-	-
	Management of account balances at value dates				,444	ddddfd	***
	Negotiation with banks	0,837			,462	12,143	***
	Management of treasury deficit funding	1*			,633	-	-
	Management of treasury peaks	0,940			,532	12,472	***
	Management of interest & exchange rate risks	0,904			,498	11,501	***
3	Management of payments and collects		1*		,598	-	-
	Monitoring of liquidity of banking operations		0,830		,480	9,085	***
	Short-term treasury forecasts			1*	,827	-	-
	Management of account balances at value dates				,888	ddddd	***
	Negotiation with banks				,999	ddddd	***
	Management of treasury deficit funding	1*			,541		-
	Management of treasury peaks	1,074			,592	10,680	***
	Management of interest & exchange rate risks	0,976			,493	10,181	***

*The scale of latent factor has fixed to 1 with this item, therefore the corresponding C.R. has not calculated.
** No standardized charges.
***Significant at 99%.

In the first fitting process it was observed that the variable *Management of Balances at Value Dates* had the lowest reliability level at 0.339 (below the recommended minimum of 0.5) and a

standardised weight of 0.582[3] (below the required minimum of 0.7). This variable was therefore eliminated from the confirmatory factorial analysis.

In the second fitting process it was determined that the variable *Negotiation With Banks* should be eliminated, also because its reliability level was below the recommended minimum of 0.5 and its standardised factorial weight was below 0.7.

Once these two variables had been eliminated, the items in the model resulting from the third and last fitting process accounted for 76.85%[4] of the variance, making for a more parsimonious model. The standardised weights of the observed variables Management of Payments and Collects, Monitoring Liquidity in Banking Operations, Short-Term Treasury Forecasts, *Management of Treasury Deficit Financing, Management of Placement Of Treasury Peaks and Management of Interest & Exchange-Rate Risks* on the three latent variables are significant and above the recommended level of 0.77 in almost all cases at 0.77, 0.69, 0.91, 0.74, 0.77 and 0.70[5] (Fornell & Larcker, 1981). Moreover, Cronbach's Alpha for each factor is high and the relative measures of internal consistency – compound reliability and extracted variance – are around or higher than the recommended levels.

Once it had been checked that the factorial weights were significant and the individual reliability levels were adequate, the next step was to check the convergent validity of the measuring instrument by means of the indices for the overall goodness of fit of the model. Table 6 shows that the fit obtained is adequate (Luque, 2000). The Chi-squared value p is greater than 0.05, and even greater than 0.2 (most conservative), GFI, AGFI, TLI and NFI are greater than 0.9 and close to 1, indicating a good fit of the model. *The Root Mean Square Error of Approximation* (RMSEA) value of less than 0.05 also indicates a good fit (Browne & Cudeck, 1993).

The validity of the scale as a discriminant is also ratified, since the correlations between the three dimensions obtained are lower than the square root of the average variance extracted (AVE). This shows that the results obtained and the coefficients of the causal analysis will not be altered by problems of co-linearity and all factors are distinct.

Once the statistical data were analysed, the final assessment model or ICT Path Diagram was represented. This shows the standardised factorial weights for each observed variable on the corresponding factor.

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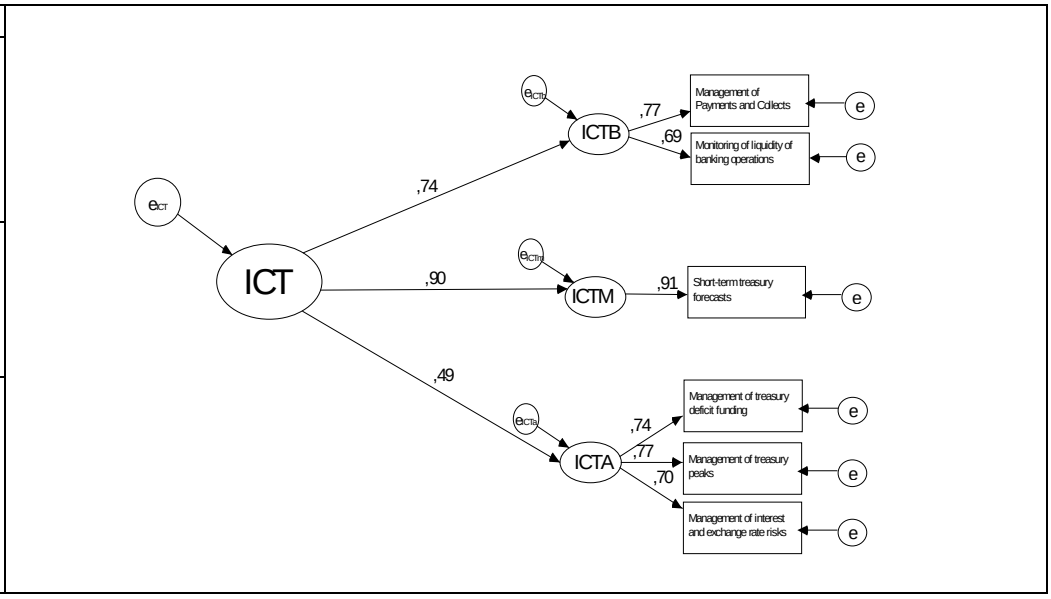
[3] In this table the weights exposed in the fitting process are defined by the non standard format and expressed in terms of the scale of each factor. By contrast, the coefficients or standard weights have the same variance and a maximum value of 1, so each factor or construct becomes invariant to scale and all variables are comparable. These standard weights are analysed because of the comparability between variables that they permit, but are not included in the fitting processes. They are, however, available upon request.

