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Investment on Heterogeneous Stock Demands: Implications from China Stock Connect

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Abstract

This paper exploits a unique scheme of the China Stock Connect for daily-level and stock-level holdings of aggregate investors across borders. We propose a demand-based asset pricing system of dual investors for the aggregate investors through the Stock Connect and the rest. Our model estimates the heterogeneous and time-varying price elasticity for the demand of individual stocks and identifies their underlying driven sources of stock characteristics and aggregate predictors. The Northbound is relatively inelastic to the Mainland market, implying its demands have a large multiplying impact, while the Southbound is almost elastic, implying its smaller multiplying impact. By decomposing the projected demand, we find cross-sectional return predictability on the price-driven and latent demands. A long-only strategy for high price-driven demand stocks delivers a weekly alpha of 0.43% and 0.28% in Northbound and Southbound during the past five years. Additionally, we show that a strong price impact from Northbound investors on A shares leads to the enlarged A-H share premium.

Keywords: A-H Share premium, China Stock Connect, Demand Asset Pricing, Elasticity, Market Integration.

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1 Introduction

The China Stock Connect program is a significant policy breakthrough in the Chinese capital market for liberalization and integration. The Shanghai-Hong Kong Stock Connect and Shenzhen-Hong Kong Stock Connect were launched in November 2014 and December 2016. The Stock Connect has become the primary channel for mutual stock market access between Mainland China and Hong Kong. It allows Mainland investors to invest in eligible stocks in the Hong Kong stock market (Southbound) and overseas investors to invest in the Mainland stock market (Northbound). The Stock Connect aggregates daily trades of Southbound and Northbound investors to manage the daily trading quota restrictions. In addition, the stock exchanges publish daily holdings of individual stocks for the aggregate Southbound and Northbound investors. These provide unique features for practitioners to observe daily holding changes for the Connect investors in each stock market as trading signals (Chen et al., 2022).

This paper exploits such unique mechanisms and daily information in the China stock market to model the individual stock demand curves. By estimating the heterogeneous and time-varying price elasticities to stock demands of Connect investors, we investigate the underlying return predictability in the cross section and time series. Given the elasticity estimation, we further study how the Stock Connect affects the A-H share premium and evaluate Connect investors' impact on markets on both sides.

On the one hand, overseas investors accessed the Mainland stock market before the Stock Connect through B-share stocks and the Qualified Foreign Institutional Investor (QFII) program.[1] While there are still access restrictions to overseas investors, the Mainland capital market opens up with better depth (trading quota) and breadth (number of stocks) through the Stock Connect Scheme (Ma et al., 2021), which further facilitates increasing diversifica-

[1] Fernald and Rogers (2002) provide one of the early studies to investigate the Chinese stock market puzzles. A recent survey of Song and Xiong (2018) provide a detailed introduction and discussion about the risks in the China financial system.

tion demands of overseas investors. The China Stock Connect program does not coincide with capital market liberalization from other countries because of an offshore and developed stock market in Hong Kong. In addition, the continuous progress of market liberalization helps the Mainland listed companies to improve their corporate dividend policies, corporate investment efficiency, and quality of corporate information disclosure.

For our research, Stock Connect exogenously splits the investors in the stock market into two groups: one is the Connect investor (who invests in the Mainland or Hong Kong stock market through Stock Connect), and the other is the counterpart of Connect investor (we call it counter-Connect investor then, who represents the rest of investors in the Mainland or Hong Kong market). The Northbound of Connect allows investors from Hong Kong and the rest of the world to invest in eligible Mainland stocks. It provides a quasi-experiment to study the stock demand and price impact on A-share stocks from overseas investors.

On the other hand, the Southbound Connect enables eligible Mainland investors to invest in eligible stocks in the Hong Kong market. Given the capital control in Mainland China, access to the Hong Kong stock market helps Mainland investors to diversify their portfolios and expand their investment universe[2]. Before implementing the Stock Connect program, the Qualified Domestic Institutional Investor (QDII) program allowed large Mainland institutional investors to invest in securities in foreign markets, including the Hong Kong stock market. The establishment of Southbound has further relaxed the capital control restrictions and increased the trading quotas on Mainland investors for investing in the Hong Kong market. In addition, given the enlarging Mainland company (primary and secondary) listings in the Hong Kong stock exchange, the market capitalization ratio for Mainland companies is about 80%. Therefore, boosting Mainland investors' access to the Hong Kong stock market helps the price discovery for most Mainland companies.

Moreover, there is a well-known A-H share premium puzzle (Fernald and Rogers, 2002) for the share price differences of those dual-listed stocks in the Mainland and Hong Kong

[2] There is a research report about the China Stock Connect from Goldman Sachs (https://www.goldmansachs.com/insights/pages/stock-connect/)

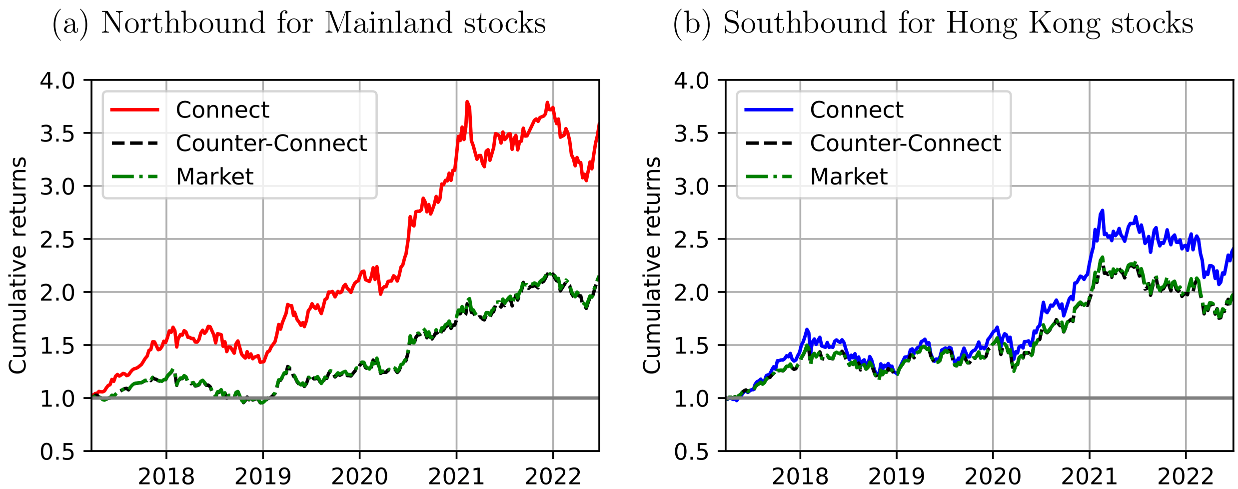

Figure 1: **Investment Performance: Connect vs. counter-Connect**

Note: This figure displays the cumulative returns of the aggregate portfolios held by the Connect investor, counter-Connect investor, and market in the eligible stock universe for (a) Northbound and (b) Southbound.

stock markets. Fan and Wang (2017) have documented the decrease of A-H share premium using the sample from Shanghai-Hong Kong stock connect. However, the A-H share premium has increased by more than 20% during the past five years. Our paper focuses on the cross-sectional variation of the A-H share ratios. We attribute the puzzle to the enhanced A-share market with a stronger price impact from Northbound investors of Stock Connect.

We start by constructing representative portfolios using aggregate Connect investor daily holdings. Our Connect portfolio is rebalanced every week, based on daily holdings reports from the Stock Exchange of Hong Kong (SEHK). The cumulative returns of Northbound and Southbound are shown in Panel A and Panel B in Figure 1, respectively.[3] We find the Connect investor outperforms the counter-Connect investors in both markets. In particular, the value of the Northbound Connect portfolio has increased nearly 3.5 times, while its counterpart has only increased by about 2 times. This is why the Connect holding changes have become popular sources of market timing signals in the Mainland stock market. To dissect this outperformance and understand the price impact from the Connect investors,

[3]Section 3 discusses details for the portfolios held by the Connect and counter-Connect investors.

we estimate the time-varying and heterogeneous price elasticity under the Stock Connect.

Our paper provides a structural estimation of the characteristics-based demand system for individual stocks under the Stock Connect. We follow the recent demand-based asset pricing of Koijen and Yogo (2019) and the instrumental variable estimation of van der Beck (2022b). The unique Stock Connect Scheme allows us to consider only two groups of representative investors in the Mainland market for Northbound or Hong Kong market for Southbound: Connect and counter-Connect investors. Connect investors' portfolio represents the aggregate holdings from all Connect investors, and the counter-Connect investors have the rest of the market. In this dual-investor system, our setting helps to evaluate and identify the price impact from the Connect investors and meets market clearing conditions.

Extending the existing demand systems, we parameterize the elasticity term by market aggregate predictors and stock-specific characteristics, which helps to capture the time-series and cross-sectional variations of individual stock elasticities. Using weekly data, we estimate the demand curves for the Northbound and Mainland local markets, and the Southbound and Hong Kong local markets, respectively. Related to Edmans et al. (2012), van der Beck (2022b), and Gabaix and Koijen (2021), we use the unexpected demand shocks from the other investor (in our dual-investor system) as idiosyncratic instruments to address the endogeneity issue of stock price changes and demand changes.

Empirical Findings. For the Northbound, we find a 1% increase in the stock price leads to a relatively small 0.31% drop in the demand from Northbound investors, while the elasticity for the Mainland investors is higher, reaching 0.59%. This indicates that the Mainland market is relatively inelastic towards flows from Northbound trading, thus suffering a strong price impact. However, for the Southbound connect, a 1% increase in the stock price leads to a considerable 0.96% drop in the demand from Mainland investors, while the elasticity for the Hong Kong investors is 0.85%. It suggests that the price impact of demand change from the Connect Mainland investors is low in the Hong Kong market. The difference in elasticities between Northbound and Southbound corresponds to the different roles of the Stock Connect program in the Mainland and Hong Kong markets. The relatively low elasticity of Northbound indicates that Northbound investors are not sensitive to the price changes of stocks in the Mainland market, but the relatively high elasticity of Southbound indicates stronger substitute effects of Hong Kong investment to Mainland investors.

We further decompose the stock demands into three parts: price-driven, fundamental-based, and latent demand. A long-only strategy for high price-driven demand stocks delivers a weekly alpha of 0.39% (0.43%) and 0.28% (0.28%) for the Connect (counter-Connect) investors in Northbound and Southbound during the past five years. Finally, about the cross-sectional variation of the A-H share ratios, we find the demand elasticities of Mainland investors in the Mainland and Hong Kong markets play highly significant roles. Those stocks with higher demand elasticities have lower A-H share ratios.

Literature. Our paper directly contributes to the application of demand-based asset pricing.[4] A recent publication of Koijen and Yogo (2019) proposes a characteristics-based demand model for heterogeneous investors. Following this model, Koijen and Yogo (2020) investigate the global currency market, and Gabaix et al. (2022) study the US housing market. Haddad et al. (2021) find that the large increase in passive investing over the last 20 years has led to substantially more inelastic aggregate demand curves for individual stocks by 15%. van der Beck (2022b) adopt idiosyncratic flow data as the IV for the demand estimation, van der Beck (2022a) shows the performance of ESG investment is strongly driven by price-pressure arising from flows towards sustainable funds. Gabaix and Koijen (2021) have developed a new instrumental variable using idiosyncratic shocks from large institutions for estimating the demand system. An (2022) develop a theoretical framework to unify risk- and demand-based approaches. Chen et al. (2022) apply this method to study how the cross section of stocks evolves during the 2015 Chinese stock market bubble. This paper

[4] Early empirical studies for estimating the downward demand curves for equities include Shleifer (1986) and Harris and Gurel (1986).

focuses on a special case of the Stock Connect for estimating demand from Connect and counter-Connect investors under market clearing.

We also contribute to studying the Chinese capital market, including its opening progress and market efficiency. Early overseas investors participate in the B-share market in China while local investors participate in A shares, which creates perfectly segmented dual-class shares for various investigations by controlling firm fundamentals (e.g., Chan et al., 2008; Mei et al., 2009; Chui et al., 2022). Most institutional investors later join the QFII (Qualified Foreign Institutional Investors) program and Liu et al. (2014) compare the investment behaviour difference between local and overseas investors. For the A-H premium puzzle between the Mainland and Hong Kong stock market, since the introduction of the Shanghai-Hong Kong Stock Connect in 2014, Zhang et al. (2020) find the decreasing impact of the US dollar index. Ma et al. (2021) find that the establishment of the Shanghai-Hong Kong Stock Connect results in lower funding costs and higher stock prices in the Mainland market. This paper is the first comprehensive study, including the Shanghai-Hong Kong and Shenzhen-Hong Kong Stock Connect, for stocks in both A-shares and the Hong Kong stock market.

For market efficiency, Liu et al. (2019) replicate the famous size and value factors in the A shares, and Lam and Tam (2011) finds the importance of the liquidity factor in the Hong Kong stock market. An et al. (2022) study the retail investor behaviour in the 2014–15 bubble-crash, Jones et al. (2022) investigate the stock picking ability of retail investors, and Du et al. (2022) find the momentum anomaly driven by non-retail investors. Our work finds anomalies driven by the price impact or latent demand only observed through the unique Stock Connect program.

