Regulatory lessons for emerging stock markets from a century of evidence on transactions costs and share price volatility in the London Stock Exchange

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Abstract

This paper draws regulatory lessons for emerging stock markets from an empirical study of the relationship between transactions costs and share price volatility in the London Stock Exchange. We concentrate our analysis on direct pecuniary costs of trading, namely transactions taxes (stamp duty) and brokerage charges, which derive directly from regulation. In a novel contribution to the transactions cost literature, we identify stock market performance with various measures of market volatility, and distinguish among market volatility, fundamental volatility and excess volatility; we also propose some simple ways of identifying the separate impact of transactions costs on these volatility measures. Our findings suggest that changes in transactions costs have a significant and dependable effect on share price volatility but the sign of this effect depends critically on the concept of volatility being measured. Among the important lessons for emerging stock markets is that transactions costs are an important factor in share market volatility and the regulatory regime therefore needs to take account of the impact of regulation on such costs. This is particularly important for those emerging stock markets that rely on stamp duty or other transactions taxes as a regulatory tool. © 2000 Elsevier Science B.V. All rights reserved.
1. Introduction

In this paper, we seek to draw regulatory lessons for emerging stock markets from a study of the historical development of transactions costs and share price volatility in the London Stock Exchange. ¹ We focus on transactions costs as one particular aspect of market operating and regulatory conditions; specifically, we study the relationship between transactions costs and market volatility, which we interpret as a measure of market performance. The regulatory regime is a key determinant of transactions costs, both indirectly through the institutional and competitive structure of the market, and more directly through any taxes or regulatory charges on market participants. Transactions costs, in turn, affect market performance, particularly but not exclusively, through their effect on trading volumes. ²

One difficulty in evaluating these arguments is that transactions costs data for most stock markets are of short span. Hence, the main innovation of this paper is that we analyse the relationship between transactions costs and market performance with the aid of a new long-term dataset on the London Stock Exchange covering almost one-and-a-quarter centuries – from 1870 to 1986. An additional innovation of the paper is that it draws on the research on the British stock market for over a century to provide some new benchmarks for appraising aspects of government policy and regulation that may influence the behaviour of stock prices and returns in emerging stock markets.

¹ Although most emerging stock markets have exhibited phenomenal performance, the financial crisis that broke out in South East Asia in the summer of 1997 has renewed the calls for a careful examination of the organisational and regulatory practices in these markets. In general, most of the markets do not have the basic legal and institutional framework for an efficient microstructure i.e., they are not efficiently organised, operated and regulated; see Lo (1995) and O’Hara (1995). Moreover, at the operating level, many of these markets are characterised by high transactions costs associated with intermittent trading of a relatively few stocks, often held by a relatively small group of investors (Murinde, 1996). Such thin markets may be subject to excess volatility or to speculative bubbles (Shiller, 1989).

² There is a substantial literature on these relationships which we briefly review in Section 2 of this paper. In general, regulatory policy has a direct impact on stock market efficiency in that trading arrangements, costs and taxes may produce too little or too much trading, and thus cause inefficiency (see Stiglitz, 1989; Roll, 1989).
markets. Moreover, by using UK data in this paper, we provide evidence on aspects of stock market regulation which have been less researched than those in the US. We focus on the long-term effect of transactions costs on market performance. We distinguish between two types of transactions cost: direct pecuniary costs and indirect costs; our analysis concentrates on the former. Stock market performance is identified with various measures of market volatility. In a novel contribution to the transactions cost literature, we distinguish among market volatility, fundamental volatility, and excess volatility; we also propose some simple ways of identifying the separate impact of transactions costs on the different concepts of volatility.

The rest of the paper is organised as follows. In Section 2, we briefly review the literature on the relationship among transactions costs, trading volume and stock market performance. Section 3 sets out our framework for empirically analysing this relationship, and describes the data. Section 4 contains the empirical results, and Section 5 has some concluding remarks.

2. Transactions costs, trading volume and market performance

Transactions costs may have several effects, not all of which are intuitively obvious. For example, one might expect that increased transactions costs

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3 Economic historians have long recognised that there are numerous parallels between the historical development experience of industrial countries and the modern experience of the developing economies. See Crafts (1985). Indeed, many of the characteristics of the 19th century British stock market are also to be found in emerging stock markets today. These include an unstructured regulatory regime, uneven information disclosure, thin trading, a restricted number of companies, complex capital structures and a limited pool of savings. Historically, financial regulation in the UK evolved alongside the systems they regulated (Chick and Dow, 1996). Within this evolutionary framework, regulation was fragmented, and was institutionally rather than functionally based. At the London Stock Exchange, regulation involved a members' club which maintained co-insurance arrangements supported by barriers to entry and by a price cartel which laid down uniform minimum commission rates. A major component of transactions costs was therefore directly set down and regulated by the stock exchange. In 1986, these restrictive arrangements were dismantled with a “Big Bang”; and replaced by a more competitive system, formalised in the Financial Services Act.

4 One promising idea for further research is to focus on indirect costs. Novel proxies for indirect costs include the number of magazines which report stock exchange issues and the space in newspapers devoted to the analysis of firms.

5 Transactions costs in stock markets fall into two broad categories. First are the direct pecuniary costs of trading. These include the market-maker's spread, the broker's fees, and any transaction taxes, such as stamp duties. Second are the indirect costs. These include the costs of acquiring and processing information about share values, companies, market movements and any other information which may be relevant to the decision to buy and sell shares. This category also includes indirect pecuniary costs such as the general tax structure. As we argued above, the regulatory regime as a whole is a major determinant of transactions costs, whatever form they take.
would increase the average holding period of securities; but Bulkley and Harris (1997) show that the reverse may be true, because increased transactions costs cause a bias in investment decisions towards assets with shorter pay-offs, thus reducing average holding periods. However, the main effect of increased transactions costs is usually thought to be that they reduce the incentive to trade, and therefore produce a thinner market. Thin trading tends to induce or increase autocorrelation in share returns, as in Boudoukh et al. (1994); it also affects volatility, although the channels by which this occurs are not altogether clear, and even the sign of the volatility effect is debatable.

