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The Changing Role of Foreign Investors in Tokyo Stock Price Formation*

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Abstract

Recent research suggests that foreign investors improve the informational efficiency of national stock markets. We examine how foreign investors contribute to efficiency. We model the influence of domestic and foreign investors' trades on the efficient price of Japanese stocks over 39 years. Our results show that foreign investors trade at an information advantage over domestic investors, and this advantage has increased since around 2000. We find this is due to a substantial increase in the importance of global stock price and exchange rate information in stock price formation. Our results suggest that foreign investors have made more use of global information in trading Japanese equities as the influence of international financial factors on the domestic market has increased over recent decades.

Keywords: Efficiency, Equities, Foreign investors, Information content of trade, Investor behavior, Market microstructure

JEL: C32, G14, G15

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1. Introduction

International stock market integration and financial liberalisation have facilitated an increase in foreign portfolio investment over recent decades. Local equity markets provide foreign investors with opportunities for exposure to international risk premia and diversification. Foreign investors are now important participants in most local markets. Researchers have examined the impacts of greater foreign equity portfolio investment on local economies, such as the real effects on invested firms and macroeconomic output (Henry, 2000a; Bekaert et al., 2005, 2011), and on the characteristics of local stock markets, including liquidity (Bekaert et al., 2007; Rhee and Wang, 2009), return volatility (Bae et al., 2004; Li et al., 2011) and the cost of capital (Bekaert and Harvey, 2000; Henry, 2000b). Recent research has found that foreign investors improve the informational efficiency of local stock markets (Kacperczyk et al., 2019; He et al., 2013; He and Shen, 2014; Kang et al., 2016). Foreign ownership or trading of local stocks appears to be positively related to efficiency, which suggests that foreign investors may posses value-relevant information.

However, exactly how foreign investors contribute to the efficiency of local markets and whether they trade at an informational advantage is less well understood. Foreign investors may trade at an information advantage or disadvantage to locals[1]. Some studies show foreigners are disadvantaged regarding local information (Kang and Stulz, 1997; Coval and Moskowitz, 1999). Other research suggests foreigners have an advantage in global information (Bae et al., 2012; Kang et al., 2016). Foreign investors outperform locals in some studies (Grinblatt and Keloharju, 2000; Karolyi, 2002; Kamesaka et al., 2003; Bae et al., 2006), but underperform in others (Timmermann and Blake, 2005; Shukla and van Inwegen, 1995; Choe et al., 2005).

In this study, we investigate whether foreign investors trade at an informational advantage to domestic investors in the Japanese stock market over a long period of 39 years. We find that foreign investors do indeed trade at an informational advantage. We also examine what types of value-relevant information within foreign investors' trades contribute to that advantage and how the information in foreign investors' trades has changed as national stock markets have become more internationally integrated over the last four decades.

The Tokyo Stock Exchange (TSE) offers an interesting setting to investigate the role of foreign investors in price formation. Foreign portfolio investors have become important par-

[1]The survey of Japanese and US investors' expectations in Shiller et al. (1996) shows that domestic and foreign investors had very different views on future stock prices around the time that the Japanese stock bubble burst at the end of 1989.

ticipants on the TSE over the last 40 years. Unique for a market classified as developed since 1969[2], the shares of Japanese total stock ownership and trading volume attributed to foreign investors have increased dramatically since the 1980s. Increased foreign participation has coincided with a substantial unwinding of large strategic cross-shareholdings by domestic financial institutions and corporate investors[3]. Figure 1 shows the ownership share of various investor groups in Panel (a) and the share of trading volume in Panel (b). The investor groups included in the figure are non-resident investors (Foreign), non-financial business corporations (Corporation), financial institutions including city, regional and trust banks, life and non-life insurers (Financial), individual or retail investors (Individual) and investment trusts that may be considered the same as mutual funds (Trust). Financials and corporations once dominated stock holdings. However, ownership by foreign investors has increased from less than 10 percent in the 1980s to around 30 percent in the current decade. Meanwhile, foreign investors' transaction volumes have grown from around 10 percent to over 60 percent. The turnover share of other groups has declined, particularly individuals who were the largest traders up to the early 1990s. The presence and importance of foreign investors in the market have grown substantially since the late-1989 peak in stock prices.

We analyse the TSE for several reasons. In addition to the substantial increase in foreign investors' presence, the Japanese market is one of the largest national markets by capitalisation and shares many characteristics with other developed markets. It has similar regulation and institutional investors are the dominant players. Our findings have general implications for other developed markets and complement the evidence from analyses of emerging markets. The TSE is the only developed market exchange that provides long-term and consistent data on stock transactions classified by investor type. This allows us to investigate the evolution of the information content of foreign and domestic investors' trades over a 39-year period.

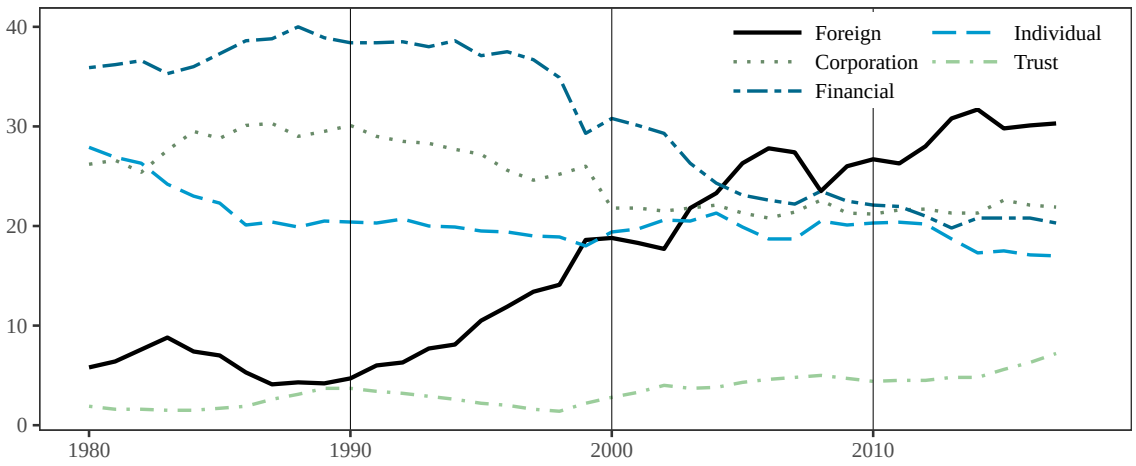
Hasbrouck (1991a,b) introduces a bivariate vector autoregression (VAR) of trades and returns that isolates the random-walk and stationary components of price. The former is considered the efficient price and the latter mispricing. Changes in the efficient price can be decomposed into a component that is attributed to trades and a component that is not. In the spirit of Hasbrouck's approach, we specify multivariate VAR models to identify the influence of for-

[2]Japan has been classified as a developed market by MSCI since 1969 (MSCI, 2012).

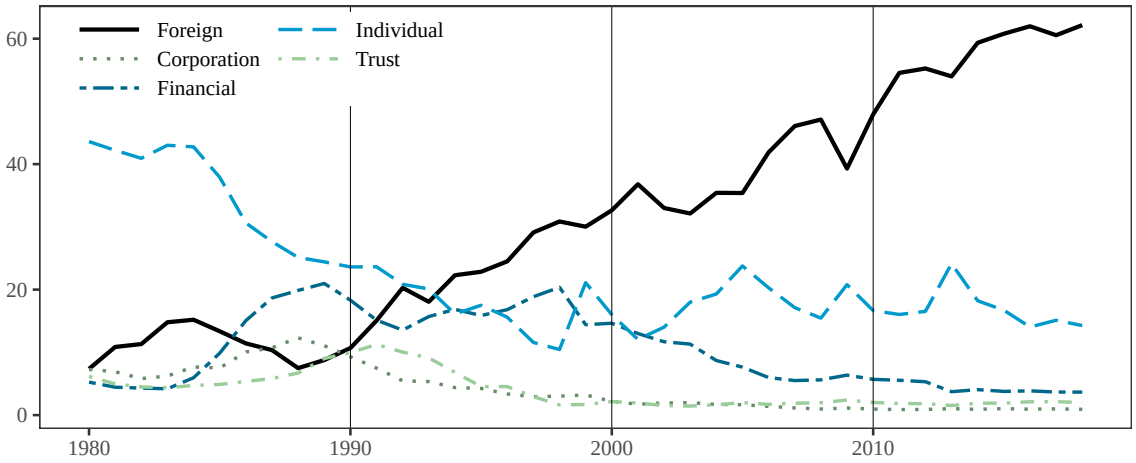
[3]Miyajima et al. (2015) provide a detailed discussion of the transition in ownership shares of domestic insiders and foreign investors. Cross-shareholdings were unwound starting in the 1990s, mostly between banks and corporations. Since the mid-2000s there has been limited renewed interest in strategic cross-shareholdings between corporations.

Figure 1: Investor Participation on the Tokyo Stock Exchange

(a) Ownership (annual, percent share)



(b) Trading Volume (annual, percent share)



Note: Trading volume for each group includes purchases plus sales.

eign and various types of domestic investors' TSE trades on the efficient price, as well as the importance of both domestic and global public information. Investors who have a substantial influence on the efficient price and a positive long-run price impact of trade are considered informed. Similarly, public information that has a substantial influence on the efficient price and a positive long-run price impact is regarded as value-relevant information for the TSE stock price.

We begin with a benchmark model that contains the trades of foreign, financial, investment trust and individual investors in Japanese First Section stocks on the TSE. We represent the return on First Section stocks by the return on the TOPIX index[4]. The benchmark model demonstrates the information shares attributable to the trades of each investor group and to do-

[4]The TOPIX is a free-float adjusted capitalisation-weighted index of all domestic common stocks in the TSE First Section.

mestic public equity information. We compare the benchmark model with an extended model that includes returns on the S&P 500 index to represent global public equity information and returns on the USD/JPY exchange rate to proxy global public foreign exchange information. We examine how the information shares to each investor groups' trades and to domestic public information change with the introduction of global public information.

The benchmark model shows that foreign investors are informed and that their influence over the efficient price of Japanese stocks has increased since around 2000. Domestic financial, trust and individual investors are uninformed. However, the extended model suggests that global stock prices and the exchange rate have become more important since around 2000 and 2010, respectively. When we control for global public information, foreign investors' information share is substantially lower than that for global public information in the same period. Using the time-varying conditional correlation analysis, we show that the dynamic correlation between foreign investors' trading and global public information increased at the same time as the influence of global public information on the efficient price of Japanese stocks increased. Our results suggest that foreign investors have made more use of global information in trading Japanese equities as the influence of international financial factors on the domestic market has increased in recent decades. We also examine the role of foreign investors in the evolution of informational efficiency over time using Hasbrouck's (1993) inefficiency measure. Although foreign investors' influence over the efficient price is small relative to that of global information, we confirm that foreign trading has contributed to efficiency even when global information is taken into account.

Our focus is on transactions rather than the holdings used in He and Shen (2014), Luo et al. (2014) and others, as transactions are more closely aligned with efficiency and the impounding of information in prices than holdings. Boehmer and Kelley (2009) find that both the transactions and holdings of institutions matter and transactions are more important where stocks are priced less efficiently. The long period over which we conduct our study allows us to examine how the information content of trade has evolved, from when foreign investors were minor participants in the early 1980s, to recent years in which they dominate both ownership and trading activity. He and Shen (2014) use the absolute change in foreign ownership as a proxy for the trading activity of foreign investors, but this is an indirect measure at best.

