

# Uninformed investors' Harm from Insider Trading

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## Abstract

We demonstrate that uninformed investors suffer two types of harm: under an "order driven market system", the presence of insiders either prevent some uninformed investors to trade, or creates a counterpart, for trades that should not have been executed. Moreover, uninformed investors can be winners or losers of the price movement induced by the presence of the insider, depending on the initial imbalance between supply and demand of shares. The amount of the harm imposed to uninformed can be estimated to the number of shares sold by the insider twice the difference between the price paid to acquire the share and the price at the disclosure of information.

# 1 Introduction

Securities fraud such as insider trading and stock price manipulation are considered in many countries as economic crimes. The regulation of securities fraud had been imposed to establish the confidence of investors in the market. Insider trading differentiates from stock price manipulation by one characteristic: the private information of the insider is a true information<sup>1</sup>. In fact stock price manipulation modifies the price of the security in a wrong way. On the contrary, the private information possessed by the insider is a true information which makes the price of the security closer to the right price. Then it has been truly argued that manipulations and undisclosed information are activities that induce investors to make wrong investments. Insider trading does not induce traders to invest in a bad way, but this fact doesn't mean that no harm to investors from insider trading exists.

Many articles focus on the desirability of insider trading<sup>2</sup>. Some deal with the impact of insider trading regulations on the welfare of investors so that wealth transfers are neutral. Meanwhile, when insider trading activity is considered as illegal, uninformed investors are the victims of these wealth transfers. Under such a legislation, victims may ask for reparation of the harm imposed to them. American law recognises the harm from insider trading and stock price manipulation<sup>3</sup>. In France, few courts decisions refer to uninformed investors harm from stock price manipulation and false information diffusion and to my knowledge, no court decision refers to an eventually harm from insider trading. Thus it seems that judges and courts need help to clarify the problem of harm from securities fraud. In the article we focus on the harm to uninformed investors from insider trading.

We show how uninformed investors suffer harm from insider trading in considering the timing characteristic of insider trading information. In particular, we focus on order driven markets such as Euronext. We demonstrate that uninformed investors suffer two types of harm : under an "order driven market system", the presence of insiders either prevent some uninformed investors to trade, or creates a counterpart, for trades that should not have been executed. In fact, when an insider buys shares, the buying power of the mar-

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<sup>1</sup>The efficient capital market theory establishes that a security market is informationally efficient when all informations are introduced into price. "A market is efficient with respect to information set  $I_t$  if it is impossible to make economic profits by trading on the basis of information set  $I_t$ " [Jensen; 1978]. A true price is close to the price that integrates all information.

<sup>2</sup>See Bainbridge [1999] and Hu and Noe [1997].

<sup>3</sup>Footnote dans easterbrook et ...schel

Easterbrook F. et Fischel D.R. [1991] *The Economic Structure of Corporate Law*, Harvard University Press, London, pages 370.

ket increases (more shares are demanded) and when an insider sells shares, the selling power increases (more shares are offered). In an "order driven market system", selling orders and buying orders are directly confronted, orders are executed if and only if there is a counterpart on the market. If insiders have the possibility to act strategically, so that their orders are executed in priority, a supplementary buying power decreases the possibility for uninformed buyers to find a counterpart on the market. A wealth transfer is then operated from uninformed to insiders.

The article is organised as follows: first we draw a short survey to understand how investor harm from insider trading is analysed in the literature (2). Then we explain how securities markets work: our analysis is mainly based on an "order driven market system", that's why the structure of transactions must be understood (3). Characteristics of the private information of the insider and his behavior are explained and translated through three assumptions (4). In the next paragraph, we show that insider trading introduces two types of harm on uninformed investors: the counterpart harm and the non execution harm (5). The analysis considers the impact of insider trading on the execution of uninformed investors' orders when no price movement is observed (6). Then we investigate for the consequences of the price movements due to insider trading (7).

## 2 Investor's harm from insider trading in the literature

A thirty years old debate about the impacts of insider trading have not removed the first idea that it is forbidden for moral reasons. Insiders have an unfair advantage, so their trading can discourage uninformed investors. Economic analysis show that insider trading has two major effects on the economy. On one hand, a part of the private information of the insider is integrated in the price of the security [Meulbroek 1992]. On the other hand, insiders imposes adverse selection costs on uninformed investors. The beneficial informational effect balance with the negative adverse selection effect providing economists to solve the controversy on the desirability of insider trading. The aim of the current article is not to enter this debate but to open a discussion about the harm imposed to uninformed investors. Few works deal with this subject, that's why we summarize below the different views developed in the literature. We first develop the point of view of the Law and Economics school who consider that insider trading is a victimless crime. Then, we survey works about the existence of a harm to investors

from insider trading.

Bainbridge [1999] examines the question of investors' harm. The author analyzes two arguments often advanced in the legal literature and concludes that neither argument is convincing. First argument establishes that when insiders trade, uninformed investors are incited to trade at a bad price, that is a price which does not reflect private information. It is true that level and direction of trades are not the same when information is publicly revealed than when it is not. However, insider's role is not to reveal this information. American law imposes an "abstain or disclose" requirement on insiders. The insider must choose between two options : either, he abstains from trading in the security until the time that the information becomes public, or he discloses, himself, the information to the marketplace before trading [Ausubel, 1990]. Many other countries propose equivalent rules. In France, insiders are supposed to abstain from trading if the firm does not disclose information. Under such scenario, insiders have no choice but to wait for the disclosure of information before trading. Precisely, it is the failure to abstain which defines insider trading. The decision of a uninformed investor to purchase or sale shares is not conditioned by the presence of an insider, all the more when the presence of the insider is not revealed. If a uninformed trader sells his shares before the course rises, the fact that his titles are bought by an insider or not, creates no harm to the salesman. It is the undisclosed of information, who leads the salesman to realize an unfavourable deal. Second argument advanced by Bainbridge [1999] concerns the impact of price effects resulting from the action of insiders. Their presence conveys information through prices so that the new price is closer to the "correct" price. So, if the behavior of uninformed investors is influenced by these price changes, it will be done in a right sense: this constitutes the beneficial effect of insider trading.

The classic Law and Economics view developed by Manne [1966a] and Carlton and Fischel [1983] considers then that insider trading is a victimless crime.

"The insider's gain is not made at the expense of anyone. The occasionally voiced objection to insider trading - that someone must be losing the specific money the insider make - is not true in any relevant sense" [Manne, 1966a, p61].

One wants to understand the impact of insider trading must have in mind two characteristics of the insider's information. First, insiders have a private (non public) and material information, allowing them to forecast prices variations of the security in question. Second, insiders know the right

time to trade on the security. Some authors shed light on this idea to argue that uninformed investors are victims of insiders trades because of an adverse selection effect.

“Insider traders buy at the right time and sell at the right time. It follows that on the average, outsider traders are being induced to do the opposite” [Manove; 1989].

Bhattacharya and Spiegel [1991] and Ausubel [1990] consider that outsiders (uninformed investors) react to the presence of insiders by giving up some trades or by requiring a risk allowance. Trading with a better informed investor is then considered as harmful for the uninformed because of the risk of adverse selection which ensues from it. The reliable loss of the investors leads them to reduce the level of their demands on the market, diminishing market liquidity. Ausubel [1990] goes forward this idea in formulating the confidence rationale as an economic argument for insider trading regulation. The term “confidence” is then interpreted as the rationale belief by outsiders that their return on investment is not being diluted by insider trading. In other words, one can consider, that insider trading is a robbery to outsiders.

Finally, uninformed investors' harm is described in two manners in the literature : the harm to liquidity traders, and the harm to outsiders. It is largely accepted that insider trading activity decreases the market liquidity [De Marzo, Fishman and Hagerty; 1998 - Fishman and Hagerty; 1992 - Leland; 1992 - Manove; 1989]. Thereby, traders who must trade for life cycle or other reasons not related to information are disadvantaged. Bajeux and Rochet [1989] prolong Kyle's [1985] model by considering the behavior of the small individual traders as an endogenous variable. They show that when insider trading is permitted, the use of their private information increases the volatility of the price for the considered asset. The small traders undergo then a loss of utility because of the increase of this volatility. Leland's analysis in 1992 considers the impact of insider trading on the welfare of the various agents concerned by such an activity. He concludes that insider trading must be prohibited because the global level of welfare decreases. The gains of the winners, the insiders and the initial shareholders, do not compensate for the loss of welfare of the uninformed investors and the liquidity traders. The liquidity traders exchanging for liquidity reasons are the main losers of insider trading, because the market becomes less liquid. Furthermore, expected gains of the uninformed investors decrease when insiders are free to trade on the market. Because they are trading against better-informed investors, they own, on average, more shares when expected returns are low and fewer shares when expected returns are high. However the risks faced by the uninformed

investors are reduced in the presence of insiders because a part of the information is integrated into prices, revealing some incurred risks. Manove [1989] formalize this idea in a model where insiders and informed speculators appropriate some part of the returns to corporate investment, at the expense of other shareholders. In fact, the structure of the trading game is such that outsiders trade with insiders and among themselves. The number of potential outsiders who want to buy a share is superior to the number of outstanding shares (shares sold by the other outsiders) so that there will always be excess demand. When insiders have information about a good news, they buy shares at the beginning of the period and outsiders who want to buy receive the remainder of shares brought to the market. On the contrary, when insiders know a bad news, he doesn't buy any share at the beginning of the period, so all the outstanding shares are received by outsiders. The structure of the model is realistic because of the timing characteristic of insider trading. As insiders know the right time to buy or sell shares, they act strategically so that their orders are executed at this right time, before the orders of outsiders. We go forward this idea in the article to show the consequences of this behavior.

