Accepted Manuscript

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PII: S0304-405X(18)30108-9
DOI: 10.1016/j.jfineco.2018.04.009
Reference: FINEC 2890

To appear in: *Journal of Financial Economics*

Received date: 7 October 2015
Revised date: 15 March 2017
Accepted date: 13 April 2017

Please cite this article as: Yongheng Deng , Xin Liu , Shang-Jin Wei , One fundamental and two taxes: when does a Tobin tax reduce financial price volatility?, *Journal of Financial Economics* (2018), doi: 10.1016/j.jfineco.2018.04.009

One fundamental and two taxes: when does a Tobin tax reduce financial price volatility?*

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* We thank Geert Bekaert, Charles Jones, Wei Xiong, Wenlan Qian, Jialin Yu, and participants in seminars at Columbia University, UCLA Anderson School, University of Hong Kong, PKU-RFS Symposium, 2014 CICF, the CF-40 Finance seminar, the 2nd ABFER conference, Fudan University, ANU, the World Bank finance group, the Federal Reserve Bank of San Francisco, 2014 FIRN conference, the 2013 Econometric Society Far Eastern meeting in Singapore for helpful comments, and Ellen Lin and Joy Glazener for proofreading. All errors are our responsibilities.

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Abstract

We aim to make two contributions to the literature on the effects of transaction costs on financial price volatility. First, by augmenting a double differencing approach with a research design with three ingredients (a common set of companies simultaneously listed on two stock exchanges, binding capital controls, and different timing of changes in transaction costs), we obtain a control group that has identical corporate fundamentals as the treatment group. We apply the research design to Chinese stocks that are cross-listed in Hong Kong and Mainland China. Second, we allow transaction costs to have different effects in markets with different maturity. We find a significantly negative relationship, on average, between stamp duty increase and price volatility. However, this average effect masks some important heterogeneity. In particular, when institutional investors have become a significant part of the traders' pool, we find an opposite effect. Overall, our results suggest that a Tobin tax could work in an immature market, but can backfire in a more developed market.

JEL Code: G12, G14, G15, G18
Keywords: Tobin tax, transaction cost, volatility, speculation, limits to arbitrage.

1. Introduction

One of the Economics Nobel Prize recipients in 2013 (Robert Shiller) is known for his pioneering work that questions whether financial prices are excessively volatile. The possibility of excessive volatility has motivated some to advocate the use of a transaction tax to dampen short-term speculation and to reduce such volatility. Prominent proponents of such an approach include Tobin (1978, 1984), Stiglitz (1989), and Summers and Summers (1989). In contrast, opponents argue that security transaction taxes (also known as a Tobin tax) could discourage fundamental-based traders more than they do noise traders, resulting in higher, not lower, volatility in the financial market (e.g., Grundfest, 1990[1], Grundfest and Shoven, 1991, and Kupiec, 1996). Interestingly, a large number of empirical papers that have investigated this question did not resolve this debate because some find a negative effect while others find a positive effect, and the conclusions do not appear to be converging in more recent publications.

We aim to make two main contributions to research on the effect of transaction taxes on price volatility. The first is methodological in nature: we argue that our research design offers us much sharper identification than any other on the topic in the literature. One key challenge for event studies is to have a proper counterfactual: what would have happened to price volatility had the transaction tax not changed? Some of the papers in the literature use a before-and-after analysis, with the implicit assumption that the before scenario is the right counterfactual. This analysis is vulnerable to the problem of confounding effects from other factors that could change market volatility for reasons unrelated to transaction costs.

The best papers in the literature use a double difference research design with a treatment and a control group together with a before-and-after comparison. But the control and treatment groups are not identical. Even if one can verify that the two groups are similar on observable dimensions, one cannot rule out the possibility that the two are different on unobserved dimensions in ways that could cause them to move differently around the event dates. For example, the paper with the best publication outlet on the topic is Jones and Seguin (1997) in the American Economic Review, which studies the event of a sharp reduction in the commission fee in 1975 for stocks traded on the

[1] Grundfest, J., 1990. The damning facts of a new stocks tax. Wall Street Journal, July 23rd.

NYSE/Amex (their treatment group). Their control group is the set of stocks traded on Nasdaq. The control and treatment groups are similar in many dimensions, but not identical, and their volatility could in principle move in different directions for unobserved reasons that are not related to the transaction cost event itself. For example, world oil prices were higher after the event date in 1975 than before. Perhaps the profits of the companies on the NYSE/Amex and those on Nasdaq have different sensitivities to the same oil price change. This possibility cannot be easily checked, especially when only a single event is studied in the paper.

Our research design has three key ingredients. (A) The treatment and control groups are the same set of firms with identical corporate fundamentals (i.e., identical dividend flows and voting rights), but are simultaneously listed on two separate stock exchanges. (B) Binding capital controls not only prevent arbitrage activities from closing the gap between the price movements in the two markets[2] but also mitigate trade migration from a higher transaction tax market to a lower tax market. (C) There are different timings of changes in the transaction costs in the two markets.[3] The combination of the three ingredients offers sharp identification for the relationship between changes in the tax and changes in the volatility. To our knowledge, this is the first paper that uses this research design to study this question.

We apply this research design to a sample of Chinese stocks that are simultaneously listed in Mainland China and Hong Kong, and thus face different transaction costs. The treatment group is composed of the Mainland-listed shares (known as A-shares), and the control group is composed of their corresponding Hong Kong-listed shares (known as H-shares). The treatment and control groups share identical corporate fundamentals as they have identical cash flow and control rights. Due to Chinese capital controls, the two markets are segmented. In particular, only Chinese residents can register

[2] For example, stocks cross-listed in New York and London cannot be used as valid treatment and control groups for this research question. Without binding capital controls, arbitrage would limit the range of disparity in price volatility of the same firms across markets. However, we are aware of the likelihood of violation of such binding capital controls; hence, we argue this setting would only offer a semi-segmented setting rather than strict segmentation.

[3] The Chinese stock market has a B-share segment, which is meant to be traded by non-Chinese nationals residing in China, and is in principle also segmented from the A-share segment. However, both A- and B-share trading are subject to the same stamp duty tax (except for a brief period during 1999–2001), which does not allow us to identify the effect of a change in the stamp duty on relative volatility. Just as important, the B-share market is generally regarded as very illiquid, further making it unsuitable for our research.

a stock account to trade A-shares listed on the Mainland exchanges. Foreign exchange controls during the sample period means it is not practical for Mainland residents to buy or sell H-shares in Hong Kong. Even though Hong Kong does not practice capital controls, Chinese capital controls prevent Hong Kong residents (and international investors in general) from buying and selling A-shares listed in the Mainland. One clear sign of binding capital controls and segmentation of the two stock markets is the price disparity of the same companies in the two stock exchanges.[4] Hong Kong listed H-shares are often traded at a discount relative to their Siamese twins listed in the Mainland (see Fernald and Rogers, 2002 for a documentation of the evidence and an explanation). In addition, while the stamp duty is always low and changes are negligible in Hong Kong, China has made several large adjustments in the stamp duty, which are very helpful to our identification.[5]

Nonetheless, we notice that even with the same fundamentals, A-H twin shares see some clear differences. For example, the pools of investors in the two markets are different and the transaction costs faced by the two sets of investors are also different. Such differences could raise concerns over our identification strategy. However, we argue that our methodology does not require the two sets of investors to have identical characteristics. Indeed, they can be different in many ways, but the identification strategy remains valid as long as within a narrow window before and after a change in the stamp duty, the characteristics of the pools of investors do not change except for what could be induced by the change in the stamp duty. In addition, different trading schemes could cause some concerns, but we argue that such concern is significantly alleviated in the presence of the same scheme around the events.[6] To further ensure that our results are not driven by any cross-share heterogeneity, we follow Gagnon and Karolyi (2010) in incorporating additional controls to capture differences across A- and H-shares in float size and liquidity. Qualitatively similar results are found for our baseline regression specification.

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[4] Foerster and Karolyi (1999) show evidence of price disparity between American Depositary Receipts and their domestic listings stemming from market segmentation.

[5] In relative terms, changes in Hong Kong stamp duty are significantly lower than the ones in the mainland. In addition, we test whether stamp duty changes in Hong Kong reflect policy responses to changes in mainland China, and find the mainland stamp duty changes to have no predictive power on Hong Kong stamp duty changes, suggesting Hong Kong stamp duty policy is independent from the Mainland's.

[6] The trade execution time is *t*+1 in Mainland China, and *t*+0 in Hong Kong.

The second contribution of the paper is to entertain the possibility that the effect of a given change in transaction taxes on price volatility can depend on the sophistication of the financial market or the level of financial development. The desirability of a Tobin tax is not a yes-or-no judgment, but is context-dependent. In immature or frontier markets, trading tends to be dominated by unsophisticated investors with little basic finance or accounting knowledge and driven by non-fundamental noises. If a Tobin tax has any hope of curbing excessive volatility, one should find it in such markets.[7] On the other hand, in more mature markets, enough investors are sophisticated in terms of understanding the fundamentals, as represented by professional managers from pension funds, mutual funds, and hedge funds. As opponents to the Tobin tax would argue, higher transaction costs could discourage these arguably better informed investors from trading, impeding, or slowing down the process of incorporating fundamental information into financial prices, and thus potentially resulting in higher, not lower, price volatility.

Given the speed of financial development, two decades of the Chinese stock market development resemble two centuries of development of some developed economies on some important dimensions. In particular, institutional investors were negligible in China either in absolute numbers or as a share of market turnover from the founding of the stock exchange in 1990 to the mid-2000s. The Chinese stock market was essentially a frontier market, similar to 40 or so other frontier or early stage emerging markets in the world, where trading was dominated by retail investors with little knowledge of accounting and finance. Since the late 2000s, however, there has been an explosion in the number of institutional investors. By 2012, the share of institutional investors in market capitalization was around 55%,[8] which is comparable to the level in the United States. By 2013, the institutional ownership for stocks in the Financial Times Stock Exchange (FTSE) China Index was 36%, which is higher than in many high-income countries, such as Japan (20%), Germany (34%), France (30%), Australia (24%), and Singapore (19%). This allows us to do something else that is unique in the literature, namely, to check if the effect of higher transaction costs on price volatility changes with a

[7] One critique of the Tobin tax idea is that a higher transaction tax could encourage trading to migrate to a lower taxed market. Capital controls in China make trading migration substantially harder; this also enhances the chance that a Tobin tax could achieve its intended effect.
[8] Calculated from Wind and the China Stock Market & Accounting Research (CSMAR) databases.

shift in market characteristics. With a changing ratio of noise traders and fundamental-based traders, a given change in the stamp duty could produce different effects on price volatility. This evolutionary or regime-dependent perspective can potentially provide a way to reconcile some of the conflicting empirical findings in the literature.

There are two key findings in the paper. First, pooling over the seven discrete changes in the stamp duty, we find a negative relationship between the transaction tax and price volatility, contrary to the influential papers by Jones and Seguin (1997) and Umlauf (1993). We interpret it as evidence that a Tobin tax could achieve its intended objective in an immature market where retail investors dominate. Note that a change in stamp duty could induce a series of spillover effects; the effect we capture in our analyses should reflect a total effect rather than the effect merely due to tax friction.

However, this is not the end of the story. Second, we find that, with a significant presence of institutional investors, the effect of a higher transaction cost is reversed. In particular, for the two most recent changes in transaction costs (a decrease in April 2008, and another decrease in September 2008) when the share of institutional ownership in Chinese stocks was closer to the level in the United States in the early 1970s, higher transaction costs are associated with higher price volatility. Also, across individual stocks, higher transaction costs are more likely to be positively related to volatility for stocks with relatively high institutional trading, but negatively related to volatility for stocks with relatively low or no institutional trading. This result might provide a way to reconcile some of the seemingly contradictory findings in the existing empirical literature.

Note that our interpretation does not require all institutional investors to be fundamental based or all retail investors to be noise traders. We need only a weaker assumption, which is that institutional investors are more likely to be fundamental based than retail investors. This appears highly likely as virtually all portfolio managers in China have an advanced degree in either economics or finance with systematic training in finance and accounting.

The rest of the paper is organized as follows. Section 2 supplies some background information. Section 3 describes the data and descriptive statistics. Sections 4 and 5 provide the statistical analysis. Section 6 concludes.

2. Background information

In this section, we provide two types of background information. First, we briefly review the existing theoretical and empirical literatures, highlighting the design of control and treatment groups as well as the main findings. We then present some basic background about the Chinese and Hong Kong stock exchanges and the seven discrete events of stamp duty changes in Mainland China.

2.1 The battle of ideas in the theory

Proponents and opponents of a Tobin tax have a different market setting in mind in the theories. For proponents (Tobin, 1978 and 1984, Stiglitz, 1989, and Summers and Summers, 1989), there are many non-fundamental based traders in the market whose actions drive a wedge between the market price and the fundamental value of the underlying asset. In that case, an increase in transaction costs, by inducing these traders to trade less, especially to trade less on a short-term basis, can reduce the noise-to-fundamental ratio in market prices.

For opponents to a Tobin tax idea, the effect of transaction tax on volatility is ambiguous and under some scenarios could be positive (see Grundfest, 1990, Grundfest and Shoven, 1991, Edwards, 1993, Schwert and Seguin, 1993, and Kupiec, 1996). The market is occupied by a sufficient number of rational, fundamental traders whose trading could stabilize the market by moving prices towards true underlying values. Noise traders exist, but the impact of their actions is limited by the arbitrage activities of fundamental based traders. An increase in transaction costs would indiscriminately discourage market participation by both types of traders. Any potentially beneficial effects on the financial market from less noise trading could be partially or fully offset by a reduction in trading activities by price-stabilizing, fundamental-based traders. Song and Zhang (2005) refer to such effect as "trader composition effect" by arguing that the net effect of a transaction tax on volatility will depend on the composition of traders. In other words, when a given fundamental trader is discouraged from trading, or when fewer fundamental traders participate, the noise-to-fundamental ratio could rise rather than fall. Note that fewer fundamental-based traders relative to noise traders do not automatically imply an increase in price volatility;[9] it only provides the possibility of an increase in volatility.

De Long, Shleifer, Summers, and Waldmann (1990) show that in the presence of noise traders, when mispricing is persistent (i.e., following an AR(1) process), stock price volatility is proportional to the square of the share of noise traders in the market. That is, the greater the share of noise traders, the higher the price volatility. In that sense, if a higher transaction cost succeeds in reducing the share of noise traders in the market, it can reduce price volatility. Without developing an additional theoretical model, Summers and Summers (1989) state their belief in the effect of transaction costs on price volatility in the following way: "The evidence reviewed above suggests that a significant part of market volatility reflects 'noise trading'—trading on the basis of something other than information about fundamental values. Those who seek to gauge 'market psychology' or to guess how the guesses of others will evolve might be labelled as noise traders. Measures discouraging such noise trading should contribute to reductions in volatility and improve the functioning of speculative markets, as De Long, Shleifer, Summers, and Waldman (1988) have demonstrated. Reductions in noise trading will cause prices to fluctuate less violently about fundamental values, both because there will be less speculative pressure on prices and because speculative pressures will be more easily resisted because risk inherent in irrational noise trade demands will be reduced." Separately, Heaton and Lo (1993) point out that a transaction tax may increase market volatility due to a reduction in market liquidity, which allows a given trade to have a larger price impact.

The ability of rational, fundamental traders to eliminate mispricing caused by noise traders has been called into question by the theory of limits of arbitrage (Shleifer and Vishny, 1997, Shleifer, 2000, and Gromb and Vayanos, 2002). On the one hand, if the limits of arbitrage are caused by risk (both fundamental and non-fundamental) or limited capital, one might think that observed market volatility is excessive and an increase in transaction costs can reduce volatility. On the other hand, if the limits of arbitrage are primarily caused by transaction costs themselves, any additional increase in

[9] In a theoretical model by Vayanos (1998) that features only fundamental traders and no noise traders, the effect of a higher transaction tax on price volatility is ambiguous.

transaction costs could further constrain the capacity of rational traders, and hence lead to a rise in price volatility (see Gromb and Vayanos, 2010, for a recent survey of the literature on limits of arbitrage). We are not aware of theoretical work that formally investigates the net effect of these competing forces in the context of Tobin taxes and financial price volatility.

Overall, the theoretical prediction for the effect of a higher transaction tax on price volatility is not clear cut, which suggests that the matter needs to be settled empirically.

2.2 Existing empirical literature

Our study with unique A-H twin shares as treatment-control pairs contributes to the literature with an improved understanding of the Tobin tax. Only a few studies find empirical evidence supporting the proponent's view of securities transaction taxes (STT). Liu and Zhu (2009) find that commission deregulation in Japan is associated with a statistically and economically significant increase in price volatility, which suggests that imposing higher transaction costs might be feasible to stabilize the market by curbing short-term noise trading. Hanke, et al. (2010) also show evidence to support that a Tobin tax would reduce speculative trading. However, neither study uses a control group that can be said to be the same as the treatment group. Moreover, since more studies[10] find the opposite effect of STT on price volatility, this paper contributes to the literature by providing a potential explanation for the inconsistencies in empirical evidences. Umlauf (1993) studies the volatility impact of the inception and increase of a Swedish tax and finds that volatility significantly increased in response to the introduction of taxes, although stock price levels and turnover declined. Jones and Seguin (1997) find consistent results with Umlauf (1993) that a reduction in transaction costs is associated with a decline in price volatility. They argue that increasing the costs of trading through transaction taxes, increasing margin requirements, or reducing the availability of low-cost substitutes like equity futures could in fact encourage, rather than reduce, the impact of noise traders and volatility. In addition, findings of no significant impact of STT on

[10] See, e.g., Hau (2006), Habemeier and Kirilenko (2001), Lanne and Vesala (2010), Aliber, Chowdhry, and Yan (2003), Chou and Wang (2006), Green, Maggioni, and Murinde (2000), Atkins and Dyl (1997), Westerholm (2003), Baltagi, Li, and Li (2006), and Phylakti and Aristidou (2007).

market volatility cast doubt on STT as an effective policy instrument. Pomeranets and Weaver (2011) examine the multiple changes of New York State Transaction Taxes between 1932 and 1981 and find that such higher taxes reduce trading volume, widen the bid-ask spread, and result in greater price impacts. Roll (1989) uses cross-country data to study the matter and finds that transaction taxes are inversely, but insignificantly, correlated with market volatility. Hu (1998) finds with Asian market data that increases in STT reduce the stock price, but have no significant impact on price volatility or turnover. In addition, some recent papers analyze the introduction of a new financial transaction tax in France on August 1st, 2012, which is a levy of 0.2% (20 basis points (bps)) on the purchase of shares of French companies with a market capitalization of more than one billion euros. They find that the STT has reduced trading volume without significant effect on volatility. (e.g., Capelle-Blancard and Havrylchyk, 2013, Coelho, 2014, Colliard and Hoffmann, 2013).

