Ca' Foscari University of Venice

Ph.D. Program in Business, 22° cycle

(A.Y. 2006/2007 – A.Y. 2009-2010)

APPLIED TOPICS IN FINANCIAL AGENTS' BEHAVIOR

Scientific-Disciplinary Sector: SECS-P/09

Ph.D. Candidate: GLORIA GARDENAL, matr. 955273

Director of the Doctoral Program **Main Advisor**

Prof. Massimo Warglien **Prof. Giorgio Bertinetti**

To my family

Preface

The undersigned Gloria Gardenal, in her quality of doctoral candidate for a Ph.D. degree in Business granted by the University of Venice, attests that the research exposed in this dissertation is original and that it has not been and it will not be used to pursue or attain any other academic degree of any level at any other academic insitution, be it foreign or italian.

Venice, 30th June 2010

Index

PAPER 3:

.

Cross-market Rebalancing and Financial Contagion in the Laboratory

Marco Cipriani, Gloria Gardenal and Antonio Guarino*

Abstract

We present an experimental study of financial contagion due to cross-market rebalancing. Subjects trade three assets with an automaton representing a fringe of noise traders. The three assets' fundamental values are independent of each other. The subjects' payoff depends on the asset values, the prices at which they buy or sell and, moreover, on their portfolio composition. Theory predicts that when the first asset is hit by a negative shock, for portfolio rebalancing, subjects should buy in the second market and sell in the third, thus transmitting the shock from the first market to the third. The aggregate behavior that we observe in the laboratory is extremely close to that predicted by theory. Although in the experiment there is heterogeneity among subjects' behavior, the prices in the three markets are remarkably similar to those theoretically predicted.

---

* Cipriani: Department of Economics, George Washington University (e-mail: marco.cipriani@gwu.edu); Gardenal: Department of Business, University of Venice Ca' Foscari (e-mail: ggardenal@unive.it); Guarino: Department of Economics and ELSE, University College London (e-mail: aguarino@ucl.ac.uk). We thank Brian Wallace, who wrote the experimental program, and Tom Rutter, who helped to run the experiment. We gratefully acknowledge the financial support of the ESRC (World Economy and Finance program) and of the ERC. We are responsible for any error.

1 Introduction

Financial crises in one country often spread to other, unrelated economies, a phenomenon known as financial contagion. Given the pervasiveness of the phenomenon in recent years, a lot of theoretical and empirical work has been devoted to its understanding. Theoretical analyses have pointed out different mechanisms that can lead to contagion. Work on financial markets data has documented and measured different instances of contagion.

The theoretical literature has identified three main channels of contagion in financial markets: informational spillovers, correlated liquidity shocks, and cross-market rebalancing[1].

Informational spillovers refer to traders updating their beliefs and positions in one market on the basis of the information they infer from the price change in another (King and Wadhwani, 1990). Correlated liquidity shocks occur when agents, hit by a liquidity shock in one market, also liquidate assets in other markets in order to meet a call for additional collateral, thus transmitting the shock to other markets (Calvo, 1999). Finally, contagion happens through cross-market rebalancing when traders hit by a shock in one market need to rebalance their portfolios of assets: a shock in market A (say an emerging market) may require changing the position in market B (say a developped market) and this may imply rebalancing the position in market C (say another emerging market). The shock may thus transmit from market A to market C although the two markets' fundamentals are not related.

In this paper we focus exclusively on the cross-market rebalancing channel of contagion. We use the methods of experimental economics to shed light on the empirical validity of this channel. There are no studies that try to test or estimate this mechanism of contagion. Our purpose is to offer a first analysis, using data coming from the controlled environment of a laboratory experiment. The purpose is to understand whether rabalancing motives are not only theoretically interesting but also relevant in the behavior of human subjects. While our study cannot serve in assessing the relevance of this channel of contagion in specific

[1] We focus on contagion in financial markets, and do not discuss here contagion due to linkages among financial institutions (like in, e.g., Allen and Gale, 2000), or contagion due to simultaneous speculative attacks (e.g., Corsetti et al., 1999; Kaminsky and Reinhart, 2000; Rigobon, 2002).

episodes of financial crises, it can offer insights on how the mechanism works, since in the laboratory we can test the theoretical predictions by controlling for variables that are unobservable in true financial markets.

Our experiment is inspired by the work of Kodres and Pritsker (2002). They study cross-market rebalancing in a rational expectations, CARA-Normal model. Their model builds on Grossman and Stiglitz (1980) and extends it to a multi-asset economy. To implement that model in the laboratory would be difficult, given that agents are assumed to have a CARA utility function, the asset values are distributed according to normal distributions and there are three types of traders. Instead of trying to design the experiment to replicate literally Kodres and Pritsker (2002), we used a different strategy. We constructed a model that still requires agents to rebalance their portfolios, but in a much simpler set-up that experimental subjects could easily understand.

In our laboratory market, subjects trade three assets with an automaton representing a fringe of noise traders. The assets' fundamental values are independent of each other. Our experimental subjects' profits, however, depend not only on the assets' fundamental values but also on the portfolio composition. In particular, having long positions on the first asset implies that the optimal position on the second asset is short and on the third is long. Similarly, when subjects are short in the first market, they should optimally be long in the second and short in the third. This means that a negative shock in the first market (e.g., a shock that lowers the first asset fundamental value) theoretically leads agents to sell in that market, buy in the second and sell in the third.

The behavior of subjects in the laboratory could deviate from equilibrium predictions in different ways. Human subjects could neglet or barely consider the need for rebalancing. Or, on the contrary, they could overreact to shocks in the first market, thus making contagion even more severe than theoretically predicted. The results from our experiment are, instead, very encouraging for the theoretical analysis: the prices that we observe in the three markets are extremely close to the equilibrium ones. While heterogeneity among subjects is observed, the aggregate behavior is very similar to that predicted in equilibrium.

The structure of the paper is as follows. Section 2 describes the theoretical framework and its predictions. Section 3 presents the experiment. Section 4 illustrates the results. Section 5 concludes. The Appendix contains the instructions.

2 The Theoretical Framework

2.1 The Model Structure

Our experiment, inspired by the work of Kodres and Pritsker (2002), aims to test experimentally the "cross-market rebalancing" channel of financial contagion. Kodres and Pritsker (2002) study cross-market rebalancing in a rational expectations, CARA-Normal model. To implement that model in the laboratory would be difficult, given that agents are assumed to have a CARA utility function, the asset values are distributed according to normal distributions and there are three types of traders. Instead of trying to design the experiment to replicate literally Kodres and Pritsker (2002), we used a different strategy. We constructed a model that requires agents to rebalance their portfolios in a much simpler set-up, which experimental subjects could easily understand.

In our model, there are three markets -labelled A, B and C- where traders can trade three assets which we denote again by A, B and C. In each market, traders face the following price schedule:

$$p^K = E(V^K) + \frac{1}{n} \sum_{i=1}^{n} x_i^K \quad (1)$$

where V^K (K = A, B, C) is the asset value, p^K is the asset price, and x_i^K is the quantity (number of shares) of asset K bought or sold by agent *i*. Overall, there are n of these traders in the economy. We will refer to these traders as informed traders. The price schedule can be interpreted as representing the net supply of noise traders, who trade for exogenous, unmodelled, reasons. The net supply of these noise traders is price elastic. In particular, if the net demand they receive from informed traders is positive ($\frac{1}{n} \sum_{i=1}^{n} x_i^K > 0$), the price will be greater than the asset unconditional expected value. If it is negative, the price will, instead, be lower. Note also that the net demand function is identical in all three markets.

The three markets open sequentially. First traders trade in market A, then in market B and, finally in market C. When market A opens, all n informed traders, independently and simultaneously, place a buy or sell order for asset A. The order to buy or sell cannot exceed 50 units. After trades have been placed, they are aggregated and the price of asset A is determined as just discussed. Market A then closes, and traders move to trade in market B, where the same trading rule applies. Market B then closes and traders trade in the last market, following again the same rules.

Apart from opening at different times, the three markets also differ for the asset values. Asset A can take two values, 0 or 100, with the same probability. The value of assets B and C is instead always equal to 50. One way to interpret the fact that asset A value is not fixed is that it is affected by shocks. The reason we refer to the n traders as informed traders is that they know the value of asset A. In particular, they receive information about the positive or negative shock on the value of asset A. Note that, given these asset values and the limits on the buy and sell orders, the price in the three markets is never negative and never higher than 100.

An informed trader maximizes the following payoff function:

$$(V^A - p^A)x_i^A + (V^B - p^B)x_i^B + (V^C - p^C)x_i^C - (x_i^A + x_i^B)^2 - (x_i^B + x_i^C)^2 \quad (2)$$

Traders have an informational reason to trade. Since the value of asset A changes, and they receive (perfect) information on it, they can make a profit in market A. Note, in fact, that, although the noise traders adjust the price to the net-demand they receive, the price does not fully aggregate the information revealed by the market order. A positive demand can indeed only occur when the asset value is 100. Therefore, a rational, uninformed, trader would only sell at a price not lower than 100. The price implied by the price function, instead, is lower than 100 unless each trader buys the highest possible amount of 50 units. Similarly, a negative demand can only occur when the asset value is 0, but, according to the above price function, the price reaches 0 only when each trader sells all 50 units.

While there are informational reasons to trade in market A, what motivates informed traders to trade in markets B and C is "portfolio rebalancing." In both these markets, the informed traders have no informational advantage on the noise traders, since the asset values are given. Moreover, since the price function has a positive slope, and the price is equal to the expected value when the demand is zero, buying or selling implies a loss in these markets for the informed traders. From the payoff function, however, it is clear, that the informed traders may still decide to trade in markets B and C, to lower the losses due to the last two terms of the payoff. These last two terms are the way in which we model portfolio rebalancing reasons in our economy. Essentially, informed traders are penalized if they hold long positions on both assets A and B, or are short on both assets. Similarly for their positions on assets B and C. In Kodres and Pritsker (2002) portfolio rebalancing motives arise from the asset values having correlated risks. Since agents in their economy are risk averse, when their exposure to a risk factor increases because of a change in their position in a market, they find it optimal to lower their exposure by modifying their position in another. In our model there is no risk associated to the assets, since their values are known to the informed traders. The quadratic loss function is a simple way to introduce in a different way portfolio rebalancing motives.

As we said, while in market A noise traders suffer an informational disadvantage, this is not the case in the other markets. Nevertheless, as a starting point, we have assumed that the price function is the same in all three markets. One interpretation of the positive slope of the price function in markets B and C is that it reflects (unmodelled) asymmetric information in these markets. In the model of Kodres and Pritsker (2002), noise traders may misconstrue the order flow in the market as being information based. A higher net demand may be wrongly interpreted as reflecting positive information received by informed traders. For this reason, a higher demand, although due to rebalancing reasons and not having any information content, may result in a higher price. Similarly, in our model, even in markets B and C, informed traders have to trade at a disadvantageous price, which makes rebalancing costly. Whether rebalancing is more or less costly (and contagion effects more or less pronounced), depends, of course, on the price elasticity. To study the effect of price elasticity, we will contrast the case just discussed with one in which in market B the price schedule is

$$p^B = E(V^B) + \frac{1}{10n}\sum_{i=1}^{n} x_i^B \quad (3)$$

In this case, the price function in market B is relatively inelastic, compared to the other two markets. As a result, rebalancing in this market is now less costly.

Under the above interpretation, market B is characterized by a lower degree of asymmetric information.

This set up is inspired by one of the cases analyzed by Kodres and Pritsker (2002). They interpret markets A and C as emerging markets and market B as a developed market. It is interesting to observe that the presence of a developped market, with less asymmetric information (i.e., a lower price elasticity) exacerbates the contagious effects of portfolio rebalancing. Since now rebalancing in market B will be less costly, informed traders will trade more aggressively in market A, rebalancing more in markets B and, then, in C. The shock in market A will therefore have a stronger effect on the price of asset C, as we will show in the next section.

2.2 Equilibrium Predictions

Given the sequential structure of the game, we find the equilibrium by backward induction. Table 1 shows the quantity that each trader buys or sells in the three markets for both the cases of $V^A = 0$ and $V^A = 100$. The first row refers to the case in which the price elasticity is the same in all three markets, while the second to the case in which the price of asset B is less elastic. Note that a quantity with the sign minus means that the quantity is sold.

	$V^A=100$						$V^A=0$					
	market A		market B		market C		market A		market B		market C	
T1	p_A	q_A	p_B	q_B	p_C	q_C	p_A	q_A	p_B	q_B	p_C	q_C
	74.39	24.39	37.19	-12.8	58.3	8.26	25.61	-24.4	62.8	12.8	41.7	-8.26
	market A		market B		market C		market A		market B		market C	
T2	p_A	q_A	p_B	q_B	p_C	q_C	p_A	q_A	p_B	q_B	p_C	q_C
	79.74	29.74	47.89	-21.09	63.6	13.6	20.26	-29.7	52.1	21.1	36.4	-13.6

Table 1. Equilibrium predictions

Let us start by considering the first case (labelled as T1). When $V^A = 100$, obviously informed traders buy asset A and the equilibrium price (74.39) is above the unconditional expected value. For cross-market rebalancing reasons, traders sell in market B and buy in market C. Prices in markets A and C co-move. The positive shock in the first market produces a price increase also in market C although the two asset values are uncorrelated. Similarly, when $V^A = 0$, informed traders sell asset A and the equilibrium price (25.61) is lower than the unconditional expected value.

To rebalance their portfolios, traders buy in market B and sell in market C. The negative shock in the first market transmits itself to market C.

In equilibrium, a negative shock in market A -i.e., $V^A = 0$ - pushes the price approximately 49 percent below the asset unconditional expected value. Because of portfolio rebalancing, the price in market B exceeds the asset value by 26 percent, whereas the price of asset C is 16 percent lower than the asset value.

When price elasticity in market B is lower (this case is labelled as T2 in the table), rebalancing becomes less costly. Anticipating this, when $V^A = 100$, informed traders buy a higher number of asset A and the equilibrium price in this market (79.74) is higher than in the previous case. The quantity sold in market B reaches now approximately 21 units, while the price in this market only moves from 50 to 47.89. Given the high number of units sold in market B, informed traders buy almost 14 units of asset C. The effect of the positive shock in market A on asset C is now significantly higher than before, since the price of asset C jumps to 63.61. The figures for the case of $V^A = 0$ are analogous. Traders sell asset A pushing the price approximately 59 percent below the asset's unconditional expected value. The price in market B exceeds the asset value by only 4 percent, whereas the price of asset C is 27 percent lower than the asset value.

3 The Experiment

In the laboratory, we implemented the model just described. We conducted two treatments, corresponding to the two different parameter specifications illustrated above. In Treatment 1, the price function was the same in all three markets ($p^K = E(V^K) + \frac{1}{n}\sum_{i=1}^{n} x_i^K$), while in Treatment 2 we changed the price function in market B to $p^B = E(V^B) + \frac{1}{10n}\sum_{i=1}^{n} x_i^B$. Apart from the price function, the two treatments were otherwise identical.

The sessions started with written instructions (in Appendix) given to all subjects. We explained to participants that they all received the same instructions. ubjects could ask clarifying questions, which we answered privately. The experiment was run at the ELSE laboratory at UCL in the Summer 2009 and in the Winter 2010. We recruited subjects from the College undergraduate population across all disciplines. They had no previous experience with this experiment. In total, we recruited 100 subjects to run 10 sessions (5 for each treatment). The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007).

The experiment consisted of 20 rounds of trading. Let us explain the procedures for each round.

In a round, the 10 participants had the opportunity to trade in three markets, exactly as explained in the previous section. To trade, subjects were provided with an endowment of 50 units of each asset (in the instructions called "good") and of 15,000 liras (a fictitious currency that was exchanged at the end of the experiment in British Pounds). In odd rounds the value of asset A was set equal to 0, while in even rounds it was set equal to 100 liras. This was explained in the instructions and, moreover, the asset value was always displayed on the computer screen. In odd rounds subjects could sell asset A, inputting an integer between 0 and 50. Similarly, in even rounds, they could buy, again a quantity between 0 and 50. We explained the price function in the instructions. Not only we presented and explained the formula, we also used some numerical examples and provided subjects with a table illustrating the price that would have occurred for many combinations of the quantities bought (or sold) by the subject himself and the aggregate net demand of all other participants. After all 10 subjects had made their trading decision for asset A, they observed a screen reporting the individual decisions of all participants, the price, and their own profit in market A. Furthermore, they were also informed of the (provisional) penalty that they would suffer just for their trade in market A (i.e., assuming no trade in the other markets).

Subjects could then make their trades in market B. They were allowed to buy and sell, independently of whether the round was odd or even. Subjects could input a number between 0 and 50 and then click on a "buy" or "sell" button. After they had all made their decision, they observed a feedback screen containing indication of individual decisions, price, profit in market B, and, finally, the penalty suffered because of the exposures in markets A and B, and the provisional penalty for the exposures in markets B and C (assuming no trade in market C). The procedure for market C was identical. The round was concluded with a summary feedback indicating the quantities bought or sold by the subject in each market, the resulting prices and profits, the two penalties and the total payoff.

The total per-round payoff only depended on the profit in each market and on the penalty terms. It did not depend on the endowments. This is because the endowments of assets and liras that we gave to subjects at the beginning of the round were taken back at the end[2].

Clearly, because of the quadratic penalty terms, it could well happen that in a round a subject had a (large) negative total profit. In this case, the payoff for that round was set equal to zero. In other words, subjects knew that if they made a loss in a round, the profit for that round was considered to be zero. This is to avoid that subjects could end the experiment with a negative payoff[3]. After the 20th round, we summed up all the per-round payoffs and we converted them into pounds. In addition, we gave subjects a show-up fee of £5. Subjects were paid in private, immediately after the experiment. Given the different parameters, we used two different exchange rates in the two treatments, £1=100 liras in Treatment 1 and £1=200 liras in Treatment 2. On average, subjects earned £25 for a 1.5 hour experiment.

4 Results

4.1 Aggregate results

We start the presentation of our results by discussing the aggregate outcomes in the three markets. For the sake of exposition, we consider first Treatment 1.

[2] The endowments had the only purpose of making the experiment more intutitive, avoiding short positions.

[3] It is easy to verify that this floor does not change subjects' incentives in a single round. The only concern, given that the experiment is repeated for many rounds, is that subjects could collude with, e.g., some subjects not trading in a round in order to let others trade at a particularly favorable price. This was, however, never observed in the data.

Table 2 reports the quantities bought or sold on average in each market and the resulting prices when the value of asset A was 100 (i.e., in even rounds). To facilitate the comparison with the equilibrium predictions, it also reports the difference between actual and equilibrium values. When the actual quantity bought or sold is higher than the equilibrium one, the difference is reported as a positive value. If it is lower, it is reported as a negative value. Similarly, a positive (negative) difference in prices means that the observed price is higher (lower) than the theoretical one.

Treat. 1	**market A**		**market B**		**market C**	
$V^A = 100$	p_A	q_A	p_B	q_B	p_C	q_C
Average	74.67	24.67	37.87	-12.13	57.23	7.23
Difference	0.28	0.28	-0.68	-0.67	-1.03	-1.03

Table 2. Average values and differences in Treatment 1 when $V^A = 100$

The average quantities traded in the three markets in the laboratory are very similar to the equilibrium ones. As a result, the actual prices differ from the equilibrium prices for less than 1 lira, a quite remarkable result. Table 3 reports the same results for the case of $V^A = 0$. The overall picture is the same, with tiny distances between actual and equilibrium decisions. The slight difference is that the deviation in market B is higher, with a price of asset B differing from the equilibrium one by almost 3 liras.

Treat. 1	**market A**		**market B**		**market C**	
$V^A = 0$	p_A	q_A	p_B	q_B	p_C	q_C
Average	26.72	-23.28	60.03	10.03	41.56	-8.44
Difference	-1.11	-1.11	-2.78	-2.77	0.18	0.18

Table 3. Average values and differences in Treatment 1 when $V^A = 0$

The fact that the behavior for $V^A = 0$ and $V^A = 100$ is almost identical is perhaps not surprising, since the quantities to be traded are identical, except for the sign. We decided to run the experiment with the value of asset A alternating between 0 and 100 (although the idea of contagion typically refers to crises more than to booms), for two reasons. First, we thought it would make the experiment more interesting and enjoyable for the subjects, thus lowering the chance of boredom effects in the laboratory. Second, one could suspect that subjects would have a higher ability to buy than to sell, a conjecture which actually does not find support in our data.

$V^A = 0$	market A		market B		market C	
	p_A	q_A	p_B	q_B	p_C	q_C
Average (round 1-10)	27.25	-22.75	59.40	9.40	41.32	-8.68
Difference	-1.64	-1.64	-3.41	-3.40	0.42	0.42
Average (round 10-20)	26.19	-23.81	60.67	10.67	41.79	-8.21
Difference	-0.58	-0.58	-2.14	-2.13	-0.05	-0.05
$V^A = 100$	**market A**		**market B**		**market C**	
	p_A	q_A	p_B	q_B	p_C	q_C
Average (round 1-10)	74.99	24.99	37.36	-12.64	56.33	6.33
Difference	0.60	0.60	-0.17	-0.16	-1.93	-1.93
Average (round 10-20)	74.36	24.36	38.38	-11.62	58.12	8.12
Difference	-0.03	-0.03	-1.19	-1.18	-0.14	-0.14

Table 4. Results distinguishing between first and second half of the experiment

In Table 4 we report the distances between actual and equilibrium values distinguishing between the first and the second half of the experiment. Although typically the distances in the second half are even lower, also in the first part the actual prices are almost identical to the equilibrium prices, indicating that learning was not the crucial factor in driving our results.

$V^A = 0$	market A		market B		market C		$V^A = 100$	market A		market B		market C	
Round	p_A	q_A	p_B	q_B	p_C	q_C	***Round***	p_A	q_A	p_B	q_B	p_C	q_C
1	28.70	-21.30	64.26	14.26	39.84	-10.16	2	77.2	27.2	39.84	-10.16	55.94	5.94
3	25.14	-24.86	59.30	9.30	42.94	-7.06	4	74.78	24.78	35.96	-14.04	55.96	5.96
5	29.30	-20.70	56.90	6.90	43.24	-6.76	6	75.9	25.9	36.72	-13.28	56.4	6.4
7	25.24	-24.76	57.78	7.78	38.40	-11.60	8	75.86	25.86	35.02	-14.98	57.48	7.48
9	27.88	-22.12	58.74	8.74	42.18	-7.82	10	71.2	21.2	39.28	-10.72	55.86	5.86
11	27.12	-22.88	61.56	11.56	43.28	-6.72	12	73.78	23.78	39.2	-10.8	54.34	4.34
13	25.12	-24.88	58.70	8.70	37.66	-12.34	14	74.22	24.22	40.7	-9.3	57.6	7.6
15	28.80	-21.20	59.40	9.40	42.34	-7.66	16	74.22	24.22	39.18	-10.82	57.36	7.36
17	25.70	-24.30	60.96	10.96	41.28	-8.72	18	74.2	24.2	37.22	-12.78	60.6	10.6
19	24.20	-25.80	62.72	12.72	44.40	-5.60	20	75.36	25.36	35.58	-14.42	60.72	10.72
max	29.30	-20.70	64.26	14.26	44.40	-5.60	***max***	77.20	27.20	40.70	-9.30	60.72	10.72
min	24.20	-25.80	56.90	6.90	37.66	-12.34	***min***	71.20	21.2	35.02	-14.98	54.34	4.34
st. dev.	1.86	1.86	2.30	2.30	2.24	2.24	***st. dev.***	1.61	1.61	2.00	2.00	2.05	2.05
Eq.	25.61	-24.39	62.81	12.80	41.74	-8.26	***Eq.***	74.39	24.39	37.19	-12.80	58.26	8.26

Table 5. Average results for each round in Treatment 1

While the average behavior in the overall experiment is remarkably similar to the theoretical one, one may wonder whether there was heterogeneity across rounds. The answer is that in all three markets the price variability was extremely low. Table 5 reports the average results (both prices and aggregate net-demands) for each round, and, moreover, the standard deviations, the minimum and the maximum values over all rounds. It is immediate to observe that the aggregate outcomes were close to equilibrium outcomes basically in all rounds.

Let us now move to Treatment 2. In this treatment subjects should realize that they can trade more aggessively in market A, since the later cost of rebalancing will be lower. This is actually what happens. As one can immediately see from Tables 6 and 7, the average quantities and the prices in market A are again remarkably close to the equilibrium ones. The sign of the difference between actual and theoretical quantities is negative, indicating that subjects buy or sell on average less than optimal, but the value of this difference is very small.

Similarly, the average quantities bought or sold in markets B and C resemble the equilibrium values. As a result, the contagious effect from the shock in market A on the price in market C is basically what one would theoretically expect.

Treat. 2	**market A**		**market B**		**market C**	
$V^A = 100$	p_A	q_A	p_B	q_B	p_C	q_C
Average	78.38	28.38	48.01	-19.88	66.19	16.19
Difference	-1.36	-1.36	-0.12	-1.21	2.58	2.58

Table 6. Average values and differences in Treatment 2 when $V^A = 100$

Treat. 2	**market A**		**market B**		**market C**	
$V^A = 0$	p_A	q_A	p_B	q_B	p_C	q_C
Average	22.61	-27.39	51.82	18.19	35.63	-14.37
Difference	-2.35	-2.35	-0.29	-2.90	0.76	0.76

Table 7. Average values and differences in Treatment 2 when $V^A = 0$

Also in this treatment learning does not play a big role, with only negligeable differences between the first and the second part of the experiment. Looking at individual rounds, one can notice that the behavior is rather homogeneous. Interestingly, however, that while in markets A and B the quantities bought and sold are rarely higher than the theoretical ones, in market C it is more common to observe that subjects over-react, asking quantities higher than theoretically predicted. This overreaction can be even more appreciated if one notices that, since subjects buy (sell) less in market B, of course, they should sell (buy) even less than in equilibrium in market C. In particular, for $V^A = 100$, given the average quantity 19.88 sold in market B, they should buy 11.79 in market C. For $V^A = 0$, given the average quantity 18.19 bought in market B, they should sell 11.01 in market C. The difference between these two values and the quantities actually traded in market C are 4.4 and 3.37, respectively.

As a result of this behavior, the observed price in market C is in some instances further away from the unconditionally expected value than the theoretical price. These are instances in which portfolio rebalancing creates slightly more contagious effects than theory predicts.

4.2 Individual decisions

We now turn our attention from aggregate variables to individual decisions. Figures 1 and 2 show the distributions of subjects' purchases (sales) in market A when V^A was equal to 100 (respectively, to 0) for Treatment 1.

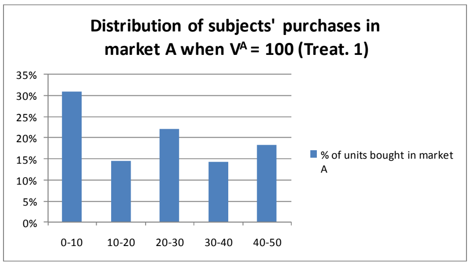

Figure 1. Distribution of subjects' purchases when $V^A = 100$

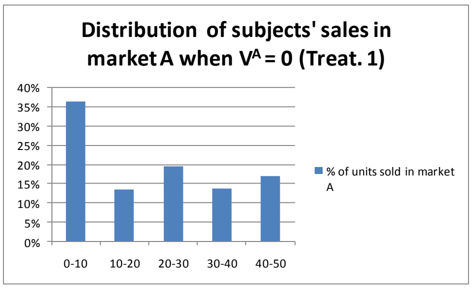

Figure 2. Distribution of subjects' purchases when $V^A = 0$

Let us focus, first, on the case of $V^A = 100$. As one can see from Figure 1, subjects' purchases are quite dispersed, with 31 percent of buy orders not higher than 10 units, and with 18% of buy orders not lower than 40 units. Similarly, when V^A was equal to zero, 36 percent of the times subjects only sold a small number of units (at most ten), and 17 percent of the time they sold large quantities (at least 40). In words, there was a large fraction of decisions to trade cautiously, buying or selling much less than in equilibrium; and a non negligible fraction of decisions to trade large amounts, which largely exceeded the equilibrium outcome.