Our paper is closely related to Bae et al. (2012) and Kang et al. (2016). Bae et al. (2012) suggest that foreign investors improve efficiency by incorporating global market information in emerging stocks more quickly. Stocks with greater investibility by foreigners incorporate global

information faster than stocks with less investibility. Returns on more investible stocks lead those of less investible stocks. Kang et al. (2016) find that foreign trading in Korean stocks reduces the time taken for global information dissemination, and that the effect is more significant for global firms with high levels of foreign investor trading. Foreign investors have an informational advantage regarding global information. Our paper is also related to research showing that greater international market integration over recent decades has increased local return correlations, suggesting a greater role for foreign or global information in domestic stock markets (Longin and Solnik, 1995; Connolly and Wang, 2003; Christoffersen et al., 2012; Chevallier et al., 2018). Our approach differs from previous research in a number of respects. We use a different measure of efficiency by examining the long-run impact of a trade shock and using a random walk to proxy for the efficient price. We also specify the form of public domestic and foreign information. Further, we examine a developed market and demonstrate similarities with the results obtained in emerging markets. Our results have general implications regarding the role of foreign investors in price formation for developed market stocks, particularly following the late 1990s 'Big Bang' financial liberalisation in Japan.

Our main contributions to the literature are fourfold. First, we show that foreign investors possess an informational advantage over domestic investors, analysed in terms of the efficient price of Japanese stocks. Second, we demonstrate that foreign investors' trades have increasingly reflected global stock price and exchange rate information over the past four decades. Third, we establish the timing of changes in the information imparted by foreign investors' trades and show that these changes are unique to the foreign investor group. Foreign investors have increasingly relied on global financial information simultaneously with global information becoming more influential over Japanese stock returns. Fourth, we describe the evolution of the information imparted by foreign investors' trades over a lengthy sample of 39 years spanning 1980 to 2019, using a consistent set of transactions and returns data.

The article proceeds as follows. We survey the relevant literature in Section 2. Section 3 explains our VAR model and the transactions and returns data used for estimation. We discuss our empirical results and supporting evidence in Section 4. Section 5 provides the implications of our research for policy-makers and investors, and concludes.

2. Relevant Literature

Several recent studies examine the whether foreign investors contribute to the efficiency of equity markets. Kacperczyk et al. (2019) build a cross country database for over 23 thousand

firms in 40 countries and document that stocks with higher foreign institutional ownership have more informative prices. Similarly, He et al. (2013) demonstrate a positive relationship between ownership by large foreign investors and price informativeness in 40 markets. He and Shen (2014) show that Japanese stock prices deviate less from a random walk for stocks with a large change in foreign ownership. The participation of foreign investors in many emerging markets has been increasing. Vo (2017) finds that foreign ownership improves stock price informativeness in the Vietnamese market and Lim et al. (2016) find that foreign investors accelerate the incorporation of both local and global information in Malaysian stocks. Using data for over four thousand stocks in twenty one emerging markets, Bae et al. (2012) find that greater investibility reduces price delay to global market information and infer that financial liberalisation yields efficiency improvements. On the other hand, Qin and Bai (2014) find emerging market stocks that are fully investible by foreigners exhibit stronger long-run price momentum than those which are non-investible. Hao et al. (2015) find that foreign investors decrease efficiency in the Taiwan stock index futures market due to their use of passive limit orders, despite a substantial increase in both domestic and foreign trading volume.

A related area of literature pertains to the information asymmetry between domestic and foreign traders, and their relative investment performance. Evidence published to date suggests that foreigners may trade at an advantage or disadvantage to locals. Numerous studies suggest that domestic investors have superior local information, and for that reason they have a performance advantage over foreign investors. Kang and Stulz (1997) show that foreign investors hold more stocks of large firms than small firms in Japan, and suggest this may indicate foreign investors have a greater information disadvantage in trading small stocks. Foreign investors may be at a disadvantage due to their distance from a firms' headquarters (Coval and Moskowitz, 1999, 2001) or language difference (Grinblatt and Keloharju, 2001)[5]. Looking over 32 countries, Ferreira et al. (2017) find foreign institutional investors are disadvantaged relative domestic institutions in countries with difficult investment environments, and during market downturns or periods of high market uncertainty. Consistent with the research suggesting domestic investors have superior information on local stocks, several studies of investment performance suggest that domestic investors outperform foreigners. Foreign investors have been found to be poor market timers (Timmermann and Blake, 2005), underperform due to informational disadvan-

[5]MSCI (2019a) notes that a lack of company and market information available in English, and a relatively poor general level corporate governance for a developed market, as well as unconventional dividend practices, constitute access impediments for foreign investors in the Japanese stock market.

tages (Shukla and van Inwegen, 1995) or experience greater price slippage when they trade compared with domestic investors (Choe et al., 2005). Dvorak (2005) shows locals are more profitable than foreigners and perform better in short-term trades, while foreigners are relatively good at longer investment horizons.

On the other hand, several studies provide evidence that foreign investors have superior information or generate higher trading profits than domestic investors. Seasholes (2000) shows that foreign investors time Taiwanese firms' earnings announcements well, and Grinblatt and Keloharju (2000) provides evidence from the Finnish equity market that suggests foreigners are better stock pickers than domestic investors. In a study of the Japanese stock market over 1995 to 2001, Karolyi (2002) found foreign investors were profitable and appeared to be good market timers, while domestic investors performed poorly. Similarly, Kamesaka et al. (2003) found foreign investors in Japanese stocks made profits while domestic retail investors did not. Bae et al. (2006) also demonstrates that foreigners have superior market timing ability in Japanese stocks. Albuquerque et al. (2009) provides a model and evidence suggesting that that US investors exploit superior global information when they invest in foreign markets.

Another relevant literature investigates the question of whether stocks are priced internationally or locally. If foreign investors play an important role in incorporating global information into stock prices, this supports the case for global pricing. Karolyi and Stulz (2003) discuss strong evidence suggesting national equity risk premia are determined internationally. For instance, a number of papers demonstrate that exchange rates influence country stock market risk premia (Dumas and Solnik, 1995; De Santis and Gérard, 1998). On the other hand, Karolyi and Stulz see less of an established case for the influence of international factors on the the cross-section of expected returns, and they note that home bias increases the local influence on asset prices.

Our work is also related to the literature on the time-varying international dependence between equity markets. Developments such as greater financial openness and international capital flows, improvements in information and communications technology, increases in international economic linkages through trade in goods and services often involving complex supply chains, greater multinational operation of listed firms, and the trend toward globalisation have contributed to increased international financial market integration over time. With greater integration, an increase in the comovement of national market stock returns would seem a reasonable hypothesis.

Longin and Solnik (1995) find an increase in international correlation between monthly de-

veloped market stock returns, including Japan, between 1960 and 1990. Berben and Jansen (2005) show that the correlations between the German, the UK and US markets doubled between 1980 and the late 1990s, although those with the Japanese market remained the same. Morana and Beltratti (2008) find greater interlinkages between the markets of Germany, Japan, the UK and the US over the period 1973 to 2004. Christoffersen et al. (2012) show that the correlations among 16 developed and 17 emerging markets have increased markedly between 1973 and 2009. Okimoto (2014) demonstrates increased asymmetric dependence between the stock markets of France, Germany, the UK and US over the period 1973 to 2008. Connolly and Wang (2003) present results for the US, UK and Japan that suggest foreign market returns are more important for domestic returns than domestic economic fundamentals. Chevallier et al. (2018) provide evidence that cross-market linkages have become stronger in the Pacific Basin region between 1993 and 2014, that the United States is the single greatest contributor to shock spillover in the region, although spillover effects from the Japanese market are limited. A common finding is that national equity market correlations rise during, or following, periods of high volatility or financial crisis (Chakrabarti and Roll, 2002; Johansson, 2011; Koch and Koch, 1991; King et al., 1994; Liu et al., 1998; Longin and Solnik, 1995; von Furstenberg and Jeon, 1989)[6].

3. Methodology and Data

3.1. VAR Model of Transactions and Returns

We estimate multivariate VAR models of the form:

$$Y_t = \Phi_0 + \Phi_1 Y_{t-1} + \cdots + \Phi_P Y_{t-P} + \epsilon_t \tag{1}$$

where Y_t contains the trade ratios and returns variables, and the Φ_i are coefficient matrices for lag $i = 1 \ldots P$ included in the VAR[7]. We estimate a benchmark model including trade ratios for four investor groups (foreign, financial, trust and individual) and TOPIX returns. The construction of the trade ratios is explained in Section 3.2. We also estimate an extended model that includes S&P 500 and USD/JPY exchange rate returns to reflect global information. We

[6]Also see articles from the contagion literature such as Bekaert et al. (2011) who suggest crisis periods lead to the international transmission of information as described by the "wake-up call hypothesis". Longin and Solnik (2001) find correlations rise during bear markets

[7]Following the approach in the literature, the block-recursive identification framework is used. The number of lags to be included in each VAR model is determined using Akaike's Information Criterion (AIC) and the models were estimated using ordinary least squares.

adapt Hasbrouck's (1991a,b) "information content of trade" approach to estimate the influence of the four investor groups' trades and return variables on the efficient price.

The price of a security, p_t, may be decomposed into the efficient price, m_t, and mispricing, s_t:

$$p_t = m_t + s_t \tag{2}$$

where m_t follows a random walk process, s_t is a mean-zero covariance stationary process, and $\lim_{h\to\infty} E(s_{t+h}) = 0$.

The permanent component of price, or efficient price, can be modelled as:

$$m_t = m_{t-1} + \omega_t \tag{3}$$

where $\omega_t \sim N\left(0, \sigma_\omega^2\right)$, and $E(\omega_t \omega_s) = 0$ for $t \neq s$.

The efficient price, m_t, is driven by the previous period's efficient price and an innovation that reflects new fundamental information, ω_t, which is incorporated in the efficient price at time t. The efficient price innovation, ω_t, has a permanent influence on the security price, while the mispricing shock, s_t, is has only a temporary effect. The s_t component represents transitory effects on the security's price, or mispricing, arising from non-information based microstructure effects, liquidity provision and noise trading. The variance of the efficient price, σ_ω^2, measures the variation in the permanent component of the price related to fundamental information.

The VAR model shown in equation (1) can be inverted to the Vector Moving Average (VMA) representation:

$$Y_t = \left(I + \theta_1 L + \theta_2 L^2 + \theta_3 L^3 + \ldots\right)\epsilon_t = \theta(L)\,\epsilon_t \tag{4}$$

where L is the lag operator, the θ_i are $N \times N$ matrices of coefficients for N variables in the model, and ϵ_t is a white noise error process with $E(\epsilon_t) = 0$ and $Var(\epsilon_t) = \Omega$.

The variance of the shock to the permanent component of the security's price is estimated from the VMA representation in (4) as:

$$\sigma_\omega^2 = [\theta(1)]_N\, \Omega\, [\theta(1)]_N' \tag{5}$$

where $[\theta(1)]_N$ denotes the N^{th} row of $[\theta(1)]$ that corresponds to the returns equation, and $[\theta(1)] = I + \theta_1 + \theta_2 + \ldots$.

