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The Determinants of Short Selling in the Hong Kong Equities Market

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Abstract

This paper investigates the determinants and information content of short selling in the Hong Kong equity market. Using daily data on the volume of short selling in individual stocks, we find that dividend payments, company fundamentals, risk, option trading, the interest rate spread and past returns and short selling are all significant determinants of short selling. Further, higher short selling in the current period is associated with higher returns in the next period. Once short sellers reduce their activity in the market however, negative returns are expected to follow.

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1 Introduction

There is widespread empirical and theoretical evidence to suggest that short sellers are integral to the efficient functioning of financial markets. For example, the market completion hypothesis suggests that short selling facilitates the process of price discovery and speeds up the rate at which the market processes information (see *inter alia* Miller 1987, Diamond and Verrecchia 1987, Raab and Schwager, 1993 and Figlewski and Webb, 1993). More recent evidence is provided by Jones and Lamont (2002), Chareonrook and Daouk (2004, 2005) Chang and Yu (2004), and Jiang (2005) who conclude that restrictions on short sales compromise the ability of the market to efficiently incorporate bad news in asset prices resulting in an upward price bias. Ali and Trombley (2006) show that short sales constraints are positively related to the magnitude of momentum in stock returns. Reed (2003) finds that short sales constraints reduce the speed at which asset prices adjust in response to the arrival of private information. Bris, Goetzmann and Zhu (2007) find that short selling leads to more efficient price discovery at the individual security level based on a global study of 47 equity markets.

In addition to promoting market efficiency, short selling is also thought to be integral to the formation of rational asset prices. The standard assumption of unrestricted lending and borrowing at the risk free rate in the capital asset pricing model (CAPM) is thought to be unrealistic giving existing constraints to short selling. Black (1972) shows that the mean-variance efficiency of the market portfolio in the absence of a riskless security is preserved where unrestricted short sales are allowed (for further discussion see Kwan 1995, Charpin and Lacaze 1999, Elton and Gruber, 2000, Fama and French, 2004 *inter alia*). Levy and Ritov (2001) show that the optimal mean-variance-efficient portfolio is composed of short positions in about half of the assets held. Further, they estimate that the Sharpe ratio can be more than double in the presence of constraints on short positions. Kempf (1996) finds that short selling restrictions are very influential determinants of the behaviour of mispricing. In fact, Rubenstein (2004) argues that short sales are so integral to the validity of the CAPM, that a wide range of well documented capital pricing anomalies may be attributed to restrictions on this type of trading strategy.

A number of papers have considered the informational content of short sales and the general consensus is that short sellers may possess superior information relative to other traders (see Angel, Christophe and Ferri, 2003, Boehmer, Jones and

Zhang, 2005, Cohen, Diether and Malloy, 2005, and Francis, Venkatachalam and Zhang, 2005 *inter alia*). For example, Cohen, Diether and Malloy (2005) employ proprietary data on rebate fees and quantities of securities available for lending to construct measures of supply and demand in the market for shorting equity, finding that shorting demand is an economically and statistically significant predictor of future stock returns for a sample of monthly US stocks.

Given the importance of short sellers to the efficient functioning of markets, it is interesting to note that relatively little is known about the determinants of their behaviour. Brent, Morse and Stice (1990) hypothesised that short selling may be motivated by speculation, arbitrage and taxation issues surrounding the deferment of capital gains. Using US data sampled over the period 1974 – 1986, they test each of these three factors in turn. Using the variance of analysts' forecasts as a measure of the heterogeneity of investor beliefs, speculative trading was not found to be a significant determinant of short selling. However, as stocks with high betas, options and convertible securities were found to exhibit significantly higher levels of short sales there was evidence in favour of arbitrage motivating short sales. Finally, the authors found evidence of a December seasonal providing limited[1] support for the taxation hypothesis.

A major limitation of the Brent, Morse and Stice (1990) paper arises from its use of monthly data on open short interest. Since the majority of short selling volume may be attributed to short term trading strategies, the use of monthly data has obvious implications for the ability of this study to capture the effect of daily or even intra-monthly short sales trading strategies. Only recently has a higher frequency investigation of the determinants of short selling been forthcoming. Diether, Lee and Werner (2005) employ daily data sampled in the first quarter of 2005 for a cross section of 2185 US equities. They find that short sellers are contrarian in nature and tend to sell short following a price increase. There is evidence that the activities of short sellers contain information about future returns, but this is not sufficient to generate profits. Finally, the authors find evidence that increasing the constraints on short sales leads to reduced short selling, but this only limits the information content about future returns in low prices equities. While Diether Lee and Werner's (2005)

[1] Capital gains or losses were not a significant determinant of the reduction in short interest in January which diminished the significance of the December seasonal as evidence of this tax hypothesis.

use of daily data presents an improvement over the Brent, Morse and Stice (1990) paper, their analysis is restricted to a fairly limited sample of only one quarter of data.

The purpose of this paper is to provide an empirical assessment of the determinants and information content of short selling. While the bulk of the previous literature has considered US short sales data[2], in this paper daily short sales information for Hong Kong stocks is considered.[3] Using data from the Hong Kong market offers a number of other distinct advantages in the current context. The first such advantage relates to the quality and quantity of short sales information. Daily data are available from 1994 onwards on a range of stocks approved for short selling, unlike the USA where market-wide short sales data is limited to monthly frequency. The second advantage of the Hong Kong data is that many of the stocks that are eligible for short selling in Hong Kong also have options traded. Option trading is closely linked to short sales trading and the Hong Kong market provides the opportunity to explicitly control for the level of short selling linked to option trading (see Senchack and Starks, 1993). Thirdly, there is extensive short selling in equity in Hong Kong, with short selling occurring on 51% (91%) of trading days in our sample for the least (most) traded stock. Moreover, short selling makes up 7.7% of average daily volume in Hong Kong over the sample period considered (see section 3 below for further details). Fourthly, the continuous, order driven nature of the market is a very simple, with no clearing transactions at open or close, and no specialists.

The remainder of the paper proceeds as follows. Section 2 provides a summary of the institutional arrangements for short selling in Hong Kong. Section 3 discusses the empirical design employed in this study. The fourth section presents the econometric model, while section 5 describes the data. Evidence on the determinants of short selling is discussed on the sixth section. Section seven considers whether short sellers are momentum or contrarian traders. The penultimate section examines the information content of short sales for future returns. The final section presents some concluding comments.

[2] One notable exception is Ho (1996) which considered short selling in the context of the Singapore market and found that volatility increased as a result of a change in the rules which restricted short selling.

[3] Similar data has previously been the focus of research in Chang and Yu (2004) and Henry and McKenzie (2006).

2 Institutional Detail

Hong Kong has a long history of securities trading with records dating back to 1866 and the formation of the Association of Stockbrokers in Hong Kong in 1891 which was later renamed the Hong Kong Stock Exchange (HKSE) in 1914. Although the HKSE has faced competition from a number of competing exchanges over the years, currently it is the sole stock exchange in the region (see Brockman and Chung, 1998, for further details). More recently, the HKSE merged with the Hong Kong Futures Exchange and the Hong Kong Securities Clearing Company to form Hong Kong Exchanges and Clearing Limited (HKEx) and was publicly listed on the HKSE in June 2000.

The trading environment of the HKSE represents one of the simplest forms of market making procedures of any exchange in the global financial arena – the exchange has no opening call market, no price controls, no liquidity providers or specialists and no special arrangements for closing. The exchange is an order driven market with continuous trading during opening hours whereby designated members place limit orders into the Automatic Order Matching and Execution System (AMS) which are prioritised by price and executed in order of time of arrival to the exchange.[4]

The HKSE first introduced short selling in January 1994, in a pilot program which designated 17 eligible stocks. Under the new rules,[5] investors were able to sell short provided they have an exercisable and unconditional right to vest the stock and the trade was not to be made at a price below the best current ask price (the 'tick rule'). The tick rule is enforced by the exchange through its AMS system and the members of the exchange have an obligation to establish whether or not the client meets these vesting rules prior to placing the order (HKSE Eleventh Schedule, Point 7). Penalties exist for both the member and the investor for failing to comply with these rules and although the exchange investigates hundreds of transactions each year, only a few result in prosecution.[6]

In 1995, naked short selling was allowed on the sale of any securities effected under a stock option and stock option market makers were exempted from the margin

[4] See Ahn, Bae and Chan (2001) for a summary of the HK order book.
[5] The short selling rules on the HKSE are less restrictive compared to those in the US (see Asquith and Muelbroek, 1996 for a summary).
[6] In 1997, the HKSE conducted 764 investigations and prosecuted in 15 instances (So, 1998 and Leung, 2000).

requirement and the up-tick rule. The tick rule was abandoned altogether in March, 1996 and the list of stocks which could be short sold increased to 113.[7] In August 1998, the Hong Kong government spent US$12.5b buying stocks and futures to support the market which was labouring under heavy speculative selling pressure. To curb future short selling and prevent a repeat of previous events, a host of new rules were introduced in September, 1998 including the reinstatement of the tick rule, although the exemption remained for short sales transactions undertaken by stock options market makers in the course of performing their duty.