Finally, our study is related to capital market liberalization and integration. Bekaert and Harvey (2000) assess the impact of market liberalizations in emerging equity markets and find the cost of capital decreases after a capital market liberalization. For the segmented dual-class shares of Chinese firms (A shares traded in Mainland China by local investors and H shares traded in Hong Kong by overseas investors), Jia et al. (2017) investigate the differential reactions of local and overseas investors to analyst recommendations Fan and Wang (2017) find evidence of market integration about the decreasing A-H premium since the introduction of the Shanghai-Hong Kong Stock Connect in 2014. This paper exploits a recently established market mechanism of the Stock Connect and utilises the unique data of daily flows traded from Connect and counter-Connect investors.

The rest of the paper proceeds as follows. Section 2 introduces the Stock Connect and data sample. In section 3, we construct the representative connect portfolios and build the dual-investor demand system. In Section 4, we estimate the elasticity and demand curve. Section 5 shows the investment strategy from demand decomposition, and Section 6 illustrates the relation between investor elasticity and A-H share premium. Section 7 concludes this paper.

2 The Stock Connect and Data

This section introduces details of the Mainland-Hong Kong Stock Connect and describes our data sample for the empirical investigation.

2.1 Background of the Stock Connect

There are two major stock exchanges in Mainland China, Shanghai and Shenzhen, and one in the Hong Kong Special Administrative Region, all of which rank in the top seven stock exchanges worldwide. The market capitalization values in mid-2022 for these three exchanges are CNY 43,999 Billion, CNY 35,432 billion, and HKD 38,970 billion, respectively. For the Hong Kong stock exchange, the market capitalization ratio for Mainland companies is about three quarters in 2021. Due to capital control, there are various restrictions for Mainland China investors investing in overseas markets (including Hong Kong) and overseas investors investing in A-shares in the Mainland market.

On the one side, multiple programs were introduced to allow overseas investors to invest in the Mainland market. The market of B shares was launched in 1992 and is open to international investors for a limited number of dual-listed A-shares stocks. As the market liberalization improved, another program, Qualified Foreign Institutional Investor (QFII), was initiated in 2002 to allow limited access to A-shares stocks.[5] To facilitate international usage of the RMB, the Renminbi Qualified Foreign Institutional Investors (RQFII) program was introduced in 2011, which allows overseas investors to use offshore RMB. On the other side, for Mainland China investors investing in overseas markets (including Hong Kong), the Qualified Domestic Institutional Investors (QDII) program was launched in 2006.

The China Stock Connect program ("Stock Connect") allows overseas investors to invest in eligible A shares listed on the Mainland stock market (Northbound) and allows Mainland investors to invest in eligible Mainland and Hong Kong companies listed in the Hong Kong stock market (Southbound). The Stock Connect was launched in November 2014 between the Shanghai Stock Exchange (SSE) and the Stock Exchange of Hong Kong (SEHK) and was extended in December 2016 to encompass the Shenzhen Stock Exchange (SZSE).

Figure 2 illustrates the eligible investment stock universe under the Stock Connect.[6] The investment stock universe covers all eligible stocks in major stock indexes for large- and mid-cap stocks and eligible small-cap stocks, as well as all dual-listed stocks for A and H shares. Figures 3 and 4 plot the number and market capitalization of eligible stocks under the Stock Connect compared to all stocks in Northbound and Southbound. About one-third of Mainland stocks are included, but less than a quarter of Hong Kong stocks are included in the Connect program. However, the Connect eligible stock universe's market capitalization values are about three quarters of the total market capitalization in both the Mainland and Hong Kong markets. The authority periodically adjusts inclusion and exclusion for the

[5] Many emerging markets have adopted policies similar to QFII when opening their capital markets, such as South Korea, Taiwan, Mexico, etc.

[6] For some exceptions, secondary listed companies in Hong Kong, such as Alibaba Group (9988), are included in the Hang Seng Composite LargeCap Index but not yet eligible under the Stock Connect. See details from SEHK (https://www.hkex.com.hk/Mutual-Market/Stock-Connect/Getting-Started/Information-Booklet-and-FAQ).

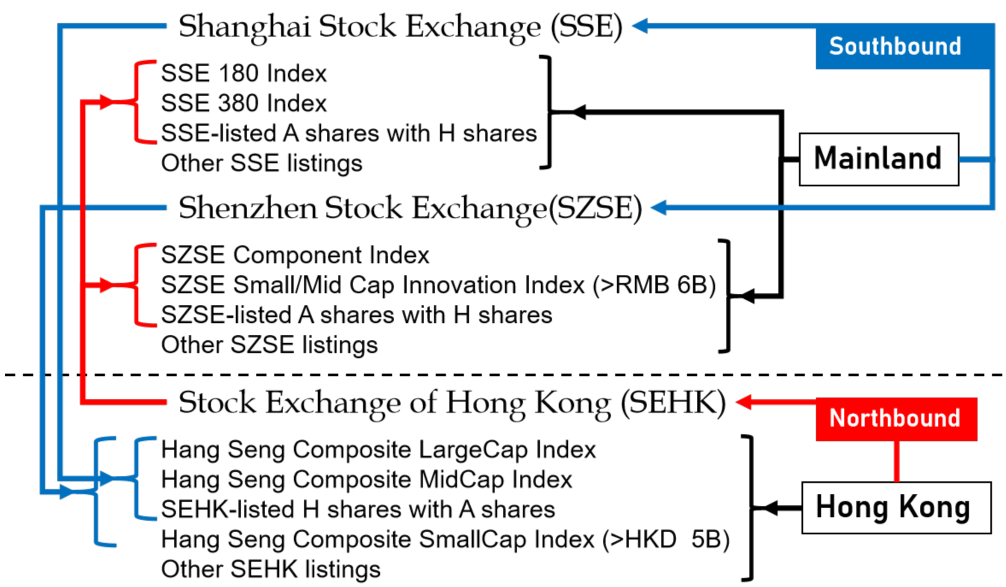

Figure 2: **Stock Connect Scheme in China**

Note: This figure displays the investment universe of the Stock Connect. The Northbound includes eligible A shares stocks (in red bracket), and the Southbound includes eligible Hong Kong stocks (in blue bracket).

eligible stock list.

There is also the trading volume restriction. Trading under the Stock Connect is subject to a Daily Quota, which limits the maximum net buy value of cross-boundary trades between Shanghai and Hong Kong, and between Shenzhen and Hong Kong. The Northbound Daily Quota to Shanghai Connect and Shenzhen Connect is set at CNY 52 billion for each. The Southbound Daily Quota from Shanghai and Shenzhen is set at CNY 42 billion for each. Notice that stock shares purchased by investors cannot be sold before settlement, which means intra-day trading is not allowed under the Stock Connect Scheme.

There are several innovations for the Stock Connect Scheme over the current programs, including B shares, QFII, RQFII, and QDII. First, for a larger investor group, the Stock Connect opens the Mainland stock market to any overseas investors through SEHK and allows both eligible institutional and retail investors from Mainland for overseas investments. Second, the daily trading quota of the Stock Connect does not discriminate against any market participants, while the quotas of QFII and QDII are allocated to respective approved institutions. Third, the availability of Northbound trading expands the investment universe for CNH (offshore CNY), and the introduction of Southbound trading allows Mainland investors to make overseas investments in Chinese companies listed in Hong Kong. In summary, while capital controls are still in place, the Mainland market opens up with better depth (larger group of investors and increased trading quotas) and breadth (more listed stocks and larger market capitalization) under the Stock Connect Scheme.

2.2 Data Sample

This paper considers the entire eligible stock universe for Shanghai, Shenzhen, and Hong Kong stock exchanges under the Stock Connect. We consider weekly data from March 17, 2017, to June 30, 2022. We use this timeframe because SEHK starts full disclosure of Stock Connect holdings on March 17, 2017, and as Exchange-Traded Fund (ETF) Connect becomes operational from July 2022, some direct investments in equities may switch to ETFs, and we try to avoid this impact. The advantage of the Stock Connect Scheme is its daily updated stock shareholding information for the aggregate Connect investors.[7] We obtain the shareholding data for both Shanghai-Hong Kong and Shenzhen-Hong Kong Connect from Gildata and SEHK. We end our sample at the end of June 2022, right before the inclusion of exchange-traded funds into Stock Connect in July 2022, to avoid the effect of passive or index investing in individual stocks.

Figure 5 displays the cross-sectional summary statistics for the stock holding ratios by Connect Investors in the eligible stock universe under the Stock Connect Scheme. We find increasing trends in shareholding on both Northbound and Southbound. Note that there is a 30% shareholding restriction on Northbound investors in individual Mainland stocks under the Stock Connect. In mid-2022, the value-weighted average of shareholding is less than 3% but more than 1% of stocks with more than 15% of overseas shareholding. There are no shareholding restrictions in Southbound, so we find more than 1% of stocks with more than

[7]See stock shareholding disclosures from SEHK (https://www2.hkexnews.hk/Shareholding-Disclosures/Stock-Connect-Shareholding)

40% of shares held by Mainland investors. For counter-Connect investors, we only consider their portfolio holdings for the same eligible stock universe under the Stock Connect.

We obtain our trading data of Mainland and Hong Kong stocks from CSMAR and Compustat Global, respectively. Stock observations with missing prices or outstanding shares are removed. We have also considered a few trading-related widely used stock characteristics, including market beta, volatility, turnover, short-term reversal, and momentum. These stock characteristics are shown with positive return predictability in Chinese stock markets (Leippold et al., 2022). Beta is the market beta estimated on Mainland and Hong Kong aggregate market correspondingly (Fama and MacBeth, 1973). Volatility is the daily stock return standard deviation in the rolling window of 20 days (Ang et al., 2006). Turnover is the weekly trading volume scaled by the number of outstanding shares (Chordia et al., 2001). Reversal is the cumulative return of the previous 21 days (Jegadeesh and Titman, 1993). Momentum is the cumulative return from the previous year except for the recent 21 days (Jegadeesh and Titman, 1993). We standardize the firm characteristics cross-sectionally in the eligible stock universe in the range $[-1, 1]$.[8] They help capture the cross-sectional variable.

We also consider aggregate predictors to capture the time-series variation, including the exchange rate of CNY-HKD, U.S. Dollar index (USDX) (Zhang et al., 2020), market volatility, market turnover, market reversal, and market momentum. CNYHKD is the exchange rate between CNY (Chinese uuan) and HKD (Hong Kong dollar). We obtain CNYHKD and USDX from WIND. We use the value-weighted aggregate market returns to calculate volatility, reversal, and momentum, which follow the definition for individual stock characteristics. Our market turnover is the value-weighted turnover of individual stocks' turnover in the aggregate market. We standardise these aggregate predictor data to the $[-1, 1]$ range by the sample percentile numbers.[9]

[8]For example, the market equity in December 2020 is uniformly standardized to the $[-1, 1]$ range. The firm with the lowest market equity is -1, and the highest market equity is 1. All others are distributed uniformly in between. If a firm has missing values for some characteristics, the imputed values are 0, implying the firm is not important in security sorting.

[9]For example, CNYHKD greater than 0.6 implies the current inflation level is higher than 80% of observations in the sample.

3 Connect Representative Investor

We have Mainland and Northbound (overseas) investors for eligible stocks in the Mainland market. For eligible stocks in the Hong Kong market, we have Southbound (Mainland) investors and Hong Kong (local and foreign) investors.

3.1 Dual-Investor Markets

The Stock Connect creates a simple scenario for two major investors: Connect investor and the counter-Connect investor. Assume that there are N_t stocks indexed by $n = 1, \cdots, N_t$ at period t. N_t is the size of the eligible investment universe under the Stock Connect program. The number of shares outstanding for stock n at period t is $M_{t,n}$, and the number of shares held by the Connect investor is $C_{t,n}$, which is the cumulative sum of share changes $\{v_{s,n}\}_{s=1}^{t}$ bought or sold for the entire periods till t:

$$C_{t,n} = \sum_{s=1}^{t} v_{s,n} \tag{1}$$

Under market clearing for two investors, the shares of stock n at period t held by the counter-Connect investor is $L_{t,n} = M_{t,n} - C_{t,n}$. We can calculate the portfolio weights held by the Connect investor. For example, for stock n at period t is:

$$w_{t,n}^{C} = \frac{P_{t,n} C_{t,n}}{\sum_{n=1}^{N_t} P_{t,n} C_{t,n}} \tag{2}$$

We also calculate the portfolio weights for the representative counter-Connect investor as

$$w_{t,n}^{L} = \frac{P_{t,n} L_{t,n}}{\sum_{n=1}^{N_t} P_{t,n} L_{t,n}} \tag{3}$$

3.2 Dual-Investor Demand System

An investor's elasticity of demand with respect to the price (henceforth elasticity) for stock n at period t is defined as the percentage change in holdings ($\Delta Q_{t,n}/Q_{t-1,n}$) when the price of a stock goes up by 1% ($\Delta P_{t,n}/P_{t-1,n}$). Because the demand curve is downward sloping, we define the elasticity as follows:

$$\zeta_{t,n} = -\frac{\Delta Q_{t,n}/Q_{t-1,n}}{\Delta P_{t,n}/P_{t-1,n}}. \tag{4}$$

The elasticity values might vary for different stocks, periods, and investors. This paper exploits a unique Stock Connect Scheme in China to estimate the elasticity values for the Connect and counter-Connect investors. The goal is to evaluate the aggregate elasticity for either the Connect or counter-Connect investors on a stock n in a period t.

