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Privacy or Publicity –
Who Drives the Wheel?

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Abstract:
Financial markets are to a very large extent influenced by the advent of information. Such disclosures, however, do not only contain information about fundamentals underlying the markets, but they also serve as a focal point for the beliefs of market participants. This dual role of information gains further importance for explaining the development of asset valuations when taking into account that information may be perceived individually (private information), or may be commonly shared by all traders (public information). This study investigates into the recently developed theoretical structures explaining the operating mechanism of the two types of information and emphasizes the empirical testability and differentiation between the role of private and public information. Concluding from a survey of experimental studies and own econometric analyses, it is argued that most often public information dominates private information. This finding justifies central bankers' unease when disseminating news to the markets and argues against the recent trend of demanding full transparency both for financial institutions and financial markets themselves.

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Observing the development of financial markets over the last decades strengthens the view that movements in prices and valuations of financial aggregates are to a very large extent influenced by the advent of information. This observation is only partly explained by the fact that such disclosures contain information about economic and financial fundamentals underlying the assets. But information plays an even more important role for financial markets. It also serves as a focal point for the beliefs of market participants (Morris and Shin, 2002a). Since the behaviour of market participants is often characterised by strategic complementarities, i.e. it is the more rewarding to choose a specific action (for instance to buy an asset), the larger the number of others is that also choose this action, traders typically find themselves in decision problems similar to coordination games. In such instances, each market participant's best choice of action depends strongly on what other traders decide to do, and one indicator of others' behaviour is the information available to them.

With regard to this explanation, it is reasonable to differentiate between two categories of information: private and public. Whereas private information refers to pieces of knowledge that may be different from one trader to the next, public information is commonly shared by all traders. What is more, public information is characterised by the fact that everyone knows that everyone shares this information, that everyone knows that everyone knows that everyone shares this information and so forth until it becomes common knowledge. Bearing in mind the dual role of information – on the one hand informing about fundamental facts, on the other hand coordinating traders' beliefs – the question arises whether it is possible to determine which type of information, the private or the public one, is more strongly responsible for the behaviour of market participants and hence for the swings in asset prices. Whereas this question has been tackled in various theoretical analyses for the last two decades, only recently have empirical studies made an attempt to give an answer and derive policy implications for an optimal information setting on financial markets. This paper aims at giving a comprehensive view particularly on the empirical testability and differentiation between the role of private and public information. In order to find potential evidence of one of the two types of information dominating the other, we will also briefly cover the theoretical work underlying the analysis of information on financial markets.

Early theoretical studies on the role of information in financial markets concentrated on private information solely. Some analyses interpreted private information as insider information and examined the informed traders' impact on the market development (Kyle, 1985; Glosten and Milgrom, 1985). Generally, it has been concluded that insiders profit from acting based on their (private) information, possibly even to such an extent that uninformed traders are no longer willing to engage in trade with them (Bhattacharya and Spiegel, 1991). Apart from very few exceptions (Holden and Subrahmanyam, 1992), these early market microstructure studies did not take into account any strategic interplay between informed traders. Hence, the dual role of information was not regarded.

Renewed research interest in financial market crises following financial turmoil in Europe, Latin America and Asia during the 1990s led to a recent strand of literature analysing the role of information in a more complex framework. Since traders' behaviour in financial crises displays a strong element of

strategic complementarity, the dual role of information is particularly obvious. Whereas earlier studies on financial crises assumed that market participants publicly observe economic fundamentals without error (Obstfeld, 1994, 1996), the model by Morris and Shin (1998) restricted fundamental information to be private rather than public. Moreover information was assumed to be slightly flawed. It was argued that economic data is usually made available from different sources with a time lag, often preliminarily with some data still missing, and subject to later revisions. Hence, traders cannot perceive these pieces of information to be fully reliable and will use earlier experience and possibly also additional information unrelated to the respective market to form individual expectations with regard to economic fundamentals. In other words, information is private rather than public, and moreover incomplete.