One may wonder whether this heterogeneity in decisions in market A comes from heterogeneous behavior across subjects or from each subject behaving differently across rounds. To answer this question, we looked at extreme decisions, that is, decisions to trade just few units or many units. The result is that few subjects explain a large proportion of extreme decisions. Indeed, when $V^A = 100$, 51 percent of decisions to buy not more than ten units are only due to ten subjects (20 percent of the participants), while the decisions of other ten subjects alone account for 56 percent of buy orders of at least 40 units. The results for $V^A = 0$ are similar, with the behavior of ten subjects explaining 43 percent of decisions to sell at most ten units and the behavior of ten subjects explaining 38 percent of decisions to sell at least 40 units.

Given this behavior in market A it is not surprising that individual decisions are heterogenous also in markets B and C. After all, even theoretically, different amounts traded in market A will require different levels of rebalancing in the other two markets. Figure 3 shows the distributions of subjects' orders in market B, again for Treatment 1.

For simplicity's sake, we have considered together the two cases of $V^A = 0$ and $V^A = 100$, since, similarly to what observed in market A, the subjects' decisions were not very different in the two cases. In the histogram in Figure 3 we have aggregated buy orders with sell orders of the same size. For instance, the last bar represents purchases (if $V^A = 0$) or sales (if $V^A = 100$) of size higher than 40. The right part of the histogram (last five bars) represents correct decisions to rebalance the portfolio, buying after selling in market A, or selling after buying in market A. Rebalancing is correct in the sign in 67 percent of the cases. Of the remaining 33 percent of cases, 17 percent are orders of modest size (less than ten units), whereas the other 16 percent represents more severe deviations from equilibrium.

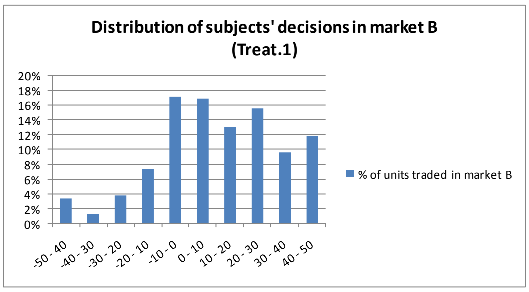

Figure 3. Distribution of subjects' decisions in market B

The results for market C are reported in the histogram in Figure 4.

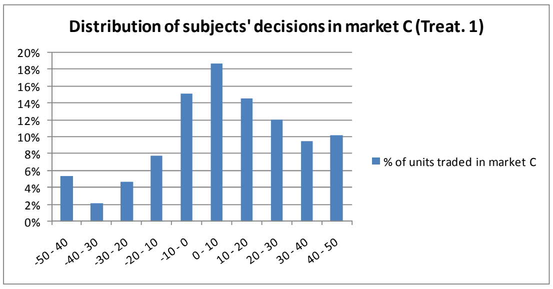

Figure 4. Distribution of subjects' decisions in market C

This histogram shows the size of buy (sell) orders in market C when the value of asset A was 100 (0). The overall picture is similar to that of market B, with a significant dispersion of decisions, 65 percent of orders of the size predicted by theory, 15 percent of orders of wrong sign but small size and 20 percent of more severe deviations from equilibrium. One has, however, to be careful in defining a decision in this market as correct or wrong, since the "correct decision" depends on whether the subject had sold or bought in market B. Indeed, if a subject had (correctly or incorrectly) bought in market B, then to increase his payoff he should have certainly sold, and viceversa[4]. When we count the number of correct decisions conditioning on the choice in market B, we find that correct decisions in market C amount to 80 percent of decisions in that market.

Let us go back to decisions in market A and ask how heterogeneity in trades affected individual payoffs. Considering market A alone, it is clear that, since the overall quantity traded was close to the symmetric equilibrium, subjects who traded aggressively outperformed subjects who traded cautiously. Essentially, these subjects took advantage of other subjects trading only small quantities. We have regressed the individual payoffs in market A (i.e., not taking into account the other two markets and the penalty terms) on the average quantities that subjects bought (if $V^A = 100$) or sold (if $V^A = 0$) in that market. The results are shown in Table 8. An increase of 1 unit in the quantity traded implies a statistically significant increase of £4.81 in the payoff in market A.

Dependent Variable: PROFITSA
Method: Least Squares
Date: 05/16/10 Time: 10:38
Sample: 1 50
Included observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.394328	5.357628	1.006850	0.3191
QA	4.813878	0.207268	23.22541	0.0000

R-squared	0.918287	Mean dependent var	119.8732
Adjusted R-squared	0.916584	S.D. dependent var	51.40692
S.E. of regression	14.84723	Akaike info criterion	8.272682
Sum squared resid	10581.13	Schwarz criterion	8.349162
Log likelihood	-204.8170	Hannan-Quinn criter.	8.301806
F-statistic	539.4196	Durbin-Watson stat	1.311328
Prob(F-statistic)	0.000000		

Table 8. Relation between individual payoffs obtained in market A and quantities traded in that market

[4] Given that on average actual decisions were correct, a subject who had made a mistake in market B would have two advantages by rebalancing in market C: he would lower the penalty, and he would earn a profit, since the price of asset C would move in a favorable way.

A regression of the total payoffs at the end of the experiment (excluding the show up fee) on the quantities traded in market A shows again a positive and statistically significant relation. An increase of 1 unit in the quantity traded in market A implies an increase of £1.30 in the total payoff, as shown in Table 9.

Dependent Variable: TOTPROFITS
Method: Least Squares
Date: 05/16/10 Time: 10:16
Sample: 1 50
Included observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.735839	7.351491	-0.780228	0.4391
QA	1.296055	0.284403	4.553587	0.0000

R-squared	0.301667	Mean dependent var	25.06186
Adjusted R-squared	0.287119	S.D. dependent var	24.12902
S.E. of regression	20.37268	Akaike info criterion	8.905445
Sum squared resid	19922.22	Schwarz criterion	8.981926
Log likelihood	-220.6361	Hannan-Quinn criter.	8.934569
F-statistic	20.73515	Durbin-Watson stat	1.300910
Prob(F statistic)	0.000036		

Table 9. Relation between total payoffs and quantities traded in market A

Regressing the total payoffs with the exclusion of payoffs in market A on quantities traded in market A does not give a statistically significant relation. Subjects who traded more aggressively in market A do not seem to be different from the others in their ability to rebalance their portfolio.

The results in Treatment 2 offer, overall, a similar picture to Treatment 1, once one takes into account that in this treatment even theoretically subjects should trade more in market A and rebalance more in the other two markets.

Market A is again characterized by heterogeneity in subjects' decisions (see Figure 5 and 6). A notable difference with the previous treatment is that the percentage of subjects choosing to trade less than 10 units is significantly lower (less then 20 percent versus more than 30 percent), perhaps not surprising given that subjects had incentives to trade more.

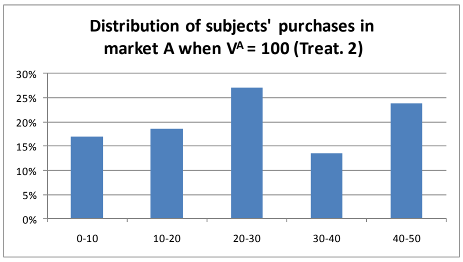

Figure 5. Distribution of subjects' purchases when $V^A = 100$

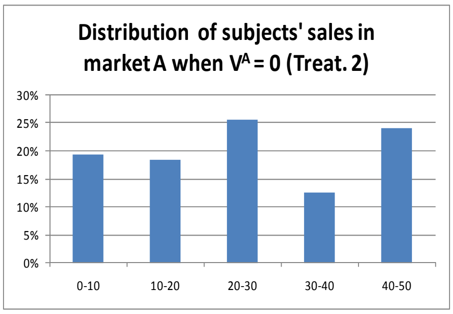

Figure 5. Distribution of subjects' purchases when $V^A = 0$

The ability of subjects to rebalance correctly is similar to that in the previous treatment. In market B, 80 percent of decisions were correct in sign, 10 percent were incorrect but of small size and 10 percent represents more relevant deviations from equilibrium.

In market C, 76 percent of orders were of the size predicted by theory, 9 percent of orders were of wrong sign but small size and 15 percent represented more severe deviations from equilibrium. Conditioning on the choice in market B, we find that correct decisions in market C amount to 88 percent of decisions in that market.

The analysis of the relation between payoffs and quantities traded in the three markets reveals a pattern similar to that of Treatment 1, although the effect of higher trade in market A is less sizeable. The regression of the individual payoffs in market A on the average quantities that subjects traded in that market shows that an increase of 1 unit in the quantity traded implies a statistically significant increase of £4.21 in the payoff in market A. An increase of 1 unit in the quantity traded in market A implies an increase of £0.49 in the total payoff. As in the previous treatment, the ability of subjects to rebalance does not seem to be related to their trading behavior in market A.

Dependent Variable: PROFITSA
Method: Least Squares
Date: 05/16/10 Time: 12:14
Sample: 1 50
Included observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002799	6.184123	-0.000453	0.9996
QA	4.207023	0.209515	20.07963	0.0000

R-squared	0.893617	Mean dependent var	118.3492
Adjusted R-squared	0.891401	S.D. dependent var	40.16135
S.E. of regression	13.23494	Akaike info criterion	8.042776
Sum squared resid	8407.855	Schwarz criterion	8.119257
Log likelihood	-199.0694	Hannan-Quinn criter.	8.071900
F-statistic	403.1995	Durbin-Watson stat	2.685371
Prob(F-statistic)	0.000000		

Table 10. Relation between individual payoffs obtained in market A and quantities traded in that market

Dependent Variable: TOTPROFITS
Method: Least Squares
Date: 05/16/10 Time: 12:13
Sample: 1 50
Included observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.146399	4.149478	0.276275	0.7835
QA	0.491898	0.140562	3.499004	0.0010

R-squared	0.203227	Mean dependent var	14.98446
Adjusted R-squared	0.186628	S.D. dependent var	9.846745
S.E. of regression	8.880498	Akaike info criterion	7.244770
Sum squared resid	3785.436	Schwarz criterion	7.321251
Log likelihood	-179.1193	Hannan-Quinn criter.	7.273895
F-statistic	12.24303	Durbin-Watson stat	2.609899
Prob(F-statistic)	0.001018		

Table 11. Relation between total payoffs and quantities traded in market A

Conclusions

In this paper we tested experimentally the channel of financial contagion known in the literature as "cross-market rebalancing". We were inspired by the work of Kodres and Pritsker (2002). To simplify their setup and make it possible to test this channel of contagion in the laboratory, we worked as follows: we made subjects trade three assets with an automaton, representing a fringe of noise traders. The three assets' fundamental values were independent of each other. The subjects' payoff function depended not only on the assets' fundamental values but also on the portfolio composition. In particular, having long positions on the first asset implied that the optimal position on the second asset was short and on the third was long. Similarly, when subjects were short in the first market, they should have optimally to be long in the second and short in the third. This meant that a negative shock in the first market (e.g. a shock that lowered the first asset fundamental value) theoretically led agents to sell in that market, buy in the second and sell in the third. Their behaviour could deviate from equilibrium predictions in different ways. They could neglect or barely consider the need for rebalancing. Or, on the contrary, they could overreact to shocks in the first market, thus making contagion even more severe that theoretically predicted. We run two treatments: one in which the price function was the same in all three markets and one in which the payoff function was slightly different in the second market, in order to control for the role played on the contagious effects by the price elasticity. The aggregate behavior that we observed in the laboratory was extremely close to that predicted by the theory. Although there was heterogeneity among subjects' behaviour, the prices in the three markets were remarkably similar to those theoretically predicted. Moreover, introducing a more inelastic price function in the second market (thus making rebalancing less costly) confirmed our hypothesis that contagious effects should have been exacerbated.

References

Allen, F. and Gale D. (2000) Financial Contagion, Journal of Political Economy, 108, 1-33.

Calvo, G. (1999) Contagion in Emerging Markets: When Wall Street is a Carrier, mimeo, University of Maryland.

Cipriani, M. and Guarino, A. (2008) "Herd Behavior and Contagion in Financial Markets," The B.E. Journal of Theoretical Economics, 8(1) (Contributions), Article 24.

Fostel, A. and J. Geanakoplos (2008) Leverage Cycles and The Anxious Economy, American Economic Review, forthcoming.

Grossman, S. J. and Stiglitz, J. (1980) On the Impossibility of Informationally Efficient Markets, American Economic Review, 70, 393-408.

Kaminsky, G. (1999) Currency and Banking Crises: The Early Warnings of Distress, IMF working paper 99/178.

Kaminsky, G. and Reinhart C. (2000) On Crises, Contagion and Confusion, Journal of International Economics, 51, 145-158.

King, M. and Wadhwani, S. (1990) Transmission of Volatility between Stock Markets, Review of Financial Studies, 3, 5-33.

Kodres, L. and Pritsker, M. (2002) "A Rational Expectations Model of Financial Contagion," Journal of Finance 57, 769-799.

Kyle, A. and Xiong, W. (2001) Contagion as a Wealth Effect, Journal of Finance, 56, 1401-1440.

Yuan, K. (2005) Asymmetric Price Movements and Borrowing Constraints: A REE Model of Crisis, Contagion, and Confusion, Journal of Finance, 60, 379-411.

Appendix

Instructions[5]

Welcome to our study! We hope you will enjoy it.

You're about to take part in a study on decision making with 9 other participants. Everyone in the study has the same instructions. Go through them carefully. If something in the instructions is not clear and you have questions, please, do not hesitate to ask for clarification. Please, do not ask your questions loudly or try to communicate with other participants. We will be happy to answer your questions privately.

Depending on your choices and those of the other participants, you will earn some money. You will receive the money immediately after the experiment.

Outline of the Study

In the study, you will be asked to buy or sell in sequence three goods: A, B and C. First, you will buy or sell good A in market A; then good B in market B and, finally, good C in market C.

The values of the goods are expressed in a fictitious currency called "lira", which will be converted into pounds at the end of the experiment according to the following exchange rate:

£1=200 liras[6].

This means that for any 200 liras that you earn, you will receive one pound.

In each market, you will trade with a computer (and not among yourselves). In particular, you will be asked to choose the quantity you want to buy from the computer or sell to it. The computer will set the price at which each of you can buy or sell based on the decisions of all participants.

---

[5] Here we are presenting the instructions delivered during Treatment 2. We will add a note each time there were differences with the instructions we delivered for Treatment 1.

[6] In Treatment 1, the exchange rate was £1=100 liras

The Rules

The experiment consists of 20 rounds. The rules are identical for all rounds. All of you will participate in all rounds.

Each round is composed of three steps. In the first step, you trade in market A. Then market A closes and market B opens. Finally, when market B closes, market C opens.

At the beginning of every round we will provide you with an endowment of 50 units of each good (that is, 50 units of good A, 50 of good B and 50 of good C) and with 15,000 liras, which you can use to buy or sell.

At the end of each round, you will receive information about how much you earned in that round, and then you will move to the next round.

Procedures for each round

At the beginning of each round, you trade good A in market A.

Market A

The value of good A can be either 0 or 100 liras**. In all the odd rounds (1-3-5…) the value is 0; in all the even rounds (2-4-6…) the value is 100.**

Your trading decision

In market A, you are asked to choose how many units you want to buy or sell. You can sell up to 50 units (which is your initial endowment of good A), and buy at most 50 units.

When the value of the good is 0, you will be asked to indicate how many units you want to sell. When the value of the good is 100, you will be asked to indicate how many units you want to buy.

In the screen, there is a Box where you indicate the number of units of good A that you want to buy or sell by clicking on the BUY or SELL button.

The price

After all of you have chosen, the computer will calculate the price of good A in the following way:

$$Price_A = 50 + 1/10 * (Total_A),$$

where

$Total_A$ = $Total_A$ Bought – $Total_A$ Sold

$Total_A$ Bought = sum of the units of the good A bought by all those who decide to buy;

$Total_A$ Sold = sum of the units of the good A sold by all those who decide to sell.

Example 1:

Assume that the value of good A is 100 and that the quantities of good A bought by the participants are as follows:

Participant	Units Bought	Units Sold	$Total_B$
1	45		
2	10		
3	30		
4	15		
5	30		
6	20		
7	26		
8	50		
9	18		
10	8		
Total A	**252**	**0**	**252**

Since the $Total_A$ is equal to [$Total_A$ Bought] - [$Total_A$ Sold] = 252 - 0 = 252, the price will be:

$$Price_A = 50+1/10 * (Total_A) = 50+1/10*(252) = 75.2$$

Example 2:

Assume that the value of good A is 0 and that all participants decide to sell 15 units, so that $Total_A$ is equal to [$Total_A$ Bought] - [$Total_A$ Sold] = 0 - 150 = -150. The price will be:

$$Price_A = 50+1/10 * (Total_A) = 50+1/10*(-150) = 35$$

In general, the more participants want to buy, the higher the price you will have to pay for each unit. The more participants want to sell, the lower the price you will receive for each unit.

To help you to familiarize with the way the computer sets the price, we provide you with a table (Table 1, at the end of these instructions) where you can see the price of the good given some possible combinations of your choices and those of the other participants.

After everyone has made his/her decision and the computer has computed the price, on the screen you will see a summary of your decision, the decisions of the other participants, and the resulting price and earnings.

After that, you will start trading in market B.

Market B

The value of good B is 50 in all rounds.

Your trading decision

Exactly as before, you will simply be asked to choose how many units of good B you want to buy or sell. You can sell up to 50 units, that is, your initial endowment of good B, and buy at most 50 units.

In the screen, there is a Box where you indicate the number of units of good B that you want to buy or sell, by clicking on the BUY or SELL button.

Note that in market B, differently to market A, since the value is 50 in any given round you will have to decide whether you want to buy or sell.

The price

After all of you have chosen, the price of good B is computed in a slightly different way from how it was computed in market A, that is,

$$Price_B = 50 + \mathbf{1/100} * (Total_B)$$ [7]

where

$Total_B$ = $Total_B$ Bought – $Total_B$ Sold

$Total_B$ Bought = sum of the units of the good B bought by all those who decide to buy;

$Total_B$ Sold = sum of the units of the good B sold by all those who decide to sell.

Note, that, in Market B, Total is multiplied by 1/100 (i.e., it is divided by 100), instead of being multiplied by 1/10 as it was in market A (i.e., in Market A, it was divided by 10).

Example 1:

The value of good B is 50. Assume that the quantities of it bought/sold by the participants are as follows:

[7] In Treatment 1, the price function in market B was the same used in markets A and C, i.e.: $Price_B = 50 + (\frac{1}{10}(Total_B))$

Participant	Units Bought	Units Sold	$Total_B$
1	30		
2	25		
3	40		
4	35		
5	20		
6	45		
7	27		
8		16	
9	50		
10	40		
Total B	**312**	**16**	**296**

As $Total_B$ is equal to [$Total_B$ Bought] - [$Total_B$ Sold] = 312 - 16 = 296, the price will be:

$$Price_B = 50+1/100 * (Total_B) = 50+1/100*(296) = 52.96$$

Example 2:

Assume that all participants decide to sell 35 units, so that $Total_B$ is equal to [$Total_B$ Bought] - [$Total_B$ Sold] = 0 - 350 = -350. The price will be:

$$Price_B = 50+1/100 * (Total_B) = 50+1/100*(-350) = 46.5$$

Note that, like for the price of good A, the more participants want to buy, the higher the price you will have to pay for each unit. The more participants want to sell, the lower the price you will receive for each unit. However, the price in market B moves away from 50 by less for a given level of units bought and sold, because Total is divided by 100 and not by 10 (as it was in market A). Again, to help you to familiarize with the way the computer sets the price, you can consult Table 2 at the end of the instructions to see the price corresponding to different combinations of your choice and those of the other participants.

After everyone has made his/her decision and the computer has computed the price, on the screen you will see a summary of your decision, the decisions of the other participants, and the resulting price and earnings. After that, you will start trading in market C.

Market C

The value of good C is 50 in all rounds.

Your trading decision

Analogously to market B, you will simply be asked to choose how many units of good C you want to buy or sell. You can sell up to 50 units, that is, your initial endowment of good C, and buy at most 50 units.

In the screen, there is a Box where you indicate the number of units of good C that you want to buy or sell, by clicking on the BUY or SELL button.

Note that in market C, as it was in market B, since the value is 50 in any given round you will have to decide whether you want to buy or sell.

The price

After everyone has made his/her decision, the computer will compute the price of good C with the same rule **as for good A**, that is,

$$Price_C = 50 + 1/10 * (Total_C)$$

where

$Total_C$ = $Total_C$ Bought – $Total_C$ Sold

$Total_C$ Bought = sum of the units of the good C bought by all those who decide to buy;

$Total_C$ Sold = sum of the units of the good C sold by all those who decide to sell.

Note that in market A and C the price is computed according to the same rule (whereas the price in market B was computed according to a slightly different rule, as explained above).

Note that, similarly to markets A and B, the more participants want to buy, the higher the price you will have to pay for each unit. The more participants want to sell, the lower the price you will receive for each unit. As for market A, Table 1 at the end of the instructions gives you the prices corresponding to different combinations of your choice and those of the other participants.

After everyone has made his/her decision and the computer has computed the price, on the screen you will see a summary of your decision, the decisions of the other participants, and the resulting price and earnings.

After that, you will receive a summary of your trading activity in the entire round and you will learn your per-round payoff.

Per-Round Payoff

As we said, at the beginning of each round we give you an endowment of 50 units of each good and of 15,000 liras so that you can sell the goods (if you want) or buy more of them (by spending your liras). At the end of the round, we will take these endowments back, so that your payoff only depends on the profits or losses made while trading and not on the endowment.

In particular, your payoff will depend on two components:

1. The earning you made in each market;
2. Two "penalty terms".

The per-round payoff will be equal to:

$$Earning_A + Earning_B + Earning_C - Penalty\_1 - Penalty\_2$$

Let us see what these terms are.

1. The earning in market A is computed in the following way:

- if you BUY,

$Earning_A = (Value_A - Price_A)$ * (Units of A good you bought).

This is because for each unit that you buy you receive the value of the good but you have to pay the price;

- if you SELL,

$Earning_A = (Price_A - Value_A)$ * (Units of A good you sold).

This is because for each unit that you sell you receive a price and you will lose the value of the good you owned.

Similarly, for market B,

- $Earning_B$ = ($Value_B$ - $Price_B$) * (Units of B good you bought) if you BUY
- $Earning_B$ = ($Price_B$ -$Value_B$) * (Units of B good you sold), if you SELL

And for market C,

- $Earning_C$ = ($Value_C$ - $Price_C$) * (Units of C good you bought), if you BUY
- $Earning_C$ = ($Price_C$ - $Value_C$) * (Units of C good you sold), if you SELL

2. The "penalty terms" are the following:

- Penalty_1= $(units_A+units_B)^2$
- Penalty_2= $(units_B+units_C)^2$

where $units_A$, $units_B$, $units_C$ are your trading "exposure" in each market. What is your trading exposure? It is the number of units you decided to buy if you bought, or, with a negative sign, the number of units you decided to sell if you sold.

How to interpret the penalty terms? Consider Penalty_1. If the sum of $units_A+units_B$ is equal to 0 the penalty is zero, meaning you are not penalized. If it is different from 0, then you will pay a penalty. Note that it does not matter whether the term is higher or lower than 0, since the penalty term is squared. Note also, that the more this sum is different from 0, the higher the penalty term. That is, your Penalty_1 will be the greater the further away your **combined** trading exposure in market A and B is from zero.

The same is true for Penalty_2=$(units_B+units_C)^2$. That is, your Penalty_2 will be the greater the further away your **combined** trading exposure in market B and C is from zero.

Note that Penalty_1 only depends on your combined trading exposure in markets A and B, whereas Penalty_2 only depends on your combined trading exposure in market B and C.

Example 1

For instance, if in market A you bought 20 units, in market B you sold 10 units and in market C you bought 5 units, then the penalty terms will be:

- Penalty_1= $(units_A+units_B)^2 = (20-10)^2 = (10)^2 = 100$
- Penalty_2= $(units_B+units_C)^2 = (-10+5)^2 = (-5)^2 = 25$

Therefore, we will subtract 125 (Penalty_1+Penalty_2=100+25) from the earnings you got trading in the 3 markets A, B and C.

Example 2

If in market A you sold 35 units, in market B you sold 30 units and in market C you sold 20 units, then the penalty terms will be:

- Penalty_1= $(units_A+units_B)^2 = (-35-30)^2 = (-65)^2 = 4225$
- Penalty_2= $(units_B+units_C)^2 = (-30-20)^2 = (-50)^2 = 2500$

Therefore, we will subtract 6725 (Penalty_1+Penalty_2=4225+2500) from the earnings you got trading in the 3 markets A, B and C.

To sum all up, the per-round payoff is the sum of the trading earnings in the three markets and the two Penalties:

- $Earning_A + Earning_B + Earning_C -$ Penalty_1 - Penalty_2

Note, however, that if this sum is <u>lower than zero</u> (that is, you have made a loss and not a profit), then your per-round payoff will be set <u>equal to zero</u>. This guarantees that, in each round, you never lose money.

Payment

To determine your final payment, we will sum up your per-round payoffs for all the 20 rounds. We will then convert this sum into pounds at the exchange rate of 200 liras = £1[8]. That is, for every 200 liras you have earned in the experiment you will get 1 pound. Moreover, you will receive a participation fee of £5 just for showing up on time. We will pay you in cash (in private) at the end of the experiment.

[8] In Treatment 1, as stated above, the exchange rate was £1=100 liras.

Modelling Risk Aversion and Information Risk

Gloria Gardenal*

Abstract

This work analyses the three major financial markets (the U.S., the European, and the Japanese one) from the point of view of investors' behavior. Our purpose is to understand if the distance between the modern neoclassical finance and the behavioral finance is really so huge. We do it in an original way: we use a neoclassical model to express a plausible variable able to describe investors' behavior and then we try to understand if, using only neoclassical tools, we can explain its pattern. In particular, we derive the level of the investors' risk aversion and we decompose it in two parts: the systematic one (function of the market structure) and the idiosyncratic one, which we consider as representative of the decisional processes of the average investor. After that, we try to find which could be a possible driver of this variable among: 1) the information risk; 2) the quality of risk. We restrict our analysis also around the last financial crisis. What we find is that no one of these quantities has significant relationships with the flow of investors' behavior so we deduce that, even if the approach of the behavioral finance, based on case events, could be considered not worth being labeled as a theory, maybe it's the unique way to understand in details how investors behave, at least in the short term.

---

* Gardenal, Department of Business, Ca' Foscari University of Venice (email: ggardenal@unive.it). We thank Giorgio Stefano Bertinetti and Guido Massimiliano Mantovani for the supervision of this work and for the precious hints. We gratefully acknowledge Elisa Daniotti for the preliminary elaborations on the data and for her support in writing this work. We are responsible for any error.

1 Introduction

The debate between modern neoclassical finance and behavioral finance is still very tough. The contrast between the two approaches has been discussed by many authors (see e.g. Frankfurter and McGoun, 2000 and 2002). On one side, the "traditionalists" are convinced that the issues have all been settled and that no controversy remains (Ross, 2002); on the opposite side, the "sustainers" of the behavioral approach proclaim the death of neoclassical finance and the rise of a new finance based on the analysis of how psychological biases affect investor behavior and capital market prices (Shleifer, 2000; Daniel et al., 2002).

The critics, moved by each faction against the other, have been numerous. The behavioral finance (BF) has strenuously attacked the efficient market hypothesis (EMH) and the concept of no arbitrage (DeBondt and Thaler, 1985 and 1987; Basu, 1978; Dreman, 1979; Fama and French, 1992), documenting, through a series of market anomalies, their inability to explain many effects. The description of the distinctiveness of BF given by one of its proponents in a 1999 special issue of the *Financial Analysts Journal devoted* to the topic is the following: "People are "rational" in standard finance; they are "normal" in behavioral finance. Rational people care about utilitarian characteristics but not value-expressive ones, are never confused by cognitive errors, have perfect self-control, are always averse to risk, and are never averse to regret. Normal people do not obediently follow that pattern" (Statman, 1999, page 12).