Another important effect of transactions costs relates to market efficiency and welfare in the context of Tobin (1978). Tobin’s proposal, for an internationally uniform tax on all foreign currency conversions, is directly related to transactions costs and stock market efficiency in the sense that prices can be fully information efficient in the short-run, but nevertheless still depart from longer-run fundamentals. This might imply excess volatility in the sense of Shiller (1989); i.e. stock values which respond efficiently to new information, but which depart erratically and excessively from their fundamentals. However, Kupiec (1996) questions Tobin’s argument using a simple general equilibrium model that exhibits excess volatility in the no-tax equilibrium. In this model, an increase in the rate of transactions tax increases excess volatility and reduces asset prices, because of the increased risk of future tax liabilities. Overall, the effect of a transactions tax is to reduce welfare.

Relationships between trading volume and return volatility are usually explained using models of information-arrival, following the seminal contribution of Fisher (1966). If information shocks are common to all traders and reach traders sequentially, they create volume and price changes, and generate a positive correlation between price volatility and trading volume. See Jennings 6 Tobin’s proposal draws on Keynes’ famous analogy between the stock market and a beauty contest in which the winner is the one whose choice is closest to the average or to that of a committee. Thus, “[p]rofessional stock market investors] are concerned not with what an investment is really worth to a man who buys it “for keeps”, but with what the market will value it at … three months or a year hence.” (Keynes, 1936, p. 155). However, Tobin’s proposal has been criticised, as for example in Chrystal and Price (1986); it has also been argued that the main purpose of an international transactions tax should be to restore autonomy to national monetary policy rather than to reduce asset price and exchange rate volatility per se; see Eichengreen et al. (1995).

7 Wu (1997) is able to explain a substantial part of the excess volatility of US stock prices in terms of rational stochastic asset bubbles. However, Bulkley and Harris (1997) argue that excess stock price volatility may be due in part to a failure of the market to form rational expectations. Using data on analysts’ expectations of long run earnings growth for individual companies, they find that the cross-section of stock prices are excessively dispersed, so that stocks with low earnings expectations are underpriced and stocks with high earnings expectations are overpriced. In contrast, as noted by Herring and Litan (1995), market volatility may be determined by other factors, including changes in delivery and payment terms.
and Barry (1983), Karpoff (1987) and Bessembinder and Seguin (1993). If, however, information shocks reach traders simultaneously, then Pagano (1989) shows that volume and price volatility are negatively correlated. In deep markets, simultaneous shocks are mutually offsetting in their effects on security demands, and thus have little effect on prices; but in thin markets, shocks are not mutually offsetting, and prices have to adjust more in either direction. Finally, if traders are distinguished by the information they possess, irrespective of how it arrives, a richer variety of results is possible. The seminal work by Grossman and Stiglitz (1980) established that in general, asset price distributions will reflect the information that each trader possesses. This suggests that if market thinness is associated with a reduction in the number of well-informed traders, it will decrease market efficiency and welfare; whereas if it is associated with a reduction in the number of pure noise traders, the information content of prices will improve and may offset Pagano’s liquidity effect. DeLong et al. (1990) used this argument to show that price variability in a stock market would increase as the proportion of well-informed traders decreases relative to that of “noise traders”. However, Black and Tonks (1992) produced a counter-example in which the reverse occurs because of the way in which less well-informed traders free-ride on the information in prices.

Empirical studies on the relationships between volume and return volatility indicate that the weight of the evidence favours a positive relationship; see Karpoff (1987) for a survey, and Bessembinder and Seguin (1993). However, some studies document a negative relationship; see, inter alia, Tauchen and Pitts (1983). With respect to empirical work on transactions costs, the evidence is more fragmentary. Jarrell (1984) found that the volume in NYSE listed shares increased dramatically following the May 1975 deregulation and consequent reduction in the commission portion of transaction costs. Jones and Seguin (1997) showed that this increased volume following deregulation was associated with a decrease in volatility. Umlauf (1993) obtained similar results in an event study of changes in transactions taxes in Sweden. Jackson and O’Donnell (1985) found that increased stamp duty in the UK had a strong effect on London Stock Exchange volume in the 1970s. Moreover, Saporta and Kan (1997) found that post-1955 UK stamp duty changes had a sharp effect on stock returns but a negligible effect on conditional volatility. Thus, it would appear that the logic of increasing transaction taxes to reduce the impact of noise traders, and therefore to reduce volatility, is not consistent with the available evidence.

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8 However, their results can probably be explained by the fact that in their sample period, there was just one change in stamp duty (an increase), which coincided with one of the largest ever annual price declines in the London Stock Exchange (in 1974).
Obviously, a major reason for the paucity of studies of transactions costs is that such costs are exceedingly difficult to measure. Moreover, a difficulty with much of the empirical research we have summarised is that it typically involves high-frequency data spanning a relatively short space of time. If transactions costs reduce volatility relative to fundamentals, this is more likely to be a relatively long-term effect. Two unusual features of the London stock market are: first, its longevity, and second the fact that, until 1986, brokerage rates were effectively determined by the London Stock Exchange cartel, which laid down minimum commission rates for its members. This means that reliable published data on commission rates and transactions taxes (stamp duty) are available at least from the mid-19th century up to October 1986 when minimum commissions were abolished. The published data offer an unusual opportunity to take a longer-term look at the impact of transactions costs changes in the London Stock Exchange.

3. Data and methodology

We investigate the impact of transactions costs on market volatility in the London Stock Exchange from 1870 to 1986, when minimum commissions were abolished with Big Bang. The two main hypotheses to be tested are: first, that changes in transactions costs do have a significant effect on the volatility of the stock market, and second, that the sign of the transactions cost effect depends on the exact measure of volatility under consideration.