A natural estimation procedure is to implement a linear regression on the change of log demand and change of log price.

$$\Delta q_{t,n} = \zeta_0 - \zeta \Delta p_{t,n} + \varepsilon_{t,n}, \tag{5}$$

where $\Delta p_{t,n} = \log(P_{t,n}) - \log(P_{t-1,n})$ is the log return for stock n in period t. For the change of log demand, we consider $\Delta q^c_{t,n}$ as the difference in log portfolio weights adjusted for the mechanical change in weights due to price changes $\Delta p_{t,n}$,

$$\Delta q_{t,n} = \log(\frac{w_{t,n}}{w_{t-1,n}}) - \Delta p_{t,n}. \tag{6}$$

This measure of $\Delta q_{t,n}$ focuses on the substitute effect by removing the income effect for the demand estimation. The regression framework allows one to control fundamental information, such as stock characteristics and aggregate predictors.

Table 1 reports summary statistics for weekly log changes for price (Δp) and demand

(Δq^C and Δq^{XC} for the Connect and counter-Connect Market). We include the averages of summary statistics for the cross section from March 2017 to June 2022 of all eligible stocks in either Northbound or Southbound. We find Δq^C in Northbound changes dramatically, from -36.71% to 37.76% for a 90% historical interval range, while this range in Southbound is only from -0.13% to 7.70%. Probably due to the large holdings of counter-Connect investors, values for Δq^{XC} are relatively small for both Northbound and Southbound. We also report the average cross-sectional Spearman's rank correlation matrix, which shows the rank correlations between two variables. In this dual-investor demand system, Δq^C and Δq^{XC} have a high negative rank correlation, as expected.

Instruments. However, an econometric challenge arises in estimating asset demand curves because price changes are endogenous to latent demand. The existing literature relies on instrumental variable (IV) estimation. Koijen and Yogo (2019) construct an IV based on mandate investments universe of institutions. Gabaix and Koijen (2020, 2021) build IVs using the idiosyncratic shocks from big players in markets. The IV adopted in Pavlova and Sikorskaya (2022) is constructed by the fraction of funds' assets in their benchmark indexes. Since Edmans et al. (2012), flow-induced demand pressure (flow pressure) has been used to identify causal effects in finance. Following van der Beck (2022b), our paper constructs an instrumental variable based on the exogenous flow pressure of the Connect and counter-Connect investors to each other. The exogenous flow pressure is the unexplained shock from the other investor based on the endogenous or explainable flow pressure on stock characteristics and aggregate predictors. For the Connect and counter-Connect investors in our study, we consider the exogenous flow pressure from their counterparts.

We consider hypothetical trades mechanically induced by flows from the Connect investor. The flow pressure on stock n from the Connect investor is

$$f^C_{t,n} = \frac{F_t C_{t-1,n} P_{t-1,n}}{VOL_{t-1,n} \sum_{n=1}^{N_{t-1}} P_{t-1,n} C_{t-1,n}} \tag{7}$$

where the term $VOL_{t-1,n}$ is the total CNY(or HKD) trading volume of stock n in period t, and total flow F_t is the net buying (or selling) through Stock Connect in period t. The flow pressure for the counter-Connect investor can be calculated as

$$f^L_{t,n} = -\frac{F_t L_{t-1,n} P_{t-1,n}}{VOL_{t-1,n} \sum_{n=1}^{N_{t-1}} P_{t-1,n} L_{t-1,n}}. \tag{8}$$

Similar to van der Beck (2022b), we decompose the flow pressure into an endogenous or explainable component by stock characteristics and aggregated predictors, and an exogenous component $f^{\perp}_{t,n}$ as the regression residual. Exogenous flows are then extracted using cross-sectional regressions for every period:

$$f_{t,n} = \eta_{t,0} + \sum_{k=1}^{K} \eta_{k,t} z_{k,t-1,n} + f^{\perp}_{t,n}. \tag{9}$$

Here, $\mathbf{Z_{t-1,n}}$ is a vector of lagged stock characteristics for stock n, including log market equity, market beta, turnover, return volatility, short-term reversal, and momentum. Exogenous flow pressures are estimated as the residuals from the above cross-sectional regressions, which are shocks to the fundamental-driven flow pressure. For a valid IV estimation of the price elasticity of demand, the IV needs to be related to the price changes but orthogonal to the investor's own unobservable demand shocks. Therefore, choosing the other investor's exogenous flow pressure shocks is a valid IV. The instrument for the Connect investor is $f^{L,\perp}_{t,n}$ by controlling $f^L_{t,n}$, and the instrument for the counter-Connect investor is $f^{C,\perp}_{t,n}$ by controlling $f^C_{t,n}$.

Two-Stage Procedure. Given the choice of these exogenous instruments, the elasticity parameter in equation (5) can be estimated by two-stage regressions: cross-sectional regressions for the exogenous flow pressure, plus the panel regression for the elasticity estimation.

1. In the first stage, for every period t, we run a cross-sectional regression of price change

$\Delta p_{t,n}$ on the orthogonal flow pressure to obtain an exogenous price change $\widehat{\Delta p_{t,n}}$.

$$\Delta p_{t,n} = \theta_{0,t} f_{t,n}^{L,\perp} + \sum_{k=1}^{K-1} \theta_{k,t} z_{k,t-1,n} + \epsilon_{t,n}, \tag{10}$$

where control variables $\mathbf{Z_{t-1,n}}$ include the same stock characteristics in the construction of IV in equation (9), except for the market equity because of its endogeneity.

2. In the second stage, we run a panel regression of investors' demand changes $\Delta q_{t,n}$ on their projected or exogenous price changes $\widehat{\Delta p_{t,n}}$ to estimate the elasticity parameter.

$$\Delta q_{t,n} = -\zeta_{t,n} \widehat{\Delta p_{t,n}} + \sum_{k=1}^{K-1} \gamma_k^{CS} z_{k,t-1,n} + \sum_{j=1}^{J} \gamma_j^{TS} x_{j,t-1} + \epsilon_{t,n} \tag{11}$$

For the control variables, except the same stock characteristics $\mathbf{Z_{t-1,n}}$ in the first stage, we also include aggregate predictors $\mathbf{X_{t-1}}$, such as CNYHKD, USDX, and various aggregate market variables (turnover, volatility, short-term reversal, and momentum).

One innovation of this paper for demand-based asset pricing is considering heterogeneous and time-varying modelling for the elasticity parameter as

$$\zeta_{t,n} = \zeta_0 + \sum_{k=1}^{K-1} \zeta_k^{CS} z_{k,t-1,n} + \sum_{j=1}^{J} \zeta_j^{TS} x_{j,t-1}. \tag{12}$$

The lag stock characteristics, $\mathbf{Z_{t-1,n}}$, capture the underlying cross-sectional variation, while the aggregate predictors, $\mathbf{X_{t-1}}$, reflect the macroeconomic dynamic variation.

Equation (11) is about the relationship between the change of log demand and the change of log price. With the estimates for price elasticities, one can construct the relationship between the level of log demand and the level of log price. Following Koijen and Yogo (2019) and van der Beck (2022b), we restrict the values of elasticity estimates $\widehat{\zeta_{t,n}}$ and run a panel regression to estimate the level of the fundamental-based demand curve,

$$\log C_{t,n} = \beta_0 + \underbrace{-\widehat{\zeta}_{t,n} \log P_{t,n}}_{\text{price-driven demand}} + \underbrace{\sum_{k=1}^{K-1} \beta_k^{CS} z_{k,t-1,n} + \sum_{j=1}^{J} \beta_j^{TS} x_{j,t-1}}_{\text{fundamental-based demand}} + \underbrace{\varepsilon_{t,n}}_{\text{latent demand}}, \tag{13}$$

where β_0 is the inherent level for the log demand of all eligible stocks. In addition to the first part of price-driven demand, the projected log demand is driven by the second part of fundamental stock characteristics and aggregate predictors.

Additionally, following Koijen and Yogo (2019), we interpret the residual $\varepsilon_{t,n}$ as the latent demand to the total demand for Connect or counter-Connect investors. This latent demand is unexplained by controlling the price impact, stock characteristics, and aggregate predictors. It can be viewed as a demand shock, which might contain other information about the future cash flows of stock demands.

4 Estimating Connect Demand System

4.1 Estimating Elasticity

Equation (11) allows us to evaluate the roles of stock characteristics in the cross-sectional variation and aggregate predictors in the time-series variation of elasticity estimates. The Stock Connect Scheme allows us to separate the aggregate demand curves for the Connect and counter-Connect investors in Northbound and Southbound. Table 2 reports demand system estimation results for Northbound and Southbound. The coefficients show the linear exposures for stock characteristics and aggregate predictors to the elasticity estimates.

Aggregate Elasticity. Figure 6 displays the time-varying elasticity estimates from Table 2. The time series of the cross-sectional median for Connect elasticity and counter-Connect elasticity estimates are plotted, along with the 10% and 90% cross-sectional estimates. Recall the price impact is the inverse of the elasticity.

For the Northbound, we find a 1% increase in the stock price leads to a relatively small 0.31% drop in the demand from Northbound investors, while the elasticity for the Mainland investors is higher, reaching 0.59%. The time series of elasticity estimates are mostly below 1, which indicates Mainland A-shares are inelastic to both Mainland and Northbound investors. The Northbound investors have lower elasticities and higher price impacts than the local Mainland investors to A-shares. In addition to the wider cross-sectional intervals, the elasticities of Northbound investors have changed dramatically over time, which reflects their capital inflows and outflows to the Mainland market. These facts are consistent with the market-timing impression for Northbound investors.

For the Southbound connect, a 1% increase in the stock price leads to a considerable 0.96% drop in the demand from Mainland investors, while the elasticity for the Hong Kong investors is 0.85%. We also find the elasticities for Southbound and Hong Kong investors are relatively stable over time and around 1. The cross-sectional variations are also relatively small. These similar estimates for Southbound and Hong Kong investors are consistent with their similar investment performance in Figure 1. The Hong Kong stock market is relatively more developed and not particularly sensitive to inflows or outflows from Southbound investors.

Elasticity Cross-Sectional Variations. Figure 7 displays cross-sectional variations of elasticity estimates for eligible stocks in Mainland and Hong Kong markets. We calculate the value-weighted aggregate elasticities of stocks in each quintile-sorted group for characteristics considered in equation (11). The average elasticity estimates for both Connect investor and count-Connect investor are plotted.

For eligible Mainland stocks, the elasticities for Mainland investors don't change much for quintile-sorted groups of different characteristics. However, the elasticities for Northbound investors have clear monotonic patterns with beta, volatility, turnover, and momentum. For example, the average elasticity of the highest turnover group is more than 0.7, while that of the lowest turnover group is less than 0.1. The price impacts from Northbound investors to stocks of these two groups are about 1.4 and 10. That is, a 1% capital inflow into stocks of the lowest turnover group might create a 10% jump. In addition, the coefficient for turnover in Table 2 is also highly significant with the correct sign. We also find similar strong model-implied patterns for the characteristics momentum, which distinguishes annual winner and loser stocks. The average elasticity of the winner group is more than 0.6, while that of the loser group is less than 0.1. That is, a 1% capital outflow into stocks of the lower group might create a 10% drop. There is also a slight positive relationship between momentum and elasticity for Hong Kong investors.

For eligible Hong Kong stocks, the elasticities for both Mainland and Hong Kong investors show similar cross-sectional patterns. The elasticities for beta, volatility, and turnover show monotonic patterns for quintile-sorted groups but are opposite to the Mainland stocks. Mainland and Hong Kong investors are elastic to the lowest beta/volatility/turnover groups but inelastic to the highest beta/volatility/turnover groups. A 1% capital inflow from Southbound investors to the highest volatility group creates a 1.4% return, which is about 1.6% for Hong Kong investors. These relatively low reactions to capital inflows or outflows show the development of the Hong Kong stock market.

Elasticity Time-Series Variations. Figures 8 displays time-series variations of average elasticity estimates for eligible stocks in Northbound and Southbound. We create the value-weighted aggregate elasticities of stocks in each quintile-sorted group for aggregate predictors considered in equation (11). The average elasticity estimates for both Connect and count-Connect investors are plotted.

For eligible Mainland stocks, the elasticities for Mainland investors don't change much for quintile-sorted groups of different aggregate predictors. However, the elasticities for Northbound investors have clear monotonic patterns with the CNYHKD exchange rate, market volatility and turnover. The elasticities are about 0.5 and 0.2 for the highest and lowest CNYHKD periods in the past five years. Therefore, when CNY's valuation is high, a 1% Northbound capital inflow might create a 5 % jump for eligible Mainland stocks on average. The average price impacts drop to 2 when the valuation of CNY is low. Consistently, the coefficient for CNYHKD in Table 2 is 0.288 and marginally significant.

