INVESTIGACIÓN & DESARROLLO, Vol. **20**, No. **2**: 57 – 74 (2020)
ISSN 2518-4431

LIQUIDITY RISK AND STOCK RETURN IN LATIN AMERICAN EMERGING MARKETS

RIESGO DE LIQUIDEZ Y RENTABILIDAD DE LAS ACCIONES EN LOS MERCADOS EMERGENTES DE AMÉRICA LATINA

Francisco Javier Vasquez-Tejos[1] y Prosper Lamothe Fernandez[2]
[1]*Escuela de Negocios, Universidad Mayor de Chile*
[2]*Departamento de Financiación e Investigación Comercial, Universidad Autónoma de Madrid*
francisco.vasquez@umayor.cl
(Recibido el 14 de septiembre 2020, aceptado para publicación el 26 de noviembre 2020)

ABSTRACT

This study analyzes the impact of liquidity risk on stock returns in four Latin American markets (Chile, Columbia, Mexico, and Peru) between January 1998 and July 2018. Several previous studies have focused on measuring this effect in developed markets and a few in emerging markets, such as Latin American stock markets. In the present study, five liquidity risk measures with a multiple regression model; three have been widely used in previous studies and two were from recently proposed measures. We found evidence of an inverse relationship between liquidity risk and stock performance, which indicates that there exist rewards for investing in less liquid positions and therefore originate new investment strategies. In general, lesser developed or smaller markets have a disadvantage for this type of study, due to lack of access to historical information on stock purchase and sales.

Keywords: Liquidity Risk, Stock Returns, Emerging Markets, Latin America, Liquidity Risk Measurements.

RESUMEN

Este estudio analiza el impacto del riesgo de liquidez y la rentabilidad de las acciones en cuatro mercados latinoamericanos (Chile, Colombia, México y Perú), entre enero de 1998 y julio de 2018. Varios estudios anteriores se han centrado en la medición de este efecto en los mercados desarrollados y unos pocos en los mercados emergentes, como lo son mercados de valores de América Latina. En el presente estudio se utiliza un modelo de regresión, el cual incorpora cinco medidas de riesgo de liquidez; tres se han utilizado ampliamente en estudios anteriores y dos proceden de medidas propuestas recientemente. Se encontraron pruebas de una relación inversa entre el riesgo de liquidez y el rendimiento de las acciones, lo que indica que existen recompensas por invertir en posiciones menos líquidas y por tanto originar nuevas estrategias de inversión. En general, los mercados menos desarrollados o más pequeños tienen una desventaja para este tipo de estudio, debido a la falta de acceso a la información histórica sobre la compra y venta de acciones.

Palabras Clave: Riesgo de Liquidez, Rentabilidad de las Acciones, Mercados Emergentes, América Latina, Medidas del Riesgo de Liquidez.

1. INTRODUCTION

Liquidity risk has become an important element for investors since it allows them to assess the speed with which an investment can be offered to the market and convert into cash, as well as the cost associated with accelerating this transition. The first liquid market concepts were introduced by Black [1], who indicated that a stock market should contain constant supply and demand of shares, minor differences in the range of prices (Bid-ask spreads), and sale and/or purchase of large quantities of shares with a low impact on the price. Another specification of a liquid market was given by Kyle [2], who maintains that the market must be in a constant equilibrium of auctions, which must contain the possibility of taking and closing positions in a short time, market depth and price resilience. Subsequently, based on the seminal article by Amihud and Mendelson [3] on the relationship between stock return and liquidity risk, several studies were initiated in developed markets on this subject, and more recently in emerging markets as well. The importance for investors of a liquid market has become more relevant since the crisis of 2008, since these markets present a necessary condition for efficiency [4].

Financial and liquidity risks are defined respectively as losses produced by adverse movements in market prices, and as the cost or inopportunity of undoing a position [5]. Three other definitions of liquidity risk can be highlighted: i) the ability to convert shares into cash (or vice versa) with the lowest transaction cost [6]. ii) the impossibility of being able to undo a position or investment at a competitive market price and with sufficient speed after the decision was made [7]. iii) the risk involved when selling the assets to meet financial obligations, which are minor and may be caused by various factors, such as the ability to make certain assets liquid or turn them into cash, delays in the sale process or having to accept prices below the market value of said assets [8].

DOI: 10.23881/idupbo.020.2-4e

On the other hand, six factors are identified that influence the liquidity of shares [9]: transaction costs, asymmetric information, demand, financial market development, investment horizon, and dividend payment date. Many of these factors leave their mark on historical transaction data, such as return, volume, number of businesses, and transaction days. Historical transaction data is easier to obtain in emerging markets, which is why this study focuses on them.

Therefore, the questions posed by this study (hypothesis) are the following: Do the different liquidity risk indicators measure their relationship with the return of shares the same way in different Latin American countries? What is the relationship between liquidity and return?

This investigation is organized as follows: in section 2, there is a bibliographic review including emerging and developed markets; in section 3, the data and methodology; in section 4, the results; and finally, in section 5, the conclusions.

2. BIBLIOGRAPHIC REVIEW

2.1 Studies focused on an emerging market from a single country

Using the liquidity adjusted capital asset pricing model (LCAPM) developed by Acharya and Pederson [10] in the Portuguese market, authors Miralles, Miralles, and Oliveira [11] found evidence that the most liquid assets, such as those with higher transaction levels, showed higher returns. The latter is contrary to evidence that has been found in other markets, i.e., a negative liquidity risk premium. In the Jordanian market, a study by Bataineh, Mohamad Ali and Hanna Alrabadi [12] found that the Amihud illiquidity measure [13] and the turnover ratio proposed by Datar, Naik, and Radcliffe [14] are the methods that produce the best results and provide evidence of an effect of liquidity on shareholder returns.Another study by Leirvik, Fiskerstrand, & Fjellvikas [15] found no evidence of a relationship between stock returns and liquidity in the Norwegian market. The authors used three liquidity measures, including the turnover rate, and none yielded significant results.

A study of the Indian market in the year 2016 on trading activity and liquidity risk concluded that there is a liquidity risk premium in the Indian stock market [16].

Studies performed on the Chilean market have found evidence of a positive relationship between liquidity risk and stock returns in the period from 2000-2008 [17] and during the period from 2000-2018 [18].