We measure share market volatility using several different statistics of an index of quoted industrial shares. We constructed a consistent monthly series of share prices and dividends from 1870 to 1987 by splicing together three separate indices: the Green et al. (1996) index of between 25 and 150 industrial and utility shares from 1866 to 1930; the Actuaries’ Investment index of about 140 industrial and utility ordinary shares from 1866 to 1930; the Actuaries’ Investment index of about 140 industrial and utility ordinary shares from 1930 to 1962; and the

9 Indirect costs are virtually impossible to measure, almost by definition. Direct costs, consisting as they do in large part of brokers’ and dealers’ margins, tend to be commercially sensitive. Bid–ask spreads are only indicative of dealers’ true costs, although they have been used as a measure of transactions costs in several recent studies. For example, Saporta et al. (1998) show how it is possible to estimate the spread using transactions data; see also Atkins and Dyl (1997).

10 One interesting extension of this paper would be to break the series into particular regulatory episodes in order to delve into the evolutionary story. The analysis could also be extended beyond 1986 to compare the competitive (post-1986) with the cartelized (pre-1986) regime. These possible extensions are beyond the immediate scope of this paper.
We focus our analysis on historical volatility, and distinguish among market volatility, fundamental volatility and excess volatility. Specifically, historical volatility is an ex-post measure of the variability of returns; it summarises the effect of unanticipated shocks on the stock market over the time period under study. Following Anderson and Breedon (1996) and Schwert (1989), we estimate the historical volatility of each variable of interest as the annual standard deviation of its monthly values. Defining $P_t$ as the stock price index, monthly capital gains on stocks ($Q_t$) are given by

$$Q_t = P_{t+1}/P_t - 1.$$  \(1\)

The annual standard deviations of monthly capital gains ($SDQ_t$) are given by

$$SDQ_{t+12} = (VQ_{t+12})^{1/2}, \quad t = 0, 12, 24, \ldots$$  \(2\)

with

$$VQ_{t+12} = \sum_{i=1}^{12} [Q_{t+i} - MQ_{t+12}]^2 / 12$$

= the variance of capital gains for the year

and

$$MQ_{t+12} = \sum_{i=1}^{12} Q_{t+i} / 12 = \text{the mean capital gain}.$$

Studies using high-frequency data typically ignore dividends in the calculation of share market volatility. This may be (just) defensible if dividends are hard to calculate sensibly, on a daily basis for example. However, Modigliani–Miller’s propositions tell us that share price movements could, in part, be a passive response to current dividend changes, as well as a response to any other shocks. Such changes could be particularly important in long-term, lower-frequency datasets such as ours. We therefore also define monthly stock returns ($R_t$) as

\[11\] In London, stocks and shares were traded in organised markets from the late 17th century. From 1812, when the Stock Exchange acquired its first rule-book and The Course of the Exchange became established as the official record of the exchange, there exists an unbroken record of twice-weekly and later daily share quotations in London through to the present day. However, these data are not readily accessible, and we had to manually retrieve the data from original records. See Green et al. (1996).

\[12\] Anderson and Breedon (1996) and Schwert (1989) provide examples of studies which ignore dividends.
$$R_t = P_{t+1}/P_t + D_{t+1}/P_t - 1$$  \hspace{2cm} (3)$$

with $D_t$ = dividends per share. Share return volatility ($SDR_t$) is calculated from $R_t$ in the same way as $SDQ_t$ is calculated from $Q_t$.

The terms $SDR_t$ and $SDQ_t$ are measures of market volatility. We conjecture that transactions costs may have a differential effect on excess volatility. A simple way of estimating this concept is to begin with the standard share valuation model

$$I_t = E_t P_{t+1}/P_t + E_t D_{t+1}/P_t$$ \hspace{2cm} (4)$$

with $I_t$ = the (risk-corrected) discount factor and $E_t$ = the conditional expectation operator.

Assuming that immediate future dividends are known, Eq. (4) implies

$$Q_t + 1 \equiv P_{t+1}/P_t = (I_t - D_{t+1}/P_t) + \varepsilon_t = FQ_t + \varepsilon_t,$$ \hspace{2cm} (5a)$$

$$R_t + 1 \equiv P_{t+1}/P_t + D_{t+1}/P_t = I_t + \varepsilon_t = FR_t + \varepsilon_t.$$ \hspace{2cm} (5b)$$

In these expressions, provided $I_t$ is the true risk-corrected discount rate, then $FQ_t$ is the one period ahead expected or fundamental capital gain; $FR_t$ is the one period ahead expected or fundamental return; and, in either case, $\varepsilon_t$ is the deviation of the actuals from the fundamentals. We use this as a framework for distinguishing between market volatility and excess volatility. Market volatility is defined as the annual volatility of $Q_t$ or $R_t$. In either case, excess volatility is defined as the excess of market volatility over the volatility of the fundamentals i.e. the volatility of $\varepsilon_t$. The fundamentals constitute the market’s one-period ahead forecast of the capital gain or return on shares (since one-period ahead dividends are invariably known for certain, at least in monthly data). We can also calculate measures of fundamental volatility as the standard deviations of $FQ_t$ and $FR_t$. The basic problem in calculating fundamental and excess volatility in practice is that the discount factor includes an unobservable and probably time-varying risk premium, and is therefore exceedingly difficult to measure empirically. In practice, we used the return on 3 month bills as a simple proxy for the discount factor. This captures time variation in the discount factor but neglects any change in the risk premium. \(^{13}\)

Thus, the historical volatility model to be estimated takes the following form

$$SDQ_t = \delta_0 + \sum_{k=1} \delta_k X_{kt-1} + \sum_{j=1} \gamma_j C_{jt-1} + u_t,$$ \hspace{2cm} (6)$$

where $SDQ_t$ is a measure of volatility; $C_{jt-1}(j = 1, \ldots, J)$ are $J$ measures of transactions costs; $X_{kt-1}(k = 1, \ldots, K)$ are $K$ other determinants of volatility. The importance of transactions costs is measured through the parameters $\gamma_j$.