Lastly, our study has broad implications for other security classes. Several researchers study the question with the housing market instead. Fu, Qian, and Yeung (2016) use the Singapore housing market data and show that prices become less informative and volatility significantly increases in the affected market following the transaction tax increase. Sheffrin and Turner (2001) find a capital gains tax with full loss offset at ordinary tax rates would generate a benefit to households by reducing the volatility of housing returns; however, the effect on the rate of return exceeds the benefits of volatility reduction. Aregger, Brown, and Rossi (2012) show that transaction taxes have no impact on house price growth based on evidence from the variation of tax rates across Swiss cantons, while capital gains taxes exacerbate house price dynamics. Note in all these studies, the treatment and control groups are the same set of housing assets.

As we restrict our attention to domestic securities markets, we ignore international dimensions of the issue. When the trading of a given financial asset can be chosen from a menu of locations, the effect of a Tobin tax can be further limited if coordination across the locations is difficult or infeasible.

2.3 Stamp duties in the Chinese stock market

The history of the stock trading stamp duty in China goes back to the early 1990s, shortly after the establishment of the two stock exchanges in Shenzhen and Shanghai, respectively. While there were three adjustments in the duty during 1990–1992, there was no cross-listed stock at the time. Therefore, these adjustments are not part of our sample.

The stamp duty applies to stock trading by all participants in either the Shanghai or the Shenzhen Stock Exchanges. No investor or form of transaction is exempted from the duty. (China uses a t+1 settlement system, and there is no waiver of stamp duty for buying and selling done within the same day.) When the stamp duty changes, there is generally no gap between announcement and implementation. More precisely, the changes in the duty are generally announced after the closing of a trading day and to be implemented starting from the following trading date.

The stamp duty is regarded by the Chinese Ministry of Finance as a revenue-generating tool. After 1992, the year in which the China Securities Regulatory Commission (CSRC) was established, a surge in the stock market transaction volume made stamp duty a noticeable source of revenue. While at the beginning, the revenue was shared 50–50 between the Chinese Ministry of Finance and local governments, the sharing rule has been adjusted a few times, progressively more in favor of the central government. After 2002, 97% of the stamp duty revenue has been accrued to the central government. The dominance of the revenue consideration makes it plausible that adjustments in the stamp duty are not an endogenous response to changes in stock price volatility.

As shown in Table 1 and Fig. 1, there are seven adjustments in stock trading stamp duty during the sample period. After an increase in stamp duty in 1997, the duty was adjusted downward three times between 1998 and 2007, but raised again in 2007, before two more downward adjustments in 2008.

The historical stamp duty adjustments in the Hong Kong Stock Exchange are also reported in Table 1 (and Fig. 1). Not only is the level of the stamp duty in Hong Kong low, the magnitudes of the adjustments are almost negligible when compared to the A-share market. In any case, the duty stayed at a low constant level of 0.1% of transaction value for buyer and seller after 2001. In our statistical analysis, we ignore the adjustments in the stamp duties in Hong Kong. If the small changes in the Hong Kong duty are not systematically related to the changes in the Mainland,[11] they are essentially noises in our analysis and make it harder for us to find statistically significant effects.

2.4 A short history of institutional investors in China

The Chinese stock market, for much of its 20-plus year history, is known to be dominated by retail investors. Fig. 2 provides a graphical illustration of the evolution of institutional investors in China based on the quarterly institutional holding information from the Wind database. First, Fig. 2a shows the time series of outstanding institutional investors in the Chinese domestic stock market. Next, the two panels in Fig. 2b show the shares of institutional holdings in the Chinese A-share market and the US market, respectively. In 1975, the year of the event studied by Jones and Seguin (1997), the share of institutional holding in the United States reached about 22%. China did not reach this level until 2008. (Both the number of institutional investors and the share of institutional holdings have exploded since 2008, though the stamp duty in the A-share market stayed at a low level of 0.1% that was set in September 2008.)

It is convenient to think of the history of Chinese institutional investors in three stages. First, in an *infant stage* between 1990 and 1997, the financial market is overwhelmingly populated by retail investors, whereas institutional investors were negligible both in number and in trading volume. In the second stage—a *toddler stage* from 1998 to 2005—mutual funds and insurance companies, and to a smaller degree, pension funds and hedge funds, began to emerge in the Chinese stock market. Finally, since 2006, a *growth stage* set in when institutional investors grew at a high speed, eventually catching up with the US level by 2012 in terms of its relative importance in both trading and shareholding.

3. Data

Since the two Chinese stock exchanges were established in 1990 and 1991, respectively, the government has implemented ten adjustments to the stamp duty. The

[11] The correlation in the monthly changes in the stamp duty between the Hong Kong and Mainland Chinese markets is –0.006.

first three took place during 1990–1992, before there were any cross-listed Chinese stocks. As a result, our sample covers the last seven changes in the stamp duties, which took place during 1996–2009. The stamp duty during our sample period was set jointly by the Chinese Ministry of Finance and the China Securities Regulatory Commission, and was always applied to stock trading on both the Shanghai and Shenzhen stock exchanges. The changes in the stamp duty are both listed in Table 1 and graphed in Fig. 1. While there are also independent changes in the stamp duties in Hong Kong, the changes are negligibly small when compared to the changes in the Mainland. The comparison can be most clearly seen in Fig. 1. In this paper, we ignore stamp duty changes in Hong Kong. Because the changes in Hong Kong are not systematically related to those in the Mainland (and are very small anyway), they mainly add noise to our inferences.

Our sample of stocks consists of the universe of 53 Chinese companies that are cross-listed in both Mainland China and Hong Kong. Because the last stamp duty event took place in September 2008, stocks that became cross-listed after 2008 do not make it into our sample. Online Internet Appendix 1 provides a list of these companies in the sample and their initial public offering (IPO) dates on both stock exchanges, sorted by the date they first became cross-listed.

Because the number of cross-listed stocks increases gradually during the sample period, the total number of unique firm-event observations is 223, less than 7×53. Daily information of A- and H-shares comes from the China Securities Market and Accounting Research Database (CSMAR), Reuters Datastream, and the Pacific Basin Capital Market Database (PACAP).

The summary statistics of our sample is reported in Table 2. In Panel A, we first show the mean and median of firm characteristics of our cross-listed sample and the entire A-share market for 1996 and 2008, respectively. Firm financials are obtained from CSMAR and institutional ownership information is from Wind, which reflects the values of the latest annual or quarter filing of the year. A few remarks are in order. First, there is a dramatic growth in market and firm size from 1996 to 2008. Second, for both 1996 and 2008, cross-listed firms are significantly larger than the market average in terms of total assets and sales. Interestingly, we see that cross-listed firms are less profitable than the market average in 1996 in terms of Earnings before interest and taxes (EBIT)/sales and net margin. However, the opposite effect is seen in 2008: cross-listed firms are, on average, more profitable than the market average. Consistently, cross-listed firms have higher leverage than the market average, highlighting their advantage in accessing debt financing. Lastly, besides the dramatic growth in the fraction of ownership held by institutional investors, cross-listed firms are higher on average in terms of institutional holdings, institutional turnover, and the number of institutional investors at the firm level.

Panel B provides the stock characteristics of A- and H-shares, respectively. For a typical cross-listed firm, even though one H-share and one A-share are entitled to the same stream of future cash flows, the H-share is traded at about 50% discount on average (6.4 RMB per unit of H-share versus 13.7 RMB per unit of A-share). This violation of the law of one price suggests that the A and H markets are segmented. Separately, almost all cross-listed firms choose to list more shares on the A-share market (RMB 129 billion per firm on average) than on the H-share market (about RMB 33 billion per firm on average, after converting Hong Kong dollars to RMBs). Although daily transaction volume and price volatility[12] are comparable, the A-share market is more liquid as suggested by the Amihud (2002) illiquidity ratio.

For each cross-listed stock, we compute its separate volatilities, averaged over the entire sample period, in the A and H markets, respectively. Fig. 3 plots the A-share volatility against its H-share counterpart across the 53 stocks. There is a visibly positive correlation between the two, which should not be too surprising.

Table 3 provides the correlation matrix of our key variables pooled over seven events of stamp duty changes and 480 days around each event. The correlation between A-share and H-share returns is 0.50, while the correlation in price volatility between the A and H markets is 0.53.

4. Empirical Results

4.1 Ideas behind the identification

[12] Strictly speaking, what we compute here is stock return volatility, variance of [logP(t)-logP(t-1)]. Because logP(t-1) is pre-determined, variance of the returns can be regarded as a scaled version of variance of the price. We follow the convention of most empirical papers in the literature on a Tobin tax and call it stock price volatility.

Our identification strategy requires an assumption that the A and H markets are segmented. In particular, stock prices on the H-share market do not respond to a change in the stamp duty in the A-share market. This strategy appears reasonable since any given (cross-listed) stock tends to have two different prices in the two markets when converted into a common currency. For example, out of 53 stocks that are cross-listed in the two markets, the average price in the A market (RMB 13.7) is more than twice that in the H market (RMB 6.4). The deviations from the law of one price is also persistent. For example, in 2008, the absolute percentage price differences were 10% or more across all trading days for 37 cross-listed stocks. The persistent price gap suggests that the legal restrictions on cross border trading must be binding in some ways, or the cost of arbitrage must be non-trivial.

We now discuss the idea behind the identification strategy. We assume that the log share price in RMB in the A-share market follows Gordon's Growth Model and can be written as follows:

$$\log(P_{it}^{A}) = \log(D_{it}) + \log(1+g_i) - \log(K_{it}^{A} - g_i) + \log\left(S_{it}^{A}\right), \qquad (1)$$

where D_{it} captures the fundamental component of the stock price, e.g., dividend or earning at time *t*, while g_i is a constant growth rate, and K_{it}^{A} is the discount rate for the A-share stock. Similar to Mei, Scheinkman, and Xiong (2009) and Liu and Seasholes (2013), the last term, S_{it}^{A}, represents a speculative (or non-fundamental) component of the log price variations. S_{it}^{A} is assumed to be a positive random variable with mean of one.

Firm *i*'s corresponding H-share price can be written in a similar format after being converted to RMB:

$$\log(P_{it}^{H,FX}) = \log(D_{it}) + \log(1+g_i) - \log(K_{it}^{H} - g_i) + \log(S_{it}^{H}), \qquad (2)$$

where $\log(P_{it}^{H,FX})$ is the log price of the H-share in RMB, K_{it}^{H} is the discount rate for the company's H-share, while S_{it}^{H} is a random speculative component in the log H-share price with mean of one.

A first-differenced version of (1) and (2) can be written as follows:

$$r_{it}^{A} = p_{it}^{A} - p_{i(t-1)}^{A} = d_{it} - k_{it}^{A} + s_{it}^{A} \qquad (3)$$

$$r_{it}^{H,FX} = p_{it}^{H,FX} - p_{i(t-1)}^{H,FX} = d_{it} - k_{it}^{H} + s_{it}^{H}, \qquad (4)$$

where d_{it} refers to the part of the return due to variations in the fundamentals, i.e., $d_{it} = \log(D_{it}/D_{i(t-1)})$, while s_{it} refers to the part of the return due to variations in the speculative component, i.e., $s_{it}^{A/H} = \log((S_{it}^{A/H})/(S_{i(t-1)}^{A/H}))$. k_{it} refers to the part of the return due to variations in the share specific discount rate, i.e., $k_{it}^{A/H} = \log((K_{it}^{A/H} - g_i)/(K_{i(t-1)}^{A/H} - g_i))$.

To simplify the discussion, we first assume that the discount rate in any given market does not change in the narrow window of time when a stamp duty change occurs, i.e., $k_{it}^{A} = k_{it}^{H} = 0$. (A derivation that takes into account discount rate changes is reported in online Internet Appendix 2.) Hence, the A- and H-share return will become

$$r_{it}^{A} = d_{it} + s_{it}^{A} \tag{5}$$

$$r_{it}^{H,FX} = d_{it} + s_{it}^{H} \; . \tag{6}$$

Next, we assume that the speculative component of the A-share price can be expressed as:

$$s_{it}^{A} = bs_{it}^{H} + \delta_{it}^{A} \; , \tag{7}$$

where b is a parameter describing the relation between the speculative components in the two markets, while δ_{it}^{A} represents the part of the speculative component of the A-share price, which is independent of the H-share's speculative activities, i.e., $cov(\delta_{it}^{A}, s_{it}^{H}) = 0$.

Note that both b and δ_{it}^{A} are functions of the degree of market segmentation q. With perfect integration ($q=0$), because the two markets would then have the same pool of underlying investors, the speculative components of two markets will become identical, $s_{it}^{A} = s_{it}^{H}$. It further implies that $b(q=0) = 1$ and $\delta_{it}^{A}(q=0) = 0$. In contrast, when the two markets are perfectly segmented ($q = 1$), s_{it}^{A} is independent of any speculative activities in the H market, so that $s_{it}^{A} = \delta_{it}^{A}(q=1)$, and $b(q=1) = 0$.

Therefore, the A-share return becomes

$$r_{it}^{A} = d_{it} + bs_{it}^{H} + \delta_{it}^{A} \; . \tag{8}$$

If the speculative component is orthogonal to the fundamental component, the variances for the A- and H-share returns can be written, respectively, as follows:

$$Var(r_{it}^{A}) = Var(d_{it}) + b^2 Var(s_{it}^{H}) + Var(\delta_{it}^{A}) \tag{9}$$

$$Var(r_{it}^{H,FX}) = Var(d_{it}) + Var(s_{it}^{H}) \; . \tag{10}$$

Suppose we define two stages, namely the time period before and after a change in stamp duty. Then, at each stage we can write the relative volatility as

$$Var\left(r_{it}^{A}\right) - Var\left(r_{it}^{H,FX}\right) = Var\left(\delta_{it}^{A}\right) + (b^2 - 1)Var\left(s_{it}^{H}\right) . \quad (11)$$

If a change in the stamp duty in the A-share market (without a corresponding change in the tax in the H-share market) does not alter the speculative component in the H-share market prices, the effect of an increase in the stamp duty in the A market (with no corresponding change in the tax in the H market) on the relative volatility of a given stock can be expressed as follows:

$$\frac{\Delta Var\left(r_{it}^{A}\right) - \Delta Var\left(r_{it}^{H,FX}\right)}{\Delta tax^{A}} = \frac{\Delta Var\left(\delta_{it}^{A}\right)}{\Delta tax^{A}}. \quad (12)$$

This motivates us to pursue the following regression, where t refers to the stage either before or after a stamp duty change:

$$Var(r_{i,t}^{A}) - Var(r_{i,t}^{H,FX}) = \gamma_0 + \gamma_1 High\_Tax_t^{A} + \varepsilon_{i,t} . \quad (13)$$

$High\_Tax_t^{A}$ is a dummy variable, which equals one if it is in the high tax regime of the A market, and zero if in the low tax regime.

Note when the two markets are perfectly integrated, $b = 1$ and $\delta_{it}^{A} = 0$, and $Var(r_{i,t}^{A}) - Var(r_{i,t}^{H,FX}) = 0$. In that case, we would not be able to run the above regression or to identify the effect of a higher stamp duty, which means that our identification requires some market segmentation.

The coefficient γ_1 is generally an inverse function of the degree of integration between the two markets. In other words, the more integrated the two markets are, the smaller the coefficient is.

Deviations from the law of one price in the A- and H- share markets in the data confirm segmentation, which facilitates our estimation. On the other hand, with some segmentation of the two markets, coincidental movements in the fundamentals and stamp duties do not affect the estimation since the part of return variance driven by changes in the fundamentals is netted out in our specification.

This discussion helps to clarify the advantage of our approach over the conventional double differencing strategy. In the conventional approach, the underlying cash flows in the treatment and control groups are not identical. For example, in Jones and Seguin (1997), the NYSE stocks and Nasdaq stocks are the treatment and control groups, respectively. It is possible that the differences in fundamental components of the two groups can change for reasons unrelated to the change in the transaction tax in 1975, such as a change in the oil price. Indeed, the global oil price did change dramatically from the period before the tax change to the year afterwards, and perhaps NYSE and Nasdaq stocks respond differently to a given increase in the oil price.

4.2 Warm-up exercise: price response to stamp duty changes

We start with examining the short-term price response of cross-listed A-H shares around stamp duty changes. As Schwert and Seguin (1993) point out, the effect of a transaction tax on the stock price could go either way. First, suppose imposing a transaction tax could effectively reduce excessive volatility, and thus reduce risk borne by investors, the risk premium of stocks should go down. Since investors now require a lower rate of return and cash flows are now discounted at a lower rate, the share price should go up. In a theoretical model by Vayanos (1998), a higher transaction cost can indeed lead to a higher stock price. On the other hand, a transaction tax could also lower the stock price as transaction costs generally diminish investors' incentive to trade unless the projected profit is higher than the transaction cost. Therefore, it raises investors' required rate of return for trading and puts downward pressure on the stock price. This discussion means that the net effect of higher transaction costs on stock prices depends on the relative strength of the two forces and is theoretically ambiguous.

Interestingly, in spite of the theoretical ambiguity, most empirical studies find a negative price response to stamp duty increases. For example, Umlauf (1993) finds a negative price reaction to increases in the stock transaction tax in Sweden. Specifically, the imposition of a round-trip tax of 1% in 1984 leads to an index return of –2.2% on the announcement date, and a cumulative index return of –5.3% for the 30-day period up to the announcement. The decline in asset price is interpreted as reflecting a greater discounted perpetuity of tax payment. Amihud and Mendelson (1992) show that more liquid stocks exhibit a greater decline in their stock prices after an imposition of a transaction tax. In particular, the introduction of a transaction tax of 0.5% led to a decline in the prices by 18% for an index of liquid stocks, such as Dow Jones Industrial. The percentage decline in stock prices far exceed the size of the transaction tax itself due to the high turnover rate.