All short selling transactions are identified to the exchange by the broker at the time the order is placed in the AMS. This information is then made available to the market via the limit order book which flags all short sales. In addition, exchange members are also required to keep a ledger with specific details of each individual short selling transactions and this must be made available to the exchange at any time. As such, detailed short sales records are kept for trades made on the HKSE and the exchange makes this information available in the form of a daily report. This report summarises total daily short sales volume and short sales value for each individual stock and is usually made available after a 24 hour delay.

3 Empirical Design

In a general sense, the desire to short sell is typically motivated either by information or non-information based reasons. In a rational expectations model, such as that of Diamond and Verrechia (1987), new information about an asset will be quickly and accurately impounded into the price, thus any negative information will lead to price falls. In the tax-based strategies discussed by Brent, Morse and Stice (1990) or informing hedge portfolios, Ross (1976), it is not necessary that new information motivates the desire to sell short.

3.1 Non-Information based trading

To hold securities without incurring market risk, an investor can offset their existing long positions with equivalent short positions leaving them neutral to the

[7] Prior to 1998 the list of designated securities was announced annually. Since 1998 however, these announcements occur three times a year although there is no fixed month for designation and disqualification announcements. Leung, Rui and Wang (2007) use designation and disqualification announcements between May 1996 and December 2000 to examine the effects of short sale constraints on stock price movements using an event study approach

market. This strategy is frequently referred to as selling short against the box or 'shorting the box' and it is useful to investors for a number of reasons, amongst the most important of which are tax avoidance, ex-dividend effects, hedging, arbitrage and derivatives trading.

Shorting the box is effective for locking in the profit on a position while deferring capital gains tax (alternatively, it can be used to defer capital losses to the following year). Further, where the tax rates on short term profits were different to those on long term profits (as was the case in the US prior to 1950), shorting against the box could be used to manipulate the timing of profits as a tax minimization strategy. Any of these factors may induce seasonality into short sales around the end of financial year.

Shorting the box is also useful for investors who need to realize their position but also wish to accrue an upcoming dividend without suffering any capital losses due to the price fall as the share goes ex-dividend. In this case, shorting the box allows the investor to lock in the profits to their position, accrue the dividend, yet avoid the price fall as the market adjusts for the share going ex. In that sense, lower short sales activity may be related to dividend ex-dates.

Derivative issuers and stock options market makers may short sell to hedge their price risk, in which case their net positions is market neutral. Further, where fund managers feel that a correction is imminent, their options are fairly limited as they must remain 'in the market'. Managers may have some discretion to increase their cash holdings (typically set at a maximum of 5 to 10 percent of total portfolio value) and/or engage in strategic asset reallocation (stocks to bonds in a diversified fund or aggressive to passive stocks in an equity fund). The limits on asset allocation however, typically mean that managers' ability to reduce their market exposure is limited. Alternatively, some markets or assets may have minimum holding periods. In either case, shorting the box is one strategy by which investors can effectively reduce their exposure to the market yet remain fully invested. By simultaneously taking a long and a short position, market participants can hold a position in the marketplace and lock in profits without further risk from unfavorable asset price movements.[8]

[8] The evidence of Almazan, Brown and Carlson (2004) suggests that most fund managers do not engage in this type of activity. They report that 70% of fund managers are not able to take short

Short selling can be used to exploit profitable arbitrage opportunities in the market. This trading strategy typically involves some form of pairs trading whereby the relative price of highly correlated assets has diverged from equilibrium (long/short hedge funds typically employ this type of strategy). By buying the stock whose price has gone down and shorting the stock whose price has gone up, profits can be made when the spread converges back to its long run equilibrium. This strategy may also apply to a basket of stocks. For example, market participants may short sell the underlying stocks of an index futures contract for arbitrage purposes. This type of trading strategy is also used to generate profits from firms engaged in mergers and acquisitions activity. Investors will often trade short the acquiring firm and take a long position in the target firm.

While shorting the box in its own right cannot yield any profits, in the presence of a third asset whose value is linked to the cash market, opportunities for arbitrage profits exist. The most obvious candidates for this are futures, options or if the stocks are sufficiently large, market index derivatives themselves. Thus, the existence of such securities may promote short selling. The direction of the relationship will depend on how options are used. On the one hand, options may be considered a substitute for short selling. In this case the options market provides an alternative venue for exploiting information and a lower cost means of establishing a short position with a written call and a long put). On the other hand, options may be used in conjunction with short sales as a part of an overall trading strategy. For example, for an options trader who writes a put, a short position can be used to cover the market risk of this position.

3.2 Information based trading

While a number of non-information based hypothesis can be justified to motivate short selling, speculation is thought to be the primary reason for the use of short trading strategies. For example, McDonald and Baron (1973) cite the results of a 1947 New York Stock Exchange survey in which approximately two thirds of short selling was speculative. It is interesting to note however, that the traditional view of short sellers trading on negative (and presumably inside) information about a company's prospects may not be valid. Instead, Francis, Venkatachalam and Zhang

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positions and only 1/3 of the remaining 30% do. Hedge fund mangers however, are able to take such positions.

(2005) produce evidence to suggest that short sellers are more likely to trade on misperceptions held by the market about the fundamentals of a firm. Dechow, Hutton, Muelbroek and Sloan (2001) and Christophe, Ferri and Angel (2004) argue that firms with low ratios of fundamentals are known to have systematically lower future stock returns. Thus, traders may monitor firm's fundamentals and sell firms as their fundamentals fall. The literature suggests that the relevant set of fundamentals may include earnings per share, book to market values and dividend yields.

The heterogeneity of the market perceptions of a firm's fundamentals may also be related to the degree of short selling experienced by a firm. To the extent that market participants diverge in their estimation of the value of a firm, those who believe the firm is overvalued may be motivated to sell short. Where a (near) consensus is held by the market however, little motivation exists for short selling. One proxy which may capture the heterogeneity of market perceptions is the distribution of analysts' coverage. The use of such a measure however, raises questions as to whether the distribution of analysts beliefs is representative of the distribution of the beliefs of all investors (need a reference about the convergence of analysts beliefs here). An alternative proxy is market volatility. If the volatility of returns is relatively low, this might suggest an absence of new information for a company and/or less divergent beliefs about its fundamentals. On the other hand, a company whose returns are relatively more volatile would suggest a wide dispersion of beliefs and/or a heavy flow of new information about the future prospects for the firm.

Broadly speaking, we may distinguish between information based traders and technical traders as the latter group typically apply some form of trading rule to past price information to make trading decisions. Distinguishing between contrarians and positive feedback traders, the former will sell short following positive returns in the expectation of a price fall in the next period (evidence of this type of behavior may be found in Diether, Lee and Werner, 2005). A positive feedback trader however, would extrapolate any trend into the next period. As such, they would sell short following a price fall with the expectation of another negative return in the next period. Evidence

of extrapolative behaviour in NYSE and NASDAQ short interest is discussed by Lamont and Stein (1994).[9]

Another possibility is that technical traders may base their decisions on general market movements rather than those of individual stocks, in which case short selling may be related to market returns. The nature of this relationship however, is not clear. Where short sellers trade on momentum, they would be less active in rising markets. Lamont and Stein (2004) find that total short selling moves counter cyclically, that is, short selling falls as the market approaches its peak. This evidence could be taken as support for the view (attributed to Keynes) that the market can remain irrational for longer than a trader can remain solvent. Alternatively, Asensio (2001) argues that "(a) bull market is a fertile ground for short sellers". As such, short selling could increase as a market approaches its peak and these positions would profit from the correction.

In addition to stock and market returns, short sales themselves may be a factor in determining current short interest. Brent, Morse and Stice (1990) note that some investors pursue a trading strategy in which they buy and sell securities based on their level of short interest. A relatively high level of short sales suggests high future demand for the stock as short sellers must close out their positions and buy the stock. Thus, short sales will decline following a period of spirited short selling.

A final variable which may explain the informational based demand for short interest relates to the discount factor used to value equity. An increase in the Hong Kong – US interest rate spread suggests Hong Kong equities will become relatively less attractive in the eyes of investors. To the extent this leads to a downward revision in Hong Kong share prices, traders may attempt to capitalize on this movement by selling Hong Kong stocks short.

4 Econometric Methodology

Section 3 suggests a number of factors which are thought to determine short sales. Firstly, the non-information based trading motivations for short selling suggest the presence of seasonal factors in the data. As such, the model may be specified with binary monthly dummy variables to capture this effect. A second variable is the ex-

[9] This issue is further complicated when we recognise that the existence of both types of traders in the market. The relative strength of these two groups in the market may mean that the signals of each may cancel out, and so no effect may be found.

date of the stock. As a form of robustness test the dividend payment date is also included and this coefficient is not expected to be significant. A binary dummy variable is used to capture the occurrence of each of these events.