\(^{13}\) Data on bills were taken from Green et al. (1993).
We estimated this equation for each measure of volatility: market volatility \((\times 2)\), excess volatility \((\times 1)\), and fundamental volatility \((\times 2)\), giving five equations in all. The model aims to explain volatility directly, and abstracts from the channels through which transactions costs influence volatility, such as changes in turnover. The reason for this is pragmatic. Data on market turnover in London are available only from quite recent times, whereas share price data are available from much earlier.

It is not the goal of this paper to estimate a tightly-specified model of volatility. However, we do condition the estimated effects of transactions costs on other fundamental determinants of volatility (i.e. the \(X_t\)). Following Fama and French (1988, 1989), it is well-documented that measures of business conditions help predict stock returns in a variety of datasets. Insofar as these variables are proxies for the time-variation in an underlying market risk premium as Fama–French argue, we would also expect them to help predict volatility. Initially we included five variables as predictors of volatility (all lagged one year in the regressions): the dividend yield, the inflation rate, the short-term real interest rate, the (term) spread between consols and bills, and the (term) spread between long-term corporate bonds and bills.\(^{14}\) We subsequently tested down by deleting predictors which were insignificant. Each of our historical volatility measures was autocorrelated; but a single lag of the dependent variable was sufficient to whiten the residuals in all the regressions. In addition, we might expect there to be feedback from increased volatility to increased transactions costs. Our measures of transactions costs exclude the non-pecuniary costs associated with information gathering and processing. As a proxy for this effect, we might expect there to be feedback among the different measures of volatility. To capture this, we included also lagged fundamental volatility as a possible predictor of market volatility and vice versa. Finally, few studies of the British stock market can explain the market fall and subsequent rebound in 1974–1975; and most of our volatility measures have a hard-to-explain spike in 1974. For this reason, the regressions were all estimated with a dummy for 1974. The dummy was not always significant, and its main effect was to reduce a little the significance of some of the other coefficients.\(^{15}\) Other dummy variables (such as 1914, when the stock market was closed for five months) were all insignificant. The definitions and mnemonics of the volatility measures and other variables are shown in Table 1.

This discussion leads to a model which is similar (apart from transactions costs) to several of those estimated by Schwert (1989) and by Anderson and Breedon (1996). Both these papers report rather mixed results for this type of model. Our own results are generally quite satisfactory.

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\(^{14}\) Data on bonds and consols were taken from Green et al. (1993).

\(^{15}\) Results excluding the 1974 dummy are available from the authors on request.
Turning next to transactions costs, in the present paper, we concentrate on estimating the influence of direct pecuniary transactions costs on share price volatility. In London, pecuniary transactions costs consisted of dealers’ margins, brokers’ commissions, and stamp duty, the latter being a tax on the value of share transactions. We focus on brokers’ commissions and stamp duty. Brokers’ minimum commission rates were laid down by the stock exchange and published in the *Stock Exchange Yearbook* from its inception in 1875. Prior to 1875, we obtained data from *The Investors’ Monthly Manual*. Minimum commission rates were laid down in some detail. Typically, the rate of commission per share or per £ was larger, the smaller the size of the deal, mostly implying diminishing marginal and average transactions costs with increasing size of transaction. Stamp duty on the other hand, was (and is) levied at a simple proportional rate on the value of the transaction. Table 2 shows the highest and lowest marginal minimum commission rates, the marginal com-

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16 Stamp duty and other taxes are a regulatory mechanism that is used in some emerging stock markets. For example, the Malaysian Securities Commission has released guidelines that regulate securities lending and borrowing, and which give preferential tax and stamp duty treatment to the institutions which perform these functions.
mission rates for the smallest and largest deal, and the rates of stamp duty. The lowest marginal commission rate was generally identical to the rate for the largest deal, and vice versa; but this was not always the case, as can be seen in Table 2.

The marginal and average cost of each share transaction depended on the size of the deal; and it is therefore impossible to calculate a meaningful measure of average pecuniary transactions costs over the period which we have analysed, either for the stock index or for individual shares. However, individual decisions to trade shares are presumably based on marginal costs; and these are easier to approximate. In recent times, the dominant influence on the stock market has been institutional investors, whose typical deal is relatively large, and will therefore most likely have been executed at the cost of the largest deal laid down by the stock exchange. This might suggest using the marginal cost of the largest deal as an approximate measure of marginal brokerage costs. However, the influence of institutional investors is a relatively recent phenomenon. Prior to 1945, it would be equally plausible to argue that individual

<table>
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<th>Year</th>
<th>Marginal rates for</th>
<th>Stamp duty: Average percentage rates (stamp)</th>
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<tr>
<td></td>
<td>Lowest (blge)</td>
<td>Highest (bsml)</td>
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<tr>
<td>1870</td>
<td>0.1667</td>
<td>1</td>
</tr>
<tr>
<td>1881</td>
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<td>1888</td>
<td>0.25</td>
<td>2.5</td>
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<td>1896</td>
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<td>2.5</td>
</tr>
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<td>1910</td>
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<td>1952</td>
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<td>1960</td>
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<td>1969</td>
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<tr>
<td>1971</td>
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</tr>
<tr>
<td>1984</td>
<td>0.125</td>
<td>1.65</td>
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*Source: Investors’ Monthly Manual, Stock Exchange Yearbook (various issues).*
investors were dominant, with a typical deal executed at the marginal rate nearer that for the smallest deal than for the largest. A further consideration is that the stock price data consists of a single index which is constructed by a regular rebalancing of the index portfolio (in fact, monthly rebalancing). Rebalancing involves a large number of (literally!) marginal adjustments to shares in the index. The transactions corresponding to these adjustments would, by construction, be executed at the marginal rate for the smallest deal. We therefore included two separate measures of marginal brokerage costs: the marginal cost of the largest deal (Table 2, column 3) reflecting the marginal costs of institutions, and the marginal costs of the smallest deal (Table 2, column 4) reflecting the marginal costs of individuals and, notionally, of the index itself.