To examine this in the context of the stamp duty in China, we adopt an event study approach. We test the 4-day return of A-shares relative to H-shares around each stamp duty change. Specifically, we first test portfolio return differences around A-share market stamp duty changes as follows:

$$r_m^A - r_m^H = \beta_0 + \beta_1 TaxHike_m^A + C_m + \varepsilon_m \ . \quad (14)$$

r_m^A and r_m^H are the portfolio returns of the A- and H-shares over the [–2days, +1day] window around stamp duty change event *m*. To capture the average A-share price response to a stamp duty increase, we introduce $TaxHike_m^A$ in the regression. We define the *TaxHike* variable in one of the two ways. First, we use a binary variable that equals to one for an increase in the stamp duty, and negative one for a decrease in the stamp duty. Second, we adopt a continuous measure of the actual size of the tax increase. In both specifications, $\widehat{\beta_1}$ captures the average price response of A-share portfolios to an increase in the stamp duty.

In addition, C_m refers to a set of additional controls, including the 12-month base interest rate in China, and its difference from the interest rate in Hong Kong. Interest rates are a proxy for discount rates that can affect how cash flows are converted to present values.

The results on price response with respect to stamp duty changes are shown in the first two columns of Table 4. In Column 1, we first use the binary variable for $TaxHike_m^A$ and obtain a significant coefficient of –0.0074, suggesting that an increase in stamp duty is associated with a reduction in the prices by 74 basis points on average. In Column 2, with the continuous measure of the tax increase, the coefficient is still negative, but not statistically significant due to low power.

Low statistical power is a problem with seven data points. Alternatively, we apply Eq. (15) to firm-level returns.

$$r_{m,i}^A = \gamma_0 + \gamma_1 r_{m,i}^H + \gamma_2 TaxHike_m^A + C_m + F + \varepsilon_{m,i} \ . \quad (15)$$

$r_{m,i}^A$ and $r_{m,i}^H$ are the 4-day returns of individual A- and H-shares around stamp duty change event *m*, firm *i*, and $TaxHike_m^A$ also takes the above two forms. Also, F reflects a collection of fixed effects controlled, particularly firm fixed effects in these regressions. $\widehat{\gamma_2}$ captures the average price response of A-shares to an increase in stamp duty.

In Columns 3 and 4, with firm level returns as the observations, the qualitatively similar results to Columns 1 and 2 are obtained. In Column 4, a negative and significant coefficient of –0.0062 indicates that an increase in the stamp duty by 0.1 percentage point is associated with a reduction in the 4-day return by 62 basis points.

Following Umlauf (1993), we can calculate the upper bound of the price impact to stamp duty change as $\frac{Stamp\ duty\ change*Annual\ turnover}{Dividend/Price}$. The calculation gives us an estimated average reduction of 7.7 percentage point (= 0.1%*(0.0055*240)/1.7%)[13] in stock price for an increase in the stamp tax by 0.1 percentage point. Given the average increase in stamp duty at 0.3 percentage point in our sample, this means that one could expect a decline in prices by as high as 23.1 percentage point in principle. Umlauf (1993) argues that this number represents an upper bound as investors probably envisioned tax avoidance and turnover reduction when announcement is made. Indeed, our announcement effect seems to be smaller than this upper bound. As Schwert and Seguin (1993) point out, if a higher stamp duty succeeds in reducing risk, then there is an offsetting effect on the returns.

4.3 Average effect on price volatility

4.3.1. Firm level price volatility

In this subsection, we examine the effect of stamp duty changes on price volatility. For event *m*, the treatment group is the set of A-share stocks in our sample, while the control group consists of their corresponding H-share stocks. Because we can match stocks in the treatment and control groups one-for-one, we can work with firm level data rather than portfolio level data (which is necessary in Jones and Seguin, 1997). We test various model specifications with price volatility of 240 trading days before and after each stamp duty change.[14] Following Jones and Seguin (1997) and most other papers on

[13]The average dividend price ratio over our sample periods is 1.7% (240 days before and after the seven stamp duty changes). Daily turnover rate is 0.0055 over the sample period as shown in Table 2 and it multiplied by 240 gives us an approximate for annual turnover rate.

[14] Ideally, intraday data should be used to compute stock price volatility. However, due to data limitations, we could only use standard deviation of daily return over various windows to proxy for stock volatility. We

this topic, we define volatility by standard deviation. However, we also use variance later as a robustness check and find that this does not affect our inference. We first regress the difference in price volatility between A- and H-shares by the following specification:

$$\Delta\sigma_{m,i,t} = \gamma_0 + \gamma_1 High\_Tax^A_{m,t} + C_{m,t} + F + \varepsilon_{m,i,t} \,. \quad (16)$$

The dependent variable is $\Delta\sigma_{m,i,t}$, which captures the difference between A-share and H-share price volatility for event *m*, firm *i*, and period *t*. In our difference-in-difference setting, *t* reflects the time period before or after a stamp duty change. We use two forms of $\Delta\sigma_{m,i,t}$: $(\sigma^A_{m,i,t} - \sigma^H_{m,i,t})$ and $log(\sigma^A_{m,i,t} / \sigma^H_{m,i,t})$. The first form is the direct difference in volatility between A- and H-shares, whereas the second one is the logarithm ratio. The price volatility is measured as the standard deviation of daily returns over the 240 trading days before and after each stamp duty change. Also, the logarithmic ratio specification does not require the A and H volatility to be on the same scale (though they are reasonably close according to Table 2 Panel B).

For each event, we use the daily return volatility based on daily closing prices during the year before and the year after to construct our sample. This length of the event window follows the choice of Jones and Seguin (1997) to maintain comparability. We have also tried a window of six months and three months before and after each event, and obtained qualitatively similar results.

Using a window of 240 trading days before and after an event, the $High\_Tax^A_{m,t}$ dummy equals to one if a trading day is in the higher stamp duty period, and zero otherwise. There are multiple events with opposite adjustment directions (i.e., increase/decrease). For example, for an upward adjustment in the stamp duty in the A market, the observations after the event date will be classified as with higher tax, and vice versa. Similar to the previous section on stock returns, F refers to a set of fixed effects, including firm fixed effects and event fixed effects, and $C_{m,t}$ refers to a set of additional controls capturing the difference in discount rate in these two markets.

Robust standard errors adjusted for heteroskedasticity are clustered at the firm level in our regressions. As Petersen (2009) points out that a small number of events (cluster<30) could lead to a bias in estimation of the standard errors, one could correct the

also implement measures of price volatility as done by Jones and Seguin (1997), and qualitatively consistent results are found. In addition, robustness regressions are also performed in the sample with different event windows, e.g., six months, nine months, etc.

inference following Cameron, Gelbach, and Miller (2008).[15] Since none of the studies on this topic in the literature clusters standard errors at the event level, we include both event and firm fixed effects, but cluster standard errors at the firm level. We also report results for each of the events separately in a later part of the paper.

We have considered several alternative measures of stock price volatility to ensure robustness. Besides the above two measures, we also compute differences in A- and H-share return variances using a firm's daily returns in the 240 trading days[16] before and after each stamp duty change. In addition, we follow Jones and Seguin (1997) in constructing a portfolio of stocks with daily return volatility measured as fitted daily price volatility.[17] Their specification allows for an arbitrary linear relationship between the price volatility of A- and H-shares. As we will see, our key inference is robust to these different specifications.

Is the reduction in volatility in the high tax regime associated with improved price efficiency? We perform two checks. First, we calculate the variance ratios for 5, 10, and 15 trading days, respectively. More precisely, the variance ratio is defined as VR(n) = $VR(n) = \frac{Var(t,t+\mathrm{n})}{\mathrm{n}Var(t,t+1)} = 1 + n\rho(1)$, where n is the number of trading days and $Var(t, t + \mathrm{n})$ is the variance of the log return from t to t+n. If the log price follows a random walk, the variance ratio should be equal to one. On the other hand, deviations from one in the variance ratio imply deviations from the random walk, indicating predictability of returns or price inefficiency. The results are reported in Panel A of online Internet Appendix 3.

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[15] To correct for a small number of clusters as described in Cameron, Gelbach, and Miller (2008), we follow sample Stata code on wild bootstrap from Doug Miller's website: http://www.econ.ucdavis.edu/faculty/dlmiller/statafiles/. Wild bootstrap is similar to residual sampling, but the sign of the bootstrap residual for each record is randomly reversed. It is useful in the presence of heteroskedastic residuals and small sample sizes.

[16] The average number of trading days in Mainland China exchanges is 245 from 1991 to 2013 and 242 from 2000 to 2013. Hence, we use 240 trading days in our sample to capture the annual trading activities in China.

[17] We follow Jones and Seguin (1997) to first compute raw daily return volatility, which is measured as $\sqrt{\frac{\pi}{2}}\left|R_{m,i,t}\right|$ for event m, stock i, at day t during a window of 240 trading days before and after an event. By multiplying the absolute change in log price with the scaling coefficient, $\sqrt{\pi/2}$, we obtain an unbiased estimator of the standard deviation at the daily frequency (assuming the log price follows a normal distribution). Further, we compute the fitted daily price volatility $\widehat{\sigma_{it}}$ from a 12-lag auto-regression, i.e., $\sigma_{it} = \sum_{n=1}^{12} \sigma_{i,t-n} + \varepsilon_t$, where σ_{it} is the unsigned daily stock return scaled by $\sqrt{\pi/2}$. Jones and Seguin (1997) follow a model specification as $\sigma(A)_{i,t} = \alpha + \beta_{i,t}\sigma(H)_{i,t} + \gamma_{i,t}\sigma(H)_{i,t} * High\,Tax_t + \varepsilon_{i,t}$, which allows an arbitrary relation between A- and H-share return volatility.

We find the variance ratio in the high tax regime to be always closer to one than that in the low tax regime, and the difference is always statistically significant. This is consistent with the interpretation that higher taxes are associated with greater price efficiency in this sample.

Second, we look at the post earnings announcement drift (PEAD) for all A-shares from 2002 to 2014.[18] This accounting-based approach examines market efficiency by looking at the speed at which prices adjust to new information in an event study setting.[19] If the market has become more efficient after imposing a higher tax, there should be faster incorporation of unexpected earning news into stock prices; hence, we would expect to see a reduction in PEAD. We incorporate the absolute level of stamp duty tax at each earnings announcement and report the results in Panel B of online Internet Appendix 3. We find a negative and significant coefficient between the stamp duty level and the standardized unexpected earnings (SUE). The finding suggests that PEAD becomes smaller when the stamp duty increases. It is also consistent with the interpretation that increases in the stamp duty have led to improvement in market efficiency on average.

4.3.1.1. Discussion of the identification strategy

For the identification to be valid, variations in the stamp duty need to be uncorrelated with the error term. Yet, changes in the stamp duty are presumably not purely random. For our purpose, we need them to be exogenous with respect to the relative volatility between the A- and H-share markets. We investigate this issue in two ways.

We use the opportunity of a meeting with a senior official in the China Securities Regulatory Commission, who also happened to be a senior officer of the Shanghai Stock Exchange during 2008–2012, and a senior officer of the Shenzhen Stock Exchange before 2008, to develop an understanding of the determination of stamp duty changes.

[18] The first year in which information on quarterly earnings announcements became available was in 2002.
[19] See Ball and Brown (1968), Beaver (1968), Foster, Olsen, and Shevlin (1984), Bernard and Thomas (1989), Ball and Bartov (1996), Bhushan (1994), and Kothari (2001).

Authors: *"How are the decisions on adjusting the stamp duty made? Do you ever look at the relative volatility between the A- and H-share markets and use it as a guide to decide on the level of the stamp duty?"*

The official: *"The stamp duty is jointly decided by the Ministry of Finance and the CSRC (China Securities Regulatory Commission). We never look at relative stock market volatility. We (at the CSRC and the stock exchanges) always advocate a low stamp duty in order to minimize transaction costs. The Ministry of Finance often wants a higher stamp duty, which is a revenue source for them."*[20]

Authors: *"When would your argument win over the Ministry of Finance?"*

The official: *"Sometimes when the broad market index is low, the Ministry of Finance would consent to lowering the stamp duty. But it doesn't always work."*

Our takeaway from the conversation is that changes in the stamp duty might be endogenous to the level of A-share index, but is unlikely to be endogenous to the relative volatility between the A-share and H-share markets because the latter is not something decision makers pay attention to.

We check this out more formally. In the first column of Table 5 Panel A, changes in the stamp duty are regressed on one lag of A-share market returns. Market return is computed as the return of Shanghai A-share Index. The coefficient on the one-month lag of the market return is positive and significant, suggesting that the policy decision is primarily driven by near-term market performance.

In the second column of Table 5 Panel A, we incorporate both one lag of monthly market return and relative volatility. The coefficients on each of the lag of relative volatility are statistically zero based on individual *t* tests. The finding supports the assumption that the decisions on changing the stamp duty do not consider the relative volatility in the two markets. Again, the regression confirms the previous finding: while the decisions on changing the stamp duty could take into account the recent past of broad

[20] A majority of the stamp duty revenue goes to the Chinese Ministry of Finance, with a small portion going to the two local governments (Shanghai and Shenzhen) that host the two exchanges. The CSRC and the stock exchanges keep a portion of stock account registration fees, but do not derive revenue from the stamp duty.

market return, they do not appear to consider the relative volatility between the Chinese and the Hong Kong stock markets.

In the third and fourth columns of Table 5 Panel A, we include three lags of market return and relative return volatility in the regression. Qualitatively same results are obtained, suggesting that the recent past levels of A-share market returns have predictive power for changes in the stamp duty, whereas relative volatilities play no role in predicting stamp duty changes.

Because there are seven actual changes in the stamp duty, the monthly changes in the stamp duty mostly take on a value of zero. In Panel B of Table 5, we look at a substantially reduced sample consisting of the seven months in which the stamp duty changes actually take place plus the six months around each of the changes. We find the same qualitative results. In particular, the coefficients on the three lags of relative volatility are both individually and jointly zero (by three *t* tests and one *F*-test). This finding is true regardless of the way relative volatility is measured, and regardless of conditioning on lags of broad market return or not. We therefore conclude that changes in the stamp duty do not take into account relative volatility in the two markets.

In Panel C of Table 5, we include additional variables which capture cross-share differences in stock characteristics, and find no predictive power from these variables on stamp duty changes in the A-share market. We will later report a placebo test that further justifies our identification strategy.

4.3.1.2. Regression results

Table 6 reports regression results following Eq. (16). Instead of using raw daily price volatility as separate observations as do Jones and Seguin (1997), we can estimate two daily price volatilities, measured as standard deviation of daily returns, for each firm and event, with one for the 240 trading days before the event and another for the 240 trading days afterwards. Such estimates of daily price volatility should be more precise, although the resulting sample size of the daily price volatility is substantially smaller. In addition, to capture the effect due to fluctuation of exchange rate, H-share price volatility is calculated from daily return that incorporates return from both price fluctuation and exchange rate fluctuation.

We start with estimation without any fixed effects by regressing the difference in daily return volatility between A- and H-shares on the higher tax dummy. Next, in Column 2, we include firm and event fixed effects and obtain a negative and significant coefficient of –0.0070. If we hold the H-share price volatility constant, this suggests a 22% (= 0.0070/0.0330) reduction in the A-share price volatility, on average, after moving from a low-tax regime to a high-tax regime. To ensure that the results are not driven by outlier stocks, we also perform a regression in a subsample where we exclude those stock observations whose A-share price premium over H-share exceeds the 90th percentile. The same qualitative results are found in the subsample, but the point estimate is somewhat smaller.

To alleviate possible contamination in results from events that are close to each other in dates, we also drop the last three events and re-estimate the model in the subsample. With this modification of the sample, the key slope parameter is still negative and the point estimator is bigger in absolute value. In Columns 5 and 6, we shorten the event windows to six months and three months before and after each stamp duty change, respectively. In Column 7, instead of calculating a single number for stock return volatility over the study window, we calculate the monthly daily return volatility for each of the 12 months before and after the stamp duty changes.

In Column 8, we adopt the Fama-MacBeth approach in the subsample excluding stock observations whose A-share price premium over H-share exceeds the 90th percentile. We calculate a monthly volatility of daily returns for the 240 trading days before and after each stamp duty change, and control for Newey-West standard errors. The same qualitative results are found for each of these robustness checks.

In Table 7, we first substitute the dependent variable with the log ratio of A-share return volatility over the H-share volatility (Panel A). Return volatility is measured by the standard deviation of daily return. The coefficient on the higher tax dummy reflects the elasticity of price volatility to tax increases. Consistently negative and significant coefficients are obtained for both the full sample and the subsample. In terms of economic significance, an increase in the stamp duty in our sample is associated with a reduction in price volatility by 26%. Given that the magnitudes of stamp duty adjustments in China are large by international comparison, this means that a relatively large adjustment in the stamp duty yields a relatively small reduction in price volatility. As a robustness check, we substitute the dependent variable with the difference in return variance between A- and H-shares (Panel B). Qualitatively consistent results are found.

Our results remain robust if we calculate stock return volatility in local currency rather than translating to the same currency as in Table 6 and Table 7. It suggests that our findings are not driven by exchange rate movements.

Because stocks in the A-share market cannot be shorted, whereas some of the H-share stocks can, one wonders whether the short-sale constraints compromises the compatibility of the treatment and control groups. Because the Hong Kong Stock Exchange permits short selling for a subset of stocks, we divide the sample into those whose H-shares can be shorted and those whose H-shares cannot. We find quantitatively similar results across the two groups, suggesting the findings do not depend on whether the corresponding H shares can be shorted or not.

4.3.1.3. Robustness

It is important to note several caveats with our identification strategy. In particular, we could fail to fully control for differences in liquidity between the Hong Kong and the Mainland stock markets. In Table 8, we examine whether differences in liquidity levels could also lead to differences in the levels of volatilities between the two markets, and thus weaken the role of H-shares as proper counterfactual for its cross-listed A-share cousins. Building on the baseline regression, we add in measures of ex-ante liquidity level of A- and H-shares, as well as their interaction terms with $High\_Tax_{m,t}^{A}$ dummy. These liquidity measures include the Amihud illiquidity ratio of the A-share, the difference in Amihud illiquidity ratio between A- and H-shares, and the logarithm of free float size of A- relative to H-shares.