Market risk may also be an important factor, firstly by motivating short sales aimed at reducing exposure to market risk though hedging, but also indicating the heterogeneity of investor's beliefs about the value of a stock. Either factor suggests a positive relationship between volatility and short selling. Unfortunately, market risk cannot be directly observed and so a proxy variable must be used. In this context, a number of candidates exist including GARCH based risk estimates, option implied volatilities and, in the absence of high frequency data from which to estimate realized volatilities, intra-daily trading range. In this paper, all three are to be considered. For the former, risk is defined as the fitted values of the conditional variance from a GARCH(1,1) model estimated using returns data over the sample period. While GARCH models have proven popular in the literature, recent evidence suggests that implied volatilities are superior (see Martens and Zein, 2003, and references therein). The use of implied estimates of volatility however, is complicated by the presence of the well documented volatility smile and most studies typically take some form of average across a selection of contracts (see Ederington and Guan, 2002). As such, an equally weighted average of implied volatility across all options contracts for a given stock is used. One problem with such a measure is it includes an element of redundant information, since not all contracts have sufficient liquidity to ensure that trades occur each day. As such, a second implied volatility series is included which is the implied volatility taken from the most heavily traded option contract each day, based on volume of trade. A final measure of risk is the trading range (price high less price low each day).

Short selling may be linked to hedging strategies involving options. In this study, net open interest for individual stock options is included as an explanatory variable for short selling. Further, as both types of options can be used for arbitrage, the explanatory power of open interest in puts and calls may also be tested separately. Open interest will exhibit strong seasonality induced by the monthly contract expiration cycle. As such, the open interest data is prewhitened by regressing it against a monthly time trend variable. This prewhitened data is included in the test equations. Option activity may not only be reflected in open interest however, but

also in the number of trades. As such, the total number of trades in an individual share option is also included as an explanatory variable.

Following Diether, Lee and Werner (2005) *inter alia*, a pooled regression approach is taken to estimating the functional relationships of the determinants of short selling. Further, due to potential problems with multicollinearity (in particular between the stock risk variables, the company fundamentals as well as the options trading activity variables), a hierarchical regression approach is adopted in which variables within the model are considered in turn. As such, a generic model of the determinants of short selling may be specified as:

$$ss_{it} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_j + \sum_{k=1}^{11} \beta_k D_k + \varepsilon_t \quad (1)$$

where ss_{it} is the logarithm of short sales trading volume for company *i* on day *t*, *X* is a vector of *j* independent variables that theory suggests may determine the level of short selling, D_k are month of the year dummies (1 = January), α and β are parameters to be estimated and ε_t are the errors which are assumed ~N(0,1).

5 Data

To be eligible for inclusion in this study a stock had to be included in the Hang Seng Index, be designated eligible for short selling and had to have options traded over the entire sample period. This criterion led to the inclusion of 17 stocks in the sample and daily short sales information for each stock is sampled over the period January, 2001 to April, 2006. This sample period is deliberately chosen so as to avoid the naked short selling period and also to ensure sufficient time had passed to allow the Hong Kong Authorities to unwind their positions taken during the August 1998 intervention (see Goodhart and Dai, 2003). In addition to the level of short sales volume, individual stock information and options data are also gathered over the same period. The short sales and options data was sourced directly from the Hong Kong Stock Exchange. All individual share data, as well as the market index are sourced from Datastream, as were the interest rates which were cross referenced to the US Federal Reserve Economic Data (FRED) database to ensure accuracy.

- Table 1 about here -

The continuously compounded daily total returns to each individual stock and to the Hang Seng index are obtained by taking the log price relative of each series,

adjusted for dividend payments. Panel A of Table 1 presents some summary statistics of this information as well as the name, and stock code of the 17 companies included in the sample. The average return for 6 of the 17 companies is negative and the lowest mean returns were –0.11% for PCCW and –0.04% for Lenovo. The price of these stocks declined over the entire sample period by 79% and 57% respectively.[10] In general, Hong Kong stock prices exhibit a great deal of variation with a one day positive and negative returns of in excess of 10% common to the sample. Lenovo experienced the largest one day fall of 15.16% on 12/9/01 when the price fell from $3.20 to $2.75. The standard deviation for these returns is quite high relative to the mean return and for five stocks exceeded 2%. Not surprisingly, the Jarque-Bera test for normality was rejected overwhelmingly in each instance.

Panel B of Table 1 presents summary information for the short sales data used in this study. The first column of Panel B summarises the percentage of days on which the short selling occurs across the sample period. SHK Property was sold short most frequently in this sample of stocks, with trades occurring on 91.05% days in our sample, while CITIC only experienced short selling on roughly half the days in the sample 57.26%.

Early studies into the information content of short sales could not establish a significant relationship (Figlewski, 1981; Woolridge and Dickinson, 1994; Brent, Morse and Stice, 1990; and Figlewski and Webb, 1993). Asquith and Meulbroek (1996) argue that the principle reason for this failure is because the level of short selling was too small to be of consequence. As such, it is important for any study to consider the level of short sales relative to the market in which they are traded. In general, the data considered in this paper suggests that short selling is a significant feature of Hong Kong's financial markets. As evidence of this, we can report that over the period 1999 – 2005, short selling in Hong Kong has increased at an average rate of 37% per annum and short interest constitutes 7.7% of daily traded volume on average.

Table 2 summarises information on the level of short sales relative to the daily traded volume as well as the number of shares on issue across days on which short sales occurred. The average level of short sales relative to traded volume ranges

[10] Share trading in PCCW was suspended in July, 2006 (after the end of the sample period) and the company is currently involved in buyout negotiations. The results and conclusions of this paper are unaltered where PCCW is excluded from the analysis.

from 4.464% for CITIC to 8.617% for PCCW. The maximum short sales relative to traded volume ranges from 35.583% for Hutchison to 67.969% for Bank of East Asia and the minimum ranges from less than 0.01% for a number of companies to 0.03% for China Resources. In terms of the level of short sales relative to outstanding shares, Table 2 reveals that the average level of short selling relative to shares outstanding estimated across all days on which short sales occurred ranged from 0.006% for China Mobile to 0.24% for PCCW and 0.23% for Lenovo. The maximum observation is recorded for PCCW (0.38%).

- Figure 1 about here -

Figure 1 presents a plot of the total daily short sales volume across all 17 stocks included in the sample as well as the Hang Seng Index. Overall, the sample period is characterized by bearish market conditions for the first half of the sample and bullish market conditions for the second half. This is an important feature of this study as it means the estimation results are taken across a range of market conditions. The early part of the sample is characterized by noticeably higher levels of short selling compared to the rest of the sample. This is consistent with the notion of Lamont and Stein (2004) that short selling moves counter cyclically.

- Figure 2 about here -

To gain a more intuitive feel for the relative magnitude of short selling across the sample stocks, Figure 2 presents the level of accumulated short selling for a selection of companies in the sample.[11] The stock with the highest level of accumulated short selling is PCCW which had 3,723m shares sold short over the entire sample period. The total level of short interest in PCCW is more than double that of Lenovo and China Mobile, which were the stocks with the next highest short sales volume. A further group of three stocks New World, Hutchison, HSBC and SHK have relatively smaller levels of short sales. The remainder of the sample of stocks may be grouped together with Henderson and CLP representing the highest and lowest short sold stocks of this final group.

- Table 3 about here -

One possible trading strategy involving short sales is to buy and sell securities based on their level of short interest. Where this is the case, positive and significant levels of autocorrelation should be observable in short sales data. Table 3 presents up

[11] Note that the y-axis is truncated to accommodate PCCW yet still allow sufficient detail in the plots of the other stocks.

to the 10^{th} order autocorrelation coefficient for short selling for each stock in the sample and clear evidence of significant autocorrelation is found in the data. The first and second order autocorrelation coefficient is positive and significant for all 17 stocks. Further, the autocorrelation coefficient at lag 3 is significant for 11 of the stocks. The degree of autocorrelation in short selling is quite persistent for some stocks, with 6 companies generating a positive and significant autocorrelation coefficient at lag 10. Thus, the short sales volume data has clear evidence of positive autocorrelation which is supportive of the view that short sellers may trade based on past short volume information. Where short sales are interpreted as a signal of future demand (short sellers must close out their positions by buying the stock back), negative autocorrelation should be evident in the data. It is therefore interesting to note that no significant negative autocorrelation coefficients are evident in Table 3. This suggests that either short selling cannot be used to infer future price increases or short sellers hold their positions for longer than 10 trading days.

- Table 4 about here-

To the extent that market risk is important for asset pricing, short selling across the stocks in the sample may exhibit positive correlation. This is because bearish conditions in the market signal unfavourable prospects for all stocks, in which case a general increase in short sales volume across all stocks may result. Where the market is bullish, stock prices are expected to increase and speculative short sales volume may decline. Further, the tax loss hypothesis also suggests short selling may be correlated during certain times of the year. Table 4 presents a correlation matrix for the short sales volume data and in general, the estimates are quite low. The maximum correlation coefficient is 0.26 between Hang Seng Bank and HK electric. The average correlation coefficient however, is only 0.07 and numerous instances of negative correlations are observed. Thus, this evidence tends to suggest that general market conditions may not have a role to play in determining the level of short selling. This issue is considered more formally in the next section.