For eligible Hong Kong stocks, the elasticities for both Mainland and Hong Kong investors show similarly low responses to aggregate predictors, consistent with Figure 6. The Southbound elasticities are higher than Hong Kong investors in all periods.

4.2 Estimating Demand Curve

Table 3 reports demand system estimation results of eligible Mainland and Hong Kong stocks for equation (13). The coefficients show the linear exposures for stock characteristics and aggregate predictors to the projected demand.

For eligible Mainland stocks, Northbound investors show economically and statistically high demands for high turnover and momentum stocks. Turnover can be a proxy of reaction to market sentiment (Baker and Wurgler, 2006), i.e., a high turnover value implies a positive investor sentiment for the stock demand. Our estimation is consistent with Liu et al. (2019)'s use of abnormal turnover to create the fourth factor for the Mainland stock market. Mainland investors also show economically and statistically high demands to high momentum stocks. Furthermore, we find opposite demand responses for Mainland and Northbound investors to exchange rates of CNYHKD and the US dollar index. Though there is a peg between Hong Kong and US dollars, their valuation increases show different impacts on Northbound investors. Finally, when the market is volatile, Northbound investors tend to reduce their demand, but Mainland investors still increase their demand.

For eligible Hong Kong stocks, Southbound investors show economically and statistically high demand for high-turnover stocks. Other significant characteristics show small coefficients. This is consistent with Lam and Tam (2011) finding that liquidity is important in the Hong Kong market, and their paper uses turnover ratio as the proxy for stock liquidity. When the exchange rate of CNYHKD is high or the market is volatile, Southbound and

Hong Kong investors tend to reduce their demand for Hong Kong stocks.

5 Investment on Projected Demands

The demand might be higher for those stocks with higher expected returns in the future, and the heterogeneous demand might drive the cross-sectional expected returns. Following equation (5), we can decompose the total demand (change of holdings) of stock into three components: price-driven demand, fundamental-based demand, and latent demand, thereby helping us understand how Connect investor creates value. This section focuses on the cross-sectional return predictability driven by different demand components and the implied investment opportunities.

5.1 Demand Factors on Demand Decomposition

Eligible Mainland Stocks. Figure 9 displays the weekly average returns for quintile portfolios sorted on components for eligible stocks in Northbound. In the last week of each month, stocks are sorted to create quintile value-weighted portfolios and rebalanced on a monthly basis. Without decomposing the total demand, there are no clear patterns between the demand magnitude and average returns. When we decompose the demand into three components, we find that sorted portfolios on the price-driven demand show a strong monotonic relationship with the return. The high-demand portfolios deliver about 0.5% average weekly returns in the sample, while the low-demand one has a negative value of about 0.2%. The findings on price-driven demand are consistent for both Connect and counter-Connect demands, and the top and bottom portfolio spreads are even larger for the counter-Connect demand. These findings on price-drive demand and average returns are only available because the Stock Connect Scheme allows one to divide the investor universe into two major groups.

For the other two components of the projected demands, the fundamental-based demand is the projected value on stock characteristics and aggregate predictors, and the latent demand is the residual unexplained by the demand equation. For the counter-Connect demand, we still find clear monotonic relationships between average returns and these two components, respectively. In particular, the top and bottom portfolio spread on the latent demand are larger than 0.2%. Due to the relatively low holding weights (about 3%) from the Connect investors, these two components from the Connect demand do not show any cross-sectional return predictability.

Table 4 shows the risk-adjusted investment performance for sorted portfolios on components of the estimated demand curve equation (13). The long-short portfolio in Panel A is the spread between the top and bottom quintile portfolios, and the long-only portfolio in Panel B is the top quintile portfolio sorted on demand components. In addition to the weekly Sharpe ratio, we provided CAPM alphas on either the Connect stock universe (about three quarters of the total market cap) or all stocks in the Mainland market.

For the Connect demand, the long-short portfolio on price-driven demand has incredibly high weekly average returns of 0.61% and highly significant CAPM alphas of 0.63%. The weekly Sharpe ratio is 0.31, above 2.2 for an annualized value. These numbers are even higher for the counter-Connect demand, which delivers 0.79% CAPM alphas and a 0.34 Sharpe ratio. With small market betas, these long-short portfolios are excellent market-neutral strategies. Notice that, our portfolios are rebalanced on a monthly basis with relatively low transaction costs. With the short sale constraint, we can only consider the long-only portfolios. The counter-Connect demand still offers 0.43% CAPM alphas and a 0.29 Sharpe ratio. This is strong evidence to show our generated price-driven demand's underlying cross-sectional return predictability.

Again, without decomposing the total demand, long-short and long-only portfolios on the total demand show negligible risk-adjusted investment performance. For the counter-Connect demand, the long-short portfolio on the latent demand still offers 0.27% CAPM alphas with slightly negative CAPM betas. Though Mainland investors dominate the market, these positive results based on the latent demand imply that there might be investment information beyond stock characteristics and aggregate predictors not captured by Northbound investors.

Eligible Hong Kong Stocks. Figure 10 displays the weekly average returns for quintile portfolios sorted on components for eligible stocks in Southbound. We also find that sorted portfolios on price-driven demand show a strong monotonic relationship with the return. The high-demand portfolios deliver about 0.38% average weekly returns, while the low-demand one has a value of about -0.3%. Different from the Mainland market, we also find a monotonic relationship between average returns and total demand. The high-demand portfolio has an average weekly return of 0.3%, while the lowest has a negative value of 0.1%. The findings on total demand and price-driven demand are consistent for both Connect and counter-Connect demands. As for the other two components of the projected demands, we do not find any clear relationship between fundamental-based and latent demands with average returns.

Table 5 shows the risk-adjusted investment performance for sorted portfolios on components from Southbound. For the Connect demand, the long-short portfolio on price-driven demand has a relatively high weekly average return of 0.70% and highly significant CAPM alphas of 0.71% and 0.76%. The weekly Sharpe ratio is 0.27, above 1.91 for an annualized value. These numbers are almost the same for the counter-Connect demand. As for the long-short portfolio on the total demand, the Connect demand has an average return of 0.42%, and the counter-Connect demand has a value of 0.35%. With slightly negative market betas, these long-short portfolios are also demonstrated to be excellent market-neutral strategies as results for the Northbound.

With the short sale constraint, we show the performance of long-only portfolios in Panel B. We can see a significant drop in the average weekly returns and alphas of the portfolios derived from price-driven demand. For average returns, there is a drop from 0.70% to 0.36%. For CAPM alphas, the decreases are from 0.71% and 0.76% to 0.28% and 0.30%, respectively. For the long-only portfolios derived on the total demand, its CAPM alphas are also reduced considerably from 0.42% and 0.35% to 0.26% and 0.10% for the Connect and counter-Connect demands. Unlike Northbound for the Mainland market, the latent demand of Southbound does not show any additional investment information. We argue that there is no investment skill difference between Mainland investors through the Southbound and Hong Kong investors from this perspective of latent demands.

5.2 Investment on Holdings

In this section, we test other holding-based investment strategies and compare them with our demand decomposition. The most direct way is to study the changes in the positions of Connect investors, as the $\Delta q_{t,n}$ in equation (6). Changes in portfolio weights reflect portfolio adjustments and thus recent information about security demands and returns.

Cremers and Petajisto (2009) and Jiang et al. (2014) emphasise the deviation of portfolio holdings from the holdings of the benchmark. They think that the wisdom of active portfolio management of fund managers is reflected in their overweighting decisions, which contain valuable information about future stock returns. Based on the Stock Connect setting, we define the deviation (DEV) for stock n at period t as the difference between the weight of Connect portfolio and the weight of Market portfolio[10]

$$DEV_{t,n} = w^C_{t,n} - w^M_{t,n}. \tag{14}$$

Apart from the above-mentioned demand change and deviation, there are other methods to analyze investor holdings information and use them for investment. However, to construct the measure, they mainly rely on the large cross-section of various investors, such as holdings dispersion (Jiang and Sun, 2014), or rely on the aggregate holdings information, such as reliance on public information (Kacperczyk and Seru, 2007), and fund return gap (Kacperczyk

[10]The weight of market portfolio, for example, for stock n at period t, is $w^M_{t,n} = \frac{P_{t,n}M_{t,n}}{\sum_{n=1}^{N_t} P_{t,n}M_{t,n}}$, where $M_{t,n}$ is the shares outstanding.

et al., 2008), which cannot reflect individual investor's preference at individual stock.

We construct their portfolios of them in a similar way to construct demand factors in the last section. Figure 11 displays the cumulative returns of portfolios formed by demand decomposition, holding deviation, and holding change[11]. It is obvious to see that for both Northbound and Southbound, neither of them captures the superior investment capabilities of Connect investors. The cumulative value of their portfolios only sees little noticeable growth over the past 5 years. Consistent with the predictability ability shown by the demand-decomposition factors in the previous section, the value of portfolios formed on price-driven components increases by up to 8 times and 6 times for Northbound and Southbound respectively. This further supports that richer investment implications can be extracted from the joint moments of prices and quantities under demand estimation and demand decomposition.

6 A-H Share Premium

6.1 Enlarged A-H Share Premium

The famous A-H share premium puzzle is about the share price difference for dual-listed stocks in Mainland and Hong Kong stock markets. The A-share prices are mostly higher than the H-share counterpart, and such cross-listing discounts might encourage long-term investors to shift from A shares to H shares for higher dividend yields. There are many possible explanations for the A-H share premium, such as limited alternative investments of Mainland investors (Fernald and Rogers, 2002), policy and corporate governance change (Cai et al., 2011), informational and anchoring role (Chang et al., 2013), political uncertainty (Cheng et al., 2021), and etc. Since the Stock Connect, Fan and Wang (2017) show the effectiveness of the Shanghai-Hong Kong Stock Connect policy in reducing the A-H share price gap. In this section, we attempt to explain this premium reduction in terms of market

[11] We only show the demand change of Connect investor. Due to the calculation of Δq from equation (6), the counter-Connect investor's demand change is exactly the inverse of Connect investor's.

integration and demand changes.

The A-H premium for stock n at time t is calculated as the ratio of A share price $P^A_{t,n}$ to its corresponding H share price $P^H_{t,n}$ at time t after adjusting the exchange rate between onshore RMB and the Hong Kong dollar.

$$AHP_{t,n} = \frac{P^A_{t,n} * CNYHKD_t}{P^H_{t,n}} \tag{15}$$

Therefore, the A-share stock trades at a premium to its H-share counterpart if $AHP_{t,n} > 1$ and at a discount, if $AHP_{t,n} < 1$.

We plot the histogram for the cross-sectional A-H share ratios for mid-2018 and mid-2022 in the bottom plot of Figure 12. One can find a larger cross-sectional variation for A-H share ratios after the COVID-19 pandemic. For the top plot of Figure 12, we create a value-weighted portfolio for dual-listed stocks using their Hong Kong market equity values and plot the time series for the A-H price ratio. The empirical evidence is that the A-H premium has been fluctuating dramatically but enlarging over the past five years.

The increase of this premium is the direct result of the enlargement of the difference between A share's price change $\Delta P^A_{t,n}$ and H share's price change $\Delta P^H_{t,n}$. Based on our modeling of the investor demand curves, the price space can be projected into the demand by the inverse of price elasticity as in equation (5). In the integrated Mainland stock market, the price impact for A share is $\Delta P^A_{t,n} \propto (\zeta^{IA}_{t,n})^{-1} \Delta q^{IA}_{t,n}$, and in integrated Hong Kong stock market, the price impact for H share is $\Delta P^H_{t,n} \propto (\zeta^{IH}_{t,n})^{-1} \Delta q^{IH}_{t,n}$. The overvaluation of A share to H share can thus be attributed to a price-impact premium between A share and H share

$$\begin{aligned} AHP_{t,n} &= \log P^A_{t,n} - \log P^H_{t,n} - \log CNYHKD_t \\ &\propto \underbrace{-\zeta^{IA}_{t,n}(z_{t-1,n}, x_{t-1})^{-1} \log q^{IA}_{t,n} + \zeta^{IH}_{t,n}(z_{t-1,n}, x_{t-1})^{-1} \log q^{IH}_{t,n}}_{\text{A-H price impact premium}} - \log CNYHKD_t. \end{aligned} \tag{16}$$

Following Gabaix and Koijen (2021), market elasticity is the size-weighted elasticity of market participants, and the measure of size is the share of equity they hold. For example, in an integrated Mainland market, the aggregate elasticity $\zeta_{n,t}^{IA}$ for a firm's stock n at time t is defined as the ownership weighted sum of elasticity of A shares held by local market and elasticity of H shares held by Southbound,

$$\zeta_{t,n}^{IA} = \frac{L_{t,n}^{A}}{L_{t,n}^{A} + C_{t,n}^{A,Connect}} \zeta_{t,n}^{A} + \frac{C_{t,n}^{A,Connect}}{L_{t,n}^{A} + C_{t,n}^{A,Connect}} \zeta_{t,n}^{A,Connect}, \tag{17}$$

and for the integrated Hong Kong market, the aggregate elasticity $\zeta_{n,t}^{IH}$ is the weighted sum of the elasticity of H shares held by the local market and the elasticity of A shares held by the Northbound

$$\zeta_{t,n}^{IH} = \frac{L_{t,n}^{H}}{L_{t,n}^{H} + C_{t,n}^{H,Connect}} \zeta_{t,n}^{H} + \frac{C_{t,n}^{H,Connect}}{L_{t,n}^{H} + C_{t,n}^{H,Connect}} \zeta_{t,n}^{H,Connect}. \tag{18}$$

Since the total shares in a market are almost fixed in the short-term, we assume that there is no change in the demand of the entire integrated market, that is, $\Delta q^{IA} = 1$ and $\Delta q^{IH} = 1$, then the premium is totally determined by the price elasticities. The toy model implies that the lower the elasticities of the Mainland local market and Southbound, the higher the premium, and the higher elasticities of the Hong Kong local market and Northbound, the higher the premium.

