JEL Classification: G10, G12, G14, C52
УДК 336.76

Т. БОУЧАДДЕХ
(Інститут менеджменту в місті Габес, м. Габес, Республіка Туніс)

А. БОУРІ
(Університет міста Сфакс, м. Сфакс, Республіка Туніс)

М. НОУАІЛІ
(Інститут менеджменту в місті Габес, м. Габес, Республіка Туніс)

Ціноутворення активів та можливість торгівлі на основі інформації: застосування на фондовому ринку Тунісу

У статті розглядається вплив приватної інформації на ціноутворення активів. Основною перешкодою, яка виникає при використанні моделі ціноутворення активів (CAPM) з приватною інформацією, є відсутність спостережуваних змінних, які безпосередньо вимірюють особисту інформація. Наукова література містить досить багато моделей оцінки приватної інформації. Значний внесок в дослідження цих питань, який став вагомим кроком уперед, здійснили Еаслей, Кіефер, О'Гара і Паперман (1996). Вони вважають, що приватну інформацію можна оцінити на основі інформації з торгів (PIN).

Дане дослідження стосується вибірки з 40 котирувань цінних паперів на фінансовому ринку Тунісу за період з 2 січня 2010 року до 31 грудня 2014 року, що надає переконливості отриманим результатам. По-перше, автори показують існування зміщення у ціноутворенні активів у порівнянні зі стандартною моделлю ціноутворення активів – CAPM. По-друге, виявлено тісний зв'язок між приватною інформацією (PIN), розширенням, поверненням на ринок покупців і продавців. Це узгоджується з ідеєю PIN щодо розширення можливості інформаційно-орієнтованої торгівлі. Нарешті, дієвість PIN як міри приватної інформації мотивувало авторів, щоб перевірити правильність моделі ціноутворення активів – CAPM.

Ключові слова: *Можливість торгівлі на основі інформації, ціноутворення активів, вартість приватної інформації, бід-аск спред, покупці та продавці угод.*

Т. БОУЧАДДЕХ
(Институт менеджмента в городе Габес, г. Габес, Республика Тунис)

А. БОУРИ
(Университет города Сфакс, г. Сфакс, Республика Тунис)

М. НОУАИЛИ
(Институт менеджмента в городе Габес, г. Габес, Республика Тунис)

Ценообразование активов и возможность торговли на основе информации: применение на фондовом рынке Туниса

В статье рассматривается влияние частной информации на ценообразование активов. Основным препятствием, которое возникает при использовании модели ценообразования активов (CAPM) с частной информацией, является отсутствие наблюдаемых переменных, которые непосредственно измеряют частную информацию. Научная литература содержит достаточно много моделей оценки частной информации. Значительный вклад в исследование этих вопросов, который стал весомым шагом вперед, осуществили Еаслей, Киефер, О'Хара и Паперман (1996). Они считают, что частную информацию можно оценить на основе информации с торгов (PIN).

Данное исследование касается выборки из 40 котировок ценных бумаг на финансовом рынке Туниса за период со 2 января 2010 года по 31 декабря 2014 года, что придает убедительности полученным результатам. Во-первых, авторы показывают существование смещение в ценообразовании активов по сравнению со *стандартной моделью ценообразования активов - CAPM. Во-вторых, выявлена тесная связь между частной информации (PIN), расширением, возвращением на рынок покупателей и продавцов. Это соответствует идее PIN по расширению возможности информационно-ориентированной торговли. Наконец, действенность PIN как меры частной информации мотивировало авторов, чтобы проверить правильность модели ценообразования активов - CAPM.*

Ключевые слова: *Возможность торговли на основе информации, ценообразования активов, стоимость частной информации, бед-аск спрэд, покупатели и продавцы соглашений.*

Tarek BOUCHADDEKH
(Institute of Management of Gabes, Gabes, Tunisia)

Abdelfatteh BOURI
(University of Sfax, Sfax, Tunisia)

Makram NOUAILI
(Institute of Management of Gabes, Gabes, Tunisia)

Asset Pricing and Probability of Information-based Trading: Application to the Tunisian Stock Market

In this paper we examine the influence of private information on Asset Pricing. The main obstacle that we face when we use CAPM with private information is the unavailability of the observable variables that directly measure private information. Microstructure literature provides many models to estimate it. An important contribution in this way was moved forward by Easley, Kiefer, O'Hara and Paperman (1996). They estimate private information by probability of information-based trading (PIN).