[4] A further factorial analysis was performed to obtain the percentage of dispersion or variance explained after grouping or reduction of the number of variables on the basis of the items observed in regard to ICT's, and once the scale was purified by eliminating the variables for use of technologies in management of bank balances at value date and in negotiations with banks.

[5] See path diagram in Table 6

Table 6: Information and Communication Technologies construct: Model fit summary and Path Diagram.

Model fit summary
Adsolute adjusted measured χ^2 = 9,732 p-value = 0,204 GFI = 0,989 RMSEA = 0,034
Incremental adjusted measured AGFI = 0,966 TLI = 0,969 NFI = 0,952
Parsimony adjusted measured (valid for model comparisons) PNFI = 0,444 PGFI = 0,330 χ^2/ df = 1,390 AIC = 39,732



In the face of these results, the model for measuring ICT use in treasury management is considered adequate. The sub-variables that result from the model cover the use of ICT's in strategic treasury management ("Advanced ICT's" or ICTA), in forecast management ("Medium ICT's" or ICTM) and in operational management ("Basic ICT's" or ICTB).

5. Concluding Remarks

The results of this study indicate that the responsibilities of treasury managers have evolved thanks to the introduction of ICT's into numerous financial operations. Payments and collects can be detailed and entered into the financial system quickly and easily thanks to ICT's, which means that treasury positions on value dates can be obtained instantly and corporate treasury surpluses and deficit can be detected at any time. Once the treasury manager knows the treasury position he/ she can engage in whatever monetary operations best suit the financial objectives of the firm, in full awareness of all the banking services and products available on the market. Relationships with banks can be formalised more quickly thanks to new channels, chief of which is the Internet, enabling financial operations to be carried out instantly. Thus, treasury forecasts can be analysed and modified so that future treasury positions are as close as possible to the desired figures. Finally, risks can be analysed systematically and consistently so that it can be determined and decided case by case whether hedging is required.

Heads of finance must establish and develop a corporate culture that embraces all the beliefs, expectations and principles inherent in treasury management responsibilities. However, for firms to meet their treasury objectives, available liquidity must be managed dynamically and efficiently. This does not depend only on the management style of the treasury manager but also on what technological tools are used by each organisation, and how they are used. Proper use of ICT's is a distinguishing feature in treasury management, propitiating technological change towards flexibility and innovation in businesses.

But although these technological tools give advantages in treasury management because of the smooth, detailed flow of information that they provide at all times, the reduction in operating costs that they permit and the way in which they mitigate asymmetries of information, making decisions on treasury management functions is still one of the main responsibilities of the treasurer himself/ herself: technological tools are no substitutes for the common sense and awareness of the future required for such decisions.

Empirical analysis shows that ICT's are used mainly in the treasury management responsibilities of Management of Payments and Collects, Monitoring of Liquidity in Banking Operations, Short-Term Treasury Forecasts and Management of Bank Balances at Value Date. Their use in other treasury management functions is less widespread. This may be because the above are repetitive functions in which ICT's can be implemented simply and cheaply, resulting in significant advantages. The other functions depend not only on ICT's but also on the conditions of the financial market, on decisions based on the experience and intuition of individual treasury managers and on the corporate culture of firms.

An explanatory model representing various levels of ICT use has been drawn up to illustrate the theory underlying the notion of using information and communication technology for treasury management operations. Three levels of use are established: operational management technologies ("Basic ICT's" or ICTB), which cover the constructs for ICT use in management of payments and collects and banking management tasks; forecast management technologies ("Medium ICT's" or ICTM), which cover the use of ICT's for treasury forecasting; and strategic treasury management technologies (Advanced ICT's or ICTA), which cover constructs for management of investments, financing and risks. Our results indicate that ICT's embrace not only the most repetitive treasury functions (ICTB and ICTM) but also ICTA, since they are used in treasury management functions that depend largely on corporate decisions and are strategic rather than operational.

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