Our hypothesis is intuitive because Stock Connect makes it easier for Mainland investors to invest the discounted H shares, and also reduces the restrictions of overseas investors to access the probably less efficient A shares. The cross-sectional variation of price elasticity from local investors plays a role in determining the level of A-H premia in the cross section. Since the Stock Connect, the additional but heterogeneous investment demands from Connect (overseas) investors allow us to decompose the cross-sectional variation of A-H premia. These effects from price elasticity might be higher for the discounted H-shares.

6.2 Price Impact to A-H Share Premium

Recall that, our elasticity estimates are heterogeneous and time-varying. We run the below panel regression for evaluating the effects of demand elasticity on the A-H premium.

$$\Delta AHP_{t,n}^{Adj} = \lambda_0 + \lambda_A \zeta_{t,n}^{A} + \lambda_{A,Connect} \zeta_{t,n}^{A,Connect} + \lambda_H \zeta_{t,n}^{H} + \lambda_{H,Connect} \zeta_{t,n}^{H,Connect} + controls + \epsilon_{t,n} \tag{19}$$

$\Delta AHP_{t,n}^{Adj}$ is the A-H premium change after adjusting the exchange rate. Fixed effect for stocks is controlled. Standard errors are clustered by week and stock. We consider different combinations of control variables, firm characteristics for cross-sectional variation, and aggregate predictors (CNYHKD and USDX) for time-series variation.

We run the regression in Model (1) on the four elasticity variables. None of these four elasticities is significant. In Model (2), we follow Fan and Wang (2017) and consider stock characteristics as cross-sectional controls, including lag market equity, beta, turnover, and volatility from both the Mainland market and the Hong Kong market. In Model (3), we follow Zhang et al. (2020) and consider market predictors as controls, including lag CNYHKD and USDX. Model (4) controls both stock characteristics and market predictors. We find the coefficients for ζ^A and $\zeta^{H,Connect}$ are more negatively significant, and the coefficient for $\zeta^{A,Connect}$ is more positively significant. Consistent with what is shown in equation (16), the decrease in $\zeta^{A,Connect}$ and the increase in $\zeta^{H,Connect}$ increases the premium of price pressure on A share and H share, which in turn leads to an increase in the premium of their stock prices. This explains why the A-H share premium has increased since the Stock Connect Scheme was launched, especially in recent years. Strong demand for A-shares from Northbound investors pushes up the prices of some stocks, while Southbound investors also have some demand for H-shares, but the impact they cause is limited. As for the positive coefficient of the Mainland local market ζ^A, it goes in the opposite direction of what we expect to lead to an increase in the premium, which suggests that demand from Mainland investors is not pushing it up right now.

7 Conclusion

This paper exploits the unique Stock Connect Scheme for China's capital market liberalization and integration. We observe that aggregate holdings of Northbound and Southbound in the Connect Scheme have achieved very high returns relative to the local markets, given the same investment universe in the Mainland stock market and Hong Kong stock market. Especially for the Northbound, it has gained nearly 250% over the past five years. This motivates us to study the source of their outperformance and understand the price impact, as well as to mine information that can be used for investment and to help us understand the Chinese market efficiency. We propose a dual-investor demand system for a representative investor for Stock Connect and its local counterpart. Our model estimates the heterogeneous and time-varying price elasticity for the demand curves of individual stocks. We identify their underlying driven sources of stock characteristics and aggregate predictors.

We find the Northbound is inelastic with an average elasticity of 0.29, implying their great impact on the Mainland market, so their demands are relatively stable even when the market is volatile. However, the Southbound is almost elastic within the average elasticity of 0.95, implying the demand from Mainland investors to the Hong Kong market is less stable, thus weaker price impacts. The difference in their elasticity reflects that the degree of diversification brought about by the liberalization is different for investors on both sides. The weak substitution effect in the Mainland market makes the demand for Northbound very active, while the strong substitution effect in the Hong Kong market makes Southbound less attractive.

We make novel contributions to the investment on investor holdings information. By decomposing the projected demand into three parts: price-driven demand, fundamental-related demand, and latent demand, we find that sorted portfolios on the price-driven demand have a strong monotonic relationship with the return. A long-only strategy for high price-driven demand stocks delivers a weekly alpha of 0.39% (0.43%) and 0.28% (0.28%) for the Connect (counter-Connect) investors in Northbound and Southbound during the past five years. The sorted portfolios on latent demand of Northbound also show investment value with weekly alpha 0.27%, but that of Southbound does not. This shows the reason that Northbound realises higher returns than Southbound.

Finally, we find the demand elasticities of Mainland investors in the Mainland and Hong Kong markets play important roles in explaining the cross-sectional variation of the A-H share ratios. After Stock Connect is established, we show that the demand from Southbound investors helps to lower the premium, but as the demand from Northbound investors is enormous and the A shares are exposed to stronger price pressure, it expands instead.

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Table 1: **Summary Statistic: Log Changes for Price and Demand**

	Obs	Mean	Std	Percentiles 5%	25%	50%	75%	95%	Correlation Matrix Δp	Δq^C	Δq^{XC}
Panel A. Eligible Mainland Stocks											
Δp	532,485	-0.23	5.40	-7.53	-2.81	-0.51	2.08	8.41	1.00	0.03	-0.04
Δq^C	532,485	-0.16	23.81	-36.71	-4.22	-0.79	4.02	37.76	0.03	1.00	-0.87
Δq^{XC}	532,485	0.07	4.25	-0.49	-0.24	-0.21	-0.18	0.13	-0.04	-0.87	1.00
Panel B. Eligible Hong Kong Stocks											
Δp	152,119	-0.22	5.30	-1.39	-0.48	0.92	7.58	7.96	1.00	0.04	-0.03
Δq^C	152,119	-0.04	5.01	-0.13	-0.08	-0.06	0.20	7.70	0.04	1.00	-0.78
Δq^{XC}	152,119	-0.08	1.65	-0.49	-0.13	-0.08	-0.06	0.20	-0.03	-0.78	1.00

Note: This table reports summary statistics for weekly log changes for price (Δp) and demand (Δq^C and Δq^{XC} for Connect and counter-Connect Market). The formula for Δq is in equation (6). We include the averages of summary statistics for the cross section from March 2017 to June 2022 of all eligible stocks in either Mainland or Hong Kong stock markets. We also report the averages of the cross-sectional Spearman's rank correlation matrix.

Table 2: **Demand System Estimation for Price Elasticity**

	Connect		Counter-Connect	
	Coefficient	t-statistics	Coefficient	t-statistics
	Panel A. Eligible Mainland Stocks			
Constant	0.305***	(4.26)	0.595***	(21.07)
Beta	-0.009	(-0.15)	-0.066***	(-4.55)
Volatility	0.064**	(2.48)	-0.046***	(-5.75)
Turnover	0.299***	(5.68)	-0.034**	(-2.04)
Reversal	0.120*	(1.89)	0.055***	(3.76)
Momentum	0.286***	(5.06)	0.139***	(8.19)
CNYHKD	0.288*	(1.75)	-0.075	(-1.15)
USDX	0.196	(1.17)	-0.089	(-1.50)
Market volatility	-0.112	(-0.89)	0.029	(0.60)
Market turnover	-0.305	(-1.64)	0.028	(0.31)
Market reversal	-0.090	(-0.66)	-0.007	(-0.17)
Market momentum	0.072	(0.40)	-0.078	(-1.17)
	Panel B. Eligible Hong Kong Stocks			
Constant	0.955***	(29.55)	0.859***	(34.37)
Beta	-0.180***	(-6.41)	-0.16***	(-6.59)
Volatility	-0.180***	(-8.55)	-0.166***	(-9.85)
Turnover	-0.051**	(-2.55)	-0.083***	(-6.81)
Reversal	0.031	(1.51)	0.056***	(4.04)
Momentum	0.045**	(2.47)	0.052***	(3.57)
CNYHKD	0.055	(1.21)	0.022	(0.51)
USDX	-0.016	(-0.23)	0.001	(0.02)
Market volatility	-0.041	(-0.57)	-0.066	(-1.22)
Market turnover	-0.072	(-1.24)	0.007	(0.14)
Market reversal	-0.022	(-0.48)	-0.064*	(-1.80)
Market momentum	0.076	(1.12)	-0.009	(-0.15)

Note: This table reports demand system estimation results for eligible Mainland and Hong Kong stocks for equation (11). The coefficients show the linear exposures for stock characteristics and aggregate predictors to the elasticity estimates. Fixed effect for stocks is controlled. Standard errors are clustered for week and stock. We report t-statistics in parentheses. Also, *, **, and *** denote significance at the 10%, 5%, and 1% significance levels.

Table 3: **Demand System Estimation for Demand Levels**

	Connect		Counter-Connect	
	Coefficient	t-statistics	Coefficient	t-statistics
	Panel A. Mainland Eligible Stocks			
Beta	0.151***	(5.58)	-0.104***	(-17.98)
Volatility	0.144***	(6.71)	-0.095***	(-23.18)
Turnover	1.253***	(22.33)	-0.127***	(-8.18)
Reversal	0.058***	(2.78)	0.196***	(41.51)
Momentum	0.301***	(8.38)	0.493***	(67.91)
CNYHKD	0.587***	(18.11)	-0.204***	(-25.65)
USDX	0.345***	(9.19)	-0.199***	(-22.63)
Market volatility	-0.322***	(-10.94)	0.047***	(6.73)
Market turnover	-1.182***	(-23.31)	-0.031***	(-2.80)
Market reversal	-0.305***	(-12.74)	-0.041***	(-6.82)
Market momentum	-0.050	(-1.21)	-0.229***	(-24.10)
	Panel B. Hong Kong Eligible Stocks			
Beta	0.260***	(8.62)	0.156***	(9.04)
Volatility	0.112***	(2.92)	0.142***	(4.98)
Turnover	0.374***	(10.10)	0.122***	(5.34)
Reversal	0.034***	(2.74)	0.015	(1.60)
Momentum	0.126***	(4.36)	0.170***	(10.95)
CNYHKD	-0.145***	(-3.78)	-0.027	(-1.31)
USDX	0.103**	(2.11)	0.077**	(2.55)
Market volatility	-0.241***	(-4.96)	-0.124***	(-4.50)
Market turnover	-0.078*	(-1.88)	-0.063***	(-2.57)
Market reversal	-0.034	(-1.22)	0.005	(0.27)
Market momentum	0.072	(1.43)	0.103***	(3.52)

Note: This table reports demand system estimation results of eligible Mainland and Hong Kong stocks for equation (13). The coefficients show the linear exposures for stock characteristics and aggregate predictors to the projected demand. Fixed effect for stocks is controlled. Standard errors are clustered for week and stock. We report t-statistics in parentheses. Also, *, **, and *** denote significance at the 10%, 5%, and 1% significance levels.