2.2 Studies that focus on emerging markets in a group of countries

The work of Gniadkowska-Szymańska [9] uses a methodology similar to what was described by Datar, Naik, and Radcliffe [14], but modified for emerging markets, using monthly returns from companies listed on the Polish and Baltic stock exchanges between the periods of January 2006 and October 2015, and found significance between the number of transactions and stock returns, but not with the turnover ratio. In another study of the seven emerging markets of Argentina, Brazil, Indonesia, Mexico, Russia, South Korea, and Thailand, Levy Yeyati, Schmukler, & Van Horen [19] used Amihud ratio indices, bid-ask spread, and weekly volume logarithms to study liquidity in two periods, pre- and post-crisis from 1994-2004. The methodology used was twofold. First, they compared their pre- and post-crisis deviations and then an econometric analysis was performed. The authors concluded that the discouragements of the market are positively correlated with volume and negatively correlated with transaction costs. There is also a strong relationship between liquidity measures and periods of crisis, and no evidence was found of market paralysis with the onset of the crisis. Another study to consider was performed on stock markets in Croatia, Slovenia, Hungary, Serbia, Bulgaria, Poland and Germany, in which two groups of liquidity measures were used: one-dimensional (Size of the firm-related liquidity measures, volume-related liquidity measures, time-related liquidity measures, and spread-related liquidity measures) and multi-dimensional (Amivest ratio and Amihud's illiquidity ratio, ILLIQ). This study found that the countries of Germany, Poland, and Hungary had a high level of liquidity, while Croatia, Slovenia, Serbia, and Bulgaria had a high level of illiquidity compared with the first group. They conclude that the Amihud Illiquidity (ILLIQ) is not an appropriate measure for emerging markets [20]. They also consider that liquidity is impossible to capture with a single index, given its multi-dimensional characteristics. The study by Vidović, Poklepović, & Aljinović [21] tested two measures of illiquidity in emerging markets of Europe, in addition to a new proposed measure, Relative Change in Volume (RCV), which used 12 continuously listed shares in seven markets (Poland, Czech Republic, Hungary, Bulgaria, Romania, Croatia, and Germany). They found that the ILLIQ and Turnover measures are not appropriate since the return of these shares did not increase with rises in illiquidity.

The study by Bekaert, Harvey & Lundblad [22], which considers 18 emerging markets, including 5 Latin American markets (Argentina, Brazil, Chile, Colombia, and Mexico), concludes that the Zero Rate Return (ZRR) Index as a monthly ratio, is a good predictor of profitability. In addition, the ZRR index is negatively related to turnover. They find that the ZRR measure captures an aspect of liquidity that is not present in turnover.

The work of Perobelli, Famá, & Sacramento [23], found a positive relationship between market risk and turnover, this along other results indicates a negative premium for market liquidity in the Brazilian market

Ahn, Cai, & Yang [24] studied 21 emerging markets, including 6 Latin American markets (Argentina, Brazil, Chile, Mexico, Peru, and Venezuela). They used two groups of liquidity indices: one with a spread and the other with a price impact. The latter used the ILLIQ indices, Amivest and the Pastor index proposed by Pastor and Stambaugh [25]. The results show that these three indices are close substitutes and that the ILLIQ index is the most effective in some cases.

2.3 Studies focused on developed markets

Several classic studies show that liquidity risk is a factor in stock returns [26], [14], [25]. In a study on the liquidity of the German market from 2006-2010, in which Amihud's ILLIQ index was used, as well as a study based on the prices of quoted funds, it was concluded that periods of illiquidity were compensated with returns, as also confirmed by the relationship between illiquidity and market return [27].

Between 2006-2014, a study using the LCAPM methodology proposed by Acharya & Pedersen [10], which considered a sample of more than 2500 shares listed on NASDAQ, concluded that liquidity risk and liquidity level are not always positively correlated. A negative relationship was also found between return and market illiquidity [28]. Another study based on the Japanese market between 1983 and 2016, which analyzed the LCAPM using different illiquidity proxies: Amihud's ILLIQ, the turnover ratio and "y" developed by Pastor and Stambaugh [25], concludes that the results support the use of LCAPM and that, to a certain extent, liquidity risk is quoted on the Tokyo Stock Exchange [29].A study of the Chinese market performed from 1995-2016 shows that market liquidity and trading activity increase over time [30].

Among the recent studies in developed markets that found evidence of a relationship between return and liquidity risk on 7 developed markets (USA, Japan, Canada, France, Germany, Italy, and United Kingdom), liquidity risk, and abnormal returns [31].

Studies of the North American market for shares listed on the FTSE 100 Index from 2005-2007 found a relationship between the frictions of liquidity risk and share returns [32]. Of shares listed on the New York Stock Exchange from 1993-2005, those who used a new index that even exceeds Amihud's ILLIQ also showed evidence of a relationship between return and liquidity risk [33].Finally, a study on a group of 45 international markets, 19 emerging markets, and 26 developed markets over a period of 22 years, found that the premium for illiquidity is higher in emerging markets than in developed markets, concluding a positive significance of return on liquidity premium in international markets [34].

3. DATA AND METHODOLOGY

3.1 Sample construction

This data was obtained from Economatica and considered shares that had an average presence equal to or greater than 70% from July 1998 to July 2018 in the stock markets of Chile, Mexico, and Peru. For Colombia, the period from August 2002 to July 2018 was considered. Monthly statistics were obtained from this data and are summarized in tables 1 and 2. From these shares, the variables of daily closing price, volume, number of businesses, number of daily securities traded, and number of shares outstanding were selected.

TABLE 1 - AVERAGE MONTHLY RETURNS AND STANDARD DEVIATION

Item	Chile	Mexico	Peru	Colombia
Number of Shares	39	31	19	7
Average	0.83%	0.85%	0.89%	1.13%
Average standard deviation	9.18%	11.07%	11.69%	10.02%

Source: Prepared by the authors.

We chose a total amount of 96 stocks, which met the stock market presence requirements of at least 70% during the analysis period of this investigation.