### 3 Stock exchange market organizations

Several types of market organisations exist around the world. Costs and risks borne by the participants are related to transactions organisation. That's why the market structure influences the supply and demand strategies of investors. Our analysis focuses on continuous price quotation markets, such as most important Stock exchange markets (Euronext Paris, Tokyo Stock Exchange, New York Stock Exchange, London Stock Exchange). They are divided in two organisationnal systems of stock exchange: the "price driven market system" (Nasdaq, London Stock exchange) and the "order driven market system" (Euronext, Tokyo Stock Exchange, Toronto Stock Exchange). Most analysis which study the harm imposed by insider trading take place on price driven market system. My objective in the current article is to analyze investors' harm in an "order driven market system". We consequently explain the functioning of the order driven market system, to understand how the harm is introduced in this type of organisation. We first describe the differences of the two organisationnal systems (2.1). Then, from the different kinds of orders which can be formulated (2.2), we explain how the official price is quoted in an "order driven market system" (2.3).

### 3.1 “Order driven market system” / “Price driven market system”

The organization of securities markets imposes on the normal customer to transmit his orders to an intermediary. According to the role of these intermediaries, one will be in the presence of a “price driven market system” or an “order driven market system”. The first market conception is organized around intermediaries called “market makers”. The market maker sets an “ask” price at which he buys shares and a “bid” price at which he proposes to sell shares. He compensates for temporary imbalance between offer and demand to insure the market’s liquidity [Foucault and Hillion; 1997]. In the second market conception, the “order driven market system”, the orders to buy or sale of investors are directly confronted. They pass on their orders to an intermediary whose role is to collect orders (credit institutions for the greater part). Then orders are passed on to other intermediaries (broking firm), who execute orders on the Stock Exchange and solve positions. Finally, the liquidity is based on the complementarity of orders of opposite directions, because any order which does not find counterpart, cannot be executed and waits (for the time of its validity), on the market’s sheet of orders.

An example of a market’s sheet of order

Buy		Sell		Last exchanges		
Quantity	Limit	Limit	Quantity	Hour	Quantity	Course
40	61.05	61.10	10	11h10	50	61.10
10	61.00	61.15	30	11h10	150	61.05
30	60.95	61.20	30	11h09	30	60.95
10	60.90	61.25	20	11h08	10	61.00
20	60.85	61.30	40	11h08	30	60.95

The selling orders are ranked on the market’s sheet of orders from the best order (the lowest price proposed) to the baddest order. On the contrary, buying orders are ranked on the market’s sheet of orders from the best order (the highest price proposed) to the baddest order. When the same price is specified on both orders, the priority of execution is put to the earliest order. When the price differs on both orders, priority of execution is put on the better price order, without considering the time the order had been registered. The official quotation will be the price in which, at a given moment, the biggest quantity of shares of a security can be negotiated [Stoulet, Deschanel; 1997].

### 3.2 Stock exchange orders

Under an “order driven market system”, several types of orders exist. Two types of orders are presented.

- 2 The “limited course Order” must specify a price limit. The buyer ...xes the price above which he does not want to buy anymore and the salesman the price beyond which he does not want to sell anymore. As soon as an order of opposite direction with a better or identical price is passed on to the market, the order is executed. If quantities proposed by the counterpart are insu¢cient, order can be split and executed for various prices compatible with its limit. Finally, the order will be either positioned on the market’s sheet of orders if there is no counterpart, or will be executed partially or totally.

As an example, a selling limited course (LC) order of 20 shares at 61.05<sup>2</sup> is transmitted to the market. The market’s sheet of order is given in the last paragraph. The selling order is immediately executed with a buying order at 61.05<sup>2</sup> and for 20 shares. The remaining of the 40 shares proposed by the buying order, executed for 20, still inscribe on the market’s sheet of orders. The new market’s sheet of order is then:

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.05	61.10	10	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	-	-
20	60.85	61.30	40	20	61.05

Q: Quantity ; L: Limit ; C: Course ; LE: Last exchanges

- 2 The “market price Order” does not specify any course indication; the investor wishes to acquire or to give up his shares as soon as possible. When this type of order arises on the market, it is transformed into a “limited course order” at the price of the best offer (demand) if it is a buying order (selling order). In case of partial execution, order remains registered on the market’s sheet of orders as a “limited course order”, whatever then the evolutions of the market.



The "limited course order" has a probability of execution inferior to unity. In fact, the price proposed to the market can be higher (smaller) to the right price in case of a selling (buying) order. That's to say that the investor who want to buy a share proposes a price lower to the market price, because he doesn't mind to wait for the execution of his order. The difference between the right price and the price proposed to the market is a sort of wage that pays the patience of the investor. On the contrary, impatient traders transmit "market price orders", that have a unity probability of execution, conditioned on the compatibility of quantities.

### 3.3 Price quotation and stock exchange transactions

Before the opening of the stock exchange, broking firms enter in the system of quotation all the orders they were passed on, since the day before. By integrating all the orders, the system calculates the theoretical course for which a maximum of shares will be traded. If several prices are then quoted, the system prefers the course leaving unserved the smallest number of shares. If it persists several courses, the system will choose the quotation closest to that of the day before.

The continuous quotation session begins with the opening price. The market's sheet of orders contains orders not executed yet, i.e. that did not find counterpart. Then the brokers can enter new orders in the system of quotation. Each time two orders of inverse direction are compatible among them, system realizes deal. The order is not necessarily executed with an opposite sense order which proposes the same price, but with the order proposing the best price<sup>4</sup>. Some orders will only be partially executed if offered and asked quantities do not meet. The remainder quantity of the order stills then registered on the market's sheet of orders. Furthermore, when two orders of a same direction stipulate the same price, priority is given to the earliest registered order.

At the conclusion of the session, the last course constitutes the closing course. The market's sheet of orders will be kept until the next day, for all valid orders (depending on the time of their validity which varies between one day and one month).

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<sup>4</sup>A selling order will be executed with the best order of opposite direction: a buying order stipulating the highest price. In fact, if the salesman agree to sell at 100 he will also agree to sell at 101, and so on. A buying order will be executed with the best selling order at the time of the transaction, the lower price. The buyer who wants to buy at 101 will agree to buy at 100 which is a better price for him.

## 4 The insider's strategy

Private information possessed by insiders allows them, on one hand, to realize investments or disinvestments anticipating the variation of stock-exchange courses, but also, on the other hand, to trade at the convenient moment. This foreknowledge gives them an advantage on other investors: they can use the information about other investors position to make sure their orders will be executed in priority<sup>5</sup>. The insider chooses the quantity (4.1) and the timing of his trade (4.2).

### 4.1 The quantity to trade

The reasoning takes place in an insider trading regulating system. Insider trading is illegal and authorities investigate to find criminals. However, as trading is not illegal in itself, distinguishing legal and illegal transactions is very hard. Then the probability of detection of insiders is low. Moreover, proof of insider trading is mainly based on statistical facts such as abnormal price moves and quantities of shares variations. So insiders act strategically in determining the number of shares to trade so that they won't be detected by the authorities. Our analysis is posterior to the insider's decision to trade illegally (he knows the expected sanction imposed to him in case of conviction): the insider has chosen the number of shares he wants to trade. We suppose that one insider enters the market and transmits an order for  $x$  shares. This order will be executed at time  $t_1$ .

### 4.2 The timing of the insider's trade

When an insider wants to trade surely, he can observe the market's sheet of orders and act in such a way that he's sure his order is executed. The quantity  $x$  to trade is chosen. Then the insider must transmit an order that guaranty him a good price and a good moment of execution. At each moment  $t$ , the market's sheet of orders is constituted of non executed orders. As the market's sheet of orders can be known by every investor, and particularly by the insider, this last one can act strategically so that his order will be executed in the right moment and at a good price. We suppose that the insider wants his order to be imperatively executed, that's why he proposes a market price order.

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<sup>5</sup>We do not distinguish between short term investors and long term investors or between outsiders and liquidity traders. Uninformed investors, are defined as all investors except the insider. As they don't know the presence of the insider, each type of investor can randomly invest the same time as insider.

Trading on a security when private informations are known, is illegal until this information is revealed to the public. If insiders respect the rules imposed to them, they abstain from trading during this period. At the disclosure of information, all investors (insiders and outsiders) have the same level of information and the quotation is closed to the "true" price. In other words, the influence of the insider trading is concentrated on the period between the insider trading in  $t_1$  and the information public disclosure in  $t_2$ . Let us call this period the "insider trading period".

## 5 Victims identification in an "Order driven market system": the "counterpart harm" and the "non execution harm"

Insiders possess foreknowledge on information allowing them to buy shares before their price rise or to sell shares before the price fall. A quite simple idea describes the harm imposed to uninformed investors by insiders: every share owned by an insider when the expected value of the share is high, should be owned by a uninformed if the insider had abstain to trade on the security. On the contrary, when the expected value of the share is low, all shares bought by uninformed to the insider, should still be owned by the insider if he had abstain to trade. Consequently, under insider trading regulation, the trading activity of insiders is simply a wealth transfert from uninformed to insiders. Even though the harm to uninformed is identified by the literature, the question of victims identification is still open.

Manne [1966a] considers that insider trading activity changes prices because a part of the information of insiders is integrated into prices. His analysis of insider trading potential victims is thereby based on the price moves. The point we want to discuss in this article focuses on the market power introduced by insider trading and ignored by Manne.

The private information of the insider makes him sure of the sense and the time of the transaction. The consequences of the presence of an insider on uninformed investors is described in a simple way, in case of a sell (5.1) and a purchase of shares (5.2) by the insider.