Based on such an informational structure underlying financial markets, Morris and Shin (1998, 2001) showed that coordinated behaviour by market participants leads to a financial crisis whenever the underlying fundamental state is sufficiently bad. In contrast, the model by Obstfeld (1994, 1996) lead to the unsatisfactory result, that, taking the example of a currency crisis, the event of a speculative attack is only one of several possible equilibria. Due to the assumption of complete and common information about economic fundamentals, an interval arises in these models where fundamentals are neither so good that all traders rationally abstain from attacking, nor so bad that all market participants join a speculative attack. The outcome is then determined by self-fulfilling beliefs: if a single trader believes his opponents to attack the currency, he will also decide to attack. Hence, the speculative mass on the market becomes so high that indeed the attack is successful, which fulfils the initial beliefs. The same holds if a trader thinks that other traders will not attack and concludes that it would be best for him not to attack either. Again, this decision ends in a self-fulfilling prophecy. The differing result derived by Morris and Shin stems from the fact that traders, relying on their imprecise private information, can no longer be sure about the knowledge of their opponents. Even if an individual speculator is perfectly convinced by his private information that the currency is in the stable region of fundamentals, he cannot be sure that his opponents know the same. This uncertainty influences the decision of whether or not to attack up to a point, where the trader, after obtaining his private information, is indifferent between attacking and not attacking the currency peg. For all private information signalling that the fundamental state of the economy is worse than this indifference point, the agent will attack, but will refrain from doing so for all private signals that are better than this threshold.

Later research, sparked off by the insightful results of the Morris and Shin model, analysed the aspects of information more closely. In order to categorise the different approaches, the following notation might be helpful. Whenever market participants try to coordinate their decisions and have to rely on potentially incomplete, i.e. not fully precise, information, two types of uncertainty may arise. First, there is uncertainty about the fundamentals underlying the assets in the respective financial market. Second, traders are also unsure about their opponents' behaviour. This latter type is referred to as behavioural uncertainty (Morris and Shin, 2002a). Game theory relying on Nash equilibria typically assumes away this type of uncertainty (Hirshleifer and Riley, 1992). Whereas the model by Obstfeld (1994, 1996) includes neither fundamental nor behavioural uncertainty due to the assumption of complete and common information, the model by Morris and Shin (1998) takes into account both types of uncertainty, as can be seen from the following table.

Tab.1:

	Fundamental Certainty	Fundamental Uncertainty
Behavioural Certainty	Obstfeld (1994,1996)	Sbracia and Zaghini (2001)
Behavioural Uncertainty	Heinemann and Illing (2002)	Morris and Shin (1998) Metz (2002, 2003a) Heinemann and Metz (2002)

A study by Sbracia and Zaghini (2001) analyses the case where information about fundamentals is public, but not completely precise, so that uncertainty about traders' behaviour is resolved, since all traders possess the same 'common' information, while fundamental uncertainty still prevails. Such situation might be interpreted as market participants holding the same view on publicly disseminated information. Everyone knows that the information they are provided with, for instance by the central bank, the government, or simply the media, might be faulty, but everyone interprets the available information in the same way. Hence, all market participants share the same opinion with regard to the fundamentals underlying the market without fully knowing their true value. As Sbracia and Zaghini prove, the fact that the information sets of the market participants are equivalent is sufficient to re-introduce multiplicity of equilibria. Furthermore, even slight changes in traders' beliefs can – in a currency crisis setting as one example - lead to a coordinated attack on the currency peg in a region of fundamentals, where the peg would have been stable if information had been private rather than public. In particular, they show that less precise public information may increase the likelihood of a speculative attack by broadening the interval of economic fundamentals where a crisis is inevitable.

The study by Heinemann and Illing (2002) is one of the few that covers behavioural uncertainty while disposing of fundamental uncertainty in financial market decisions. Proceeding from the currency crisis model by Morris and Shin (1998), Heinemann and Illing examine the consequences of completely precise private information. In contrast to Sbracia and Zaghini, their model allows for individual beliefs about the fundamental state, while at the same time assuming that private information is very close to the actual economic state, i.e. private information is infinitely precise. Even though the traders' information sets become very similar the more precise private information is, beliefs are not shared. As a result, the model does not display multiple equilibria, but renders a unique threshold dividing the range of fundamentals into an attack-interval and an interval where the fixed parity is stable. Heinemann and Illing then prove that a decrease in the noisiness of private information reduces the probability of traders coordinating on a speculative attack. They conclude that increased transparency about economic fundamentals and about policy measures influencing the economic development is a necessary ingredient of a policy setting that aims at reducing the danger of speculative attacks. Transparency in this sense is defined as disseminating private information of maximum precision.