TABLE 2 - MONTHLY RETURNS AND STANDARD DEVIATION PER SHARE

Share	Country	Return (%)	Standard deviation (%)	Share	Country	Return (%)	Standard deviation (%)	Share	Country	Return (%)	Standard deviation (%)
CUPRUM	Chile	1,62	8,88	FALABELLA	Chile	1,32	7,69	SIMECB	México	0,80	16,33
HABITAT	Chile	1,77	6,84	SM-CHILE B	Chile	1,37	6,64	SORIANAB	México	0,57	9,06
PROVIDA	Chile	1,39	6,48	ORO BLANCO	Chile	1,11	11,29	TLEVISACPO	México	0,70	9,75
AESGENER	Chile	0,60	9,87	SQM-B	Chile	1,48	10,06	AZTECACPO	México	-0,23	13,10
AGUAS-A	Chile	1,15	6,98	CONCHATORO	Chile	0,85	7,53	VITROA	México	0,85	12,50
BANMEDICA	Chile	1,44	7,66	VSPT	Chile	0,60	7,38	WALMEX	México	1,28	7,20
BESALCO	Chile	1,17	12,48	ZOFRI	Chile	1,35	8,46	ALICORC1	Perú	1,38	9,16
CAP	Chile	1,14	14,11	ALFAA	México	0,98	11,95	BVN	Perú	0,62	12,26
CEMENTOS	Chile	0,79	8,55	ALSEA	México	1,41	8,71	CASAGRC1	Perú	0,53	16,25
CENCOSUD	Chile	0,49	6,27	AMXL	México	1,07	6,87	CPACASC1	Perú	1,06	9,51
COLBUN	Chile	0,83	6,74	ARA	México	0,49	9,81	CORAREI1	Perú	0,92	13,78
CCU	Chile	0,97	7,04	AC	México	1,08	6,04	BAP	Perú	1,37	9,48
VAPORES	Chile	0,66	12,17	ASURB	México	1,53	8,47%	BROCALC1	Perú	0,30	16,51
ANDINA-A	Chile	0,63	7,69	AUTLANB	México	0,69	20,26	ENGEPEC1	Perú	1,12	7,63
ANDINA-B	Chile	0,76	7,59	BACHOCOB	México	1,25	8,53	FERREYC1	Perú	0,84	11,01
ENTEL	Chile	0,98	7,68	BIMBOA	México	0,94	7,90	GRAMONC1	Perú	0,61	14,79
CMPC	Chile	1,05	7,00	GCC	México	1,22	8,65	LUSURC1	Perú	1,46	6,28
COPEC	Chile	1,13	6,96	CEMEXCPO	México	0,51	11,63	MILPOC1	Perú	1,35	11,12
IANSA	Chile	-0,23	12,92	KOFL	México	0,94	8,39	MINSURI1	Perú	0,85	11,70

NUEVAPOLAR	Chile	-1,00	14,74	ELEKTRA	México	1,56	15,51	RELAPAC1	Perú	-0,31	12,17
ENELAM	Chile	0,16	7,89	FEMSAUBD	México	1,60	8,03	CVERDEC1	Perú	1,93	13,49
ENELGXCH	Chile	0,83	7,43	GCARSOA1	México	1,28	8,81	TELEFBC1	Perú	-0,27	13,38
ECL	Chile	1,24	11,24	GEOB	México	-1,16	21,03	BACKUSI1	Perú	1,75	7,90
GASCO	Chile	1,07	8,07	GMEXICOB	México	1,54	11,87	UNACEMC1	Perú	0,45	8,51
SECURITY	Chile	1,20	6,90	GRUMAB	México	1,13	12,38	VOLCABC1	Perú	0,90	17,15
INVERCAP	Chile	1,06	14,97	KUOB	México	0,55	10,06	CEMARGOS	Colombia	1,64	9,56
INVEXANS	Chile	-1,22	12,27	ICHB	México	0,96	11,30	ETB	Colombia	0,19	8,22
LTM	Chile	1,12	11,06	KIMBERA	México	0,92	6,98	EXITO	Colombia	1,09	9,59
MASISA	Chile	0,03	11,31	MEXCHEM	México	1,91	10,46	ISA	Colombia	1,42	6,64
NORTEGRAN	Chile	0,59	12,98	PE&OLES	México	1,23	13,00	MINEROS	Colombia	2,01	10,32
PARAUCO	Chile	1,17	7,53	PINFRA	México	0,88	16,31	NUTRESA	Colombia	1,47	8,78
QUINENCO	Chile	0,94	8,72	SAREB	México	-2,10	12,16	FABRICATO	Colombia	0,11	17,03

Source: Prepared by the authors.

3.2 Liquidity Measures

(1) There are countless liquidity measures that have appeared in the literature over the past 30 years. They can be separated into three main groups: transaction cost, trading activity and price impact. One of the classifications of liquidity indices is proposed by Aitken and Comerton-Forde [6], who separate the indices into two groups: one based on trading activity and the other on transaction orders .This research was based on measures constructed with transaction data, since good quality price range data was difficult to find or unavailable for emerging markets. Four widely used measures were analyzed as well as two that were recently proposed by Vásquez, Pape, and Ireta [18]:Turnover Ratio, proposed by Datar, Naik, and Radcliffe [14], corresponds to an index that estimates the value of the shares traded, divided by the market capitalization value for the period analyzed. It is also known as asset rotation.

(2) Amihud's measure of illiquidity (ILLIQ) [35] is a measure of approximation to liquidity that represents the price variation of a traded currency unit. The illiquidity ratio of an asset *i* in month *t* can be calculated:

$$ILLIQ_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_i} \frac{|R_{itd}|}{V_{itd}} \tag{1}$$

where R_{itd} and V_{itd} are the return and trading volume of asset i on day d of month t respectively, and D_{it} is the number of days the share is negotiated within month *t*. This index or measure is multiplied by 10^6. The economic significance of this measure is based on the fact that an asset is illiquid and therefore its measure reaches a high value if the price of the the asset experiences a high fluctuation in response to a reduced volume [36].

(3) The illiquidity ratio by turnover ratio proposed by Vásquez, Pape and Ireta [18], represents the absolute return of the price produced by a turnover ratio percentage. The illiquidity ratio of an asset *i* in month t can be calculated:

$$ILLIQTRN_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_i} \frac{|R_{itd}|}{TRN_{itd}} \tag{2}$$

where R_{itd} and TRN_{itd} are the return and turnover ratio of asset *i* on day d of month *t* respectively, and D_{it} is the number of days the share is negotiated within month *t*. In other words, the higher the ratio, the less liquid the asset must be, since a change in the TRN results in a greater change in return. This proposal is based on the measure proposed by Amihud [13] and the conclusion of the Gniadkowska-Szymansca [9] study that the turnover measure does not affect return in the Polish market.