Although the stocks included in the sample are all large, heavily traded and well known Hong Kong stocks, the above analysis clearly establishes the heterogeneous nature of short selling across the sample in terms of trading volume and frequency. To account for the possibility of such size effects, the measure of short sales in equation (1) may be specified using a variable that is normalised across stocks. To this end, the Short Interest Ratio (SIR) is defined as total short sales

volume relative to total traded volume. In the analysis that follows, equation (1) shall be tested using both raw short sales and SIR data and any differences discussed.

6 The Determinants of Short Selling

In this paper, we argue that short sales volumes are a function of a number of information and non-information based factors. Equation (1) presents a stylized form of pooled testing equation in which each of these factors are proxied by a number of different variables. Due to potential problems with multicolinearity, each variable is tested in turn and a parsimonious model of short sales constructed. As a starting point for analysis, Table 5 presents the estimation results where the log of short sales is specified as the dependent variable.

- Table 5 about here -

The first model estimated included a lagged dependent variable and month-of-the-year dummy variables. The seasonal dummy coefficients are not reported (for this or any other model estimated) to conserve space[12]. In general, the results may be compactly summarized by stating that while individual monthly dummy coefficients were significant, there was no systematic pattern of short sales for any of the models tested. As such, tax arbitrage does not appear to be a significant motivation for short sellers in Hong Kong. The lagged short sales coefficient is positive and highly significant, which is to be expected given the evidence of serial correlation in table 3. The overall explanatory power of the equation is 26% and the Durbin Watson statistic suggests a lack of significant time dependent structure in the errors.

The second column of table 5 reports estimation results for an extended model which included a dummy variable for the ex-dividend date. The lagged dependent variable was again positive and highly significant. The ex-dividend date dummy was also significant and the negative sign on the coefficient suggests that lower short sales are observed on the date the share goes ex dividend. As a form of robustness test, the model was re-estimated with the dividend payment date instead of the ex-dividend date. This coefficient is not expected to be significant as there is no advantage to short selling on the payment date. The results presented in the third column of Table 5 reveal that the coefficient is insignificant as expected. Thus, the evidence suggests that short sales fall on the day the share goes ex-dividend.

[12] These results are available from the authors upon request.

The next series of variables to be included in the model were chosen to capture the fundamentals of the firm. Recall that firms with lower fundamentals are expected to have a higher level of short sales in anticipation of poor future price performance. Thus, as fundamentals fall, short sales should increase suggesting a negative coefficient. Dividend Yield, Earnings per Share and Book to Market Value are all tested in turn in the model and each estimated coefficient was individually significant and negative, with the R^2 value for the model incorporating the dividend yield being highest of the three models considered. Further, where all three variables were simultaneously included, only the dividend yield remained significant and retained its sign. As such, the dividend yield was retained in the model to capture firm fundamentals and the other variables were excluded.

Risk is thought to be an important factor in determining short selling, as risk increases, the benefit to hedging rises and so the incentive to sell short may increase. Additionally, where the heterogeneity of investor expectations is reflected in the firms share price volatility, more short selling is expected in stocks with relatively higher price risk. The alternative measures of risk were considered in this paper; the first is an estimate of the time varying conditional of the returns obtained from a GARCH(1,1). The second measure is the daily trading range, the difference between the highest and lowest price at each date in the sample. The final measure is obtained from the implied volatility taken from either the most heavily traded option or the average across all traded options. Each of these proxies for risk was included in turn and all generated a positive and significant coefficient which is consistent with higher risk stocks exhibiting higher levels of short selling. Of these four measures of risk, the implied volatility is retained as the literature suggests that they provide the most accurate volatility forecasts (see Day and Lewis, 1993, Jorion, 1995 and Christensen and Prabhala, 1998). The use of the implied volatility from the most heavily traded option and the average implied volatility across all listed options does not impact on the tenor of the results (in this and all other estimated models), and so the former is chosen as it does not incorporate redundant volatility information from thinly traded options contracts.

The work of arbitragers in the market frequently involves simultaneous trading in options and short selling of the underlying asset. To test the relationship between options trading and short selling, the log of the total open interest across all listed options was included in the model. The results support the conjecture that open

interest is a positive and significant determinant of short selling. This suggests that the more heavily traded are the options on an individual equity, the greater will be the volume of short sales, all else equal. It is interesting to retest open interest by distinguishing between open interest on the call and the put option. The estimation results indicate that while both are positive and significant, put option open interest is three times more influential on the level of short selling. Recall from the discussion in section 3 that arbitrage may involve long and short positions in put contracts but only short positions in call contracts.[13] Thus, this asymmetry may reflect the heavier concentration of short sales activity being linked to put option trading.

An alternative measure of the effect of options trading may be a measure of the number of trades in the options market. Thus, the log of the number of trades as well as an equivalent measure of the number of trades in the call and the put were included in the model. The results indicate that higher trading activity in the options market is associated with high levels of short volume. Distinguishing between calls and puts, and the number of trades in both are found to exert a positive and significant influence on short selling. A Wald test of coefficient equality suggests that the two estimated coefficients are not statistically significantly different from each other. Where open interest and trading volume are jointly included in the model, both retain their signs and remain significant, although the estimated coefficient for the number of trades is noticeably lower in value.

Where technical traders are present in the market, past stock price and market information may influence the level of short trading. To test this possibility, the model was augmented to include a one period lagged stock return term and the estimated coefficient was positive and significant. Thus, a positive (negative) price movement suggests higher (lower) levels of short selling in the following period. This result is suggestive of contrarian trading being the dominant strategy employed by short sellers where they rely on price reversals to create profitable opportunities.

In addition to short trading based on idiosyncratic information, market wide information, as measured by the total return to the Hang Seng Index, may also be used. That is, a general increase in short interest across stocks may be observed where the market sentiment turns bearish. The estimated model generated a positive and significant coefficient estimate. Recall, the short selling correlation information

[13] Option trading based on speculation of a price fall however, may manifest on one side of either option.

presented earlier suggests the comovement in short positions across stocks is low. Thus, this significant result runs somewhat counter-intuitive to the correlation information. Recall, however, that our sample represents half of the stocks included in the index. Thus, individual stock movements will have an important bearing on the direction of the market and so, these two variables are capturing similar information. To test this possibility, the model was estimated with both stock specific and market-wide return measures included and the results (not reported) show that only the individual returns remained significant. We therefore exclude the returns to the Hang Seng Index and specify the model with individual stock returns.

The final independent variable tested in the model is the interest rate spread. The model is estimated using the 3 month Hong Kong – US interest rate differential and the estimated results show that this variable is insignificant.[14] Where the 3 year spread is specified (not reported), the same outcome is produced.

The outcome of this hierarchical procedure yields the model presented in the last column of Table 5 which brings all of the significant factors together from the previous analysis.[15] Short selling on the stocks in the sample is specified as a function of past short selling, dividend payments, company fundamentals proxied by dividend yield, risk measured by implied volatility, option market activity and past stock returns. The estimated model has an explanatory power of 30% and all of the coefficients have consistent signs and retain their significance (except for the ex-dividend date dummy which is significant at the 10% level).

One possible criticism of the previous model is that it specifies log short sales volume as the dependent variable. Figure 2 shows how the short sales data for the companies included in this study varies markedly over the sample period and it is possible that size effects may be present in this data, that is, the results may be unduly influenced by the larger companies in the sample. To address the robustness of the results to any such bias a model with the SIR as the dependent variable was estimated and the results are presented in Table 6.

- Table 6 about here -

[14] The 3 year spread was also tested and the results are unchanged. They are not presented to conserve space.

[15] This hierarchical type approach to modeling touches on issues which are currently being developed in the general-to-specific modeling literature (see Campos, Ericsson and Hendry, 2005). The most pertinent issue for this paper is the possibility that the results are dependent on the order in which the variables are introduced into the model. Unreported results confirm the robustness of these results to the ordering of the determinants of short selling.

Considering each variable in turn, the results in Table 6 reveal that lagged SIR are important in explaining the variance in the current SIR. The dividend cycle of the stocks in the sample was not found to be a significant influence on the SIR. This result stands in contrast to the raw short selling results previously discussed. Each of the three company fundamental variables are negative and significant when tested individually. Where they were jointly included, the dividend yield and MTBV variables retain their sign and significance and are included in the model to be estimated for the SIR. All the measures of risk generated the expected positive signs, however only the implied volatility measures were significant. This implies that the SIR will be higher on days with relatively higher risk.

The level of the SIR was found to be positively related to the open interest in the individual share options market. Where the model is adapted to distinguish between call and put option open interest, however, it is the former that was found to be significant. This could possibly be because option trading for hedging purposes is focused on one side of the call contract, whereas it involves both sides of the put contract. The option market trading volume is not a significant in explaining the variance of the SIR; this result is robust to the inclusion of call and put trading volume individually.

The influence of past stock and market returns on the SIR was quite different to the raw short sales volume version of the model. Neither variable is statistically significant, whether they are included individually or jointly in the regression (not presented). The interest rate spread was significant explanatory of variance in the SIR, this result is robust to the choice of maturity of the interest rate. The positive coefficient estimate is consistent with the notion that, following an increase in the Hong Kong – US interest rate spread, Hong Kong equities will become relatively less attractive in the eyes of investors. Given the currency board arrangement underlying the HK$, these spreads over the US interests rate may reflect a risk premium for Hong Kong. A widening of the spread is associated with heightened short selling relative to trading volume, in the expectation of reduced demand for Hong Kong shares.