However, it stands to reason whether it is always only one of the two types of uncertainty that prevails in the market. If that were the case, i.e. if uncertainty about the market participants' behaviour would vanish whenever traders are uncertain about the development of economic and financial fundamentals, while fundamental uncertainty would be resolved whenever traders are unable to figure out their

opponents' optimal actions, the theoretical results would advise the information providing authorities to disclose fundamentally relevant information with the highest possible level of precision to prevent inefficient speculative pressure on the price of an asset. This would mean, for instance, that economic data should be published as timely and accurately as possible, covering as many statistics as might be of interest to financial market participants. This plead for transparency has been supported by many institutions overseeing financial markets, among them the IMF. Referring to its Special Data Dissemination Standard (SDDS), the IMF states that "better transparency, in both economic policy and in data on economic and financial developments, can strengthen the markets' ability to undertake appropriate credit risk assessment and so reduce the likelihood of crises and mitigate their severity when they do occur" (IMF, 1998).

Yet, the argument in favour of increased transparency does not fully take into account the dual role of information, but relies merely on dissolving fundamental uncertainty. The dilemma of striking the optimal balance between resolving fundamental uncertainty while not giving rise to too strong an emphasis on coordination motives has been recognized in particular by policy makers at central banks. Fearing that market participants might overreact to - usually not completely precise -public information, they are very cautious when publicly communicating with financial markets. Recent research therefore argued that both private and public information influence the decisions of market participants so that fundamental as well as behavioural uncertainty prevails on financial markets.

In order to give advice to policy makers searching for the optimal design of information policy, Metz (2002, 2003a) and Heinemann and Metz (2002) examined more closely the simultaneous interrelation of private and public information on foreign exchange markets and their influence on traders' behaviour when characterized by strategic complementarities.[1] The studies found that the impact of the precision of information on traders' behaviour is contingent on two factors. First, it depends on the so-called market sentiment, i.e. on the belief that is generally held by the market with regard to the underlying economic and financial fundamentals. The market sentiment is constituted as the aggregation of commonly shared information. Since in these models public information is assumed to be not completely precise, the market sentiment can be defined as the mean of the distribution of public information. Secondly, the influence of information precision depends on the type of information, private or public. The studies showed that increasing the precision of either public or private information nearly always has opposite effect on traders' behaviour. Whenever the market sentiment is very pessimistic with regard to the economic development, increasing the precision of public information will raise the likelihood of a speculative attack while disseminating more precise private information will decrease it. In contrast, if the market is very optimistic concerning economic fundamentals, more precise public information will reduce the probability of a crisis while more precise private information will increase the likelihood of a crisis.

What is the underlying rationale for this rather complex result? Market participants in these models receive both private and public information, i.e. they partly share beliefs, since they all read the newspapers, listen to central bank announcements, etc. and - this is important - they know that all

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[1] With regard to the question of whether a unique equilibrium or multiple equilibria emerge from the coordination problem among traders, Morris and Shin (2002b) and Hellwig (2002) found the precision ratio of private information relative to public information to be the determining factor. Only if private information is sufficiently precise, a unique equilibrium can be sustained and further statements can be made on the impact of information on financial markets.