Our study concerns a sample of 40 quoted securities in Tunisian financial market, over the period going from January 02, 2010 until December 31, 2014, and results appear conclusive. Firstly, we show the existence of asset pricing bias compared to the standard CAPM. Secondly, we find a strong relation between private information (PIN), spread, buyer and seller trades returns. This is consistent with the idea of PIN capturing the probability of informed trading. Finally, the validity of PIN as measure of private information, gave us a motivation to test the validity of CAPM with private information cost based on Probability of Information-based Trading.

Keywords: *Probability of Information-based Trading, Asset Pricing, private Information cost, bid-ask spread, buyer and seller trades.*

1. Introduction.

The microstructure literature supplies structural models about price and volatility efficiency. After the relative empirical failure of the CAPM and the questioning of variables size and ratio book to-market in the model of Fama and French (1992), the question of the evaluation of couple profitability-risk is always put. The theoretical and empirical literature in this domain shows the incapacity of the traditional portfolio theories (in particular the standard CAPM to explain correctly the prices formation. Indeed, these traditional theories are based on unrealistic hypotheses, worth knowing: the efficiency and the perfection of the market. The markets microstructure theory, based on more realistic hypotheses, comes to propose modeling closer to the reality of stock markets.

The effects of taxes and transaction costs on asset pricing were presented, first, by Black (1974) who showed that taxes discourage some investors to invest in some assets and in some countries. Stulz (1981) proposeed a model for which the detention of the foreign assets were very expensive. He stipulated that because of higher costs, some securities were not the object of exchanges and the foreign investors tend to hold more domestic securities. This implies the existence of evaluation bias in the traditional CAPM.

The idea that returns depend on characteristics of the exchange process was differently examined in the literature. The most important study was that of Amihud and Mendelson (1986). They asserted that liquidity, measured by the bid-ask spread, affects securities returns. For them, this gives some explanation by the fact that in equilibrium, the traders are going to require higher returns to hold securities with wide bid-ask spread.

Easley, Kiefer, O'Hara and Paperman (1996) establish model based on private information by diverting a measure of Probability of Information-based Trading (PIN). This variable (PIN) was used, also, by several researchers (Easley, Kiefer and O Hara (1997a, 1997b), Easley, O Hara and Paperman (1998) and Easley, Hividkiaer & O Hara (2002)) to show the role of private information in explaining the yields of assets. Easley, Hividkiaer, O Hara and Paperman (1996) confirm that the PIN variable is correlated with the various measures of liquidity (spread, volume of transaction and prices volatility) and that it has a stronger effect on the ***returns*** than on the other measures of liquidity. This proves the importance to take into account the variable PIN in the capital assets pricing models.

Easley and O'Hara (2004) argue that stocks with more information asymmetry have higher expected returns. In this model, the effects of information asymmetry are undiversifiable since the uninformed expect to lose to the informed and therefore demand to be compensated for this expected loss. In spite of the fact that private information should be diversifiable in a large economy, empirically a proxy for information asymmetry, PIN, is positively and significantly related to average stock returns.

The purpose looked for this paper is to examine the relative problem in search of a modeling asset pricing based on private information measured by Probability of Information-based Trading.

To answer empirically our problem, we adopted the following methodology:

First, we tested the validity of standard CAPM. Secondly we estimated private information, while examining their effects on spread, buyer trades and seller trades. Finally, we tried to identify a CAPM with private information cost suited to the Tunisian stock market.