### 5.1 The insider sells shares of a security on which he possess private information

If an insider decides to sell his shares because he knows that the course of the security is going to fall, these shares will inevitably be bought by a

uninformed investor. So, the fall in the share price which would have been borne by the insider, is transmitted to the uninformed agent. If the insider had abstained from selling his shares following his confidentiality's duty, the buyer would have not necessarily removed his order. However, the execution of the order would either not be realized, or meet another counterpart, that is to say a uninformed seller. In case the order had been executed, the situation is unchanged for the uninformed buyer : he doesn't mind if the salesman is privy or not. Nevertheless, the uninformed investor who would have sold his shares had done it at the convenient moment. He would have transferred the loss in value of the share on the buyer. As the insider's order has priority on the order of the uninformed, the action of the insider prevents the uninformed seller from avoiding a loss of money due to the future decrease of the security's price.

## 5.2 The insider buys shares of a security on which he possess private information

The purchase of shares by an insider allows to develop a similar demonstration. If the insider had refrained from buying the shares, either the uninformed salesman would not have found counterpart for his selling order, or another uninformed buyer would have bought them. So, profits realized by the insider constitute a transfer of wealth from uninformed investors to the insider.

**Proposition 1** When an insider buys (sells) shares on a security market, he brings a buying (selling) power on the market that creates two types of harm to uninformed investors trading within the "insider trading period". Some uninformed investors propose orders of the same sense as insiders that are not executed because of the presence of the insider. We propose to call it "non execution harm". Some uninformed investors propose orders of opposite sense as insiders that are executed because of the presence of the insider (they should not have been executed if insiders had abstain from trading). We propose to call it "counterpart harm".

One may formulate the following remark. A stock exchange market is not only constituted by three investors. If a uninformed can't sell or buy at the precise time the insider trades, other investors can constitute counterparts, so that the effect of the insider trade is non determined. We answer this remark by two points.

First, it is true that the impact of insider trading is not only concentrated on simultaneous investors. In order to understand the whole impact of

insider trading on the market transactions of the security, one must consider the period between the insider trading and the information public disclosure. The uninformed investor robbed is not necessarily trading at the beginning of the period, but can also be a potential seller or buyer at the end of the period. What must be understood is that an insider's sell (buy) of shares constitutes a selling (buying) power. Then aggregated demands and aggregated orders arising during the "insider trading period" will be increased by the buying or the selling power of the insider.

Second, what is essential to consider is the time of the trade, that determines the conditions of trade. The upside analysis is a simplification of the reality but shows that the presence of insiders modifies the trades of securities shares. In case of a sale of shares by the insider, we consider that a uninformed seller is harmed because of a wealth transfer, depending on the fact that his order may not be executed. It is likely that this uninformed seller will have the opportunity to sell his shares to another uninformed buyer, but as the time of the transaction has changed (maybe just for few seconds). The trade may be done at another price and perhaps not for the whole quantities. The presence of insiders has an impact on the security price that must be described.

In the next paragraph, we go forward this analysis to determine precisely which uninformed investors are the victims of the insider. First, we draw the study on the assumption of no price movements induced by the insider (6). Then, we introduce price movements due to the presence of the insider (7).

## **6 Analysis of the uninformed investor's harm from insider trading when prices don't move**

The trade of the insider modifies the transactions on the market, compared to a situation where no insider trade. Firstly, a buying (selling) order increases (decreases) the net aggregated demand of the market. Secondly, informations are transmitted to the market price through the insider's trade. That's why a comparison of a situation without and with insider is complex. To simplify the analysis, we propose to make the comparison between the two situations under the assumption of no price movement. We first introduce the assumptions of such an analysis (6.1). Then, the consequences of an insider's selling order (6.2) and of a buying order (6.3) are described. The conclusions of the analysis under the assumption of no price movement is summarize in the last paragraph (6.4).

## 6.1 The no price movement assumption

The no price movement assumption is central to build an analysis of the insider's effect, everything being equal. It implies that the market doesn't react to the presence of the insider and that the other investors don't modify their behavior. Consequently, three assumptions are formulated.

Firstly, the comparison of a situation with insider to a situation without him requires that the orders transmitted are still the same between the two situations. No order is cancelled, and no feature of any order is modified. To respect this characteristic of the analysis, orders transmitted are only "course limited orders". In fact, the features of a course limited order specify the quantity and the limited price to trade. This fixed price limit enables a comparison between the two situations everything being equal. On the contrary, the price of execution of a market price order varies with the orders written down the market's sheet of orders. As insider trading introduces new orders, the market's sheet of order changes between the two situations, and the price of execution of a market price orders varies in consequence. That's why in this section, only limited course orders are transmitted by the uninformed.

Secondly, some extreme orders will never be executed, because their limit are too far from the transaction price. In  $t_1$ , the market's sheet of orders is given and contains buying and selling orders not executed yet. Each order registered on the market's sheet of orders or arising during the "insider trading period" between  $t_1$  and  $t_2$  can either compete with an insider order or be the counterpart of this order. Orders to sell proposing a high limit price of execution and orders to buy proposing the lowest price of execution are the most expensive. Also our analysis only consider orders (from outsiders or insiders) whose price is included in an interval [lowest asking price including a counterpart ; highest offered price including a counterpart]. Let us call it the "price interval"<sup>6</sup>.

Thirdly, the analysis proposed in the next paragraph comes from a mathematical comparison between the orders flows in the two situations. On an order driven market, some orders are not executed, because no counterpart exist, or because the features of the orders are not compatible. We suppose that orders comprised in the price interval offer a maximal compatibility<sup>7</sup>.

<sup>2</sup> Let  $P_{D_{NI}}$  be the aggregated demand of shares of the uninformed investors during the "insider trading period" whose price is included in

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<sup>6</sup>This point is illustrated in Appendix.

<sup>7</sup>For an illustration of this assumption, see the cases developed in Appendix. Implications of this assumption are discussed later, see 6.4.

the price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart].

- <sup>2</sup> Let  $\sum O_{NI}$  be the aggregated offer of shares of the uninformed investors during the "insider trading period" whose price is included in the price interval.
- <sup>2</sup>  $O_I$  represents the selling power of the insider when he offers a quantity  $x$  of shares in  $t_1$ . In case, the insider asks for  $x$  of shares in  $t_1$ ,  $D_I$  is the buying power of the insider.

We analyse below the consequences of the presence of the insider in cases of sell and buy of shares.

## 6.2 The selling power of the insider

The assumptions formulated in the last paragraph enables us to make a comparison between the chain of execution of the orders when no insider trade, and when an insider sells his shares. The consequences of the presence of the insider are deducted from a mathematical equilibrium between the quantity of orders transmitted to the bid and to the ask. Under the assumption of total compatibility between orders, the identification of the victims depends on the order flow transmitted to the market between  $t_1$  and  $t_2$ .

If an insider possesses information on a bad news, he can forecast that the price of the security will decline at disclosure of information<sup>8</sup>. As he doesn't want to lose money, he decides to commit insider trading in selling his shares. The selling power of the period is then increased.

- <sup>2</sup> Suppose that the aggregated number of orders of uninformed during the "insider trading period" is such a way that the aggregated demand of uninformed is superior to the aggregated supply.

$$\sum D_{NI} > \sum O_{NI}$$

In other words the security price should have increased during the "insider trading period". Then, the insider intervention is contrary to the market tendency. One may interpret this fact in terms of a surprising bad news concerning the firm. Two cases can then be distinguished:

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<sup>8</sup>We call bad (good) news an information if publicly revealed would make the security price decrease (increase). For instance a bad news can be privately known by managers when the society makes decisions whereas it had announced the contrary during the year.

- $P_{D_{NI}} > P_{O_{NI}} + O_I$  : Orders of the insider (compatible with buying orders of uninformed) allow some uninformed buyers to acquire shares of the security. However, the information hold by insiders and not yet disclosed is a bad news, so this investment leads to lose money. These investors should not have bought the shares. So, insiders have operated a wealth transfer that creates a “counterpart harm” to uninformed buyers. The selling power of the insider is insufficient to reverse the market tendency<sup>9</sup>. However, uninformed buyers are major loser of the intervention of insiders : as they constitute the counterpart of the trade, and had badly forecast the evolution of the security price, they suffer harm from insider trading.

**Example 2** Suppose that an insider transmit a selling order for 10 shares. The comparison of a situation without insider and with insider is illustrated in Appendix, Case N<sup>#</sup>1: The summary of the case is explained in the table below.

Case N<sup>#</sup>1 :  $P_{D_{NI}} = 150$  ;  $P_{O_{NI}} = 130$  et  $O_I = 10$

		Without insider	With insider		
Number of transactions		130	140		
Inside spread in $t_2$		[61.15 ; 61.20]	[61.15 ; 61.20]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
7	B	10	NE	61.05	CTp H

B:Buy ; S:Sell ; NE:Non Execution ; CTp: Counterpart ; H:Harm ; G:Gain

The insider sells 10 shares that creates a counterpart for the order (7). Without insider this order won't be executed. With insider the order is executed at 61.05<sup>2</sup> and for 10 shares. As the price will fall in  $t_2$ , the buyer who wouldn't have bought this shares, suffer a counterpart harm.

<sup>9</sup>If the insider takes care of the probability of conviction for insider trading, he will act strategically so that his trades will not be detected on the market. In fact, he will sell a little amount of shares so that the market tendency will not be reversed.



- $P_{D_{NI}} < P_{O_{NI}} + O_I$  : The aggregated supply of shares is superior to the aggregated demand so some orders to sell will not be executed. If the insider can formulate orders which can be executed in priority to uninformed orders, some of these last one will not be executed. Furthermore, some buying orders that would not have been executed will be. Finally in this situation, some buyers suffer a "counterpart harm" and some sellers suffer a "non execution harm".