The variance of the trade-related component for an investor group, g, is:

$$\sigma^2_{\omega,x_g} = [\theta^\star(1)]_N \, \Omega \, [\theta^\star(1)]'_N \tag{6}$$

where $\theta^\star$ represents θ from the VMA with the coefficients related to all other investor groups and the nontrade-related coefficients set to zero. Similarly, the variance of the non-trade-related component $\sigma^2_{\omega,r}$ is calculated by setting $\theta^\star$ to the θ from the VMA with zeros for the coefficients related to all investor groups.

As the trading behaviour of the different investor groups is correlated, we expect Ω to be a non-diagonal covariance matrix. Accordingly, we use Cholesky factorisation to extract σ^2_ω. Set $\Omega = F'F$, where where F is the upper triangular Cholesky factor, and let $d = [\theta(1)]_N F'$. Then the variance of the permanent shock is the sum of the squares of the elements of d:

$$\sigma^2_w = \sum d_i^2 \tag{7}$$

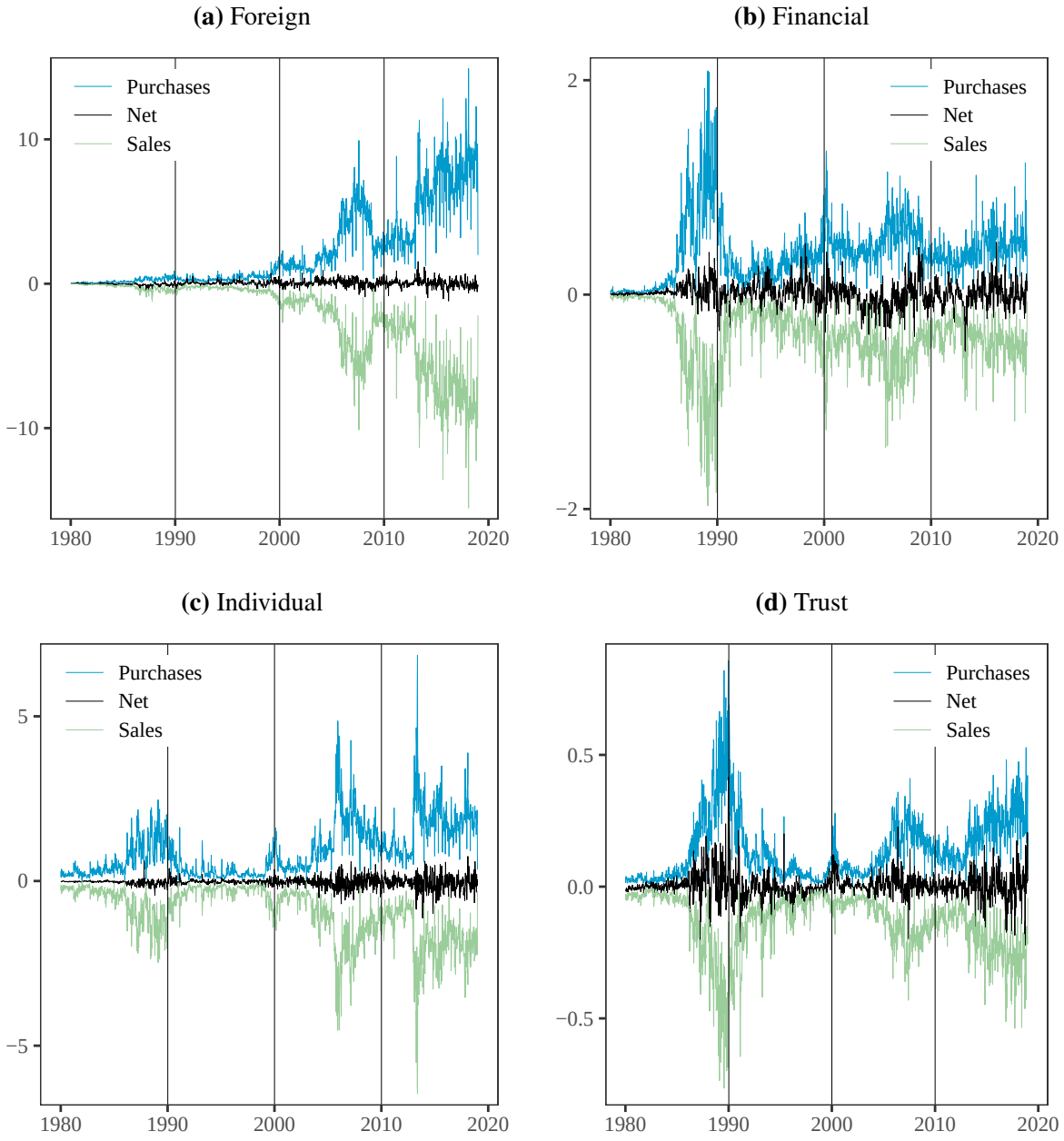
We can obtain the variance due to trade-related, σ^2_{ω,x_g}, and non-trade-related, $\sigma^2_{\omega,r}$, components using this procedure, and express these relative to the total variance of the permanent component σ^2_ω. The relative trade-related variance for an investor group provides a measure of the relative influence of that group's trades on the efficient price. The relative non-trade-related variance gives a measure of the influence of public information on the efficient price.

3.2. Transactions and Returns Data

We use weekly data on the yen value of trading by different types of investors on the TSE from the first week of January 1980 to the last week of December 2018. The transactions are for Japanese stocks that are listed on the First Section of the Exchange, which contains large firms[8]. The transactions data is collected by the TSE from its member firms (general trading participants) on the exchange who have a minimum capital of three billion yen. It includes all the member firms' proprietary and client initiated brokerage transactions. We exclude the member firms' proprietary trades given that these trades include liquidity provision for client orders as well as trades on their own book. The client brokerage transactions represent around 80 percent of all trades on TSE. The transactions data set was obtained from the Nikkei Financial Quest database.

[8]The TSE First Section contains 2150 large firms, as of 16 August 2019. The minimum capitalisation for First Section listing is currently two billion yen.

Figure 2: Transactions Data (weekly, trillions of yen, sales shown as negative)

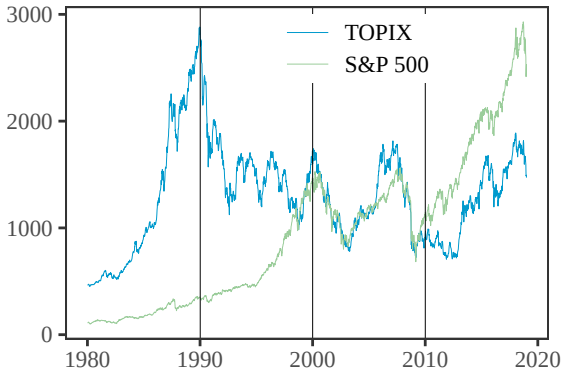


The transactions are broken down into the value of purchases and sales by different types of investor[9]. We include four investor groups in our analysis: foreign, individual, trust, and financial. Foreign investors are defined as all non-resident investors. While the category includes both foreign institutional and individual investors, the vast majority of trades are by institutions. Financial is composed of various types of domestic financial institutions, including life and

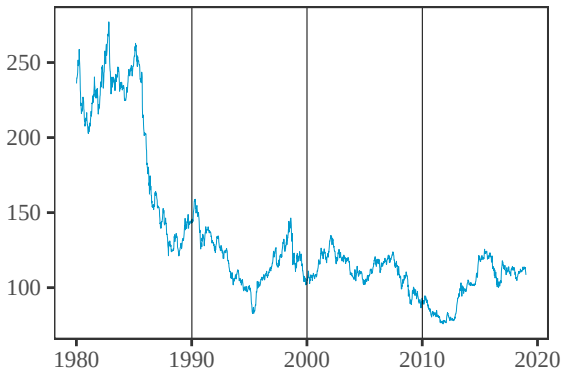
[9]The TSE data contains the following breakdown. Total trading value is divided into proprietary trading and client initiated brokerage trading. Client initiated brokerage transactions are divided into institutions; individuals; foreigners; and securities companies. Institutions are decomposed into investment trusts; business corporations; other corporations; and financial institutions. Financial institutions are further divided into life and non-life insurers; city and regional banks; trust banks; and other financials.

Figure 3: Equity Index and Exchange Rate Data (weekly)

(a) TOPIX and S&P 500



(b) USD/JPY Exchange Rate



non-life insurers, city and regional banks, trust banks and others. We exclude the trades of corporations and securities firms from our analysis. Both groups constitute a small share of trades, and corporate transactions reflect, in part, changes in strategic cross-shareholdings rather than profit motivated trades.

Plots of the purchases, sales (shown as negative values) and net purchases for each investor group are shown in Figure 2. Note the different vertical axis scales in each panel. The plots give a clear visualisation of when the four investor groups have been relatively active traders, by the yen value of their transactions. Foreign investors' trading activity increased substantially in the 2000s and 2010s. Individuals have also been relatively active over the last two decades. Financials and trusts were relatively active during the 1980s bull market in Japan.

Using the TSE transactions data we calculate the trade ratio, $x_{g,t}$, for each investor group, $g = 1, \ldots, 4$, as:

$$x_{g,t} = log\left(\frac{B_{g,t}}{S_{g,t}}\right) \tag{8}$$

where $B_{g,t}$ and $S_{g,t}$ represent the yen value of stock purchases and sales by investor group g at time t, respectively[10].

We also use weekly logarithmic returns on the TOPIX, S&P 500 and the USD/JPY ex-

[10]Our trade ratio is approximately equal to $(B_{g,t}-S_{g,t})/S_{g,t}$ if $B_{g,t}/S_{g,t}$ is near 1. We considered two alternative trade ratio indicators: (i) the difference between each group's purchases and sales, and (ii) the difference between each group's purchases and sales divided by purchases plus sales. Linear dependence between the trade ratios may be induced by (i) since all buys equal all sells, thus the trade indicator must be standardised in some way. Appendix A shows the results using (i) as the trade indicator. Standardisation by (ii) and our trade ratio are both invariant to scale. For example, each indicator will be the same for buys equal to 10 thousand and sells equal to 9 thousand as for buys equal to 10 million an sells equal to 9 million. The logarithm of purchases divided by sales has the mildest variation over the sample and generates similar results to (ii), which we will make available on request.

change rate. TOPIX returns represent the return on domestic stocks[11]. S&P 500 returns are used as a proxy for foreign or global equity returns. The USD/JPY return is used to represent information from the currency market. Returns on the TOPIX and S&P 500 are calculated using the weekly close index value, while the USD/JPY return is calculated using the New York close rate. TOPIX is obtained from the Nikkei Financial Quest database while the S&P 500 and USD/JPY are taken from Bloomberg. Plots of the equity indices and exchange rate are shown in Figure 3.

We divide our 39 year sample into four approximately equal length subsamples to study changes in the information content of trades. One of the advantages of our study is the ability to examine these changes over a very long horizon using consistent time series of weekly transactions data with sufficient observations for modelling. The subsamples span the first week in January to the last week in December for the following periods: 1980 to 1989 (referred to as the 1980s), 1990 to 1999 (1990s), 2000 to 2009 (2000s) and 2010 to 2018 (2010s). The number of weekly observations in each subsample is 520, 521, 522 and 470 for the 1980s, 1990s, 2000s and 2010s, respectively. The vertical lines in Figures 1, 2 and 3 delineate the subsamples.