The rest of paper is articulated as follow:

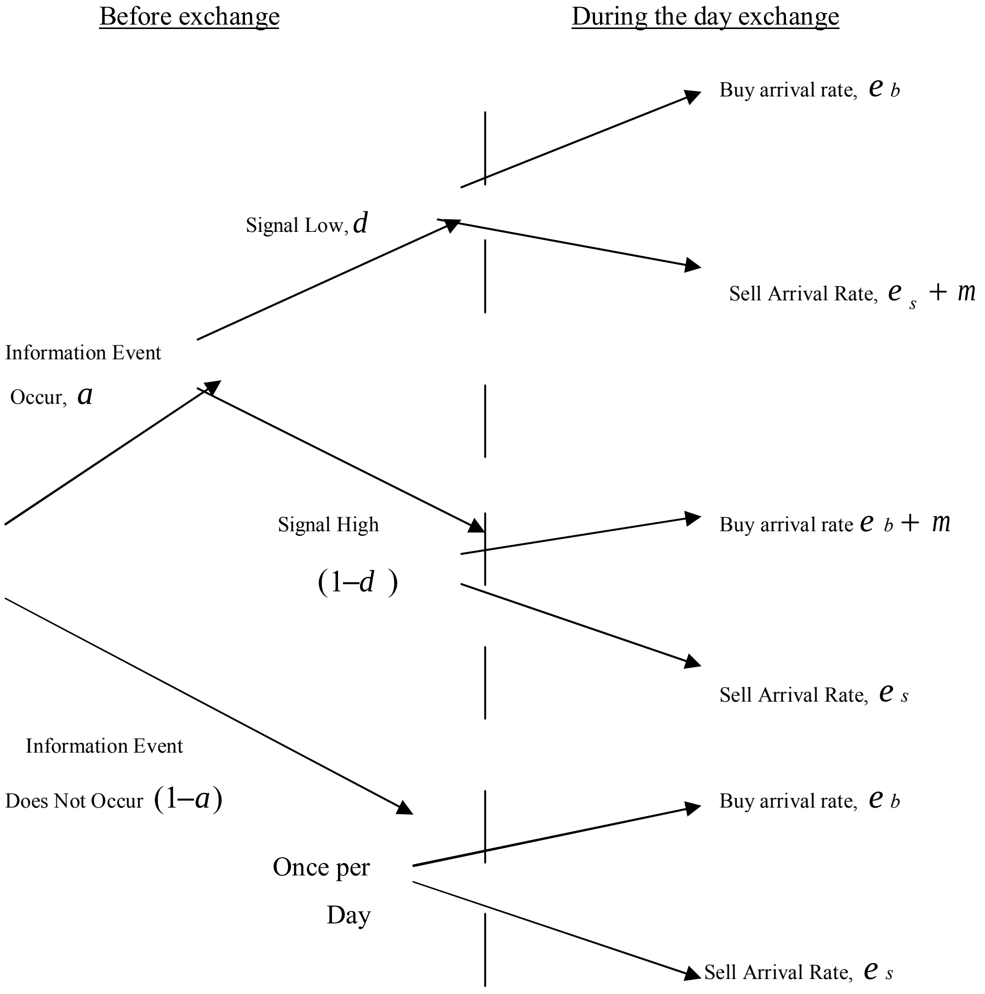
Section 2, presents a theoretical model estimating private information proposed by Easley, Kiefer, O'Hara and Paperman (1996). Section 3, supplies the database and the estimations results of econometrics models used in our empirical study. The conclusion will be the object of section 4.

2. Probability of Information-based trading (PIN) model proposed by Easley, Kiefer, O'Hara and Paperman (1996)

These authors established their model on the basis of private information by diverting a measure of information based on Probability of Information-based Trading (PIN). This variable (PIN) was used, also, by several researchers (Easley, Kiefer and O Hara (1997a, 1997b), Easley, O Hara and Paperman (1998) and Easley, Hividkiaer & O Hara (2002)) to show the role of private information in explaining the yields of assets. Easley, Hividkiaer, O Hara and Paperman (1996) confirm that the PIN variable is correlated with the various measures of liquidity (spread, volume of transaction and prices volatility) and that it has a stronger effect on the ***returns*** than on the other measures of liquidity. This proves the importance to take into account the variable PIN in the capital assets pricing models.