The illiquidity ratio for the number of businesses (*NN*) proposed by Vásquez, Pape and Ireta [18], represents the absolute return of the price it produces for a business (a transaction). The illiquidity ratio of an asset *i* in month t can be calculated:

$$ILLIQNN_{it} = \frac{1}{D_{it}} \sum_{d=1}^{D_i} \frac{|R_{itd}|}{NN_{itd}} \tag{3}$$

where R_{itd} and NN_{itd} are the return and the number of businesses of asset *i* on day d of month *t*, respectively, and D_{it} is the number of days the share is negotiated within month t. In other words, the higher the ratio, the less liquid the asset must be, since a change in the number of businesses results in a greater change in returns. This index or measure was multiplied by 10^3. This proposal is based on the measure proposed by Amihud Y [13] and the conclusion of the Gniadkowska-Szymańsca [9] study, which indicates that the number of transactions in Baltic markets and share returns are statistically significant.

(4) The ZRR was initially introduced by Lesmond, Ogden, and Trzcinka [37] and in our study, we estimated it as the number of days with zero return divided by the number of days with a transaction during the period.

3.3 Methodology

This study was descriptive, correlational, non-experimental, and longitudinal, because it considered data from July 1998 to July 2018 for Chile, Mexico, and Peru, and from August 2002 to July 2018 for Colombia. The observation variables were the monthly yields of the shares traded on the main stock exchanges of Chile, Colombia, Mexico, and Peru and their liquidity measures.

The shares are grouped into three portfolios from higher to lower average returns over the period (table 3), with the aim of determining the differences in the impact of liquidity at different levels of return. To achieve this objective, the study focused on Portfolio 1 with the highest returns and on Portfolio 3 with the lowest returns. For the selected portfolios, monthly statistics were estimated and monthly liquidity risk indicators were constructed from the indices in the previous section. Portfolios 2 with medium profitability will not be included in the final analysis so as to check the relationship of a portfolio with a high and another with low profitability with liquidity risk. Portfolios 1 and 2 will be made up of 13, 3, 10, and 6 shares respectively for Chile, Colombia, Mexico, and Peru.

TABLE 3 - PORTFOLIO COMPOSITION BY COUNTRY

CHILE	
Porfolio 1	**Porfolio 3**
HABITAT	CEMENTOS
CUPRUM	ANDINA-B
SQM-B	ANDINA-A
BANMEDICA	VSPT
PROVIDA	AESGENER
SM-CHILE B	NORTEGRAN
ZOFRI	CENCOSUD
FALABELLA	ENELAM
ECL	MASISA
SECURITY	IANSA
PARAUCO	VAPORES
BESALCO	NUEVAPOLAR
AGUAS-A	INVEXANS
COLOMBIA	
Porfolio 1	**Porfolio 3**
MINEROS	EXITO
CEMARGOS	ETB
NUTRESA	FABRICATO
MEXICO	
Porfolio 1	**Porfolio 3**
MEXCHEM	SIMECB
FEMSAUBD	TLEVISACPO
ELEKTRA	AUTLANB
GMEXICOB	SORIANAB
ASURB	KUOB
ALSEA	CEMEXCPO
GCARSOA1	ARA
WALMEX	AZTECACPO
BACHOCOB	GEOB
PE&OLES	SAREB
PERU	
Porfolio 1	**Porfolio 3**
CVERDEC1	GRAMONC1
BACKUSI1	CASAGRC1
LUSURC1	UNACEMC1
ALICORC1	BROCALC1

BAP	TELEFBC1
MILPOC1	RELAPAC1

Source: Prepared by the authors.

The objective of this study was to determine whether or not there is a relationship between the liquidity and stock return of the companies listed in these four Latin American stock markets. According to the available data, a regression model following the methodology of Leirvik, Fiskerstrand, & Fjellvikas [15], who uses this model to evaluate the relationship between equity profitability and liquidity risk in Norway, an economy that, despite being developed in size, is very similar to the Latin American ones. The model contained a dependent variable that represented the share return and two independent variables: the monthly return of the market portfolio and the liquidity indicator.

$$r_{i,t} = \alpha + \beta_1 r_{m,t} + \beta_2 LIQ_{i,t} + \varepsilon_T \quad (4)$$

where $r_{i,t}$ is the monthly return of month t of action i, β_1 is the beta of market return, $r_{m,t}$ is the return of the market in month t, β_2 is the beta of the liquidity index, $LIQ_{i,t}$ is the liquidity index of asset i in the month t and ε is the error of the model. We used a stock index representative of each country as a proxy for market return; IPSA for Chile, COLPAP for Colombia, MEXBOL for Mexico and SPBLPGPT for Peru.

Several tests will be carried out for these types of regression models, presenting the results in the results tables. Amongst them to assess the specification of the model, heteroscedasticity, self-relationship, normality of errors, among others.

4. RESULTS

Table 4 describes the monthly statistics for the different variables. Tables 5, 6, 7 and 8 show a good fit for all of the models, the generally high R2s, most of the Durbin-Watson statistic close to 2, all "F" tests were significant and the condition indices were less than 30; the latter indicated that there were no autocorrelation or multicollinearity problems. The above represents a good overall fit of the models.