7 Are Short Sellers Momentum or Contrarian Traders?

The evidence from Section 5 suggests that short sellers respond to past price information when making trading decisions. In this section, we revisit this result in an attempt to provide further insights into how investors react to past price information.

Diether et al (2005, p. 10) note that "virtually every book on short selling uses price-pattern-based technical trading rules." Thus, it is almost certain that at least some short sellers will base their decisions on past price information. However, it is not clear over what time horizon they frame their decisions. On the one hand, it could be over a very short horizon, incorporating only the price movement from the previous day. Alternatively, it could be over a longer time horizon, perhaps 10 trading days or more. Further, it is also not clear what the nature of this relationship may be. If short sellers are momentum traders, a fall in prices may lead to an increase in short selling, as investors expect the downward price trend to continue. On the other hand, where a contrarian investment strategy dominates, short sellers increase their positions following a positive return in anticipation of a reversal in the next period.

To test whether short sellers are momentum or contrarian traders, the parsimonious regression model presented in the last column of Table 5 may be modified to allow for the different time horizons of investors. Thus, in addition to the 1 day returns already tested, returns estimated over a 2, 5 and 10 day window preceding the day of the short sale may also be tested.[16] For example, where W = 5, the return is the log change in price over the previous –1 to –5 days denoted as $R_{t-1}^{(W)}$ for W=5.

The results for each of the different return windows are presented in Panel A of Table 7 Panel A, where the log of short sales is specified. Note that while the full model is estimated, the table only presents the estimated coefficients for the lagged return as well as past short selling (which has a high degree of explanatory power). The other coefficients are consistent with those reported in Table 5 and so further discussion is omitted. The first row of results in Panel A, are the same as those presented for the full model in Table 5, where short sellers are assumed to have a very short time horizon and trade based on the past days return (W=1), the estimated coefficient is positive and significant. Distinguishing between positive and negative returns, $R_{t-1}^{(W)}$-, it is possible to explore the symmetry of short selling responses to past price movements. In this case, past returns are separated into past positive and negative returns. Two new series are tested: $R_{t-1}^{(W)}$+, which takes the value of the

[16] Note that Diether et al (2005) use adjusted returns in their analysis. It is argued in the context of this study that this is inappropriate as to profit from a short selling strategy, the investor must identify a stock whose price falls and not just underperforms the market. Thus, unadjusted returns data is the focus of analysis.

return if it is positive and zero otherwise; and $R_{t-1}^{(W)}$ - which takes the absolute value of the return if it is negative and zero otherwise. Each of these two terms are included in a second version of our model and both coefficients are positive although only positive returns are significant. A Wald test confirms that the estimated differences between these coefficients are statistically significant. Recall that the short sales data includes both information based and non-information based trading. Thus, only a portion of short selling will respond to recent price changes and a certain level of short selling will take place irrespective as to recent returns. The positive sign on these asymmetry coefficients is consistent with this notion. The fact that short selling is greater following positive returns however, is consistent with the contrarian hypothesis. Short sales increase following positive returns as investors take positions in anticipation of a price reversal. Thus, short sellers are contrarian traders. In the context of the previous literature, this result is consistent with the results for the US market provided by Diether et al (2005).

-Table 7 about here-

It is possible that traders may consider returns over a longer time horizon when short selling. As such, returns estimated over a window of the past 2, 5 and 10 days are also considered. The coefficient for the past returns variable is positive and significant in each case. This suggests that short sales are responsive to returns over a 2 day and longer time horizon. Where positive and negative returns are considered individually, the results mirror the one day returns results as the positive return coefficients are positive and significant in every case. Further, the Wald test shows that the positive coefficient is significantly greater than the negative coefficient in each case.

To account for the possibility of any size effects biasing these results the previous analysis is repeated using the SIR as the dependent variable. The results for this analysis are presented in Panel B of Table 7 and may be compactly summarized as follows. Past returns generally have an insignificant impact on current period relative short sales volume. Distinguishing between positive and negative returns didd little to alter this result. Only the positive return over a two day window was significant, however its sign was perverse. Thus, there is no compelling evidence of past returns being a factor in making the decision to sell short in the relative short sales data.

8 The Information Content of Short Selling

Where short selling is driven by information, the information set may consist of past prices or some form of news about the company's future prospects. The previous section provides evidence of the former in that short sales are found to respond to past returns. Where price rises, short sales will increase on the assumption of a price reversal. Success for this strategy is simply the result of speculation that the market will not sustain the recent price trend. Thus, these trades do not reveal any information to the market.

Where traders are taking short positions on a superior (and possibly inside) information set[17], their trading will reveal that information to the market. In this case, short selling may have predictive power for future returns. Any such evidence however, should not be interpreted as an indication of the potential profits to short positions. To draw such conclusions would require information on how long they hold their positions for. Further, trading costs also need to be taken into account, which the literature suggests are significant and highly variable (see Cohen, Diether and Malloy, 2005).

To provide some insights to the predictive power of short selling, the W period return in period t+1 is regressed against information for day *t*, ie.

$$R_{i,t+1}^{(W)} = a_0 + a_1 ss_{i,t} + a_2 mv_{i,t} + a_3 mtbv_{i,t} + \varepsilon_{i,t+1} \quad (3)$$

Where $ss_{i,t}$ $mv_{i,t}$ and $mtbv_{i,t}$ represent the logarithms of Short Sales, Market Value and Market to Book Value, respectively, for firm *i* at time *t*. Fama and French (1992) show that firm size and the book to market ratio are important factors in explaining the cross sectional variation of returns. As such, the market value of the firm and book-to-market ratio of each firm are included as further explanatory variables. The estimation results for this equation are presented in Panel A of Table 8 for W = 1, 2, 5 and 10 days ahead returns where the errors are modeled as an AR(1) process.

-Table 8 about here-

The estimation results for the one day ahead return produce a negative and significant coefficient on the short sales volume variable. Thus, higher levels of short selling in the current period are associated with declines in returns in the following period. This result is consistent with the previous literature, see Senchack and Starks (1993), *inter alia*. To account for potential autocorrelation in short selling, this

[17] Singal and Xu (2005) argue that short sellers possess superior information.

equation was re-estimated to include the one period lead of the short sales term. The results show that the coefficient for the current period short sales variable remains negative and significant and so does not serve to alter the initial conclusion. It is interesting to note that the signs of these two variables are opposite which is consistent with the results of Diether et al (2005). Thus, where short sellers are building a position, positive returns are expected until such time as this trend changes, in which case negative returns are expected.

Where 2, 5 and 10 day ahead returns are considered, none of the current period short sales terms are significant. It is interesting to note that the one period ahead short sales term is significant in the control equation for the two day returns. This result suggest that short selling in the following period leads to lower average returns in the following period and is consistent with the results for the one period return equation. Of the control variables, only the market to book value variable is significant for the longer time horizon return equations.

In panel B of Table 8, the ability of the SIR to predict future returns is considered. The results largely mirror those of Panel A insomuch as higher current period short sales suggest lower future returns in the next period. Of the control variables, market to book value is significant in all of the models tested. With the exception of the one period lead of SIR for two-day returns, none of the other return windows produced significant evidence of a predictive power in the relative short sales data.

Taken together, the results of this section suggest that where short sellers are establishing a position in the market, higher short selling in the current period is associated with higher returns in the next period. Once short sellers reduce their activity in the market however, negative returns are expected in the following period. In general, short sellers appear to have reasonably short time horizons as little evidence can be found of them either reacting to or influencing longer time horizon stock returns. This evidence may help to explain why many past papers which use monthly data, have failed to establish any predictive power of short selling. The information content of short sales may only extend to the next day (or even less as indicated by the results of Aitken, Frino, McCorry and Swan (1999).

9 Conclusion

This paper investigates the determinants and information content of short selling in the Hong Kong equity market. We argue that short selling results from the activities of both informed and uninformed traders. A number of variables are tested that are designed to capture the impact of various aspects of each group of traders on short sales volumes. The results suggest that past levels of short selling, dividend payments, company fundamentals, risk, option market activity, the interest rate spread and past stock returns may all have some influence over the current level of short selling. Further analysis of the influence of past returns on current short selling reveals that it is only immediate past price information which enters into the decision making function of short sellers.

In the event that trading decisions on short positions are made based on company information, the level of short selling may have predictive power for future returns. The results of the analysis in this paper are consistent with such a view. Where short sellers are taking a position against a stock, higher short selling in the current period is associated with higher returns in the next period. Once short sellers reduce their activity in the market however, negative returns are expected in the following period.