**Example 3** An insider transmit a price market order to sell for 40 shares. The summary of the case is explained in the table below.

Case N°2:  $P_{D_{NI}} = 150$  ;  $P_{O_{NI}} = 130$  et  $O_I = 40$

		Without insider	With insider		
Number of transactions		130	150		
Inside spread in $t_2$		[61.15 ; 61.20]	[61.00 ; 61.15]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
3	B	20	61.10	61.05	G
4	B	20	61.15	61.10	G
5	S	20	61.15	NE	NE H
7	B	20	NE	61.15	CTp H

The selling power of the insider creates a counterpart for the order (7) on 20 shares and prevent the order (5) to be executed for 20 shares. The sum of individual harm concern a quantity of 40 shares, corresponding to the number of shares sell by the insider. The non execution harm posits on the selling order proposing the highest price in the price intervall. Furthermore, the presence of the insider is bene...cial for investors who transmitted the buying orders (3) and (4), because their price execution is better with insider than without.

- <sup>2</sup> If the structure of orders is such that the aggregated demand of shares of uninformed investors is inferior to the supply ( $P_{D_{NI}} < P_{O_{NI}}$ ), the selling power of the insider leads to a surplus of share supply

( $P_{D_{NI}} < P_{O_{NI}} + O_I$ ). The insider intervention improves the market tendency to a price decrease. Then insiders sales can increase compared to the first situation because its detection is more difficult. The consequence of the presence of the insider is that some uninformed selling orders are not executed : these outsiders suffer a "non execution harm". They had rightly forecast the price evolution of the share, but the presence of insider prevent them from selling their shares. As a consequence, the intervention of the insider is completely borne by uninformed salesmen.

**Example 4** The case of an insider who transmits a price market order for 30 shares is illustrated in appendix, case N°3. The summary of the case is explained in the table below.

Case N°3 :  $P_{D_{NI}} = 120$  et  $P_{O_{NI}} + O_I = 160 + 30$

		Without insider	With insider		
Number of transactions		120	120		
Inside spread in $t_2$		[61.00 ; 61.15]	[61.00 ; 61.05]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
3	B	20	61.10	61.05	G
4	B	20	61.15	61.10	G
5	S	10	61.15	NE	NE H
7'	S	10	61.15	NE	NE H
6	S	10	61.05	NE	NE H

With insider, three orders don't find counterpart, for a whole quantity of 30 shares. The selling order (5) and (7') have the highest price limit, that's why the risk of non execution is greater for them.

### 6.3 The buying power of the insider

When an insider privately knows a good news on a firm situation that is likely to increase the price of the security, he can decide to buy shares of the security. The buying power of the insider increases the number of shares bought by all investors.

<sup>2</sup> If the aggregated demand of shares is initially superior to the supply ( $D_{NI} > O_{NI}$ ), the intervention of the insider increases the buying power during the insider trading period.

$$D_{NI} + D_I > O_{NI}$$

Then, uninformed buyers suffer a “non execution” harm from insider trading. In reality, these investors had rightly forecast the price evolution, but the presence of the insider, who possesses better information allows him to buy shares instead of some uninformed investors. Furthermore, the intervention of insider increases the market tendency of price rise, so that the probability of detection of insider trading is reduced (when authorities base their investigations on surprising price evolution).

Example 5 The case of a buying order from the insider for 20 shares is illustrated in Appendix, Case N<sup>4</sup>.

Case N<sup>4</sup> :  $D_{NI} + D_I = 150 + 20$  et  $O_{NI} = 130$

		Without insider	With insider		
Number of transactions		130	130		
Inside spread in $t_2$		[61.15 ; 61.20]	[61.15 ; 61.20]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
6	S	10	61.05	61.10	G
1'	B	20	61.05	NE	NE H

The non execution harm is suffered by the investor who transmitted the buying order (1'). This order is a course limited order, written on the market's sheet of order in  $t_1$ , and proposing a low limit price of execution.

<sup>2</sup> When the general tendency of price evolution is to decrease (that's to say that uninformed sales are superior to uninformed purchases ( $O_{NI} > D_{NI}$ )), the private information possessed by the insider is inverse to the market tendency. Then if the buying power of the insider is limited so that the aggregated demand is still under the aggregated offer, only uninformed sellers are harmed by insider trading ( $D_{NI} + D_I < O_{NI}$ ). These investors had badly forecast the price

evolution of the security and should not have been executed (because the demand is insufficient). Nevertheless, the presence of insiders increases the number of shares bought and some orders to sell are executed.

**Example 6** An insider transmits a buying order for 15 shares. This case is illustrated in appendix, case N<sup>#5</sup>:

$$\text{Case N}^{\#5} : P_{D_{NI}} + D_I = 120 + 15 \text{ et } P_{O_{NI}} = 160$$

		Without insider	With insider		
Number of transactions		120	135		
Inside spread in $t_2$		[61.00 ; 61.05]	[61.00 ; 61.05]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
1	S	5	61.05	61.10	G
4	B	10	61.10	61.15	H
5	S	10	NE	61.15	CTp H
6	S	5	NE	61.05	CTp H

The counterpart harm is put on the most recent orders. Moreover, the selling order (1) benefits from a better price, although the buying order (4) is executed at a baddest price.

- <sup>2</sup> When the buying power of the insider is sufficiently strong to inverse the market tendency ( $P_{D_{NI}} + D_I > P_{O_{NI}}$ ), both uninformed sellers and uninformed buyers are harmed. The former suffer a "counterpart harm" and the latter a "non execution" harm.

**Example 7** An insider transmits a buying order for 50 shares (appendix Case N<sup>#6</sup>). Nevertheless, in this case, the compatibility between orders is not complete.

$$\text{Cas N}^{\#6} : P_{D_{NI}} + D_I = 120 + 50 \text{ et } P_{O_{NI}} = 160$$

		Without insider	With insider		
Number of transactions		120	140		
Inside spread in $t_2$		[61.00 ; 61.05]	[61.05 ; 61.15]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
1	S	30	61.05	61.10	G
3	B	10	61.10	61.05	G
4	B	10	61.10	61.15	H
5	S	10	NE	61.15	CTp H
6	S	10	NE	61.10	CTp H
7	B	10	61.05	NE	NE H
1'	B	20	61.05	NE	NE H

The sum of individual harm concerns a quantity of 50 shares. The counterpart harm put on orders (5) and (6) is about 20 shares, whereas, in case of total compatibility between orders, it would have been about 40 shares. Without total compatibility the counterpart harm is transformed into a non execution harm for 20 shares.

## 6.4 Concluding results

The wealth transfer operated by the insider is identified in the literature. We showed that under an "order driven market system", the presence of insiders either prevent some uninformed investors to trade, or creates a counterpart, for trades that should not have been executed. The key conclusion is straightforward : the more insider trade (quantity of shares sold or times of the trade), greater is the robbery to uninformed. .

		Initial market tendency	
		$D_{NI} > O_{NI}$	$D_{NI} < O_{NI}$
Insider order	Final tendency	Harm	
$O_I$	$D_{NI} > O_{NI} + O_I$	Counterpart	-
	$D_{NI} < O_{NI} + O_I$	Counterpart and	Non execution
		Non execution	
$D_I$	$D_{NI} + D_I > O_{NI}$	Non execution	Counterpart and
			Non execution
	$D_{NI} + D_I < O_{NI}$	-	Counterpart

Furthermore, when the insider intervention increases the market tendency, uninformed investors trading in the same sense as insiders (i.e. those who had correctly forecast the market tendency) are harmed, because some of their orders are not executed. When the intervention of the insider is contrary to the market tendency, but insufficient to reverse the tendency, counterpart harm appears. Finally, when the intervention of the insider is contrary to the market tendency so that it reverses the tendency, uninformed investors suffer two types of harm. If  $T_1$  is the number of transactions realised without insider trading and  $T_2$  the number of transactions realised with insider trading, then  $T_2 - T_1$  is the number of shares who found a counterpart with insider trading.  $(x_i - (T_2 - T_1))$  is the number of shares which can't be executed because of the insider.

When the liquidity or the features of execution prevent the total compatibility between orders, the analysis of the number of shares unexecuted or finding a counterpart prevails. Nevertheless, uninformed investor's harm can't be inferred from the initial tendency on the market. When the compatibility exists without insider trading but not with it, the number of orders not executed increases compared to a situation of perfect compatibility<sup>10</sup>. When the compatibility doesn't exist without insider trading, the presence of the insider may provide counterpart for orders which wouldn't have been executed<sup>11</sup>.

## 6.5 The amount of harm

The analysis of individual harm from insider trading that we develop in this article is built on a very simple mathematical equilibrium. The proposition to value the amount of harm is then very simple.

**Proposition 8** The sum of individual harm suffered by uninformed investors from insider trading concern a quantity of shares equal to the number of shares traded by the insider. That's why we can say that this harm is a wealth transfer from uninformed investors to the insider.

The chain of transactions of the two situations allows us to compare the financial situation of each investor. The amount of harm (or gain) imposed to them can be calculated.

In case, the insider transmit a selling order, he transfers the loss he would have borne to the uninformed investors. The non execution harm prevent some uninformed sellers to sell their shares before the price decrease. The

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<sup>10</sup>See, case N°6:

<sup>11</sup>A case of this type is presented in Appendix, Case N°7:

decrease in value per share imposed to them worth  $(\mu_1 \text{ ; } \mu_2)$ , when  $\mu_1$  is the price at which the uninformed would have sold his share, and  $\mu_2$  is the price of the share after the diffusion of information in  $t_2$ . The counterpart harm concern buyers, who bear the decrease of value that should have been borne by the insider. It worth  $\mu_1^0 \text{ ; } \mu_2$  per share, with  $\mu_1^0$  the buying price of the share. The prices  $\mu_1$  and  $\mu_1^0$  are individual prices for each uninformed investor who suffer harm. The whole precise amount of harm must then be studied case after case.