The results of these robustness regressions are shown in Table 8. Overall, our baseline results are maintained with these additional controls. First, the results suggest that for those A-shares with lower liquidity ex-ante, increases in stamp duty have a larger impact. Moreover, the differences in liquidity level of sample A- and H-shares do not predict the effects of stamp duty changes.

To further ensure that our results do not reflect spurious correlations, we conduct a placebo test. We do it in two steps. First, we pick a set of fake event days—days on which there are no changes in the stamp duty. Second, we perform regressions similar to Column 1 of Table 6 and see if we falsely conclude that the volatility goes down on the fake event days when there are in fact no increases in the stamp duty.

To pick fake event dates, we make use of the fitted values of regression one in Table 5 Panel A during periods when there is no actual stamp duty change. It includes (1999.01–2000.11), (2002.04–2004.01), and (2005.06–2006.05). There are a total of six dates on which the absolute values of predicted stamp duty changes exceed 0.20 (approximately top and bottom 10%). We use them as fake event months for a stamp duty increase if the predicted values are positive, and fake event months for a stamp duty decrease if the predicted values are negative. To go from the fake event months to fake event dates, we try three possibilities by defining the fake event dates at the beginning, the middle, or the end of the fake event months, respectively. We pool the eight fake events and run three regressions, respectively, by choosing the beginning, middle, and end of a fake event month as the corresponding fake dates. We redo the basic difference-in-differences regressions on these fake events, and report the results in Table 9.

It turns out that the coefficients on the fake higher tax dummy are always not statistically different from zero. This finding is reassuring as we do not obtain a negative coefficient when we are not supposed to. It helps to bolster our confidence that our key results are unlikely to be driven by spurious correlations.

4.4.2. Portfolio level price volatility

Many studies in the existing literature form portfolios to examine the effects of stamp duty. This approach is mostly out of necessity as there is a lack of stock-by-stock correspondence between the treatment and control groups. In comparison, we can have an identical set of firms in both the treatment and control groups. It is an advantage of our approach. Nevertheless, for comparison purposes, we follow Jones and Seguin (1997) and re-estimate the model with portfolio level data. Equally weighted portfolios of the full sample and subsample are estimated.

Table 10 shows the regression results. We examine the portfolio price volatility response to stamp duty changes with two model specifications as in Tables 6 and 7. First, in Columns 1 and 2 of Table 10, we regress the difference in price volatility between A- and H-share on the higher tax dummy and find that both the full sample and the subsample estimations give us similar results as the firm level analyses. In terms of magnitude, the effect is strengthened with the portfolio level data. In Columns 3 and 4, we substitute the dependent variable with the logarithm value of the ratio of daily volatility of A- over H-shares and obtain similar results.

4.4.3. Continuous measure of stamp duty changes

We substitute the dummy variable with a term that captures the relative magnitude of stamp duty adjustments in the following specification:

$$\Delta\sigma_{m,i,t} = \gamma_0 + \gamma_1(change\ in\ stamp\ duty)_{m,t} + C_{m,t} + F + \varepsilon_{m,i,\mathrm{t}}\ , \qquad (17)$$

where $(change\ in\ stamp\ duty)_{m,t}$ is measured as the actual change in percentage points in A-share stamp duty in event *m*.

The results are reported in Table 11 and are qualitatively similar to those in Table 6. A larger increase in the stamp duty is associated with a larger reduction in the volatility.

4.5. Trading volume

We also investigate the impact of stamp duty changes on trading volume. Unlike price volatility, empirical evidence appears to agree that increases in stamp duty reduce trading volume[21] and such reduction can be substantial. For example, Umlauf (1993) shows a 60% drop in trading volume in the Stockholm Exchange after the imposition of a 1% transaction tax. Jackson and O'Donnell (1985) examine the quarterly data in UK and find that one percentage point cut in stamp tax leads to a 70% increase in share turnover. Similarly, Lindgren and Westlund (1990) use Swedish data and find that a one percentage point cut in stamp tax could lead to a 50%—70% decrease in the long run turnover rate. In calibrations of a theoretical model, Vayanos (1998) finds that a small increase in the transaction tax can produce a large drop in trading volume.

In our case, turnover is measured as daily trading volume scaled by market

[21] See Hu (1998),Umlauf (1993), Baltagi (2006), and Schwert and Seguin (1993) for an example.

capitalization, averaged over 240 trading days either immediately before the event date or immediately afterwards. Turnover at the firm level is examined in a difference-in-differences regression model as follows:

$$\Delta Turnover_{m,i,t} = \gamma_0 + \gamma_1 High\_Tax^{A}_{m,t} + C_{m,t} + F + \varepsilon_{m,i,t} . \quad (18)$$

$\Delta Turnover_{m,i,t}$ is the difference in log daily share turnover between A- and H-shares for firm *i* in tax regime *t* in event *m*.

The results are reported in Table 12. A negative sign on the high tax dummy means that the turnover tends to fall when the stamp duty increases. The sign of the effect is consistent with virtually all papers in the existing literature. In Column 1 of Table 12, our results show that an increase in the stamp duty (by approximately 0.3 percentage point on average in the sample) is associated with a reduction in turnover by 55% (during the 240 days after the stamp duty change relative to the 240 days before). The reduction in turnover becomes smaller (by 24%) if we use a narrower time window (30 days after the change in the stamp duty compared to the 30 days prior to the change).

We also compute the change in the turnover for each individual event and plot it against the change in the stamp duty (see Figure 6). We find that the seven data points are either in the upper left quadrant or the lower right quadrant. While we can see some variations in the implied elasticities across the events, the broad conclusions are remarkably robust. First, a decline in the stamp duty is always associated with an increase in the turnover (the upper left quadrant); conversely, an increase in the stamp duty is always associated with a decline in the turnover (lower right quadrant). Second, on average, a bigger change in the stamp duty (in absolute value) is associated with a bigger change in the turnover (in absolute value). These patterns suggest that the negative slope coefficients on the high tax dummy in Table 12 are not driven by outliers but are a robust feature of the data.

5. Market development and evolving effects of transaction costs

We have argued that the effect of a higher transaction cost on price volatility depends on whether the transaction cost drives out more informed fundamental-based traders or more non-fundamental-based noise traders. The negative effect we have found so far could reflect the fact that the young Chinese stock market has been dominated by non-fundamental-based noise traders. We now aim to extract more insight by exploring a possible heterogeneous volatility response both across time periods and across stocks.

As shown in Fig. 2b, there were no institutional shares in the Chinese market in the early part of the sample period, and they remain significantly lower than developed markets until recently. For example, in Jones and Seguin (1997), institutional ownership in the US stock market around the time of commission deregulation in 1975 is about 22%, while for China the number was lower until 2008. If a greater share of institutional trading implies a proportionately smaller role of speculative noise trading, it would be interesting to examine whether the effect of a higher transaction cost on price volatility is reversed in the later part of the sample period.

5.1 Evolution of institutional investors in China

Guided by Fig. 2b, we divide the entire history of the Chinese equity market into three periods of approximately equal length: (1) The *infant stage* (1990–1997)—after the Shanghai and Shenzhen stock exchanges were established in 1990, there were virtually no institutional investors, and the market was almost entirely dominated by retail investors. (2) The *toddler stage* (1998–2005)—institutional investors have emerged though still not significant in trading. Investors became relatively less naive after having experienced several ups and downs in the stock market in the preceding years. (3) The *growth stage* (after 2006)—institutional investors start to grow at a high speed and play a more important role in the Chinese stock market, while some of the retail investors have also become more sophisticated and more exposed to the knowledge of finance and economics. At the same time, the number of stocks has increased dramatically. Fig. 4 provides snapshots of the number of institutional investors and institutional ownership at the firm level in the fourth quarters of 2000 and 2008, respectively. While the exact separating lines among the three periods are somewhat arbitrary, they roughly divide the history of the Chinese equity market (from late 1990 to now) into three stages of equal length, and are meant to capture the evolution of the relative importance of institutional traders in the market.

We implement the same regression specification as in Column 1 of Table 6 for each time period and report the results in Table 13. We first focus our discussions on the ordinary least squares (OLS) coefficients for the higher tax dummy in Columns 1, 3, and 5. Interestingly, we see a negative coefficient for the first two historical periods (1990–1997 and 1998–2005), but a positive coefficient in the more recent period (after 2006). This intriguing pattern of signs is consistent with the notion that in earlier periods when the market is dominated by retail traders, a higher transaction cost reduces price volatility, whereas in the most recent period when institutional investors have started to play a more important role in the market, a higher transaction cost raises price volatility. It is also interesting to note that when we allow the effects to be different in different time periods, the volatility suppressing effect of a higher transaction cost has also become bigger in the earlier periods. The coefficients (–0.0229 and –0.0097, respectively) are bigger than the corresponding ones in Table 6.

In addition, we perform a set of Fama-MacBeth regressions for these two sub-periods and report the results in Columns 2, 4, and 6 of Table 13. The sign patterns are the same as the OLS regressions. While the coefficient for the first subperiod is statistically significant, those for the last two subperiods are not.

The differential effects of a higher stamp duty in the different sub-periods have the potential to explain the difference between our findings and those of the opponents of a Tobin tax in the literature, such as Jones and Seguin (1997). As pointed out earlier, the institutional share in the Chinese financial market in the growth era reached a level similar to that of the US market around the time of the commission deregulation in 1975 as discussed by Jones and Seguin (1997). Therefore, our findings highlight a potentially important role of investor structure in driving the conflicting evidence in the literature.

In addition to looking at three subperiods, we perform separate event studies for each of the seven changes in the stamp duty. Table 14 provides event level evidence from univariate analyses. For the first five events (during 1997–2007), higher transaction costs are associated with lower volatility. However, for the last two events (both of which took place in 2008), the opposite correlation is observed.

The double differencing results at the individual event level are summarized by Fig. 5a and 5b, respectively. Across the seven events, on balance, higher transaction costs and lower volatility go together. This result can be seen from the fact that most of the data points are in either the Northwest or the Southeast quadrants. In addition, on average, larger increases in the stamp duty are associated with larger decreases in the price volatility. However, this average pattern masks some interesting heterogeneity. In particular, the observations for the last two events are different from the other five.

5.2 Institutional share and price volatility

While the results in the previous section are suggestive, we cannot read too much into a data pattern from three time periods. We explore cross-stock heterogeneity in the relative importance of institutional trading. To motivate our specification, let us start with a modified version of the assumption in Eq. (12) for the price volatility of stock *i* in market A and time *t*:

$$Var\left(r_{it}^{A}|\text{Inst}_{i,t}^{A}\right) = Var\left(d_{it}|\text{Inst}_{i,t}^{A}\right) + Var\left(\delta_{it}^{A}|\text{Inst}_{i,t}^{A}\right) + b^{2}Var\left(s_{it}^{H}|\text{Inst}_{i,t}^{A}\right). \quad (19)$$

Eq. (19) considers the degree of institutional trading for each stock. $Var\left(r_{it}^{A}|\ \text{Inst}_{i,t}^{A}\right)$ refers to the return variance conditional on the degree of institutional trading for stock *i* at time *t*. In other words, the price volatility for stock *i* now depends on the relative importance of institutional trading for that stock in the relevant market and time period. The price volatility is still assumed to be the sum of the two components. Importantly, institutional trading affects the price volatility only through its effect on the non-fundamental component.

Similarly, the price volatility in the H market can be expressed as:

$$Var\left(r_{it}^{H,FX}|\text{Inst}_{i,t}^{H}\right) = Var\left(d_{it}|\text{Inst}_{i,t}^{H}\right) + Var\left(s_{it}^{H}|\text{Inst}_{i,t}^{H}\right). \quad (20)$$

Under the assumptions that any factor other than transaction costs affects fundamentals in the A- and H-share markets equally,[22] and that a change in the stamp duty in the A market does not affect $Var\left(s_{it}^{H}|\text{Inst}_{i,t}^{H}\right)$, we have the following expression:

$$\frac{\Delta Var\left(r_{it}^{A}|\text{Inst}_{i,t}^{A}\right) - \Delta Var(r_{it}^{H,FX}|\text{Inst}_{i,t}^{H})}{\Delta tax^{A}} = \frac{\Delta Var\left(\delta_{it}^{A}|\text{Inst}_{i,t}^{A}\right)}{\Delta tax^{A}} \quad (21)$$

We note two things. First, the effect of a change in the stamp duty in the A market on the non-fundamental component of price volatility in the A-share market potentially depends on the relative importance of institutional trading in the A-share market. Second, to identify such an effect, we do not need to know the extent of institutional trading in the

[22] It implies that $Var\left(d_{it}|\text{Inst}_{i,t}^{A}\right) = Var\left(d_{it}|\text{Inst}_{i,t}^{H}\right) = Var(d_{it})$.

H-share market (under the assumption that it doesn't change in the narrow window of a change in the stamp duty in the A-share market).

It motivates us to consider the following regression specification:

$$\Delta\sigma_{m,i,t} = \gamma_0 + \gamma_1 High\_Tax^{A}_{m,t} + \gamma_2 IO_{m,i,t} + \gamma_3 High\_Tax^{A}_{m,t} * IO_{m,i,t} + C_{m,t} + F + \varepsilon_{m,i,t}. \quad (22)$$

$IO_{m,i,t}$ refers to the extent of institutional trading. We use two proxies for institutional trading in the estimations, constructed with institutional ownership level and number of institutional investors.[23] First, we collect from the Wind database information on institutional ownership at the firm level on a quarterly basis. The first available data starts from the second quarter of 1998. For firms without such information, we assign zero institutional ownership at the reporting time. (We also omit firm quarters with missing information as a robustness check.)

Our first measure is institutional turnover, which is the cumulative absolute change in ownership of each institutional investor in the latest quarter prior to each stamp duty change in our sample. Our second measure of the relative importance of institutional investors at the stock-event level is the log(1 + number of institutional investors) following Cornett, et al. (2007).

The results in Table 15 are interesting. While the coefficients on the higher tax dummy are always negative and statistically significant across the regressions, the coefficients on the interaction between institutional ownership and the higher tax dummy are always positive and significant. This finding means that for stock periods with low institutional trading, higher transaction taxes are associated with lower price volatility. However, for stock periods with a sufficiently high level of institutional trading, the opposite association appears—higher transaction costs are now associated with higher, not lower, volatility.

In spite of the extensive studies in the literature on the informational role of institutional investors, empirical evidences remain mixed and inconclusive. One stream of the literature argues that institutional investors are better informed and their trading is

[23] Information on institutional ownership for sample A-shares one quarter prior to the stamp duty changes is obtained from the Wind database.

profitable and strongly predicts future returns.[24] On the other hand, other studies find, typically in developed markets, institutional traders to have no stock-picking skill. Their trades are deviated from fundamentals and in general cannot and do not outperform the market portfolio (net of fees).[25] Note that we do not assume that every single institutional investor is a fundamental investor and every retail investor is a noise investor. Rather, on average, institutional investors are more likely to be aware of fundamentals and its implication for stock prices than retail investors.

5.3 Instrumental variable regressions

In order to mitigate a potential endogeneity issue in variables reflecting institutional trading, we conduct two stage least squares (2SLS) estimations by introducing two sets of instrumental variables (IV). Note that 2SLS can also alleviate concerns about measurement errors of the institutional trading, which is a form of endogeneity. The first set of IVs includes the Amihud illiquidity ratio for A-share stock and the natural logarithm of total asset, while the second set of IVs includes the Amihud illiquidity ratio and a dummy variable which equals to one if a stock is a member of the CSI 300 index, and zero otherwise. Firm size and liquidity are well discussed in the literature as correlated with institutional trading or institutional ownership. In addition, after the CSI 300 was established in April 2005, a growing number of funds have benchmarked to it. We argue that a stock that becomes a member of the CSI 300 would naturally attract more institutional trading.

The 2SLS regressions are pursued in the following way. In the first stage, we regress our measures of institutional trading on the IVs following equation (23)

$$IO_{m,i} = \gamma_0 + \gamma_1 IV_1 + \gamma_2 IV_2 + F + \varepsilon_{m,i} \,. \tag{23}$$

$IO_{m,i}$ refers to the measures of institutional trading as in Table 15, while IV_1 and IV_2 refer to the IVs of each IV set used. Results of the first stage regression are reported in Panel A of Table 16. The predicted values of $IO_{m,i}$ are obtained from the first stage regression and are incorporated into the second stage regressions.

[24] See, e.g., Ke and Petroni (2004), Ke and Ramalingegowda (2005), Ke, Ramalingegowda, and Yu (2006), Nofsinger and Sias (1999), Sias, Starks, and Titman (2006), Chen, Jegadeesh, and Wermers (2000), Daniel, et al. (1997), Baker, et al. (2010), Zhang and Yan (2009), and Baik, Kang, and Kim (2010).

[25] See, e.g., Jensen (1968), Lewellen (2011), Carhart (1997), Gruber (1996), and DeVault, Sias, and Starks (2014).

In the second stage regressions, we follow Eq. (24) to substitute institutional trading measures with predicted values obtained from first stage estimations with instruments.

$$\Delta\sigma_{m,i,t} = \gamma_0 + \gamma_1 High\_Tax^A_{m,t} + \gamma_2 \widehat{IO}_{m,i} + \gamma_3 High\_Tax^A_{m,t} * \widehat{IO}_{m,i} + C_{m,t} + F + \varepsilon_{m,i,t.} \tag{24}$$

Panel B of Table 16 shows the results of 2SLS regressions. Consistent with the OLS regressions, γ_1 is consistently negative and statistically significant across the four regressions. For the interaction terms, regressions show positive and statistically significant coefficients. These results confirm the basic pattern: while higher transaction costs lead to lower volatility for stocks with low institutional investor trading, the reverse is true for stocks with high institutional trading. Based on the point estimates in Column 1, the switching point occurs when the absolute change in the institutional ownership reaches 15%. The switching point can be seen visually in Fig. 7a (which also plots the switching point implied by the OLS estimates for comparison). If we use the point estimates in Column 2, the switching point occurs when the number of institutional investors at the stock level reaches about 20. This can be seen in Fig. 7b. Of course, the switching point estimates should be interpreted with caution as institutional investors are not homogeneous in terms of their size, awareness of fundamentals, and ability.