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Table 1
Descriptive Statistics of Returns and Short Selling Data

Stock Code	Stock Name	Panel A: Returns					Panel B:Short Sales			
		Mean	Maximum	Minimum	Std. Dev.	J-Bera	% of Days	Average (excl 0's)	Maximum	Cumulative
-	Hang Seng	0.0001	0.0435	- 0.0929	0.0115	1092.0	-	-	-	-
1	Cheung Kong	-0.0001	0.0671	- 0.1135	0.0169	305.8	80.51%	288,287	5,974,000	321,440,000
2	CLP Holdings	0.0003	0.0387	- 0.0544	0.0079	1,271.3	58.48%	198,517	1,729,000	160,798,500
4	Wharf Holdings	0.0003	0.0994	- 0.1382	0.0199	759.9	79.49%	292,072	3,072,000	321,571,000
5	HSBC	0.0001	0.0664	- 0.0896	0.0112	5,676.0	81.23%	675,426	7,644,800	759,854,000
6	HK Electric	0.0003	0.0439	- 0.0447	0.0096	483.8	59.28%	206,728	2,096,500	169,723,500
8	PCCW	-0.0011	0.1214	- 0.1208	0.0221	835.1	71.48%	3,761,289	84,379,000	3,723,676,000
11	Hang Seng Bank	-0.0000	0.0508	- 0.0688	0.0099	1,168.8	68.59%	174,793	2,677,300	166,052,900
12	Henderson Land	0.0000	0.0974	- 0.0920	0.0199	371.9	83.68%	353,700	6,383,000	409,938,000
13	Hutchison	-0.0002	0.0691	- 0.1370	0.0162	1,258.5	86.50%	491,340	5,715,000	588,625,000
16	SHK Property	0.0000	0.0817	- 0.0907	0.0186	288.1	91.05%	473,892	5,292,000	597,578,000
17	New World Dev.	0.0002	0.1308	- 0.1385	0.0276	473.2	64.04%	625,959	10,302,000	555,226,000
19	Swire Pacific 'A'	0.0002	0.0914	- 0.1308	0.0183	792.1	77.18%	174,049	2,363,000	186,058,500
23	Bank of East Asia	0.0003	0.0883	- 0.0639	0.0142	752.8	58.63%	242,725	4,441,200	197,093,000
267	CITIC	-0.0000	0.0896	- 0.1413	0.0181	2,828.4	57.26%	196,852	3,554,000	156,104,000
291	China Resources	0.0003	0.0886	- 0.1318	0.0218	732.3	66.57%	331,091	11,328,000	305,266,000
941	China Mobile	0.0000	0.1054	- 0.1106	0.0215	574.0	90.97%	1,259,885	11,839,000	1,587,455,500
992	Lenovo Group	-0.0004	0.1289	- 0.1516	0.0281	362.3	73.14%	1,832,182	38,200,000	1,856,000,000

Table 2
Short Sales Relative to Traded Volume and Shares Outstanding – Measured across days on which short trades occur

Stock Code	Company Name	Relative to Traded Volume			Relative to Shares on Issue	
		Average	Maximum	Minimum	Average	Maximum
1	Cheung Kong	4.908%	39.216%	0.009%	0.012%	0.258%
2	CLP Holdings	6.202%	64.347%	0.014%	0.008%	0.072%
4	Wharf Holdings	7.840%	49.922%	0.015%	0.012%	0.126%
5	HSBC	6.304%	44.200%	0.012%	0.007%	0.081%
6	HK Electric	7.170%	55.319%	0.008%	0.010%	0.098%
8	PCCW	7.044%	59.496%	0.009%	0.024%	0.380%
11	Hang Seng Bank	8.617%	48.715%	0.009%	0.009%	0.140%
12	Henderson Land	8.303%	52.359%	0.024%	0.020%	0.352%
13	Hutchison	5.245%	35.583%	0.005%	0.012%	0.134%
16	SHK Property	8.499%	46.455%	0.013%	0.020%	0.220%
17	New World Dev.	4.682%	48.274%	0.008%	0.023%	0.324%
19	Swire Pacific ‘A’	6.744%	49.008%	0.016%	0.019%	0.254%
23	Bank of East Asia	7.389%	67.969%	0.005%	0.017%	0.298%
267	CITIC	4.464%	40.968%	0.026%	0.009%	0.162%
291	China Resources	5.962%	45.223%	0.031%	0.016%	0.565%
941	China Mobile	5.955%	43.407%	0.003%	0.006%	0.060%
992	Lenovo Group	7.773%	60.380%	0.009%	0.023%	0.449%

Table 3
Autocorrelations of Short Selling

Notes to Table: Statistical significance at the 5% level indicated as *.

	Lag									
Company	1	2	3	4	5	6	7	8	9	10
Cheung Kong	0.338 *	0.206 *	0.079 *	0.075 *	0.100 *	0.030	0.087 *	0.075 *	-0.018	0.028
CLP Holdings	0.243 *	0.189 *	-0.019	0.062 *	0.012	0.029	0.014	0.016	-0.018	0.032
Wharf Holdings	0.309 *	0.136 *	0.035	0.013	0.034	0.022	0.019	0.052	0.031	0.088 *
HSBC	0.415 *	0.207 *	0.048	0.118 *	0.071 *	0.098 *	-0.011	0.065 *	-0.019	-0.014
HK Electric	0.289 *	0.143 *	0.112 *	0.061 *	0.051	0.137 *	0.014	0.033	0.077 *	-0.034
PCCW	0.455 *	0.202 *	0.232 *	0.037	0.153 *	0.002	0.086 *	-0.008	0.022	0.109 *
Hang Seng Bank	0.405 *	0.218 *	0.095 *	0.069 *	0.102 *	0.015	0.110 *	0.032	0.000	0.028
Henderson Land	0.505 *	0.055 *	0.044	0.069 *	0.094 *	0.048	-0.010	0.033	0.076 *	0.006
Hutchison	0.388 *	0.194 *	0.111 *	0.135 *	0.235 *	0.002	0.020	0.074 *	0.022	0.090 *
SHK Property	0.376 *	0.163 *	0.054 *	0.025	0.051	0.120 *	0.020	0.001	-0.004	0.086 *
New World Dev.	0.392 *	0.112 *	0.186 *	0.009	0.075 *	0.032	0.084 *	0.021	0.178 *	0.020
Swire Pacific ‘A’	0.313 *	0.143 *	0.109 *	0.056 *	0.133 *	0.069 *	0.080 *	0.077 *	0.051	0.018
Bank of East Asia	0.439 *	0.079 *	-0.017	0.023	0.009	0.077 *	0.084 *	0.030	-0.017	-0.018
CITIC	0.311 *	0.149 *	0.026	0.028	0.063 *	0.115 *	0.031	0.014	0.048	0.076 *
China Resources	0.258 *	0.148 *	0.103 *	0.085 *	0.124 *	-0.008	0.034	0.004	0.078 *	-0.066
China Mobile	0.384 *	0.153 *	0.110 *	0.066 *	0.066 *	0.047	0.057 *	0.042	0.023	0.058 *
Lenovo Group	0.408 *	0.102 *	0.076 *	0.101 *	0.171 *	-0.005	0.070 *	0.013	0.021	0.029

Table 4
Short Selling Correlations

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Cheung Kong	1.00																
2	CLP Holdings	-0.03																
3	Wharf Holdings	0.13	0.15															
4	HSBC	0.05	0.12	0.05														
5	HK Electric	0.08	0.24	0.09	0.16													
6	PCCW	-0.02	0.05	0.14	0.01	0.11												
7	Hang Seng Bank	0.03	0.15	0.11	0.20	0.26	0.15											
8	Henderson Land	0.04	0.03	0.08	0.06	0.07	-0.05	0.02										
9	Hutchison	0.20	0.01	0.03	0.12	0.04	-0.06	0.10	0.03									
10	SHK Property	0.17	0.10	0.11	0.10	0.01	-0.08	0.10	0.15	0.19								
11	New World Dev.	0.08	0.05	0.09	0.04	-0.01	-0.07	-0.02	0.18	0.00	0.13							
12	Swire Pacific ‘A’	0.09	0.08	0.16	0.10	0.01	0.06	0.15	0.04	0.06	0.08	0.10						
13	Bank of East Asia	0.08	0.01	0.00	0.06	0.05	-0.05	0.09	0.00	0.08	0.02	0.02	0.05					
14	CITIC	0.07	0.12	0.10	0.16	0.16	0.06	0.26	0.03	0.07	0.08	0.06	0.13	0.11				
15	China Resources	0.05	0.05	0.07	0.01	0.02	0.02	0.06	0.03	-0.02	0.04	0.06	0.04	0.06	0.06			
16	China Mobile	0.16	0.07	0.06	0.20	0.10	0.01	0.12	0.04	0.21	0.21	0.00	0.05	0.06	0.11	0.00		
17	Lenovo Group	0.07	-0.01	-0.02	0.04	0.00	-0.01	-0.03	0.08	0.17	0.15	-0.02	-0.02	0.03	-0.06	0.05	0.17	
-	Hang Seng	-0.01	-0.01	0.02	-0.09	-0.04	0.02	-0.09	0.03	-0.07	-0.03	-0.01	0.04	-0.05	-0.12	-0.01	-0.01	0.05

Table 5
Pooled Hierarchical Regression Output

This table presents the regression output for $ss_{it} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_j + \sum_{k=1}^{11} \beta_k D_k + \varepsilon_t$ where the independent variables (X_t) in each equation are specified in the left hand column. All regression equations include month dummy variables (not presented to conserve space). Standard errors are displayed as (.)