TABLE 4 – MONTHLY DESCRIPTIVE STATISTICS BY VARIABLE, PORTFOLIO AND COUNTRY

Chile										
	Portafolio 1 (Ch1)					**Portafolio 3 (Ch3)**				
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Rm	241	0,01	0,05	-0,35	0,15	241	0,01	0,05	-0,35	0,15
Rmes	241	0,01	0,05	-0,25	0,25	241	0,00	0,06	-0,28	0,21
ILLIQ	241	0,08	0,23	0,00	2,58	241	0,06	0,16	0,00	1,67
TRN	241	0,67	6,38	0,01	99,28	241	0,02	0,02	0,00	0,08
ILLIQTRN	241	24,47	169,74	0,54	2.619,08	241	12,05	32,89	0,52	304,74
ILLIQNN	241	0,05	0,08	-	0,69	241	0,05	0,09	-	1,14
ZR	241	0,32	0,13	0,10	0,62	241	0,26	0,09	0,04	0,53
Colombia										
	Portafolio 1 (Col1)					**Portafolio 3 (Col3)**				
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Rm	192	0,01	0,06	-0,21	0,16	192	0,01	0,06	-0,21	0,16
Rmes	192	0,02	0,06	-0,15	0,25	192	0,00	0,09	-0,46	0,26
ILLIQ	192	0,00	0,01	0,00	0,07	192	0,00	0,01	0,00	0,11
TRN	192	0,01	0,00	0,00	0,03	192	0,81	1,29	0,00	9,13

ILLIQTRN	192	7,07	5,15	1,15	32,31	192	5,20	7,07	0,00	54,49
ILLIQNN	192	0,05	0,05	0,01	0,38	192	0,05	0,08	0,00	0,75
ZR	192	0,28	0,12	0,05	0,68	192	0,31	0,14	0,03	0,73
Mexico										
Portafolio 1 (Mx1)						**Portafolio 3 (Mx3)**				
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Rm	241	0,01	0,06	-0,35	0,18	241	0,01	0,06	-0,35	0,18
Rmes	241	0,01	0,05	-0,25	0,28	241	0,01	0,07	-0,38	0,20
ILLIQ	241	4,98	19,52	0,02	190,36	241	3,12	15,58	0,02	171,82
TRN	241	0,03	0,02	0,01	0,15	241	0,02	0,01	0,01	0,05
ILLIQTRN	241	15,09	67,22	0,41	904,95	241	20,75	112,00	0,94	1.229,22
ILLIQNN	241	0,16	0,38	0,00	4,12	241	0,06	0,17	0,00	1,83
ZR	241	0,23	0,17	0,01	0,62	241	0,18	0,14	0,00	0,56
Peru										
Portafolio 1 (Pe1)						**Portafolio 3 (Pe3)**				
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Rm	241	0,01	0,08	-0,47	0,33	241	0,01	0,08	-0,47	0,33
Rmes	241	0,02	0,06	-0,34	0,20	241	0,00	0,09	-0,43	0,27
ILLIQ	241	115,24	598,27	0,45	6.428,98	241	35,39	132,03	0,97	1.238,91
TRN	241	0,01	0,01	0,00	0,17	241	0,03	0,08	0,00	0,77
ILLIQTRN	241	30,42	68,70	0,40	830,42	241	29,30	54,84	0,51	721,29
ILLIQNN	241	0,41	2,17	0,02	31,71	241	0,36	1,45	0,02	19,70
ZR	241	0,40	0,13	0,19	0,74	241	0,45	0,16	0,17	0,83

Rm corresponds to the return of the market and R(month) is the average return of the shares that make up the sample.
Source: Prepared by the authors.

The results of the Ramsey reset test show that, in general, the models are well specified, except for Portfolio 1 in Mexico and Peru. No autocorrelation is seen in the models using the Durbin Watson and Breusch-Godfrey tests, except for Mexico in portfolio 3. Several models showed the presence of heteroscedasticity, which is corrected with White's adjustment (major errors) shown in Table 9. We also carried out normality tests of the errors with the Shapiro-Wilk test.

TABLE 5 - RESULTS FOR CHILE OF THE MODELS WITH THE DEPENDENT VARIABLE "PORTFOLIO RETURN"

Variable		Ch1_ILLIQ	Ch1_TRN	Ch1_ILLIQTRN	Ch1_ILLIQNN	Ch1_ZR	Ch3_ILLIQ	Ch3_TRN	Ch3_ILLIQTRN	Ch3_ILLIQNN	Ch3_ZR
Rm		0,78543041***	0,77668752***	0,77855081***	0,77924542***	0,77507331***	0,96758123***	0,96717694***	0,96515915***	0,96764299***	0,96526942***
ILLIQ		-0,02227191**					-0,03452718**				
TRN			0,00007241					0,14905447			
ILLIQTRN				-0,00001817					-,00014823*		
ILLIQNN					-,06531537**					-0,04168631	
ZR						-,03606373*					-0,03706036
_cons		,00927094***	,00760804***	,00808689***	,01069495***	,01919101***	-0,00411875	-,00955294**	-,00440293*	-0,00420143	0,00357943
N		241	241	241	241	241	241	241	241	241	241
r2		0,6587611	0,64809203	0,65186345	0,65796408	0,65644378	0,72428981	0,71745094	0,72276889	0,7202844	0,7192008
r2_a		0,65589354	0,64513482	0,64893793	0,65508983	0,65355675	0,72197291	0,71507657	0,72043922	0,71793385	0,71684115
F		229,72929	219,15659	222,8199	228,91668	227,37708	312,61262	302,16579	310,24476	306,43212	304,79039
Ramsey RESET	F	0,45	0,44	0,43	0,42	0,7	3,41	3,63	3,27	3,36	3,7
	Prob	0,7157	0,7247	0,7345	0,7423	0,552	0,0182	0,0137	0,0219	0,0196	0,0124
Durbin-Watson		2,031316	1,989431	2,011375	2,013856	1,982902	2,008005	2,026911	2,019409	2,020097	1,993503
Breusch-Godfrey	F	0,209	0,032	0,09	0,117	0,017	0,095	0,211	0,381	0,327	0,112
	Prob	0,648	0,8587	0,764	0,7324	0,8964	0,7584	0,6466	0,5376	0,5683	0,7386
White's test	chi2	19,81	14,69	16,52	15,96	10,35	9,39	15,33	8,91	8,6	10,8
	Prob	0,0014	0,0118	0,0055	0,007	0,066	0,0945	0,009	0,1128	0,1261	0,0556
Breusch-Pagan	chi2	8,11	12,13	12,1	16,73	7,61	1,21	1,73	1,38	0,51	2,5
	Prob	0,0044	0,0005	0,0005	0	0,0058	0,2715	0,189	0,24	0,4736	0,114
Shapiro-Wilk		0,00001	0,00001	0,00001	0	0,00001	0,00399	0,00534	0,00657	0,00237	0,00405

* p<0.05; ** p<0.01; *** p<0.001

Source: Prepared by the authors.