Our data also permit us to distinguish between private costs (brokerage) and government-imposed costs (stamp duty), but we would emphasise that this distinction is largely second-order, for, as we argued above, the regulatory regime as a whole will be a major determinant of transactions costs, whatever form they take. Stamp duty has a constant marginal rate in each time period, and this was therefore used as a third regressor along with the marginal brokerage costs.

Selected data are shown in Figs. 1 and 2. Fig. 1 shows capital gains on stocks; Fig. 2 shows the standard deviations of capital gains. The main feature of both is the spike in 1974. In general, it appears from both charts that, on this measure stock price volatility in London has increased over time, particularly...
but not exclusively in the post-war era. The return series exhibit broadly similar patterns.

All the data were tested for order of integration using the Dickey and Fuller (1979) and Phillips and Perron (1988) tests; as clearly shown in Table 3, all were found to be $I(0)$. Initially therefore, Eq. (6) was estimated by ordinary least squares. This is not entirely satisfactory as all the volatility measures are bounded from below by zero. We therefore re-estimated all the equations using the Tobit estimator to force the volatility measures to be positive in the regression. The Tobit estimates had very little impact on the regression results. For precision, we report Tobit coefficients and standard errors together with some OLS diagnostics and F tests. The regressions were done in TSP.

We also carried out an ARCH-LM test for autoregressive conditional heteroskedasticity in the main historical volatility equations when they are estimated by OLS. The test was based on the regression of squared residuals on lagged squared residuals. The test results are given in Table 4 and clearly show that there is no evidence of ARCH effects in the five historical volatility equations.

It is important to stress that the fact that the historical variance does not exhibit ARCH has no bearing at all on whether the conditional mean of the process exhibits ARCH – the two are completely unrelated concepts. We did explore the impact of transactions costs on the conditional volatility of asset returns using the Fama–French approach to model conditional mean returns, with GARCH errors to model conditional volatility (variance). The results of these explorations are reported in Appendix A.

Fig. 2. Return volatility: 1866–1991.
Table 3
Tests for order of integration

<table>
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<tr>
<th></th>
<th>SDQ</th>
<th>SDR</th>
<th>xsdf</th>
<th>SDQF</th>
<th>SDFR</th>
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<tr>
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<tr>
<td>p-Value</td>
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<td>0.0027</td>
<td>0.0026</td>
<td>0.0036</td>
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<td>0.0035</td>
<td>0.0114</td>
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<td>0.0002</td>
</tr>
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</table>

*p-Value for the probability of rejecting the null hypothesis that the variable is I(1). The variables are defined in Table 1.
4. Empirical results

The results for historical volatility are reported in Tables 5 and 6. We see that our model explains about 60% of the annual variation in each of the different measures of stock return volatility. The first-order lag is significant in all the equations although, not surprisingly, it is rather smaller in magnitude than has been found in higher frequency datasets. Apart from this, the main explanatory variables for market volatility and for excess volatility are the dividend yield and the inflation rate (Table 5). In contrast, in the equations for fundamental volatility (Table 6), the main explanatory variables are the real interest rate and the yield spread between corporate bonds and bills. There are also interesting feedbacks between the different concepts of volatility, providing some support for our argument that changes in volatility may affect non-pecuniary transactions costs. Thus, $SDQ_t$ helps predict $SDFQ_t$, and vice versa; $SDR_t$ helps predict $SDFR_t$ though not vice versa.

The transaction costs variables are collectively strongly significant in all the equations although, as we would expect, there is some variation in the significance of individual variables in the different equations. In the market volatility and excess volatility regressions, stamp duty and small transactions brokerage are significant in all the equations, whereas large transactions brokerage is generally not significant. In the fundamental volatility equations, small and large transactions brokerage are significant, but stamp duty is not. In each individual equation, the broad magnitudes of the (short-run) coefficients are mostly quite similar, giving additional confidence in our measures of transactions costs. However, the most simple and striking feature of these results is that they do bear out our conjectures about the possible conflicts in the effects of transactions costs, although not precisely in the way we had expected. All transactions costs variables have uniformly positive signs in the market volatility and excess volatility equations. Given that increased transactions costs presumably reduce trading, these results are consistent with the evidence of Jones and Seguin (1997) and Umlauf (1993) that increased transactions costs will increase volatility through a thin trading effect. In contrast, the same transactions costs variables have equally uniformly negative signs in the equations for fundamental volatility. This in turn suggests that increased
### Table 5
**Historical volatility: Market volatility and excess volatility**

<table>
<thead>
<tr>
<th>Market volatility</th>
<th>Reset</th>
<th>LM</th>
<th>$R^2$</th>
<th>F (d.o.f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SDQ$ 0.6459</td>
<td>0.9317</td>
<td>0.7211</td>
<td>0.4632</td>
<td>8.409</td>
</tr>
<tr>
<td>$(t)$ 2.8*</td>
<td>1.4</td>
<td>2.4*</td>
<td>5.6*</td>
<td>1.6</td>
</tr>
<tr>
<td>$SDQ$ 0.5488</td>
<td>0.8788</td>
<td>0.7290</td>
<td>0.4360</td>
<td>12.85</td>
</tr>
<tr>
<td>$(t)$ 2.4*</td>
<td>1.4</td>
<td>2.4*</td>
<td>5.6*</td>
<td>2.9*</td>
</tr>
<tr>
<td>$SDR$ 0.5323</td>
<td>0.4970</td>
<td>0.6755</td>
<td>0.4830</td>
<td>-3.680</td>
</tr>
<tr>
<td>$(t)$ 2.2*</td>
<td>0.8</td>
<td>2.2*</td>
<td>5.9*</td>
<td>0.8</td>
</tr>
<tr>
<td>$SDR$ 0.4631</td>
<td>0.4708</td>
<td>0.7737</td>
<td>0.4880</td>
<td>0.3195</td>
</tr>
<tr>
<td>$(t)$ 2.1*</td>
<td>0.8</td>
<td>2.7*</td>
<td>6.5*</td>
<td>2.7*</td>
</tr>
</tbody>
</table>