Our decision to divide the sample into four equal periods rather than search for potential break points in the series was based on two considerations: (i) consistency with the periods of deregulation that improved foreign investors' access to the domestic equity market; and (ii) the practicality of having enough observations in each subsample to estimate the VAR model.

The broad trends in Japanese stock prices during the "bubble era" of the 1980s and the collapse of the 1990s appear relatively independent of those in global stock prices, while there is a much more obvious comovement between domestic and global stock prices in the 2000s and 2010s[12]. The 1980s saw a series of important financial liberalisations affecting the domestic equity market that were implemented as the bubble in Japanese asset prices began to inflate. In December 1980, the government amended the Foreign Exchange and Foreign Trade Control Law of 1949, changing the regulatory regime for international capital flows from a "prohibition in principle" to a "permission in principle" approach for many types of transactions (Takagi,

[11]We follow the approach employed by Karolyi (2002) and Kamesaka et al. (2003) under which the trade ratio is calculated using aggregated transactions in individual First Section stocks and returns are calculated on a relevant market index. We argue this approach is justified given that we are interested in the information investors exploit in timing the market. Returns on the TOPIX are preferable to those on the NIKKEI 225 because the TOPIX is calculated using all First Section stocks matching the stocks included in the transactions data, while the NIKKEI 225 includes only a subset of relatively large firms.

[12]Our sub-samples also approximately correspond with the timing of major equity market shocks: the Japanese asset price bubble burst at the end of the 1980s, the Asia crisis in the late 1990s and the Global Financial Crises in the late 2000s.

2009). At the same time, the government also abolished the Foreign Investment Law of 1950 that controlled the acquisition of domestic stocks by non-residents. Several further policy and regulatory reforms were implemented in the mid-1980s with the aim of internationalising the yen and domestic financial markets. These included formation of the Japan-U.S. Yen-Dollar Committee, abolition of a requirement that forward exchange transactions must correspond to bona fide transactions, liberalisation of euroyen transactions and the Plaza Accord. The late 1980s also saw the introduction of stock futures, stock index futures and index options trading in Japan. The next round of major reforms occurred in the late 1990s within an entirely different context of macroeconomic stagnation and declining asset prices. Japan's Big Bang liberalisation that aimed to make domestic financial markets and institutions more competitive and efficient was announced in November 1996 (Takagi, 2009). The most important component was a new Foreign Exchange and Foreign Trade Law that came into force in 1998. This provided for the full deregulation of foreign exchange transactions and abolished the system of authorised foreign exchange banks and designated securities firms. Other measures implemented in the late 1990s improved access for foreign investors and removed several remaining impediments to their transactions in domestic financial markets. These reforms coincided with an increase in foreign participation in the domestic stock market and and the partial unwinding of cross-shareholdings among Japanese listed firms. Aronson (2011) notes that the Big Bang led to an increase in the importance of equity relative to debt finance for Japanese non-financial firms between 1995 and 2005.

3.3. Summary Statistics

Summary statistics for the equity transactions and returns data are provided for each subsample in Tables 1 and 2. We show summary statistics for the purchases, sales and net transactions of foreign, financial, trust and individual investors. Also included are statistics for total transactions, which includes proprietary trades and client initiated brokerage trades for all investor groups in the TSE data set. There are differences in the net transactions of the four investor groups over the subsamples. Foreign investors are net sellers in the 1980s and net buyers thereafter. Individuals are net sellers in all subsamples. Financials are net buyers in the 1980s and 1990s, and net sellers in the 2000s and 2010s. Trusts are net buyers in the 1980s, 2000s and 2010s, and sellers in the 1990s. Foreign investors have the largest average purchases and sales in all subsamples, except the 1980s when individuals are the largest traders as a group. Purchases and sales generally show high autocorrelation, while net purchases are somewhat less

Table 1: Summary Statistics for the 1980s and 1990s

	Mean	Med	Max	Min	Sum	S.D	Skew	Kurt	ρ_1	ρ_2	ρ_3
1980s Equity Transactions											
Total purchases	2084.85	1050.03	9778.34	46.30	1084.12	2058.27	1.33	3.84	0.88	0.83	0.82
Total sales	2073.33	1040.86	9793.53	43.43	1078.13	2050.81	1.33	3.85	0.89	0.83	0.82
Net purchases	11.52	8.70	109.93	-142.02	5.99	25.47	0.24	7.84	0.43	0.23	0.18
Foreign purchases	189.16	134.97	881.95	3.02	98.36	153.75	1.21	4.10	0.69	0.54	0.51
Foreign sales	224.06	150.78	1226.62	5.09	116.51	196.79	1.20	4.24	0.88	0.82	0.81
Foreign net purchases	-34.90	-11.86	203.05	-1045.39	-18.15	94.21	-4.05	34.84	0.85	0.80	0.77
Financial purchases	358.07	84.20	2087.08	5.03	186.20	468.55	1.39	3.99	0.90	0.86	0.85
Financial sales	326.65	61.77	1969.98	1.88	169.86	443.75	1.46	4.24	0.89	0.85	0.84
Financial net purchases	31.43	12.15	394.24	-182.94	16.34	66.98	1.44	7.59	0.56	0.39	0.38
Trust purchases	142.34	49.28	857.57	3.02	74.02	168.94	1.62	5.02	0.89	0.86	0.86
Trust sales	132.07	48.85	764.97	1.15	68.67	157.57	1.69	5.16	0.89	0.86	0.85
Trust net purchases	10.28	1.73	415.08	-212.28	5.34	49.37	1.87	16.78	0.51	0.19	0.14
Individual purchases	595.13	407.91	2464.17	16.12	309.47	493.63	1.39	4.26	0.84	0.76	0.75
Individual sales	631.47	431.55	2477.82	18.71	328.36	518.85	1.35	4.15	0.84	0.76	0.75
Individual net purchases	-36.34	-19.60	623.10	-434.08	-18.90	65.94	0.55	25.50	0.48	0.28	0.22
1980s Equity and Exchange Rate Returns											
TOPIX	0.3497	0.3461	6.9552	-12.1678		1.8468	-0.57	7.77	0.00	0.06	0.07
S&P 500	0.2300	0.4604	8.4617	-13.0071		2.2416	-0.61	6.42	0.01	0.04	-0.04
USD/JPY exchange rate	-0.0943	0.0373	6.3120	-8.6974		1.5251	-0.64	5.73	0.09	0.09	0.04
1990s Equity Transactions											
Total purchases	1804.39	1584.91	5415.19	125.43	940.09	928.42	1.32	4.78	0.80	0.70	0.64
Total sales	1793.86	1570.32	5405.68	121.51	934.60	929.53	1.33	4.81	0.80	0.70	0.64
Net purchases	10.52	11.37	133.24	-146.73	5.48	20.62	-0.77	16.76	0.43	0.30	0.13
Foreign purchases	422.40	346.24	1860.58	19.42	220.07	266.30	1.95	7.92	0.83	0.75	0.71
Foreign sales	376.88	320.11	1465.84	13.67	196.36	220.95	1.69	6.99	0.87	0.79	0.76
Foreign net purchases	45.52	30.84	719.86	-519.35	23.72	126.99	0.65	6.76	0.62	0.52	0.40
Financial purchases	306.64	285.93	952.35	12.64	159.76	161.18	1.12	4.79	0.75	0.63	0.57
Financial sales	293.38	242.74	1044.81	5.75	152.85	190.53	1.30	4.67	0.77	0.65	0.59
Financial net purchases	13.26	19.23	476.02	-543.45	6.91	109.08	-0.38	5.37	0.63	0.48	0.43
Trust purchases	103.41	70.81	689.14	5.74	53.88	99.26	2.22	8.95	0.86	0.81	0.76
Trust sales	114.31	83.61	644.84	1.95	59.55	97.45	1.91	6.94	0.86	0.81	0.76
Trust net purchases	-10.90	-9.84	280.44	-210.18	-5.68	45.90	0.93	10.99	0.59	0.37	0.26
Individual purchases	325.45	220.77	1629.21	21.00	169.56	264.91	1.84	6.38	0.83	0.72	0.65
Individual sales	343.49	246.58	1408.17	24.19	178.96	251.76	1.64	5.54	0.82	0.72	0.66
Individual net purchases	-18.04	-19.29	384.58	-264.93	-9.40	68.53	1.20	9.15	0.48	0.38	0.20
1990s Equity and Exchange Rate Returns, Forward Earnings Per Share											
TOPIX	-0.0956	-0.0381	10.8383	-11.9169		2.7857	-0.03	4.74	-0.01	0.08	0.04
S&P 500	0.2741	0.3456	7.0619	-6.8626		1.8624	-0.05	3.77	-0.12	0.07	0.01
MSCI Kokusai	0.2430	0.2238	8.2359	-5.4495		1.6368	0.00	4.22	-0.03	0.06	0.05
FEPS	-0.0777	-0.1236	149.6206	-76.5629		13.0387	5.25	70.59	-0.01	-0.09	0.04
USD/JPY exchange rate	-0.0650	0.1094	5.9878	-14.9794		1.7284	-1.48	13.56	-0.04	0.05	-0.01

The summary statistics are the mean (Mean), median (Med), maximum (Max), minimum (Min), sum (Sum), standard deviation (S.D.), skewness (Skew), excess kurtosis (Kurt), and the autocorrelation coefficients for one (ρ_1), two (ρ_2) and three (ρ_3) lags. Transactions are in billions of yen per week, except for the sum which is stated as trillions of yen for the whole subsample. Returns are in percent per week. The 1980s sample consists of 520 weekly observations spanning the first week in January 1980 to the last week in December 1989. The 1990s sample consists of 521 weekly observations spanning the first week in January 1990 to the last week in December 1999. Forward Earnings Per Share (FEPS) data starts from 1994.