On the other side, the modern neoclassical finance doesn't seem to accept the validity of BF as a theory (Ross, 2002). In fact, the empirical evidence in support of most behavioral findings is almost exclusively event studies, which are seriously flawed (Frankfurter and McGoun, 1995). And so-far, having been designated the "anomalies literature", the sole purpose of BF has been to discredit the EMH/CAPM. This gives modern finance the home court advantage and virtually immunizes it from refutation, because terminal flaws can always be found in every empirical test.

Given these premises, we have decided to attempt a reconciliation of the two research approaches, analyzing the three major financial markets (the U.S., the European, and the Japanese one) through a neoclassical lens (and not through an event study) but with a critical eye on the limits of this approach and on the possibility of the "behavioral stream" of research to enrich the understanding of financial markets. More precisely, we propose a hierarchy of research objects, with a top-down level of investigation: 1) can we find a link between the neoclassical models of inquiry and the behavioral ones?; 2) knowing that the neoclassical finance assumes that investors take decisions considering only the binomial mean-variance (see Bodie et al., 1993), can we explain their behavior considering as a further variable the possible sources of risk? Can we say that the quality of risk matters?; 3) can we attribute the anomalies of investors' behavior only to problems of information?

The paper is organized as follows: Section 2 presents the dataset in details; Section 3 introduces our "original" model to investigate investors' behavior and answers to research question 3 (proceeding backward with respect to the hierarchy just mentioned); Section 4 analyses the role of the quality of risk and answers to research question 2; Section 5 answers to the main research question (1) and concludes.

2 The Dataset

This empirical analysis considers the three major financial markets in terms of number of financial instruments and trading volumes: respectively the American, the European and the Japanese stock markets.
The data, collected from three different databases (Bloomberg Professional, Thomson DataStream and Fides), consists of daily quotations (closing prices) from 1/01/1992 to 7/12/2009 of three market indexes: 1) the Standard and Poor's 500 (for the American market); 2) the Dow Jones Euro Stoxx Price Index (for the European market); and 3) the Topix (for the Japanese market).
The choice of these indexes has been made according to two criteria: **1.** the ability to represent the market to which they belong and **2.** the length of the time series available. For each of these general market indexes we considered also the relative sector indexes, which are 118 for the S&P 500, 18 for the DJ Euro Stoxx and 33 for the Topix. A list of all the indexes considered is provided by Table 1.

EUROPE	JAPAN	US	
OIL & GAS	FISHERIES	ADVERTISING	INTEGRATED OIL & GAS
TECHNOLOGY	MINING	AEROSPACE & DEFENCE	INTEGRATED TELECOM SERV
AUTOMOBILES & PARTS	CONSTRUCTION	AGRICULTURAL PRODUCTS	INTERNET RETAIL
BASIC RESOURCES	FOODS	AIR FREIGHT & COURIERS SI	INTERNET SOFTWARE & SERV
RETAIL	TEXTILES	AIRLINES SI	IT CONS& O/SVS
INSURANCE	PULP & PAPER	ALUMINIUM	LEISUREPRODUCTS
FOOD AND BEVERAGE	OIL & COAL PRODS	APPAREL& ACCESSORIES	LIFE & HEALTH INS
TRAVEL AND LEISURE	RUBBER PRODUCTS	APPARELRETAIL	MANAGEDHEALTH CARE
FINANCIAL SERVICES	GLASS & CERAMICS	APPLICATION SOFTWARE	METAL &GLASS CONT
PERSONAL & HOUSEHOLD GOODS	IRON & STEEL	AUTO PARTS & EQUIP	MOTORCYCLE MANUFACTURERS
MEDIA	NONFERROUS METS	AUTOMOBILE MANUFACTURERS	MOVIES & ENTERTAINMENT
BANKS	METAL PRODUCTS	DIV BANKS	MULTILINE INSURANCE
CONSTUCTION AND MATERIALS	MACHINERY	BIOTECHNOLOGY	MULTI UTILITIES
INDUSTRIAL GOODS AND SERVICES	ELECTRIC MACHINE	BREWERS	OFFICE ELECTRONICS
CHEMICALS	TRANSPORT EQUIP.	BROADCASTING & CABLE TV	OFFICE SERV & SUPPLIES
HEALTH CARE	PRECISIONINSTR.	BUILDING PRODUCTS	OIL & GAS DRILLING
TELECOMUNICATIONS	OTHER PRODUCTS	CASINOS & GAMING	OIL & GAS EQUIP & SERV
UTILITIES	REAL ESTATE	COMMERCIAL PRINTING	OIL & GAS EXPLOR & PROD
	LAND TRANSPORT	COMPUTER & ELECTR RETAIL	OIL & GAS REFING & MARK
	MARINE TRANSPORT	COMPUTER HWARE	PACKAGED FOODS
	AIR TRANSPORT	COMP STORAGE & PERIPHERALS	PAPER PACKAGING
	WAREHOUSE	CONSTRUCTION & ENGINEERING	PAPER PRODUCTS
	INFO & COMMUNICATION	CONSTRUCTION & FARM MACHINE	PERSONAL PRODUCTS
	ELEC.POWER & GAS	CONSTRUCTION MATERIALS	PHARMACEUTICALS
	SERVICE	DEPARTMENT STORES	PHOTOGRAPHIC PRODUCTS
	PHARMACEUTICAL	DISTRIBUTORS	PROPERTY & CASUALTY INSUR
	WHOLESALE	DIVERSIFIED CHEMICALS	PUBLISHING & PRINTING
	RETAIL	DIV COMM & PROF SERV	RAILROADS
	SECURITIES	DIV FINSVS	REAL ESTATE INVST TRUSTS
	INSURANCE	DIVERSIFIED METALS & MINING	RESTAURANTS
	OTHER FINANCIALS	DRUG RETAIL	SOFT DRINKS
	CHEMICAL	ELECTRIC UTILITIES	SPECIALTY CHEMICALS
	BANKS	ELECTRICAL COMP & EQUIP	SPECIALTY STORES
		ELEC EQMANUF.	STEEL
		HR & EMPL OYMENT SERV	SYSTEMSSOFTWARE
		ENVR & FA CILITIES SERV	TIRES &RUBBER
		FERTILISER & AGRI CHEMICALS	TOBACCO
		FOOD DISTRIBUTORS	TRADINGCOMP & DISTRIBUTORS
		FOOD RETAIL	WIRELESS TELECOM SERV
		FOOTWEAR	HYP MKTS&SUP CNT
		FOREST PRODUCTS	H/C SERVICES
		GAS UTILITIES	REGIONAL BNKS
		GENERALMERCH STORES	THRFTS/MGE FIN
		GOLD	SPEC FINANCE
		H/CARE DIST	CONS FINANCE
		HEALTH CARE EQUIP	ASS MGT&CUST BNK
		HEALTH CARE FACILITIES	INV BNK& BROK
		HEALTH CARE SUPPLIES	DATA PRO&OUT SVS
		HOME FURNISHINGS	HM ENT S/WARE
		HOME IMPROVE RETAIL	COMM. EQUIPMENT
		HOMEBUILDING	ELEC MANU SVS
		HOTELS	S/CON EQUIPMENT
		HOUSEHOLD APPLIANCES	SEMICONDUCTORS
		HOUSEHOLD PRODUCTS	OIL & GAS STORAGE & TRANSP
		HOUSEWARES & SPECIALTIES	EDUCATION SERVICES SI
		INDUSTRIAL CONGLOMERATES	SPL. CONS. SERVICES SI
		INDUSTRIAL GASES	AUTOMOTIVE RETAIL SI
		INDUSTRIAL MACHINERY	HOMEFURNSH RETAIL SI
		INSURANCE BROKERS	IND. POWER PROD & ENERGY TR

Table 1. List of the sector indexes analyzed for each market

The number of observations collected for each index amounts to 4'679, which corresponds to a total number of 804'788 quotations analyzed. The data are all expressed in their local currency and are of type "price"[9]. Moreover, we decided to work with the closing prices, including the non-trading days in order to have the same number of observations for each index. In fact, given that the open market days are different among Countries, the number of information available would have been very different if we included only the active days[10].

As previously mentioned, the three financial markets taken into account in this work present an enormous diversity in terms of number of industry indexes listed. This doesn't threaten the validity of our work because the purpose is not to make crossed comparisons but simply to monitor the same variables in different financial settings.

One remark is necessary to explain how we worked with the industrial indexes of the S&P500. Both databases we consulted (we are referring here to Bloomberg and DataStream, main data sources for this work) provide quotations of 139 different industrial indexes but 21 of them stopped to quote before the 1st January 1992, starting date of our analysis and so we decided to eliminate them. Instead, we decided to include in our sample those indexes which started to quote after the 01/01/1992 but are still listed on an exchange.

3 The Model

In the modern neoclassical finance, the investment process consists of two broad tasks. One task is the security and market analysis, by which we assess the risk and expected-return attributes of the entire set of possible investment vehicles. The second task is the formation of an optimal portfolio of assets. This task involves the determination of the best risk-return opportunities available from feasible investment portfolios and the choice of the best portfolio from the

[9] Quotations can be of two types: *price* or *return*. The former provides a "pure" information; the latter incorporates also dividends distributed to the investors by the companies being part of the index.
[10] The database Bloomberg allows users to download time series choosing among three options: 1) active days; 2) non-trading days; 3) all calendar days.

feasible set. This latter task is what we usually define portfolio theory. The three guiding themes of this theory are the following: first, investors avoid risk and demand a reward for engaging in risky investments, which is taken as a premium (i.e. an expected rate of return higher than that available on alternative risk-free investments). The second guiding line allows us to summarize and quantify investors' personal trade-offs between portfolio risk and expected return. To do this, the theory introduces the utility function, which assumes that investors can assign a welfare, or "utility", score to any investment portfolio depending on its risk and return. Finally, the third guide is that we cannot evaluate the risk of an asset separate from the portfolio of which it is part: i.e. we have to assess its impact on the volatility of the entire portfolio of investments.

Taking this theory as the framework of our analysis, our attempt to reconcile the modern neoclassical finance and behavioral finance consists of extracting from the classical model of Expected Utility (Von Neumann and Morgenstern, 1947) a variable able to catch the flow of investor behavior and then trying to understand how it is influenced by the level of information and the quality of risk. Our idea is that, if we are not able to explain the flow of this variable through neoclassical instruments, then there is room for the behavioral models of inquiry, meaning that some inefficiencies in the investors' behavior can only be explained through event studies, and not at a macro level.

3.1 First elaborations

The analysis is made of several phases that we are going to treat in details, underlying the main hypothesis and giving evidence of the intermediate results.
Firstly, we computed the logarithmic weekly returns of the three general indexes (S&P 500, DJ Euro Stoxx, Topix) and of their relative sector indexes. The two hypothesis adopted in this first step of analysis are the following: 1) we assumed that the standard number of working days per week is 5 and so we considered a range of 5 observations to get the weekly returns; 2) we decided to compute *ex-ante* returns. In broad terms, this hypothesis assumes that, *ex-ante*, we are able to

foresee what actually will happen in the immediate future[11]. More formally, this means that at time $t = t_1$, the *ex-ante* quarterly return must be computed as:

$$r_1 = \ln(P_5/P_1) \quad (1)$$

From a practical point of view, this determined the "loss" of the last 5 observations of each time series (from 4'679 to 4'674).

The second step has been the computation of the standard deviations of the returns obtained in the previous step. Also in this case we have considered a weekly measure, meaning that we computed it for the first 5 observations and then rolled it for the whole time series, obtaining a smoothed measure of the standard deviation.

After that, we computed the extra-returns of each sector index with respect to its general index as follows:

$$\text{extra} - \text{return}_{it} = \text{sector return}_{it} - \text{index return}_t \quad (2)$$

Clearly, a negative value of the extra-return implies that, on average, the sector has underperformed the market; on the contrary, a positive extra-return indicates that the sector has outperformed the benchmark.

Then we measured the correlations between the weekly returns of each sector and those of their relative market index as:

$$\rho_{iM} = \frac{\text{COV}(r_i, r_M)}{\sigma_i \ \sigma_M} \quad (3)$$

where $COV(r_i, r_M)$ represents the covariance between the market index M (in our case the general index) and the sector *i*, whereas σ_i and σ_M are the standard deviations of the two variables. Also in this case, we computed a weekly value of

[11] This hypothesis assumes the presence of homogeneous and rational expectations in the investors' behaviors. This means that all economic agents analyze stocks in the same way and have the same vision of the world. The consequence of all this are identical estimations of the probability distribution of the future cash flows of the stocks available on the market. Instead, rationality implies that agents optimize the binomial mean-variance, following the approach proposed by Markowitz. This hypothesis are the foundation of the CAPM (Bodie, Z., Kane A., Marcus A.J., (1993, second ed.), Investments, Richard D. Irwin Inc., p. 243)

the correlation, coming up having a time series of the correlations, as for the returns, for the standard deviations (and for the extra-returns).

The last step of these first elaborations consisted in the computation of the betas of each sector index *i* as:

$$\beta_i = \frac{COV(r_i, r_M)}{\sigma_M^2} \ldots (4)$$

where σ_M^2 is the variance of the market returns.
The data obtained so far are presented in Table A. 1 - Table A. 3 in the Appendix.

3.2 Research of the behavioral variable

Using the "basic ingredients" presented above, we moved further in order to find a variable able to catch and describe investors' behavior. Hereafter we present the procedure in details.

First of all, we computed the utility relative to the investment in the various sectors analyzed. We assumed, as in the previous elaborations, that agents have homogeneous and rational expectations and that the indifference curves, which describe investors' preferences, are quadratic and represented by branches of parabola, according to the Von Neumann-Morgenstern's approach. This hypothesis let us express the utility of the investment as a function of the expected return and risk of the investment itself. To this extent, we can apply many score systems. One reasonable function that is commonly employed by financial theorists assigns a portfolio with expected return E(r) and variance of returns σ^2 the following utility score:

$$U_i = E(r_i) - 0.005 A_i \sigma_i^2 \quad (5)$$

where U_i is the utility value and A_i is an index of the investors' risk aversion. (The factor 0.005 is a scaling convention that allows us to express the expected return and deviation in equation (5) as percentages rather than decimals)[12]. As far as A is concerned, we adopted a result according to which this indicator has an average

[12] See: Bodie, Z., Kane A., Marcus A.J., (1993, second ed.), *Investments*, Richard D. Irwin Inc., p. 146.

long term value equal to 5 and moves along a sinusoid that ranges from 4 to 6[13]. A high/low value of A indicates that investors are more risk averse/lover. We computed the daily value of the utility of investing in each sector index (ending up having always as many time series as the number of the sector indexes analyzed). We used this procedure also for the steps we are presenting below.

After that, we tried to decompose A into the two typical components of risk: the systematic one (market dependent) and the idiosyncratic one (in our case due to the specific characteristics of the sector).

Defined the systematic risk as:

$$\sigma_{S,i}^2 = \beta_i^2 \sigma_M^2 \quad (6)$$

where $\sigma_{S,i}^2$ is the systematic component of the variance of the sector returns, β_i^2 is the squared value of the systematic risk of the investment in the *i-th* sector and σ_M^2 is the market risk. In equilibrium the level of utility (5) must also be equal to:

$$U_i = E(r_i) - 0.005 A_{S,i} \sigma_{S,i}^2 \quad (7)$$

from which we could derive the precise value of the systematic risk aversion as:

$$A_{S,i} = \frac{U_i - E(r_i)}{-\sigma_{S,i}^2} \Big/ 0.005 \quad (8)$$

The next step consisted of the computation of the variations of the utility as:

$$\Delta U_i = U_{t+1,\mathrm{i}} - U_{t,i} \quad (9)$$

and on the "depuration" of this variations from the effects deriving from the variation in the returns ($(\Delta E(r))$). In fact, a variation in the level of the utility can be explained by three types of variations: 1) $\Delta E(r_i)$, i.e. variations in the expected returns; 2) $\Delta \sigma_\mathrm{i}^2$, i.e. variations in the levels of risk; 3) ΔA_i, i.e. variations in the levels of risk aversion. Thus, eliminating from ΔU_i the variation due to the expected returns, we remain with the part (now redefined as $\Delta U_{\sigma,\mathrm{i}}$) due only to variations in the quantity of risk or of A. Formally:

$$\Delta U_{\sigma,\mathrm{i}} = \Delta U_i - \Delta E(r_i) \quad (10)$$

[13] Mantovani, G.M., (1998), Rischio e valore dell'impresa. *L'approccio* contingent claim *della finanza aziendale*, EGEA, p. 78.

After that we started analyzing $\Delta U_{\sigma,i}$. Our purpose was, as stated above, to get the idiosyncratic risk aversion, which is what we defined at the beginning as the behavioral variable. Our idea was that finding and understanding the flow of this variable could say us more about the "adjustments" of investors' behavior.

As we have just seen, one of the two components of $\Delta U_{\sigma,i}$ is $\Delta\sigma_i^2$, i.e. the variations in the risk. This variable can be divided into the two usual parts: the systematic one and the idiosyncratic one. As we saw before (6), the systematic component of $\Delta\sigma_i^2$ is equal to $\sigma_{s,i}^2 = \beta_i^2\sigma_M^2$. Thus we could determine the variations of $\sigma_{S,i}^2$ as:

$$\Delta\sigma_{S,i}^2 = \beta_{i,t+1}^2\sigma_{M,t+1}^2 - \beta_{i,t}^2\sigma_{M,t}^2 \quad (11)$$

After that, remembering the formalization of $A_{S,i}$ (8), we could determine the variations of the utility due only to the systematic risk as:

$$\Delta U_{S,i} = \Delta\sigma_{S,i}^2 0.005 A_{S,i} \quad (12)$$

In doing this computation, we assumed that the systematic risk aversion $A_{S,i}$ at time t was equal to that at time t-1 (delayed variable). In fact, we consider more probable that the variations of the systematic risk aversion are more stable than those of the idiosyncratic one.

By difference, we determined the variations of the utility due only to the idiosyncratic (or diversifiable) risk aversion as:

$$\Delta U_{D,i} = \Delta U_{\sigma,i} - \Delta U_{S,i} \quad (13)$$

Also for $\Delta U_{D,i}$ we adopted the procedure used before, i.e. we decomposed it into its two parts: $\Delta\sigma_{D,i}^2$ and $\Delta A_{D,i}$. To do that, first we computed the diversifiable risk as the difference between the total risk and the systematic risk:

$$\sigma_{D,i}^2 = \sigma_i^2 - \sigma_{S,i}^2 \quad (14)$$

Then we obtained the variations of the diversifiable risk as:

$$\Delta\sigma_{D,i}^2 = \sigma_{D,it+1}^2 - \sigma_{D,it}^2 \quad (15)$$

Finally, we could derive the object of our research, i.e. the variations of the idiosyncratic risk aversion as:

$$\Delta A_{D,i} = \frac{\Delta U_{D,i}}{\Delta \sigma^2_{D,i}} \quad (16)$$

In the Table A. 4 - Table A. 6 in the Appendix, we present the results of this analysis. As we can see, the values of $A_{S,i}$ and $A_{D,i}$ are not means but medians. This choice depends on the fact that, given the length of the time horizon considered (15 years), the presence of peaks (anomalies) in the sample (due to extraordinary market events like, e.g. September 11th, or the last financial crisis) determined huge and misleading values of the mean itself. Instead, the use of the median fits the reality (and the hypothesis of the model) better.

Another much more important observation regards the average values of our variable of interest, i.e. the idiosyncratic risk aversion. As we can see, its values are all very small, nearly zero. This could suggest, at a first glance, that in the long term the flow of investors' risk aversion depends only on systematic factors (proper of the structure of the market) and not on the specific ones (e.g. investors' decisional process). Actually, this conclusion is "wrong". In fact, constructing the graph of all the sectors' A_D levels (in each market) and restricting the scale of observation (the range of the y-axis) focusing our attention on the short term adjustments, we discovered that this variable exhibits frequent peaks in its pattern, evidencing a tendency to adjusts to some other "undiscovered" quantities . Being impossible to reproduce all the analysis we have made (given the huge dataset considered), we provide just three examples (one for each market) of this evidence in Figure 1, Figure 2 and Figure 3.

The evidence is very strong in the sense that all the sector indexes analyzed exhibit patterns of A_D similar to those presented below.

So, as a first result of our analysis, we could state that *in the short term the flow of the idiosyncratic risk aversion (our proxy of the investors' behavior) is not flat but dynamic.*

The next important step was to understand which could be the variables that make A_D react.

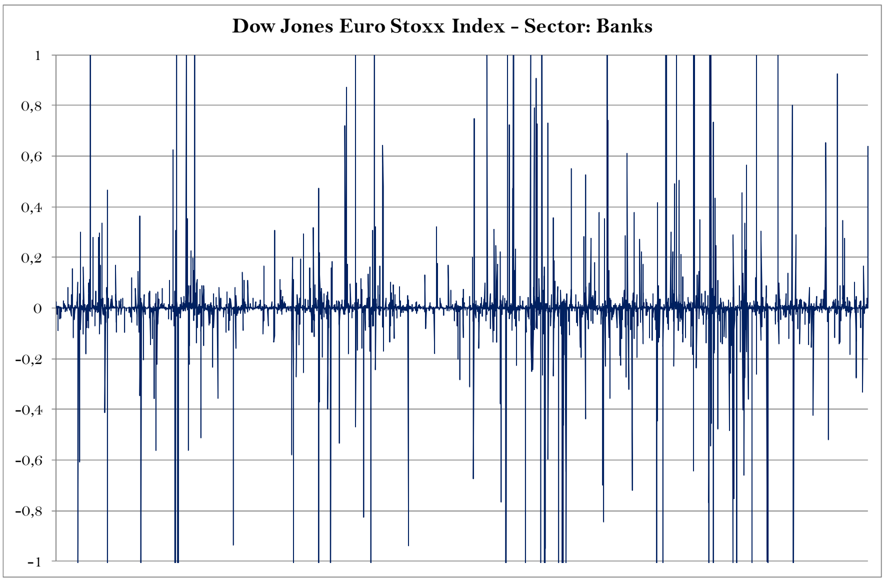

Figure 1. Pattern of A_D for the Banks sector (European market)

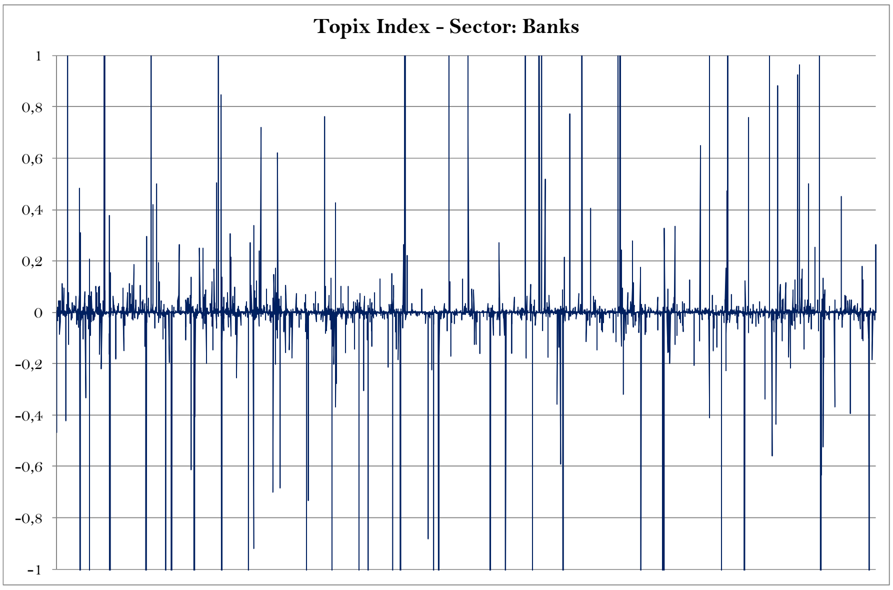

Figure 2. Pattern of A_Ds for the Banks sector (Japanese market)

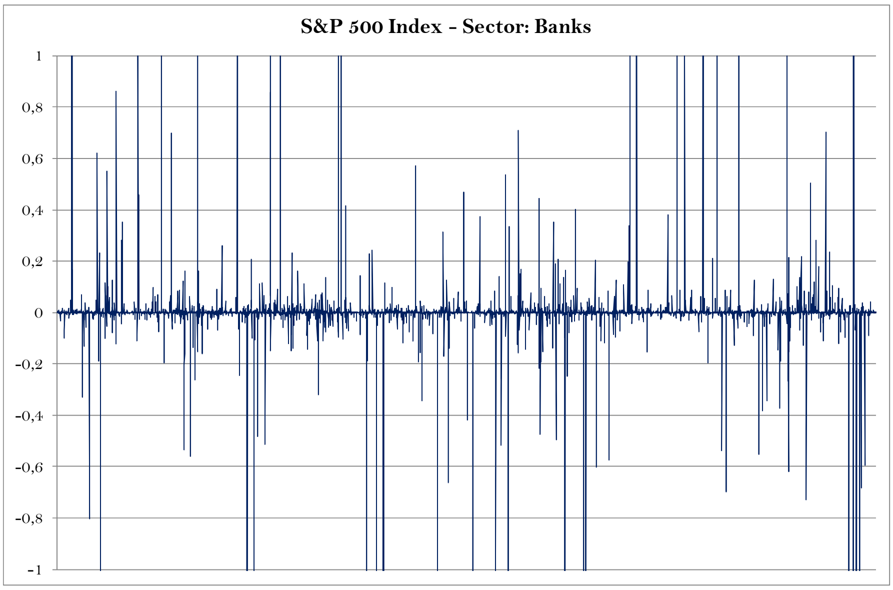

Figure 3. Pattern of A_D for the Banks sector (US market)

Deriving our model from the neoclassical finance, whose cornerstone is the notion of market efficiency, we decided to test if the pattern of A_D (both in the long and in the short term) depends on information. Before introducing our tests, we just want to point out that also the majority of the contributes of the behavioral finance literature deals with how agents process information. There the perspective is different because they assume that agents interpret information through heuristic processes, some sorts of rules of the thumb that in many cases work well but in some other cases can generate severe systematic errors. Kahneman and Tversky (1974) were the first to illustrate these *heuristic biases.*

Instead, we decided to consider the concept of ***information risk*** (Allen and Gale, 1994), which is the extra-volatility of stock prices due to investors' errors in evaluating the payoff risk (tied to the nature of "doing business" and so to organizational decisions, economical results, governance,…) and to the time that the market needs to understand the right measure of the payoff risk itself. In particular, the information risk can be of three types (Mantovani, 2004): 1) *risk of informative error*, due to the difficulties to estimate the value of an entrepreneurial initiative; 2) *risk of informative timing*, due to the time that information needs to be known by investors; 3) *risk of financial disclosure*, due to time and methods of information transmission.

Synthetically, the model of the information risk studies the differences between the long term and the short term volatilities, in order to understand how the market adjusts to the arrival of new information. In our analysis, for the short term standard deviations (σ_{ST}), we continued using those computed on the ex-ante weekly (meaning 5 observations) returns; whereas for the long term standard deviation (σ_{LT}) we adopted the ex-post 7-months (meaning 150 observations) standard deviations of the returns. The hypothesis to use ex-post data of standard deviation derives from the assumption that in the long term prices are mean reverting.

As for standard deviations, the third step was to compute the short term and the long term betas (respectively: β_{ST} and β_{LT}). Given these first elaborations, the model of the information risk establishes to compute a global measure of information risk (called RIT) as:

$$RIT_i = \sigma_{i,ST} - \sigma_{i,LT} \quad (17)$$

From (17) we can compute its daily variations as:

$$dRIT_i = RIT_{i,t+1} - \mathrm{RIT}_{\mathrm{i,t}} \quad (18)$$

Then we derive the systematic component of RIT, called RIS as:

$$RIS_i = \beta_{i,ST}\sigma_{i,ST} - \beta_{i,LT}\sigma_{i,LT} \quad (19)$$

As in (18), we compute its daily variations as:

$$dRIS_i = RIS_{i,t+1} - RIS_{i,t} \quad (20)$$

which is a measure of the information risk determined by the market structure. Finally, we can extract the variations of the diversifiable information risk (RID) as:

$$dRID_i = dRIT_i - dRIS_i \quad (21)$$

which represent the part of the information risk determined by the investors' appetite for risk in a specific sector/market.