Table 4: **Demand-Sorted Investment for Northbound**

	Connect				Counter-Connect			
	Demand	Price	Funda	Latent	Demand	Price	Funda	Latent
				Panel A. Long-Short Portfolios				
Avg (%)	0.06	0.61	-0.10	0.01	-0.11	0.81	0.09	0.23
Sharpe	0.04	0.31	-0.05	0.01	-0.08	0.34	0.05	0.12
α (%)	0.04	0.63***	-0.13	0.04	-0.09	0.79***	0.07	0.27***
	(0.42)	(5.20)	(-1.07)	(0.40)	(-1.03)	(5.39)	(0.55)	(2.35)
$\beta_{MKT}^{Connect}$	0.07**	-0.07	0.10**	-0.09**	-0.05	0.07	0.09*	-0.11**
	(2.04)	(-1.31)	(1.99)	(-2.33)	(-1.53)	(1.11)	(1.78)	(-2.45)
α^{All} (%)	0.04	0.63***	-0.13	0.04	-0.09	0.79***	0.07	0.27**
	(0.40)	(5.20)	(-1.09)	(0.41)	(-1.02)	(5.38)	(0.56)	(2.35)
β_{MKT}^{All}	0.07**	-0.06	0.10**	-0.09**	-0.05	0.07	0.08	-0.11**
	(2.06)	(-1.29)	(2.02)	(-2.30)	(-1.53)	(1.10)	(1.64)	(-2.35)
				Panel B. Long-Only Portfolios				
Avg (%)	0.17	0.48	0.12	0.21	0.09	0.56	0.15	0.48
Sharpe	0.10	0.30	0.07	0.14	0.06	0.29	0.09	0.27
$\alpha^{Connect}$ (%)	0.06	0.39***	0.00	0.11	0.00	0.43***	0.03	0.36***
	(0.71)	(4.27)	(0.03)	(1.32)	(-0.06)	(4.19)	(0.42)	(3.71)
$\beta_{MKT}^{Connect}$	0.32***	0.25***	0.36***	0.30***	0.28***	0.38***	0.36***	0.35***
	(8.72)	(6.65)	(9.39)	(8.51)	(8.87)	(8.90)	(10.30)	(8.54)
α^{All} (%)	0.06	0.39***	0,00	0.11	-0.01	0.43***	0.03	0.36***
	(0.64)	(4.22)	(-0.03)	(1.24)	(-0.11)	(4.12)	(0.35)	(3.65)
β_{MKT}^{All}	0.33***	0.25***	0.35***	0.30***	0.28***	0.38***	0.35***	0.35***
	(8.88)	(6.70)	(9.34)	(8.68)	(8.81)	(8.96)	(10.23)	(8.64)

Note: This table shows the investment performance for sorted portfolios on components of the estimated demand curve equation (13), shown in Figure 9. “Demand” sorts portfolios on the observed log demand, “Price” sorts on the price-driven demand, “Funda” sorts on the fundamental-based demand, and “Latent” sorts on the residual latent demand. We report the weekly average and Sharpe ratio for sorted portfolios. In addition, we also show the risk-adjusted performance of CAPM on the Connect eligible stock (with superscript ”Connect”) and aggregate market for Northbound (with superscript ”All”), respectively. Also, *, **, and *** denote significance at the 10%, 5%, and 1% significance levels.

Table 5: **Demand-Sorted Investment for Southbound**

	Connect				Counter-Connect			
	Demand	Price	Funda	Latent	Demand	Price	Funda	Latent
				Panel A. Long-short portfolio				
Avg (%)	0.42	0.70	0.02	-0.04	0.35	0.70	-0.03	-0.06
Sharpe	0.21	0.27	0.01	-0.02	0.17	0.28	-0.01	-0.03
$\alpha^{Connect}$ (%)	0.46***	0.71***	-0.03	-0.01	0.39***	0.71***	-0.05	-0.05
	(3.84)	(4.48)	(-0.20)	(-0.14)	(3.20)	(4.55)	(-0.34)	(-0.40)
$\beta^{Connect}_{MKT}$	-0.17***	-0.05	0.21***	-0.10**	-0.15***	-0.06	0.09	-0.03
	(-3.95)	(-0.95)	(3.78)	(-2.55)	(-3.41)	(-1.01)	(1.61)	(-0.60)
α^{All} (%)	0.48***	0.76***	-0.02	-0.02	0.38***	0.76***	-0.03	-0.07
	(3.76)	(4.61)	(-0.12)	(-0.18)	(2.91)	(4.74)	(-0.16)	(-0.52)
β^{All}_{MKT}	-0.13**	-0.07	0.22***	0.00	-0.08	-0.07	0.11	0.05
	(-2.53)	(-1.00)	(3.26)	(-0.09)	(-1.59)	(-1.06)	(1.61)	(1.04)
				B. Long-only portfolios				
Avg (%)	0.26	0.36	0.18	-0.03	0.10	0.36	0.00	-0.04
Sharpe	0.16	0.20	0.09	-0.02	0.05	0.20	0.00	-0.02
$\alpha^{Connect}$ (%)	0.18**	0.28***	0.08	-0.10	0.22**	0.28***	-0.08	-0.11
	(2.14)	(2.85)	(0.73)	(-1.30)	(2.10)	(2.82)	(-0.93)	(-1.54)
$\beta^{Connect}_{MKT}$	0.29***	0.32***	0.26***	0.26***	0.45***	0.32***	0.30***	0.26***
	(9.36)	(9.23)	(10.88)	(9.64)	(12.12)	(9.21)	(9.87)	(7.78)
α^{All} (%)	0.23**	0.30***	0.09	-0.06	0.19	0.30***	-0.06	-0.08
	(2.37)	(2.73)	(0.78)	(-0.74)	(1.56)	(2.76)	(-0.68)	(-0.93)
β^{All}_{MKT}	0.21***	0.25***	0.37***	0.21***	0.35***	0.25***	0.24***	0.19***
	(5.27)	(5.52)	(7.76)	(6.25)	(6.89)	(5.48)	(6.09)	(4.40)

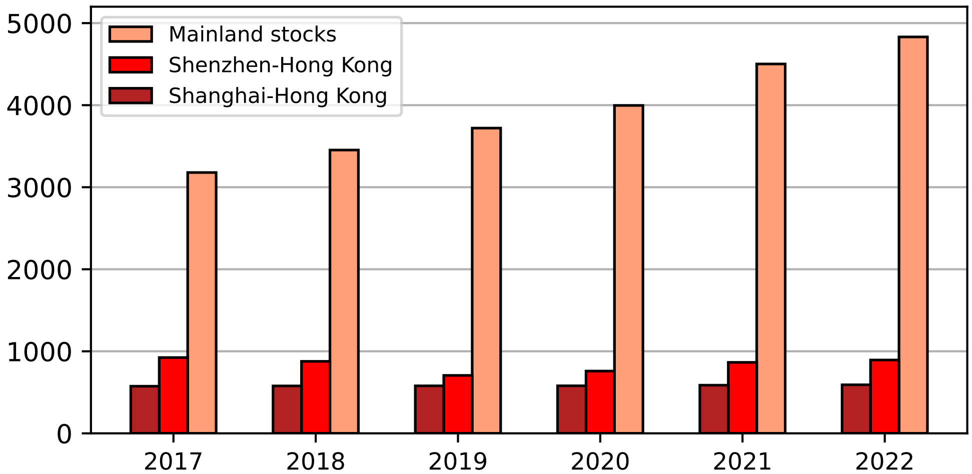
Note: This table shows the investment performance for sorted portfolios on components of the estimated demand curve equation (13), shown in Figure 10. “Demand” sorts portfolios on the observed log demand, “Price” sorts on the price-driven demand, “Funda” sorts on the fundamental-based demand, and “Latent” sorts on the residual latent demand. We report the weekly average and Sharpe ratio for sorted portfolios. In addition, we also show the risk-adjusted performance of CAPM on the Connect eligible stock (with superscript ”Connect”) and aggregate market for Northbound (with superscript ”All”), respectively. Also, *, **, and *** denote significance at the 10%, 5%, and 1% significance levels.

Table 6: **Regression Results for Adjusted A-H Share Premium Change on Elasticity**

	(1)	(2)	(3)	(4)
ζ^{A}	-0.004	0.004	-0.004	0.014**
	(-0.93)	(0.99)	(-0.66)	(2.01)
$\zeta^{A,Connect}$	0.000	-0.002	-0.000	-0.008**
	(0.40)	(-1.53)	(-0.133)	(-2.35)
ζ^{H}	0.007	-0.012	0.013	-0.011
	(0.83)	(-1.08)	(1.16)	(-0.96)
$\zeta^{H,Connect}$	-0.005	0.011	-0.001	0.030**
	(-0.61)	(1.07)	(-0.07)	(2.06)
Controls (stock)	No	Yes	No	Yes
Controls (market)	No	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Clustering	Yes	Yes	Yes	Yes
Observations	27,665	27,665	27,665	27,665
Adj R^2 (%)	0.60	1.56	0.37	2.19

Note: This table reports panel regression results for A-H share premium on elasticities and other controls. Controls (stock) include lag market equity, beta, turnover, and volatility from both the Mainland market and the Hong Kong market. Controls (market) include CNYHKD and USDX. Firm FE is a fixed effect for stocks. Standard errors are clustered for week and stock. We report t-statistics in parentheses. Also, *, **, and *** denote significance at the 10%, 5%, and 1% significance levels.

(a) Eligible Mainland Stocks



(b) Eligible Hong Kong Stocks

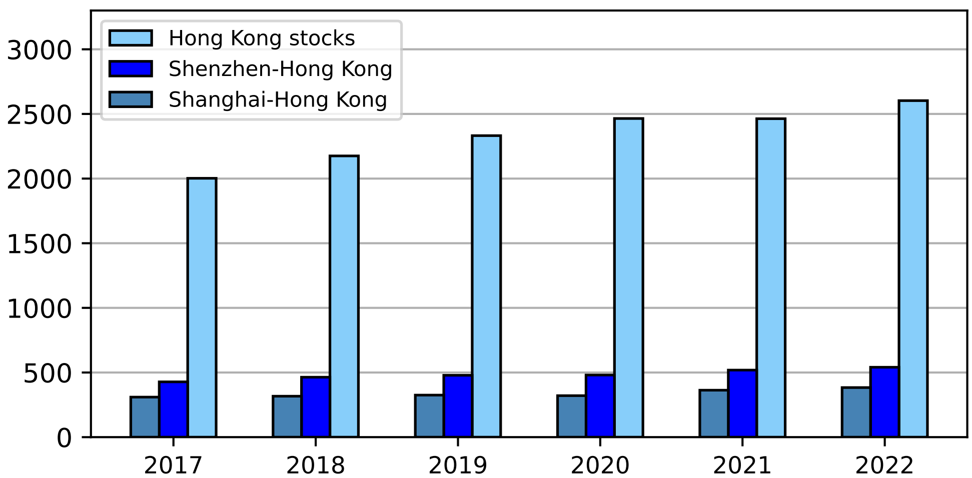
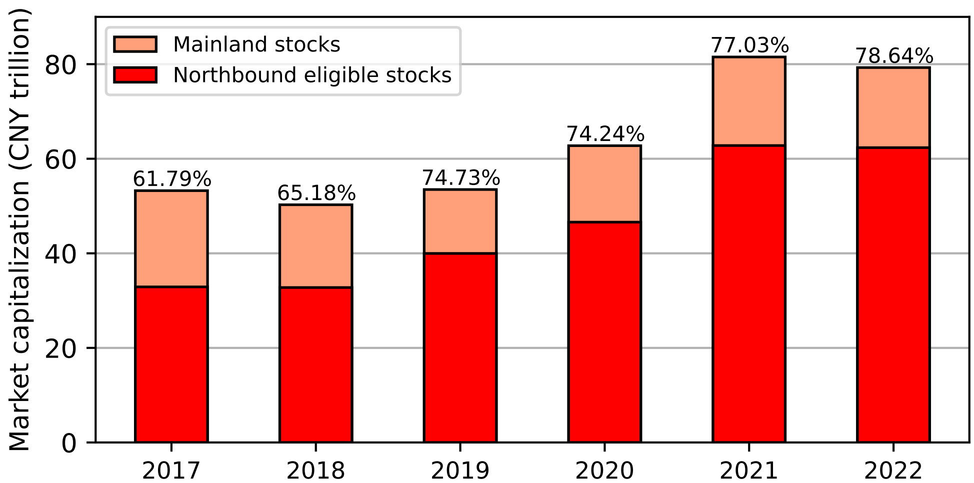


Figure 3: **Numbers for Connect Eligible Stocks**

Note: This figure displays the number of eligible stocks in the China Stock Connect. The bars represent the number of eligible stocks at the end of June each year. Panel (a) is for eligible Mainland stocks, and Panel (b) is for eligible Hong Kong stocks. The number of Mainland stocks includes all stocks in Shanghai and Shenzhen stock exchanges. The eligible stock universe for Shanghai-Hong Connect is a subset of that for Shenzhen-Hong Kong Connect.