Table 2: Summary Statistics for the 2000s and 2010s

	Mean	Med	Max	Min	Sum	S.D.	Skew	Kurt	ρ_1	ρ_2	ρ_3
2000s Equity Transactions											
Total purchases	6655.49	5507.85	18911.57	170.15	3474.16	3712.40	0.81	2.74	0.88	0.82	0.82
Total sales	6651.60	5496.66	18907.18	169.55	3472.14	3713.76	0.81	2.75	0.88	0.82	0.82
Net purchases	3.88	4.15	84.70	-87.00	2.03	20.27	-0.20	4.33	0.20	0.08	0.03
Foreign purchases	2699.85	2033.32	9921.18	61.52	1409.32	1795.67	0.94	2.93	0.90	0.85	0.85
Foreign sales	2638.04	1930.63	10122.76	61.90	1377.06	1794.86	1.04	3.26	0.90	0.84	0.83
Foreign net purchases	61.81	48.65	932.43	-911.73	32.27	224.04	-0.03	4.15	0.39	0.31	0.27
Financial purchases	504.76	481.61	1341.30	18.86	263.49	185.05	0.78	4.83	0.62	0.48	0.42
Financial sales	525.80	494.05	1424.84	5.86	274.47	211.07	0.85	4.42	0.64	0.46	0.43
Financial net purchases	-21.03	-18.64	438.73	-692.50	-10.98	131.90	0.12	4.90	0.62	0.48	0.42
Trust purchases	130.32	115.94	410.57	2.23	68.03	75.89	0.69	2.72	0.82	0.78	0.76
Trust sales	120.66	99.21	431.36	1.45	62.98	74.17	0.89	3.32	0.83	0.78	0.77
Trust net purchases	9.66	6.08	226.39	-197.84	5.04	33.82	0.60	9.25	0.45	0.39	0.26
Individual purchases	1196.72	1010.39	4859.04	30.65	624.69	825.24	1.31	5.17	0.89	0.84	0.82
Individual sales	1233.22	1078.94	4534.86	28.43	643.74	831.54	1.16	4.47	0.89	0.85	0.83
Individual net purchases	-36.51	-32.87	587.79	-691.38	-19.06	173.81	0.03	4.29	0.16	0.10	0.04
2000s Equity and Exchange Rate Returns, Forward Earnings Per Share											
TOPIX	-0.1227	0.1026	9.2469	-22.0185		2.9393	-0.94	8.72	-0.06	0.04	-0.03
S&P 500	-0.0528	0.0958	11.3559	-20.0837		2.7847	-0.86	10.07	-0.06	0.06	-0.09
MSCI Kokusai	-0.0300	0.2024	12.6402	-23.0701		2.8129	-1.19	13.38	-0.03	0.07	-0.07
FEPS	-0.2671	-0.0758	254.4334	-100.0000		17.9571	8.43	124.67	0.41	0.00	-0.06
USD/JPY exchange rate	-0.0186	0.0208	4.5521	-7.5236		1.4609	-0.37	4.42	-0.07	0.06	-0.03
2010s Equity Transactions											
Total purchases	10170.49	10462.93	23617.75	2048.79	4780.13	3936.67	0.16	2.42	0.77	0.68	0.68
Total sales	10167.24	10466.92	23664.30	2047.38	4778.60	3934.44	0.16	2.43	0.77	0.69	0.68
Net purchases	3.25	2.11	89.91	-80.64	1.53	17.38	0.40	7.88	0.33	0.12	0.06
Foreign purchases	5961.64	6160.41	14896.54	1029.23	2801.97	2545.00	0.14	2.20	0.80	0.73	0.72
Foreign sales	5930.58	6214.47	15535.88	844.97	2787.37	2574.39	0.20	2.33	0.81	0.74	0.73
Foreign net purchases	31.06	17.93	1535.62	-1193.50	14.60	289.11	0.23	6.27	0.44	0.30	0.18
Financial purchases	417.12	402.15	1229.02	50.77	196.05	149.76	1.02	6.05	0.48	0.30	0.27
Financial sales	421.62	406.18	1179.05	49.61	198.16	155.32	0.99	5.68	0.47	0.37	0.37
Financial net purchases	-4.49	-6.39	487.89	-543.13	-2.11	116.46	-0.14	5.15	0.61	0.45	0.37
Trust purchases	196.11	187.37	527.98	21.28	92.17	88.32	0.56	2.97	0.69	0.62	0.59
Trust sales	195.97	184.74	537.65	19.70	92.11	91.58	0.71	3.46	0.71	0.61	0.60
Trust net purchases	0.14	0.74	205.39	-223.45	0.07	51.88	-0.38	6.16	0.40	0.17	0.07
Individual purchases	1677.21	1660.68	6855.67	351.73	788.29	775.06	1.46	8.95	0.78	0.69	0.66
Individual sales	1742.05	1699.22	6456.86	303.72	818.76	819.34	1.29	7.37	0.77	0.68	0.65
Individual net purchases	-64.83	-47.90	746.69	-1124.51	-30.47	237.41	-0.47	5.03	0.31	0.11	0.01
2010s Equity and Exchange Rate Returns, Forward Earnings Per Share											
TOPIX	0.1028	0.3788	8.4911	-13.4842		2.6198	-0.62	4.91	0.03	0.00	-0.06
S&P 500	0.1745	0.2835	7.1284	-7.4603		1.9800	-0.60	4.93	-0.11	0.00	-0.05
MSCI Kokusai	0.1039	0.2353	8.1464	-9.3374		2.0441	-0.70	5.67	-0.07	-0.05	-0.04
FEPS	0.3670	0.0222	29.0549	-12.2419		2.8723	5.63	51.30	0.32	0.36	0.10
USD/JPY exchange rate	0.0327	0.0635	4.2261	-4.8477		1.3253	-0.10	3.54	-0.02	-0.01	0.00

The summary statistics are the mean (Mean), median (Med), maximum (Max), minimum (Min), sum (Sum), standard deviation (S.D.), skewness (Skew), excess kurtosis (Kurt), and the autocorrelation coefficients for one (ρ_1), two (ρ_2) and three (ρ_3) lags. Transactions are in billions of yen per week, except for the sum which is stated as trillions of yen for the whole subsample. Returns are in percent per week. The 2000s sample consists of 522 weekly observations spanning the first week in January 2000 to the last week in December 2009. The 2010s sample consists of 470 weekly observations spanning the first week in January 2010 to the last week in December 2018.

autocorrelated, particularly in the latter half of the sample.

3.4. Order of Variables in the VAR

The order in which variables enter a VAR can influence the orthogonalized impulse responses. Variables should be ordered from most to least exogenous. We assume that global stock returns are the most exogenous and thus should enter the VAR first, followed by returns on the USD/JPY exchange rate. The daily close of trade on TSE occurs prior to the NYSE open. However, on a weekly basis it is reasonable to expect that the US equity market influences Tokyo more than the other way around, consistent with the finding of Chevallier et al. (2018) that the Tokyo market receives more shocks than it transmits. The market capitalisation of NYSE is far greater than that of TSE and the bulk of global market moving economic and corporate news is released during European and US trading hours, influencing US equity indices before Tokyo. We order the remaining variables as foreign, financial, trust and individual trade ratios followed by TOPIX, thus we assume that TSE transactions are more exogenous than TOPIX returns. Appendix C demonstrates that our main conclusions are robust to an alternative variable order.

4. Empirical Results and Discussion

4.1. VAR Empirical Results

Our benchmark model is specified in the spirit of Hasbrouck's (1991a,b) "information content of trade" approach, which includes a trade indicator for a security and its return as endogenous variables in a VAR system. Our specification includes the trade ratio of transactions in TSE First Section stocks for each investor group and TOPIX returns as the endogenous variables. Table 3 shows the results for the benchmark model.

Panel (a) provides the long-run price impact of trade for each investor group, which is the cumulative impulse response to a one standard deviation unanticipated increase in the investor group's trade ratio, evaluated at 30 weeks ahead. The long-run price impact of a shock to TOPIX returns is also provided in the table. A positive (negative) long-run price impact of trade for an investor group shows that an unanticipated purchase is expected to be followed by a cumulative increase (decrease) in price over the following 30 weeks. An investor group may be informed if the long-run price impact of their trades is positive, and uninformed if the long-run price impact is zero or negative.

Table 3: Benchmark Model

	1980s	1990s	2000s	2010s
(a) Long-Run Price Impact of Trade				
Foreign	1.27	1.89	2.07	1.82
Financial	-0.17	-0.44	0.06	0.04
Trust	0.27	-0.10	-0.36	-0.17
Individual	-0.45	-1.05	-1.02	-1.52
TOPIX	1.71	2.39	2.09	1.53
(b) Variance Decomposition of the Efficient Price (%)				
Foreign	33.23	33.84	43.74	41.63
Financial	0.57	1.83	0.04	0.02
Trust	1.49	0.09	1.33	0.34
Individual	4.21	10.45	10.60	28.80
TOPIX	60.49	53.79	44.29	29.20
Observations	516	521	522	470
Lags	4	3	4	2

The order in which the variables were included in the VAR is Foreign, Financial, Trust, Individual and TOPIX.

The variance decomposition of the efficient price in percent share is given in Panel (b). This shows the extent to which an exogenous shock to each variable in the model explains the variance of the efficient price shock. The share for each investor group reflects the proportion of efficient price variation attributed to their unanticipated trades, and represent the trade-related components of the efficient price. The variance decomposition share for the TOPIX represents the nontrade-related component of the efficient price, which is the efficient price variation due to unanticipated shocks in stock prices. Investors with a positive long-run impact and relatively large trade-related information share are considered to be more informed.

In the benchmark model, foreign investors appear to be informed. Foreigners have a positive long-run price impact in Table 3 Panel (a) and a relatively large information share for all subsamples in Panel (b). The influence of foreign investors' trades on the efficient price increased substantially in the 2000s and remained high in the 2010s as indicated by the sustained increase in information share from the 2000s. At the same time, the influence of TOPIX on the efficient price falls in the 2000s and again in the 2010s. Financials, trusts and individuals are uninformed. Financials and trusts have mixed positive and negative long-run price impacts that are relatively small in absolute value, and their information shares are low suggesting they have

almost no influence on the efficient price. Individual investors have negative long-run price impacts in all four subsamples. Their information share does increase over time, but the negative long-run price impact suggests their trades supply liquidity to other investors.

The foreign investors' positive long-run price impact of trade and relatively large information share suggests they possess an informational advantage over the other investor groups. However, the benchmark model does not tell the full story. Next, we examine the information content of foreign investors' trades controlled for global public information.

Table 4: Extended Model Including S&P 500 and USD/JPY Exchange Rate Returns

	1980s	1990s	2000s	2010s
(a) Long-Run Price Impact of Trade				
Foreign	0.66	1.60	1.09	0.78
Financial	-0.01	-0.44	0.12	0.15
Trust	0.18	-0.06	-0.20	-0.18
Individual	-0.20	-1.15	-0.64	-0.73
TOPIX	1.47	2.23	1.55	1.21
S&P 500	0.98	1.45	2.25	1.78
USD/JPY	-0.27	-0.52	0.48	1.40
(b) Variance Decomposition of the Efficient Price (%)				
Foreign	11.81	22.35	12.68	7.83
Financial	0.00	1.67	0.17	0.30
Trust	0.92	0.04	0.45	0.40
Individual	1.08	11.63	4.45	6.91
TOPIX	58.43	43.64	25.65	18.89
S&P 500	25.75	18.35	54.16	40.62
USD/JPY	2.00	2.33	2.44	25.04
Observations	518	521	522	470
Lags	2	2	2	1

The order in which the variables were included in the VAR is S&P 500, USD/JPY, Foreign, Financial, Trust, Individual and TOPIX.

As discussed in Section 2, numerous studies have shown that international equity market and exchange rate information is important for local stock market risk premia. International equity market comovement and cross market linkages have increased (Berben and Jansen, 2005; Chevallier et al., 2018; Christoffersen et al., 2012; Karolyi and Stulz, 2003; Longin and Solnik, 1995; Okimoto, 2014) which suggests global equity information is important. Karolyi and Stulz

(2003) suggest that national equity risk premia are internationally determined. Exchange rates have been shown to influence local stock market risk premia (Dumas and Solnik, 1995; De Santis and Gérard, 1998). To examine the influence of foreign investors' trades on the efficient price of Japanese stocks in the presence of global information, we add two variables to the benchmark model and refer to this as the extended model. We include the return on the S&P 500 index in the model to proxy for global equity market information and the USD/JPY exchange rate to capture information in the foreign exchange market. Inclusion of these variables in the VAR allows us to assess the informational advantage of foreign investors controlled for global public information.