Since our purpose was to understand the relationship between the investors' idiosyncratic risk aversion and the information risk, first we computed three types of simple linear regressions, considering our dataset as a panel time series:

a) $dAD_t = \alpha + \beta dRID_t + \varepsilon_t$;

b) $dAD_t = \alpha + \beta dRIS_t + \varepsilon_t$;

c) $dAD_t = \alpha + \beta dRIT_t + \varepsilon_t$;

As Table 2, Table 3 and Table 4 demonstrate, there are no significant relationships between these variables.

Source	SS	df	MS		
Model	12015930.1	1	12015930.1	Number of obs =	81414
Residual	4.4950e+11	81412	5521347.72	F(1, 81412) =	2.18
				Prob > F =	0.1402
				R-squared =	0.0000
				Adj R-squared =	0.0000
Total	4.4952e+11	81413	5521427.49	Root MSE =	2349.8

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-2782.325	1886.043	-1.48	0.140	-6478.957	914.3072
_cons	8.4674	8.235178	1.03	0.304	-7.673493	24.60829

Table 2.a. Regression of dAD_t over $dRID_t$ for the Dow Jones Euro Stoxx Sector Indexes

Source	SS	df	MS		
Model	8348854.82	1	8348854.82	Number of obs =	81414
Residual	4.4951e+11	81412	5521392.76	F(1, 81412) =	1.51
				Prob > F =	0.2188
				R-squared =	0.0000
				Adj R-squared =	0.0000
Total	4.4952e+11	81413	5521427.49	Root MSE =	2349.8

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	1484.185	1206.976	1.23	0.219	-881.4808	3849.85
_cons	8.467781	8.235212	1.03	0.304	-7.673177	24.60874

Table 2.b. Regression of dAD_t over $dRIS_t$ for the Dow Jones Euro Stoxx Sector Indexes

Source	SS	df	MS		Number of obs = 81414
Model	657340.073	1	657340.073		F(1, 81412) = 0.12
Residual	4.4952e+11	81412	5521487.24		Prob > F = 0.7301
					R-squared = 0.0000
					Adj R-squared = -0.0000
Total	4.4952e+11	81413	5521427.49		Root MSE = 2349.8

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	503.0355	1457.913	0.35	0.730	-2354.464	3360.535
_cons	8.466311	8.235282	1.03	0.304	-7.674785	24.60741

Table 2.c. Regression of dAD_t over $dRIT_t$ for the Dow Jones Euro Stoxx Sector Indexes

Source	SS	df	MS		Number of obs = 149259
Model	42372.7574	1	42372.7574		F(1,149257) = 0.13
Residual	4.6857e+10	149257	313933.699		Prob > F = 0.7133
					R-squared = 0.0000
					Adj R-squared = -0.0000
Total	4.6857e+10	149258	313931.88		Root MSE = 560.3

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	104.2999	283.8961	0.37	0.713	-452.1308	660.7305
_cons	1.24833	1.450269	0.86	0.389	-1.594169	4.090829

Table 3.a. Regression of dADt over dRIDt for the Topix Sector Indexes

Source	SS	df	MS		Number of obs = 149259
Model	40968.8943	1	40968.8943		F(1,149257) = 0.13
Residual	4.6857e+10	149257	313933.708		Prob > F = 0.7179
					R-squared = 0.0000
					Adj R-squared = -0.0000
Total	4.6857e+10	149258	313931.88		Root MSE = 560.3

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-103.4532	286.3755	-0.36	0.718	-664.7433	457.8369
_cons	1.248714	1.45027	0.86	0.389	-1.593786	4.091214

Table 3.b. Regression of dAD_t over $dRIS_t$ for the Topix Sector Indexes

Source	SS	df	MS
Model	17.496109	1	17.496109
Residual	4.6857e+10	149257	313933.983
Total	4.6857e+10	149258	313931.88

Number of obs	=	149259
F(1,149257)	=	0.00
Prob > F	=	0.9940
R-squared	=	0.0000
Adj R-squared	=	-0.0000
Root MSE	=	560.3

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	1.71906	230.2684	0.01	0.994	-449.6023	453.0405
_cons	1.248257	1.45027	0.86	0.389	-1.594244	4.090758

Table 3.c. Regression of dAD_t over $dRIT_t$ for the Topix Sector Indexes

Source	SS	df	MS
Model	1.9193e+09	1	1.9193e+09
Residual	8.1086e+14	366092	2.2149e+09
Total	8.1086e+14	366093	2.2149e+09

Number of obs	=	366094
F(1,366092)	=	0.87
Prob > F	=	0.3519
R-squared	=	0.0000
Adj R-squared	=	-0.0000
Root MSE	=	47063

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	9786.172	10512.8	0.93	0.352	-10818.61	30390.96
_cons	21.97757	77.78242	0.28	0.778	-130.4737	174.4288

Table 4.a. Regression of dAD_t over $dRID_t$ for the S&P 500 Sector Indexes

Source	SS	df	MS
Model	3.0460e+09	1	3.0460e+09
Residual	8.1086e+14	366092	2.2149e+09
Total	8.1086e+14	366093	2.2149e+09

Number of obs	=	366094
F(1,366092)	=	1.38
Prob > F	=	0.2409
R-squared	=	0.0000
Adj R-squared	=	0.0000
Root MSE	=	47063

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-9819.422	8373.315	-1.17	0.241	-26230.87	6592.027
_cons	21.96633	77.78236	0.28	0.778	-130.4848	174.4175

Table 4.b. Regression of dAD_t over $dRIS_t$ for the S&P 500 Sector Indexes

```
      Source |       SS       df       MS              Number of obs =  366094
-------------+------------------------------           F(  1,366092) =    0.33
       Model |   727100208     1   727100208           Prob > F      =  0.5667
    Residual |  8.1086e+14366092  2.2149e+09           R-squared     =  0.0000
-------------+------------------------------           Adj R-squared = -0.0000
       Total |  8.1086e+14366093  2.2149e+09           Root MSE      =   47063

------------------------------------------------------------------------------
         dAD |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dRIT |  -6373.947   11124.74    -0.57   0.567     -28178.1    15430.21
       _cons |    21.9551   77.78247     0.28   0.778    -130.4962    174.4065
------------------------------------------------------------------------------
```

Table 4.c. Regression of dAD_t over $dRIT_t$ for the S&P 500 Sector Indexes

Then we replicated our 3 linear regressions for each sector index[14]. As Table 5 shows, only few sectors exhibit a significant relation between our behavioural variable (represented by the A_D levels) and the information risk.

The output of all the significant regressions is presented in the Appendix (Table A. 7-Table A. 23)

dRID	dRIS	dRIT
EUROPE	**EUROPE**	**EUROPE**
RETAIL		
MEDIA		
UTILITIES		
JAPAN	**JAPAN**	**JAPAN**
FISHERIES	SECURITIES	FISHERIES
INFO & COMMUNICATION		INFO & COMMUNICATION
US	**US**	**US**
APPLICATION SOFTWARE	HOUSEHOLD PRODUCTS	INDUSTRIAL CONGLOMERATES
HOUSEHOLD PRODUCTS	TIRES &RUBBER	BREWERS
INDUSTRIAL CONGLOMERATES		
TIRES &RUBBER		

Table 5. Sectors with significant relations between A_D and the information risk

[14] Being the dataset regarding the US market really huge, we considered only a sub-sample of the S&P's 500 sector indexes. In particular, we analyzed only those sector indexes presenting a complete time series, excluding those which started to quote after the 1/1/1992.

Given the results obtained, we could derive a second important implication from our model, i.e. that *in the long term the markets are efficient from the informational point of view.* In fact, the variations of the investors' idiosyncratic risk aversion (A_D) are not due to problems of information risk.
Someone could argue that this result is not surprising since we saw that variations of A_D emerge only in the short term and disappear in the long term.

Another attempt we did was to restrict our attention to the period around the last financial crises. We run again our three regressions considering only the time period 1/1/2007 – 31/3/2009. Again we discovered no relations between the risk aversion levels and the information risk, as Table 6,Table 7,Table 8,Table 9 and Table A. 24-

-> Sector = 73

Source	SS	df	MS		
Model	.606096114	1	.606096114	Number of obs =	587
Residual	62.0768754	585	.106114317	F(1, 585) =	5.71
				Prob > F =	0.0172
Total	62.6829715	586	.106967528	R-squared =	0.0097
				Adj R-squared =	0.0080
				Root MSE =	.32575

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	-2.631889	1.101245	-2.39	0.017	-4.794763	-.4690143
_cons	.0009307	.0134454	0.07	0.945	-.0254764	.0273377

Table A. 46 in the Appendix suggest.

Source	SS	df	MS		
Model	105.646564	1	105.646564	Number of obs =	10566
Residual	3311909.78	10564	313.509067	F(1, 10564) =	0.34
				Prob > F =	0.5616
Total	3312015.43	10565	313.489392	R-squared =	0.0000
				Adj R-squared =	-0.0001
				Root MSE =	17.706

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-12.35518	21.28367	-0.58	0.562	-54.07518	29.36482
_cons	.2441879	.1722542	1.42	0.156	-.0934628	.5818385

Table 6.a. Regression of dAD_t over $dRID_t$ for the restricted sample of the Dow Jones Euro Stoxx Sectors Indexes

Source	SS	df	MS
Model	.129342684	1	.129342684
Residual	3312015.3	10564	313.519055
Total	3312015.43	10565	313.489392

Number of obs =	10566
F(1, 10564) =	0.00
Prob > F =	0.9838
R-squared =	0.0000
Adj R-squared =	-0.0001
Root MSE =	17.706

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-.3522386	17.34195	-0.02	0.984	-34.34573	33.64125
_cons	.2441725	.1722572	1.42	0.156	-.0934842	.5818292

Table 6.b. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Dow Jones Euro Stoxx Sector Indexes

Source	SS	df	MS
Model	111.867763	1	111.867763
Residual	3311903.56	10564	313.508478
Total	3312015.43	10565	313.489392

Number of obs =	10566
F(1, 10564) =	0.36
Prob > F =	0.5503
R-squared =	0.0000
Adj R-squared =	-0.0001
Root MSE =	17.706

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	-12.54502	21.00118	-0.60	0.550	-53.71129	28.62125
_cons	.2439443	.1722545	1.42	0.157	-.093707	.5815955

Table 6.c. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Dow Jones Euro Stoxx Sector Indexes

Source	SS	df	MS
Model	373.846361	1	373.846361
Residual	249381174	19369	12875.2736
Total	249381547	19370	12874.6282

Number of obs =	19371
F(1, 19369) =	0.03
Prob > F =	0.8647
R-squared =	0.0000
Adj R-squared =	-0.0001
Root MSE =	113.47

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-20.81266	122.1404	-0.17	0.865	-260.2183	218.593
_cons	-.5428311	.8152715	-0.67	0.506	-2.140834	1.055171

Table 7.a. Regression of dAD_t over $dRID_t$ for the restricted sample of the Topix Sector Indexes

Source	SS	df	MS
Model	2733.62852	1	2733.62852
Residual	249378814	19369	12875.1517
Total	249381547	19370	12874.6282

Number of obs	= 19371
F(1, 19369)	= 0.21
Prob > F	= 0.6450
R-squared	= 0.0000
Adj R-squared	= -0.0000
Root MSE	= 113.47

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-51.55248	111.8809	-0.46	0.645	-270.8487	167.7438
_cons	-.5425559	.8152677	-0.67	0.506	-2.140551	1.055439

Table 7.b. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Topix Sector Indexes

Source	SS	df	MS
Model	3394.22639	1	3394.22639
Residual	249378153	19369	12875.1176
Total	249381547	19370	12874.6282

Number of obs	= 19371
F(1, 19369)	= 0.26
Prob > F	= 0.6076
R-squared	= 0.0000
Adj R-squared	= -0.0000
Root MSE	= 113.47

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	-47.8146	93.12487	-0.51	0.608	-230.3474	134.7182
_cons	-.5427054	.8152665	-0.67	0.506	-2.140698	1.055287

Table 7.c. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Topix Sector Indexes

Source	SS	df	MS
Model	4.26326525	1	4.26326525
Residual	115122562	47278	2435.01338
Total	115122567	47279	2434.96196

Number of obs	= 47280
F(1, 47278)	= 0.00
Prob > F	= 0.9666
R-squared	= 0.0000
Adj R-squared	= -0.0000
Root MSE	= 49.346

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	1.264797	30.22737	0.04	0.967	-57.98127	60.51087
_cons	.1751607	.2269405	0.77	0.440	-.2696459	.6199674

Table 8.a. Regression of dAD_t over $dRID_t$ for the restricted sample of the S&P 500 Sector Indexes

```
      Source |       SS       df       MS              Number of obs =   47280
-------------+------------------------------           F(  1, 47278) =    0.03
       Model |  75.7675758     1  75.7675758           Prob > F      =  0.8600
    Residual |   115122491 47278  2435.01186           R-squared     =  0.0000
-------------+------------------------------           Adj R-squared = -0.0000
       Total |   115122567 47279  2434.96196           Root MSE      =  49.346

------------------------------------------------------------------------------
         dAD |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dRIS |  -3.228486   18.30239    -0.18   0.860    -39.10142    32.64445
       _cons |     .17507   .2269411     0.77   0.440    -.2697377    .6198778
```

Table 8.b. Regression of dAD_t over $dRIS_t$ for the restricted sample of the S&P 500 Sector Indexes

```
      Source |       SS       df       MS              Number of obs =   47280
-------------+------------------------------           F(  1, 47278) =    0.03
       Model |  83.3538461     1  83.3538461           Prob > F      =  0.8532
    Residual |   115122483 47278   2435.0117           R-squared     =  0.0000
-------------+------------------------------           Adj R-squared = -0.0000
       Total |   115122567 47279  2434.96196           Root MSE      =  49.346

------------------------------------------------------------------------------
         dAD |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dRIT |  -4.147924   22.41912    -0.19   0.853    -48.08971    39.79386
       _cons |   .1750665   .2269411     0.77   0.440    -.2697412    .6198742
```

Table 8.c. Regression of dAD_t over $dRIT_t$ for the restricted sample of the S&P 500 Sectors Indexes

dRID	dRIS	dRIT
EUROPE	**EUROPE**	**EUROPE**
	OIL & GAS	OIL & GAS
	CONSTRUCTION AND MATERIALS	CONSTRUCTION AND MATERIALS
JAPAN	**JAPAN**	**JAPAN**
RUBBER PRODUCTS	METAL PRODUCTS	METAL PRODUCTS
	SECURITIES	
US	**US**	**US**
ALUMINIUM	BUILDING PRODUCTS	ALUMINIUM
BREWERS	HOME FURNISHINGS	HOME FURNISHINGS
ELECTRICAL COMP & EQUIP	INSURANCE BROKERS	CONSUMER FINANCE
GAS UTILITIES	SYSTEMS SOFTWARE	
INSURANCE BROKERS	CONSUMER FINANCE	
PERSONAL PRODUCTS		
SYSTEMS SOFTWARE		

Table 9. Sectors with significant relationships between A_D and the information risk for the restrict sample

Coming back to our research objects and in particular to the third one, we can answer that, even in this neoclassical framework of analysis, investors' behavior doesn't seem to be determined by the information risk. So, in the long term markets are efficient whereas the short term fluctuations of A_D, our behavioral variable, must be explained using different approaches. In this sense, the choice of the behavioral finance's researchers to trust on event studies appears now stronger.

4 Role of the quality of risk

Having discovered the absence of any kind of relation between A_D and the level of information in the market, we tried to understand if the value of this variable in each specific industrial index was significantly correlated to that of other industries and if there were common results in all markets. Doing this, we tried to investigate the problem of the quality of risk. As we said before (Section 3), in the neoclassical finance the usual way to evaluate a portfolio is the binomial mean-variance. The model assumes that, in stochastic dominance of second kind (i.e. expected returns are normally distributed, agents maximize utility and are all risk averse) the relationship between risk and return is linear. Instead, premium prices are not linear because, being the agents all risk averse, they will require a higher premium in cases of downside risk than in those of upside risk. Along with this (see Copeland, Weston, 1988 for a more detailed analysis), the model doesn't consider the possibility that the quality of risk affects the shape of the utility curve and thus the determination of the premiums.
Our idea is that, if we discovered high values of correlation among the A_Ds of specific industries and the evidence was common in all the markets, then we could say that investors' behavior is influenced by the appetite for specific classes of risk. The following tables (Table 10. Correlation Matrix among ADs for the DJ Eurostoxx Sectors (part 1)-Table 19) show the correlation matrixes of the A_D of each sector index in each of the three markets analyzed.

	OIL & GAS	TECHNOLOGY	AUTOMOBILES & PARTS	BASIC RESOURCES	RETAIL	INSURANCE	FOOD AND BEVERAGE	TRAVEL AND LEISURE	FINANCIAL SERVICES
OIL & GAS	1								
TECHNOLOGY	0,00002	1							
AUTOMOBILES & PARTS	-0,00015	-0,00037	1						
BASIC RESOURCES	-0,00006	0,00029	0,00010	1					
RETAIL	-0,00037	-0,00165	-0,00013	-0,00002	1				
INSURANCE	-0,00040	-0,00034	-0,00201	-0,00017	-0,00015	1			
FOOD AND BEVERAGE	0,00021	0,00006	0,00000	0,00004	0,00021	0,00018	1		
TRAVEL AND LEISURE	-0,00054	-0,00011	0,00012	-0,00004	-0,00038	-0,00047	0,00022	1	
FINANCIAL SERVICES	0,00028	-0,00022	0,00050	-0,00049	-0,00187	0,00161	-0,00096	0,00915	1
PERSONAL & HOUSEHOLD GOODS	-0,00049	-0,00037	-0,00336	-0,00024	-0,00046	-0,00025	0,00027	0,00067	0,00037
MEDIA	-0,00032	-0,00011	0,00000	0,00001	-0,00021	-0,00024	0,00013	-0,00036	0,00019
BANKS	-0,00024	0,00005	0,00000	0,00055	-0,00017	-0,00068	0,00010	-0,00029	0,00010
CONSTUCTION AND MATERIALS	0,00317	-0,00009	0,00263	0,00018	0,00018	-0,00142	-0,00434	0,00011	0,00012
INDUSTRIAL GOODS AND SERVICES	-0,00031	-0,00003	0,00009	-0,00002	0,00127	-0,00019	0,00011	-0,00031	0,00161
CHEMICALS	-0,00039	-0,00007	0,00000	-0,00003	-0,00020	-0,00029	0,00013	-0,00035	0,00016
HEALTH CARE	0,00002	0,00332	-0,00033	-0,00009	-0,00019	-0,00008	0,00001	-0,00006	0,00275
TELECOMUNICATIONS	0,00032	0,00008	-0,00012	0,00004	0,00024	0,00031	-0,00013	0,00039	-0,00020
UTILITIES	0,00000	-0,00007	0,00012	0,00003	-0,00008	-0,00005	0,00000	-0,00004	-0,00014

Table 10. Correlation Matrix among A_Ds for the DJ Eurostoxx Sectors (part 1)

	PERSONAL & HOUSEHOLD GOODS	MEDIA	BANKS	CONSTUCTION AND MATERIALS	INDUSTRIAL GOODS AND SERVICES	CHEMICALS	HEALTH CARE	TELECOMUNICATIONS	UTILITIES
PERSONAL & HOUSEHOLD GOODS	1								
MEDIA	-0,00027	1							
BANKS	-0,00014	-0,00017	1						
CONSTUCTION AND MATERIALS	0,00007	-0,00006	-0,00019	1					
INDUSTRIAL GOODS AND SERVICES	-0,00022	-0,00018	-0,00014	0,00006	1				
CHEMICALS	-0,00028	-0,00021	-0,00017	-0,00004	-0,00018	1			
HEALTH CARE	-0,00041	0,00003	0,00005	0,00037	0,00007	0,00008	1		
TELECOMUNICATIONS	0,00027	0,00021	0,00240	0,00008	0,00017	0,00021	-0,00006	1	
UTILITIES	-0,00002	-0,00001	-0,00010	-0,00066	-0,00001	-0,00002	0,00002	0,00002	1

Table 11. Correlation Matrix among A_Ds for the DJ Eurostoxx Sectors (part 2)

	FISHERIES	MINING	CONSTRUCTI ON	FOODS	TEXTILES	PULP & PAPER	OIL & COAL PRODS	RUBBER PRODUCTS	GLASS & CERAMICS
FISHERIES	1								
MINING	0,00004	1							
CONSTRUCTION	-0,00024	0,00083	1						
FOODS	0,00020	-0,00006	0,00006	1					
TEXTILES	-0,00031	-0,00197	0,00077	0,00021	1				
PULP & PAPER	-0,00021	0,00005	0,00008	0,00021	-0,00037	1			
OIL & COAL PRODS	0,00019	-0,00001	-0,00081	-0,00020	0,02437	0,00021	1		
RUBBER PRODUCTS	0,00018	-0,00009	-0,00015	-0,00019	-0,00008	0,00020	-0,00023	1	
GLASS & CERAMICS	0,00037	-0,00015	-0,00037	-0,00034	0,00035	0,00037	-0,00037	-0,00048	1
IRON & STEEL	0,00007	0,00116	0,00007	-0,00003	-0,00033	0,00020	-0,00031	-0,00021	-0,00038
NONFERROUS METS	0,00012	-0,03068	-0,00002	-0,00011	0,03337	0,00012	-0,00012	-0,00010	-0,00021
METAL PRODUCTS	-0,00016	0,00005	-0,00003	0,00019	0,00131	-0,00021	0,00052	0,00031	0,00034
MACHINERY	-0,00019	-0,00004	0,00008	0,00020	0,00150	-0,00026	0,00021	-0,00032	0,00041
ELECTRIC MACHINE	-0,00052	0,00193	-0,00038	-0,00023	0,00225	-0,00195	0,00004	0,00122	0,00107
TRANSPORT EQUIP.	-0,00023	-0,00006	-0,00013	-0,98511	-0,00033	-0,00023	0,00035	0,00020	0,00040
PRECISIONINSTR.	0,00020	-0,00007	-0,00008	-0,00020	0,00037	0,00021	-0,00021	-0,00014	-0,00020
OTHER PRODUCTS	-0,00045	-0,00010	0,00018	0,00022	-0,00075	-0,00027	0,00016	0,00004	0,00053
REAL ESTATE	-0,00026	0,00190	0,00011	0,00025	-0,00030	-0,00025	0,00025	0,00015	0,00217
LAND TRANSPORT	-0,00019	0,00143	0,00009	0,00021	-0,00089	-0,00022	0,00018	0,00019	0,00042
MARINE TRANSPORT	-0,00015	0,00076	-0,00168	-0,00004	0,00037	0,00002	-0,00012	-0,00004	0,00481
AIR TRANSPORT	-0,00016	-0,00297	-0,00074	0,00015	-0,00048	-0,00040	0,00016	0,00038	0,00030
WAREHOUSE	-0,00014	0,00012	-0,00019	0,00023	-0,00192	-0,00024	0,00026	0,00025	0,00042
INFO & COMMUNICATION	0,00019	-0,00006	-0,00005	-0,00019	0,00022	0,00020	-0,00009	-0,00017	-0,00026
ELEC.POWER & GAS	-0,00003	0,00053	0,12446	0,00002	0,00010	-0,00002	0,00005	0,00007	0,00004
SERVICE	0,00024	-0,00006	-0,00011	-0,00021	0,00029	0,00018	-0,00021	-0,00025	0,00031
PHARMACEUTICAL	0,00018	-0,00008	-0,00006	-0,00020	0,00022	0,00021	-0,00022	-0,00019	-0,00043
WHOLESALE	0,00019	0,00002	0,00054	-0,00018	0,00111	0,00020	-0,00018	-0,00014	-0,00033
RETAIL	-0,00112	0,00055	-0,00114	0,00006	0,00237	-0,00009	0,00006	0,00007	0,00010
SECURITIES	0,00120	0,00108	-0,00004	-0,00003	0,00042	0,00006	-0,00001	-0,00005	-0,00006
INSURANCE	-0,00038	0,00029	0,00056	0,00035	-0,00067	-0,00041	0,00036	0,00042	0,00065
OTHER FINANCIALS	-0,00007	0,00196	0,00004	0,00016	-0,00248	-0,00015	0,00018	0,00020	0,00025
CHEMICAL	-0,00012	0,00065	0,00006	0,00014	-0,00013	-0,00013	0,00037	-0,00003	0,00029
BANKS	-0,00012	0,00013	-0,00016	0,00026	-0,00037	-0,00026	0,00027	0,00021	0,00047

Table 12. Correlation Matrix among A_Ds for the Topix Sectors (part 1)

	IRON & STEEL	NONFERROUS METS	METAL PRODUCTS	MACHINERY	ELECTRIC MACHINE	TRANSPORT EQUIP.	PRECISIONINSTR.	OTHER PRODUCTS	REAL ESTATE
IRON & STEEL	1								
NONFERROUS METS	-0,00010	1							
METAL PRODUCTS	0,00013	0,00009	1						
MACHINERY	0,00022	0,00023	-0,00020	1					
ELECTRIC MACHINE	0,00048	-0,00002	0,00012	0,00015	1				
TRANSPORT EQUIP.	0,00019	-0,01426	-0,00022	-0,00025	0,00065	1			
PRECISIONINSTR.	-0,00019	-0,00012	0,00021	0,00022	-0,00030	0,00022	1		
OTHER PRODUCTS	0,00026	0,00012	-0,00031	-0,00025	0,00306	-0,00026	0,00024	1	
REAL ESTATE	0,00026	0,00014	-0,00024	-0,00024	0,00024	-0,00027	0,00025	-0,00028	1
LAND TRANSPORT	0,00021	0,00012	-0,00020	-0,00021	0,00042	-0,00024	0,00022	-0,00023	-0,00025
MARINE TRANSPORT	-0,00132	0,00051	-0,00004	0,00038	0,00068	0,00025	-0,00005	0,00141	0,00017
AIR TRANSPORT	0,00016	0,00009	-0,01006	-0,00445	-0,00206	-0,00017	0,00016	-0,00016	-0,00015
WAREHOUSE	0,00023	0,00010	-0,00017	-0,00063	0,01050	-0,00025	0,00024	-0,00027	-0,00028
INFO & COMMUNICATION	-0,00019	-0,00011	0,00020	0,00006	-0,00024	0,00023	-0,00020	0,00023	0,00023
ELEC.POWER & GAS	0,00004	0,00001	-0,00009	-0,00014	-0,00178	-0,00013	0,00002	-0,00005	-0,00001
SERVICE	-0,00020	-0,00013	0,00020	0,00054	-0,00039	0,00024	-0,00022	0,00028	0,00027
PHARMACEUTICAL	-0,00021	-0,00012	0,00044	0,00022	-0,00106	0,00026	-0,00021	0,00024	0,00025
WHOLESALE	-0,00018	-0,00019	0,00018	0,00020	-0,00131	0,00014	-0,00019	0,00023	0,00020
RETAIL	0,00007	0,00005	-0,00005	-0,00037	-0,00211	-0,00005	0,00007	0,02494	0,00221
SECURITIES	0,00001	-0,00029	-0,00001	0,00036	-0,00014	0,00000	-0,00006	0,00036	0,00024
INSURANCE	0,00029	0,00019	-0,00093	-0,00042	0,00074	-0,00537	0,00038	-0,00035	-0,00032
OTHER FINANCIALS	-0,00258	0,00012	-0,00019	-0,00022	-0,00041	-0,00017	0,00017	-0,00046	-0,00020
CHEMICAL	-0,00046	-0,00017	-0,00023	-0,00022	-0,00114	-0,00022	0,00038	-0,00011	0,00109
BANKS	0,00066	0,00015	-0,00026	-0,00038	0,00041	-0,00031	0,00027	-0,00030	0,00332