C	5.9958 (60.72)	5.9975 (60.74)	5.9981 (60.72)	7.2854 (65.83)	6.2414 (61.22)	6.0041 (60.73)	7.2969 (65.73)	7.2428 (64.82)	7.2153 (64.83)	7.0721 (59.92)	7.064 (58.92)
Log Short Sales (-1)	0.5083 (70.16)	0.5082 (70.15)	0.5083 (70.15)	0.4488 (59.68)	0.4995 (68.57)	0.5081 (70.14)	0.4486 (59.64)	0.4496 (59.76)	0.4448 (58.94)	0.4463 (59.28)	0.4464 (59.28)
$D_{\text{Dividend Ex-Date}}$		-0.3049 (2.34)		-0.2228 (1.74)	-0.2872 (2.21)	-0.3048 (2.33)	-0.2216 (1.73)	-0.2238 (1.75)	-0.2192 (1.71)	-0.2186 (1.71)	-0.2172 (1.70)
$D_{\text{Dividend Payment Date}}$			-0.1329 (0.98)								
Dividend Yield				-0.1925 (23.98)			-0.1889 (22.05)	-0.1927 (24.01)	-0.1764 (20.64)	-0.169 (18.33)	-0.1686 (17.84)
EPS					-0.051 (9.20)		-0.008 (1.37)				
MTBV						-0.0027 (1.30)	0.001 (0.49)				
Trading Range								0.0423 (2.73)			
ARCH									201.0107 (5.46)		
Implied Volatility										0.0060 (5.16)	
Average Implied Volatility											0.0061 (4.78)
R-squared	0.2626	0.2629	0.2627	0.2921	0.2674	0.263	0.2922	0.2924	0.2936	0.2934	0.2932
Durbin-Watson stat	2.1653	2.1659	2.1653	2.1111	2.158	2.166	2.1109	2.1091	2.1078	2.1102	2.1097

Table 5 (Continued)

Dependent Variable : Log Short Sales									
C	5.5123 (35.82)	5.5074 (35.61)	6.7198 (54.54)	6.6317 (49.59)	5.5548 (32.59)	5.5322 (32.42)	5.5146 (32.32)	5.5886 (31.59)	5.5164 (31.50)
Log Short Sales(-1)	0.4208 (55.07)	0.4198 (54.89)	0.4311 (54.8)	0.4196 (48.12)	0.4176 (52.47)	0.4169 (52.38)	0.4183 (52.57)	0.4169 (52.38)	0.4168 (52.34)
$D_{\text{Dividend Ex-Date}}$	-0.196 (1.54)	-0.2017 (1.59)	-0.2601 (2.01)	-0.3493 (2.52)	-0.2326 (1.81)	-0.2304 (1.79)	-0.223 (1.73)	-0.2292 (1.78)	-0.2305 (1.79)
Dividend Yield	-0.1513 (16.42)	-0.148 (16.01)	-0.1381 (14.18)	-0.1053 (9.81)	-0.1389 (14.32)	-0.1384 (14.26)	-0.1371 (14.11)	-0.1422 (13.94)	-0.1369 (13.11)
Implied Volatility	0.0127 (10.26)	0.0145 (10.55)	0.0096 (7.67)	0.0112 (8.17)	0.0122 (9.56)	0.0125 (9.75)	0.0126 (9.83)	0.0119 (8.65)	0.0128 (8.65)
Log Option Open Interest	0.1655 (15.61)				0.1473 (9.85)	0.1498 (10.00)	0.1494 (9.99)	0.1484 (9.88)	0.1501 (10.01)
Log Call Option Open Interest		0.0406 (2.24)							
Log Put Option Open Interest		0.1337 (6.31)							
Log No. Option Trades			0.1223 (14.53)		0.0493 (4.40)	0.0484 (4.32)	0.0484 (4.32)	0.0489 (4.36)	0.0482 (4.29)
Log No. Call Option Trades				0.1087 (6.87)					
Log No. Put Option Trades				0.0894 (5.66)					
Stock Return (-1)						1.957 (3.42)		1.9497 (3.41)	1.9557 (3.42)
Market Return (-1)							4.4358 (4.62)		
Interest Rate Spread								0.0297 (1.20)	
R-squared	0.3055	0.3063	0.3025	0.3004	0.3077	0.3084	0.3089	0.3084	0.3084
Durbin-Watson stat	2.0899	2.0911	2.0352	2.0326	2.0266	2.0279	2.0264	2.0278	2.0278

Table 6
Short Interest Ratio

This table presents the regression output for $SIR_{it} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_j + \sum_{k=1}^{11} \beta_k D_k + \varepsilon_t$ where the independent variables (X_t) in each equation are specified in the left hand column. All regression equations include month dummy variables (not presented to conserve space). Standard errors are displayed as (.)

C	0.0224 (11.00)	0.0224 (11.01)	0.0224 (10.98)	0.0378 (15.96)	0.0258 (12.00)	0.0244 (11.93)	0.0397 (16.60)	0.0389 (16.00)	0.0389 (14.83)	0.0329 (9.81)	0.0326 (9.19)
SIR_{t-1}	0.5875 (111.24)	0.5875 (111.24)	0.5875 (111.23)	0.5768 (108.21)	0.5858 (110.75)	0.582 (109.65)	0.5717 (106.77)	0.5719 (106.82)	0.5719 (106.81)	0.5715 (106.71)	0.5715 (106.73)
$D_{\text{Dividend Ex-Date}}$		-0.0059 (0.91)									
$D_{\text{Dividend Payment Date}}$			0.0007 (0.11)								
Dividend Yield				-0.0046 (12.62)			-0.0043 (11.02)	-0.0045 (12.29)	-0.0045 (11.09)	-0.0039 (8.76)	-0.0038 (8.46)
EPS					-0.0013 (4.89)		-0.0004 (1.39)				
MTBV						-0.0008 (9.04)	-0.0007 (8.65)	-0.0007 (8.48)	-0.0007 (8.54)	-0.0007 (8.37)	-0.0007 (8.41)
Trading Range								0.0005 (0.62)			
ARCH									0.6068 (0.32)		
Implied Volatility										0.0001 (2.68)	
Average Implied Volatility											0.0001 (2.52)
R-squared	0.3458	0.3459	0.3458	0.3502	0.3465	0.3481	0.3523	0.3523	0.3523	0.3525	0.3524
Durbin-Watson stat	2.2485	2.2484	2.2485	2.2378	2.2467	2.2429	2.2327	2.2329	2.2328	2.2327	2.2325

Table 6 (Continued)

Dependent Variable : SIR							
C	-0.0154 (2.31)	-0.0078 (1.15)	0.0364 (9.07)	0.0303 (6.97)	-0.0153 (2.28)	-0.0152 (2.26)	0.0004 (0.06)
SIR_{t-1}	0.5669 (105.47)	0.5675 (105.63)	0.6066 (104.74)	0.588 (88.22)	0.5667 (105.47)	0.5666 (105.45)	0.5634 (104.47)
Dividend Yield	-0.0034 (7.61)	-0.0034 (7.63)	-0.0040 (8.33)	-0.0024 (4.50)	-0.0034 (7.68)	-0.0034 (7.70)	-0.0044 (9.39)
MTBV	-0.0007 (8.59)	-0.0007 (8.45)	-0.0008 (8.97)	-0.0009 (8.49)	-0.0007 (8.53)	-0.0007 (8.53)	-0.0007 (8.48)
Implied Volatility	0.0003 (5.01)	0.0002 (4.01)	0.0001 (2.44)	0.0002 (3.28)	0.0003 (4.93)	0.0002 (4.9)	0.0001 (2.19)
Log Option Open Interest	0.0044 (8.33)				0.0044 (8.34)	0.0044 (8.33)	0.0041 (7.78)
Log Call Option Open Interest		0.003 (3.44)					
Log Put Option Open Interest		0.0009 (0.95)					
Log No. Option Trades			-0.0003 (0.92)				
Log No. Call Option Trades				0.0012 (1.56)			
Log No. Put Option Trades				-0.0009 (1.24)			
Stock Return (-1)					-0.0178 (0.58)		
Market Return (-1)						-0.0574 (1.15)	
Interest Rate Spread							0.008 (7.07)
R-squared	0.3544	0.3545	0.3806	0.3557	0.3545	0.3546	0.3557
Durbin-Watson stat	2.2287	2.2289	2.1953	2.0821	2.2306	2.231	2.2249

Table 7
Short Sales and Past Stock Returns

This table presents the regression output for $ss_{it} = \alpha_0 + \sum_{j=1}^{n} \alpha_j X_j + \sum_{k=1}^{11} \beta_k D_k + \varepsilon_t$ where the independent variables (X_t) in each equation are specified in the left hand column. All regression equations include month dummy variables (not presented to conserve space). Standard errors are displayed as (.),, marginal significance levels are displayed as [.].