Table 4 provides the estimates of the long-run price impact of trade and the variance decomposition of the efficient price for the extended model. The long-run price impact of unanticipated S&P 500 shocks on the efficient price of Japanese stocks is positive as would be expected. Good news for global stocks is good news for Japanese stocks. The long-run price impact of the USD/JPY exchange rate is negative in the 1980s and 1990s, but positive in the 2000s and 2010s. During the 2010s, unexpected depreciation of the Japanese yen is associated with higher Japanese stock prices.

Global stock price shocks have an important influence over the efficient price of Japanese stocks during each subsample in Table 4, and in particular for the 2000s and 2010s. During the 2000s and 2010s, global equity market shocks account for around half the variance in the efficient price of Japanese stocks. The USD/JPY exchange rate has a substantial influence on the efficient price during the 2010s, but a negligible impact in the 1980s, 1990s and 2000s. Global equity and exchange rate information together account for around two thirds of the variance in the efficient price of Japanese stocks in the 2010s, up from just over one quarter in the 1980s.

Relative to the benchmark model, the influence of TOPIX returns on the efficient price in the extended model is lower in the 1990s, and substantially lower in the 2000s and 2010s. Controlling for global public financial information, the importance of domestic equity market news has also declined over time. In the extended model, TOPIX returns account for around 60 percent of the variance of the efficient price in the 1980s, but under 20 percent in the 2010s. Global rather than local information has become relatively important in the formation of Japanese stock prices, particularly in the 2000s and 2010s.

Compared with the benchmark model, foreign investors' information share is substantially lower in all subsamples under the extended model. Whereas under the benchmark model, foreign investors have a higher information share in the 2000s and 2010s than the 1980s and 1990s,

this is no longer the case when we control for global stock prices and the exchange rate. We argue that the majority of the information attributed to the trades of foreign investors in the benchmark model is related to international financial factors, as proxied by S&P 500 and exchange rate returns in the extended model. Interestingly, foreign investors have a relatively large information share during the difficult 1990s period compared with all other decades when we control for international financial factors, while at the same time global and domestic stock prices together have the lowest information share of all decades. Our results are robust to using the MSCI Kokusai index as a broader alternative proxy for global stock price information (Appendix B) and the main conclusions remain unchanged for an alternative ordering of the variables in the VAR models (Appendix C).

Table 5: Correlations Between Trade Ratio and Returns Series

	For	Fin	Tru	Ind	TOP	SP5	For	Fin	Tru	Ind	TOP	SP5
	1980s						*1990s*					
Fin	-0.24***						-0.49***					
Tru	-0.37***	0.01					-0.27***	0.15***				
Ind	-0.43***	-0.04	-0.20***				-0.29***	-0.14***	0.06			
TOP	0.33***	-0.21***	0.01	-0.29***			0.24***	-0.30***	-0.10**	-0.26***		
SP5	0.25***	-0.15***	0.03	-0.19***	0.37***		0.11***	-0.13***	-0.05	-0.17***	0.33***	
JPY	-0.10**	0.12***	-0.04	0.14***	-0.16***	-0.04	0.02	0.00	-0.04	-0.04	-0.07	0.11**
	2000s						*2010s*					
Fin	-0.55***						-0.45***					
Tru	-0.25***	0.30***					-0.21***	0.43***				
Ind	-0.56***	0.17***	0.07*				-0.63***	0.16***	0.19***			
TOP	0.48***	-0.18***	-0.03	-0.64***			0.51***	-0.10**	-0.11**	-0.75***		
SP5	0.25***	-0.12***	0.00	-0.34***	0.52***		0.28***	-0.06	-0.06	-0.49***	0.56***	
JPY	-0.04	-0.01	-0.02	-0.09*	0.22***	0.22***	0.30***	-0.09*	-0.12***	-0.44***	0.57***	0.28***

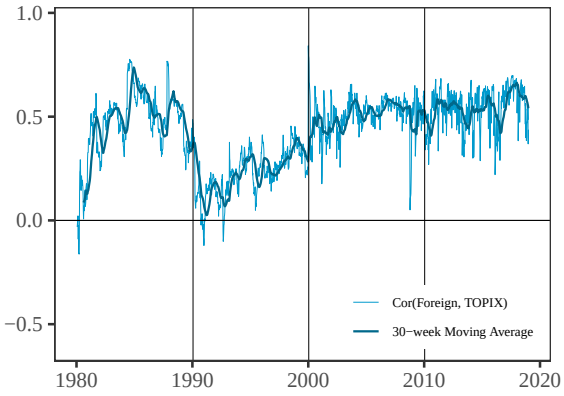
The trade ratios are foreign (For), financial (Fin), trust (Tru) and individual (Ind). The returns are TOPIX (TOP), S&P 500 (SP5) and USD/JPY (JPY). Significant at 1% shown by ***, at 5% shown by **, at 10% shown by *.

We provide supporting evidence for our argument in the form of: (i) correlations between the data series (the trade ratios for the four investor groups and the TOPIX, S&P 500 and USD/JPY exchange rate returns) in Table 5; and (ii) estimated time-varying conditional correlations between the residuals of each equation in the extended model, as shown in Figure 4. We estimated the time-varying conditional correlations using a restricted version of diagonal Baba, Engle, Kraft and Kroner (BEKK) model (Baba et al., 1985) as defined in Engle and Kroner (1995)[13]. We estimated four diagonal BEKK models, one for each of the four subsamples, us-

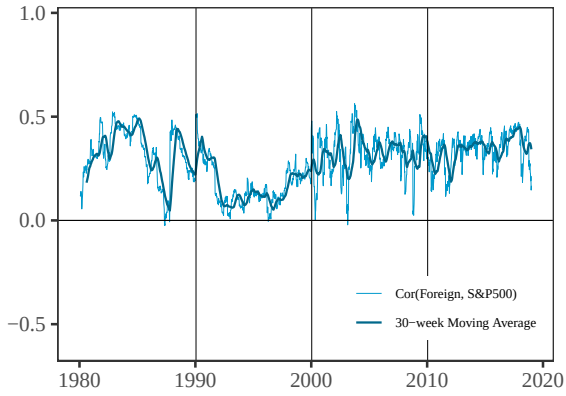
[13]We selected diagonal BEKK as the most appropriate multivariate model for estimating time-varying condi-

Figure 4: Dynamic Correlations Estimated for the Residuals of the Extended Model

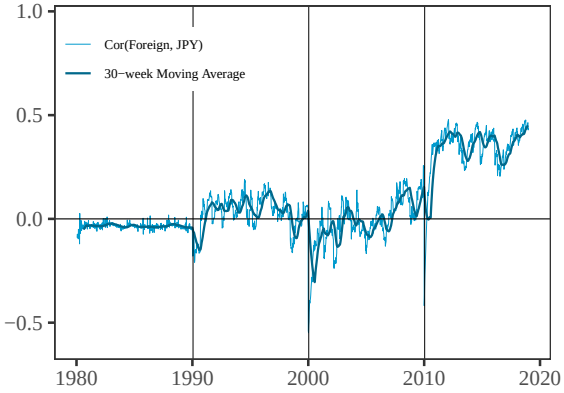
(a) Foreign and TOPIX



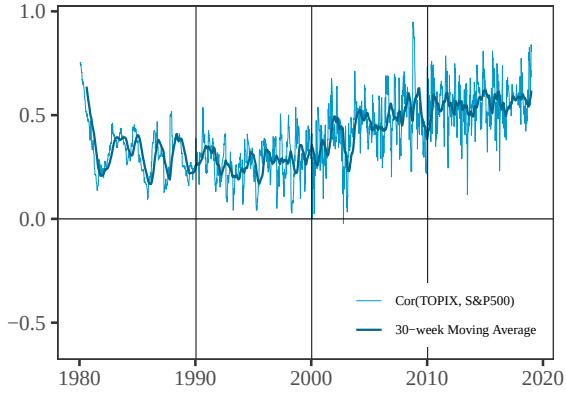
(b) Foreign and S&P500



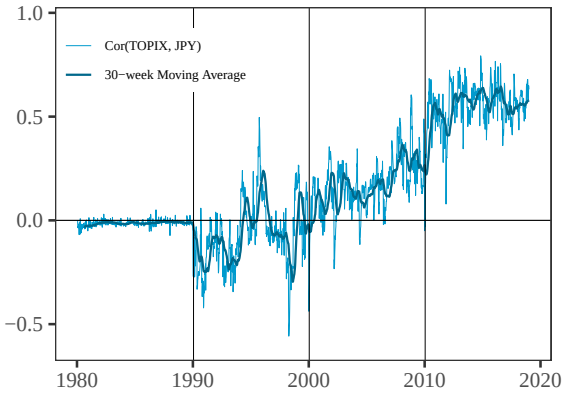
(c) Foreign and USD/JPY Exchange Rate



(d) TOPIX and S&P500



(e) TOPIX and USD/JPY Exchange Rate



ing the residuals of the extended model. Recall that the residuals for the trade ratio equations may be interpreted as unanticipated trades while those for the TOPIX, S&P 500 and USD/JPY equations are return innovations. Overall, the two correlation analyses show that foreign investors increased their reliance on global information to trade Japanese stocks simultaneously with the increase in the influence of international financial factors on the domestic market.

tional correlations given the limitations of similar models discussed in Caporin and McAleer (2013).

Table 5 shows that foreign investors' trades are positively and significantly correlated with TOPIX and S&P 500 returns in all subsamples. Foreign trades and TOPIX returns are substantially more correlated in the 2000s and 2010s than in the 1980s and 1990s, while foreign trades and both stock return series have relatively low correlations in the 1990s. Similarly, the conditional correlation between unanticipated foreign trades and TOPIX innovations (Figure 4 Panel (a)) shows a stable positive relationship around the 0.5 level during the 2000s and 2010s, but not in the 1980s and 1990s. Unanticipated foreign trades are also more consistently related to global stock return innovations throughout the 2000s and 2010s compared with the 1980s and 1990s (Figure 4 Panel (b)) suggesting a stronger relationship between global information and foreign investors' trades in Japanese stocks. Foreign trades and USD/JPY exchange rate are positively and significantly correlated during the 2010s, but not in the 1980s, 1990s or 2000s. Similarly, Figure 4 Panel (c) shows a stable positive relationship between unanticipated foreign trades and exchange rate return innovations for the 2010s only. The correlation analyses demonstrate that the increase in the correlations between foreign investors' trades and global financial variables coincides with the increase in the influence of global information on the efficient price shown in Table 4.

Table 5 also suggests that foreign investors' trading behaviour is quite different to that of domestic investors. The domestic investor groups' trades have low or negative and significant correlations with both domestic and foreign equity information. Domestic investors' trades are generally positively correlated with exchange rate returns in the 1980s and negatively correlated in the 2010s. The correlations between foreign and domestic investor groups' trades are negative and significant in all subsamples. This is consistent with the conclusion drawn from Tables 3 and 4 that only foreign investors' trades are related to global information.