Example 9 Case N<sup>2</sup>:  $P_{D_{NI}} = 150$  ;  $P_{O_{NI}} = 130$  et  $O_1 = 40$

Suppose  $\mu_2 = 55$

The insider's decrease of value avoided per share is the difference between the price perceived at the sell minus the real value of the share in  $t_2$ . In Case N<sup>2</sup>, the insider sells his shares at 61.05, so the decrease of value avoided worth 60.50<sup>2</sup>.

$$10 \times (61.05 \text{ ; } 55) = 60:50$$

The amount of harm suffered by each uninformed investor is summarize in the table below.

Orders for which execution conditions vary between the two situations						
Order	Sense	Quantity	Price	Price	Harm or	Amount of harm
			No I	I	Gain	or gain
3	B	20	61.10	61.05	G	$20 \times (61:10 \text{ ; } 61:05) = 1$
4	B	20	61.15	61.10	G	$20 \times (61:15 \text{ ; } 61:10) = 1$
5	S	20	61.15	NE	NE H	$20 \times (61:15 \text{ ; } 55) = 123$
7	B	20	NE	61.05	CTp H	$20 \times (61:05 \text{ ; } 55) = 121$

No I = No insider ; I = Insider

The decrease of value avoided by the insider is about 242<sup>2</sup> whereas, the sum of individual harm is about 244<sup>2</sup>. Two uninformed investors gain 1<sup>2</sup> because a better execution price prevails.

In case of a buy of shares from the insider, a symmetric analysis can be developed. The insider profit from an increase in value, whereas he prevents uninformed investors to benefit from this increase in value. Non execution harm or counterpart harm worth  $(\mu_2 \text{ ; } \mu_1)$  per share, with  $\mu_1$  the price at

which uninformed buyers would have bought their shares or uninformed sellers have sell their shares. Finally, we show that the amount of harm is not necessary equal to the amount of profit (or loss avoided). Nevertheless, it approximates the same amount.

In a continuous quotation system, securities' prices vary in one second. The intervention of the insider on the market influences the price movements because "a part of the private information is transmitted into prices" [Meulbroek; 1992]. Is the former analysis modified when prices variations are taking into account ? Is the harm to investors more or less important ? We answer these questions below.

## 7 Consequences of the price move due to insider trading

The presence of the insider as a buying or a selling power influences the price of the security. The official quotation of the security constitutes a reference for investors. If the price falls (rises), the orders are more likely to find counterpart at a lower (higher) price. In other words, when the price moves, investors modify their trading behavior. The former analysis is built on the assumption of the unvariation of prices, an appropriate framework to formulate conclusions everything being equal. In this paragraph, we discuss the relevance of such conclusions taking into account the influence of the insider on price variations.

First, insider trading introduces informations on the market, so that price move in the right sense [Meulbroek; 1992]. The variation of prices is due to the insider's behavior. The more the order of the insider is aggressive, in quantity or in price, the more the market detect his presence and react. In the former analysis, some execution price were closer with the insider than without, describing the fact that prices naturally move in the right direction when they take account of the presence of the insider. The assumptions formulated in the last section, "refrained" this informationnal beneficial effect. The introduction of market price orders instead of limited courses orders increase the impact of insider trading on prices. As a consequence, transactions will be realized at a price closer to the fundamental price.

**Example 10** The case N<sup>8</sup> presented in appendix constitutes a variation of the case N<sup>2</sup>, because orders 1; 3; 5 and 7 become market price orders. The chain of transactions is modified because the prices of transactions are realized at lower prices. As a consequence, some buyers of the shares gain



from the new situation whereas some sellers of the share are losers of the new situation.

Orders for which execution conditions vary between the two situations						
Order	Sense	Q	Price No I	Price I	Harm or Gain	Amount of harm or gain
1	S	20	61.05	61.00	H	$20 \times (61:05 \text{ j } 61:00) = 0:5$
3	B	30	61.10	61.00	G	$30 \times (61:10 \text{ j } 61:00) = 3$
4	B	30	61.15	61.10	G	$30 \times (61:15 \text{ j } 61:10) = 1:5$
5	S	30	61.15	61.00	H	$30 \times (61:15 \text{ j } 61:00) = 4:5$
7	B	10	61.15	61.00	G	$10 \times (61:15 \text{ j } 61:10) = 0:5$
6	S	20	61.05	NE	NE H	$20 \times (61:05 \text{ j } 55) = 121$
7'	S	10	61.15	NE	NE H	$10 \times (61:15 \text{ j } 55) = 61:50$
2'	B	10	NE	61.00	CTp H	$10 \times (61:00 \text{ j } 55) = 60$

The amount of harm suffered by uninformed investors whose orders are not executed or are executed because of the insider is about 242.50<sup>2</sup>. This amount is slightly inferior to the amount of harm in Case N<sup>2</sup>. However the main conclusions about individual harm imposed are not modified. The price market orders formulated are executed or registered on the market's sheet of orders at the better price proposed. So the average transaction price is decreasing. In other words, the major loser of the price decrease are potential salesmen whose price is over the new price quotation. They are less likely to find counterpart and bear the risk of a non execution. The limited course order (6) don't find counterpart even though the price limit specified is 61.05<sup>2</sup>.

As insider trading moves prices, the signal contained in securities prices varies and may induce some investors to modify their trading behavior. Suppose that the price falls, because of the selling power of the insider. Investors who transmit their orders must decide the type of order they want to formulate. In case of a limited course order, quantity and price limit must be chosen. Both sellers and buyers set price limit closer to the official quotation. The average price proposed in the whole orders is then decreasing. Investors modify their behavior in changing the features of their orders, or cancelling their orders which don't fit with the new conditions on the market. Then transactions that should have been realized are not.

**Example 11** To illustrate this idea, case N<sup>9</sup>, presented in appendix, is modified version of the case N<sup>8</sup> because the limited course order N<sup>4</sup> is now

proposing a price limit of 61.00<sup>2</sup>. As a consequence, the compatibility between orders is not fully respected; more orders never find counterparts. On the price interval [61.00; 61.15], 100 orders are not executed. Particularly, 40 orders are buying orders and 60 orders are selling orders. That's to say, added to the non execution of selling orders because of insider trading, the modification of the features of the order 4 prevent 40 orders to sell, and 40 orders to buy to meet. The non execution of the buying orders constitutes a gain of non execution because the price of the title is going to fall.

Orders for which execution conditions vary between the two situations						
Order	Sense	Q	Price	Price	Harm or	Amount of harm
			No I	I	Gain	or gain
1	S	20	61.05	61.00	H	$20 \times (61:05 \text{ j } 61:00) = 1$
2	S	20	61.10	NE	NE H	$20 \times (61:10 \text{ j } 55) = 122$
3	B	30	61.10	61.00	G	$30 \times (61:10 \text{ j } 61:00) = 3$
4	B	10	61.15	61.00	G	$10 \times (61:15 \text{ j } 61:00) = 1:5$
4	B	40	61.15	NE	NE G	$40 \times (61:15 \text{ j } 55) = 246$
5	S	30	61.15	61.00	H	$30 \times (61:15 \text{ j } 61:00) = 4:5$
7	B	10	61.15	61.05	G	$10 \times (61:15 \text{ j } 61:05) = 1$
7	B	10	NE	61.05	CTp H	$10 \times (61:05 \text{ j } 55) = 60:50$
7'	S	30	61.15	NE	NE H	$30 \times (61:15 \text{ j } 55) = 184:50$
6'	S	10	61.10	NE	NE H	$10 \times (61:10 \text{ j } 55) = 61$
2'	B	10	NE	61.00	CTp H	$10 \times (61:00 \text{ j } 55) = 60$

Finally, the modification of uninformed investors behavior may change the structure of the market of the title. The structure of the market varies in the sense of an increasing demand of shares and a decreasing offer of shares. Consider that the price falls from 101 to 100, investors who wanted to buy at 101 also agree to buy at 100. The aggregated demand of the security is then increasing because some marginal buyers enter the market (or quantity stipulated in the orders are superior). On supply side, investors who wanted to sell at 101 don't agree to sell at 100, so the aggregated number of outstanding shares sold is decreasing. Then two cases can be distinguished:

- <sup>2</sup> First, we consider the case of an initial increase tendency of the price security:

$$\begin{matrix} \times & & \times \\ D_{NI} & > & O_{NI} \end{matrix}$$

As the number of outstanding shares decreases and the number of potential buyers increases after insider trading, the imbalance between

supply and demand increases. So less orders will find counterparts: the number of transactions is decreasing. More orders to buy and to sell will never meet and will never be executed. Considering the fact that the insider sells his shares because the private information he possesses is a bad news, one can say that major losers are potential sellers that have not sold their shares. On the contrary potential buyers that have not bought the shares because of the price decrease are winners: they haven't bought a share whose value is going to fall. Furthermore, it is very likely that orders to sell that don't find counterpart are the orders written on the market's sheet of orders before insider trading. As the uninformed investors transmitted orders based on the former price, the price limit specified on these orders may be too high. If these investors don't modify the features of their orders, they bear a very high risk of non execution.

- <sup>2</sup> Second, we consider the case of an initial decrease tendency of the price security:

$$X_{D_{NI}} < X_{O_{NI}}$$

The presence of the insider decreases the price of the security: the number of outstanding shares decreases and the number of potential buyers increases. So the imbalance between supply and demand decreases, more transactions are realised. In other words, major losers are buyers whose orders are executed: the value of the share bought will decrease and they potentially bear a loss of money<sup>12</sup>.