TABLE 6 - RESULTS FOR COLOMBIA OF THE MODELS WITH THE DEPENDENT VARIABLE "PORTFOLIO RETURN"

Variable		Col1_ILLIQ	Col1_TRN	Col1_ILLIQTRN	Col1_ILLIQNN	Col1_ZR	Col3_ILLIQ	Col3_TRN	Col3_ILLIQTRN	Col3_ILLIQNN	Col3_ZR
Rm		0,83552521***	0,80548118***	0,83629702***	0,84015219***	0,84372032***	0,79781333***	0,80072311***	0,81097252***	0,79625536***	0,81296303***
ILLIQ		0,64588908					-0,82375775				
TRN			2,435925***					0,00938373*			
ILLIQTRN				-0,00022699					-0,00029671		
ILLIQNN					,1088414*					-0,09092874	
ZR						-0,00904187					-0,03041348
_cons		0,00411619	-0,00709415	0,0079973	0,00098101	0,00886434	-0,00185774	-,01353455*	-0,00455889	-0,0014642	0,00320238
N		192	192	192	192	192	192	192	192	192	192
r2		0,6596956	0,67549065	0,65428841	0,66113215	0,65427661	0,34211711	0,35195255	0,33270629	0,33881603	0,33475928
r2_a		0,65609449	0,67205669	0,65063009	0,65754625	0,65061816	0,33515539	0,34509491	0,32564498	0,33181937	0,3277197
F		183,19256	196,70887	178,84924	184,36978	178,83991	49,142587	51,322656	47,1168	48,425425	47,553843
Ramsey RESET test	**F**	2,31	0,84	2,36	1,97	2,54	0,22	0,34	0,02	0,08	0,13
	Prob	0,0782	0,4714	0,0726	0,12	0,058	0,8825	0,7952	0,9948	0,9694	0,9435
Durbin-Watson		1,802432	1,977739	1,804919	1,806772	1,798344	1,752382	1,748263	1,707355	1,723189	1,708392
Breusch-Godfrey	**F**	1,831	0,023	1,822	1,776	1,948	1,837	2,191	3,19	2,729	3,026
	Prob	0,1777	0,8793	0,1788	0,1843	0,1644	0,1769	0,1405	0,0757	0,1002	0,0836
White's test	**chi2**	26,44	22,85	24,38	26,84	30,15	9,09	2,57	1,3	8,83	4,52
	Prob	0,0001	0,0004	0,0002	0,0001	0	0,1057	0,7656	0,935	0,116	0,4777
Breusch-Pagan	**chi2**	10,15	16,04	10,84	10,26	10,29	2,41	0,25	0,74	1,77	0,98
	Prob	0,0014	0,0001	0,001	0,0014	0,0013	0,1207	0,6194	0,3905	0,1835	0,3214
Shapiro-Wilk		0,00074	0,02165	0,00079	0,00069	0,001	0	0	0	0	0

* p<0.05; ** p<0.01; *** p<0.001

Source: Prepared by the authors.

TABLE 7 - RESULTS FOR MEXICO OF THE MODELS WITH THE DEPENDENT VARIABLE "PORTFOLIO RETURN"

Variable		Mx1_ILLIQ	Mx1_TRN	Mx1_ILLIQTRN	Mx1_ILLIQNN	Mx1_ZR	Mx3_ILLIQ	Mx3_TRN	Mx3_ILLIQTRN	Mx3_ILLIQNN	Mx3_ZR
Rm		0,64836036***	0,65255824***	0,65363932***	0,65435141***	0,65303929***	0,94382074***	0,93641571***	0,94328056***	0,94379239***	,94488277***
ILLIQ		-0,00015884					-0,00007154				
TRN			-0,01352936					0,46775092			
ILLIQTRN				-0,00003634					-3,987E-08		
ILLIQNN					-,02352712***					-0,00508261	
ZR						-,03556101*					-0,0187611
_cons		0,00484692	0,00447515	0,00455019	,0077446**	,01224061**	-0,00348407	-,01300282*	-0,00370128	-0,00340259	-0,00036854
N		241	241	241	241	241	241	241	241	241	241
r2		0,52639071	0,52318212	0,52517195	0,55081092	0,53574877	0,70889161	0,71151225	0,70862077	0,70878889	0,71017909
r2_a		0,5224108	0,51917525	0,5211818	0,54703622	0,5318475	0,70644532	0,70908798	0,70617221	0,70634174	0,70774362
F		132,26196	130,57118	131,61704	145,92184	137,32673	289,78245	293,49585	289,40248	289,63826	291,5984
Ramsey RESET test	**F**	5,68	7,61	7,25	3,75	3,08	1,52	2,24	1,56	1,52	1,2
	Prob	0,0009	0,0001	0,0001	0,0117	0,0282	0,2089	0,0838	0,1996	0,2111	0,3088
Durbin-Watson		1,73064	1,67802	1,692148	1,835333	1,733059	1,858792	1,858573	1,852397	1,860323	1,871133
Breusch-Godfrey	**F**	4,307	6,104	5,604	1,53	4,193	1,137	1,161	1,245	1,113	0,934
	Prob	0,039	0,0142	0,0187	0,2173	0,0417	0,2874	0,2824	0,2656	0,2926	0,3349
White's test	**chi2**	8,5	14,52	7,65	6,38	9,22	1,92	4,33	1,42	12,61	3,63
	Prob	0,131	0,0126	0,1768	0,2706	0,1005	0,8603	0,5032	0,9216	0,0273	0,6032
Breusch-Pagan	**chi2**	1,11	2,98	3,21	0,01	0,11	0,12	0,04	0,13	0,09	0,01
	Prob	0,2928	0,0845	0,0731	0,9171	0,7413	0,7301	0,8408	0,7178	0,7612	0,9229
Shapiro-Wilk		0	0	0	0	0	0,01077	0,01114	0,01034	0,00788	0,00379

* p<0.05; ** p<0.01; *** p<0.001

Source: Prepared by the authors.