Both Table 5 and Figure 4 Panel (d) illustrate the closer relationship between Japanese and global stock returns in the latter half of our sample. TOPIX and S&P 500 returns have higher positive correlations in the 2000s and 2010s than the 1980s and 1990s. Conditional correlations during the 2000s and 2010s are greater, on average, than in the 1980s and 1990s. TOPIX and the exchange rate show a high correlation in the 2010s, both in terms of the return correlations in Table 5 and the conditional correlation of innovations in Figure 4 Panel (e). The conditional correlation increased over the 2000s, prior to which there was no stable relationship between the TOPIX and USD/JPY innovations. These results are consistent with the hypothesis that international financial factors have become more important for the Japanese equity market over recent decades.

The extended model shows that the influence of global stock price and exchange rate information on the efficient price of Japanese stocks has increased over time. Global information has had a substantial permanent impact on domestic stock prices, particularly during recent decades. At the same time, the correlation between foreign investors' trading and global information has also increased. The timing of the increase in correlation between foreign investors' trading and global financial variables coincides with the increase in the influence of global information on the efficient price of Japanese stocks. As the comovement between Japanese and international stock returns increased over time, the trade strategies of foreign investors appear to exploit more global equity price and exchange rate information. In contrast, the trading of the domestic investor groups does not show a similar pattern. Their trades are negatively related or unrelated to global public information.

A number of interpretations are possible. Foreign investors may use global public information to trade Japanese stocks on the knowledge that international factors have become more important for domestic stock returns. Foreign investors may also possess private information related to global public information and use this to trade Japanese stocks. An alternative interpretation is that the increase in foreign trading activity in Japanese stocks may have led to the increase in correlation between domestic returns and global information. A limitation of our study is that we are unable to determine the extent to which foreign investors exploit public or private global information in their trading, or to identify whether causality runs from increased foreign activity to higher international return correlation or the other way around.

4.2. Foreign Investors and Efficiency

Our benchmark and extended models provide estimates of the relative influence of foreign investors on the efficient price compared with the other trade- and nontrade-related components and show that foreign investors' information share declines from the 1990s. However, do the trades of foreign investors contribute to the informational efficiency of the Japanese stock market? Has the market become more efficient over time with greater foreign investor participation? To examine these questions, we estimate measures of informational inefficiency that can be derived from our benchmark and extended VAR models, based on the approach of Hasbrouck (1993).

Equation (2) specifies the price of a security, p_t, as the sum of the efficient price, m_t, and mispricing, s_t. Boehmer and Kelley (2009) interpret the standard deviation of s_t, σ_s, as a mea-

Table 6: Informational Inefficiency Measures

	1980s	1990s	2000s	2010s
(a) Benchmark Model				
σ_s	2.43	2.67	1.75	0.59
σ_s/σ_ω	1.10	0.82	0.56	0.21
$\sigma_s/\sigma_{\omega,Foreign}$	1.92	1.41	0.84	0.33
$\sigma_s/\sigma_{\omega,Financial}$	14.57	6.08	27.66	14.76
$\sigma_s/\sigma_{\omega,Trust}$	9.03	26.74	4.84	3.59
$\sigma_s/\sigma_{\omega,Individual}$	5.38	2.54	1.72	0.39
$\sigma_s/\sigma_{\omega,TOPIX}$	1.42	1.12	0.84	0.39
(b) Extended Model Including S&P 500 and USD/JPY Exchange Rate				
σ_s	1.99	2.67	1.17	0.48
σ_s/σ_ω	1.03	0.79	0.38	0.17
$\sigma_s/\sigma_{\omega,Foreign}$	3.00	1.67	1.08	0.61
$\sigma_s/\sigma_{\omega,Financial}$	175.20	6.11	9.39	3.15
$\sigma_s/\sigma_{\omega,Trust}$	10.76	41.33	5.73	2.71
$\sigma_s/\sigma_{\omega,Individual}$	9.92	0.34	1.82	0.65
$\sigma_s/\sigma_{\omega,S\&P500}$	2.03	1.84	0.52	0.27
$\sigma_s/\sigma_{\omega,USD/JPY}$	7.29	5.18	2.46	0.34
$\sigma_s/\sigma_{\omega,TOPIX}$	1.35	1.20	0.76	0.40

sure of market inefficiency because it shows the extent to which p_t deviates from m_t over time[14]. Hasbrouck (1993) provides a method to estimate the lower bound for σ_s from VARs of transactions and returns, such as our benchmark and extended models. For simplicity, we use the notation σ_s to refer to this lower bound from this point onward. We examine the evolution of both market inefficiency and inefficiency relative to fundamental information over the four decades from the 1980s to the 2010s.

We calculate inefficiency divided by the standard deviation of the efficient price, σ_s/σ_ω, from the benchmark and extended model estimates. This is a measure of inefficiency relative to fundamental information, including both the trade- and nontrade-related components. We calculate $\sigma_s/\sigma_{\omega,x_g}$ which is inefficiency per standard deviation of the trade-related contribution to the efficient price by each investor group, where $g = 1, \ldots, 4$, denotes the four investor groups, foreign, financial, trust and individual. These measures represent inefficiency relative to each trade-related fundamental information source. We use these measures to demonstrate the extent

[14] As s_t has a zero mean, σ_s, represents the magnitude of mispricing over time. Specifically, Boehmer and Kelley (2009) call σ_s an (inverse) measure of market efficiency, while Hasbrouck (1993) uses σ_s as a measure of market quality.

to which market inefficiency decreases over time relative to each investor group's contribution to the efficient price through trades. Similarly, $\sigma_s/\sigma_{\omega,r_h}$ is inefficiency per standard deviation of the nontrade-related contribution to the efficient price by each return variable, where $h = 1, \ldots, 3$, denotes the three returns series S&P 500, USD/JPY and TOPIX.

We calculate $\sigma_s/\sigma_{\omega,x_g}$ as:

$$\sigma_s/\sigma_{\omega,x_g} = \frac{\sigma_s/\sigma_\omega}{\sigma_{\omega,x_g}/\sigma_\omega} \tag{9}$$

where σ_s/σ_ω (inefficiency per standard deviation of the efficient price) and $\sigma_{\omega,x_g}/\sigma_\omega$ (square root of the variance decomposition for each investor group) are obtained from the variance decomposition of the efficient price for the benchmark and extended models. $\sigma_s/\sigma_{\omega,r_h}$ is calculated in a similar fashion.

Table 6 provides the estimates of σ_s and the associated ratios to fundamental information, σ_s/σ_ω, for the benchmark and extended models. Both models show that informational efficiency has improved since the 1990s. The 1990s is the least efficient subsample, coinciding with the decade following the collapse of the Japanese asset price bubble. σ_s/σ_ω declines in each decade following the 1980s, suggesting that fundamental information has contributed to the improvement in efficiency of the Japanese stock market. According to both the benchmark and extended models, $\sigma_s/\sigma_{\omega,Foreign}$ also declines continuously from decade to decade, and is relatively small compared with the ratios for the other investor groups. Foreign investors' trades have improved the efficiency of the Japanese stock market, even when controlling for the informational contribution of global stock prices and the exchange rate.

4.3. Forward Earnings Information

The influence of foreign investors' trades on the efficient price of Japanese stocks may reflect their use of fundamental information on Japanese stocks. Foreign investors' trades may exploit forecasts of Japanese stock price fundamentals. Global stock or exchange rate information may also be related to domestic stock price fundamentals. To examine whether the influence of foreign investors trades and/or the global information variables reflect fundamental information, we include a measure of earnings forecasts for TSE First Section stocks in the extended model. The Nikkei newspaper produces a forecast price-earnings ratio for the TSE First Section, calculated as the market capitalisation of the First Section divided by the newspaper's forecast of total First Section earnings for the next twelve months. This data is available from

1994[15]. We calculate the forecast earnings per share (FEPS) for First Section companies by dividing the TOPIX by the newspaper's price-earnings ratio. We use the percentage change of FEPS in our model, both for consistency with the percent change units of the other variables, and because the level of FEPS is non-stationary. Summary statistics for the percentage change in FEPS appear in Tables 1 and 2.

Table 7: Extended Model Including S&P 500, USD/JPY Exchange Rate Returns Plus FEPS

	1990s	2000s	2010s
(a) Long-Run Price Impact of Trade			
Foreign	1.17	1.08	0.81
Financial	-0.66	0.15	0.12
Trust	-0.06	-0.19	0.00
Individual	-0.81	-0.66	-0.66
TOPIX	1.57	1.51	1.05
S&P 500	1.11	2.27	1.93
USD/JPY	0.04	0.55	1.30
FEPS	0.08	-0.06	-0.45
(b) Variance Decomposition of the Efficient Price (%)			
Foreign	22.14	12.45	8.37
Financial	6.99	0.25	0.18
Trust	0.05	0.40	0.00
Individual	10.70	4.57	5.58
TOPIX	39.80	24.14	14.14
S&P 500	20.17	54.91	47.57
USD/JPY	0.02	3.24	21.53
FEPS	0.11	0.04	2.64
Observations	299	513	470
Lags	1	2	2

The order in which the variables were included in the VAR is S&P 500, USD/JPY, FEPS, Foreign, Financial, Trust, Individual and TOPIX. The 1990s sample begins in 1994.

Table 7 provides the results for the extended model with FEPS. The variance decomposition of the efficient price suggests that FEPS has a negligible influence over the efficient price. Thus including Japanese fundamental equity information in the extended model does not change our

[15]There are three gaps in the Nikkei newspaper price-earnings ratio data, from 28 February to 21 May 1999, 24 March to 10 May 2002, and 3 May to 5 May 2009.

main results. This suggests that the information in foreign investors' trades is not related to forecasts of Japanese corporate earnings[16]. Note that the long-run price impact of unanticipated revisions to FEPS is negative in the 2010s, indicating that an unexpected increase in earnings would be followed by lower stock prices. This suggests that earnings forecast revisions have not been a good signal for Japanese stock prices during the most recent decade.

4.4. Discussion

Our benchmark model demonstrated that foreign investors trade at an information advantage to domestic investors, and that their information advantage increased since around 2000. When we control for global public information using the extended model, we find that the influence of global stock prices on the Japanese market increased since the 2000s and the influence of the exchange rate increased during the 2010. Together, these sources of public information account for the increase in foreign investors' information advantage implied by the benchmark model. The extended model shows that local public information, represented by TOPIX returns, has the largest information share in the 1980s and 1990s, while global public information has the largest information share in the 2000s and 2010s. We also show that foreign investors' trades become more correlated with both global public information variables at the same time as these variables exert greater influence over Japanese stock prices. However, why has global stock price information influenced Japanese stocks to a greater extent since 2000 and why has the exchange rate influenced Japanese stock prices only since 2010?

Previous research on national equity market comovement provides evidence consistent with our finding that global stock price information was of greater importance for the Japanese market during the 2000s and 2010s than the 1980s and 1990s. Berben and Jansen (2005) conclude that the Japanese market was comparatively disconnected from global market developments between 1980 and 2000, potentially reflecting the severe financial problems faced by the Japanese economy at the time. Morana and Beltratti (2008) note that while international linkages continued to strengthen over the last decade of their 1973 to 2004 sample for the German, UK and US markets, this was not the case for Japan. They suggest that the protracted macroeconomic stagnation of the 1990s resulted in a more idiosyncratic Japanese market, that is, domestic fundamentals dominated the trend toward greater international comovement of equity prices. Christoffersen et al. (2012) note that Japanese stocks have a relatively low return correlation

[16]It is possible that foreign investors forecast earnings ahead of the NIKKEI newspaper forecast, which may mute the influence of FEPS on the efficient price.

with other developed markets from 1973 to 2000, after which the correlations increase.