We showed that insider trading activity modifies market transactions. The decreasing price movement induces investors to trade at a lower price, closer to the right price (informational efficiency improvement). Nevertheless, orders that execute their orders are not the same persons as if insider had abstained from trading. Finally the number of transactions may increase (when insider trading stresses the market tendency) or decrease, implying winners and losers of the new situation. In case of a buy of shares from the insider, the analysis is just the contrary and leads to similar conclusions. Economically, the harm from insider trading is a wealth transfer from uninformed investors to the insider. The amount of this harm is based on the number of shares the insider transmitted to the market. However, the presence of the insider modifies the chain of transactions and the structure of the market of the title. As a consequence, some investors lose from this new situation whereas other

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<sup>12</sup>The loss of money is real only when the investor sells his shares. If he waits for a new increasing price movement of the security, he can sell the share at a better price.

gain in the same proportion. The judicial question which comes naturally is whether investors harmed from the new market's conditions, independently of the wealth transfer operated by the insider, may ask for civil reparations.

## 8 Conclusion

Our analysis identifies specific victims from insider trading who suffer a "counterpart harm" or a "non execution harm". Prices variations creates no additional harm. Meanwhile investors can be winners or losers of this price movement depending on the initial imbalance between supply and demand of shares. The uninformed harm, characterized by a wealth transfer to insiders exists and is theoretically known. However, few victims sue. In France no case of reparation of harm from insider trading has occurred. The problem is clear: victims rarely know that they have been harmed by an insider because of the complexity and the high number of transactions, and for the same reason, it would be very complicated for authorities to establish which person was effectively harmed during the "insider trading period".

## Appendix

### Illustration of the effect of insider trading: victims identification by the counterpart and the non execution harm

The initial market tendency determines the type of harm introduced on the market by the insider. We propose two cases to feature the two possible initial market tendency. The market's sheet of order in  $t_1$  is given. It is the starting point of each period of transactions.

N <sup>±</sup>	Buy		N <sup>±</sup>	Sell	
	Q	L		L	Q
1'	40	61.05	6'	61.10	10
2'	10	61.00	7'	61.15	30
3'	30	60.95	8'	61.20	30
4'	10	60.90	9'	61.25	20
5'	20	60.85	10'	61.30	40

N<sup>±</sup> : Identification of the order

Q :Quantity proposed by the limited course order written on the market's sheet of order

L : Price limit of the market's sheet of order

1) Transaction flow when no insider trade on the market and when the market tendency is increasing

$$\begin{matrix} \times & & \times \\ & D_{NI} > & O_{NI} \end{matrix}$$

The increasing initial market tendency between  $t_1$  and  $t_2$  is featured by an order flow composed of 4 buying order and 4 selling orders. The orders are transmitted to the market between  $t_1$  and  $t_2$  in the following chronology<sup>13</sup>.

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<sup>13</sup>The order flow and its chronology is typical of each case where the initial tendency of the market is increasing. It concerns the case without insider trading, which is the reference case. Cases with insider trading are developed later as case N<sup>±</sup> 1; 2; 4; 7; 8; 9:

N <sup>o</sup>	Sense of order	Q	L
1	Sell	20	61.05
2	Sell	20	61.10
3	Buy	30	61.10
4	Buy	50	61.15
5	Sell	30	61.15
6	Sell	20	61.05
7	Buy	30	61.15
8	Buy	30	61.00

The first selling order is transmitted to the market and immediately executed for 20 shares at 61.05<sup>2</sup>. The new market's sheet of orders is:

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.05	61.10	10	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	-	-
20	60.85	61.30	40	20	61.05

Q: Quantity ; L: Limit ; C: Course ; LE: Last Exchanges

The second selling order is transmitted to the market and written on the market's sheet of orders waiting for a counterpart.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.05	61.10	30	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	-	-
20	60.85	61.30	40	20	61.05

The buying order of 30 shares at 61.10<sup>2</sup> ...nd counterpart and is executed. The new order's sheet of market is:

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.05	61.15	30	-	-
10	61.00	61.20	30	-	-
30	60.95	61.25	20	-	-
10	60.90	61.30	40	20	61.05
20	60.85	-	-	30	61.10

The buying LC order for 50 shares at 61.15<sup>2</sup> is partially executed for 30 shares.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.15	61.20	30	-	-
20	61.05	61.25	20	-	-
10	61.00	61.30	40	20	61.05
30	60.95	-	-	30	61.10
10	60.90	-	-	30	61.15

The selling order for 30 shares at 61.15<sup>2</sup> is executed for 20 shares, and the selling order of 20 shares at 61.05<sup>2</sup> is fully executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.15	10	20	61.05
30	60.95	61.20	30	30	61.10
10	60.90	61.25	20	30	61.15
-	-	61.30	40	20	61.15
-	-	-	-	20	61.05

The selling order for 30 shares at 61.15<sup>2</sup> is executed for 10 shares, and the last buying LC order is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.15	61.20	30	30	61.10
10	61.00	61.25	20	30	61.15
30	61.00	61.30	40	20	61.15
30	60.95	-	-	20	61.05
10	60.90	-	-	10	61.15

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$\overset{\times}{D_{NI}} = 150 > \overset{\times}{O_{NI}} = 130$$

The compatibility of orders on the interval is maximal because 130 transactions have been realized when the aggregated number of shares offered is 130. Only 20 shares of the order (7) don't ...nd a counterpart.

2) Transaction flow when no insider trade on the market and when the market tendency is decreasing

$$\overset{\times}{O_{NI}} > \overset{\times}{D_{NI}}$$

The decreasing initial market tendency between  $t_1$  and  $t_2$  is featured by an order flow composed of 4 buying order and 4 selling orders. The orders are transmitted to the market between  $t_1$  and  $t_2$  in the following chronology<sup>14</sup>.

N <sup>±</sup>	Sense of order	Q	L
1	Sell	30	61.05
2	Sell	20	61.10
3	Buy	20	61.10
4	Buy	50	61.15
5	Sell	40	61.15
6	Sell	30	61.05
7	Buy	10	61.05
8	Buy	30	61.00

The ...rst selling order is transmitted to the market and immediately executed for 30 shares at 61.05<sup>2</sup>. The new market's sheet of orders is:

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.05	61.10	10	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	-	-
20	60.85	61.30	40	30	61.05

<sup>14</sup>The order flow and its chronology is typical of each case where the initial tendency of the market is decreasing. It concerns the case without insider trading, which is the reference case. Cases with insider trading are developed later as case N<sup>±</sup> 3; 5 and 6.



Q: Quantity ; L: Limit ; C: Course ; LE: Last Exchanges

The second selling order is transmitted to the market and written on the market's sheet of orders waiting for a counterpart.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.05	61.10	30	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	-	-
20	60.85	61.30	40	30	61.05

The buying order of 20 shares at 61.10<sup>2</sup> ...nd counterpart and is executed. The new order's sheet of market is:

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.05	61.10	10	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	30	61.05
20	60.85	61.30	40	20	61.10

The buying LC order for 50 shares at 61.15<sup>2</sup> is partially executed for 10 shares at 61.10<sup>2</sup> and for 30 shares at 61.15<sup>2</sup>.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.15	-	-	-	-
10	61.05	61.20	30	30	61.05
10	61.00	61.25	20	20	61.10
30	60.95	61.30	40	10	61.10
10	60.90	-	-	30	61.15

The selling order for 40 shares at 61.15<sup>2</sup> is executed for 10 shares, and the selling order of 30 shares at 61.05<sup>2</sup> is executed for 10 shares at 61.05<sup>2</sup>.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.05	20	20	61.10
30	60.95	61.15	30	10	61.10
10	60.90	61.20	30	30	61.15
-	-	61.25	20	10	61.15
-	-	61.30	40	10	61.05

The selling order for 10 shares at 61.05<sup>2</sup> is executed for 10 shares, and the last buying LC order is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
40	61.00	61.05	10	10	61.10
30	60.95	61.15	30	30	61.15
10	60.90	61.20	30	10	61.15
-	-	61.25	20	10	61.05
-	-	61.30	40	10	61.05

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$\times O_{NI} = 160 > \times D_{NI} = 120$$

The compatibility of orders on the interval is maximal because 120 transactions have been realized when the aggregated number of shares demanded is 120. 30 shares of the selling order (5) and 10 shares of the selling order (6) don't ...nd a counterpart.

### 3) Transactions flow with insider trading

#### A- The selling power of the insider

Case N<sup>#1</sup> :

$$\times D_{NI} = 150 > \times O_{NI} = 130$$

Suppose that an insider transmits a market price selling order in t1, for 10 shares. The best buying limit on the initial market's sheet of order is 61.05<sup>2</sup>, so the order is fully executed because the counterpart exist.

Buy		Sell		LE	
Q	L	L	Q	Q	C
30	61.05	61.10	10	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	-	-
20	60.85	61.30	40	10	61.05

Then the uninformed investors orders are transmitted to the market. The selling order (1) is executed and the selling order (2) is written on the markets sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.05	61.10	30	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	10	61.05
20	60.85	61.30	40	20	61.05

The third market order is executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.05	-	-	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	10	61.05
10	60.90	61.25	20	20	61.05
20	60.85	61.30	40	30	61.10

The buying order (4) is partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.15	-	-	-	-
10	61.05	-	-	10	61.05
10	61.00	61.20	30	20	61.05
30	60.95	61.25	20	30	61.10
10	60.90	61.30	40	30	61.15

The selling orders (5) and (6) are partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.05	10	20	61.05
-	-	61.15	10	30	61.10
10	61.00	61.20	30	30	61.15
30	60.95	61.25	20	20	61.15
10	60.90	61.30	40	10	61.05

The buying order (7) is partially executed and the order (8) is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	30	61.15
10	61.15	-	-	20	61.15
40	61.00	61.20	30	10	61.05
30	60.95	61.25	20	10	61.05
10	60.90	61.30	40	10	61.15

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$\overset{\times}{D}_{NI} = 150 > \overset{\times}{O}_{NI} + O_I = 130 + 10$$

The compatibility of orders on the interval is maximal because 140 transactions have been realized when the aggregated number of shares offered is 140.