#### Excess volatility

| $XSDF$ 0.5798 | 0.6447 | 0.6810 | 0.4858 | 0.3098 | 0.1473 | 0.0709 | -0.0072 | -0.0077 | 0.0332 | 0.03 | 1.13 | 0.60 | (1) 0.69 |
| $(t)$ 2.5* | 1.0 | 2.3* | 5.9* | 2.5* | 2.5* | 1.2 | 0.2 | 0.3 | 2.0 | | | | | | | |
| $XSDF$ 0.4591 | 0.4654 | 0.7739 | 0.4872 | 0.3161 | 0.0849 | | | | | | | | | | | | | |
| $(t)$ 2.1* | 0.8 | 2.6* | 6.5* | 2.7* | 3.3* | | | | | | | | | | | | | |

---

- **SDQ**: Market volatility
- **SDR**: Market volatility
- **XSDF**: Excess volatility
- **bsml**, **blge**, **stamp**: Defined in Table 2; the rest of the variables and volatility measures are defined in Table 1.
- **Reset**: Ramsey’s Reset test with linear and quadratic terms.
- **LM**: LM test for first-order autocorrelation.
- **$F$**: (1) $F$ test to delete insignificant variables (except bsml, blge and stamp). (2) $F$ test to delete bsml, blge and stamp. bsml, blge and stamp are defined in Table 2; the rest of the variables and volatility measures are defined in Table 1.
- **$*$**: Significant at the 5% level.

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*a Data period 1870–1986 (annual data). All explanatory variables except D74 are dated at $t - 1$. Reset: Ramsey’s Reset test with linear and quadratic terms. LM: LM test for first-order autocorrelation. $F$: (1) $F$ test to delete insignificant variables (except bsml, blge and stamp). (2) $F$ test to delete bsml, blge and stamp. bsml, blge and stamp are defined in Table 2; the rest of the variables and volatility measures are defined in Table 1.*
### Table 6
**Historical volatility: Fundamental volatility**

<table>
<thead>
<tr>
<th>Fundamental volatility</th>
<th>SD</th>
<th>bsm</th>
<th>blge</th>
<th>stamp</th>
<th>SDQ</th>
<th>SDFQ</th>
<th>dy</th>
<th>inf</th>
<th>rby</th>
<th>xcbr</th>
<th>xcnr</th>
<th>D74</th>
<th>Reset</th>
<th>LM</th>
<th>$R^2$</th>
<th>$F$ (d.o.f)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SDFQ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(t)</td>
<td>2.8*</td>
<td>3.6*</td>
<td>1.1</td>
<td>1.7</td>
<td>3.2*</td>
<td>1.0</td>
<td>0.9</td>
<td>1.6</td>
<td>1.8</td>
<td>0.1</td>
<td>3.2*</td>
<td>0.0114</td>
<td>0.0405</td>
<td>0.0057</td>
<td>0.0024</td>
<td>0.3031</td>
</tr>
<tr>
<td><strong>SDFQ</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(t)</td>
<td>3.4*</td>
<td>3.9*</td>
<td>1.0</td>
<td>1.8</td>
<td>4.9*</td>
<td>1.8</td>
<td>3.1*</td>
<td>3.2*</td>
<td>0.0008</td>
<td>-0.0010</td>
<td>0.0009</td>
<td>0.03</td>
<td>0.16</td>
<td>0.60</td>
<td>(2) 6.59*</td>
<td></td>
</tr>
<tr>
<td><strong>SDFR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(t)</td>
<td>3.3*</td>
<td>3.4*</td>
<td>0.3</td>
<td>1.6</td>
<td>3.6*</td>
<td>0.8</td>
<td>1.2</td>
<td>2.1*</td>
<td>2.6*</td>
<td>1.2</td>
<td>2.9*</td>
<td>0.0165</td>
<td>0.0461</td>
<td>-0.0019</td>
<td>0.0027</td>
<td>0.3476</td>
</tr>
<tr>
<td><strong>SDFR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(t)</td>
<td>3.9*</td>
<td>3.7*</td>
<td>0.2</td>
<td>2.1*</td>
<td>4.8*</td>
<td>2.6*</td>
<td>2.7*</td>
<td>2.8*</td>
<td>0.0014</td>
<td>-0.0010</td>
<td>0.0010</td>
<td>1.13</td>
<td>0.06</td>
<td>0.52</td>
<td>(2) 7.15*</td>
<td></td>
</tr>
</tbody>
</table>

---

* * Significant at the 5% level.

---

* Data period 1870–1986 (annual data). All explanatory variables except D74 are dated at $t - 1$. Reset: Ramsey’s Reset test with linear and quadratic terms. LM: LM test for first-order autocorrelation. F: (1) $F$ test to delete insignificant variables (except bsm, blge and stamp). (2) $F$ test to delete bsm, blge and stamp. bsm, blge, bsm and stamp are defined in Table 2; the rest of the variables and volatility measures are defined in Table 1.
transactions costs (including taxes) may indeed dampen down share price volatility in some form.