others do this as well, but they also interpret this information individually. These private interpretations might be due to additional information gathered from earlier experience or observations from various other markets. Traders may now be inclined to give more weight to their individual interpretations, i.e. they perceive private information to be very precise relative to public information, and therefore adjust their trading decisions more strongly towards the private part of information. Alternatively, they may mistrust their private information, for instance if it is compounded of different or even contradictory signals, but believe public information to be very precise. This might be due to the fact that the market sentiment has repeatedly been vindicated by the economic development in the past. In that case, each trader would place more emphasis on the public part of his information. Each trader's posterior expectation with regard to economic fundamentals therefore constitutes a weighted average of his private and public information with the weights given by the relative precision of the respective information type. If the market is very pessimistic concerning the fundamental development, i.e. if the mean of public information is rather low (or 'bad'), and traders put more weight on this public information when it carries the higher precision, the whole market gets more aggressive. This impact of public information is strengthened by the fact that each trader knows that all of them succumb to this line of reasoning. As such, crises are still self-fulfilling. If, instead, private information is very precise in this instance, this might induce the individual trader to disregard the content of public information and abstain from attacking, provided that his or her individual interpretation of the economic development is sufficiently optimistic, i.e. his private information is high (or 'good'). Exactly the opposite holds if the market is optimistic in general.

What can be learnt from these models for the optimal design of information dissemination by policy makers and financial authorities? Taking the case of a pessimistic market as the more serious background for speculation against the price of an asset, providing information publicly increases the aggressiveness of traders the more precise this information is. In case of an optimistic market, instead, making public utterances with high precision should be beneficial to prevent speculative action. It stands to reason, however, whether the authorities are also able to disclose information privately. If they are, the precision of private information should be highest in pessimistic markets and lowest in optimistic markets. But can public authorities really influence private information? For public information to coordinate behaviour by acting as a focal point for beliefs, the content of this information has to be common knowledge. This poses very strong requirements on the visibility and comprehensibility of the announcements to the market, so that it might be argued that even though information is disseminated by the public sector to the whole market, the content of this information does not necessarily have to become public information in the sense defined in the literature. Even if one does not want to align with this reasoning, it might be argued that the information disseminating institutions might try to disperse the individual interpretations of the market participants, thereby making private information less precise. Hence, information disclosures by the authorities might lead to both private and public information being generated on the markets. Policy advice regarding the dissemination of information through public authorities therefore becomes even more complex. The question remains whether possibly one of the two types of information dominates the other, so that clearer advice may be given with regard to an optimal information setting for financial markets.

The results presented so far have been derived from theoretical work solely. Only recently have studies begun to ask for empirical underpinnings of the role of information in financial markets. In particular, it may be interesting to know what kind of uncertainty drives the markets. Is it possible to differentiate between behavioural and fundamental uncertainty at all? In which way are they

influenced by private and public information? Most importantly, what is the result of aggregated behaviour on financial markets due to private and public information? In general there are two ways to try to answer these questions. Either traders' behaviour is examined individually, for instance in a laboratory situation, or aggregated behaviour is looked at by taking data from the whole market. Accordingly, two strands of literature appeared in the last few months that concentrated on either experimental or econometric tools to test for the influence of private and public information on financial markets.

Recent experimental studies on the influence of information on coordination decisions have been conducted by Heinemann et al. (2002) and Cabrales et al. (2002). Whereas the latter focused on the question which equilibrium prevails if agents possess either private or public information, Heinemann et al. (2002) additionally compared the individual impact of private information on the one hand and public information on the other hand on the decision making process. Their experiment is structured as to resemble a currency crisis situation without giving reference to this particular example in the explanation to the participating subjects. Subjects had to choose on either a safe action or a risky action. The risky action delivered a positive payoff whenever the number of agents deciding on this action was higher than an exogenously given hurdle. The payoff to the risky action was positively linked to the underlying fundamental state. In the 'public' setting of the experiment, subjects were informed about the fundamental state and knew that this was common knowledge. In the 'private' setting, subjects individually received private signals about the fundamental state while sharing knowledge about the random process generating the private signals. As a preliminary result, Heinemann et al. (2002) showed that players behaved rather similarly in situations with private and public information. In particular, the subjects' decisions were consistent with threshold strategies in both settings, i.e. the risky action was chosen only if the observed signals, respectively the observed fundamental state, exceeded a certain threshold value. Even though this seems to be an intuitive result, theory predicts the employment of threshold strategies only for an infinitely large number of levels on beliefs over beliefs (Nagel, 1995). This result can therefore be taken as a first indication that public information is more easily generated than might have been believed. Furthermore, the authors were able to show that the set of states in which subjects coordinated on the risky action was larger under public information than under private information. They concluded that public information not only makes coordination among players easier, but it also increases their trust in the strength of a group decision, thereby reducing behavioural uncertainty. Converted to the currency crisis example, their result implies that with public information on economic and financial fundamentals traders will coordinate on a speculative attack for fundamental states in which they would refrain from attacking if information were purely private. Hence, according to the experiment, a central bank should have a clear overall incentive "to withhold information and leave traders to rely on less precise outside information" (Heinemann, 2002).