Summary of the case N#1

			Without insider	With insider	
Number of transactions			130	140	
Inside spread in $t_2$			[61.15 ; 61.20]	[61.15 ; 61.20]	
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
7	B	10	NE	61.05	CTp H

B:Buy ; S:Sell ; NE:Non Execution ; CTp: Counterpart ; H:Harm ; G:Gain

Case N#2 :  $\times D_{NI} = 150 > \times O_{NI} = 130$

Suppose that an insider transmits a market price selling order in  $t_1$ , for 40 shares. The best buying limit on the initial market's sheet of order is 61.05<sup>2</sup>, so the order is fully executed because the counterpart exist.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.10	10	-	-
30	60.95	61.15	30	-	-
10	60.90	61.20	30	-	-
20	60.85	61.25	20	-	-
-	-	61.30	40	40	61.05

Then the uninformed investors orders are transmitted to the market. The selling order (1) and the selling order (2) are written on the markets sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.05	20	-	-
30	60.95	61.10	30	-	-
10	60.90	61.15	30	-	-
20	60.85	61.20	30	-	-
-	-	61.25	20	40	61.05

The third market order is partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.10	20	-	-
30	60.95	61.15	30	-	-
10	60.90	61.20	30	40	61.05
20	60.85	61.25	20	20	61.05
-	-	-	-	10	61.10

The buying order (4) is executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.20	30	40	61.05
30	60.95	61.25	20	20	61.05
10	60.90	-	-	10	61.10
20	60.85	-	-	20	61.10
-	-	-	-	30	61.15

The selling orders (5) and (6) are written on the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.05	20	40	61.05
30	60.95	61.15	30	20	61.05
10	60.90	61.20	30	10	61.10
20	60.85	61.25	20	20	61.10
-	-	-	-	30	61.15

The buying order (7) is executed and the order (8) is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
40	61.00	61.15	20	10	61.10
30	60.95	61.20	30	20	61.10
10	60.90	61.25	20	30	61.15
20	60.85	-	-	20	61.05
-	-	-	-	10	61.15

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$\overset{\times}{D_{NI}} = 150 < \overset{\times}{O_{NI}} + O_I = 130 + 40$$

The compatibility of orders on the interval is maximal because 150 transactions have been realized when the aggregated number of shares demanded is 150.

Summary of the case N#2

Case N#2:  $D_{NI} = 150$  ;  $O_{NI} = 130$  et  $O_I = 40$

		Without insider	With insider		
Number of transactions		130	150		
Inside spread in $t_2$		[61.15 ; 61.20]	[61.00 ; 61.15]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
3	B	20	61.10	61.05	G
4	B	20	61.15	61.10	G
5	S	20	61.15	NE	NE H
7	B	20	NE	61.15	CTp H

Case N#3 :

$$\times O_{NI} = 160 > \times D_{NI} = 120$$

Suppose that an insider transmits a market price selling order in  $t_1$ , for 30 shares. The best buying limit on the initial market's sheet of order is 61.05<sup>2</sup>, so the order is fully executed because the counterpart exist.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.05	61.10	10	-	-
10	61.00	61.15	30	-	-
30	60.95	61.20	30	-	-
10	60.90	61.25	20	-	-
20	60.85	61.30	40	30	61.05

Then the uninformed investors orders are transmitted to the market. The selling order (1) is partially executed and the selling order (2) is written on the markets sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.05	20	-	-
10	61.00	61.10	30	-	-
30	60.95	61.15	30	-	-
10	60.90	61.20	30	30	61.05
20	60.85	61.25	20	10	61.05

The third market order is executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	-	-
10	61.00	61.10	30	-	-
30	60.95	61.15	30	30	61.05
10	60.90	61.20	30	10	61.05
20	60.85	61.25	20	20	61.05

The buying order (4) is executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	30	61.05
10	61.00	-	-	10	61.05
30	60.95	61.15	10	20	61.05
10	60.90	61.20	30	30	61.10
20	60.85	61.25	20	20	61.15

The selling orders (5) and (6) are written on the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	30	61.05
10	61.00	61.05	30	10	61.05
30	60.95	61.15	50	20	61.05
10	60.90	61.20	30	30	61.10
20	60.85	61.25	20	20	61.15



The buying order (7) is executed and the order (8) is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	10	61.05
40	61.00	61.05	20	20	61.05
30	60.95	61.15	50	30	61.10
10	60.90	61.20	30	20	61.15
20	60.85	61.25	20	10	61.05

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$\times O_{NI} + O_I = 160 + 40 > \times D_{NI} = 120$$

The compatibility of orders on the interval is maximal because 120 transactions have been realized when the aggregated number of shares demanded is 120.

Summary of the case N<sup>#3</sup>

Case N<sup>#3</sup> :  $\times D_{NI} = 120$  et  $\times O_{NI} + O_I = 160 + 30$

		Without insider	With insider		
Number of transactions		120	120		
Inside spread in $t_2$		[61.00 ; 61.15]	[61.00 ; 61.05]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
3	B	20	61.10	61.05	G
4	B	20	61.15	61.10	G
5	S	10	61.15	NE	NE H
7'	S	10	61.15	NE	NE H
6	S	10	61.05	NE	NE H

B- The buying power of the insider

Case N<sup>#4</sup> :  $\times D_{NI} = 150 > \times O_{NI} = 130$

Suppose that an insider transmits a market price buying order in  $t_1$ , for 20 shares. The best selling limit on the initial market's sheet of order is 61.10<sup>2</sup>, so the order is executed for 10 shares. The remainder of the insider's order is written down the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.10	-	-	-	-
40	61.05	61.15	30	-	-
10	61.00	61.20	30	-	-
30	60.95	61.25	20	-	-
10	60.90	61.30	40	10	61.10

Then the uninformed investors orders are transmitted to the market. The selling order (1) is executed and the selling order (2) is written on the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	-	-
-	-	61.10	20	-	-
30	61.05	61.15	30	10	61.10
10	61.00	61.20	30	10	61.10
30	60.95	61.25	20	10	61.05

The third market order is partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	-	-
10	61.10	-	-	10	61.10
30	61.05	61.15	30	10	61.10
10	61.00	61.20	30	10	61.05
30	60.95	61.25	20	20	61.10

The buying order (4) is partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.15	-	-	10	61.10
10	61.10	-	-	10	61.10
30	61.05	-	-	10	61.05
10	61.00	61.20	30	20	61.10
30	60.95	61.25	20	30	61.15

The selling orders (5) and (6) are executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	20	61.10
-	-	-	-	30	61.15
20	61.05	61.15	10	20	61.15
10	61.00	61.20	30	10	61.10
30	60.95	61.25	20	10	61.05

The buying order (7) is executed and the order (8) is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	30	61.15
20	61.15	-	-	20	61.15
20	61.05	-	-	10	61.10
40	61.00	61.20	30	10	61.05
30	60.95	61.25	20	10	61.15

Results :

The price interval [lowest asking price ...nding a counterpart ; highest oæred price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$\overset{\times}{D_{NI}} + D_I = 150 + 20 > \overset{\times}{O_{NI}} = 130$$

The compatibility of orders on the interval is maximal because 130 transactions have been realized when the aggregated number of shares oæred is 130.

Summary of the case N<sup>4</sup>

$$\overset{P}{\text{Case N}^4} : \overset{P}{D_{NI}} + D_I = 150 + 20 \text{ et } \overset{P}{O_{NI}} = 130$$

			Without insider	With insider	
Number of transactions			130	130	
Inside spread in $t_2$			[61.15 ; 61.20]	[61.15 ; 61.20]	
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
6	S	10	61.05	61.10	G
1'	B	20	61.05	NE	NE H

Case N#5 :  $\times D_{NI} = 120 < \times O_{NI} = 160$

Suppose that an insider transmits a market price buying order in  $t_1$ , for 15 shares. The best selling limit on the initial market's sheet of order is 61.10<sup>2</sup>, so the order is executed for 10 shares. The remainder of the insider's order is written down the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
5	61.10	-	-	-	-
40	61.05	61.15	30	-	-
10	61.00	61.20	30	-	-
30	60.95	61.25	20	-	-
10	60.90	61.30	40	10	61.10

Then the uninformed investors orders are transmitted to the market. The selling order (1) is executed and the selling order (2) is written down the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.10	20	-	-
15	61.05	61.15	30	-	-
10	61.00	61.20	30	10	61.10
30	60.95	61.25	20	5	61.10
10	60.90	61.30	40	25	61.05

The third market order and the buying order (4) are partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.15	-	-	10	61.10
15	61.05	-	-	5	61.10
10	61.00	61.20	30	25	61.05
30	60.95	61.25	20	20	61.10
10	60.90	61.30	40	30	61.15

The selling orders (5) and (6) are partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.05	15	25	61.05
-	-	61.15	20	20	61.10
10	61.00	61.20	30	30	61.15
30	60.95	61.25	20	20	61.15
10	60.90	61.30	40	15	61.05

The buying order (7) is executed and the order (8) is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.05	5	20	61.10
-	-	61.15	20	30	61.15
40	61.00	61.20	30	20	61.15
30	60.95	61.25	20	15	61.05
10	60.90	61.30	40	10	61.05

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$\times D_{NI} + D_I = 120 + 15 < \times O_{NI} = 160$$

The compatibility of orders on the interval is maximal because 135 transactions have been realized when the aggregated number of shares demanded is 135.