In what follows, we are going to expand the PIN measure estimate procedure, adopted by Easley, Hividkiaer, O Hara and Paperman (1996). The authors were based on the exchange process on the market, given by figure 1:

Figure 1: **Tree diagram of the trading process**



Note that nodes to the left of the dotted line occur once per day

Where,

a : The probability of an information event;

d : The probability of low signal;

m : The rate of informed trade arrival;

e_b : The rate of uninformed trade buy trade arrival;

e_s : The rate of uninformed trade sell trade arrival.

The microstructure models consider the exchange as a play between market content and the traders who are repeated to make exchanges every days i = 1, j. There are two states of the nature. If happened there a new information at the exchange opening day, this event occurs with α probability and in this case the underlying asset costs *V*. Otherwise, the event occurs with (1-*α*) probability and the asset costs $\bar{V}$.

Good news occur with a probability of $(1-d)$ and bad news occur with a probability of d .The authors suppose that, during the quotation's session, the arrival of the traders on the market follows a Poisson process. The market Content sets bid and ask prices at any time t, and execute the orders. The orders of the informed investors arrive at a rate of m (in the daytime of the information's event), while the orders of the badly informed buyers and sellers arrive at rates of e_b and e_s , respectively.

The informed investors choose to buy if they saw good news and decide to sell if they saw bad news. If an order arrives at the moment t, market content observes this exchange (purchase or sale), and use this information to update its faiths. The new prices are established, the exchanges evolve, and the price handles movements in answer to the change of the market content's faiths.

Easley, Hividkiaer, O Hara and Paperman (1996) propose a structural model, based on exchange, in the form of a likelihood function, namely:

$$L(q\ /B,S)=(1-a)\exp(-e_b)\frac{e_b^B}{B!}\exp(-e_s)\frac{e_s^S}{S!}+ad\exp(-e_b)\frac{e_b^B}{B!}\exp(-m-e_s)\frac{(m+e_s)^S}{S!}$$

$$+a(1-d)\exp(-m-e_b)\frac{(m+e_b)^B}{B!}\exp(-e_s)\frac{e_s^S}{S!} \qquad (1)$$

Where B and S are the number of buys and sells for a given day.

Using this function, Easley and al (1996) esteems the private Probability of Information-based Trading (PIN):

$$PIN = \frac{am}{am + e_s + e_b} \qquad (2)$$

The likelihood equation shows that at each node of the tree in Figure 1 buys and sells arrive according to independent Poisson process, with the intensity parameters differing according to the node of the tree.

The most empirical results detected by Easley and al (1996) is that the risk of information-based trading is lower for active stocks and does not differ between our medium and low volume stocks, yielding the prediction that spread for these stocks should also not differ. They then test the predictions of their model using price data, and found strong support this model.

3. Empirical Evidence

The data used in this work come from website tustex.com.tn and a company of market intermediation. We have retained as sample 40 securities quoted in continuous on the Tunisian stock market. These securities are selected according to criteria of market capitalization and number of day's quotations. Data concerns daily closing prices, the best prices and offered and demanded quantities, the transactions volume and the number of transactions. It should note that we are going to exclude Saturdays, Sundays, day holidays and the days for which the securities were not quoted. The study is conducted on the period going January 02, 2010 until December 31, 2014.

This research task provides an empirical study applied to the assets pricing models with private information. With this intention, we proceeded as follows: initially, we tested the validity of standard CAPM model. Then, we estimated the private information (we use PIN model), while examining their effects on the assets returns. Lastly, we tested the CAPM with private information cost.

3.1. Empirical Validation of standard CAPM

The standard CAPM is a model of evaluation in equilibrium which makes it possible to visualize the existing relation between the assets returns excess (compared to the rate without risk) and the market portfolio returns (or the systematic risk). The standard CAPM is presented as follows:

$$E(R_{i,t})-R_{f,t}=b_i\left[E(R_{m,t})-R_{f,t}\right]+e_{i,t}\ \textbf{où},\ \ e_{i,t}\rightarrow iid(0,s^2) \qquad (3)$$

$E(R_{i,t})$: Expected returns portfolio or title i at time t.

$E(R_{m,t})$: Expected returns from the portfolio market at the time t.

$R_{f,t}$: The rate of risk-free return for the period of investment

b_i : The sensitivity coefficient of portfolio or title i of the market portfolio.