(a) Eligible Mainland Stocks



(b) Eligible Hong Kong Stocks

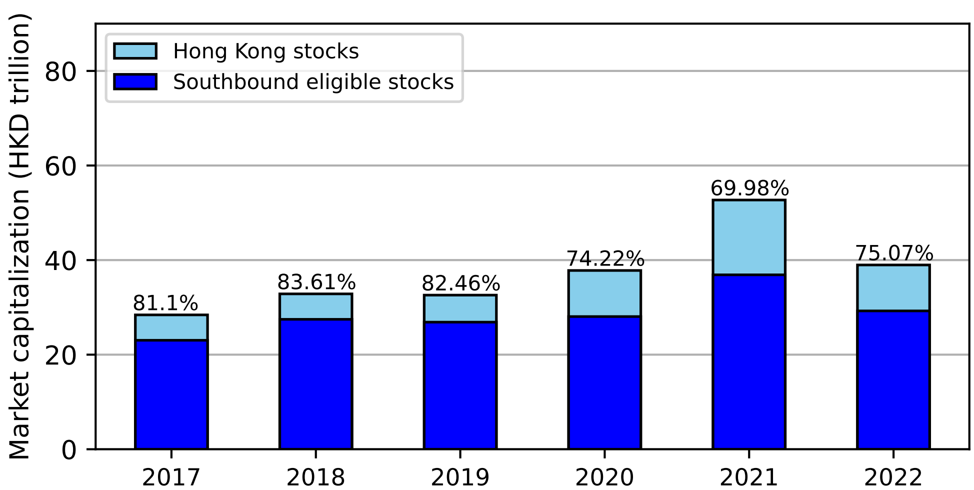
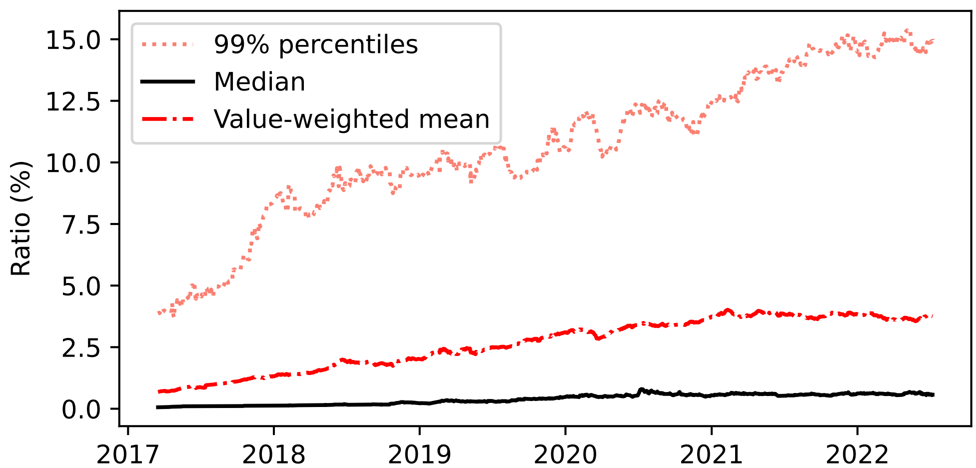


Figure 4: **Market Capitalization for Connect Eligible Stocks**

Note: This figure displays the market capitalization of eligible stocks under the China Stock Connect relative to the corresponding entire stock market. The bars represent the average market capitalization values of eligible stocks at the end of June each year. Panel (a) is for eligible Mainland stocks, and Panel (b) is for eligible Hong Kong stocks.

(a) Eligible Mainland Stocks



(b) Eligible Hong Kong Stocks

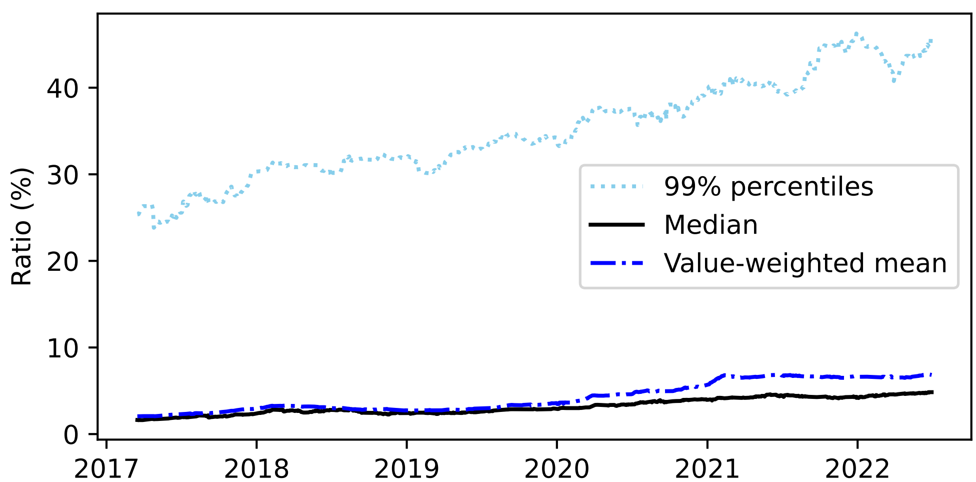
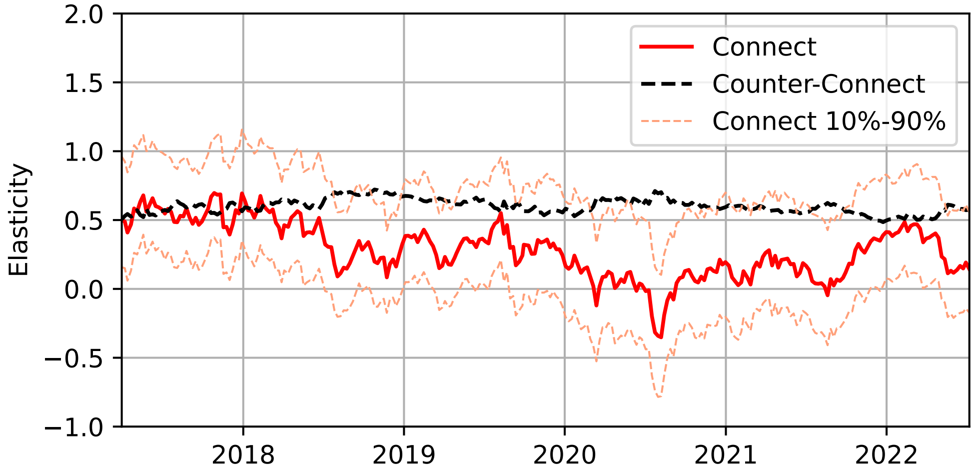


Figure 5: **Stock Holding Ratios by Connect Investors**

Note: This figure displays the cross-sectional summary statistics for the stock holding ratios by Connect Investors in the eligible stock universe under the Stock Connect program. Panel (a) is for eligible Mainland stocks, and Panel (b) is for eligible Hong Kong stocks.

(a) Eligible Mainland Stocks



(b) Eligible Hong Kong Stocks

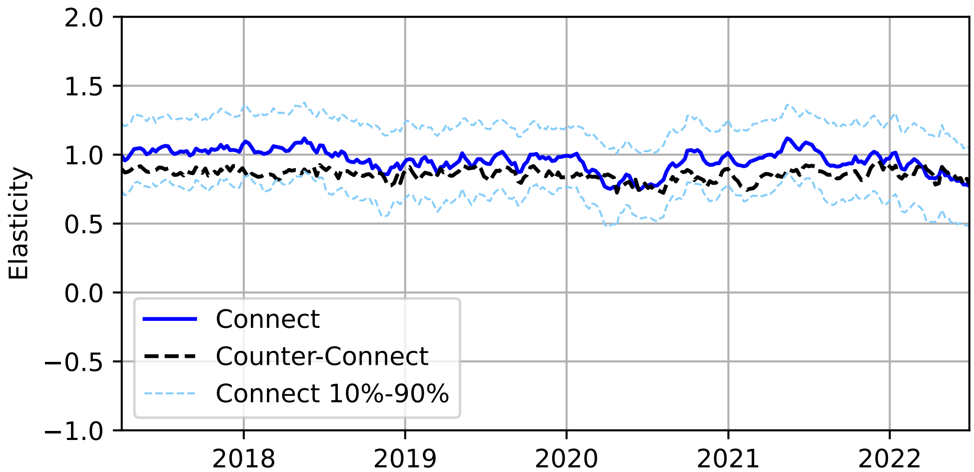


Figure 6: **Estimated Elasticity**

Note: This figure displays the time-varying elasticity estimates from Table 2. The time series of the cross-sectional median for Connect and count-Connect elasticity estimates are plotted, along with the 10% and 90% cross-sectional estimates. Panel (a) is for eligible Mainland stocks, and Panel (b) is for eligible Hong Kong stocks. The sample period ranges from March 2017 to June 2022.

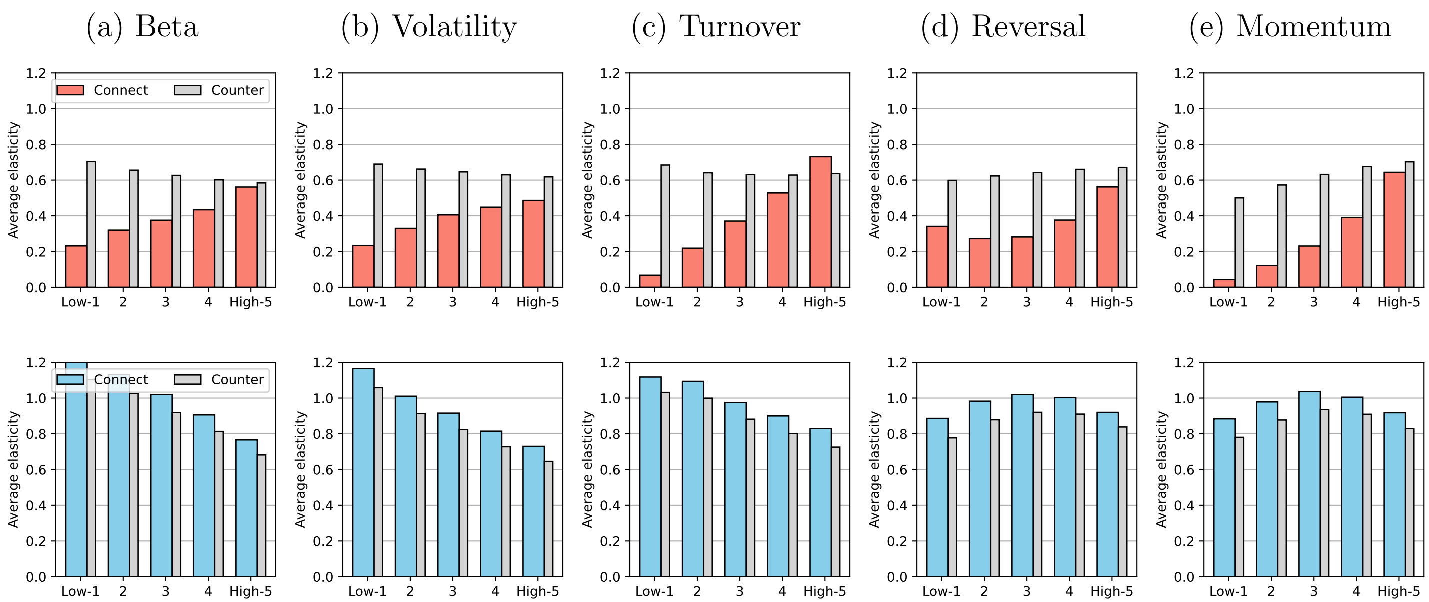


Figure 7: **Cross-Sectional Variation of Elasticity**

Note: This figure displays cross-sectional variations of elasticity estimates for eligible stocks in Mainland (upper plot) and Hong Kong (lower plot) stock markets. We calculate the value-weighted aggregate elasticities in each quintile-sorted group for characteristics considered in equation (11). The average elasticity estimates for both Connect and count-Connect investors are plotted. The sample period ranges from March 2017 to June 2022.

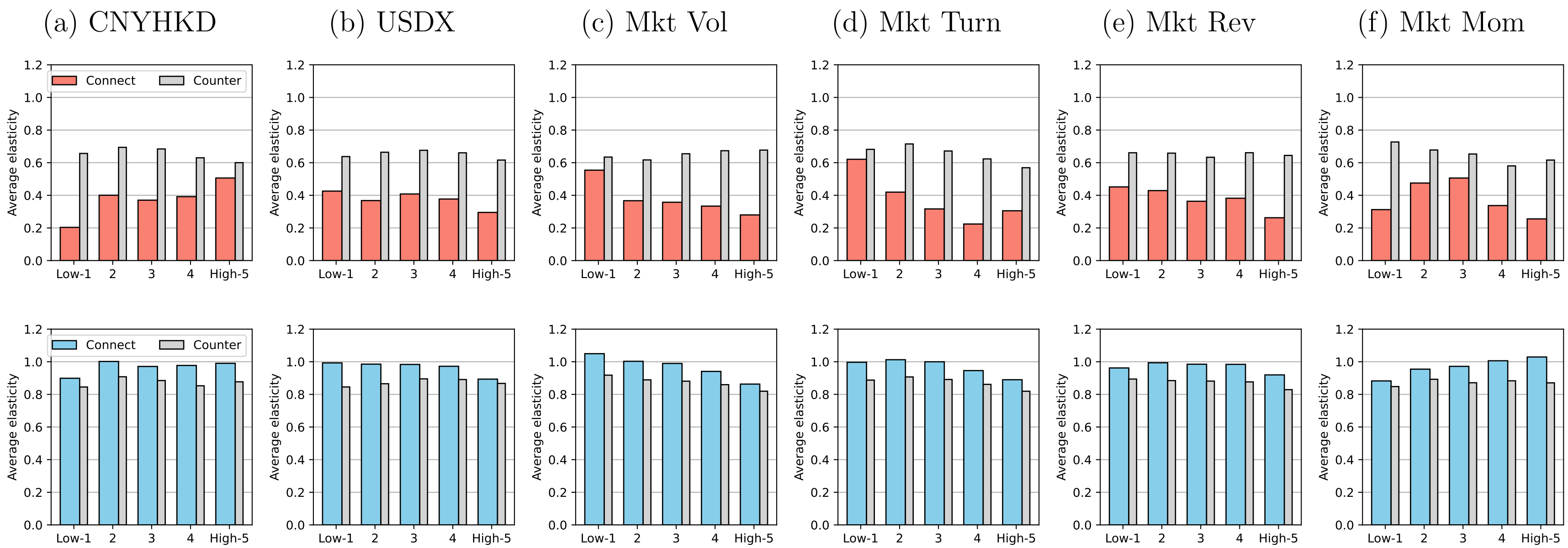


Figure 8: **Time-Series Variations of Elasticity**

Note: This figure displays time-series variations of average elasticity estimates for eligible stocks in Northbound (upper plot) and Southbound (lower plot). We create the value-weighted aggregate elasticities of stocks in each quintile-sorted group for aggregate predictors considered in equation (11). The average elasticity estimates for both Connect and count-Connect investors are plotted. The sample period ranges from March 2017 to June 2022.