Two recent empirical studies (Prati and Sbracia, 2002; Metz, 2003b) on the influence of information in financial markets focus on the 1997-98 Asian crisis and the Mexican Peso crisis in 1994-95, respectively. In particular, monetary policy in Mexico in the months before the crisis in December 1994 has been characterised as very intransparent, since the Mexican central bank did not disclose any data on monetary aggregates for most of the year 1994. The 1997-98 Asian crisis also proves to be a useful example of information driving financial markets because of the many diverging beliefs held over the various Asian countries in the run-up to the crisis. The testable hypotheses in both papers, based on Metz (2002, 2003a), question whether the uncertainty among market participants before and

during the crises significantly influenced the speculative pressure on the fixed parities and if this impact was contingent on both the market sentiment and on the type of information dominating the market, i.e. either private or public information. Both studies come to an insightful result: the currency crises in Asia and Latin America have been driven largely by public rather than private information about the economic and financial development.

Data on traders' information at the time of the respective crises in both studies have been taken from Consensus Economics. The data sets delivered by Consensus Economics contain one-year forecasts of various economic variables collected from different forecasting research agencies, banks, and other financial institutions. The market sentiment defined in the theoretical models is mirrored by the mean of forecasts with regard to each variable. The market is interpreted as optimistic, if the mean of forecasts is higher than a threshold representing the actual realization of the fundamental variable for the respective time period, and pessimistic if it is lower. Uncertainty is measured by the standard deviation of forecasts and is interpreted as the inverse of the precision of information. The exchange rate pressure index is estimated as the sum of the normalized monthly depreciation of the respective currencies against the US$, the normalized fall in international reserves and the normalized short-term interest rate. In both the Asian and the Mexican crisis, the index of exchange rate pressure spiked at the onset of the crisis and decreased afterwards. The study by Prati and Sbracia finds that only forecasts with regard to GDP-growth have significantly influenced traders' behaviour. Since the sign of uncertainty in GDP-growth forecasts is positive, Prati and Sbracia conclude that it was largely public information that influenced speculative behaviour. In particular at the onset of the Asian crisis expectations about economic fundamentals were still good but uncertainty was increasing. Taking this uncertainty as being driven by public information, it follows from the theoretical model that the market became more aggressive and exchange rate pressure therefore increased.

The study by Metz (2003b) contains forecasts of both GDP-growth and of foreign exchange reserves. Since the Mexican central bank did not disclose any data on its international reserves between April and October 1994, one might be inclined to believe uncertainties about this variable to be individual and therefore private rather than public. The econometric analysis, however, comes to the result that uncertainties both with regard to GDP-growth and to foreign exchange reserves were driven by public information and increased the speculative pressure on the fixed Peso parity. The interpretation of the impact of these uncertainties is rather contrary, though. Comparing the expected and the actual development of fundamentals, it is found that in the months leading up to the Peso crisis the market was overly pessimistic with regard to GDP-growth but very optimistic concerning the development of international currency reserves. At the same time, uncertainties in the forecasts of the former variable were decreasing, while the disparities in reserves forecasts were increasing. Had the central bank's deliberately chosen policy of not disclosing any data on monetary aggregates resulted in individual, private expectations being formed by traders, the increasing uncertainty would have reduced speculative pressure in the still optimistic market. Obviously, however, the central bank's information policy was interpreted similarly by all market participants. They all knew that the central bank tried to hide the actual development of reserves and this quickly became common knowledge. Combined with the fact that the true value of international reserves was still not known, the dispersion of forecasts was a sign of public rather than private information being imprecise. This strongly increased speculative pressure, even though the market in general was still optimistic with regard to the development of currency reserves. For the expectations concerning GDP-growth, the opposite held. Since the market was timely informed about the data on actual GDP development by the authorities, uncertainties

decreased and this, in an already rather pessimistic market concerning the real development of the economy, made speculators even more aggressive.