Table 13. Correlation Matrix among A_Ds for the Topix Sectors (part 2)

	LAND TRANSPORT	MARINE TRANSPORT	AIR TRANSPORT	WAREHOUSE	INFO & COMMUNICATION	ELEC.POWER & GAS	SERVICE	PHARMACEUTICAL	WHOLESALE
LAND TRANSPORT	1								
MARINE TRANSPORT	0,00009	1							
AIR TRANSPORT	-0,00016	0,00025	1						
WAREHOUSE	-0,00024	0,00127	-0,00001	1					
INFO & COMMUNICATION	0,00020	-0,00008	0,00013	0,00022	1				
ELEC.POWER & GAS	-0,00004	0,00297	0,00033	-0,00004	0,00002	1			
SERVICE	0,00023	-0,00017	0,00017	0,00030	-0,00019	-0,00001	1		
PHARMACEUTICAL	0,00021	-0,00017	0,00016	0,00024	-0,00020	0,00003	-0,00021	1	
WHOLESALE	0,00002	-0,00004	-0,00002	0,00020	-0,00018	-0,05157	-0,00020	-0,00020	1
RETAIL	-0,00005	-0,00076	-0,00014	-0,00011	0,00006	0,00006	0,00006	0,00007	-0,00077
SECURITIES	0,00002	-0,00090	0,00023	-0,00002	-0,00005	-0,00006	-0,00236	-0,00007	0,00006
INSURANCE	-0,00034	-0,00010	0,00119	-0,00042	0,00020	-0,00003	0,00048	0,00027	0,00115
OTHER FINANCIALS	-0,00017	-0,00020	-0,00062	-0,00019	0,00009	0,00059	0,00015	0,00019	0,00015
CHEMICAL	-0,00014	0,00026	-0,00009	-0,00015	0,00021	0,00002	0,00015	0,00018	0,00029
BANKS	-0,00027	0,00004	-0,00021	-0,00034	0,00027	-0,00008	0,00005	0,00028	0,00025

Table 14. Correlation Matrix among A_Ds for the Topix Sectors (part 3)

	RETAIL	SECURITIES	INSURANCE	OTHER FINANCIALS	CHEMICAL	BANKS
RETAIL	1					
SECURITIES	0,00000	1				
INSURANCE	-0,00009	-0,00063	1			
OTHER FINANCIALS	-0,00019	0,00031	-0,00034	1		
CHEMICAL	0,00000	0,00059	-0,00050	0,00082	1	
BANKS	-0,00009	-0,00005	-0,00044	-0,00018	-0,00044	1

Table 15. Correlation Matrix among A_Ds for the Topix Sectors (part 4)

	ADVERTISING	AEROSPACE & DEFENCE	AGRICULTURAL PRODUCTS	AIR FREIGHT & COURIERS SI	AIRLINES SI	ALUMINIUM	APPAREL& ACCESSORIES	APPARELRETAIL
ADVERTISING	1,00000							
AEROSPACE & DEFENCE	0,001784	1,000000						
AGRICULTURAL PRODUCTS	0,040938	-0,000261	1,000000					
AIR FREIGHT & COURIERS SI	0,008025	0,002332	-0,001781	1,000000				
AIRLINES SI	0,002691	0,001981	-0,002196	0,006159	1,000000			
ALUMINIUM	0,998606	0,001747	-0,001787	0,008359	-0,000148	1,000000		
APPAREL& ACCESSORIES	-0,037251	-0,000464	-0,000199	0,039706	0,001719	-0,037580	1,000000	
APPARELRETAIL	0,000401	-0,000463	0,001367	0,001994	0,000226	-0,010722	0,000527	1,000000
APPLICATION SOFTWARE	-0,002932	0,002730	-0,012341	-0,003321	-0,003070	-0,002651	0,003074	-0,000814
AUTO PARTS & EQUIP	0,001135	-0,001889	-0,012757	-0,046036	0,002691	0,001834	0,000942	-0,000644
AUTOMOBILE MANUFACTURERS	0,001966	-0,001078	0,004842	0,003490	0,000912	0,002007	-0,000148	0,012418
DIV BANKS	-0,005230	0,002560	-0,000563	-0,005780	-0,006445	-0,005170	0,000504	-0,001273
BIOTECHNOLOGY	0,000693	-0,001950	0,010431	-0,007745	0,002611	0,000505	-0,001770	-0,003473
BREWERS	0,000775	-0,002276	0,004519	0,003135	-0,050580	0,000644	-0,001881	-0,001827
BROADCASTING & CABLE TV	0,001276	-0,002270	0,005247	0,011200	0,001540	0,001438	-0,026945	-0,000684
BUILDING PRODUCTS	0,003806	-0,001968	0,002272	0,000163	0,000277	0,003687	-0,001747	0,001428
CASINOS & GAMING	0,004884	-0,002290	0,001034	-0,065711	0,002894	0,002381	-0,007143	-0,000196
COMMERCIAL PRINTING	0,006906	0,001258	-0,040231	0,012157	-0,024261	0,008814	-0,000930	-0,004615
COMPUTER & ELECTR RETAIL	0,001048	-0,000109	0,017018	-0,000709	0,000881	0,001850	-0,001061	0,000242
COMPUTER HWARE	0,001973	0,003416	0,008867	0,005565	-0,000124	0,000799	0,010005	0,000709
COMP STORAGE & PERIPHERALS	0,004810	0,003742	0,010003	0,034491	-0,001101	0,005280	0,018363	0,003065
CONSTRUCTION & ENGINEERING	0,001847	-0,001429	0,002164	0,005175	0,001872	0,001972	-0,001574	0,000250
CONSTRUCTION & FARM MACHINE	-0,002236	0,001906	-0,002019	-0,022854	-0,019308	-0,002064	0,002521	-0,000976
CONSTRUCTION MATERIALS	-0,002034	0,003051	-0,004498	0,000716	-0,001919	-0,001879	0,001895	0,003560
DEPARTMENT STORES	-0,001768	0,001734	-0,002546	-0,001221	-0,002058	-0,001735	0,001688	0,000344
DISTRIBUTORS	-0,004082	0,001938	0,235772	-0,017853	-0,012414	-0,002809	-0,005234	0,002179
DIVERSIFIED CHEMICALS	0,008155	-0,002352	0,096353	0,002926	0,000654	0,005219	0,003434	-0,000391
DIV COMM & PROF SERV	-0,001610	0,000688	0,002157	0,004598	-0,001610	-0,000593	0,004240	-0,002329
DIV FINSVS	0,001993	0,001490	0,003621	0,002543	0,004288	0,001766	0,001264	-0,001582

Table 16. Part of the Correlation Matrix among A_Ds for the S&P 500 Sectors (part 1)

	APPLICATION SOFTWARE	AUTO PARTS & EQUIP	AUTOMOBILE MANUFACTURERS	DIV BANKS	BIOTECHNOLOGY	BREWERS	BROADCASTING & CABLE TV	BUILDING PRODUCTS
APPLICATION SOFTWARE	1,000000							
AUTO PARTS & EQUIP	0,003030	1,000000						
AUTOMOBILE MANUFACTURERS	0,015121	-0,001031	1,000000					
DIV BANKS	-0,003239	0,002066	0,000410	1,000000				
BIOTECHNOLOGY	0,003330	-0,001878	0,002355	0,059521	1,000000			
BREWERS	0,003496	-0,006329	-0,001745	0,003512	-0,001223	1,000000		
BROADCASTING & CABLE TV	0,003431	0,000368	-0,020563	0,001446	0,000641	-0,003803	1,000000	
BUILDING PRODUCTS	0,003129	-0,002097	-0,000498	0,002287	-0,001767	-0,003102	-0,004233	1,000000
CASINOS & GAMING	0,002355	0,021497	-0,000804	-0,015682	0,001190	-0,003095	-0,019049	-0,002364
COMMERCIAL PRINTING	-0,019186	0,001914	0,007730	0,008233	0,004988	-0,010225	-0,001897	0,000134
COMPUTER & ELECTR RETAIL	0,000113	-0,000372	0,001891	0,000120	-0,002097	-0,004809	0,000687	-0,000186
COMPUTER HWARE	-0,004275	-0,000259	-0,020324	-0,013765	0,002075	0,001828	-0,004511	-0,003110
COMP STORAGE & PERIPHERALS	0,025492	0,000312	0,016138	-0,000781	0,002629	-0,023167	0,000590	-0,000881
CONSTRUCTION & ENGINEERING	0,002175	-0,001465	-0,000339	0,001817	-0,001000	-0,001966	-0,000352	-0,001590
CONSTRUCTION & FARM MACHINE	0,037759	-0,023841	0,003518	-0,004252	0,005830	0,000429	-0,003727	0,003117
CONSTRUCTION MATERIALS	-0,004295	0,002733	0,000567	0,028753	0,001636	-0,001039	0,002713	0,001915
DEPARTMENT STORES	-0,002679	0,001850	-0,015494	-0,002007	0,001564	0,002219	0,007166	0,001916
DISTRIBUTORS	0,011670	-0,014009	0,004947	-0,027196	-0,015494	0,005799	0,015103	0,001599
DIVERSIFIED CHEMICALS	-0,021759	0,000294	-0,000969	0,004935	0,001288	-0,002258	0,001977	-0,004729
DIV COMM & PROF SERV	0,020468	0,000298	0,036598	0,003612	0,000432	0,001323	0,001765	0,000607
DIV FINSVS	0,023014	-0,000544	0,023752	0,003245	0,007751	-0,016724	0,136777	-0,001730

Table 17. Part of the Correlation Matrix among A_Ds for the S&P500 Sectors (part 2)

	CASINOS & GAMING	COMMERCIAL PRINTING	COMPUTER & ELECTR RETAIL	COMPUTER HWARE	COMP STORAGE & PERIPHERALS	CONSTRUCTION & ENGINEERING	CONSTRUCTION & FARM MACHINE	CONSTRUCTION MATERIALS
CASINOS & GAMING	1,000000							
COMMERCIAL PRINTING	-0,003038	1,000000						
COMPUTER & ELECTR RETAIL	-0,000328	0,002106	1,000000					
COMPUTER HWARE	-0,012678	0,004296	-0,002213	1,000000				
COMP STORAGE & PERIPHERALS	-0,000464	0,005362	0,000440	0,005235	1,000000			
CONSTRUCTION & ENGINEERING	-0,002047	0,000847	-0,000609	-0,000240	0,000308	1,000000		
CONSTRUCTION & FARM MACHINE	0,002546	0,007923	-0,001624	-0,037981	0,003113	-0,000156	1,000000	
CONSTRUCTION MATERIALS	0,000944	0,302026	0,002573	0,015454	0,003417	0,001410	-0,000595	1,000000
DEPARTMENT STORES	0,002273	-0,000650	0,000163	-0,000522	-0,000620	0,001505	-0,001983	-0,001756
DISTRIBUTORS	-0,000221	0,007529	-0,005029	-0,005903	0,015316	0,002314	0,522934	0,016966
DIVERSIFIED CHEMICALS	0,642978	0,001491	-0,000151	0,093845	0,008933	-0,001986	-0,023517	0,002486
DIV COMM & PROF SERV	0,000613	0,000542	-0,001815	-0,011690	-0,000426	0,000519	-0,001210	-0,000846
DIV FINSVS	-0,004420	-0,000660	0,000659	-0,002123	0,002613	-0,001624	0,003337	-0,003924

Table 18. Part of the Correlation Matrix among A_Ds for the S&P500 Sectors (part 3)

	DEPARTMENT STORES	DISTRIBUTORS	DIVERSIFIED CHEMICALS	DIV COMM & PROF SERV	DIV FINSVS
DEPARTMENT STORES	1,000000				
DISTRIBUTORS	-0,002355	1,000000			
DIVERSIFIED CHEMICALS	0,000676	0,160974	1,000000		
DIV COMM & PROF SERV	-0,000663	0,003771	0,000982	1,000000	
DIV FINSVS	0,002224	-0,000620	0,005036	0,043956	1,000000

Table 19. Part of the Correlation Matrix among A_Ds for the S&P500 Sectors (part 4)

The cells evidenced in grey show all the correlations greater than 25%. As we can see, there are significant values of correlation among the A_Ds of some industries but this high values are not common among markets, meaning that there isn't any appetite for specific sources of risk.
So, the third result of our analysis could be that: *the appetite for specific sources of risk doesn't explain the flow of the investors' idiosyncratic risk aversion.*

Conclusions

The purpose of this work was to take a position in the debate between the modern neoclassical finance and the behavioral finance.
Our attempt was to demonstrate that, even in a neoclassical framework, we can find evidence of the fact that investors' behavior (here measured by the flow of the idiosyncratic risk aversion) is a variable that needs to be taken into account (at least in the short term) in order to understand how financial markets work. In this analysis, however, we discovered that: A_D doesn't depend on the level/quantity of information in the market and it's independent also from the quality of risk. So, using a neoclassical approach we weren't able to say "something more" about investors' behavior. Actually, the consequence of this could be that the neoclassical approach is indeed unable to investigate investors' behavior. In other words, even if neoclassical finance still dominates the usual way to analyze financial markets at a macro level, the validity of the behavioral approach, marginalized as the "anomalies literature", could be the right key to understand how agents behave in the short term.

References

Allen, F., Gale, D., 1994, *Financial Innovation and risk sharing*, Mit-Press, pages 57-132.

Basu, S., 1978, "*The effect of earnings yield on assessments of the association between annual accounting income numbers and security prices*", in The Accounting Review 53, 599-625.

Bodie, Z., Kane A., Marcus A.J., 1993, second ed., *Investments*, Richard D. Irwin Inc., p. 243.

Copeland T.E., Weston J.F., (1988), *Teoria della Finanza e Politiche d'Impresa*, Addison- Wesley-EGEA, p. 275 and 339-418.

Daniel, K., Hirshleifer, D., Teoh, S.H., 2002, "*Investor psychology in capital markets: evidence and policy implications*", in Journal of Monetary Economics.

DeBondt, W.F.M., Thaler, R.H., 1985, "*Does the stock market over-react?*", in Journal of Finance 40, 793-805.

DeBondt, W.F.M., Thaler, R.H., 1987, "*Further evidence on investor over-reaction and stock market seasonality*", in Journal of Finance 42, 557-580.

Dreman, D., 1979, "*Contrarian investment strategy*", Random House, New York.

Fama, E.F., 1970, "*Efficient capital markets: a review of theory and empirical work*", in Journal of Finance 25, 34-105.

Fama, E.F., French, K., 1992, "*The cross-section of expected stock returns*", in Journal of Finance 47, 427-465.

Frankfurter, G.M., McGoun, E.G., 1995, "*The event study: is it either?*", in Journal of Investing 4, 8-16.

Frankfurter, G.M., McGoun, E.G., 2000, "*Market efficiency and behavioral finance: the nature of the debate*", in The Journal of Psychology and Financial Markets 1, 200-210.

Frankfurter, G.M., McGoun, E.G., 2002, "*Resistance is futile: the assimilation of behavioural finance*", in The Journal of Economic Behavior and Organization 48, 375-389.

Kahneman, D., Tversky, A., 1974, "*Judgement under Uncertainty: Heuristics and Biases*", in Science 185, 1124-1131.

Mantovani G.M., 1998, Rischio e valore dell'impresa. *L'approccio* contingent claim *della finanza aziendale*, EGEA, p. 78.

Mantovani G.M., *Assetti di* corporate governance *e rischi informativi: un tentativo di misurazione*, in AA.VV., (2004), *Riforma della* corporate governance *e nuove frontiere della comunicazione finanziaria: difendere il valore o le regole del gioco?*, Giorgio Bertinetti ed., FK Editore.

Ross, S.A., 2002, *A Neoclassical Look at Behavioral Finance; Closed End Funds*, European Financial Management, 8, 129-137.

Schleifer, A., 2000, "*Inefficient Markets, An Introduction to Behavioral Finance*", Claredon Lectures in Economics, Oxford University Press, Oxford, England.

Statman, M., 1999, *Behavioral Finance: past battles and future engagements*, Financial Analysts Journal 55, 18-27.

Von Neumann J., Morgenstern O., (1947), *Theory of Games and Economic Behaviour*, Princeton: Princeton University Press.

Appendix

SECTORS	AVERAGE RETURNS	AVERAGE ST. DEV.	AVERAGE EXTRA-RETURNS	AVERAGE ρ	AVERAGE BETA
DOW JONES EURO STOXX	0,08%	1,40%			
OIL & GAS	0,10%	1,62%	0,01%	0,64	0,83
TECHNOLOGY	0,06%	2,27%	-0,02%	0,77	1,33
AUTOMOBILES & PARTS	0,07%	1,94%	-0,01%	0,72	1,09
BASIC RESOURCES	0,08%	1,86%	-0,01%	0,61	0,89
RETAIL	0,07%	1,41%	-0,02%	0,73	0,82
INSURANCE	0,04%	1,89%	-0,05%	0,81	1,16
FOOD AND BEVERAGE	0,09%	1,26%	0,00%	0,60	0,63
TRAVEL AND LEISURE	0,05%	1,78%	-0,04%	0,59	0,82
FINANCIAL SERVICES	0,07%	1,54%	-0,01%	0,73	0,86
PERSONAL & HOUSEHOLD GOODS	0,08%	1,76%	0,00%	0,77	1,10
MEDIA	0,03%	1,67%	-0,05%	0,71	0,92
BANKS	0,07%	1,63%	-0,02%	0,86	1,01
CONSTUCTION AND MATERIALS	0,09%	1,50%	0,00%	0,76	0,93
INDUSTRIAL GOODS AND SERVICES	0,11%	1,55%	0,03%	0,82	0,96
CHEMICALS	0,14%	1,61%	0,06%	0,71	0,91
HEALTH CARE	0,12%	1,59%	0,03%	0,54	0,72
TELECOMUNICATIONS	0,12%	1,93%	0,04%	0,68	1,11
UTILITIES	0,11%	1,36%	0,03%	0,70	0,80

Table A. 1. Main Statistics for the Dow Jones Euro Stoxx Index

SECTORS	AVERAGE RETURNS	AVERAGE ST. DEV.	AVERAGE EXTRA-RETURNS	AVERAGE ρ	AVERAGE BETA
TOPIX	-0,06%	1,59%			
FISHERIES	-0,12%	1,78%	-0,06%	0,55	0,73
MINING	-0,09%	2,37%	-0,03%	0,49	0,81
CONSTRUCTION	-0,14%	1,76%	-0,09%	0,76	0,92
FOODS	-0,03%	1,25%	0,03%	0,65	0,58
TEXTILES	-0,08%	1,64%	-0,02%	0,75	0,85
PULP & PAPER	-0,10%	1,96%	-0,04%	0,57	0,77
OIL & COAL PRODS	-0,09%	2,11%	-0,04%	0,55	0,80
RUBBER PRODUCTS	-0,01%	2,19%	0,05%	0,60	0,90
GLASS & CERAMICS	-0,05%	1,95%	0,01%	0,75	1,00
IRON & STEEL	-0,04%	2,28%	0,02%	0,70	1,11
NONFERROUS METS	-0,05%	2,20%	0,01%	0,78	1,16
METAL PRODUCTS	-0,08%	1,72%	-0,03%	0,71	0,83
MACHINERY	-0,02%	1,79%	0,03%	0,85	1,01
ELECTRIC MACHINE	-0,02%	1,97%	0,04%	0,83	1,09
TRANSPORT EQUIP.	0,03%	1,90%	0,09%	0,76	0,97
PRECISIONINSTR.	0,05%	1,90%	0,11%	0,74	0,98
OTHER PRODUCTS	-0,04%	1,74%	0,02%	0,72	0,85
REAL ESTATE	-0,03%	2,61%	0,03%	0,71	1,28
LAND TRANSPORT	-0,03%	1,38%	-1,88%	0,66	0,68
MARINE TRANSPORT	-0,06%	2,47%	-1,90%	0,60	1,07
AIR TRANSPORT	-0,17%	1,95%	-2,02%	0,55	0,78
WAREHOUSE	-0,07%	1,85%	-1,91%	0,67	0,86
INFO & COMMUNICATION	-0,04%	2,25%	-1,89%	0,68	1,09
ELEC.POWER & GAS	-0,03%	1,24%	-1,88%	0,42	0,37
SERVICE	-0,07%	1,66%	-1,92%	0,78	0,86
PHARMACEUTICAL	0,03%	1,40%	-1,82%	0,59	0,59
WHOLESALE	-0,02%	2,11%	-1,87%	0,80	1,09
RETAIL	-0,06%	1,68%	-1,91%	0,73	0,83
SECURITIES	-0,09%	3,00%	-1,94%	0,78	1,59
INSURANCE	-0,04%	2,17%	-1,89%	0,64	0,97
OTHER FINANCIALS	-0,12%	2,28%	-1,97%	0,68	1,06
CHEMICAL	-0,02%	1,55%	-1,87%	0,86	0,90
BANKS	-0,17%	2,38%	-2,02%	0,79	1,26

Table A. 2. Main Statistics for the Topix Index

SECTORS	AVERAGE RETURNS	AVERAGE ST. DEV.	AVERAGE EXTRA-RETURNS	AVERAGE ρ	AVERAGE BETA
S&P 500	0,08%	1,28%			
ADVERTISING	0,03%	2,24%	-0,02%	0,58	0,95
AEROSPACE & DEFENCE	0,13%	1,52%	0,05%	0,64	0,83
AGRICULTURAL PRODUCTS	0,16%	2,34%	0,07%	0,34	0,67
AIR FREIGHT & COURIERS SI	0,14%	2,14%	0,06%	0,52	0,92
AIRLINES SI	-0,04%	2,55%	-0,13%	0,44	1,05
ALUMINIUM	0,00%	2,69%	-0,08%	0,47	1,12
APPAREL& ACCESSORIES	0,03%	1,93%	-0,05%	0,50	0,90
APPARELRETAIL	0,08%	2,50%	0,00%	0,51	1,08
APPLICATION SOFTWARE	-0,06%	3,46%	-0,14%	0,55	1,68
AUTO PARTS & EQUIP	0,04%	1,90%	-0,05%	0,57	0,95
AUTOMOBILE MANUFACTURERS	-0,01%	2,70%	-0,10%	0,49	1,19
DIV BANKS	0,08%	2,09%	0,00%	0,70	1,14
BIOTECHNOLOGY	0,17%	2,65%	0,09%	0,47	1,10
BREWERS	0,13%	1,54%	0,05%	0,36	0,51
BROADCASTING & CABLE TV	0,10%	2,36%	0,02%	0,55	1,08
BUILDING PRODUCTS	0,03%	2,16%	-0,05%	0,53	0,98
CASINOS & GAMING	0,17%	2,88%	0,09%	0,40	0,90
COMMERCIAL PRINTING	-0,03%	1,84%	-0,11%	0,48	0,82
COMPUTER & ELECTR RETAIL	0,09%	3,04%	0,02%	0,53	1,27
COMPUTER HWARE	0,14%	2,17%	0,07%	0,60	1,17
COMP STORAGE & PERIPHERALS	0,14%	3,49%	0,06%	0,59	1,60
CONSTRUCTION & ENGINEERING	0,04%	2,57%	-0,03%	0,46	1,04
CONSTRUCTION & FARM MACHINE	0,17%	2,15%	0,09%	0,56	1,09
CONSTRUCTION MATERIALS	0,00%	2,53%	-0,08%	0,55	1,12
DEPARTMENT STORES	0,04%	2,13%	-0,03%	0,57	1,10
DISTRIBUTORS	0,05%	1,57%	-0,03%	0,66	0,86
DIVERSIFIED CHEMICALS	0,05%	1,85%	-0,02%	0,58	0,93
DIV COMM & PROF SERV	0,01%	1,72%	-0,07%	0,59	0,94
DIV FINSVS	-0,15%	2,58%	-0,23%	0,72	1,30
DIVERSIFIED METALS & MINING	0,15%	2,78%	0,08%	0,42	1,08
DRUG RETAIL	0,14%	1,90%	0,07%	0,45	0,79
ELECTRIC UTILITIES	0,04%	1,28%	-0,03%	0,47	0,56
ELECTRICAL COMP & EQUIP	0,12%	1,75%	0,05%	0,68	1,01

Table A. 3. Main Statistics for the S&P 500 Index

SECTORS	AVERAGE RETURNS	AVERAGE ST. DEV.	AVERAGE EXTRA-RETURNS	AVERAGE ρ	AVERAGE BETA
ELEC EQMANUF.	0,07%	2,59%	-0,01%	0,58	1,38
HR & EMPL OYMENT SERV	-0,05%	3,04%	-0,13%	0,63	1,55
ENVR & FA CILITIES SERV	-0,03%	2,13%	-0,10%	0,43	0,76
FERTILISER & AGRI CHEMICALS	0,48%	2,82%	0,41%	0,47	1,09
FOOD DISTRIBUTORS	0,10%	1,69%	0,03%	0,42	0,63
FOOD RETAIL	0,02%	1,75%	-0,06%	0,45	0,72
FOOTWEAR	0,13%	2,32%	0,06%	0,42	0,87
FOREST PRODUCTS	0,02%	2,39%	-0,05%	0,50	1,06
GAS UTILITIES	0,08%	1,65%	0,01%	0,50	0,73
GENERALMERCH STORES	0,13%	2,18%	0,06%	0,54	1,07
GOLD	0,05%	2,93%	-0,03%	0,06	0,11
H/CARE DIST	0,07%	2,12%	0,00%	0,44	0,85
HEALTH CARE EQUIP	0,11%	1,64%	0,04%	0,57	0,87
HEALTH CARE FACILITIES	0,05%	2,42%	-0,03%	0,37	0,72
HEALTH CARE SUPPLIES	-0,02%	2,02%	-0,09%	0,40	0,70
HOME FURNISHINGS	0,00%	2,14%	-0,07%	0,47	0,91
HOME IMPROVE RETAIL	0,14%	2,44%	0,06%	0,59	1,26
HOMEBUILDING	0,07%	2,98%	0,00%	0,53	1,44
HOTELS	0,11%	2,28%	0,03%	0,58	1,15
HOUSEHOLD APPLIANCES	0,07%	1,87%	0,00%	0,59	0,94
HOUSEHOLD PRODUCTS	0,14%	1,47%	0,06%	0,48	0,67
HOUSEWARES & SPECIALTIES	-0,02%	1,64%	-0,10%	0,54	0,81
INDUSTRIAL CONGLOMERATES	0,08%	1,80%	0,00%	0,69	1,05
INDUSTRIAL GASES	0,16%	2,04%	0,09%	0,53	0,97
INDUSTRIAL MACHINERY	0,13%	1,62%	0,05%	0,67	0,94
INSURANCE BROKERS	0,05%	1,80%	-0,02%	0,54	0,80
INTEGRATED OIL & GAS	0,13%	1,63%	0,06%	0,50	0,74
INTEGRATED TELECOM SERV	0,03%	1,64%	-0,05%	0,59	0,87
INTERNET RETAIL	0,38%	2,97%	0,31%	0,54	1,35
INTERNET SOFTWARE & SERV	0,08%	3,81%	0,01%	0,58	1,72
IT CONS& O/SVS	0,03%	2,79%	-0,04%	0,44	1,11
LEISUREPRODUCTS	0,04%	1,96%	-0,03%	0,48	0,84
LIFE & HEALTH INS	0,06%	1,89%	-0,01%	0,65	0,99
MANAGEDHEALTH CARE	0,10%	2,43%	0,02%	0,39	0,73