We conduct tests to check the validity of the instruments, and summarize the test results at the bottom of Panel B of Table 16. First, we perform a Hausman (1978) test of the endogeneity of the regressors. We reject the null that the IV and OLS estimates are the same, suggesting the existence of measurement errors or other types of endogeneity. Second, Hansen's over-identification tests are conducted. In three out of four cases, we cannot reject the null that the IVs and the error term in the main regression are not correlated. In these cases, in a mechanical sense, the instruments appear valid. Lastly, Stock and Yogo (2002) tests of weak IV are performed; we can reject the null of weak IV in three out of four cases.[26]

[26] We note that Scheinkman and Xiong (2003) also suggest a link between transaction costs and price volatility under a combination of no short sell constraint and differential degrees of overconfidence across traders. Their model does not generate the empirical pattern that we show here—a reversal of the effects of higher transaction costs on price volatility as the importance of institutional investors grows.

6. Conclusion

While the effect of a Tobin tax on price volatility is an economically important topic, the existing empirical results in the literature are mixed. This paper makes two useful contributions. In terms of methodology, our use of stocks that are simultaneously listed in two segmented markets allows us to have a control group that has identical corporate fundamentals as the treatment group, and thus a much cleaner control group than any in the existing empirical studies. In terms of the economic message, we allow the effect of a Tobin tax on price volatility to depend on the maturity of the market; this perspective is also unique relative to all existing empirical studies on the topic.

We find evidence that for immature markets, higher transaction costs tend to reduce price volatility. It is intuitive—if the Tobin tax argument has any hope of curbing excessive volatility, one should find it in an immature market where non-fundamental-based trading is prevalent. However, we also find evidence that higher transaction costs tend to increase, rather than decrease, volatility in a more mature market (defined by the relative role of institutional investors). This finding is also intuitive. In such markets, many investors are fundamental based. Higher transaction costs discourage both fundamental-based and noise traders. By impeding timely incorporation of fundamental information into prices, a Tobin tax could backfire. Our findings are not without limitations; we note that the Chinese market have some unique features, such as a short-sale constraint. While our study has shed light on the important topic, future studies are needed to examine the generalizability of our findings.

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Table 1
Historical adjustment of stamp duties on stock trading in China and Hong Kong

Table 1 lists all the historical adjustments of stock trading stamp duty in China (A-share) and Hong Kong (H-share) markets after 1993 when the first cross-listed firm appeared. Unless specified, otherwise stamp duty reported below aggregates the tax rate of both buyer and seller sides.

Date	Activities
Panel A: historical adjustments of stamp duty on stock trading in China	
12-May-97	Trading stamp tax increased from 0.6% to 1.0%
12-Jun-98	Trading stamp tax reduced from 1.0% to 0.8%
16-Nov-01	Trading stamp tax reduced from 0.8% to 0.4%
23-Jan-05	Trading stamp tax reduced from 0.4% to 0.2%
30-May-07	Trading stamp tax increased from 0.2% to 0.6%
24-Apr-08	Trading stamp tax reduced from 0.6% to 0.2%
19-Sep-08	Trading stamp tax for buyer abolished, while stamp tax for seller remains at 0.1%
Panel B: historical adjustments of stamp duty on stock trading in Hong Kong	
1-Apr-98	Trading stamp tax reduced from 0.3% to 0.25%
7-Apr-00	Trading stamp tax reduced from 0.25% to 0.225%
1-Sep-01	Trading stamp tax reduced from 0.225% to 0.2%

Table 2
Summary Statistics

Table 2 reports the summary statistics of sample firms. The sample contains 223 unique firm-event observations from 1997 to 2008. In Panel A, we first provide the mean and median of firm characteristics for our sample stocks and the entire A-share market in 1996 and 2008, respectively. The information is acquired from CSMAR and Wind for the annual filing (December). Inst_own is calculated instructional ownership as a fraction of total number of tradable shares in the reporting period. Inst_turn is measured as the absolute change in the institutional ownership with respect to one quarter prior in the reporting period. Inst_size is total number of institutional investors for each quarter and obtained directly from Wind database. In Panel B, stock characteristics of sample A- and H-shares are reported respectively. For each variable, it takes the average of the daily value over a 480-trading-day period around each stamp duty change. All the value variables are reported in RMB, and for H-shares, we convert the HKD to RMB based on the historical daily exchange rate. H-share return volatility considers volatilities both of daily H-share return and of daily exchange rate between HKD and RMB. Appendix 1 has the details on variable definition.

Panel A: Firm characteristics

	1996		2008	
	Cross-listed Sample	A-share market	Cross-listed sample	A-share market
Currency: RMB	Mean/Median	Mean/Median	Mean/Median	Mean/Median
No. observations	13	602	51	1,712
TA (mil)	5,989/3,244	1,244/ 659	703,067/56,459	9,427/1,959
Sales (mil)	3,041/1,516	632/301	108,805/36,836	4,586/1,191
EBIT/Sales	7.3%/5.4%	14.1%/10.7%	11.5%/5.5%	–1.6%/4.3%
NI/Sales	5.9%/3.9%	12.6%/10.1%	9.2%/4.3%	2.9%/4.7%
Sales_growth	–2.9%/1.2%	8.1%/2.3%	15.7%/17.5%	17.8%/10.0%
Cash/TA	16.7%/19.1%	10.0%/8.0%	11.5%/8.1%	16.0%/12.8%
Debt/TA	6.0%/3.9%	5.1%/2.2%	11.9%/8.6%	5.9%/1.0%
Inst_own	0.0%/0.0%	0.0%/0.0%	35.1%/29.3%	23.2%/17.3%
Inst_turn	0.0%/0.0%	0.0%/0.0%	15.6%/9.2%	7.7%/2.7%
Inst_size	0/0	0/0	62/31	16/6

Panel B: Stock characteristics

Currency: RMB	A-share	H-share
Mkt_Cap (mil)	129,292	32,612
Prc	13.7	6.4
Volume (mil)	282	252
R	0.02%	0.01% (–0.01%)*
V	0.0330	0.0380
T	0.0055	0.0115
Illiq	0.0014	0.0325

* Daily return of H-share calculated with stock price in RMB is reported in parentheses. It is calculated as $r_{i,t}^{H,FX} = (r_{i,t}^{H}+1)\times(r_{i,t}^{FX}+1)-1$

Table 3
Variable correlation matrix

Table 3 provides the correlation matrix of the key variables pooled over seven events of stamp duty changes and 480 days around each event. First, for volatility, return and turnover, we calculate or average over a window of 480 trading days around (240 trading days before and 240 trading days after) each stamp duty change. In particular, *V(A)* and *V(H)* are volatility of A- and H-shares calculated as standard deviation of daily return over 480 trading days around each stamp duty change. *R(A)* and *R(H)* refer to average daily stock return, and *T(A)* and *T(H)* refer to the average daily share turnover over the same window. *R(H)* and *V(H)* also consider the effect of exchange rate change. Second, other variables are calculated using values prior to each stamp duty change. *Inst_own* refers to the institutional ownership obtained in the latest quarter prior to each stamp duty change. For the sample A-shares, *Inst_turn* refers to the summation of the absolute value of changes in ownership of each institutional investor in the latest quarter prior to stamp duty changes relative to one quarter before. *Inst_size* is the number of institutional investors for each sample firm in the latest quarter prior to each stamp duty change. *I_STT* is the initial level of stamp duty in the A-share market prior to each stamp duty change, while *ΔSTT* refers to the change in stamp duty for each stamp duty change. Lastly, *Rf* in China and HK are monthly rates reflecting the 12-month base rates average over 480 trading days around each stamp duty change, while *FX* refers to the average value of HKD:RMB over the same window. Details on the variable definition can be found in Appendix 1.

	V(A)	V(H)	R(A)	R(H)	T(A)	T(H)	Inst_own	Inst_turn	Inst_size	I_STT	ΔSTT	Rf_cn	Rf_hk	FX
V(A)	1													
V(H)	0.53	1												
R(A)	0.31	–0.09	1											
R(H)	–0.14	–0.36	0.50	1										
T(A)	0.61	0.23	0.29	–0.10	1									
T(H)	0.23	0.36	0.13	0.05	0.09	1								
Inst_own	0.15	–0.15	–0.02	0.17	–0.03	0.18	1							
Inst_turn	0.12	–0.11	0.02	0.16	0.02	0.20	0.73	1						
Inst_size	0.03	–0.10	–0.09	0.09	–0.05	0.18	0.63	0.62	1					
I_STT	–0.33	0.35	–0.26	–0.27	–0.30	–0.04	–0.37	–0.39	–0.36	1				
ΔSTT	0.20	–0.14	0.61	0.21	0.16	0.02	–0.11	0.00	–0.04	–0.55	1			
Rf_cn	0.01	0.38	0.05	–0.43	–0.11	–0.03	–0.31	–0.27	–0.21	0.40	0.33	1		
Rf_hk	–0.12	0.03	0.55	0.11	–0.08	0.00	–0.43	–0.35	–0.43	0.32	0.56	0.55	1	
FX	0.61	0.20	–0.09	–0.11	0.38	0.12	0.41	0.33	0.36	–0.51	–0.13	–0.43	–0.66	1

Table 4
Price response to stamp duty changes

This table reports the price reaction of sample shares to the announcement of stamp duty changes. In Column 1 and 2, we follow the specification as $r_m^A - r_m^H = \beta_0 + \beta_1 TaxHike_m^A + C_m + \varepsilon_m$, where the dependent variable is the portfolio return difference between A-shares and H-shares over the [+2days, +1day] window around each stamp duty change. We construct equally weighted portfolios with sample A and H shares around each event respectively. In Column 3 and 4, firm-level returns are examined as $r_{m,i}^A = \gamma_0 + \gamma_1 r_{m,i}^H + \gamma_2 TaxHike_m^A + C_m + F + \varepsilon_{m,i}$. The dependent variable is return of A-shares over the [+2day, +1day] window around each stamp duty change, while H-share return serves as a control in the regression. Main independent variable *TaxHike* takes two forms: (1) *TaxHike (dummy)* is a binary variable which equals +1 if it's a tax increase, and equals –1 if it's a tax reduction, and (2) *TaxHike (value)* is a continuous measure of the actual increase in stamp tax and its unit is 10 basis point. Firm fixed effects are controlled in some of the specifications. In addition, we control the 12-month base interest rate for China and its difference from Hong Kong's. Robust standard errors adjusted for heteroskedasticity are reported in parentheses. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are omitted in reporting.

	(1)	(2)	(3)	(4)
Variables	R(A)-R(H)		R(A)	
TaxHike (dummy)	*–0.0074***		*–0.0142*	
	(0.0017)		(0.0093)	
TaxHike (value)		*–0.0036*		*–0.0062***
		(0.0018)		(0.0025)
R(H)			0.6956***	0.6860***
			(0.0993)	(0.0995)
Rf_cn	–0.1139	0.1015	0.2770	0.5803
	(0.4966)	(0.3395)	(0.5899)	(0.5979)
ΔRf (cn–hk)	2.6872***	2.4955***	0.9776	0.6762
	(0.3936)	(0.2677)	(0.6172)	(0.5979)
Observations	7	7	223	223
Firm fixed effects	N/A	N/A	Yes	Yes
Adj. R-square	0.84	0.87	0.42	0.43

Table 5
Determinants of stamp duty changes

This table examines potential endogeneity stamp duty changes. Dependent variable is the monthly change in stamp duty in the A-share market from Apr. 1996 to Dec. 2009. In Panel A, the regressors include lags of A-share market returns, and lags of difference in relative return volatility. In Panel B, the sample is restricted to the seven months in which the stamp duty changes actually take place plus the three months each before and after each change. In Panel C, additional controls such as *AH_Prem*, *float(A)/float(H)*, and *T(A)/T(H)* are included in the regressions. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are included in the regressions, but omitted in reporting.

Panel A: Over period of 1996/04-2009/12

	ΔSTT_t (1996/04–2009/12)			
Variables	(1)	(2)	(3)	(4)
$R(MKT)_{t-1}$	1.95***	1.97***	1.73***	1.77***
	(0.57)	(0.57)	(0.58)	(0.58)
$R(MKT)_{t-2}$			0.75	0.78
			(0.57)	(0.58)
$R(MKT)_{t-3}$			0.87	0.86
			(0.58)	(0.59)
$[V(A)–V(H)]_{t-1}$		–0.60		–4.81
		(2.66)		(3.37)
$[V(A)–V(H)]_{t-2}$				2.87
				(3.70)
$[V(A)–V(H)]_{t-3}$				2.68
				(3.32)
Observations	166	166	164	164
Adj. R-squared	0.06	0.06	0.07	0.07
F-test (market return lags jointly = 0)	*11.88****	*11.80****	*5.38****	*5.28****
F-test (volatility lags jointly = 0)		*0.05*		*0.93*

Panel B: Months around actual event month

	ΔSTT_t (3 months before and after each real stamp duty change)			
Variables	(1)	(2)	(3)	(4)
$R(MKT)_{t-1}$	5.12***	5.25***	4.54**	4.58**
	(1.69)	(1.76)	(1.80)	(1.86)
$R(MKT)_{t-2}$			1.68	1.64
			(1.62)	(1.66)
$R(MKT)_{t-3}$			1.44	1.73
			(1.80)	(1.85)
$[V(A)–V(H)]_{t-1}$		–3.14		–12.97
		(9.71)		(11.48)
$[V(A)–V(H)]_{t-2}$				5.08
				(9.84)
$[V(A)–V(H)]_{t-3}$				6.96
				(9.19)
Observations	47	47	47	47
Adj. R-squared	0.15	0.13	0.15	0.13

F-test (market return lags jointly = 0)	*9.18****	*8.96****	*3.74***	*3.55***
F-test (volatility lags jointly = 0)		*0.10*		*0.65*

Panel C: Additional cross-market features

	ΔSTT_t (1996/04–2009/12)			
Variables	(1)	(2)	(3)	(4)
$R(MKT)_{t-1}$	1.69***	1.71***	1.84***	1.86***
	(0.59)	(0.58)	(0.61)	(0.63)
$R(MKT)_{t-2}$	0.64	0.74	0.63	0.53
	(0.59)	(0.57)	(0.59)	(0.63)
$R(MKT)_{t-3}$	0.80	0.89	0.67	0.49
	(0.60)	(0.59)	(0.61)	(0.64)
AH_Prem_{t-1}	0.55			–0.03
	(1.37)			(1.74)
AH_Prem_{t-2}	0.43			1.68
	(2.05)			(2.65)
AH_Prem_{t-3}	–0.99			–1.59
	(1.37)			(1.75)
$[float(A)/float(H)]_{t-1}$		0.10		0.20
		(0.17)		(0.22)
$[float(A)/float(H)]_{t-2}$		–0.16		–0.40
		(0.27)		(0.35)
$[float(A)/float(H)]_{t-3}$		0.04		0.17
		(0.17)		(0.22)
$[T(A)/T(H)]_{t-1}$			–0.01	–0.01
			(0.01)	(0.01)
$[T(A)/T(H)]_{t-2}$			0.01	0.01
			(0.01)	(0.01)
$[T(A)/T(H)]_{t-3}$			0.01	0.01
			(0.01)	(0.01)
Observations	164	164	164	164
Adj. R-square	0.06	0.06	0.07	0.05

Table 6

Stamp duties and stock price volatility

The table below examines the effects of stamp duty changes on price volatility. The model specification is $\Delta\sigma_{m,i,t} = \gamma_0 + \gamma_1 High\_tax^A_{m,t} + C_{m,t} + F + \varepsilon_{m,i,t}$. Dependent variable is stock return volatility of A-share minus its corresponding H-share's and the key independent variable is *HIGH_TAX*, which equals to one if the observation is in the high tax regime, and zero otherwise. In Column 1, daily return volatility is calculated as the standard deviation of daily return over 240 trading days (1 year contains 240 trading days on average in China) before and after stamp duty changes respectively. In Column 2, firm and event fixed effects are controlled for. In Column 3, daily observations are dropped if the A-share price premium over H-share exceeds the 90th percentile. In Column 4, the last three events are dropped. In Columns 5 and 6, stock return volatilities are calculated over three- and six-month windows, respectively. In Column 7, monthly return volatility is computed over 20 daily returns before and after each event. In Column 8, the Fama-MacBeth method and Newey-West standard errors are applied to the subsample in Column 3. In all Columns except for otherwise noted, V(H) is exchange rate included volatility in the H-share market. Robust standard errors corrected for heteroskedasticity and clustered at firm level are reported in parentheses. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels. Constant terms are omitted in reporting.

	V(A)–V(H), where volatility is measured by standard deviation of returns							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Full sample	Full sample	Subsample	Excl. last 3 events	Full sample	Full sample	Full sample	Fama-MacBeth subsample
HIGH_TAX	*–0.0027****	*–0.0070****	*–0.0058****	*–0.0177****	*–0.0074****	*–0.0057****	*–0.0054****	*–0.0068**
	(0.0008)	(0.0010)	(0.0009)	(0.0010)	(0.0009)	(0.0008)	(0.0009)	(0.0039)
Rf_cn	–0.0499**	0.5409***	0.8118***	0.1199	1.1251***	1.8226***	0.4096***	–0.2830**
	(0.0231)	(0.0465)	(0.1209)	(0.0809)	(0.0764)	(0.1305)	(0.0333)	(0.1253)
ΔRf (cn-hk)	–0.1472***	–0.2701***	–0.2638***	0.2646***	–0.4784***	–0.6475***	–0.1781***	–0.0081
	(0.0279)	(0.0232)	(0.0262)	(0.0563)	(0.0466)	(0.0721)	(0.0173)	(0.1282)
Estimated over	1 year	1 year	1 year	1 year	6 months	3 months	monthly	monthly
Observations	446	446	392	158	446	446	5,091	4,479
Firm fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Event fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Newey-West standard error	No	No	No	No	No	No	No	Yes
Standard error cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	N/A
Adj. R-square	0.10	0.54	0.58	0.82	0.53	0.53	0.23	0.29*

* Average R-square are reported for the Fama-MacBeth regression in Column 8.