These conflicting results are by no means the end of the story. Because of the feedbacks between the different volatility measures, the total long-run effect of changing transactions costs depends also on the structure of these feedbacks. Indeed because of these feedbacks, regulators might well find that the short-run effects of changing transactions costs are significantly different from their long-term effects. We can demonstrate this by calculating the long-run effects of changes in transactions costs on market volatility, using for this purpose the equations for capital gains \( Q_t \) in which the volatility feedbacks are significant in all equations. The short-run effect of a change in bsml, blge or stamp on market volatility is given by each of their respective coefficients in the equation for \( SDQ_t \). The long-run effect of a change is found by solving out the equations for \( SDQ_t \) and \( SDFQ_t \). On performing this exercise we find that the long-run effect on market volatility of a change in bsml is \(+0.5438\), or very close to its short-run effect of \(+0.5488\); for blge in contrast, the long-run effect is \(-0.0115\) the opposite sign to the short-run effect of \(+0.8788\); and for stamp the long-run effect is \(+0.3913\) compared to a short-run effect of \(+0.7290\). We emphasise that these calculations are illustrative, not least because not all the transactions costs variables are significant in all equations, and they are, in any event, necessarily serving as proxies for the true underlying transactions costs. However, they do underline the point that regulatory intervention in stock markets needs to be undertaken with attention to the long-term and short-run effects.

Finally, in all the equations for historical volatility, there are some interactions among the transactions cost variables, particularly the brokerages, in that, omitting any one of these three variables increases the significance of the remainder without changing their signs. In comparing these results with the conditional volatility results (reported in Appendix A), we find that both sets of results are broadly consistent, although the latter are somewhat the weaker. We argue that more weight should be given to those for historical volatility, because they make use of the monthly data, and because they are not reliant on the model for the conditional mean of the price process. Nevertheless, both sets of results clearly suggest that increased transactions costs have an important impact on share price volatility; and that the sign of the effect depends on the concept of volatility under consideration, being positive for market and excess volatility, and negative for fundamental volatility. The historical volatility results also show that there may be important feedbacks between different volatility concepts, which should be taken into account by a regulator when

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17 The vector first-order difference equation in \( SDQ \) and \( SDFQ \) has two stable real roots: 0.5881 and 0.2248.

18 These results are available on request to the authors.
considering the possible impact of direct interventions, such as a transactions tax.

5. Concluding remarks

Our results show that a relatively high proportion of long-run share market volatility in London can be explained by a few measures of business conditions and our three transactions cost variables. In general, changes in each type of transactions cost have a broadly similar short-run effect on volatility, but their long-run effects differ more markedly. Overall, the evidence suggests that increased transactions costs generally increase market volatility — probably through a thin trading effect. However, increased transactions costs tend to reduce fundamental volatility. Moreover, our results show that there are volatility feedbacks — from market volatility to fundamental volatility and vice versa — probably due in part to a feedback from volatility to (non-pecuniary) transactions costs. This implies that a careful distinction has to be drawn between the possible long-run and short-run effects of transactions cost changes.

We turn finally to the key regulatory lessons which emerging stock markets may draw from our evidence. The broad implications are clear, if not necessarily unexpected: market transactions costs are an important factor in share market volatility and therefore need to be got right. It is particularly important that we get mostly similar results for each of the three cost variables. This implies that regulators must pay attention to the overall implications of market structure and regulation for private brokerage and other costs, and not just to those directly regulated costs such as transactions taxes. This has important implications for those emerging stock markets that use stamp duty as a regulatory tool. Regulators in these markets cannot assume that changes in stamp duty are the only way in which they can influence turnover and volatility. In addition, regulators in emerging markets need to consider the balance of the regulatory regime as between market structure and directly regulated costs. For example, it may be possible simultaneously to reduce volatility and enhance market liquidity by imposing obligations on designated liquidity providers in return for stamp duty relief. Alternatively, an optimal combination of liquidity and volatility may be secured for some shares, not by liquidity provider obligations but by a combination of several factors, including reliance on market forces and obligations imposed by rule.  

19 In the historical context of the UK, the Securities and Investments Board (SIB) advised the Chancellor of the Exchequer on how stamp duty arrangements in the UK equity market should be updated to reflect changes to the market. In formulating the report, the SIB would consider whether the liquidity of the UK equity market could be enhanced by imposing new obligations on designated liquidity providers in return for stamp duty relief.
In general, our results support much of the theoretical literature in emphasising that the sign of the relationship between transactions costs and share market volatility cannot be determined a priori, although like other empirical researchers, we do mostly find the sign to be positive. However, a new contribution of this paper is to show that there may be a difference between long-run and short-run effects of transactions cost changes because of volatility feedbacks. More specific conclusions clearly require a more detailed investigation of the channels connecting transactions costs and volatility. Further research on these issues is necessary.

Acknowledgements

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Appendix A. Conditional volatility

We also explored the impact of transactions costs on the conditional volatility of asset returns using GARCH models to estimate conditional volatility. Bollerslev and Mikkelsen (1996) used fractionally integrated GARCH and EGARCH models to characterise financial market volatility; but Brailsford and Faff (1996) have found evidence which supports the superiority of the simpler techniques we have applied in this paper. As it was often difficult or impossible to determine the precise month in which a change in brokerage or stamp duty occurred, GARCH models had to be estimated using annual data rather than the underlying monthly data (thus discarding 11/12ths of the data).

We began with a return measure ($Q_t$, for example) rather than with volatility.

$$Q_t = \phi_0 + \sum_{g=1}^{\phi} \phi_g Z_{g,t-1} + \sum_{j=1}^{\theta_j} \theta_j C_{j,t-1} + \eta_t,$$

(A.1)
\[ u_t \sim N(0, v_t), \]  
(A.2)  
\[ v_t = \alpha_0 + \sum_{m=1}^{\infty} \gamma_m u_{t-m}^2 + \sum_{l=1}^{\infty} \beta_l v_{t-l} + \sum_{k=1}^{\infty} \delta_k X_{kt-1} + \sum_{j=1}^{\infty} \gamma_j C_{jt-1}, \]  
(A.3)

\( Z_{gt} \) and \( C_{jt} \) are variables which influence the conditional mean of \( Q_t \). \( Z_{gt} \) may be the same as, or may differ from \( X_{kt} \) (although in a GARCH-M model, \( Z_{gt} \) and \( X_{kt} \) must be mutually exclusive in order to avoid singularity); but \( C_{jt} \) are the same transactions costs as in the conditional variance model (A.3). We estimated GARCH models for: market volatility (\( \times 2 \)), excess volatility (\( \times 1 \)), and fundamental volatility (\( \times 2 \)), giving five equations.