Table A. 3 bis. Main Statistics for the S&P 500 Index

SECTORS	AVERAGE RETURNS	AVERAGE ST. DEV.	AVERAGE EXTRA-RETURNS	AVERAGE ρ	AVERAGE BETA
METAL &GLASS CONT	0,01%	1,95%	-0,06%	0,45	0,77
MOTORCYCLE MANUFACTURERS	-0,03%	2,87%	-0,11%	0,52	1,10
MOVIES & ENTERTAINMENT	0,05%	2,09%	-0,02%	0,61	1,11
MULTILINE INSURANCE	-0,02%	2,27%	-0,10%	0,63	1,16
MULTI UTILITIES	-0,25%	2,33%	-0,33%	0,51	0,87
OFFICE ELECTRONICS	-0,19%	3,20%	-0,27%	0,45	0,99
OFFICE SERV & SUPPLIES	0,05%	1,65%	-0,02%	0,59	0,83
OIL & GAS DRILLING	0,15%	3,14%	0,08%	0,35	0,96
OIL & GAS EQUIP & SERV	0,11%	2,71%	0,04%	0,40	0,97
OIL & GAS EXPLOR & PROD	0,09%	2,38%	0,02%	0,38	0,83
OIL & GAS REFING & MARK	0,05%	2,36%	-0,03%	0,44	0,89
PACKAGED FOODS	0,07%	1,17%	0,00%	0,56	0,61
PAPER PACKAGING	0,02%	1,96%	-0,06%	0,55	1,00
PAPER PRODUCTS	0,03%	2,10%	-0,04%	0,52	0,96
PERSONAL PRODUCTS	0,14%	1,83%	0,07%	0,43	0,72
PHARMACEUTICALS	0,08%	1,59%	0,00%	0,57	0,83
PHOTOGRAPHIC PRODUCTS	-0,19%	2,61%	-0,27%	0,43	1,00
PROPERTY & CASUALTY INSUR	0,07%	1,68%	-0,01%	0,63	0,89
PUBLISHING & PRINTING	0,04%	1,49%	-0,04%	0,60	0,78
RAILROADS	0,14%	1,90%	0,07%	0,54	0,94
REAL ESTATE INVST TRUSTS	-0,02%	2,24%	-0,09%	0,61	1,11
RESTAURANTS	0,16%	1,77%	0,09%	0,47	0,79
SOFT DRINKS	0,10%	1,58%	0,02%	0,47	0,65
SPECIALTY CHEMICALS	0,12%	1,50%	0,05%	0,61	0,79
SPECIALTY STORES	0,01%	2,14%	-0,07%	0,59	1,10
STEEL	0,07%	2,65%	0,00%	0,48	1,19
SYSTEMSSOFTWARE	0,20%	2,31%	0,13%	0,63	1,29
TIRES &RUBBER	-0,05%	2,82%	-0,13%	0,47	1,15
TOBACCO	0,10%	1,96%	0,03%	0,35	0,61
TRADINGCOMP & DISTRIBUTORS	0,07%	1,87%	-0,01%	0,56	0,80
WIRELESS TELECOM SERV	0,03%	3,13%	-0,05%	0,50	1,25
HYP MKTS&SUP CNT	0,01%	1,53%	-0,07%	0,51	0,74
H/C SERVICES	0,33%	1,67%	0,25%	0,47	0,70
REGIONAL BNKS	-0,19%	2,53%	-0,27%	0,76	1,30

Table A. 3 ter. Main Statistics for the S&P 500 Index

SECTORS	AVERAGE RETURNS	AVERAGE ST. DEV.	AVERAGE EXTRA-RETURNS	AVERAGE ρ	AVERAGE BETA
THRFTS/MGE FIN	-0,69%	2,76%	-0,76%	0,64	1,34
SPEC FINANCE	-0,02%	2,38%	-0,09%	0,61	1,18
CONS FINANCE	0,13%	2,45%	0,06%	0,63	1,24
ASS MGT&CUST BNK	0,05%	2,33%	-0,03%	0,80	1,42
INV BNK& BROK	-0,02%	2,83%	-0,09%	0,76	1,63
DATA PRO&OUT SVS	0,05%	1,45%	-0,02%	0,73	0,90
HM ENT S/WARE	-0,14%	2,89%	-0,22%	0,50	1,33
COMM. EQUIPMENT	0,02%	2,66%	-0,05%	0,63	1,47
ELEC MANU SVS	-0,08%	2,59%	-0,15%	0,61	1,48
S/CON EQUIPMENT	0,11%	3,97%	0,03%	0,55	1,73
SEMICONDUCTORS	0,18%	2,98%	0,11%	0,59	1,65
OIL & GAS STORAGE & TRANSP	0,01%	2,43%	-0,07%	0,57	1,09
EDUCATION SERVICES SI	-0,06%	3,20%	-0,13%	0,34	1,03
SPL. CONS. SERVICES SI	-0,07%	2,53%	-0,14%	0,50	0,92
AUTOMOTIVE RETAIL SI	0,14%	2,05%	0,07%	0,55	0,82
HOMEFURNSH RETAIL SI	0,01%	2,65%	-0,06%	0,58	1,16
IND. POWER PROD & ENERGY TR	-0,12%	2,35%	-0,19%	0,54	0,89

Table A. 3 quater. Main Statistics for the S&P 500 Index

SECTORS	AVERAGE UTILITY	MEDIAN OF AS	MEDIAN OF dAD
OIL & GAS	-0,32%	697,03%	0,01%
TECHNOLOGY	-14,28%	603,08%	0,02%
AUTOMOBILES & PARTS	-11,98%	642,24%	0,01%
BASIC RESOURCES	-7,44%	753,35%	0,01%
RETAIL	-1,16%	644,14%	0,01%
INSURANCE	-11,81%	569,87%	0,03%
FOOD AND BEVERAGE	2,57%	730,18%	0,01%
TRAVEL AND LEISURE	-7,32%	783,43%	0,01%
FINANCIAL SERVICES	-2,95%	628,63%	0,02%
PERSONAL & HOUSEHOLD GOODS	-3,07%	601,86%	0,02%
MEDIA	-8,86%	655,88%	0,02%
BANKS	-5,36%	543,48%	0,04%
CONSTUCTION AND MATERIALS	-0,37%	612,35%	0,02%
INDUSTRIAL GOODS AND SERVICES	1,30%	575,62%	0,02%
CHEMICALS	4,02%	640,77%	0,01%
HEALTH CARE	2,16%	865,24%	0,01%
TELECOMUNICATIONS	-1,96%	673,93%	0,02%
UTILITIES	4,17%	661,80%	0,01%

Table A. 4. Utility, systematic risk aversion, idiosyncratic risk aversion for the Dow Jones Euro Stoxx Index

SECTORS	AVERAGE UTILITY	MEDIAN OF AS	MEDIAN OF dAD
FISHERIES	-0,23617	8,48347	0,00008
MINING	-0,29878	9,26878	0,00005
CONSTRUCTION	-0,26738	5,90087	0,00013
FOODS	-0,08995	6,88943	0,00018
TEXTILES	-0,18204	6,11259	0,00020
PULP & PAPER	-0,24637	7,88831	0,00010
OIL & COAL PRODS	-0,26005	8,28584	0,00011
RUBBER PRODUCTS	-0,19481	7,67641	0,00006
GLASS & CERAMICS	-0,19733	6,14208	0,00017
IRON & STEEL	-0,23779	6,54913	0,00015
NONFERROUS METS	-0,23372	6,01174	0,00020
METAL PRODUCTS	-0,19621	6,47553	0,00016
MACHINERY	-0,15059	5,55797	0,00031
ELECTRIC MACHINE	-0,16984	5,61654	0,00031
TRANSPORT EQUIP.	-0,11215	6,05120	0,00022
PRECISIONINSTR.	-0,09077	6,35460	0,00016
OTHER PRODUCTS	-0,15753	6,39138	0,00012
REAL ESTATE	-0,28696	6,66439	0,00015
LAND TRANSPORT	-0,10426	6,86721	0,00014
MARINE TRANSPORT	-0,28396	7,45952	0,00009
AIR TRANSPORT	-0,31574	8,82815	0,00007
WAREHOUSE	-0,19309	6,91039	0,00011
INFO & COMMUNICATION	-0,23998	6,84996	0,00011
ELEC.POWER & GAS	-0,09642	9,56842	0,00005
SERVICE	-0,18802	6,02105	0,00018
PHARMACEUTICAL	-0,04937	7,67832	0,00013
WHOLESALE	-0,20226	5,85696	0,00024
RETAIL	-0,17069	6,23665	0,00017
SECURITIES	-0,41790	5,95396	0,00016
INSURANCE	-0,22995	7,08807	0,00011
OTHER FINANCIALS	-0,33231	6,71708	0,00011
CHEMICAL	-0,10999	5,51687	0,00034
BANKS	-0,38910	5,87296	0,00020

Table A. 5. Utility, systematic risk aversion, idiosyncratic risk aversion for the Topix Index

SECTORS	AVERAGE UTILITY	MEDIAN OF AS	MEDIAN OF dAD
ADVERTISING	-0,16074	8,31622	0,00009
AEROSPACE & DEFENCE	0,04299	7,35951	0,00012
AGRICULTURAL PRODUCTS	-0,04643	12,69040	0,00001
AIR FREIGHT & COURIERS SI	-0,03324	8,79113	0,00000
AIRLINES SI	-0,28575	10,82744	0,00004
ALUMINIUM	-0,28961	9,92612	0,00002
APPAREL& ACCESSORIES	-0,11989	9,42620	0,00004
APPARELRETAIL	-0,14231	9,42099	0,00003
APPLICATION SOFTWARE	-0,53299	8,50810	0,00005
AUTO PARTS & EQUIP	-0,11728	8,14311	0,00003
AUTOMOBILE MANUFACTURERS	-0,33015	9,88386	0,00003
DIV BANKS	-0,15894	6,65384	0,00017
BIOTECHNOLOGY	-0,07876	10,31325	0,00004
BREWERS	0,04267	12,15568	0,00002
BROADCASTING & CABLE TV	-0,14838	8,33707	0,00008
BUILDING PRODUCTS	-0,16426	8,89266	0,00003
CASINOS & GAMING	-0,16042	10,67615	0,00000
COMMERCIAL PRINTING	-0,16797	9,92913	0,00003
COMPUTER & ELECTR RETAIL	-0,24817	8,89037	0,00002
COMPUTER HWARE	-0,02499	7,70779	0,00012
COMP STORAGE & PERIPHERALS	-0,33252	8,06760	0,00005
CONSTRUCTION & ENGINEERING	-0,22120	10,20371	0,00000
CONSTRUCTION & FARM MACHINE	-0,00169	8,07929	0,00003
CONSTRUCTION MATERIALS	-0,25568	8,60556	0,00004
DEPARTMENT STORES	-0,12655	8,36505	0,00005
DISTRIBUTORS	-0,05054	7,40162	0,00016
DIVERSIFIED CHEMICALS	-0,07621	7,86092	0,00007
DIV COMM & PROF SERV	-0,10852	7,90676	0,00007
DIV FINSVS	-0,59933	6,41827	0,00013
DIVERSIFIED METALS & MINING	-0,15990	10,97538	-0,00001
DRUG RETAIL	0,01186	10,44843	0,00002
ELECTRIC UTILITIES	-0,02471	9,55365	0,00006
ELECTRICAL COMP & EQUIP	0,00399	6,78512	0,00012
ELEC EQMANUF.	-0,18861	8,27580	0,00003

Table A. 6. Utility, systematic risk aversion, idiosyncratic risk aversion for the S&P 500 Index

SECTORS	AVERAGE UTILITY	MEDIAN OF AS	MEDIAN OF dAD
HR & EMPL OYMENT SERV	-0,38948	7,79871	0,00001
ENVR & FA CILITIES SERV	-0,21230	10,61079	0,00000
FERTILISER & AGRI CHEMICALS	0,16634	10,79768	0,00002
FOOD DISTRIBUTORS	0,00067	11,33283	0,00001
FOOD RETAIL	-0,09706	10,36135	0,00002
FOOTWEAR	-0,07174	11,21558	0,00000
FOREST PRODUCTS	-0,19690	9,12544	0,00006
GAS UTILITIES	-0,03830	9,22798	0,00002
GENERALMERCH STORES	-0,04122	8,83108	0,00007
GOLD	-0,25031	15,89803	-0,00001
H/CARE DIST	-0,09824	10,76540	0,00000
HEALTH CARE EQUIP	0,01333	8,29931	0,00003
HEALTH CARE FACILITIES	-0,24640	11,75149	-0,00003
HEALTH CARE SUPPLIES	-0,55890	11,05521	-0,00001
HOME FURNISHINGS	-0,17065	10,42032	0,00002
HOME IMPROVE RETAIL	-0,08375	8,26950	0,00005
HOMEBUILDING	-0,29011	8,87080	0,00004
HOTELS	-0,09898	8,25771	0,00011
HOUSEHOLD APPLIANCES	-0,06478	7,86742	0,00005
HOUSEHOLD PRODUCTS	0,04950	9,67503	0,00006
HOUSEWARES & SPECIALTIES	-0,13059	8,77818	0,00003
INDUSTRIAL CONGLOMERATES	-0,05498	6,74260	0,00011
INDUSTRIAL GASES	0,00960	8,56521	0,00006
INDUSTRIAL MACHINERY	0,02989	6,78716	0,00011
INSURANCE BROKERS	-0,08540	8,70690	0,00004
INTEGRATED OIL & GAS	0,03568	9,28977	0,00008
INTEGRATED TELECOM SERV	-0,08019	8,14420	0,00010
INTERNET RETAIL	0,04761	8,32233	0,00003
INTERNET SOFTWARE & SERV	-0,47877	7,96160	0,00008
IT CONS& O/SVS	-0,26245	10,09113	0,00002
LEISUREPRODUCTS	-0,10319	10,15988	0,00003
LIFE & HEALTH INS	-0,14227	7,05399	0,00009
MANAGEDHEALTH CARE	-0,12898	11,12699	-0,00001
METAL &GLASS CONT	-0,12216	9,85562	0,00002

Table A. 6 bis. Utility, systematic risk aversion, idiosyncratic risk aversion for the S&P 500 Index

SECTORS	AVERAGE UTILITY	MEDIAN OF AS	MEDIAN OF dAD
MOTORCYCLE MANUFACTURERS	-0,38084	8,99236	0,00003
MOVIES & ENTERTAINMENT	-0,12406	7,79164	0,00007
MULTILINE INSURANCE	-0,28830	7,39207	0,00009
MULTI UTILITIES	-0,50321	9,18251	0,00004
OFFICE ELECTRONICS	-0,63646	10,24895	0,00002
OFFICE SERV & SUPPLIES	-0,04871	7,91238	0,00006
OIL & GAS DRILLING	-0,19220	11,94336	-0,00004
OIL & GAS EQUIP & SERV	-0,15350	11,03018	0,00001
OIL & GAS EXPLOR & PROD	-0,11201	11,49640	0,00001
OIL & GAS REFING & MARK	-0,17972	10,76154	-0,00002
PACKAGED FOODS	0,02024	8,31312	0,00008
PAPER PACKAGING	-0,12312	8,15950	0,00007
PAPER PRODUCTS	-0,15045	8,84006	0,00002
PERSONAL PRODUCTS	0,01171	10,61122	-0,00002
PHARMACEUTICALS	-0,01363	7,96351	0,00008
PHOTOGRAPHIC PRODUCTS	-0,49250	10,71576	0,00003
PROPERTY & CASUALTY INSUR	-0,05504	7,37476	0,00006
PUBLISHING & PRINTING	-0,06444	7,89875	0,00011
RAILROADS	0,01169	8,70354	0,00006
REAL ESTATE INVST TRUSTS	-0,29869	7,78218	0,00008
RESTAURANTS	0,05521	9,38555	0,00004
SOFT DRINKS	0,00517	9,61435	0,00000
SPECIALTY CHEMICALS	0,03705	7,49782	0,00010
SPECIALTY STORES	-0,17573	7,89356	0,00006
STEEL	-0,19383	9,43366	0,00005
SYSTEMSSOFTWARE	0,00798	7,49030	0,00013
TIRES &RUBBER	-0,38485	9,92291	0,00002
TOBACCO	-0,04468	11,99403	0,00000
TRADINGCOMP & DISTRIBUTORS	-0,06718	8,31544	0,00002
WIRELESS TELECOM SERV	-0,38953	9,81101	0,00000
HYP MKTS&SUP CNT	-0,07538	9,87149	0,00001
H/C SERVICES	0,21846	10,98862	0,00000
REGIONAL BNKS	-0,60972	6,40666	0,00017
THRFTS/MGE FIN	-1,20575	7,76337	0,00007

Table A. 6 ter. Utility, systematic risk aversion, idiosyncratic risk aversion for the S&P 500 Index

SECTORS	AVERAGE UTILITY	MEDIAN OF AS	MEDIAN OF dAD
SPEC FINANCE	-0,30530	7,72740	0,00009
CONS FINANCE	-0,12949	7,37954	0,00005
ASS MGT&CUST BNK	-0,22831	6,06852	0,00025
INV BNK& BROK	-0,44703	6,22459	0,00016
DATA PRO&OUT SVS	-0,02831	6,34974	0,00014
HM ENT S/WARE	-0,44230	9,69494	0,00004
COMM. EQUIPMENT	-0,24334	7,35536	0,00007
ELEC MANU SVS	-0,32651	7,77493	0,00003
S/CON EQUIPMENT	-0,45808	8,63886	0,00003
SEMICONDUCTORS	-0,12835	7,80720	0,00006
OIL & GAS STORAGE & TRANSP	-0,25301	8,02237	0,00002
EDUCATION SERVICES SI	-0,49493	12,83000	0,00000
SPL. CONS. SERVICES SI	-0,33468	9,18589	0,00004
AUTOMOTIVE RETAIL SI	-0,03014	8,68052	0,00010
HOMEFURNSH RETAIL SI	-0,25715	8,18188	0,00004
IND. POWER PROD & ENERGY TR	-0,39949	8,52889	0,00008

Table A. 6 quater. Utility, systematic risk aversion, idiosyncratic risk aversion for the S&P 500 Index

```
-> Sector = 5

      Source |       SS       df       MS              Number of obs =    4523
-------------+------------------------------           F(  1,  4521) =    7.66
       Model |  531.082175     1  531.082175           Prob > F      =  0.0057
    Residual |  313381.799  4521  69.3169207           R-squared     =  0.0017
-------------+------------------------------           Adj R-squared =  0.0015
       Total |  313912.881  4522   69.419036           Root MSE      =  8.3257

------------------------------------------------------------------------------
         dAD |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dRID |  -131.2753   47.42657    -2.77   0.006    -224.2545   -38.29601
       _cons |   .1184544   .1237959     0.96   0.339    -.1242461     .361155
```

Table A. 7. Regression of dAD_t over $dRID_t$ for the Retail Index-DJ Eurostoxx

-> Sector = 11

Source	SS	df	MS
Model	396338103	1	396338103
Residual	4.4837e+11	4521	99175521
Total	4.4877e+11	4522	99241235.9

Number of obs	=	4523
F(1, 4521)	=	4.00
Prob > F	=	0.0457
R-squared	=	0.0009
Adj R-squared	=	0.0007
Root MSE	=	9958.7

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-92947.25	46494.96	-2.00	0.046	-184100.1	-1794.4
_cons	148.1814	148.0775	1.00	0.317	-142.1228	438.4856

Table A. 8. Regression of dAD_t over $dRID_t$ for the Media Index-DJ Eurostoxx

-> Sector = 16

Source	SS	df	MS
Model	92.2491212	1	92.2491212
Residual	55463.8881	4521	12.2680575
Total	55556.1372	4522	12.2857446

Number of obs	=	4523
F(1, 4521)	=	7.52
Prob > F	=	0.0061
R-squared	=	0.0017
Adj R-squared	=	0.0014
Root MSE	=	3.5026

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	30.38792	11.08174	2.74	0.006	8.662303	52.11354
_cons	-.0072876	.0520804	-0.14	0.889	-.1093907	.0948155

Table A. 9. Regression of dAD_t over $dRID_t$ for the Health Care Index-DJ Eurostoxx

-> Sector = 18

Source	SS	df	MS
Model	15007.7637	1	15007.7637
Residual	10461026.7	4521	2313.87452
Total	10476034.5	4522	2316.68166

Number of obs	=	4523
F(1, 4521)	=	6.49
Prob > F	=	0.0109
R-squared	=	0.0014
Adj R-squared	=	0.0012
Root MSE	=	48.103

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-706.8746	277.5583	-2.55	0.011	-1251.025	-162.7246
_cons	.0742126	.7152479	0.10	0.917	-1.328023	1.476448

Table A. 10. Regression of dAD_t over $dRID_t$ for the Utilities Index-DJ Eurostoxx

-> sector = 1

Source	SS	df	MS
Model	3905.71376	1	3905.71376
Residual	3697257.57	4521	817.79641
Total	3701163.28	4522	818.479276

Number of obs =	4523
F(1, 4521) =	4.78
Prob > F =	0.0289
R-squared =	0.0011
Adj R-squared =	0.0008
Root MSE =	28.597

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	184.1545	84.26644	2.19	0.029	18.95105	349.3579
_cons	.406474	.4252157	0.96	0.339	-.4271567	1.240105

Table A. 11 Regression of dAD_t over $dRID_t$ for the Fisheries Index-Topix

-> sector = 23

Source	SS	df	MS
Model	22602.4147	1	22602.4147
Residual	16489199.4	4521	3647.24604
Total	16511801.8	4522	3651.43781

Number of obs =	4523
F(1, 4521) =	6.20
Prob > F =	0.0128
R-squared =	0.0014
Adj R-squared =	0.0011
Root MSE =	60.392

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-380.2198	152.7354	-2.49	0.013	-679.6559	-80.78365
_cons	-.8299806	.8979854	-0.92	0.355	-2.590471	.9305099

Table A. 12. Regression of dAD_t over $dRID_t$ for the Communication Index-Topix

Source	SS	df	MS
Model	19.577972	1	19.577972
Residual	15428.9677	4521	3.41273341
Total	15448.5457	4522	3.41630821

Number of obs =	4523
F(1, 4521) =	5.74
Prob > F =	0.0167
R-squared =	0.0013
Adj R-squared =	0.0010
Root MSE =	1.8474

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	7.981407	3.33232	2.40	0.017	1.448429	14.51438
_cons	-.005036	.0274687	-0.18	0.855	-.0588881	.0488161

Table A. 13. Regression of dAD_t over $dRIS_t$ for the Securities Index-Topix

-> sector = 1

Source	SS	df	MS
Model	4056.94324	1	4056.94324
Residual	3697106.34	4521	817.76296
Total	3701163.28	4522	818.479276

Number of obs	=	4523
F(1, 4521)	=	4.96
Prob > F	=	0.0260
R-squared	=	0.0011
Adj R-squared	=	0.0009
Root MSE	=	28.597

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	167.9692	75.41259	2.23	0.026	20.12364	315.8147
_cons	.4060308	.4252071	0.95	0.340	-.427583	1.239645

Table A. 14. Regression of dAD_t over $dRIT_t$ for the Fisheries Index-Topix

-> sector = 23

Source	SS	df	MS
Model	18509.9694	1	18509.9694
Residual	16493291.8	4521	3648.15125
Total	16511801.8	4522	3651.43781

Number of obs	=	4523
F(1, 4521)	=	5.07
Prob > F	=	0.0243
R-squared	=	0.0011
Adj R-squared	=	0.0009
Root MSE	=	60.4

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	-275.6228	122.3626	-2.25	0.024	-515.5133	-35.73228
_cons	-.8287595	.8980967	-0.92	0.356	-2.589468	.9319492

Table A. 15. Regression of dAD_t over $dRIT_t$ for the Communication Index-Topix

-> sector = 7

Source	SS	df	MS
Model	48.5815045	1	48.5815045
Residual	51412.8505	4521	11.3720085
Total	51461.432	4522	11.3802371

Number of obs	=	4523
F(1, 4521)	=	4.27
Prob > F	=	0.0388
R-squared	=	0.0009
Adj R-squared	=	0.0007
Root MSE	=	3.3722

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	7.773828	3.761127	2.07	0.039	.4001798	15.14748
_cons	.0651644	.0501424	1.30	0.194	-.0331393	.1634681

Table A. 16. Regression of dAD_t over $dRID_t$ for the Application Software Index-S&P 500

-> sector = 41

Source	SS	df	MS
Model	388.942928	1	388.942928
Residual	273619.65	4521	60.521931
Total	274008.593	4522	60.5945584

Number of obs	=	4523
F(1, 4521)	=	6.43
Prob > F	=	0.0113
R-squared	=	0.0014
Adj R-squared	=	0.0012
Root MSE	=	7.7796

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-54.85319	21.63791	-2.54	0.011	-97.27407	-12.43231
_cons	.0475674	.115676	0.41	0.681	-.179214	.2743488

Table A. 17. Regression of dAD_t over $dRID_t$ for the Household Products Index-S&P 500

-> sector = 43

Source	SS	df	MS
Model	1804703.81	1	1804703.81
Residual	800298543	4521	177018.036
Total	802103247	4522	177377.985

Number of obs	=	4523
F(1, 4521)	=	10.20
Prob > F	=	0.0014
R-squared	=	0.0022
Adj R-squared	=	0.0020
Root MSE	=	420.74

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	5671.97	1776.396	3.19	0.001	2189.366	9154.574
_cons	5.902618	6.255982	0.94	0.345	-6.362165	18.1674

Table A. 18. Regression of dAD_t over $dRID_t$ for the Industrial Conglomerates Index-S&P 500

-> sector = 72

Source	SS	df	MS
Model	22605180	1	22605180
Residual	4.9216e+09	4521	1088608.87
Total	4.9442e+09	4522	1093367.06

Number of obs	=	4523
F(1, 4521)	=	20.77
Prob > F	=	0.0000
R-squared	=	0.0046
Adj R-squared	=	0.0044
Root MSE	=	1043.4

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	7451.769	1635.277	4.56	0.000	4245.827	10657.71
_cons	-15.49591	15.51396	-1.00	0.318	-45.91085	14.91904

Table A. 19. Regression of dAD_t over $dRID_t$ for the Tyres&Rubbers Index-S&P 500

-> sector = 41

Source	SS	df	MS
Model	240.963229	1	240.963229
Residual	273767.63	4521	60.5546627
Total	274008.593	4522	60.5945584

Number of obs	= 4523
F(1, 4521)	= 3.98
Prob > F	= 0.0461
R-squared	= 0.0009
Adj R-squared	= 0.0007
Root MSE	= 7.7817

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	36.15161	18.12283	1.99	0.046	.6220011	71.68121
_cons	.0475418	.1157072	0.41	0.681	-.1793009	.2743845

Table A. 20. Regression of dAD_t over $dRIS_t$ for the Household Products Index-S&P 500

-> sector = 72

Source	SS	df	MS
Model	17885518.5	1	17885518.5
Residual	4.9263e+09	4521	1089652.81
Total	4.9442e+09	4522	1093367.06

Number of obs	= 4523
F(1, 4521)	= 16.41
Prob > F	= 0.0001
R-squared	= 0.0036
Adj R-squared	= 0.0034
Root MSE	= 1043.9

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-5149.009	1270.916	-4.05	0.000	-7640.626	-2657.392
_cons	-15.51446	15.5214	-1.00	0.318	-45.94398	14.91507

Table A. 21. Regression of dAD_t over $dRIS_t$ for the Tyres&Rubbers Index-S&P 500

-> sector = 43

Source	SS	df	MS
Model	1601885.65	1	1601885.65
Residual	800501361	4521	177062.898
Total	802103247	4522	177377.985

Number of obs	= 4523
F(1, 4521)	= 9.05
Prob > F	= 0.0026
R-squared	= 0.0020
Adj R-squared	= 0.0018
Root MSE	= 420.79

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	3266.123	1085.877	3.01	0.003	1137.273	5394.972
_cons	5.890965	6.256775	0.94	0.346	-6.375373	18.1573

Table A. 22. Regression of dAD_t over $dRIT_t$ for the Industrial Conglomerates Index-S&P 500

-> sector = 76

Source	SS	df	MS
Model	14150.9933	1	14150.9933
Residual	15709343.8	4521	3474.74979
Total	15723494.8	4522	3477.11075

Number of obs =	4523
F(1, 4521) =	4.07
Prob > F =	0.0436
R-squared =	0.0009
Adj R-squared =	0.0007
Root MSE =	58.947