Table 7

Alternative specification

This table follows similar specifications as in Table 6, but changes the dependent variable to two alternative measures of relative volatility: Panel A uses the ratio of log return volatility of A-share over that of H-share, where the return volatility is measured as the standard deviation of daily returns over the 240 trading days before and after a stamp duty change; Panel B uses the difference between the variance of A-share and that of H-share daily returns. See the notes to Table 6 for other information.

Panel A

	Log(V(A)/V(H)), where volatility is measured by standard deviation of returns							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Full sample	Full sample	Subsample	Excl. last 3 events	Full sample	Full sample	Full sample	Fama-MacBeth Subsample
HIGH_TAX	*–0.1219****	*–0.2595****	*–0.2312****	*–0.5525****	*–0.2358****	*–0.1899****	*–0.2505****	*–0.2817***
	(0.0214)	(0.0266)	(0.0263)	(0.0293)	(0.0259)	(0.0251)	(0.0344)	(0.1309)
Rf_cn	0.0412	18.8731***	25.6975***	8.8553***	29.3268***	41.3331***	18.0195***	–8.0778*
	(0.7027)	(1.5578)	(2.8225)	(2.5459)	(2.3761)	(3.8037)	(1.3701)	(4.1318)
ΔRf (cn–hk)	–4.6295***	–8.6622***	–8.6514***	4.5417**	–13.9368***	–14.4019***	–6.6171***	0.2784
	(0.9448)	(0.7662)	(0.8023)	(1.7590)	(1.6204)	(2.1759)	(0.7260)	(4.3919)
Estimated over	1 year	1 year	1 year	1 year	6 months	3 months	monthly	monthly
Observations	446	446	392	158	446	446	5,090	4,478
Firm fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Event fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Newey-West standard error	No	No	No	No	No	No	No	Yes
Standard error cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	N/A
Adj. R-square	0.09	0.57	0.59	0.83	0.54	0.49	0.26	0.23*

* Average R-square are reported for the Fama-MacBeth regression.

Panel B

	V(A)–V(H), where volatility is measured by variance of daily returns							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Full sample	Full sample	Subsample	Excl. last 3 events	Full sample	Full sample	Full sample	Fama-MacBeth subsample
HIGH_TAX	*–0.0001**	*–0.0004****	*–0.0003****	*–0.0012****	*–0.0005****	*–0.0004****	*–0.0003****	*–0.0005**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0003)
Rf_cn	–0.0071***	0.0323***	0.0550***	–0.0029	0.0933***	0.1723***	0.0184***	–0.0224**
	(0.0018)	(0.0032)	(0.0108)	(0.0060)	(0.0061)	(0.0121)	(0.0025)	(0.0099)
ΔRf(cn-hk)	–0.0105***	–0.0188***	–0.0179***	0.0251***	–0.0373***	–0.0692***	–0.0129***	–0.0039
	(0.0019)	(0.0018)	(0.0021)	(0.0043)	(0.0036)	(0.0071)	(0.0014)	(0.0098)
Estimated over	1 year	1 year	1 year	1 year	6 months	3 months	monthly	monthly
Observations	446	446	392	158	446	446	5,091	4,479
Firm fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Event fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Newey-West standard error	No	No	No	No	No	No	No	Yes
Standard error cluster	Firm	Firm	Firm	Firm	Firm	Firm	Firm	N/A
Adj. R-square	0.13	0.50	0.54	0.77	0.48	0.55	0.17	0.29*

* Average R-square are reported for the Fama-MacBeth regression.

Table 8
Robustness regressions
The baseline specification (as in Table 6 column 2) is augmented with additional controls: the Amihud illiquidity ratio for A- and H-shares, and the free float market capital of A-shares over the value of their corresponding H-shares before each stamp duty change. ***, **, and * indicate statistically significant at the 1%, 5%, and 10% levels, respectively. Constant terms are included in the regressions, but omitted in reporting.

	V(A)–V(H)				
VARIABLES	(1)	(2)	(3)	(4)	(5)
HIGH_TAX	*–0.0070****	*–0.0042****	*–0.0070****	*–0.0075****	*–0.0045****
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0012)
Illiq(A)	–0.1056	0.5912**			0.5392**
	(0.1357)	(0.2508)			(0.2490)
HIGH_TAX Illiq (A)*		*–1.4024****			*–1.3613****
		(0.3562)			(0.3629)
ΔIlliq (A–H)	–0.0011	–0.0078*			–0.0085*
	(0.0025)	(0.0042)			(0.0043)
HIGH_TAX Δ Illiq (A–H)*		*0.0135*			*0.0114*
		(0.0112)			(0.0114)
Ln(Float(A)/Float(H))			0.0007	0.0007	0.0007
			(0.0012)	(0.0012)	(0.0012)
HIGH_TAX Ln(Float(A)/Float(H))*			*–0.0012*	*–0.0001*	*–0.0011*
			(0.0008)	(0.0010)	(0.0010)
Ln(Float(A))				–0.0022**	–0.0008
				(0.0009)	(0.0009)
Rf_cn	0.5410***	0.5861***	0.5405***	0.5660***	0.5920***
	(0.0468)	(0.0561)	(0.0464)	(0.0481)	(0.0550)
ΔRf(cn–hk)	–0.2701***	–0.2149***	–0.2701***	–0.2876***	–0.2240***
	(0.0232)	(0.0306)	(0.0231)	(0.0235)	(0.0315)
Observations	446	446	446	446	446
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Event fixed effects	Yes	Yes	Yes	Yes	Yes
Standard error cluster	Firm	Firm	Firm	Firm	Firm
Adj. R-square	0.54	0.59	0.54	0.55	0.59

Table 9

Placebo regressions

The table reports placebo regressions with fake event dates predicted from Table 5 Panel A Column 1. Specifically, we pick fake event dates based on the predicted value of the regression (i.e., whose absolute value is above 0.20—approximately top and bottom 10%—as the potential pool for fake event dates). We require that included the periods around the fake events do not include any actual events. This yields (1999.01–2000.11), (2002.04–2004.01), and (2005.06–2006.05). For each selected fake event month, we choose the beginning, middle, and end of the month to generate three sets of fake event dates. For each set of fake dates, we pool the events and run the regression as in Column 2 of Table 6. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are omitted in reporting.

	V(A)–V(H)		
Variables	Beginning of month	Middle of month	End of month
HIGH_TAX	*–0.0002*	*–0.0055*	*–0.0024*
	(0.0019)	(0.0065)	(0.0030)
Rf_cn	–0.3635*	–1.0205	–0.5460
	(0.1877)	(0.7918)	(0.3622)
ΔRf(cn–hk)	0.0403	0.3745	0.1428
	(0.1744)	(0.4140)	(0.2040)
Observations	266	268	268
Firm fixed effects	Yes	Yes	Yes
Event fixed effects	Yes	Yes	Yes
Standard error cluster	Firm	Firm	Firm
Adj. R-square	0.29	0.10	0.24

Table 10

Portfolio price volatility

Following Jones and Seguin (1997), equally weighted portfolios and daily price volatilities in 240 trading days before and after each stamp duty change are used for regressions. Robust standard errors adjusted for heteroskedasticity and autocorrelation are reported in parentheses. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are omitted in reporting.

	V(A)–V(H)		Log(V(A)/V(H))	
	Full sample	Subsample	Full sample	Subsample
Variables	(1)	(2)	(3)	(4)
HIGH_TAX	*–0.0116****	*–0.2025****	*–0.0110****	*–0.1863****
	(0.0016)	(0.0233)	(0.0016)	(0.0226)
Rf_cn	0.3626***	8.1488***	0.4584***	9.5940***
	(0.1085)	(1.4954)	(0.1072)	(1.4007)
ΔRf(cn–hk)	–0.2076***	–3.7206***	–0.2157***	–3.7377***
	(0.0484)	(0.6892)	(0.0475)	(0.6729)
Observations	3,356	3,356	3,356	3,321
Month fixed effects	Yes	Yes	Yes	Yes
Event fixed effects	Yes	Yes	Yes	Yes
Adj. R-square	0.09	0.21	0.11	0.26

Table 11
Effect of stamp duty change (actual values in percentage point)
Instead of a dummy for a high-tax regime, changes in the actual values of the stamp duty (in percentage point) are used. Robust standard errors adjusted for heteroscedasticity, and firm level clustering are reported in parentheses. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are omitted in reporting.

	V(A)–V(H)			
Variables	Full sample	Subsample	Excl. last 3 events	Full sample
Change in stamp duty	*–0.0217****	*–0.0155****	*–0.0592****	*–0.0261****
	(0.0031)	(0.0029)	(0.0034)	(0.0028)
Rf_cn	0.4109***	0.6406***	0.2232**	0.9046***
	(0.0362)	(0.0986)	(0.0810)	(0.0581)
ΔRf(cn–hk)	–0.2571***	–0.2456***	–0.0323	–0.4797***
	(0.0201)	(0.0247)	(0.0574)	(0.0414)
Observations	446	392	158	446
Firm fixed effects	Yes	Yes	Yes	Yes
Event fixed effects	Yes	Yes	Yes	Yes
Estimated over	1 year	1 year	1 year	6 month
Standard error cluster	Firm	Firm	Firm	Firm
Adj. R-square	0.56	0.58	0.83	0.57

Table 12
Effects of transaction costs on share turnover
Daily share turnover is calculated as $\frac{Volume_{m,i,t}}{Total\ share\ outstanding_{m,i,t}}$ for event *m*, stock *i*, at day *t*, and dependent variable is the log ratio of A-share's daily turnover over that of H-shares. The subsample in Column 2 excludes potential outliers with price(A-share)/price(H-share) above the 90th percentile. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are omitted in reporting.

	Log(T(A)/T(H))			
Variables	Full sample	Subsample	Full sample	Full sample
HIGH_TAX	*–0.5463****	*–0.5207****	*–0.4196****	*–0.2384****
	(0.0553)	(0.0571)	(0.0542)	(0.0559)
Rf_cn	11.9712**	30.1697***	48.3133***	75.4450***
	(5.4937)	(5.3737)	(9.0224)	(16.5534)
ΔRf(cn–hk)	–4.7934**	–3.9414**	–7.2766	2.4721
	(1.8040)	(1.7150)	(5.9913)	(5.9127)
Estimated over	1 year	1 year	60 trading days	30 trading days
Observations	446	392	446	446
Firm fixed effects	Yes	Yes	Yes	Yes
Event fixed effects	Yes	Yes	Yes	Yes
Standard error cluster	Firm	Firm	Firm	Firm
Adj. R-square	0.75	0.82	0.73	0.71

Table 13
Effects of stamp duties on price volatility over time
We divide the history of the Chinese stock market into three approximately equally spaced sub periods: 1990–1997, 1998–2005, and post-2006 period. Two types of regressions are tested: (1) OLS regression; and (2) Fama-MacBeth regression. As the number of cross-listed sample firms in the early stages is small, in the OLS regressions, we follow Cameron, Gelbach, and Miller (2008) and use wild bootstrap to correct the inferences with a small number of clusters. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are included in the regressions, but omitted in the reporting.

	V(A)–V(H)					
	Infant stage (1990–1997)		Toddler stage (1998–2005)		Growth stage (after 2006)	
VARIABLES	OLS	Fama-MacBeth	OLS	Fama-MacBeth	OLS	Fama-MacBeth
HIGH_TAX	*–0.0229****	*–0.0145***	*–0.0097****	*–0.0043*	*0.0011**	*0.0180*
	(0.0018)	(0.0065)	(0.0009)	(0.0093)	(0.0006)	(0.0207)
Rf_cn	–2.0574*	0.0000	–0.3971***	–9.1742	0.4633***	–2.5396
	(1.1604)	(0.0000)	(0.0404)	(18.6974)	(0.0570)	(1.6790)
ΔRf(cn–hk)	1.9194**	–3.8452	0.2994***	0.2647	–0.1515***	–0.2510
	(0.7919)	(3.9353)	(0.0284)	(1.0298)	(0.0155)	(0.4453)
Observations	348	348	1,460	1,460	3,283	3,283
Standard error cluster	Firm	N/A	Firm	N/A	Firm	N/A
Newey-West standard error	N/A	Yes	N/A	Yes	N/A	Yes
Adj. R-square*	0.41	0.24	0.22	0.49	0.12	0.27

* Average R-square are reported for the Fama-MacBeth regression.

Table 14
Separate estimates by event
Changes in price volatility, share turnover, and price levels over 240 trading days before and after each stamp duty change are reported. ***, **, and * indicate significance of t-statistics at 1%, 5%, and 10% levels, respectively.

Event date	Stamp duty change direction	Cross-listed firms	Δ V(A)– Δ V(H)	Δ Log(V(A)/V(H))	Δ T(A)– Δ T(H)	Δ R(A)– Δ R(H)
12-May-97	+	13	–0.0318***	–0.8350***	–0.0124***	0.0041***
12-Jun-98	–	16	0.0066***	0.1020**	0.0077***	–0.0060***
16-Nov-01	–	21	0.0186***	0.5484***	0.0094***	0.0039***
23-Jan-05	–	29	0.0109***	0.4507***	0.0034***	0.0011***
30-May-07	+	42	–0.0022*	–0.1229***	–0.0033***	–0.0034***
24-Apr-08	–	51	–0.0066***	–0.1676***	0.0013*	0.0012***
19-Sep-08	–	51	–0.0115***	–0.3010***	0.0013**	0.0005

Table 15
Institutional shares and price volatility
We report the OLS estimates on the role of institutional trading for the stock volatility response to stamp duty changes. We follow $\Delta\sigma_{m,i,t} = \gamma_0 + \gamma_1 High\_Tax^A_{m,t} + \gamma_2 IO_{m,i} + \gamma_3 High\_Tax^A_{m,t} * IO_{m,i} + C_{m,t} + F + \varepsilon_{m,i,t}$ to examine the effect of institutional trading on volatility response to stamp duty changes. *Inst_turn* equals to the sum of the absolute value of the change in ownership of each institutional investor for sample A-shares in the latest quarter prior to each stamp duty change. *Inst_size* is calculated as Ln(number of institutional investors+1) in A-share stocks a quarter prior to stamp duty changes. Firm and event fixed effects are controlled, and robust standard errors adjusted for heteroskedasticity and firm level clustering are reported in parentheses. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are omitted in reporting.

	V(A)–V(H)		Log(V(A)/V(H))	
Variables	(1)	(2)	(3)	(4)
HIGH_TAX	*–0.0098****	*–0.0162****	*–0.3225****	*–0.4820****
	(0.0013)	(0.0015)	(0.0338)	(0.0405)
Inst_turn	–0.0159***		–0.3323**	
	(0.0046)		(0.1418)	
Inst_turn HIGH_TAX*	*0.0291****		*0.6566****	
	(0.0078)		(0.2067)	
Inst_size		–0.0032***		–0.0752***
		(0.0005)		(0.0217)
Inst_size HIGH_TAX*		*0.0046****		*0.1113****
		(0.0006)		(0.0160)
Rf_cn	0.5460***	0.5588***	18.9877***	19.3070***
	(0.0470)	(0.0529)	(1.5777)	(1.7080)
ΔRf(cn–hk)	–0.2539***	–0.1993***	–8.2963***	–6.9343***
	(0.0254)	(0.0264)	(0.8322)	(0.8543)
Observations	446	446	446	446
Firm fixed effects	Yes	Yes	Yes	Yes
Event fixed effects	Yes	Yes	Yes	Yes
Standard error cluster	Firm	Firm	Firm	Firm
Adj. R-squared	0.58	0.68	0.59	0.66

Table 16
Instrumental variable estimates
Two sets of instruments are used. The first set of IVs includes the Amihud illiquidity ratio for A-share stock and log total asset; the second set of IVs includes the Amihud illiquidity ratio for A-share stock and a dummy variable for stocks that are members of the CSI 300 index. The first stage estimation follows $IO_{m,i} = \gamma_0 + \gamma_1 IV_1 + \gamma_2 IV_2 + F + \varepsilon_{m,i}$. In Panel A, we report results of the first stage regression. In the second stage, we estimate $\Delta\sigma_{m,i,t} = \gamma_0 + \gamma_1 High\_Tax^A_{m,t} + \gamma_2 \widehat{IO}_{m,i} + \gamma_3 High\_Tax^A_{m,t} * \widehat{IO}_{m,i} + C_{m,t} + F + \varepsilon_{m,i,t}$. In Panel B, we provide the results of the second stage estimations for the full sample. In Columns 1 and 2, we provide regression estimations when institutional trading variables are estimated with IV set 1, while in Columns 3 and 4, we provide results when institutional trading variables are estimated with IV set 2. In addition, for each set of instruments, we perform the Hausman (1978) test of the endogeneity of regressors, the over-identification test following Hansen (1982), and the weak IV test following Stock and Yogo (2002). Test statistics are reported in the following table and * denotes rejection of the null hypothesis. HIGH_TAX dummy equals to one if day *t* is in the higher stamp duty time period, and zero otherwise. *Inst_turn* equals to the sum of the absolute value of the change in ownership of each institutional investor for sample A-shares in the latest quarter prior to each stamp duty change. *Inst_size* is calculated as Ln(number of institutional investors+1) in A-share stocks a quarter prior to stamp duty changes. In addition, we control the 12-month base interest rate for China and its difference from Hong Kong's, respectively with monthly frequency. Also, firm and event fixed effects are controlled in different specifications. Robust standard errors adjusted for heteroskedasticity and firm level clustering are reported in parentheses. ***, **, and * indicate statistically significant at 1%, 5%, and 10% levels, respectively. Constant terms are omitted in reporting.