Conditional volatility differs from historical volatility (in Section 3 of the paper) in two major ways. First, conditional volatility conditions on an explicit model of the mean of the process as well as of the variance; second, conditional volatility uses only the annual observations, and therefore discards 11/12ths of the pricing data. If asset prices are subject to short-term over-reaction, volatility measured from the annual data will be smoother than that measured from the monthly data. These differences lead us to conjecture that transactions costs effects will be less clear in the conditional volatility regressions than in the historical volatility regressions.

The use of a GARCH model brings benefits as well as costs, mainly because we are now forced to model the mean of the pricing process. Changes in transactions costs are likely to affect the mean return on securities as well as the variance and, in principle, Eqs. (A.1)–(A.3) allow us to model both effects. However, the precision of the estimated coefficients depends on the maintained model for the conditional mean as well as on that for the variance. If the former is mis-specified, the variance process will also be mis-specified. A particular problem is that all the variables used to model the historical variance (including transactions costs) may also be expected to help predict the conditional mean.

We experimented with several GARCH models using Bollerslev’s (1986) suggestions for identification, and concluded that a GARCH (1,1) model was a parsimonious fit. To reduce the specification search, we initially included among the \( X_{kt} \) variables only those previously found significant in the model of historical volatility. We included among the \( Z_{gt} \) all six variables initially included in the historical volatility model; see Table 1. The three transactions costs variables were included both in the conditional mean and conditional variance process. It transpired that there was substantial redundancy among the regressors in terms of their significance. We therefore tested down using likelihood ratio tests; and, for parsimony, we report in Table 7 only the final version of the conditional volatility (GARCH (1,1)) equations.

Conditional volatility exhibits considerable persistence in each equation, with the coefficients on \( u_{t-1}^2 \) and \( v_{t-1} \) typically summing to close to unity. This
Table 7
Conditional volatility*

<table>
<thead>
<tr>
<th>Y</th>
<th>Mean</th>
<th>Variance</th>
<th>LL</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bsm</td>
<td>blge</td>
<td>stamp</td>
<td>dy</td>
</tr>
<tr>
<td>Market return</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q</td>
<td>Coef</td>
<td>1.652</td>
<td>1.048</td>
<td>1.783</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>1.4</td>
<td>0.2</td>
<td>0.9</td>
</tr>
<tr>
<td>$\chi^2$ (1)</td>
<td></td>
<td>1.8</td>
<td>0.1</td>
<td>0.8</td>
</tr>
<tr>
<td>R</td>
<td>Coef</td>
<td>9766</td>
<td>-0.557</td>
<td>1.155</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>0.8</td>
<td>0.1</td>
<td>0.6</td>
</tr>
<tr>
<td>$\chi^2$ (1)</td>
<td></td>
<td>0.4</td>
<td>0.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Excess return</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>R–I</td>
<td>Coef</td>
<td>2.260</td>
<td>2.600</td>
<td>2.638</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>1.7</td>
<td>0.6</td>
<td>1.8</td>
</tr>
<tr>
<td>$\chi^2$ (1)</td>
<td></td>
<td>3.1</td>
<td>0.4</td>
<td>2.8</td>
</tr>
<tr>
<td>Fundamental return</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>FQ</td>
<td>Coef</td>
<td>-0.2674</td>
<td>0.9502</td>
<td>-0.1044</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>1.1</td>
<td>2.1*</td>
<td>0.4</td>
</tr>
<tr>
<td>$\chi^2$ (1)</td>
<td></td>
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<td>2.1</td>
<td>0.2</td>
</tr>
<tr>
<td>FR</td>
<td>Coef</td>
<td>-0.3231</td>
<td>0.9205</td>
<td>-0.0540</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>1.5</td>
<td>1.6</td>
<td>0.2</td>
</tr>
<tr>
<td>$\chi^2$ (1)</td>
<td></td>
<td>3.4</td>
<td>0.0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

*Data period 1870–1986 (annual data). All explanatory variables except D74 are dated at $t–1$. LL: Log-likelihood. blge, bsm and stamp are defined in Table 2; the rest of the variables, and volatility measures are defined in Table 1.

* Significant at the 5% level.
“near-I-GARCH” result is quite common in high-frequency studies of stock returns (see for example Engle and Chowdhury, 1992). However, because of this persistence, it is perhaps not surprising to find that other variables do not have a significant effect on the conditional variance. The business conditions variables, the 1974 dummy, and all but one of the transactions costs variables are insignificant in the model of the variance, even when all or any combination of explanatory variables for the conditional mean are omitted from the model. As an exception, stamp duty is significant and positive in the equations for market volatility and excess volatility, just as before. Moreover, it also has a negative sign in the equation for fundamental volatility, just as before (in Section 3), although the \( \chi^2 \) and \( t \)-statistics give conflicting results as to its significance in these equations. The effect of transactions costs on the level of market returns is weaker, but is mostly not consistent with the argument that increased costs necessarily reduce net returns.

Thus, the results of these regressions broadly confirm our conjecture: they lend further, albeit weaker, support to the argument that transactions costs may have different effects on different concepts of volatility. In our data, increased transactions costs clearly increase market volatility but reduce fundamental volatility. Hence, the historical and conditional volatility results are broadly consistent, although the latter are somewhat the weaker of the two.

References


20 Coefficients in the GARCH model must be positive to ensure that the conditional variance is strictly positive. In the fundamental volatility equations, stamp duty is entered as “one minus the stamp duty rate”. The coefficient on this variable is positive so that a rise in stamp duty reduces the conditional variance.