Both empirical studies therefore conclude that it is public rather than private information that moves the markets. An additional regression on the Mexican data, covering the interval 1993-2000, supports this statement by including even more forecast data. The regression equation follows Metz (2003b):

$$ERP = \gamma_0 + \gamma_1 GDP^f mean + \gamma_2 GDP^f uncert + \gamma_3 RES^f mean + \gamma_4 RES^f uncert + \gamma_5 BB^f mean + \gamma_6 BB^f uncert + \gamma_7 CA^f mean$$
$$+ \gamma_8 CA^f uncert + \gamma_9 ExchRate + u$$

As can be seen from the following table, almost each of the uncertainty variables turns out to have a positive coefficient, which is a sign of public information fuelling the uncertainty.[2] Obviously, public information fuelled the uncertainty among traders for an even larger set of economic variables than indicated by the recent empirical models.[3]

Tab.2:

Variable	Coefficient	Standard Error
Constant	4,3124***	1,0498
GDP forecast mean	-1,0526***	0,3717
GDP forecast uncertainty	0,5271*	0,3451
Reserves forecast mean	-1,3182***	0,2302
Reserves forecast uncertainty	0,7447***	0,0946
Budgetbalance forecast mean	0,405	0,5592
Budgetbalance forecast uncertainty	3,997*	2,3165
Current account forecast mean	0,0301	0,0197
Current account forecast uncertainty	-0,0009	0,0008
Exchange rate (lagged)	0,1737**	0,0685
R-squared	0,749	
DW-Statistic	2,1971	
F-Statistic	11,9341	
Prob(F-Statistic)	0,0000	
***, **, * significance at 1, 5, and 10 percent		

Even though strong theoretical requirements on the order of beliefs cast doubt on the efficacy of public information steering the behaviour of financial market participants, both experimental and empirical

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[2] The uncertainty variables are constructed by multiplying the standard deviation of the forecasts in each period with an index measuring whether the market is optimistic or pessimistic compared to the actual development of the respective variable. An overly optimistic market results in a positive sign of the uncertainty variable. If in such a case increasing uncertainty raises the exchange rate pressure (i.e. the coefficient is positive), the theoretical model attributes this to public information being the source of uncertainty. In an overly pessimistic market, the index measuring optimism versus pessimism has a negative sign. Whenever the coefficient of the uncertainty variable then turns out to be positive, again it should have been imprecise public information driving the uncertainty, thereby decreasing speculative pressure.

[3] The displayed regression does not, however, emphasize the test of a negative influence of the forecasts' mean, as compared to the studies by Prati and Sbracia (2002) and Metz (2003b).

studies promote the dominance of public information over private. Obviously, publicly delivered fundamental information succeeds in resolving behavioural uncertainty, thereby rendering traders much more optimistic towards the success of coordinated actions. At the same time, however, the direction in which traders' actions are influenced by information disclosures depends on the market sentiment. Public information therefore not necessarily renders markets more aggressive or unstable. What can be learned from these results? Obviously, it would be wrong for policy makers to conclude that in situations of financial turmoil the 'best' information is 'no' information. Clearly, such a policy would be aimed at hiding a deteriorating fundamental development in order not to make traders too aggressive. However, this policy measure only accounts for the role of delivering, respectively withholding, informational content, while ignoring the coordination role of information. If the lack of information is interpreted publicly while the market in general is still optimistic, as has been the case in Mexico in 1994 with regard to the monetary development, the withholding of information might even be the very trigger of a full-blown financial crisis. Optimal information policy therefore very carefully has to take into account the interplay of market sentiment and the actual development of fundamentals, thereby acting discretionary rather than always being fully transparent as has often been claimed as optimal. Since public utterances by the information providing authorities seem to become public information rather than being interpreted individually, only an overly pessimistic market sentiment should be accompanied by intransparent, i.e. imprecise, information disclosures. In contrast, an over-optimistic market should be strengthened by a dissemination of fully transparent information.

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