Panel A: first stage

	INST_TURN		INST_SIZE	
Variables	(1)	(2)	(3)	(4)
Illiq (A)	–10.1386***	–8.5258***	–114.1341***	–123.9504***
	(3.0258)	(2.3287)	(35.1791)	(29.0311)
Ln(TA)	0.0099**		0.2484***	
	(0.0041)		(0.0426)	
CSI-300		0.0773***		1.2412***
		(0.0176)		(0.1924)
Observations	223	223	223	223
Year fixed effects	Yes	Yes	Yes	Yes
Standard error cluster	Firm	Firm	Firm	Firm
Adj. R-square	0.22	0.25	0.68	0.69

Panel B: Second stage

	V(A)–V(H)			
	IV set 1		IV set 2	
Varibles	(1)	(2)	(3)	(4)
HIGH_TAX	*–0.0195****	*–0.0210****	*–0.0200****	*–0.0247****
	(0.0021)	(0.0025)	(0.0022)	(0.0027)
Inst_turn	–0.0507**		–0.0640***	
	(0.0213)		(0.0144)	
*Inst_turn*HIGH_TAX*	*0.1291****		*0.1316****	
	(0.0196)		(0.0147)	
Inst_size		–0.0018		–0.0041***
		(0.0017)		(0.0009)
*Inst_size*HIGH_TAX*		*0.0068****		*0.0084****
		(0.0012)		(0.0009)
Rf_cn	0.5732***	0.5568***	0.6216***	0.6209***
	(0.0469)	(0.0459)	(0.0540)	(0.0541)
ΔRf(cn–hk)	–0.2014***	–0.2103***	–0.1999***	–0.2015***
	(0.0298)	(0.0283)	(0.0281)	(0.0280)
Observations	446	446	446	446
Firm fixed effects	Yes	Yes	Yes	Yes
Event fixed effects	Yes	Yes	Yes	Yes
Standard error cluster	Firm	Firm	Firm	Firm
Adj. R-square	0.61	0.60	0.65	0.65

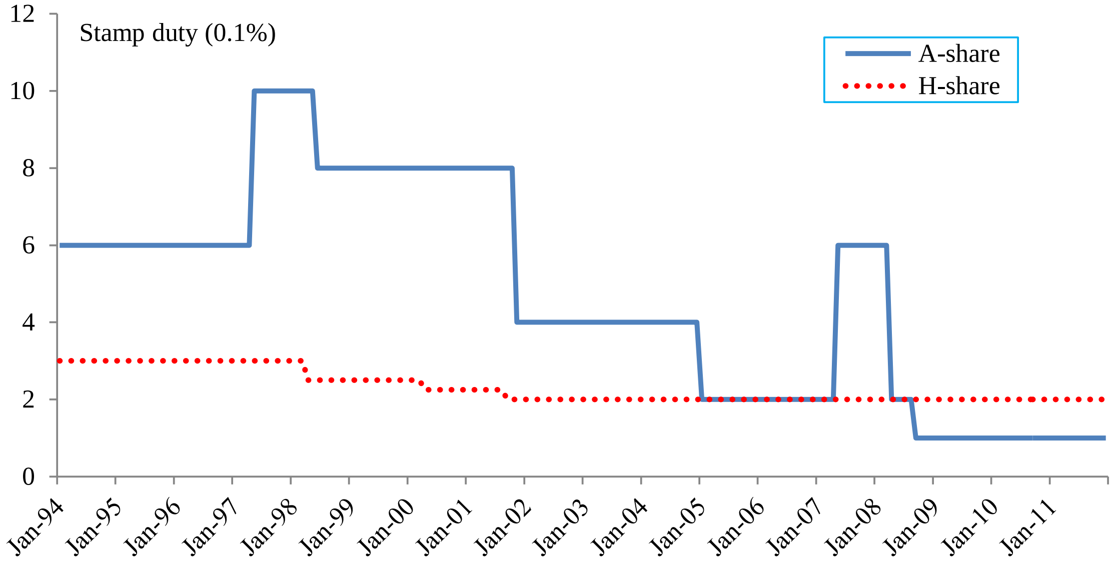
IV necessity and validity tests

	IV set 1		IV set 2	
	Inst_turn	Inst_size	Inst_turn	Inst_size
Hausman (H0: Regressors are exogenous)	F-stat= 19.26***	F-stat= 3.89**	F-stat= 40.79***	F-stat= 5.91***
Over-identification (H0: IVs are not correlated with the error)	J-stat= 0.71	J-stat= 4.81*	J-stat= 0.11	J-test= 0.55
Stock-Yogo (H0: weak IV)	F-stat= 11.17**	F-stat= 21.77**	F-stat= 6.11	F-stat= 30.47**

***, **, and * indicate rejection of the null hypotheses at 1%, 5%, and 10% levels, respectively. Because the Stata output of the Stock-Yogo test is capped at the 5% maximal level, the significance level is only reported at 5% at the maximum.

Fig.1: Evolution of Stamp Duties in China and Hong Kong

The figure shows the evolution of trading stamp duty (sum over buyers and sellers) in A-share and H-share markets from January 1994. The y-axis shows the absolute level of stamp duty to both buyer and seller in a unit of 0.1%. The table below shows the average level and percentage change of A- and H-share market stamp duty around each A-share stamp duty change. Δ change (level) is calculated as average monthly stamp duty over the 12 months prior to the month when the A-share stamp duty changes minus the average monthly stamp duty over the 12 months on and after the month of the stamp duty changes. Δ percentage change is calculated as the Δ change (level) over the average monthly stamp duty level prior to each stamp duty change.



	May-97	Jun-98	Nov-01	Jan-05	May-07	Apr-08	Sep-08
Panel A: A-share market stamp duty							
Δ change (level) (%)	0.40	–0.20	–0.40	–0.20	0.37	–0.43	–0.33
Δ percentage change	66.67%	–20%	–50%	–50%	183.50%	–25.04%	–76.91%
Panel B: H-share market stamp duty							
Δ change (level) (%)	–0.00	–0.04	–0.02	0.00	0.00	0.00	0.00
Δ percentage change	–1.33%	–14.3%	–9.50%	0.00%	0.00%	0.00%	0.00%

Fig. 2: Evolution of institutional investors in China

Information on Chinese institutional holding is from the Wind database on semi-annual basis from 1999 to 2012. Fig. 2a reports the absolute number of institutional investors in the Chinese market. The left and right panels of Fig. 2b report the proportion of institutional holding with respect to the market capitalization of tradable shares in the Chinese A-share market (1998–2012) and the US market (1950–2006), respectively. The broken line indicates the level of institutional investor share in the US market in 1975 (the year of the event studied by Jones and Seguin, 1997).

Fig. 2a: Size of institutional investors group

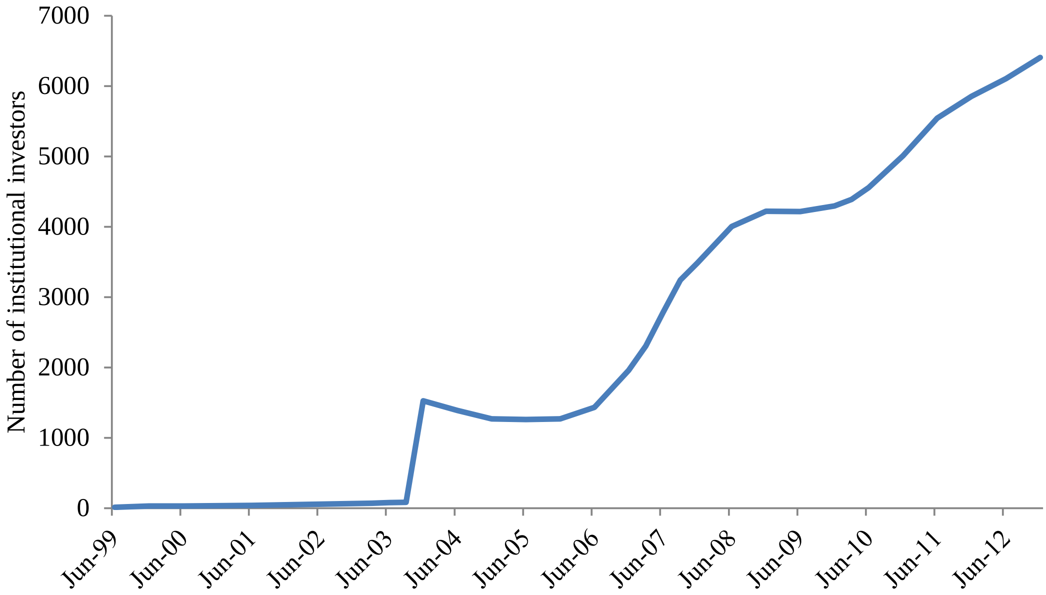


Fig. 2b: Share of institutional investor holdings

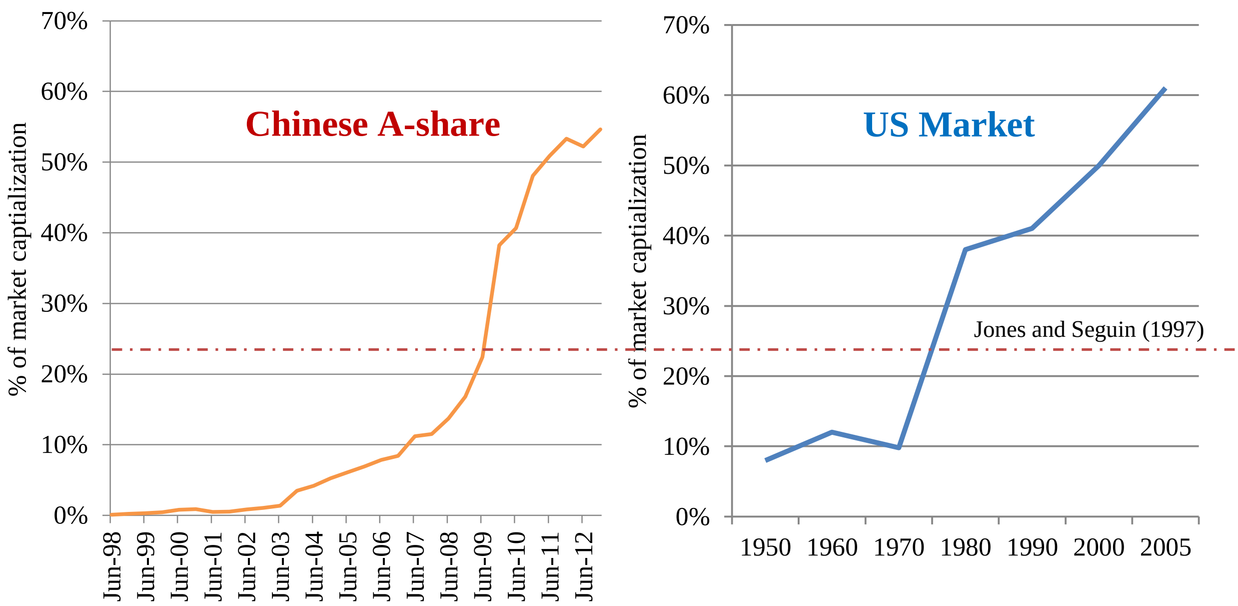


Fig. 3: Scatter plots of price volatility in the two markets
The y-axis is the A-share price volatility averaged over the sample period, and the x-axis is the H-share price volatility averaged over the sample period.

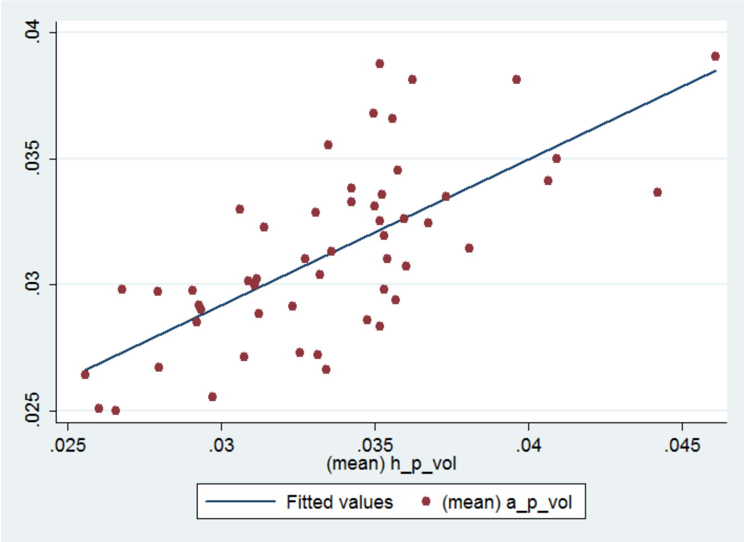


Fig. 4: Institutional investors and their turnovers at the stock level
The figures below provide snapshots of institutional investor share in the A-share market at the stock level in 2000 and 2008. Fig. 4a shows the average number of institutional investors at the stock level at the end of Q4 in 2000 and 2008, while Fig. 4b shows the institutional turnover at the stock level.

Fig. 4a: Number of institutional investors at stock level

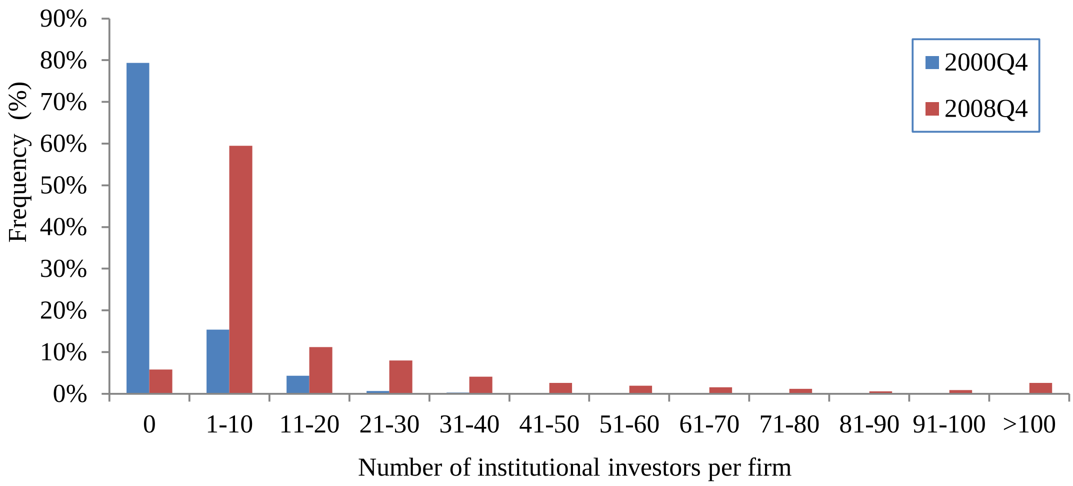


Fig. 4b: Institutional holding turnover at stock level

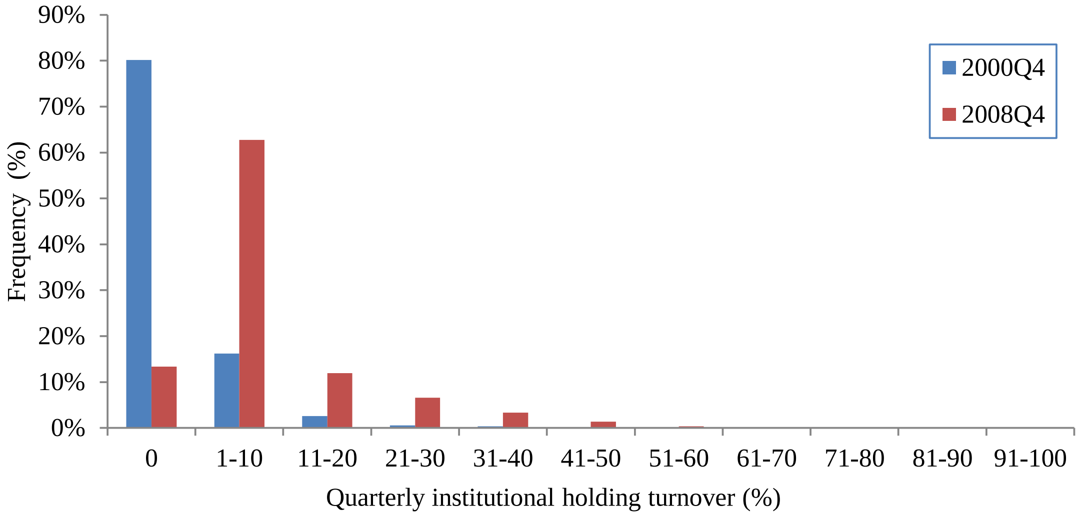
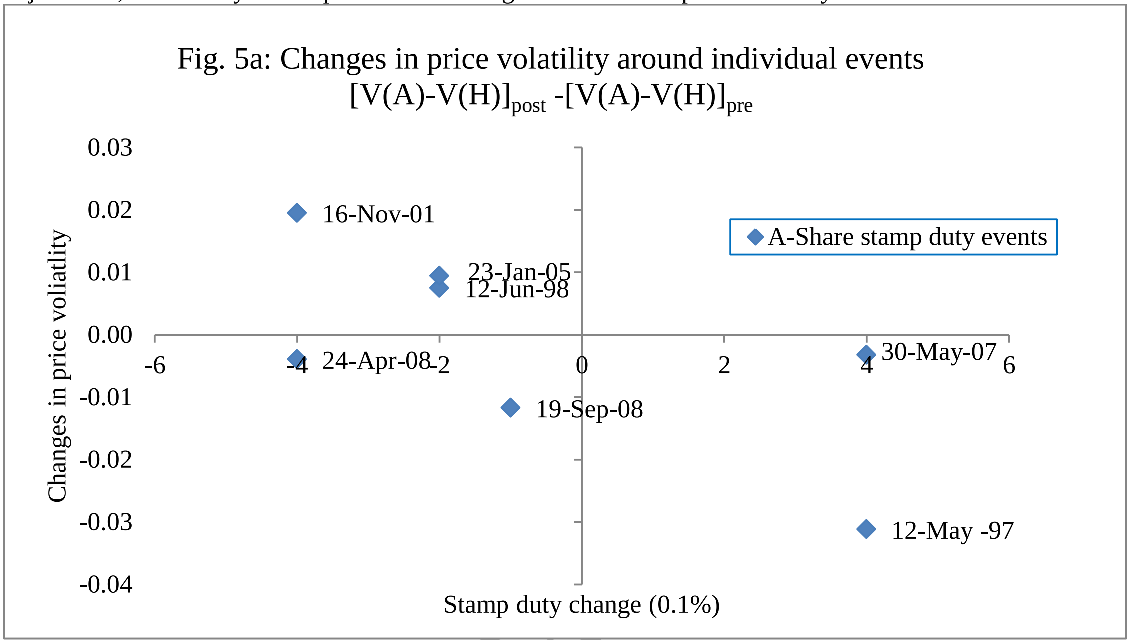


Fig. 5: Changes in relative volatility by event

Fig. 5 shows the changes in price volatility of the treatment group (A-shares) against the control group (H-shares) around individual events. For each event, price volatility is calculated as the standard deviation over 240 trading days before and after the stamp duty change. Two forms of changes in price volatility are used. In Fig. 5a, changes in price volatility is calculated as $(V(A) - V(H))_{Post} - (V(A) - V(H))_{Pre}$, while in Fig. 5b it takes a form of $(log\left(\frac{V(A)}{V(H)}\right)_{post} - log\left(\frac{V(A)}{V(H)}\right)_{pre})$. The X-axis represents the magnitude of the stamp duty adjustment, while the y-axis represents the change in the relative price volatility.