For ends of estimate, it is convenient to transform the standard version of CAPM into an equivalent expression based on observable variables, namely:

$$R_{i,t}-R_{f,t}=b_i\left[R_{m,t}-R_{f,t}\right]+e_{i,t} \qquad (4)$$

Most empirical work carried in this field introduces a constant with this last expression:

$$R_{i,t}-R_{f,t}=a_i+b_i\left[R_{m,t}-R_{f,t}\right]+e_{i,t} \qquad (5)$$

According to waiting of this equilibrium equation, the coefficients a must be statistically null. On the other hand, the coefficients b will be positive and significant. In short, to test the standard CAPM on the Tunisian stock market, we must estimate expression given by the equation (5). With this intention, we calculated monthly variables as follow:

- $R_{i,t} = (P_t - P_{t-1}) / P_{t-1}$: Where, P_t, is the closing price relative to month t.
- $R_{m,t} = (I_t - I_{t-1}) / I_{t-1}$, where I_t, is the closing price of BVMT score to month t
- $R_{f,t} = (1 + R_{f,at})^{1/12} - 1$ Where, $R_{f,at}$, is the annual balanced average rate of the subscription for the treasury bills transferable relating to the month t (all confused expiries).

The econometric technique used in this study is to estimate the regression given by equation (5) by OLS on panel data. The estimation results are presented in the table 1.

Table 1. **Empirical Validation of the standard CAPM:** $R_{i,t}-R_{f,t}=a_i+b_i\left[R_{m,t}-R_{f,t}\right]+e_{i,t}$

a	t-student	b	t-student	R^2	F-stat
-0.001237	**-5.47213**	**0.717459**	**10.254556**	**0.15221**	**4.4254155**

While referring to the statistics of Student, we notice clearly that the coefficient b , is positive and significant with the level of 1%. This validates waiting of standard CAPM and implies that the systematic risk plays an important role in the investor's remuneration. In the same way, the coefficient a_i is statistically not null with the level of 1%. This is in contradiction with waiting's of standard CAPM and implies that the constant intervenes significantly in the explanation securities returns excess quoted in continuous on the Tunisian stock market. Moreover, the determination coefficient R^2 is a little low (15%). This justified the existence of an anomaly.

The existence of such an anomaly requires us to think of introducing to the standard CAPM other factors which can significantly influence the excess returns of the securities stock exchange. These factors can be at the origin of several sources, such as: private information, asymmetric information cost, liquidity cost, etc.

3.2. Estimation of private information and its correlations with spread, buyer trades and seller trades

Recently, several research studies have presented statistical models to estimate and decompose the bid-ask spread. These models can be divided into two broad classes. The first class of models is introduced by Roll (1984) which was one of the first to propose a simple estimator for the bid-ask spread. This estimator is established on the covariance of returns, since the real transactions are either at best price offered (ask), or at the best price demanded (bid). The models of Choi et al. (1988) and George et al. (1991) are in conformity to the model of Roll (1984). Another class of models is based on the idea that bid-ask spread depends on indicators of the trade. These indicators of trade models are driven by the arrival of orders and the response of prices to the arrival of these orders. These models include: Glosten and Harris (1988), Stoll (1989), Hasbrouck (1991), Easley et al. (1996) and Huang et al. (1997).

According to Pin model proposed by Easley & al. (1996), Evangelos Benos and Marek Jochec (2007) put the PIN variable (Probability of Information-based trading) to test. We find that for a large set of stocks, the PIN variable is lower (albeit insignificantly) in the periods before earnings announcements dates than in the periods after earnings announcements dates. This is inconsistent with the idea of PIN capturing the probability of informed trading.

Among the models presented previously, our choice is related to the estimation of private information suggested by Easley, Kiefer, O'Hara and Paperman (1996) mainly because this model relates to a market directed by the orders, this choice seems adequate. Lastly, this model seems to be more robust concerning its estimate (See Jefferson Duarte and Lance Young; 2007).