Panel A: Short Sales								
Variable	C	SS_{t-1}	$R_{t-1}^{(W)}$	$R_{t-1}^{(W)}+$	$R_{t-1}^{(W)}-$	R^2	D-W	Wald Test
SS_t (W=1)	5.5164	0.4168	1.9557					
	(31.50)	(52.34)	(3.42)			0.3084	2.0278	
	5.5341	0.4133		4.8603	0.9493			
	(32.48)	(51.45)		(4.59)	(0.89)	0.3089	2.1519	[0.0006]
SS_t (W=2)	5.5287	0.4165	1.1206					
	(32.36)	(52.27)	(2.77)			0.3083	2.1471	
	5.5022	0.4146		1.8062	0.0605			
	(32.19)	(51.65)		(3.55)	(0.08)	0.3085	2.1506	[0.0144]
SS_t (W=5)	5.4952	0.4151	0.8279					
	(32.04)	(52.01)	(3.09)			0.3085	2.1697	
	5.5025	0.4139		2.0926	0.3964			
	(32.19)	(51.67		(4.10)	(0.8044	0.3087	2.1492	[0.0015]
SS_t (W=10)	5.4703	0.4140	0.7794					
	(31.75)	(51.75)	(4.00)			0.3085	2.1791	
	5.4875	0.4153		1.2058	-0.3318			
	(32.06)	(52.04)		(3.35)	(0.89)	0.3087	2.1512	[0.0001]
Panel B: Short Interest Ratio								
Variable	C	SIR_{t-1}	$R_{t-1}^{(W)}$	$R_{t-1}^{(W)}+$	$R_{t-1}^{(W)}-$	R^2	D-W	Wald Test
SIR_t (W=1)	0.0005	0.5632	-0.0180					
	(0.07)	(104.48)	(0.58)			0.3559	2.2269	
	0.0006	0.5634		-0.0270	0.0087			
	(0.08)	(104.40)		(0.49)	(0.16)	0.3558	2.2249	[0.5579]
SIR_t (W=2)	0.0009	0.5628	-0.0080					
	(0.12)	(104.32)	(0.37)			0.3554	2.2268	
	0.0011	0.5635		-0.0579	-0.0619			
	(0.16)	(104.48)		(2.25)	(1.63)	0.3559	2.2251	[0.9138]
SIR_t (W=5)	0.0114	0.5627	-0.0186					
	(0.16)	(104.09)	(1.35)			0.3549	2.2251	
	0.0011	0.5633		-0.0213	0.0159			
	(0.16)	(104.45)		(0.82)	(0.63)	0.3558	2.2248	[0.1755]
SIR_t (W=10)	0.0006	0.5617	0.0160					
	(0.09)	(103.97)	(1.61)			0.3548	2.2223	
	-0.0012	0.5634		-0.0030	-0.0351			
	(0.17)	(104.47)		(0.16)	(1.94)	0.3559	2.2251	[0.1052]

Table 8
The Predictive Ability of Short Sales

This table presents the regression output for $R_{i,t+1}^{(W)} = a_0 + a_1 ss_{i,t} + a_2 mv_{i,t} + a_3 mtbv_{i,t} + \varepsilon_{i,t+1}$. All regression equations include month dummy variables (not presented to conserve space). Standard errors are displayed as (.),, marginal significance levels are displayed as [.].

Panel A: Short Sales						
Variable	C	SS_t	SS_{t+1}	MV	MTBV	D-W stat
$R_{t+1}^{(W)}$, w=1	0.0042	-0.0004		0.0001	-0.0003	
	(2.09)	(4.08)		(0.55)	(1.29)	2.1083
	0.0016	-0.0006	0.0003	0.0001	-0.0003	
	(0.64)	(4.68)	(2.21)	(1.09)	(1.25)	2.0301
$R_{t+1}^{(W)}$, w=2	0.0018	0.0002		-0.0002	-0.0016	
	(0.42)	(1.38)		(0.79)	(2.99)	1.6090
	0.0057	0.0001	-0.0003	-0.0002	-0.0014	
	(1.12)	(1.11)	(2.11)	(0.68)	(2.4)	1.6015
$R_{t+1}^{(W)}$, w=5	0.0079	0.0001		-0.0007	-0.0005	
	(0.69)	(1.23)		(0.75)	(0.38)	1.7878
	0.0155	0.0001	-0.0002	-0.0010	-0.0014	
	(1.22)	(0.98)	(1.15)	(1.01)	(0.85)	1.7156
$R_{t+1}^{(W)}$, w=10	0.0109	0.0002		-0.0006	-0.0077	
	(0.47)	(1.54)		(0.34)	(2.53)	1.9283
	0.0155	0.0001	-0.0002	-0.0010	-0.0014	
	(1.22)	(0.98)	(1.15)	(1.01)	(0.85)	1.7156
Panel B: Short Interest Ratio						
Variable	C	SIR_t	SIR_{t+1}	MV	MTBV	D-W stat
$R_{t+1}^{(W)}$, w=1	0.0013	-0.0058		0.0001	-0.0003	
	(1.03)	(3.25)		(0.62)	(2.27)	1.9962
	0.0013	-0.0057	-0.0001	00001	-0.0003	
	(1.03)	(3.03)	(0.07)	(0.62)	(2.27)	1.9962
$R_{t+1}^{(W)}$, w=2	0.0025	-0.0005		-0.0001	-0.0008	
	(0.85)	(0.25)		(0.66)	(2.10)	1.6245
	0.0027	-0.0017	-0.0062	-0.0001	-0.0008	
	(0.9)	(0.72)	(2.56)	(0.59)	(2.09)	1.6246
$R_{t+1}^{(W)}$, w=5	0.0065	0.0019		-0.0004	-0.0022	
	(0.79)	(0.81)		(0.65)	(2.13)	1.7372
	0.0065	0.0019		-0.0004	-0.0022	
	(0.79)	(0.74)	0 (0.01)	(0.65)	(2.13)	1.7372
$R_{t+1}^{(W)}$, w=10	0.0168	0.0035		-0.0012	-0.0054	
	(1.02)	(1.5)		(0.85)	(2.64)	1.8299
	0.0169	0.0024	-0.0024	-0.0012	-0.0054	
	(1.02)	(0.97)	(0.95)	(0.84)	(2.64)	1.8297

Figure 1
Total Short Sales across Sample Stocks and Hang Seng Index

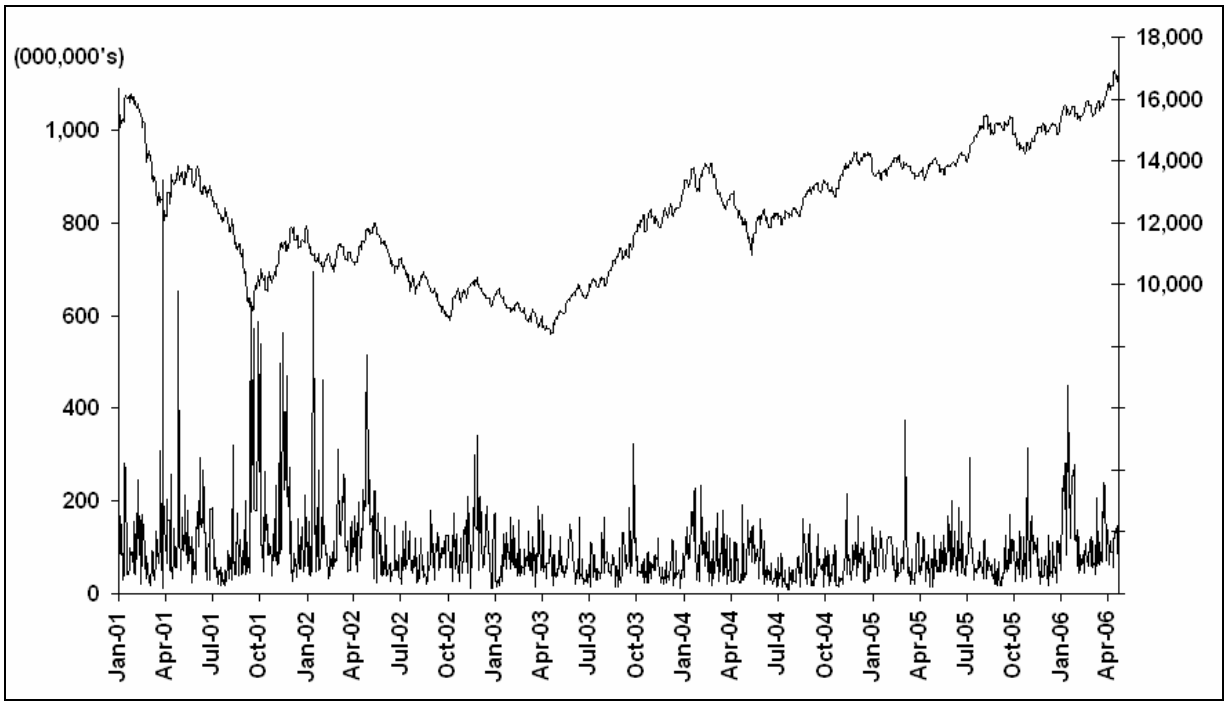

Figure 2
Cumulative Short Sales for Selected Hong Kong Equities

This figure presents the cumulative short sales volume for 5 of the equities included in the initial pilot program. Note that as PCCW has a much greater level of cumulative short sales (2.55 bn. by 2001), the y-axis was truncated to allow the detail for the other stocks to be seen.