TABLE 8 - RESULTS FOR PERU OF THE MODELS WITH THE DEPENDENT VARIABLE "PORTFOLIO RETURN"

Variable		Pe1_ILLIQ	Pe1_TRN	Pe1_ILLIQTRN	Pe1_ILLIQNN	Pe1_ZR	Pe3_ILLIQ	Pe3_TRN	Pe3_ILLIQTRN	Pe3_ILLIQNN	Pe3_ZR
Rm		0,64025352***	0,64031352***	064025366***	0,63885914***	0,63646107***	0,84478812***	0,83693779***	0,84450527***	0,846183***	0,84560362***
ILLIQ		-0,000002864					-0,00008308***				
TRN			0,03358699					0,06356914			
ILLIQTRN				-0,00001024					-0,00012186*		
ILLIQNN					-0,00102571					-,005149*	
ZR						-,03842953*					-,0434506*
_cons		0,00901579***	0,00841281***	,0089971***	,00911834***	,02418853***	-0,00370013	-,00864684*	-0,00306592	-0,00479331	0,01297781
N		241	241	241	241	241	241	241	241	241	241
r2		0,71495993	0,71427763	0,7143417	0,71546853	0,72057908	0,69060187	0,67762707	0,68023049	0,68176044	0,6803517
r2_a		0,71256463	0,71187661	0,71194121	0,71307751	0,71823101	0,68800189	0,67491806	0,67754335	0,67908616	0,67766558
F		298,48516	297,48822	297,58163	299,23142	306,88079	265,61771	250,1377	253,14305	254,93214	253,28416
Ramsey RESET test	**F**	9,28	9,28	9,23	9,23	9,23	2,59	2,09	2,22	2,72	2,7
	Prob	0	0	0	0	0	0,0537	0,1017	0,0866	0,0451	0,0467
Durbin-Watson		2,034212	2,028557	2,030529	2,036552	2,049029	2,024984	1,969943	2,008754	2,000131	2,00894
Breusch-Godfrey	**F**	0,073	0,051	0,058	0,083	0,149	0,054	0,03	0,015	0,005	0,017
	Prob	0,7878	0,8214	0,8097	0,7734	0,6995	0,8166	0,8619	0,9031	0,9442	0,8963
White's test	**chi2**	25,3	28	29,13	24,83	26,65	7,86	6,04	16,59	32,35	8,16
	Prob	0,0001	0	0	0,0002	0,0001	0,1641	0,3021	0,0054	0	0,1475
Breusch-Pagan	**chi2**	7,03	6,56	6,5	6,77	5,43	3,4	4,01	4,49	2,66	1,8
	Prob	0,008	0,0104	0,0108	0,0093	0,0198	0,0654	0,0452	0,0342	0,1026	0,1797
Shapiro-Wilk		0,00939	0,01058	0,01135	0,00918	0,00897	0,01308	0,01041	0,01077	0,00993	0,00878

* p<0.05; ** p<0.01; *** p<0.001

Source: Prepared by the authors.

TABLE 9 - RESULTS OF THE MODELS WITH SETTING WHITE (ROBUST STD. ERR.) AND WITH THE DEPENDENT VARIABLE "PORTFOLIO RETURN"

Variable	Ch1_ILLIQ	Ch1_TRN	Ch1_ILLIQTRN	Ch1_ILLIQNN	Ch1_ZR	Ch3_ILLIQ	Ch3_TRN	Ch3_ILLIQTRN	Ch3_ILLIQNN	Ch3_ZR
Rm	0,78543041***	0,77668752***	0,77855081***	0,77924542***	0,77507331***	0,96758123***	0,96717694***	0,96515915***	0,96764299***	0,96526942***
ILLIQ	-0,02227191					-0,03452718***				
TRN		0,00007241					0,14905447			
ILLIQTRN			-0,00001817***					-,00014823*		
ILLIQNN				-0,06531537***					-,04168631*	
ZR					-0,03606373*					-0,03706036
_cons	0,00927094***	0,00760804***	0,00808689***	0,01069495***	,01919101***	-0,00411875	-0,00955294*	-0,00440293*	-0,00420143	0,00357943
N	241	241	241	241	241	241	241	241	241	241
r2	0,6587611	0,64809203	0,65186345	0,65796408	0,65644378	0,72428981	0,71745094	0,72276889	0,7202844	0,7192008
r2_a	0,65589354	0,64513482	0,64893793	0,65508983	0,65355675	0,72197291	0,71507657	0,72043922	0,71793385	0,71684115
F	166,30898	157,44531	168,14809	162,84779	161,90476	159,02406	142,19968	150,13438	158,36345	140,16336
Variable	Col1_ILLIQ	Col1_TRN	Col1_ILLIQTRN	Col1_ILLIQNN	Col1_ZR	Col3_ILLIQ	Col3_TRN	Col3_ILLIQTRN	Col3_ILLIQNN	Col3_ZR
Rm	0,83552521***	0,80548118***	0,83629702***	0,84015219***	0,84372032***	0,79781333***	0,80072311***	0,81097252***	0,79625536***	0,81296303***
ILLIQ	0,64588908					-0,82375775				
TRN		2,435925**					0,00938373			
ILLIQTRN			-0,00022699					-0,00029671		
ILLIQNN				0,1088414					-0,09092874	
ZR					-0,00904187					-0,03041348
_cons	0,00411619	-0,00709415	0,0079973	0,00098101	0,00886434	-0,00185774	-,01353455*	-0,00455889	-0,0014642	0,00320238
N	192	192	192	192	192	192	192	192	192	192
r2	0,6596956	0,67549065	0,65428841	0,66113215	0,65427661	0,34211711	0,35195255	0,33270629	0,33881603	0,33475928
r2_a	0,65609449	0,67205669	0,65063009	0,65754625	0,65061816	0,33515539	0,34509491	0,32564498	0,33181937	0,3277197
F	102,07844	143,54103	99,460657	98,783632	101,66407	40,347982	40,077172	39,304604	39,753776	39,949384
Variable	Mx1_ILLIQ	Mx1_TRN	Mx1_ILLIQTRN	Mx1_ILLIQNN	Mx1_ZR	Mx3_ILLIQ	Mx3_TRN	Mx3_ILLIQTRN	Mx3_ILLIQNN	Mx3_ZR
Rm	,64836036***	,65255824***	,65363932***	,65435141***	,65303929***	,94382074***	,93641571***	,94328056***	,94379239***	,94488277***
ILLIQ	-0,00015884					-0,00007154				
TRN		-0,01352936					0,46775092			