We would argue that the relatively low influence of global public stock price information during the 1980s and 1990s is likely due to the Japanese market's idiosyncratic asset price bubble during the latter half of the 1980s and dealing with the fallout of an idiosyncratic bust for much of the 1990s. The "bubble era" of the 1980s saw asset prices, particularly real estate and stocks, rise substantially and broadly independently from asset prices in other countries[17]. The collapse of the bubble saw a prolonged period of macroeconomic stagnation, falling asset prices, lingering zombie corporations, an intensifying non-performing loan problem and a banking crisis in 1997 (Tsuruta and Miyasaka, 1999). In contrast, a bull market in stocks developed from the mid-1990s in the US.

The late 1990s also saw Japan's Big Bang period of financial deregulation during which numerous restrictions on financial trading and cross-border transactions that persisted through the 1980s and 1990s were lifted, as discussed in Section 3.2. Significant liberalisation aimed to increase price competition and efficiency in financial services. Deregulation and efforts to internationalise the Japanese yen resulted in accelerated financial integration with the rest of the developed world and a highly financially open economy (Takagi, 2009). Financial globalisation as a result of the Big Bang deregulations is likely to have contributed to the relatively greater influence of international financial factors on Japanese stock prices in the 2000s and 2010s.

Our results show that the exchange rate only influences Japanese stock prices during the 2010s, and not before. The 2010s saw substantially greater monetary easing from the Bank of Japan (BoJ). This began with "Comprehensive Monetary Easing" in October 2010, followed by the Prime Minister's announcement of a new policy to overcome deflation and adopt unlimited monetary easing in November 2012. In 2013 the BoJ adopted an aggressive and unconventional monetary policy stance, including a two percent "Price Stability Target" in January, followed by the introduction of "Qualitative and Quantitative Monetary Easing" (QQE) in April. QQE involves very large scale asset purchases, far in excess of previous episodes of quantitative easing in Japan. The Bank expanded QQE in 2014, and enhanced the program with "Quantitative and Qualitative Monetary Easing with a Negative Interest Rate" and "Quantitative and Qualitative Monetary Easing with Yield Curve Control", both in 2016. These policies sharpened global investor focus on the relatively accommodative monetary stance in Japan.

Several studies show that the BoJ's unconventional monetary policy has been associated

[17]Outward investment from Japan did elevate asset prices in some smaller economies (Reinhart and Rogoff, 2009).

with yen depreciation and higher domestic stock prices (Rogers et al., 2014; Fukuda, 2015; Kawai, 2015; Ryou et al., 2019), spillover effects to other Asian stock markets (Kawai, 2015; Fukuda, 2018; Sugimoto and Matsuki, 2019) and economies (Ryou et al., 2019)[18]. Yen depreciation itself should be favourable for Japanese stock returns on higher yen-denominated earnings from international operations and greater export sales, particularly where pricing-to-market occurs. Rogers et al. (2014) note that BoJ asset purchase announcements have a larger effect on the exchange rate and stock prices than other monetary policy announcements. Fukuda (2015) finds that nighttime traders, assumed to be foreign, purchased Japanese stocks and sold the yen more aggressively than daytime traders, assumed to be domestic, in response to Japanese unconventional monetary policy news between November 2012 and October 2014. The effects of the BoJ's unconventional monetary policy stance over the 2010s corresponds with our finding that exchange rate information influences stock prices over the same period.

We have demonstrated that foreign investors have possessed an informational advantage over domestic investors since the 1980s. We have also shown that their informational advantage is primarily related to global public information since the 2000s. Why has the behaviour of foreign investors changed since the 2000s? The timing coincides with the increase in correlation between Japanese stock returns and global stocks returns, during the 2000s and 2010s, and exchange rate returns, during the 2010s. At the same time, foreign investors have contributed to the efficiency of the Japanese market. As international financial factors have become more influential over Japanese stock returns, foreign investors have made greater use of global public information. In contrast, domestic investors have not made profitable use of global public information. The trades of foreign investors have been the conduit for incorporating global financial information in Japanese stock prices as the TSE has internationalised. In this context, foreign investors are key players in the Japanese stock market.

5. Conclusion

In this paper, we examined whether foreign investors trade at an informational advantage to domestic investors, what types of information within foreign investors' trades contribute

[18] Although the BoJ pioneered quantitative easing between March 2001 and March 2006, long-term bond purchases were limited to less than the amount of bank notes in circulation by the Bank's self imposed "bank note rule". Asset purchases during this period were small in comparison to those implemented from 2013 onward when the Bank ceased observing the bank note rule (Rogers et al., 2014). Using a VAR, Honda et al. (2013) show that quantitative easing shocks during the 2001 to 2006 period lead to a statistically insignificant yen depreciation response.

to stock prices, and how the information in foreign investors' trades has changed as national stock markets have become more integrated overtime. Our empirical analysis investigated the information content of foreign and domestic investors' trades on the TSE over a long sample period of 39 years. The sample was divided into four approximately decade long subsamples to reveal the changing role of foreign investors in stock price formation.

To summarise our results, we show that (i) foreign investors possesses an informational advantage over domestic investors; (ii) foreign investors' trades predominantly contain global information related to global stock prices since the 2000s and the exchange rate since the 2010s; (iii) foreign investors' trades are not related to fundamental information on forecast future earnings of domestic firms; (iv) foreign investors' trades increasingly influence Japanese stock prices over time in a way which coincides with the increasing importance of global public information in stock prices, and (v) foreign investors have consistently contributed to the informational efficiency of the Japanese stock market over the last 39 years even when we control for global stock price and exchange rate information.

Our research has three main implications for policy-makers and investors. First, from an informational efficiency perspective, our research supports policies that provide access for foreign investors to domestic markets. Foreign investors contribute global information to, and improve the efficiency of, local markets. Our research is generalisable to other developed markets, and to emerging markets where the participation of foreign investors may increase from a low level as it did in Japan. Second, although we are unable to infer causality, foreign investors' trading of Japanese stocks using global information has increased the comovement between Japanese and U.S. stock market returns. While the efficiency of the Japanese market has improved as a result of foreign investors' trading, the increased comovement is detrimental to global stock diversification opportunities for investors, at least at the country level. Our results suggest the benefits of diversification across national stock markets have declined since the 2000s. Third, Japanese domestic investors may over-rely on local information and under-rely on global information, given the greater importance of global information during the 2000s and 2010s and their poor investment performance.

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Appendix A. Robustness to Alternative Trade Indicator

Table A.8 provides the empirical results for the extended model where the trade indicator for each investor group is defined as the yen value of stock purchases minus sales. The results are very similar to those in Table 4 in Section 4.1.

Table A.8: Extended Model Including S&P 500 and USD/JPY Exchange Rate Returns

	1980s	1990s	2000s	2010s
(a) Long-Run Price Impact of Trade				
Foreign	0.86	1.83	1.12	0.83
Financial	0.19	-0.13	0.14	0.31
Trust	0.11	-0.09	-0.04	-0.14
Individual	0.02	-1.11	-0.67	-0.75
TOPIX	1.53	2.20	1.44	1.15
S&P 500	1.15	1.44	2.24	1.76
USD/JPY	-0.31	-0.55	0.47	1.38
(b) Variance Decomposition of the Efficient Price (%)				
Foreign	16.46	28.26	13.88	9.07
Financial	0.75	0.13	0.20	1.25
Trust	0.28	0.07	0.02	0.27
Individual	0.00	10.44	5.04	7.24
TOPIX	51.37	41.06	22.83	17.17
S&P 500	29.00	17.53	55.59	40.08
USD/JPY	2.14	2.51	2.43	24.92
Observations	517	521	522	470
Lags	3	2	2	1

The order in which the variables were included in the VAR is S&P 500, USD/JPY, Foreign, Financial, Trust, Individual and TOPIX.

Appendix B. Robustness to Alternative Proxy for Global Equity Prices

The S&P 500 index is often used as a proxy for global large-cap stock prices given the size and importance of the US equity market. We examine whether our results are robust to a broader proxy for global stock prices by estimating the extended model using the MSCI Kokusai index in place of the S&P 500. The MSCI Kokusai index is the MSCI World index ex-Japan and was launched on 31 March 1986[19]. Summary statistics for MSCI Kokusai returns appear in Tables 1 and 2. We conduct the robustness check over the 1990s, 2000s and 2010s subsamples. Table B.9 suggests our results are robust to the broader proxy for global equity prices.

Table B.9: Model Including MSCI Kokusai and USD/JPY Exchange Rate Returns

	1990s	2000s	2010s
(a) Long-Run Price Impact of Trade			
Foreign	1.50	1.02	0.69
Financial	-0.41	0.14	0.18
Trust	-0.04	-0.26	-0.19
Individual	-1.11	-0.64	-0.67
TOPIX	2.15	1.51	1.20
Kokusai	1.74	2.33	1.78
USD/JPY	-0.32	0.51	1.44
(b) Variance Decomposition of the Efficient Price (%)			
Foreign	19.74	10.96	6.14
Financial	1.48	0.22	0.43
Trust	0.02	0.71	0.49
Individual	10.77	4.26	5.85
TOPIX	40.55	23.97	18.88
Kokusai	26.55	57.18	41.43
USD/JPY	0.89	2.71	26.78
Observations	520	521	470
Lags	2	2	1

The variable order is Kokusai, USD/JPY, Foreign, Financial, Trust, Individual, TOPIX.

[19]MSCI Kokusai contains large- and mid-cap firms in 22 developed markets (Japan is excluded), has 1,326 constituents and covers approximately 85 percent of the free float-adjusted market capitalisation in each country (MSCI, 2019b). Securities or portfolios tracking the MSCI Kokusai index are commonly used by Japanese investors to take exposure to global stocks.

Appendix C. Robustness to Alternative Order of the Variables in the VAR

Table C.10 provides the results for the extended model with the variables in the following order: financial, trust, individual, foreign, USD/JPY, S&P 500, and TOPIX. The results presented in Table 4 in Section 4.1 are robust to different variable orders.

Table C.10: Extended Model Including S&P 500 and USD/JPY Exchange Rate Returns

	1980s	1990s	2000s	2010s
(a) Long-Run Price Impact of Trade				
Foreign	0.66	0.89	0.50	0.21
Financial	-0.37	-1.34	-0.80	-0.35
Trust	0.13	-0.27	-0.24	-0.34
Individual	-0.75	-1.67	-1.78	-2.20
TOPIX	1.47	2.23	1.55	1.21
S&P 500	0.61	0.90	1.47	0.69
USD/JPY	-0.12	-0.44	0.79	0.86
(b) Variance Decomposition of the Efficient Price (%)				
Foreign	11.74	6.87	2.72	0.59
Financial	3.66	15.59	6.93	1.54
Trust	0.45	0.62	0.63	1.51
Individual	15.32	24.53	34.15	61.99
TOPIX	58.43	43.64	25.65	18.89
S&P 500	10.00	7.07	23.23	6.09
USD/JPY	0.40	1.68	6.70	9.39
Observations	518	521	522	470
Lags	2	2	2	1

The order in which the variables were included in the VAR is Financial, Trust, Individual, Foreign, USD/JPY, S&P 500, and TOPIX.