Summary of the case N#5

Case N#5 :  $D_{NI} + D_I = 120 + 15$  et  $O_{NI} = 160$

		Without insider	With insider		
Number of transactions		120	135		
Inside spread in $t_2$		[61.00 ; 61.05]	[61.00 ; 61.05]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
1	S	5	61.05	61.10	G
4	B	10	61.10	61.15	H
5	S	10	NE	61.15	CTp H
6	S	5	NE	61.05	CTp H

Case N#6 :  $D_{NI} = 120 < O_{NI} = 160$

Suppose that an insider transmits a market price buying order in  $t_1$ , for 50 shares. The best selling limit on the initial market's sheet of order is 61.10<sup>2</sup>, so the order is executed for 10 shares. The remainder of the insider's order is written down the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
40	61.10	-	-	-	-
40	61.05	61.15	30	-	-
10	61.00	61.20	30	-	-
30	60.95	61.25	20	-	-
10	60.90	61.30	40	10	61.10

Then the uninformed investors orders are transmitted to the market. The selling order (1) and the selling order (2) are executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.10	10	-	-
40	61.05	61.15	30	-	-
10	61.00	61.20	30	10	61.10
30	60.95	61.25	20	30	61.10
10	60.90	61.30	40	10	61.10

The third market order and the buying order (4) are partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.15	-	-	30	61.10
10	61.10	-	-	10	61.10
40	61.05	61.20	30	10	61.10
10	61.00	61.25	20	10	61.10
30	60.95	61.30	40	30	61.15

The selling orders (5) and (6) are partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	10	61.10
20	61.05	61.15	20	30	61.15
10	61.00	61.20	30	20	61.15
30	60.95	61.25	20	10	61.10
10	60.90	61.30	40	20	61.05

The buying order (7) and the order (8) are not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	-	-	10	61.10
30	61.05	61.15	20	30	61.15
40	61.00	61.20	30	20	61.15
30	60.95	61.25	20	10	61.10
10	60.90	61.30	40	20	61.05

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.05 ; 61.15]. On this interval,

$$D_{NI} + D_I = 120 + 50 > O_{NI} = 160$$

The compatibility of orders on the interval is not maximal because only 140 transactions have been realized when the aggregated number of shares demanded is 170.

Summary of the case N#6

Cas N#6 :  $D_{NI} + D_I = 120 + 50$  et  $O_{NI} = 160$

		Without insider	With insider		
Number of transactions		120	140		
Inside spread in $t_2$		[61.00 ; 61.05]	[61.05 ; 61.15]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
1	S	30	61.05	61.10	G
3	B	10	61.10	61.05	G
4	B	10	61.10	61.15	H
5	S	10	NE	61.15	CTp H
6	S	10	NE	61.10	CTp H
7	B	10	61.05	NE	NE H
1'	B	20	61.05	NE	NE H

#### 4) Particular case

Case N#7

Suppose a simple case with the following initial market's sheet of orders

Buy		Sell		LE	
Q	L	L	Q	Q	C
120	60	-	-	-	-
-	-	61	30	-	-
-	-	62	40	-	-



A buying order for 10 shares at 62<sup>2</sup>, and a selling order for 50 shares at 60<sup>2</sup> are transmitted. They are immediately executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
120	60	60	50	-	-
-	-	61	30	10	62
-	-	62	40	50	60

Without insider trading,  $P_{D_{NI}} = 130 > P_{O_{NI}} = 120$ . The compatibility of orders is not complete because the number of transactions is only of 60. If an insider transmits a market price selling order for 40 shares, the order will immediately be executed, creating a counterpart for buying orders waiting on the market's sheet of orders.

### 5) Implications of the presence of market price orders

Case N<sup>#</sup>8:

In the case N<sup>#</sup>2, CL orders 1,3,5 et 7 are limited course orders. They become market price orders in the case N<sup>#</sup>8. The flow of transactions without insider trading is the same, but in the presence of the insider, the chain of transactions varies.

$$X_{D_{NI}} = 190 > X_{O_{NI}} = 130$$

Suppose that an insider transmits a market price selling order in  $t_1$ , for 40 shares. The best buying limit on the initial market's sheet of order is 61.05<sup>2</sup>, so the order is executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.10	10	-	-
30	60.95	61.15	30	-	-
10	60.90	61.20	30	-	-
20	60.85	61.25	20	-	-
-	-	61.30	40	40	61.05

Then the uninformed investors orders are transmitted to the market. The selling order (1) is executed at 61.00<sup>2</sup> and the selling order (2) is waiting on the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.00	10	-	-
30	60.95	61.10	30	-	-
10	60.90	61.15	30	-	-
20	60.85	61.20	30	40	61.05
-	-	61.25	20	10	61.00

The third market order and the buying order (4) are partially executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
20	61.00	-	-	40	61.05
30	60.95	-	-	10	61.00
10	60.90	61.15	10	10	61.00
20	60.85	61.20	30	30	61.10
-	-	61.25	20	20	61.15

The selling orders (5) is partially executed and the order (6) is written on the market's sheet of order.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.00	10	40	61.05
30	60.95	61.05	20	10	61.00
10	60.90	61.15	10	30	61.10
20	60.85	61.20	30	20	61.15
-	-	61.25	20	20	61.00

The buying order (7) is partially executed and the order (8) is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
50	61.00	-	-	10	61.00
30	60.95	61.05	20	30	61.10
10	60.90	61.15	10	20	61.15
20	60.85	61.20	30	20	61.00
-	-	61.25	20	10	61.00

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.00 ; 61.15]. On this interval,

$$\times D_{NI} = 190 > \times O_{NI} + O_I = 130 + 40$$

The compatibility of orders on the interval is not maximal because only 140 transactions have been realized when the aggregated number of shares offered is 170.

Summary of the case N#8

		Without insider	With insider		
Number of transactions		130	140		
Inside spread in $t_2$		[61.15 ; 61.20]	[61.00 ; 61.05]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
1	V	20	61.05	61.00	P
3	A	30	61.10	61.00	G
4	A	30	61.15	61.10	G
5	V	30	61.15	61.00	P
7	A	10	61.15	61.00	G
6	V	20	61.15	NE	P de NE
7'	V	10	61.15	NE	P de NE
2'	A	10	NE	61.00	P de CTp

## 6) Implications of the modification of one outsider's behavior

Case N#9

In the case N#9, orders 1,3,5 et 7 are market price orders. Moreover, the course limited order n#4 proposes a price limit to buy at 61:00<sup>2</sup>.

$$\times D_{NI} = 190 > \times O_{NI} = 130$$

Suppose that an insider transmits a market price selling order in  $t_1$ , for 40 shares. The best buying limit on the initial market's sheet of order is 61.05<sup>2</sup>, so the order is executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.00	61.10	10	-	-
30	60.95	61.15	30	-	-
10	60.90	61.20	30	-	-
20	60.85	61.25	20	-	-
-	-	61.30	40	40	61.05

Then the uninformed investors orders are transmitted to the market. The selling order (1) is executed at 61.00<sup>2</sup> and the selling order (2) is waiting on the market's sheet of orders.

Buy		Sell		LE	
Q	L	L	Q	Q	C
-	-	61.00	10	-	-
30	60.95	61.10	30	-	-
10	60.90	61.15	30	-	-
20	60.85	61.20	30	40	61.05
-	-	61.25	20	10	61.00

The third market order is partially executed and the buying order (4) is not .

Buy		Sell		LE	
Q	L	L	Q	Q	C
70	61.00	-	-	-	-
30	60.95	61.10	30	-	-
10	60.90	61.15	30	40	61.05
20	60.85	61.20	30	10	61.00
-	-	61.25	20	-	-

The selling orders (5) is executed and the order (6) is written on the market's sheet of order.

Buy		Sell		LE	
Q	L	L	Q	Q	C
40	61.00	61.05	20	-	-
30	60.95	61.10	30	40	61.05
10	60.90	61.15	30	10	61.00
20	60.85	61.20	30	10	61.00
-	-	61.25	20	30	61.00

The buying order (7) is partially executed and the order (8) is not executed.

Buy		Sell		LE	
Q	L	L	Q	Q	C
10	61.05	-	-	40	61.05
70	61.00	61.10	30	10	61.00
30	60.95	61.15	30	10	61.00
10	60.90	61.20	30	30	61.00
20	60.85	61.25	20	20	61.05

Results :

The price interval [lowest asking price ...nding a counterpart ; highest offered price ...nding a counterpart] is [61.00 ; 61.15]. On this interval,

$$\times D_{NI} = 190 > \times O_{NI} + O_I = 130 + 40$$

The compatibility of orders on the interval is not maximal because only 120 transactions have been realized when the aggregated number of shares offered is 170.

Summary of the case N#9

		Without insider	With insider		
Number of transactions		130	120		
Inside spread in $t_2$		[61.15 ; 61.20]	[61.00 ; 61.05]		
Orders for which execution conditions vary between the two situations					
Order number	Sense of order	Quantity	Execution price	Execution price	Harm or Gain
1	V	20	61.05	61.00	P
2	V	20	61.10	NE	P de NE
3	A	30	61.10	61.00	G
4	A	10	61.15	61.00	G
4	A	40	61.15	NE	P de NE
5	V	30	61.15	61.00	P
7	A	10	61.15	61.05	G
7	A	10	NE	61.05	P de CTp
7'	V	30	61.15	NE	P de NE
6'	V	10	61.10	NE	P de NE
2'	A	10	NE	61.00	P de CTp

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