We use this model of exchange described higher is driven for every title. The method of the maximum log likelihood function using the algorithm Marquardt (as well as the algorithm Berndt-Hall-Hall Hausman for confrontation of the results) is used to estimate the parameters a, m, e_b, e_s and d.

$$+a(1-d)\exp(-m-e_b)\frac{(m+e_b)^B}{B!}\exp(-e_s)\frac{e_s^S}{S!} \quad (6)$$

$$LogL(q/B,S)=(1-a)\exp(-e_b)\frac{e_b^B}{B!}\exp(-e_s)\frac{e_s^S}{S!}+ad\exp(-e_b)\frac{e_b^B}{B!}\exp(-m-e_s)\frac{(m+e_s)^S}{S!}$$

To classify trades as buyer or seller-initiated, we classify a trade as a buy (B, initiated by buyer) above the midpoint of the bid and ask prices. In opposite, we classify a trade as a sell (S, initiated by seller) if it is executed below the midpoint of the bid and ask prices. On other way a trade executed close to the bid (ask) price is more likely to be a sell (buy), (See, Lee-Ready (1991) algorithm).

The buyer trades Bj and seller trades Sj for day j constitute the necessary data base to estimate our model.

To determine the monthly parameters a, m, e_b, e_s, d and PIN, we estimate equation by maximizing log likelihood function on daily time series of one month (21 days*40 securities= 840 observations for each month). The study period extends from January 03, 2010 to December 31, 2014. In total, we have been carried out 2400 (60 month * 40 securities) estimates for each equation to extract monthly shares of PIN.

Then, we estimate this latest model on the panel data of 40 securities quoted on Tunisian stock market. The value of the parameter a, m, e_b, e_s, d and PIN retained for the 40 securities in our sample, correspond to the average of the monthly values throughout the period of our study.

The estimations results on the Eviews 6.1 software, by using panel data for 40 for each month and by maximizing log likelihood function, are summarized in the following table.

Tableau 2. **Estimators parameters and PIN**

Parameters	a	m	e_b	e_s	d
Value	**0.104**	**15.9**	**3,54**	**2,12**	**0.23**
Statistique Z	**5.8962**	**41.6456**	**21,55**	**32,22**	**2.14**
Log L	**= -1382.1547**				
$PIN = \frac{am}{am + e_s + e_b}$	**0.224369**				

It thus seems that the majority of the coefficients are significant. Furthermore, the values of a and $d \in [0,1]$. This justifies the validity of our model to estimate PIN variable.

We tested the quality of PIN by verifying whether PIN is strongly associated with other measures of information asymmetry that are extensively employed in extant empirical studies. Easley, Kiefer, O'Hara, and Paperman (1996) contend that if the quality of PIN estimates is adequate, and then PIN should have a positive effect on bid–ask spreads.

To address this issue, we tested correlations between PIN and several information proxies, such as: spread, buyer trades and seller trades.

First, to calculate the monthly average of: quoted spread (SPREAD), buyer trades (B) and seller trades (S). These variables are formulated as follows:

- *The quoted spread: SPREAD = Log (Ask/Bid); (where Ask, is the seller price and Bid, is the buyer price).*
- *Buyer trades: B = transaction volume if it is executed above the midpoint of the bid and ask prices and zero if not.*
- *Seller trades: S = transaction volume if it is executed below the midpoint of the bid and ask prices and zero if not.*

Second, we try to test the hypothesis that PIN is positively correlated with SPREAD and negatively correlated with buyer and seller trades.

Table 3. **Matrix correlation between the variables PIN, SPREAD, B and S**

	PIN	***SPREAD***	***B***	***S***
PIN	**1**			
SPREAD	**0.4003404**	**1**		
B	**-0.453245**	**- 0.331548**	**1**	
S	**-0.156081**	**- 0.23458**	**0.49523**	**1**

As expected, PIN was positively correlated with SPREAD. Besides, we observe a negative correlation between PIN and buyer and Seller trades. This is consistent with the idea of PIN capturing the probability of informed trading.