ILLIQTRN			-0,00003634*					-3,987E-08		
ILLIQNN				-,02352712**					-0,00508261	
ZR					-,03556101*					-0,0187611
_cons	0,00484692	0,00447515	0,00455019	,0077446**	,01224061***	-0,00348407	-,01300282*	-0,00370128	-0,00340259	-0,00036854
N	241	241	241	241	241	241	241	241	241	241
r2	0,52639071	0,52318212	0,52517195	0,55081092	0,53574877	0,70889161	0,71151225	0,70862077	0,70878889	0,71017909
r2_a	0,5224108	0,51917525	0,5211818	0,54703622	0,5318475	0,70644532	0,70908798	0,70617221	0,70634174	0,70774362
F	61,507468	60,239882	60,136488	68,312346	63,981129	237,67123	216,64381	242,96565	240,21801	240,60595
Variable	**Pe1_ILLIQ**	**Pe1_TRN**	**Pe1_ILLIQTRN**	**Pe1_ILLIQNN**	**Pe1_ZR**	**Pe3_ILLIQ**	**Pe3_TRN**	**Pe3_ILLIQTRN**	**Pe3_ILLIQNN**	**Pe3_ZR**
Rm	0,64025352***	0,64031352***	0,64025366***	0,63885914***	0,63646107***	0,84478812***	0,83693779***	0,84450527***	0,846183***	0,84560362***
ILLIQ	-0,000002864					-,00008308**				
TRN		0,03358699					0,06356914			
ILLIQTRN			-0,00001024					-,00012186*		
ILLIQNN				-0,00102571**					-0,005149	
ZR					-0,03842953**					-0,0434506*
_cons	0,00901579***	0,00841281***	0,0089971***	0,00911834***	0,02418853***	-0,00370013	-0,00864684*	-0,00306592	-0,00479331	0,01297781
N	241	241	241	241	241	241	241	241	241	241
r2	0,71495993	0,71427763	0,7143417	0,71546853	0,72057908	0,69060187	0,67762707	0,68023049	0,68176044	0,6803517
r2_a	0,71256463	0,71187661	0,71194121	0,71307751	0,71823101	0,68800189	0,67491806	0,67754335	0,67908616	0,67766558
F	133,82078	135,24845	144,15884	162,63603	140,11885	184,7777	179,64419	187,49843	181,208	176,45097
* p<0.05; ** p<0.01; *** p<0.001										

Source: Prepared by the authors.

Table 5 and 9 demonstrates that in the case of Chile, the turnover (TRN) was not significant for portfolio 1 and 3, whereas for both portfolios, the beta of ILLITRN were negative and significant at 99% and 95%, respectively. This is consistent with the inverse expected relationship between return and liquidity risk. In the case of the ILLIQ is only significant in portfolio 3, while for portfolio 1, the ILLIQNN and ZR measures were also significant.

In the case of Colombia (Table 7), the turnover was positive and significant (portafolio 1), which indicates that the Colombian market rewards greater liquidity of assets. The ILLIQ, ILLIQTRN, ILLIQNN and ZR were not significant. These results may be influenced by the low number of shares of each portfolio. The low number of actions that met the requirements lead us to be cautious with these results.

In Mexico (Table 7), almost all the indicators were not significant, except in the most profitable portfolio, the ILLIQNN and ZR indices, which resulted in negative and significant betas at 99% and 95%, respectively. This shows the expected relationship between return and liquidity risk.
The Table 8 and 9 shows the results for Peru. In the case of the most profitable portfolio (1), the ILLIQNN and ZRR measures were negative and significant. In the case of the least profitable portfolio, only the ZR index had not significant beta. This suggests that the Peruvian market liquidity risk is relevant in the case of less profitable investments (portfolios).

5. CONCLUSIONS

This study analyzed the relationship of liquidity risk on return in 96 shares of companies that trade on stock exchanges in Latin America (Chile, Colombia, Mexico, and Peru) within the period from January 1998 to July 2018. Five liquidity risk measures were used: three of which were widely used in previous studies and two that were recently proposed. The results with the turnover ratio in three out of four countries were not significant, with the exception of Colombia, which is consistent with the conclusion of Lesmond [38], that it is not a viable method for measuring liquidity in emerging markets, and Zhao [39], that it does not efficiently measure liquidity in the Chinese stock market. The foregoing is contrary to what Datar, Naik, & Radcliffe [14] indicated, who found a negative relationship between return and turnover.

The ILLIQ measure [13] does not present good results, opposite to expectations due to the good results of this measure in studies in other markets. In relation to the proposed ILLIQTRN and ILLIQNN measures [18], the former was significant in the lower-yielding portfolios in Chile and Peru, it was also significant in Chile's high-profitability portfolio. The second one (ILLIQNN) was significant in the high-yield portfolios of Chile, Mexico, and Peru, and the low-yield portfolio of Peru.

The ZR measure turned out to be significant in the Chilean, Mexico and Peruvian portfolios in the most profitable portfolio. In both portfolios of high and low profitability of Peru, this measure was significant. However, the ZR did not show good results in the other countries under study.

All the indices that were statistically significant in Chile, Mexico, and Peru showed an inverse relationship with return, which is consistent with the theory. In Colombia on the other hand, a mostly direct relationship was observed, which indicates the need to perform new tests with a larger sample.

The new proposal by Vásquez-Tejos et al., [18], ILLIQTRN and ILLIQNN, were the best performers. However, in terms of which index best captures the relationship between return and liquidity risk, the results of the present study are consistent with [17] and [40], which indicate that liquidity is multidimensional, that it can be measured by different indices, and that they will adapt differently in markets with different microstructures. Therefore, this question will remain open for future research. Considering that the ILLIQ and ILLIQNN measures delivered statistically significant results in several portfolios in different Latin American countries when applied to the Leirvik, Fiskerstrand, and Fjellvikas model [15], we can conclude that liquidity risk has an impact on shareholder return in the Latin American market. The original hypothesis is therefore accepted. This is consistent with other studies in emerging markets where there is evidence that returns increase with liquidity risk [12], [11]. In studies on developed markets, similar conclusions can be found for the German market [28], the American NASDAQ [27], the Indian market [16], and in the market of the G7 countries [31]. A future line of research should construct a price range using indicators with information from the stock supply and demand book. This study's limitations included restricted access to databases of this type, so another option for future studies is to analyze of the resilience of stock prices or portfolios as a proxy for liquidity.

6. BIBLIOGRAPHY

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