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	-376.4874	186.5601	-2.02	0.044	-742.2364	-10.73842
_cons	1.337788	.8764935	1.53	0.127	-.3805672	3.056144

Table A. 23. Regression of dAD_t over $dRIT_t$ for the Brewers Index-S&P 500

-> sector = 1

Source	SS	df	MS
Model	13.7851655	1	13.7851655
Residual	330.936499	585	.565703418
Total	344.721665	586	.588262227

Number of obs	= 587
F(1, 585)	= 24.37
Prob > F	= 0.0000
R-squared	= 0.0400
Adj R-squared	= 0.0383
Root MSE	= .75213

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-18.08311	3.663208	-4.94	0.000	-25.27775	-10.88847
_cons	.0350352	.031044	1.13	0.260	-.025936	.0960064

Table A. 24. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Oil & Gas Index-DJ Eurostoxx

-> sector = 13

Source	SS	df	MS
Model	3.7433007	1	3.7433007
Residual	125.848058	585	.215124885
Total	129.591358	586	.221145663

Number of obs	= 587
F(1, 585)	= 17.40
Prob > F	= 0.0000
R-squared	= 0.0289
Adj R-squared	= 0.0272
Root MSE	= .46382

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-8.251023	1.977998	-4.17	0.000	-12.13587	-4.366182
_cons	.0432353	.0191437	2.26	0.024	.0056364	.0808341

Table A. 25. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Construction and Materials Index-DJ Eurostoxx

-> sector = 1

Source	SS	df	MS
Model	15.943771	1	15.943771
Residual	328.777894	585	.562013494
Total	344.721665	586	.588262227

Number of obs	= 587
F(1, 585)	= 28.37
Prob > F	= 0.0000
R-squared	= 0.0463
Adj R-squared	= 0.0446
Root MSE	= .74968

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	-23.24243	4.363744	-5.33	0.000	-31.81294	-14.67191
_cons	.0348152	.0309427	1.13	0.261	-.0259571	.0955875

Table A. 26. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Oil & Gas Index-DJ Eurostoxx

-> sector = 13

Source	SS	df	MS
Model	4.89693284	1	4.89693284
Residual	124.694425	585	.213152864
Total	129.591358	586	.221145663

Number of obs	=	587
F(1, 585)	=	22.97
Prob > F	=	0.0000
R-squared	=	0.0378
Adj R-squared	=	0.0361
Root MSE	=	.46168

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	-10.60878	2.213344	-4.79	0.000	-14.95585	-6.261712
_cons	.0431779	.0190558	2.27	0.024	.0057517	.080604

Table A. 27. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Construction and Materials Index-DJ Eurostoxx

-> sector = 8

Source	SS	df	MS
Model	.048637707	1	.048637707
Residual	3.02144955	585	.005164871
Total	3.07008725	586	.005239057

Number of obs	=	587
F(1, 585)	=	9.42
Prob > F	=	0.0022
R-squared	=	0.0158
Adj R-squared	=	0.0142
Root MSE	=	.07187

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-1.23508	.4024746	-3.07	0.002	-2.025551	-.4446094
_cons	-.000978	.0029663	-0.33	0.742	-.0068039	.0048478

Table A. 28 Regression of dAD_t over $dRID_t$ for the restricted sample of the Rubber Products Index-Topix

-> sector = 12

Source	SS	df	MS
Model	.552568208	1	.552568208
Residual	41.4233112	585	.070809079
Total	41.9758794	586	.071631193

Number of obs	=	587
F(1, 585)	=	7.80
Prob > F	=	0.0054
R-squared	=	0.0132
Adj R-squared	=	0.0115
Root MSE	=	.2661

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	4.594651	1.644766	2.79	0.005	1.364286	7.825015
_cons	-.0086127	.0109831	-0.78	0.433	-.0301838	.0129584

Table A. 29. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Metal Products Index-Topix

-> sector = 29

Source	SS	df	MS
Model	77.1681848	1	77.1681848
Residual	10828.3858	585	18.5100612
Total	10905.554	586	18.6101603

Number of obs =	587
F(1, 585) =	4.17
Prob > F =	0.0416
R-squared =	0.0071
Adj R-squared =	0.0054
Root MSE =	4.3023

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	35.65047	17.46023	2.04	0.042	1.358093	69.94284
_cons	.1468528	.1775763	0.83	0.409	-.201912	.4956176

Table A. 30. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Securities Index-Topix

Source	SS	df	MS
Model	.664112972	1	.664112972
Residual	41.3117664	585	.070618404
Total	41.9758794	586	.071631193

Number of obs =	587
F(1, 585) =	9.40
Prob > F =	0.0023
R-squared =	0.0158
Adj R-squared =	0.0141
Root MSE =	.26574

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	4.619012	1.506215	3.07	0.002	1.660764	7.577261
_cons	-.0085637	.0109683	-0.78	0.435	-.0301058	.0129784

Table A. 31. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Metal Products Index-Topix

-> Sector = 4

Source	SS	df	MS
Model	6.66841686	1	6.66841686
Residual	169.721675	585	.290122521
Total	176.390092	586	.301006982

Number of obs =	587
F(1, 585) =	22.98
Prob > F =	0.0000
R-squared =	0.0378
Adj R-squared =	0.0362
Root MSE =	.53863

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	8.692045	1.813015	4.79	0.000	5.131235	12.25286
_cons	.0450729	.0222316	2.03	0.043	.0014094	.0887365

Table A. 32. Regression of dAD_t over $dRID_t$ for the restricted sample of the Aluminum Index-S&P 500

-> Sector = 22

Source	SS	df	MS
Model	1.39494507	1	1.39494507
Residual	47.8410356	585	.081779548
Total	49.2359807	586	.084020445

Number of obs	587
F(1, 585)	17.06
Prob > F	0.0000
R-squared	0.0283
Adj R-squared	0.0267
Root MSE	.28597

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-14.2783	3.457166	-4.13	0.000	-21.06827	-7.488329
_cons	.0085004	.0118034	0.72	0.472	-.0146817	.0316825

Table A. 33. Regression of dAD_t over $dRID_t$ for the restricted sample of the Electrical Components & Equipment Index-S&P 500

-> Sector = 29

Source	SS	df	MS
Model	4.50683728	1	4.50683728
Residual	236.237349	585	.403824527
Total	240.744186	586	.410826256

Number of obs	587
F(1, 585)	11.16
Prob > F	0.0009
R-squared	0.0187
Adj R-squared	0.0170
Root MSE	.63547

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-12.79397	3.82971	-3.34	0.001	-20.31563	-5.272319
_cons	-.0231272	.0262288	-0.88	0.378	-.0746413	.0283868

Table A. 34. Regression of dAD_t over $dRID_t$ for the restricted sample of the Gas Utilities Index-S&P 500

-> Sector = 46

Source	SS	df	MS
Model	355.096875	1	355.096875
Residual	16302.0416	585	27.8667378
Total	16657.1385	586	28.425151

Number of obs	587
F(1, 585)	12.74
Prob > F	0.0004
R-squared	0.0213
Adj R-squared	0.0196
Root MSE	5.2789

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-152.3342	42.67437	-3.57	0.000	-236.1479	-68.52059
_cons	.2167023	.2178914	0.99	0.320	-.2112424	.6446469

Table A. 35. Regression of dAD_t over $dRID_t$ for the restricted sample of the Insurance Brokers Index-S&P 500

-> Sector = 62

Source	SS	df	MS
Model	15.4299808	1	15.4299808
Residual	1587.18046	585	2.713129
Total	1602.61044	586	2.73483011

Number of obs	=	587
F(1, 585)	=	5.69
Prob > F	=	0.0174
R-squared	=	0.0096
Adj R-squared	=	0.0079
Root MSE	=	1.6472

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-22.39033	9.388865	-2.38	0.017	-40.83032	-3.950345
_cons	.1015933	.0679861	1.49	0.136	-.0319333	.2351198

Table A. 36 Regression of dAD_t over $dRID_t$ for the restricted sample of the Personal Products Index-S&P 500

-> Sector = 71

Source	SS	df	MS
Model	130.939476	1	130.939476
Residual	17471.6586	585	29.8660832
Total	17602.5981	586	30.0385633

Number of obs	=	587
F(1, 585)	=	4.38
Prob > F	=	0.0367
R-squared	=	0.0074
Adj R-squared	=	0.0057
Root MSE	=	5.465

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	98.8908	47.22911	2.09	0.037	6.131541	191.6501
_cons	-.2084106	.2255648	-0.92	0.356	-.6514261	.2346049

Table A. 37 Regression of dAD_t over $dRID_t$ for the restricted sample of the System Software Index-S&P 500

-> Sector = 76

Source	SS	df	MS
Model	322.316503	1	322.316503
Residual	32286.0882	585	55.1898944
Total	32608.4047	586	55.6457418

Number of obs	=	587
F(1, 585)	=	5.84
Prob > F	=	0.0160
R-squared	=	0.0099
Adj R-squared	=	0.0082
Root MSE	=	7.429

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRID	-94.66389	39.17174	-2.42	0.016	-171.5983	-17.72952
_cons	.4454051	.3066274	1.45	0.147	-.1568196	1.04763

Table A. 38 Regression of dAD_t over $dRID_t$ for the restricted sample of the Brewers Index-S&P 500

-> Sector = 12

Source	SS	df	MS
Model	16.6648269	1	16.6648269
Residual	1954.77342	585	3.34149303
Total	1971.43825	586	3.3642291

Number of obs	=	587
F(1, 585)	=	4.99
Prob > F	=	0.0259
R-squared	=	0.0085
Adj R-squared	=	0.0068
Root MSE	=	1.828

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-11.84996	5.306237	-2.23	0.026	-22.27155	-1.428362
_cons	.0617214	.0754522	0.82	0.414	-.0864688	.2099115

Table A. 39. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Building Products Index-S&P 500

-> Sector = 36

Source	SS	df	MS
Model	26.0649336	1	26.0649336
Residual	1926.3376	585	3.29288479
Total	1952.40254	586	3.33174495

Number of obs	=	587
F(1, 585)	=	7.92
Prob > F	=	0.0051
R-squared	=	0.0134
Adj R-squared	=	0.0117
Root MSE	=	1.8146

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-18.34941	6.522018	-2.81	0.005	-31.15883	-5.539985
_cons	-.0762631	.074898	-1.02	0.309	-.2233649	.0708387

Table A. 40. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Home Furnishings Index-S&P 500

-> Sector = 46

Source	SS	df	MS
Model	259.128864	1	259.128864
Residual	16398.0096	585	28.0307857
Total	16657.1385	586	28.425151

Number of obs	=	587
F(1, 585)	=	9.24
Prob > F	=	0.0025
R-squared	=	0.0156
Adj R-squared	=	0.0139
Root MSE	=	5.2944

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	84.80786	27.89304	3.04	0.002	30.02516	139.5906
_cons	.2204161	.2185259	1.01	0.314	-.2087748	.649607

Table A. 41. Regression of dAD_t over $dRIS_t$ for the restricted sample of the Insurance Brokers Index-S&P 500

-> Sector = 71

Source	SS	df	MS
Model	196.462203	1	196.462203
Residual	17406.1359	585	29.7540785
Total	17602.5981	586	30.0385633

Number of obs	=	587
F(1, 585)	=	6.60
Prob > F	=	0.0104
R-squared	=	0.0112
Adj R-squared	=	0.0095
Root MSE	=	5.4547

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-65.49659	25.48898	-2.57	0.010	-115.5576	-15.43554
_cons	-.2098283	.2251408	-0.93	0.352	-.652011	.2323545

Table A. 42. Regression of dAD_t over $dRIS_t$ for the restricted sample of the System Software Index-S&P 500

-> Sector = 73

Source	SS	df	MS
Model	.453484448	1	.453484448
Residual	62.2294871	585	.106375192
Total	62.6829715	586	.106967528

Number of obs	=	587
F(1, 585)	=	4.26
Prob > F	=	0.0394
R-squared	=	0.0072
Adj R-squared	=	0.0055
Root MSE	=	.32615

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIS	-1.962546	.9505148	-2.06	0.039	-3.829383	-.0957091
_cons	.0008033	.0134617	0.06	0.952	-.0256359	.0272425

Table A. 43.Regression of dAD_t over $dRIS_t$ for the restricted sample of the Consumer Finance Index-S&P 500

-> Sector = 4

Source	SS	df	MS
Model	2.32751795	1	2.32751795
Residual	174.062574	585	.297542861
Total	176.390092	586	.301006982

Number of obs	=	587
F(1, 585)	=	7.82
Prob > F	=	0.0053
R-squared	=	0.0132
Adj R-squared	=	0.0115
Root MSE	=	.54547

dAD	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
dRIT	4.132862	1.477676	2.80	0.005	1.230666	7.035058
_cons	.0453555	.0225144	2.01	0.044	.0011365	.0895744

Table A. 44. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Aluminum Index-S&P 500

```
-> Sector = 36

      Source |       SS       df       MS              Number of obs =     587
-------------+------------------------------           F(  1,   585) =   11.08
       Model |  36.2759011     1  36.2759011           Prob > F      =  0.0009
    Residual |  1916.12664   585  3.27543015           R-squared     =  0.0186
-------------+------------------------------           Adj R-squared =  0.0169
       Total |  1952.40254   586  3.33174495           Root MSE      =  1.8098

------------------------------------------------------------------------------
         dAD |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dRIT |  -26.38458   7.928211    -3.33   0.001     -41.9558   -10.81335
       _cons |  -.0765917   .0746995    -1.03   0.306    -.2233035    .0701201
```

Table A. 45. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Home Furnishings Index-S&P 500

```
-> Sector = 73

      Source |       SS       df       MS              Number of obs =     587
-------------+------------------------------           F(  1,   585) =    5.71
       Model |  .606096114     1  .606096114           Prob > F      =  0.0172
    Residual |  62.0768754   585  .106114317           R-squared     =  0.0097
-------------+------------------------------           Adj R-squared =  0.0080
       Total |  62.6829715   586  .106967528           Root MSE      =  .32575

------------------------------------------------------------------------------
         dAD |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        dRIT |  -2.631889   1.101245    -2.39   0.017    -4.794763   -.4690143
       _cons |   .0009307   .0134454     0.07   0.945    -.0254764    .0273377
```

Table A. 46. Regression of dAD_t over $dRIT_t$ for the restricted sample of the Consumer Finance Index-S&P 500

The "selection bias" in Private Equity: the Treviso case

Gloria Gardenal*

Abstract

We present an empirical study in which we make an effort to overcome the well-known firm-selection problems in private equity, i.e. the difficulties to identify the best risk-return projects when firms are not listed on a public market. We get our main idea from Lintner '65's paper and the Expected Utility Theory. Using the certainty equivalent concept introduced by Lintner and the utility from investing in a generic company we define our firm selection criterion, which is innovative because it only requires accounting measures. We apply it to a sample of 2974 Italian private firms operating in all industrial sectors and located in Treviso, in the North East of Italy and we extract 94 firms which could be potentially used to form a private equity fund. Interestingly, the simple analysis of the raw data suggests a possible reason why private equity is not effective in Italy: i.e. the risk-return relation is inverted for all the sample, highlighting difficulties by the entrepreneurs to manage risk in an effective way.

---

* Gardenal, Department of Business, Ca' Foscari University of Venice (email: ggardenal@unive.it). We thank Giorgio Stefano Bertinetti and Guido Massimiliano Mantovani for the supervision of this work and for the precious hints. We gratefully acknowledge Elisa Daniotti for the preliminary elaborations on the data collected. We are responsible for any error.

1 Introduction

The private equity market is an important source of funds for some specific categories of firms: start-up firms, private middle-market firms, firms in financial distress, and public firms seeking buyout financing.
We can distinguish between the *organized private equity market*, which regards professionally managed equity investments in the unregistered securities of private and public companies, and two other markets: one is for *angel capital*, meaning investments in small, closely held companies by wealthy individuals, many of whom have experience operating in similar companies; the other is the *informal private equity market*, in which unregistered securities are sold to institutional investors and accredited individuals, the number of investors in any one company typically is larger, and minimum investments smaller than in either the organized private equity market or the angel capital market.
To provide an idea of the current dimension of the phenomenon and its growth rates, let's consider that, in 2006, the estimate of the capitals managed by private equity funds amounted, according to a research[15] published by Morgan Stanley, to 1,300 billion of US dollars, with an annual compound growth rate of 24% from 1980 to nowadays. Moreover, the amount of capitals collected by funds has grown considerably and has been estimated around 400 billion of US dollars, with a growth of 260% between 2003 and 2006.

Although these extremely promising data (and expectations) about growth rates and the importance of this activity for corporate finance, the private equity market has received little attention both in the academic literature (Sahlman, 1990; Jensen, 1994) and in the financial press. This lack of attention can be due mainly to the nature of the instrument itself: actually a private equity security is exempt from registration by virtue of its being issued in transactions "not involving any public offering". Thus, information about private transactions is often limited, and analyzing developments in the market is difficult.

Further, and this is the topic from which this research stems, many of the firms that issue private equity securities are private (meaning not listed on a public exchange), and they do not disclose financial and operating data about themselves.

---

[15] *Big is Better: Growth and Market Structure*, in *Global Buyouts*, P. Cornelius, B. Langerlaar, M. van Rossum (AlpInvest Partners), 2007.

If a private equiter, i.e. a subject who wants to invest in private capital, had access to the market data of the target firm, he could easily evaluate the Net Present Value of the investment using the Discounted Cash Flow Model (Fisher, 1930 and Williams, 1938). This model takes as input the future cash flows produced by the investment (the firm in our case) and the proper discount rate. To this extent, it's good to remember that the discount rate is the sum of two components: 1) the time value of money (i.e. the risk-free rate), and 2) the risk-premium, which reflects the extra return investors demand because they want to be compensated for the risk that the cash flow might not materialize after all. Following the CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966), the risk-premium is given by the difference between the market portfolio return R_M and the risk-free rate R_F, multiplied by the coefficient beta of the investment *i*. Therefore, to find the proper discount rate, we need to know the market portfolio returns[16], the *i-th* investment returns (to compute the beta) and the risk-free rate. It's evident that this procedure is not applicable to an investment in private equity because there is no information about the *i-th* firm's market returns, being the firm not listed on a public exchange. The lack of information about the firms' market returns prevents each investor from knowing the value of the risk premium in advance and thus to compute the proper rate to discount the future cash flows produced by the investment. In other words, a private equiter will mainly face two levels of difficulty in the evaluation process of the (target) firm: at firm level, the only presence of book values; at methodological level, the need to 1) define a set of "comparable" firms, listed on a public exchange and having characteristics similar to those of the target firm, to use as a benchmark, and, as said before, 2) define the risk premium.

Our idea is to propose a model able to overcome this limitation and, above all, a tool to enhance the private equiters' ability to select among a sample of non-listed firms the most appropriate to constitute a private equity fund. We derived our idea from Lintner's seminal paper (Lintner, 1965). In that work, one year after Sharpe's

[16] We also need the variance of the market portfolio returns as the formula for the beta of the *i-th* stock is:

$$\beta_i = \frac{COV(R_M, R_i)}{Var(R_M)}$$

where R_M is the market portfolio return, R_i is the return of the *i-th* stock and $Var(R_M)$ is the variance of the market portfolio returns.

seminal paper, in which he demonstrated the well-know *Capital Asset Pricing Model*, Lintner derived Sharpe's same result through a different approach: he showed that, instead of evaluating an investment only through the discounted cash flow model (thus requiring the risk-free rate, the beta of the investment, the market returns of the investment and those of the market portfolio), we can compute its value through the certainty equivalent model. Without recovering all the technicalities of that paper, here we briefly mention two main results of that work. First, he proved that the value of the investment we get through the certainty equivalent approach is equivalent to what we would find through the market value approach and, moreover, that the Separation Theorem (Tobin, 1958) holds also within this framework. The advantage of this approach is that we can get information about the market value of an investment without knowing its risk-premium in advance: we just require the risk-free rate and the covariance between the determinants of the risk-to-return ratio of the company, which permits to discover the certainty equivalent of the investment (to be discounted at the risk-free rate). Second and consequent to what just said, Lintner proved that we can use accounting measures (meaning indicators taken from the financial reports) to get the certainty equivalent of the investment.

Using these important results in the way we will show in the following section, we tried to answer the following research questions: 1) can we use a Lintner-based approach to evaluate private investments?; 2) can this approach explain the private equiter's behavior?; 3) can it define the drivers of "optimal" selection criteria for private equiters?; 4) does it work in an attractive context like Treviso[17]?.

The structure of the paper is as follows. Section 2 describes the theoretical model and its application. Section 3 presents the dataset and some preliminary results. Section 4 illustrates the main results. Section 5 concludes.

2 The Model

In general terms, the certainty equivalent is the dollar amount that an individual would accept instead of a fair bet, and the difference between the certainty equivalent and the expected value of the bet is called the risk premium.

[17] Treviso and the North-East of Italy is one of the most productive and industrialized areas of Italy.

In a firm context, and using Lintner's approach, we can express this concept as follows:

$$\frac{E(CF)}{E(R)} = \frac{\overline{CF}}{R_F} \quad (1)$$

where E(CF) are the expected cash flows of the firm; E(R) is the expected return of the firm (the discount rate); $\overline{CF}$ is the certainty equivalent of the cash flows; and R_F is the risk-free rate. The expression in (1) is valid only if we assume that the cash flows produced by the firm are a perpetuity ($t \rightarrow \infty$), i.e. that the firm is a steady-state[18].

From the relation proposed in (1) and from the Expected Utility Theory, we get that the utility deriving from investing in the firm *i* must be equal to the utility from investing in the *i-th* firm's certainty equivalent, i.e.:

$$\begin{aligned} U &= E(R) - A\sigma^2 \\ U_{\overline{CF}} &= R_F - A0 = R_F \end{aligned} \quad (2)$$

(where U is the utility from investing in the firm *i*; A is the investor's risk aversion; σ^2 is the volatility of the returns of *i-th* firm; U_{CF} is the utility from investing in the *i-th* firm's certainty equivalent; 0 is the variability of a free-risk investment) must be equal.

According to Lintner's proof of the Separation Theorem also through the certainty equivalent approach, the equalities presented in (2) considering a well-diversified portfolio instead that a single firm must be equal also to the utility of the investment in the market portfolio, i.e.:

$$U_M = E(R_M) - A \cdot \sigma_M^2 \quad (3)$$

where U_M is the utility from investing in the market portfolio, $E(R_M)$ is the expected return of the market portfolio, A is the investors' risk aversion and σ_M^2 is the volatility of the returns of the market portfolio.

[18] Obviously, if the firm is not steady-state, we should consider the value of time and discount the firm's cash flows accordingly.

Using these results our idea was to: a) start from the investment in the market portfolio and get the average risk-premium from the market data, which are fully available; b) derive the corresponding level of the utility from this investment, using equation (3); c) find the optimal conditions (in a sense, the determinants of the private equiter's behavior) according to which the level of the utility by investing in a portfolio of private companies is at least equal to the level of utility by investing in the market portfolio; d) these optimal conditions can then be used to derive the utility by investing in each specific private company belonging to our sample thus providing us with the following selection criterion: a private equiter will choose to invest in a specific private firm (of the sample) if the utility of this investment is at least equal to the utility of the investment in the market portfolio.

In doing this, we had to deal with a double set of problems. First of all, as we said at the beginning of this work, the presence of book values only, from which the impossibility to derive directly the relative market values and thus to evaluate the investment in private capital. Secondly, an even major problem in obtaining a measure of the risk connected to the investment in each private firm, given the impossibility to get a single measure of the volatility of its returns using only accounting data. To overcome these methodological obstacles, we decided to move from two key points: 1) we used Lintner's findings according to which accounting measures and, therefore, financial reports provide enough information to extract good proxies of the risk-return ratio of the firms; 2) we realized that our accounting measure of risk (i.e. our proxy for the volatility) couldn't be well represented by only one accounting indicator but that it could be more reliable if represented by a set of risk measures. This appears, according to the writer, pretty obvious: we cannot accept that, e.g., the D/E indicator (i.e. the indicator of the firm's financial structure) is a sufficient measure of the total risk of the firm. In fact, each firm will face also operating risks (variations in the sales), price risks (variations in the prices of its products), technology risks (age and usage of the plants), etc. Moreover, all these risks won't be independent of each other (as they are managed together in the firm's everyday activity) but interrelated.

To support point 1) above, let's see that from equation (1) we can also write:

$$\frac{R_F}{E(R)} = \frac{\overline{CF}}{E(CF)} \quad (4)$$

From here, and using the expected shortfall concept[19] together with Lintner's results, we have the equivalence between the following equalities:

$$\overline{CF} = E(CF) - z \cdot \sigma_{CF} \quad (5)$$

$$R_F = E(R) - z \cdot \sigma_R \quad (6)$$

$$R_F = E(BR) - z \cdot \sigma_{BR} \quad (7)$$

where $\overline{CF}$ is the certainty equivalent of the cash flows of the firm; E(CF) are its expected cash flows; σ_{CF} is the volatility of the cash flows; R_F is the risk-free rate, E(R) are the expected market returns of the firm; σ_R is the volatility of the firm's market returns; E(BR) are the expected returns of the investment measured through book ratios; σ_{BR} is the volatility of the firm's book returns. Being (5), (6) and (7) equal among themselves, this implies that:

$$prob_{\sigma_{CF}} \left\{ CF \leq \overline{CF} \right\} = prob_{\sigma_{BR}} \left\{ BR \leq R_F \right\} \quad (8)$$

where we are conditioning the probabilities to the levels of variability of the investment and where σ_{BR} is represented by the mix of the accounting risk factors, which we call for the moment $\alpha, \beta, \gamma, \ldots$

Instead, to account for the evidence presented in point 2), i.e., the need to consider more accounting risk indicators (interrelated among themselves!) to

---

19 Expected shortfall is a risk measure, a concept used in finance (and more specifically in the field of financial risk measurement) to evaluate the market risk (or credit risk) of a portfolio. It is an alternative to value at risk (VaR). The "expected shortfall at z% level" is the expected return on the portfolio in the worst z% of the cases.
Expected shortfall is also called conditional value at risk (CVaR) and expected tail loss (ETL).
ES evaluates the value (or risk) of an investment in a conservative way, focusing on the less profitable outcomes. For high values of z it ignores the most profitable but unlikely possibilities, for small values of z it focuses on the worst losses. On the other hand, unlike the discounted maximum loss even for lower values of z expected shortfall does not consider only the single most catastrophic outcome. A value of z often used in practice is 5%.

define a volatility measure of the private firm, we decided to work as follows. Given that our purpose is to compute the utility of the investment in a portfolio of private companies according to the relation $U_i = E(R) - A\sigma_i^2$ and using only book ratios, we decided to: a) choose a single accounting return indicator to define the sample's E(R); b) decompose the part of variability of this relation (i.e., $A \cdot \sigma_i^2$) in this way:

$$\begin{bmatrix} A_\alpha & A_\beta & A_\gamma & A_\delta & A_\eta \end{bmatrix} = \begin{bmatrix} A - Var_\alpha \\ A - Var_\beta \\ A - Var_\gamma \\ A - Var_\delta \\ A - Var_\eta \end{bmatrix}^T * Var - Cov[\alpha, \beta, \gamma, \delta, \eta] \quad (9)$$

where A is the vector (1x5)[20] of the private equiter's risk aversion to each specific accounting risk indicator ($\alpha, \beta, \gamma, \ldots$); the so called A-Var vector represents the private equiter's ability to change the firm's risk management (see below); and Var-Cov is the variance-covariance matrix[21] of the specific accounting risk indicators of the portfolio of private firms (computed to account for the variability of each risk indicator and its interrelations with the other risk factors).

After computing the vector A, we transposed it and multiplied it by the vector of the accounting risk indicators (our σ-vector) as follows:

$$A \cdot \sigma = \begin{bmatrix} A_\alpha \\ A_\beta \\ A_\gamma \\ A_\delta \\ A_\eta \end{bmatrix} * \begin{bmatrix} \alpha \\ \beta \\ \gamma \\ \delta \\ \eta \end{bmatrix} \quad (10)$$

[20] We are assuming to consider only 5 accounting risk factors, but there could be more. Here we put 5 because it is exactly the number we used in our application (See section 3 and 4).