3.3. Empirical Validation of CAPM with private information cost

The objective of this sub-section is to empirically validate the theoretical model of asset pricing taking into account private information. According to empirical model derivate by Aboura and Bellalah (2001), we incorporate private information cost to a standard CAPM. Then, we estimate our model as follow:

$$R_{i,t} - R_{f,t} = a_i + a_i PIN_{i,t} * SPREAD_{i,t} + b_i \left\lfloor R_{m,t} - R_{f,t} - PIN_{m,t} SPREAD_{m,t} \right\rfloor + e_{i,t} \qquad (7)$$

$R_{it} = \ln(P_t / P_{t-1})$

R : The risk-free interest rate.

b_i : The beta of security i.

$PIN_{i,t} * SPREAD_{i,t}$: The private information cost for each security.

$PIN_{mt} * SPREAD_{m,t}$: The aggregate market private information costs.

Note that we estimate private information cost by multiplying PIN by SPREAD.

According to the expectations of the balance equation, the coefficients should be statistically zero. In contrast, the coefficients will be significant and positive to reflect a positive relationship between excess returns (over the risk free rate, and private information costs) and net systematic risk of private information cost. The estimation results, OLS, from equation (7), using panel data, on the software Eviews 6.1 are presented in the table 4.

Table 4. **Estimation of the CAPM with private information cost**

a	**t-Statistic**	a	**t-Statistic**	b	**t-Statistic**	**R^2**	F-stat
-0.00168	**-2.94178**	**0.091235**	**4.802547**	**0.472025**	**7.350864**	**0.323254**	**5.1244123**

The results presented in Table 4 are consistent, likely expectations of this model. Indeed, on the one hand, the coefficients a and b are positive and significant at the 1% level. On the other hand, the coefficient of determination R^2 and Fisher statistic are improved compared to the standard CAPM previously estimated, rising from 18% to 32% and 4.4254155 to 5.1244123 respectively.

Finally this result shows that CAPM with private information cost has a better specification compared to standard CAPM.

4. Conclusions

The objective of this paper is to determine a suitable CAPM based on private information for the Tunisian stock market. This model is based on the standard CAPM while releasing the assumption of the absence of market frictions. These frictions are mainly due to the presence of informed investors. For this, we empirically tested a CAPM with private information cost.

The estimation of this model put a problem of the existence of unobservable variables, ie, the private information, which require recourse to estimation models. Regarding the estimation of private information, market microstructure literature offers a multitude of methods, namely Glosten and Harris (1988), Stoll (1989), Hasbrouck (1991), Lin Sanger & Booth (1995), Easley and al. (1996) and Huang and Stoll (1997).

Our choice is focused on the Easley et al. (1996) model, since this model is best suited to the realities of the Tunisian stock market order-driven (no market maker). In this model, the method of the maximum log likelihood function using the algorithm Marquardt is used to estimate the parameters used to calculate PIN variable. In this fact, we try to test the quality of PIN by verifying whether PIN is strongly associated with other measures of information asymmetry that are extensively employed in extant empirical studies. To this end, we test correlations between PIN and several information proxies, such as: spread, buyer trades and seller trades. According to study of Easley, Kiefer, O'Hara, and Paperman (1996) and as expected, our result demonstrates that PIN has positive correlation with bid-ask spread and negative correlations with buyer and Seller trades. This is consistent with the idea of PIN capturing the probability of informed trading.

The validity of PIN as measure of private information, gave us a motivation to test the validity of CAPM with private information cost based on Probability of Information-based Trading. The estimate results are very powerful. Indeed, all coefficients are significant at 1% and conform to the expectations of the model. In addition, the coefficient of determination R^2 and Fisher statistic were improved relatively to previous estimated of standard CAPM. In brief, this study demonstrates the importance of taking into account the private information in asset pricing.

4 References

- *Amihud,Y.*, *Mendelson, H.* (1989), The effects of beta, bid-ask spread, residual risk, and size on stock returns, Journal of Finance, 44, 479-486.