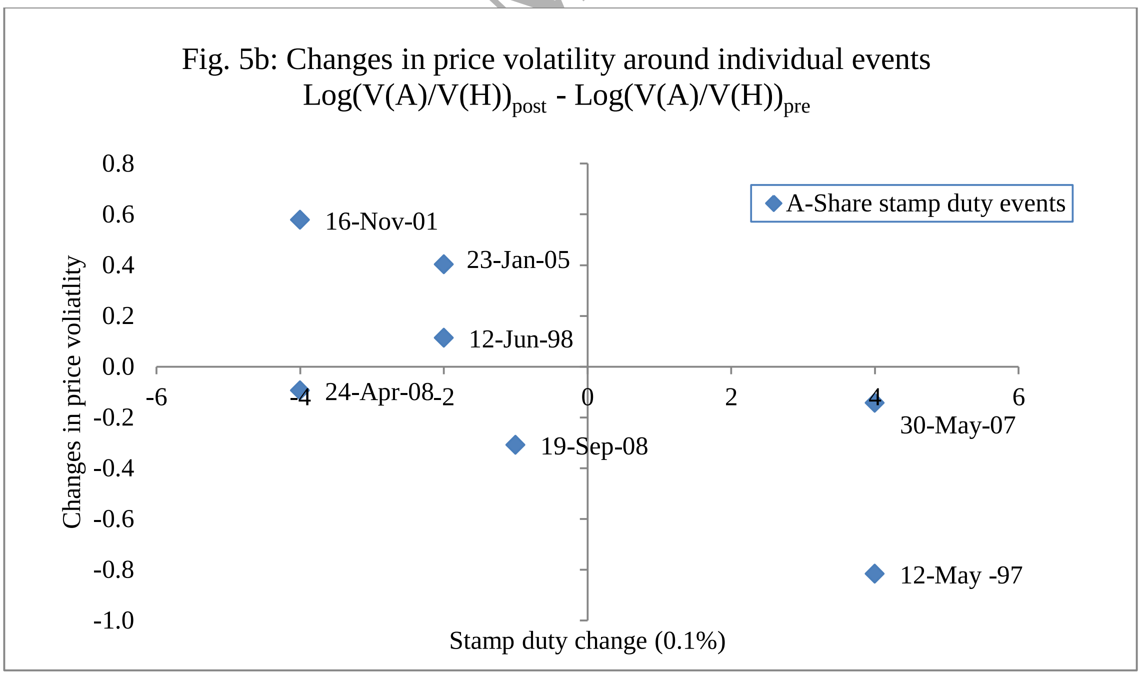
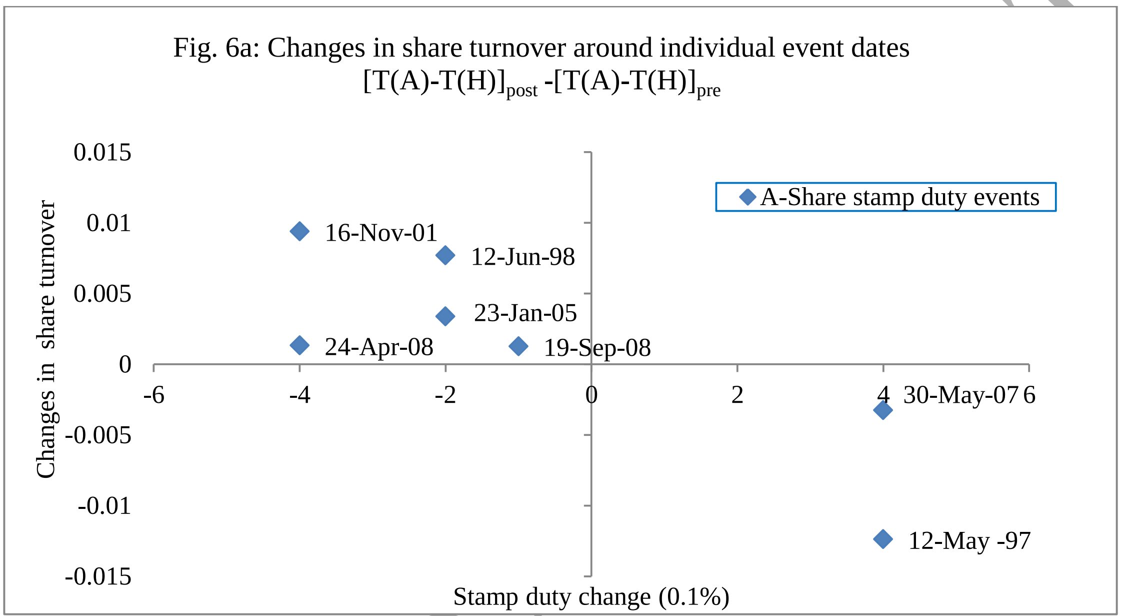


Fig. 6: Changes in relative turnover by event

Fig. 6 shows the changes in turnover of the treatment group (A-shares) against the control group (H-shares) around individual events. For each event, daily share turnover is measured as daily trading volume over total share outstanding and then average over 240 trading days before and after the stamp duty change respectively. Two forms of changes in turnover are used. In Fig. 6a, changes in turnover is calculated as $(T(A)-T(H))_{Post} - (T(A)-T(H))_{Pre}$ while in Fig. 6b it takes a form of $\left(\log\left(\frac{T(A)}{T(H)}\right)_{post} - \log\left(\frac{T(A)}{T(H)}\right)_{pre}\right)$. The x-axis represents the magnitude of the stamp duty adjustment, while the y-axis represents the change in the relative share turnover.



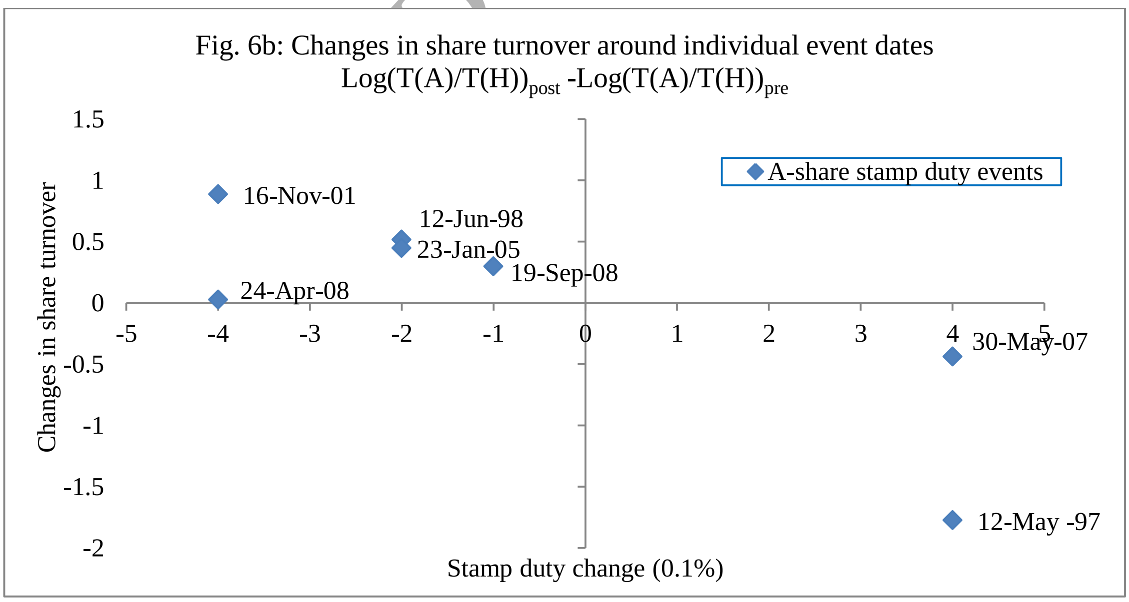
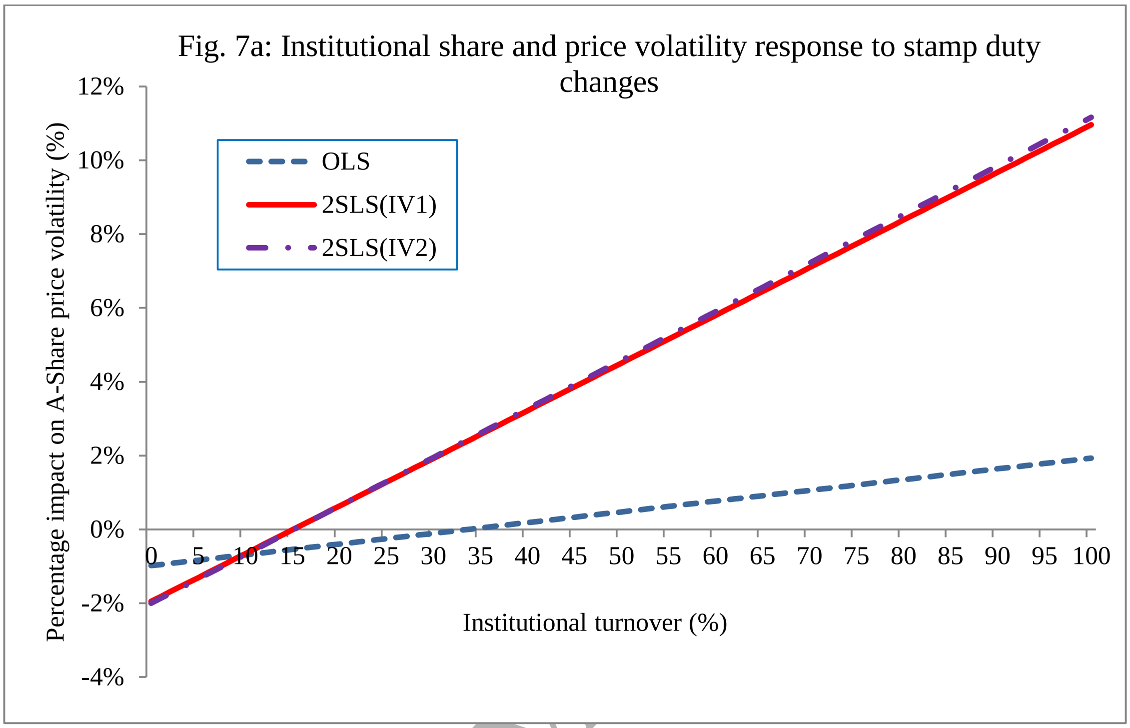
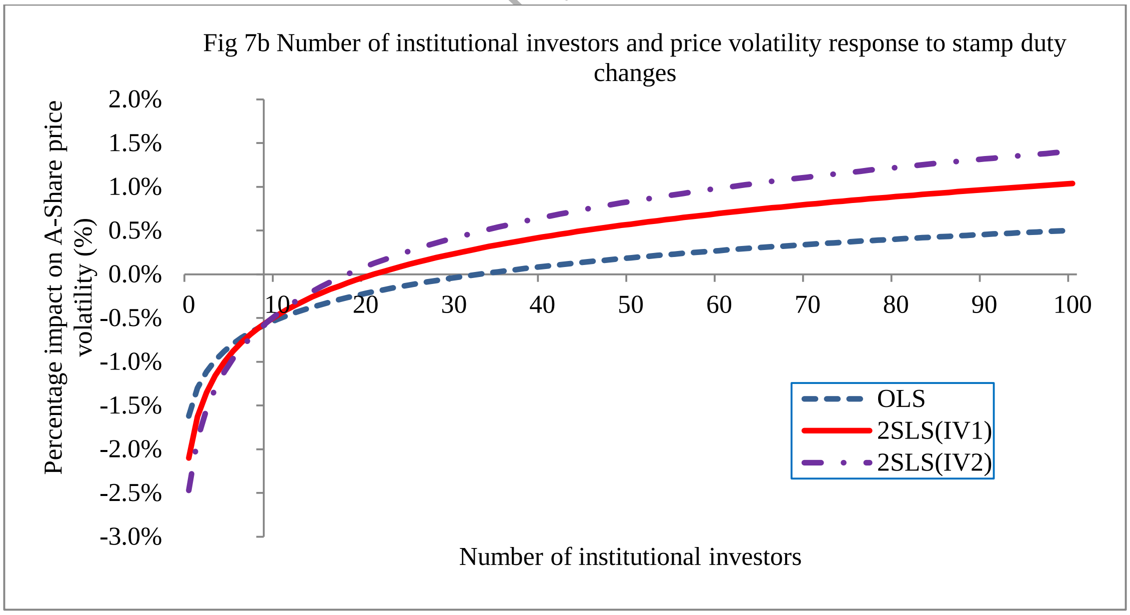


Fig. 7: Effects of stamp duty on price volatility depends on institutional investor shares
Graphical illustrations of the estimated price volatility response to stamp duty changes as a function of institutional trading are provided below. Both results of OLS regression (Columns 1–2 of Table 15) and 2SLS (Table 16) are plotted.





Appendix 1: Definition of variables

Variable	Definition
Stamp duty adjustment related variables	
TaxHike (dummy)	Equals +1 if it's a tax increase, and equals –1 if it's a tax reduction.
TaxHike (value)	Equals the actual size of change in stamp duty. Unit = 10 basis point.
HIGH_TAX	A dummy equal to 1 if day *t* is in the higher stamp duty time period and 0 otherwise.
I_STT	Initial level of stamp duty prior to the event.
ΔSTT	The actual change in percentage points in A-share stamp duty in event m.
Stock characteristics variables	
R(A) and R(H)	Daily returns of A- and H-shares are obtained directly from databases including CSMAR, PACAP, and Datastream. For R(H), we also incorporate the same day exchange rate return, i.e., R(H) = (R(H_raw)+1)*(R(FX)+1)–1.
T(A) and T(H)	Share turnover ratios for A- and H-shares are calculated as $\frac{Volume_{m,i,t}}{Total\ share\ outstanding_{m,i,t}}$ for stock i at day t.
V(A) and V(H)	Standard deviation of daily return R(A) or R(H) over 240 trading days before and after each stamp duty change. Note that V(H) also considers daily fluctuation of exchange rate between HKD and RMB.
Portfolio Price volatility	Fitted price volatility is the predicted value of $\sigma_{it} = \sum_{n=1}^{12} \sigma_{i,t-n} + \varepsilon_t$, where σ_{it} is the unsigned daily stock return scaled by $\sqrt{\pi/2}$ as in Jones and Seguin (1997).
Mkt_Cap	Market capitalization of A- or H-shares, obtained from CSMAR and PACAP.
Prc	Daily closing price obtained directly from CSMAR and PACAP.
Volume (mil)	Daily transaction volume in million RMB. Obtained from CSMAR and PACAP.
AH_Prem	The variable calculated AH price premium as (price(A)–price(H))/price(A). Price of H-share is converted to RMB with daily exchange rate.
Float(A)/Float(H)	The variable is calculated as the free float (tradable) market capitalization of A-share divided by the free float (tradable) market capitalization of H-share.
Illiq(A)/Illiq(H)	Ratio of illiquidity ratios of A-share over the value of H-share. Illiquidity ratios are calculated as $ILLIQ_{i,y} = \frac{1}{Days_{i,y}} \sum_{d=1}^{Days_{i,y}} \frac{\lvert R_{i,y,d} \rvert}{DVol_{i,y,d}}$, where $Days_{i,y}$ is the number of valid observation days in year y, $R_{i,y,d}$ and $DVol_{i,y,d}$ are the daily return and dollar volume of stock *i* on day *d* of year *y*. The ratio is rescaled by a factor of 10^6.
T (A)/T(H)	Ratio of share turnover of A over the value of H-share turnover.
Frim characteristics	
TA (mil)	Total asset of a firm in million RMB. Obtained from CSMAR.
Sales (mil)	Sales in million RMB. Obtained from CSMAR.
EBIT/Sales	Calculated as EBIT over sales.
NI/Sales	Calculated as net income over sales.
Sales_growth	Sales growth with respect to last financial year.
Cash/TA	Calculated as cash over total asset.
Debt/TA	Calculated as total debt over total asset.
Market level variables	
R(MKT)	Return of the market index.
Rf_cn	The variable is calculated as 12-month interest rate in China (unit: %).
ΔRf (cn-hk)	The variable is calculated as difference in 12-month interest rate in China and Hong Kong (unit: %).
Institutional share variables	
Inst_own	Obtained from the Wind database and reflects the latest quarter filing prior to a certain stamp duty change. Institutional ownership is percentage ownership over total tradable shares.
Inst_turn	The sum of absolute value of change in ownership of each institutional investor for sample A-share in the latest quarter prior to each stamp duty change. Obtained from the Wind database with unit of %.
Inst_size	Ln(number of outstanding institutional investors +1) in A-share stocks a quarter prior to stamp duty changes. Obtained from the WIND database.
Instruments	
CSI-300	Dummy variable equal to 1 if a sample A-share is a member of the CSI 300 index at the time of a certain stamp duty change, and 0 otherwise.

Ln(TA)	Natural logarithm of total asset obtained from CSMAR in the latest annual filing prior to each stamp duty change.
Illiq	Illiquidity ratio is calculated as $ILLIQ_{i,y} = \frac{1}{Days_{i,y}} \sum_{d=1}^{Days_{i,y}} \frac{\lvert R_{i,y,d} \rvert}{DVol_{i,y,d}}$, where $Days_{i,y}$ is the number of valid observation days in year y, $R_{i,y,d}$ and $DVol_{i,y,d}$ are the daily return and dollar volume of stock *i* on day *d* of year *y*. The ratio is rescaled by a factor of 10^6.
Potential outlier stocks	Stocks with ratio of price(A-share)/price(H-share) above the 90th percentile.