[21] Here a (5x5) matrix.

which comes up being a vector and which represents, according to our perspective, a measure of the risk of investing in that particular firm as a function of its risk book ratios.

As we can see, there are many assumption behind this procedure: 1) different levels of risk aversion for each specific factor; 2) it introduces a new variable, A-Var, to control for the ability of the investor (in our case the private equiter) to manage each specific class of risk; 3) it uses the vector of the accounting risk indicators as measures of variability. As for point 1), we got our idea from another model in finance, i.e. the *Arbitrage Pricing Theory* (Ross, 1976), which assumes that the return of an investment is the linear combination of its risk factors. As for point 2), we considered that, in private equity more than in other markets, the ability to manage the different sources of risk is what makes the private equiter decide to invest in that project or not. In fact, one could decide to invest in private capital for two reasons: either he takes the firm's risk as given and chooses the company only because it provides a level of utility greater than what he would get by investing in the public market, or he invests in that firm even if the risk is too high because he thinks he will be able to intervene on the firm's specific risk components, meaning that he will use his managerial abilities to enhance the firm risk-return relation. As for point 3), it is not a strong assumption: the key is to choose accounting indicators expressing variability (see next session).

Being impossible with the information we had to detect how A-Var could change according to each agent's ability to manage risks, what we did for solving our exercise was as follows: 1) we fixed the set of accounting risk-return indicators for each private firm (assuming to have a sample of private firms); 2) we computed the utility of investing in the market portfolio (for which data are fully available); 3) through a simple simulation method, we set the utility of the investment in private capital equal to the market one and found the vector A-Var that satisfies this condition. To satisfy our constraint, we imposed the A-Var vector to have the same value for each component (i.e. we assumed that the private equiter selects the private capital in which to invest only comparing the utility it gives with respect to the utility from investing in the market portfolio and not according to his skills in managing the risks of the firm). The selection criterion makes the private equiter choose the private firms which provide a greater utility than the market one. Let's see in the following session an application of this procedure.

3 The Dataset

3.1 First elaborations

We used a sample of 2974 non-listed companies operating in all industries and located in the Treviso Country, in the North-East of Italy. Our data source was the database AIDA-Bureau Van Dijck. For each company we collected the financial reports in the time period going from 2003 to 2008. We considered only those companies which exhibited a continuity in the presentation of the financial reports along all the time period of interest.

For each company we computed a selection of accounting indicators, summarized in Table 1 and which are, according to the writer, the more effective in describing the risk-return relation of a generic firm. The table presents, in column 2, the full name of the indicator and, in column 3, its description.

INDEX	FULL NAME	DESCRIPTION
ROC %	Return on Capital	Profitability of the capital invested
QOL	Quantity Operating Leverage	Measure of the impact on EBIT of a change in the quantities sold
POL	Price Operating Leverage	Measure of the impact on EBIT of a change in the prices of sales
R-LIFE	Residual Life	Technological risk measure: the residual life (expressed in years) of fixed assets
D/E	DEBT/EQUITY	Relation between debt and equity
NWC/SALES %	NET WORKING CAPITAL ON SALES	The amount of net working capital invested per 100 € of sales

Table 1. The financial indicators chosen

The first indicator (i.e. ROC%) is a return indicator and provides information about the firm's assets profitability (i.e. about its core business); instead the remaining five indicators (i.e. QOL, POL, R-LIFE, D/E, and NWC/SALES%) are risk indicators.

The first thing we did was to compute these accounting indicators for each of the 2794 firms of our sample, for each of the 6 years of interest. After that, we computed the correlation between these indicators year-by-year and also over the whole sample. This last case is summarized in Table 2.

Average Correlation	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES %
ROC%	1.0000					
QOL	-0.0022	1.0000				
POL	-0.0011	-0.0095	1.0000			
R-LIFE	-0.0083	-0.0035	-0.0041	1.0000		
D/E	-0.0063	-0.0026	0.1863	0.0331	1.0000	
NWC/SALE%	-0.0043	0.0004	-0.0009	-0.0291	-0.0057	1.0000

Table 2. Correlation between the sample risk-return indicators (2003-2008)

As we can see from the Table, there are no significant average correlations between these indicators, apart from the D/E and the POL, which show a correlation of 18%.

After that we ran a linear regression between our return indicator (ROC%), considered as our dependent variable, and the risk indicators (our independent variables).

Dependent Variable: ROC
Method: Least Squares
Date: 12/05/10 Time: 10:55
Sample: 1 17844
Included observations: 17092

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.907258	2.891417	3.426437	0.0006
NWC/SALES	1.33E-07	3.08E-06	0.043253	0.9655
D/E	-3.47E-05	0.000195	-0.178544	0.8583
QOL	-0.000282	0.014950	-0.018878	0.9849
POL	0.012332	0.065528	0.188189	0.8507
R-Life	-0.000847	0.007771	-0.109025	0.9132

R-squared	0.000005	Mean dependent var	9.947919
Adjusted R-squared	-0.000346	S.D. dependent var	373.3384
S.E. of regression	373.4031	Akaike info criterion	14.68360
Sum squared resid	2.38E+09	Schwarz criterion	14.68678
Log likelihood	-125479.1	Hannan-Quinn criter.	14.68465
F-statistic	0.014144	Durbin-Watson stat	2.076276
Prob(F-statistic)	0.999988		

Figure 1. Regression analysis between risk-return indicators (full sample)

As we can see from Figure 1, we found no statistically significant relations between our indicators and, moreover, the model didn't seem to well describe the risk-return relation of our sample firms.
To enhance our analysis, we decided to redefine our sample.

3.2 Sample redefinition

The criteria we used to redefine the sample are as follows: 1) we eliminated all the firms which presented "abnormal" indicators; 2) we eliminated the firms also if they presented an "abnormal" indicator only in one year.
We considered "abnormal" the following cases: ROC>150% or <-150%; QOL>50% or <-50%; POL>50% or <-50%; R-LIFE<0 or >30 years; D/E>30 or <30; NWC/SALES >500% or <-500%. These extreme values were not "economically" justifiable and, in most of the cases, they could be the consequence of "window-dressing" phenomena.
After applying these rules, we ended up with a much smaller sample of 913 firms (i.e. we lost 2/3 of our initial sample).
We replicated the correlation analysis among the indicators (year-by-year and on the whole sample) and the regression analysis and we found that: there are significant levels of correlation among risk-return indicators (as Table 3 suggests) and the coefficients of our linear regression are now all significant. Moreover, the model seems to fit the data pretty well (see Figure 2), as the F-test suggests.

Average Correlation	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES%
ROC%	1.0000					
QOL	-0.2650	1.0000				
POL	-0.2020	-0.1372	1.0000			
R-LIFE	-0.1869	-0.0432	0.1092	1.0000		
D/E	-0.1794	0.1509	0.0980	0.0579	1.0000	
NWC/SALE%	-0.1709	-0.1305	-0.0145	-0.0789	-0.0402	1.0000

Table 3. Correlation between the risk-return indicators of the reduced sample (time horizon: 2003-2008)

Dependent Variable: ROC
Method: Least Squares
Date: 12/05/10 Time: 10:34
Sample: 1 5478
Included observations: 5478

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	35.76125	0.602961	59.30938	0.0000
NWC/SALES	-0.192684	0.010160	-18.96483	0.0000
D/E	-0.250846	0.030336	-8.268788	0.0000
POL	-0.882696	0.034076	-25.90397	0.0000
QOL	-1.199821	0.064600	-18.57298	0.0000
R-Life	-0.543229	0.042277	-12.84924	0.0000

R-squared	0.220389	Mean dependent var	15.89530
Adjusted R-squared	0.219534	S.D. dependent var	16.63988
S.E. of regression	14.70033	Akaike info criterion	8.214894
Sum squared resid	1182281.	Schwarz criterion	8.223339
Log likelihood	-22493.59	Hannan-Quinn criter.	8.217840
F-statistic	257.7672	Durbin-Watson stat	2.028020
Prob(F-statistic)	0.000000		

Figure 2. Regression analysis between risk-return indicators (reduced sample)

Surprisingly, what we discovered is a contrarian relationship between the risk level and the actual return of the firms of the sample. This is evidenced both by the values of the risk coefficients of our regression (which are all negative) and also by the first column of the correlation matrix presented in Table 3, in which we get the correlation between our return index (ROC%) and the risk indicators (all the others): as we see all the values are negative. This implies that, to a higher industrial risk of the firm, normally corresponds a lower return, which is exactly the contrary of what we would expect. This evidence is observable on the whole time horizon, as the following tables and figures suggest.

Average Correlation (2003)	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES%
ROC%	1					
QOL	-0.2517	1				
POL	-0.1881	-0.1867	1			
R-LIFE	-0.2195	-0.0374	0.10352	1		
D/E	-0.1697	0.13924	0.10714	0.10881	1	
NWC/SALE%	-0.1803	-0.086	-0.0121	-0.0857	-0.0853	1

Table 4. Correlation between the risk-return indicators of the reduced sample (2003)

Dependent Variable: ROC_2003
Method: Least Squares
Date: 11/05/10 Time: 11:30
Sample: 1 913
Included observations: 913

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	37.49011	1.461041	25.65986	0.0000
R-Life	-0.814563	0.110729	-7.356382	0.0000
NWC/SALES	-0.189265	0.023618	-8.013496	0.0000
D/E	-0.304215	0.090886	-3.347217	0.0008
QOL	-0.825168	0.081554	-10.11802	0.0000
POL	-1.117865	0.156880	-7.125629	0.0000

R-squared	0.225082	Mean dependent var	15.40609
Adjusted R-squared	0.220810	S.D. dependent var	17.44179
S.E. of regression	15.39617	Akaike info criterion	8.312665
Sum squared resid	214997.3	Schwarz criterion	8.344320
Log likelihood	-3788.732	Hannan-Quinn criter.	8.324749
F-statistic	52.68916	Durbin-Watson stat	2.064188
Prob(F-statistic)	0.000000		

Figure 3. Regression analysis between risk-return indicators (reduced sample), 2003

Average Correlation (2004)	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES%
ROC%	1					
QOL	-0.1876	1				
POL	-0.2238	-0.1461	1			
R-LIFE	-0.198	-0.0794	0.10684	1		
D/E	-0.1173	0.03555	0.06181	0.05781	1	
NWC/SALE%	-0.1873	-0.1149	-0.0011	-0.0826	0.00683	1

Table 5. Correlation between the risk-return indicators of the reduced sample (2004)

Dependent Variable: ROC_2004
Method: Least Squares
Date: 11/05/10 Time: 11:32
Sample: 1 913
Included observations: 913

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	35.10545	1.554009	22.59026	0.0000
R-Life	-0.656563	0.118625	-5.534786	0.0000
NWC/SALES	-0.232506	0.028485	-8.162457	0.0000
D/E	-0.117891	0.043033	-2.739544	0.0063
QOL	-0.760508	0.087685	-8.673193	0.0000
POL	-1.328310	0.162027	-8.198091	0.0000

R-squared	0.202469	Mean dependent var	15.49054
Adjusted R-squared	0.197187	S.D. dependent var	16.89760
S.E. of regression	15.14022	Akaike info criterion	8.280224
Sum squared resid	207679.1	Schwarz criterion	8.317154
Log likelihood	-3772.922	Hannan-Quinn criter.	8.294322
F-statistic	38.33423	Durbin-Watson stat	2.002540
Prob(F-statistic)	0.000000		

Figure 4. Regression analysis between risk-return indicators (reduced sample), 2004

Average Correlation (2005)	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES%
ROC%	1					
QOL	-0.1876	1				
POL	-0.2238	-0.1461	1			
R-LIFE	-0.198	-0.0794	0.10684	1		
D/E	-0.1173	0.03555	0.06181	0.05781	1	
NWC/SALE%	-0.1873	-0.1149	-0.0011	-0.0826	0.00683	1

Table 6. Correlation between the sample risk-return indicators of the reduced sample (2005)

Dependent Variable: ROC_2005
Method: Least Squares
Date: 11/05/10 Time: 11:34
Sample: 1 913
Included observations: 913

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	36.60673	1.457875	25.10965	0.0000
R-Life	-0.508595	0.110375	-4.607896	0.0000
NWC/SALES	-0.200807	0.025223	-7.961123	0.0000
D/E	-0.326902	0.097132	-3.365543	0.0008
QOL	-0.905102	0.081259	-11.13853	0.0000
POL	-1.308265	0.154139	-8.487572	0.0000

R-squared	0.234879	Mean dependent var	15.94691
Adjusted R-squared	0.229812	S.D. dependent var	16.19660
S.E. of regression	14.21420	Akaike info criterion	8.153997
Sum squared resid	183051.4	Schwarz criterion	8.190927
Log likelihood	-3715.300	Hannan-Quinn criter.	8.168095
F-statistic	46.35431	Durbin-Watson stat	2.021621
Prob(F-statistic)	0.000000		

Figure 5. Regression analysis between risk-return indicators (reduced sample), 2005

Average Correlation (2006)	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES%
ROC%	1					
QOL	-0.3317	1				
POL	-0.2118	-0.1415	1			
R-LIFE	-0.1823	-0.0318	0.11705	1		
D/E	-0.2292	0.16076	0.14494	0.06647	1	
NWC/SALE%	-0.1869	-0.1224	-0.01	-0.1012	-0.0644	1

Table 7. Correlation between the sample risk-return indicators of the reduced sample (2006)

Dependent Variable: ROC_2006
Method: Least Squares
Date: 11/05/10 Time: 11:36
Sample: 1 913
Included observations: 913

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	40.26479	1.408485	28.58730	0.0000
R-Life	-0.564921	0.101218	-5.581215	0.0000
NWC/SALES	-0.217419	0.024538	-8.860641	0.0000
D/E	-0.467312	0.095066	-4.915654	0.0000
QOL	-1.189757	0.090919	-13.08592	0.0000
POL	-1.181555	0.149289	-7.914550	0.0000

R-squared	0.290316	Mean dependent var	16.83506
Adjusted R-squared	0.285616	S.D. dependent var	15.89672
S.E. of regression	13.43610	Akaike info criterion	8.041405
Sum squared resid	163559.2	Schwarz criterion	8.078335
Log likelihood	-3663.902	Hannan-Quinn criter.	8.055503
F-statistic	61.77081	Durbin-Watson stat	2.022522
Prob(F-statistic)	0.000000		

Figure 6. Regression analysis between risk-return indicators (reduced sample), 2006

Average Correlation (2007)	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES%
ROC%	1					
QOL	-0.3137	1				
POL	-0.2299	-0.1024	1			
R-LIFE	-0.1664	-0.0321	0.11719	1		
D/E	-0.252	0.23069	0.12543	0.0963	1	
NWC/SALES%	-0.1691	-0.2411	-0.0012	-0.0756	-0.0317	1

Table 8. Correlation between the sample risk-return indicators of the reduced sample (2007)

Dependent Variable: ROC_2007
Method: Least Squares
Date: 11/05/10 Time: 11:38
Sample: 1 913
Included observations: 913

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	39.94756	1.472457	27.12986	0.0000
R-Life	-0.448236	0.103308	-4.338819	0.0000
NWC/SALES	-0.232088	0.024227	-9.579734	0.0000
D/E	-0.461168	0.102379	-4.504497	0.0000
QOL	-1.135011	0.090321	-12.56643	0.0000
POL	-1.342968	0.159482	-8.420822	0.0000

R-squared	0.282602	Mean dependent var	17.15315
Adjusted R-squared	0.277851	S.D. dependent var	16.54127
S.E. of regression	14.05667	Akaike info criterion	8.131708
Sum squared resid	179016.5	Schwarz criterion	8.168638
Log likelihood	-3705.125	Hannan-Quinn criter.	8.145806
F-statistic	59.48287	Durbin-Watson stat	2.119302
Prob(F-statistic)	0.000000		

Figure 7. Regression analysis between risk-return indicators (reduced sample), 2007

Average Correlation (2008)	ROC%	QOL	POL	R-LIFE	D/E	NWC/SALES%
ROC%	1					
QOL	-0.2336	1				
POL	-0.1432	-0.1141	1			
R-LIFE	-0.1902	-0.0415	0.10069	1		
D/E	-0.1561	0.22398	0.04742	-0.0425	1	
NWC/SALES%	-0.1335	-0.1278	-0.0136	-0.0219	-0.0175	1

Table 9. Correlation between the sample risk-return indicators of the reduced sample (2008)

Dependent Variable: ROC 2008
Method: Least Squares
Date: 11/05/10 Time: 11:39
Sample: 1 913
Included observations: 913

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	29.89937	1.499005	19.94615	0.0000
R-Life	-0.436433	0.087514	-4.987031	0.0000
NWC/SALES	-0.128072	0.021935	-5.838663	0.0000
D/E	-0.373775	0.110144	-3.393512	0.0007
QOL	-0.612900	0.077462	-7.912223	0.0000
POL	-0.806752	0.158417	-5.092593	0.0000

R-squared	0.160279	Mean dependent var	14.54004
Adjusted R-squared	0.154718	S.D. dependent var	16.72494
S.E. of regression	15.37678	Akaike info criterion	8.311232
Sum squared resid	214219.6	Schwarz criterion	8.348162
Log likelihood	-3787.077	Hannan-Quinn criter.	8.325330
F-statistic	28.82164	Durbin-Watson stat	1.982632
Prob(F-statistic)	0.000000		

Figure 8. Regression analysis between risk-return indicators (reduced sample), 2008

These results highlight that the Italian private companies, located in the Treviso country are unable to “anticipate” the industrial risk they suffer (or will suffer) from, meaning that they manage it when it has already manifested, i.e., when they have already realized a loss. If they were able to anticipate and manage risks properly, we would surely face an inverted risk-return relation, i.e. we would see that to a greater level of risk would correspond a higher return.

Moreover, we discovered that the correlation matrixes of the risk-return indicators are pretty stable across time, meaning that the entrepreneurs persevere in managing the risks ex-post.

This evidence provides, by itself, a first result: a private equiter will difficultly decide to invest in such corporations, unless he is convinced to be able to invert this relation. His choice is, therefore, "biased" by the awareness that his financial investment doesn't necessarily have a positive NPV (Net Present Value). We think that the reason why in the Treviso country, unless a huge number of productive firms and one of the highest industrialization rates in Italy, the investments in private equity are not so common because of this inefficiency in managing risks by the entrepreneurs.

After this first analysis of the accounting risk-return indicators of our sample, let's apply our selection criterion.

4 Results

As explained in section 2, we had to: 1) compute the utility deriving from the investment in the market portfolio (i.e. using market data); 2) compute the utility of investing in our private capital, i.e. in our sample of 913 Italian private companies; 3) choose only those firms whose utility was greater than the utility of the investment in the market portfolio.

As for point 1, we considered the Dow Jones Eurostoxx Price Index as our market portfolio. To compute the utility of investing in this index we used the following scoring function:

$$U_M = E(R_M) - 0.005 \cdot A \cdot \sigma_M^2 \quad (12)$$

where $E(R_M)$ was the average annual ex-ante return of the market portfolio in the period 2003-2008 and was equal to 4.58%; A (the average value of risk aversion) is normally fixed and equal to 5[22], σ_M^2 was the annual variance of the ex-ante returns of the Dow Jones Index in the period 2003-2008 and was equal to 23,73%. Therefore, the utility of investing in the market portfolio was equal to -9.51. The

[22] Same hypothesis used in paper 2 of this thesis.

result was surprising because it ended up being negative. It appeared clear that investing in the financial market gives a disutility. As we will see below, the negative value was due mainly to the negative dynamics of the index in 2008, the period around the last financial crisis. Anyway, we took that value of utility as our starting point.

After that we had to compute the utility of investing in our portfolio of private firms. As we said before, this was not immediate because we only had accounting measures. Therefore, we followed the procedure explained in Section 2 and: a) we used the average value of the ROC% of all the firms, along the whole time period, as a measure of the return of the investment in the private capital portfolio: in our case this value was 15,90%; b) we computed the A-vector (i.e. the vector of the investor's risk aversion to each specific risk factor) as follows:

$$\lfloor A_{QOL} \quad A_{POL} \quad A_{R-LIFE} \quad A_{D/E} \quad A_{NWC/SALES\%} \rfloor = \begin{bmatrix} A - Var_{QOL} \\ A - Var_{POL} \\ A - Var_{R-LIFE} \\ A - Var_{D/E} \\ A - Var_{NWC/SALES\%} \end{bmatrix}^T * \sum\nolimits_{BR}$$

where the A-vector was expressed as a function of the A-Vars (which, at this point, were still unknown quantities) and Σ_{BR}, i.e. the variance-covariance matrix of the five risk book ratios we chose. The matrix for our sample was the following:

	QOL	POL	R-LIFE	D/E	NWC/SALES
QOL	35.9518	-2.6564	-1.2648	4.7840	-17.0423
POL	-2.6564	10.5008	1.7861	1.8128	-1.0171
R-LIFE	-1.2648	1.7861	26.2898	1.3303	-7.7568
D/E	4.7840	1.8128	1.3303	44.0896	-4.6627
NWC/SALES	-17.0423	-1.0171	-7.7568	-4.6627	479.1132

Table 10. Variance-covariance matrix of the accounting indicators (reduced-sample, 2003-2008)

After setting the vector of the As (still unknown because the A-Vars were not defined yet) we had to (transpose it and) multiply it by the vector of the risk indicators. The vector of the indicators we used was:

$$\begin{bmatrix} QOL \\ POL \\ R-LIFE \\ D/E \\ NWC/SALES \end{bmatrix} = \begin{bmatrix} 6.99 \\ 4.13 \\ 7.00 \\ 4.70 \\ 24.91 \end{bmatrix}$$

At this point we ran our simulation and we made the vector of the A-Var vary in order to make the utility of the investment in private capital equal to -9.51 (i.e. the utility of the investment in the market portfolio). We also imposed that the components of the vector A-Var were all equal among each other, for the reasons explained in Section 2.
The optimal A-Var vector was equal to:

$$A-Var = \begin{bmatrix} 0.002158936 \\ 0.002158936 \\ 0.002158936 \\ 0.002158936 \\ 0.002158936 \end{bmatrix}$$

which, transposed and multiplied by the Var-cov matrix of the indicators presented above gave a vector of As equal to:

$$\begin{bmatrix} 0.043 & 0.023 & 0.044 & 0.1022 & 0.9686 \end{bmatrix}$$

We used this vector as the optimal level of risk aversion to each specific category of risk. Optimal because it derives from that particular level of A-Var (which is the private equiter's ability to change the risk management) that makes the utility of the investment in our portfolio of private companies equal to the utility of the investment in the market portfolio.
What we did after this was to calculate the utility of the investment in each of the 913 firms of our sample. We used the same procedure presented above but: we took the specific accounting risk-return indicators of each firm (we moved from the sample considered as a whole to the single firms), using as optimal levels of risk aversion to each specific type of risk those represented by the vector of As discovered above. After that, we selected only those firms providing a higher

utility than the market one. With this selection criterion we were able to extract 94 firms which, according to our perspective, could be good to enter a private equity fund.
As we noticed above, the market portfolio gave a disutility due to the bad results obtained during 2008. Therefore we replicated our analysis on the time horizon 2003-2007. In this case, the investment in the market portfolio gave a positive utility equal to 0.15. Imposing this new level of utility, we simulated again the optimal value of the A-Vars and, consequently, the optimal values of the A-vector. The selection criterion permitted to select 195 firms, nearly 100 more than in the previous case, confirming that 2008 was a bad year for both financial markets and private companies.

Conclusions

In this simple study we tried to overcome one of the biggest problems in evaluating investments in private equity, i.e. the absence of market data. We used some insights from a seminal study by Lintner and the Expected Utility Theory to define a selection criterion able to identify, within a sample of 2974 Italian firms, those that could be a target of the private equity activity. This criterion, although weak in some points and surely improvable, has the advantage of using accounting indicators and not market data. Moreover, it highlights the necessity, when thinking about private equity, to consider the investor's ability to intervene and change the risk management of the firm. Here we introduced the variable A-Var, together with the variance-covariance matrix of the risk indicators, to account for this aspect and to indentify a possible driver of the investors' behavior. For simplicity we assumed that the A-Var is equal for each risk indicator but this is not a rule. If the A-Var vector was different, we would select firms differently.
This study was also useful to identify an anomaly in the risk-return relations of the firms located in the Treviso country: we found that to higher risks correspond lower returns. This means that the entrepreneurs manage risks ex-post, when they have already determined a loss for the firm. This contrarian relation biases the choices of a private equiter, who should accept to invest in the private capital of these firms only if he believes that he will be able to change the risk management

of the firm itself. If not, the Treviso area, although the high rate of industrialization, would not attract so easily investments in the private capital.

References

Fisher, I., 1930, The Theory of Interest, New York: The Macmillan Co.

Jensen, M.C., 1994, The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems, *Journal of Applied Corporate Finance*, 6, pp. 4-23

Lintner, J., 1965, The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets, *The Review of Economics and Statistics*, 47, pp. 13-37

Mossin, J., 1966, Equilibrium in Capital Asset Market, *Econometrica*, 34, pp.768-783

Sahlman, W.A., 1990, The structure and governance of venture-capital organizations, *Journal of Financial Economics*,27, pp. 473-521

Sharpe, W., 1964, Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk, *The Journal of Finance*, 19, pp. 425-442

Tobin, J.,1958, "Liquidity Preference as Behavior Towards Risk". *Review of Economic Studies*, 25, pp. 65–86.

Williams, J.B., 1938, *The Theory of Investment Value*. Harvard University Press, Fraser Publishing.

Estratto per riassunto della tesi di dottorato

Studente: GLORIA GARDENAL **Matricola: 955273**

Dottorato in: Economia Aziendale (DEA)

Ciclo: 22°

Titolo della tesi: APPLIED TOPICS IN FINANCIAL AGENTS' BEHAVIOR

Riassunto:

La tesi si compone di 3 articoli che indagano, secondo prospettive diverse, il comportamento degli agenti economici nei mercati finanziari. Il primo lavoro, di tipo sperimentale, si pone come obiettivo quello di misurare la portata del contagio finanziario dovuto a ribilanciamenti dei portafogli di investimento in mercati diversi. Lo studio evidenzia come uno shock sul prezzo di un titolo negoziato in un mercato si propaghi anche in mercati ad esso non direttamente collegati ma in modo conforme a quanto previsto dalla teoria. Il laboratorio non evidenzia aggiustamenti o comportamenti irrazionali.

Il secondo lavoro, di tipo empirico, cerca invece di individuare possibili relazioni tra l'avversione al rischio diversificabile, utilizzata come proxy del comportamento degli investitori, e il rischio informativo, ovvero quel rischio legato al tempo necessario all'informazione per essere compresa e processata dagli investitori stessi. Lo studio evidenzia l'assenza di legami tra queste due variabili, dimostrando che i mercati sono efficienti.

Il terzo lavoro, più di tipo applicativo, cerca di fornire un criterio per guidare il comportamento dei private equiter nella selezione di aziende su cui investire. Il criterio utilizza la semplice informazione contabile e il concetto di utilità dell'investimento.

Abstract (english version):

The thesis is composed of three papers that investigate, using different perspectives, the financial agents' behavior in the financial markets. The first paper, an experiment, aims to measure the impact of the financial contagion due to cross-market rebalancing. The study highlights that a shock in the prices of a stock traded in one market spreads to other unrelated markets but according to what the theory predicts. The laboratory doesn't show irrational adjustments or behaviors.

The second paper is an empirical work that aims to detect possible relations between the idiosyncratic risk aversion, used as a proxy of the investors' behavior, and the information risk, i.e. the risk due to the time needed by a piece of information to be understood and processed by the investors. The study highlights the absence of any linkages between these two variables, demonstrating that financial markets are efficient.

The third paper is an application and tries to provide the (generic) private equiter with a criterion to select possible firms in which to invest. The criterion uses the information provided by the financial reports and the concept of the utility of the investment.