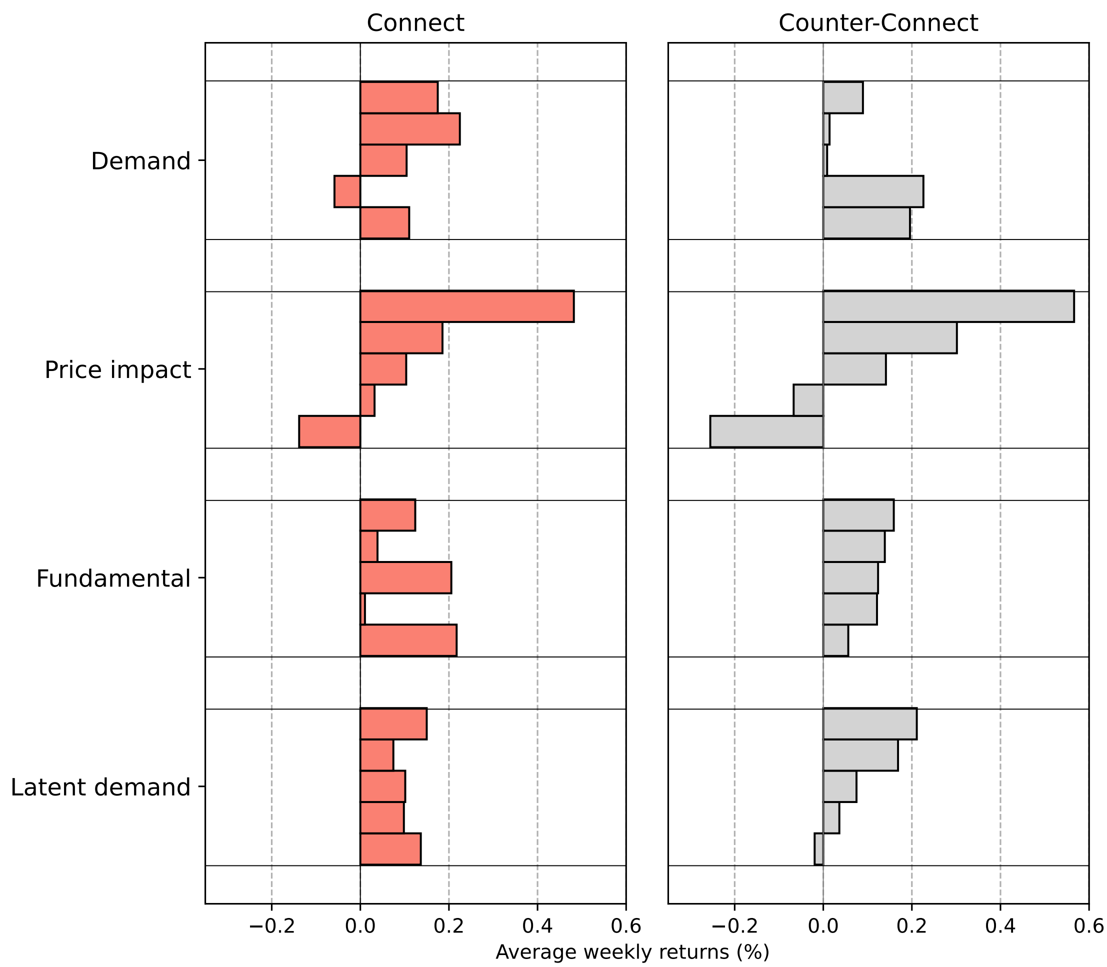


Figure 9: **Demand-Sorted Investment for Eligible Mainland Stocks**

Note: This figure displays the weekly average returns for quintile portfolios sorted on components of the estimated demand curve equation (13) for eligible Mainland stocks. Stocks are equally divided into 5 groups according to corresponding components from high value (top bar) to low value (bottom bar) on a monthly basis. The sample period ranges from March 2017 to June 2022.

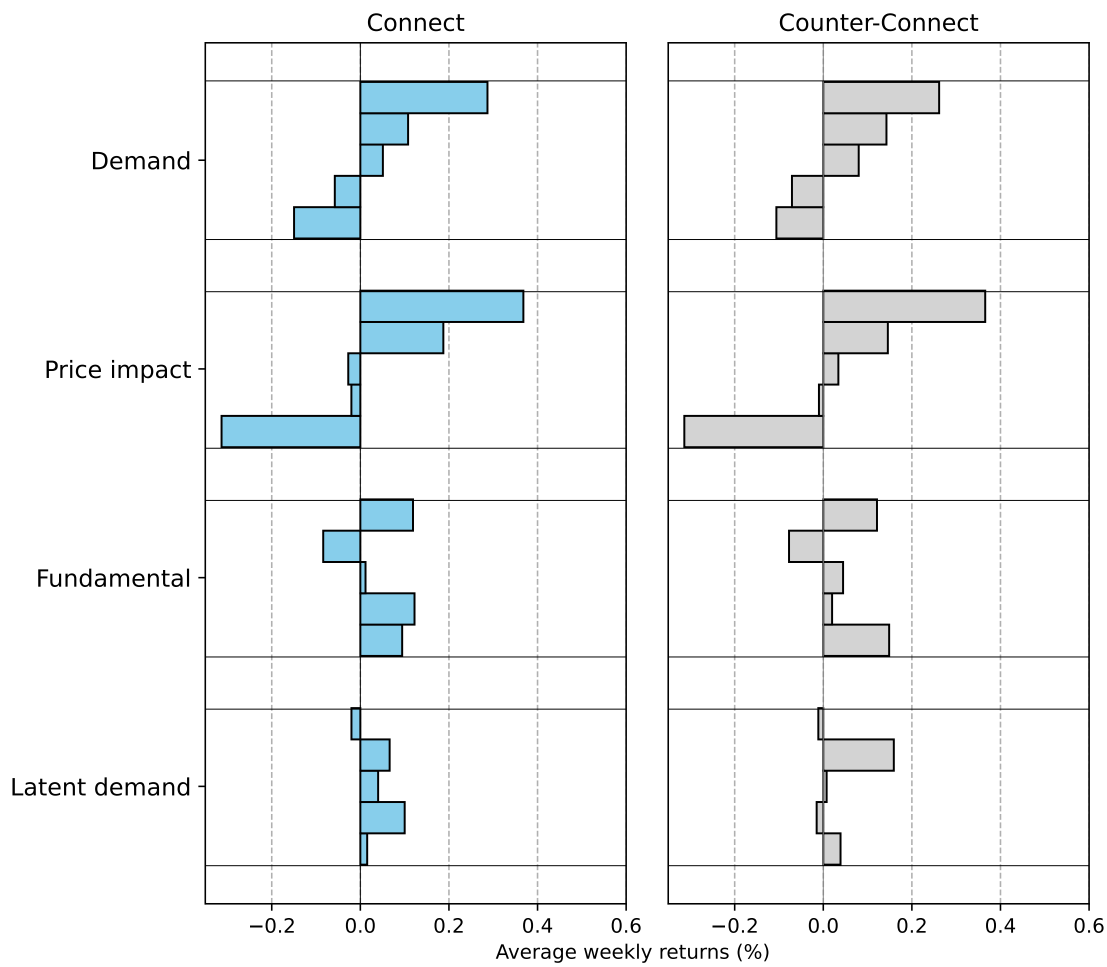
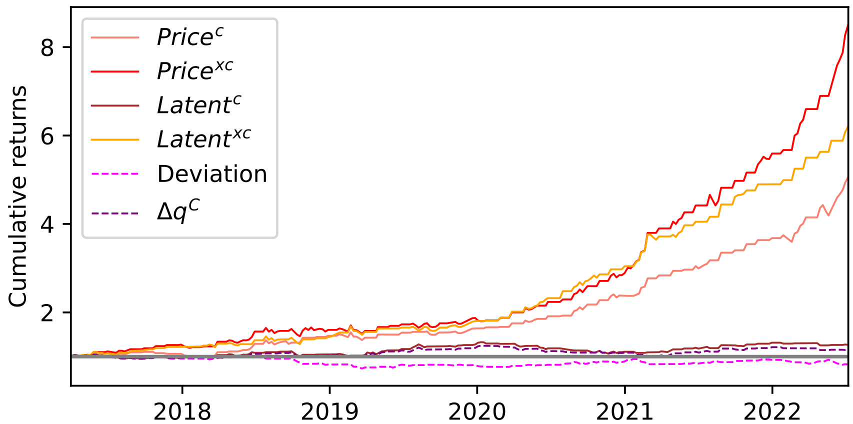


Figure 10: **Demand-Sorted Investment for Eligible Hong Kong Stocks**

Note: This figure displays the weekly average returns for quintile portfolios sorted on components of the estimated demand curve equation (13) for eligible Hong Kong stocks. Stocks are equally divided into 5 groups according to corresponding components from high value (top bar) to low value (bottom bar) on a monthly basis. The sample period ranges from March 2017 to June 2022.

(b) Eligible Mainland Stocks



(d) Eligible Hong Kong Stocks

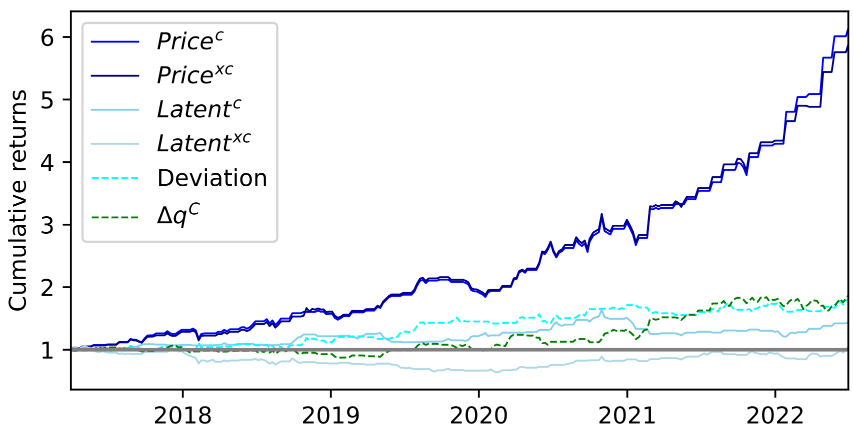


Figure 11: **Cumulative Returns of Holdings-based Portfolios**

Note: This figure displays the cumulative returns portfolios based on Stock Connect holdings. Stocks are equally divided into 5 groups according to corresponding components from high value (top bar) to low value (bottom bar) on a monthly basis. The sample period ranges from March 2017 to June 2022.

(b) A-H Share Premium over time

(d) Cross-Sectional A-H Share Premia

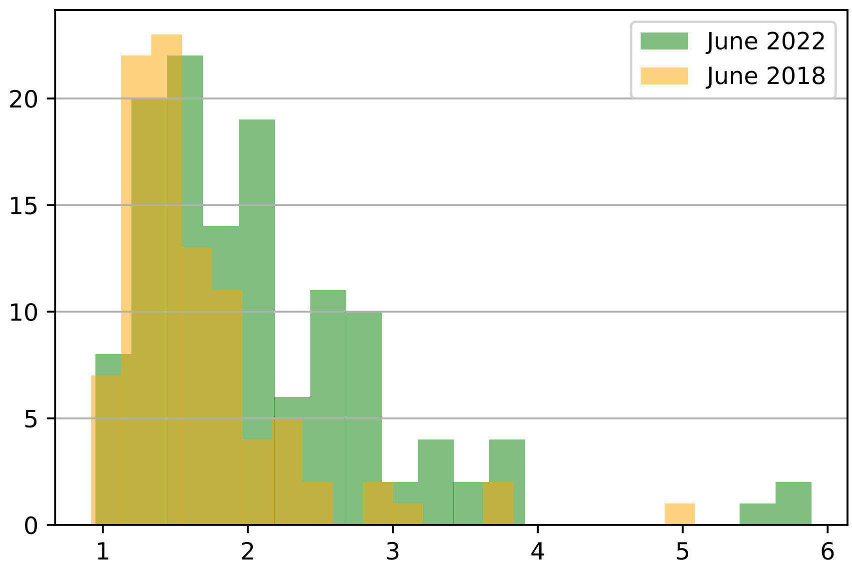


Figure 12: **A-H Share Premium**

Note: We consider all dual-listed stocks eligible under the Stock Connect. The top figure plots the time-series path of A-H Share premium for the value-weighted portfolio by their Hong Kong market equity values. The bottom figure plots the cross-sectional A-H Share premia of individual firms in mid-2018 and mid-2022.