- *Amihud, Yakov, and Haim Mendelson*, 1986, 'Asset pricing and the bid-ask spread', Journal of Financial Economics 17, 223-249.
- *Banz*, *R*. (1981), The relationship between return and market value of common stock. Journal of Financial Economics, 9, 3-12.
- *Bellalah,* M., *Aboura,* S. (2001), The effect of asymmetric information and transaction costs on Asset Pricing: theory and tests. CEREG University of Paris Dauphine.
- *Black, F.* (1974), International Capital Market Equilibrium with Investment Barriers, Journal of Financial Economics, 1(4), 337-352.
- *Brennan, M.J., Subrahmanyam, A.* (1995), Investment analysis and price formation in securities markets, Journal of Financial Economics 38, 361-381.
- *Choi, J. Y., D. Salandro, and K. Shastri,* 1988, On the estimation of bid-ask spreads: Theory and evidence, Journal of Financial and Quantitative Analysis 23, 219-230.
- *Demsetz, H.* (1968), The cost of transacting. Quarterly Journal of Finance 45, 33-53.
- *Easley, David, and Maureen O'Hara,* 2004, Information and the cost of capital, Journal of Finance 59, 1553-1583.
- *Easley, David, Nicholas M. Kiefer, and Maureen O'Hara,* 1997, One day in the life of a very common stock, Review of Financial Studies 10, 805-835.
- *Easley, D., Hvidkjaer,s., O'Hara*, M. 2002. (2002).Is Information Risk a Determinant of Asset Returns? The Journal of Finance, LVII(5), 2185-2221.
- *Easley, D., N. Kiefer, M. O'Hara, and J. Paperman*, 1996, Liquidity, information, and infrequently traded stocks, Journal of Finance 51, 1405-1436.
- *Eugene F. Fama and Kenneth R.French*,1992, The Cross-Section of Expected Stock Returns, Journal of Finance Vol XLVII, June 1992.
- *Evangelos Benos and Marek Jochec*, March 12, 2007, Testing the PIN variable, business.illinois.edu/finance/phd/pdf/5299.pdf
- *Glosten, L.R., Harris, L.E.* (1988), Estimating the components of the bid-ask spread. Journal of Financial Economics 14, 123-142.
- *Hasbrouck, J.* (1991), Measuring the information content of stock trades, Journal of Finance 46, 129-207.
- *Huang, R.D., Stoll, H.R.* (1997), He components of the bid-ask spread: A general approach, The Review of Financial Studies 10, 995-1034.
- *Jefferson Duarte and Lance Young*, August 31, 2007.Why is PIN priced? finance.sauder.ubc.ca/conferences.
- *Lee, Charles M.C. and Mark J. Ready,* 1991, Inferring trade direction from intraday data, Journal of Finance 46, 733-746.
- *Lin, J. - Heidle, H.G.* (1999 C., Sanger, G.C., Booth, G.G. (1995), Trade size and components of the bid-ask spread, The Review of Financial Studies 8, 1153-1183.
- *Lintner,* (1965), The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets, Review of Economics and Statistics, 47: 13-37.
- *Markowitz Harry* (1952), Portfolio Selection, The Journal of Finance, Vol. 7, No. 1. pp. 77-91.
- *Merton. R* (1987), A Simple Model of Capital Market Equilibrium with Incomplete Information, Journal of Finace, 42, 1987, p. 483-511.
- *Mossin Jan* (1966), Equilibrium in a Capital Asset Market, journal of Econometrica, Vol. 34, No. 4 (Oct., 1966), pp. 768-783
- *Reinganum, Marc R.,* 1990, Market microstructure and asset pricing: An empirical investigation of NYSE and NASDAQ securities, Journal of Financial Economics 28, 127–147.
- *Roll. R* (1984) A Simple implicit Measure of the Effective Bid-Ask Spread in an Efficient Market". Journal of Finance,39, 1127-1140.
- *Sharpe, W.F.,* (1964), Capital asset prices: a theory of market equilibrium under condition of risk, Journal of Finance.
- *Stoll, H.* (1989), Inferring the components of the bid-ask spread: Theory and empirical tests. Journal of Finance, 44, 115-134.
- *Stulz. R.* (1981), On the Effect of International Investment, Journal of Finance, p.923-934.
- *Viral, Acharaya & Pederson* (2004), Liquidity-adjusted capital asset pricing model; LACAPM,
- Preprint submitted to Elsevier Science, 1 July 2004.