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Stock market evidence on the international transmission channels of US monetary policy surprises

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ABSTRACT

We reveal the economic sources of the stock market responses of 40 countries to US monetary policy surprises by decomposing stock market returns into components reflecting investors' revisions in expectations (news) about future cash flows and different components of discount rates. US monetary policy surprises have persistent effects on foreign stock markets because they primarily constitute cash flow news. This finding pertains to different measures of the surprises. The liquidity of stock markets and the perceived country risk affect the sensitivities of unexpected stock market returns to the US monetary policy surprises while other country characteristics, e.g., the exchange rate regime, have no effect.

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1. Introduction

Ample evidence suggests that US monetary policy affects the stock markets of developed and emerging countries worldwide (Ammer et al., 2010; Brusa et al., 2020; Ehrmann and Fratzscher, 2009; Jiang et al., 2020; Miranda-Agrippino and Rey, 2020; Wongswan, 2009).

In a textbook world, monetary policymakers influence stock markets through the discount rate. They move the policy rate to change current short-term real interest rates and affect expectations about short-term movements in future real interest rates. This effect is temporary. Monetary policy temporarily raises (lowers) discount rates, which leads to a capital loss (gain) today that will be offset by higher (lower) expected returns in the future (Campbell, 1991).

However, there is growing evidence, based on high-frequency data, that non-monetary information, e.g., the central bank's growth outlook or risk assessment, is an important part of central bank communication to which financial markets respond (Andrade and Ferroni, 2021; Cieslak and Schrimpf, 2019; Degaspari et al., 2020; Jarociński and Karadi, 2020; Kroencke et al., 2021; Nakamura and Steinsson, 2018; Miranda-Agrippino and Ricco, 2021).[1]

This background raises the question of the channels through which US monetary policy surprises influence foreign stock markets. According to the dividend discount model, the value of a stock is the sum of all future dividends discounted by expected stock returns. In this paper, we thus ask: Do US monetary policy surprises alter expectations about future dividends

[1] Madeira and Madeira (2019) show in a high-frequency event study that even the degree of consent among Fed' s Federal Open Market Committee members affects stock prices. Moreover, Lakdawala et al. (2021) show that uncertainty about future US monetary policy has a strong impact on asset markets worldwide.

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or discount rates on foreign stock markets? Do unconventional monetary policy measures, e.g., large-scale asset purchases (LSAP), affect foreign stock markets through the same channels as conventional measures, such as Fed funds rate (FFR) changes? Are there any country characteristics that make foreign stock markets more sensitive to US monetary policy surprises?

Our main empirical analysis is based on panel versions (Vuolteenaho, 2002) of monthly vector autoregressive (VAR) representations of the dividend discount model proposed by Ammer and Mei (1996). This approach allows decomposing unexpected variation in excess stock returns denominated in US dollar (USD) into revisions in expectations (news) about future cash flows (dividends) and future discount rates. In this framework, discount rates of foreign USD-denominated excess stock returns vary because of variation in expected future excess returns, revisions in expectations about current and future US real interest rates, revisions in expectations about current and future USD real exchange rates, or an arbitrary combination of the three. We then follow Bernanke and Kuttner (2005) and integrate high-frequency US monetary policy surprises as exogenous variables into the VAR, which enables us to provide a detailed examination of the potential channels through which US monetary policy surprises transmit to foreign stock markets.

We evaluate the relationship between unexpected variation in foreign stock market returns and measures of US monetary policy surprises from Swanson (2021), who differentiates between surprises related to the FFR, the Fed's forward guidance (FG), and LSAP.[2] Furthermore, we check the robustness of our results with the unified US monetary policy surprise series of Bu et al. (2021).

We find that US monetary policy surprises mainly affect foreign stock markets because they lead to revisions in expectations about future dividend growth. Restrictive US monetary policy surprises constitute adverse cash flow news for foreign stock markets. This observation suggests that the US monetary policy surprises lead to revisions in expectations about the long-term economic outlook for foreign economies. This finding pertains to both developed and emerging markets and is in line with evidence of US monetary policy shocks having real economic effects abroad (Dedola et al., 2017; Degaspari et al., 2020; Vicondoa, 2019). Moreover, it is robust to variations in the specification of our VAR, holds for different measures of US monetary policy surprises, and is similar to what we and earlier studies (Bernanke and Kuttner, 2005) find for the US.

We also assess whether country-specific characteristics affect the sensitivity of foreign stock market returns to US monetary policy surprises. Studies based on high-frequency data attribute cross-country variation in sensitivities to US monetary policy surprises to differences in country-specific stock market liquidity, global integration (Ehrmann and Fratzscher, 2009), the exchange rate regime, or the share of equity holdings of US investors in foreign stock markets (Hausman and Wongswan, 2011). Our assessment exploits recent advances in the classification of de facto exchange rate regimes by Ilzetzki et al. (2019) and uses data on stock market investment restrictions by Fernandez et al. (2016). It thereby contributes to ongoing discussions on whether the exchange rate regime matters in the international transmission of economic shocks (Rey, 2016; Obstfeld et al., 2019). Moreover, we use data from Hassan et al. (2021) to control for country risk perceptions. Finally, we implicitly account for stock market liquidity by comparing developed and emerging stock markets.

Our results suggest that the liquidity of stock markets influences the sensitivity of foreign stock market returns to US monetary policy surprises. In addition, we find that changes in perceived country risk are associated with sensitivities of unexpected foreign stock market excess returns to FFR surprises. This observation indicates that the perceived riskiness of a country together with the liquidity of a national stock market are important determinants of the responses of foreign stock markets to US monetary policy surprises.

This finding does not pertain to the other country characteristics we examine, which confirms Dedola et al. (2017). They find a link between foreign stock prices and US monetary policy shocks but no significant cross-country differences due to different country characteristics such as the foreign exchange rate regime, trade intensity, or financial links.

The remainder of the paper is organised as follows. Section 2 highlights the main contributions of our paper in the context of the related literature. Section 3 provides the background for the decomposition of unexpected stock market returns into different news components. Section 4 introduces the empirical framework to obtain the effects of monetary policy surprises on the news components. Details on the data are outlined in Section 5. Section 6 presents results for the US as a benchmark for our main empirical results discussed in Section 7, and Section 8 concludes. The separate online appendix provides supporting information and additional results.

2. Main contributions and related literature

Our paper mainly relates to two strands in the literature. First, we contribute to the empirical literature on the effects of monetary policy on financial markets. Within this literature, the paper closest to ours is Bernanke and Kuttner (2005). They link different US stock return news components to monetary policy surprises by employing a VAR with exogenous variables that is similar to our empirical framework. Unlike them, however, we do not focus on the US but analyse a sample of 40 developed and emerging markets. Furthermore, we evaluate the responses of different stock return news components to different types of monetary policy surprises (Swanson, 2021). Moreover, our sample includes the zero lower bound (ZLB) period during which the Fed resorted to unconventional measures. Our analysis of stock markets thus complements Rogers et al. (2018), who use a VAR framework with exogenously approximated monetary policy surprises related to the different facets

[2] We are grateful to Eric Swanson for sharing the monetary policy surprise series with us.

of the Fed's monetary policy to study the impact of US monetary policy surprises on bond premia and forward exchange rate premia (relative to USD) in the euro area, Japan and the UK.

Furthermore, we relate to event studies examining the impact of US monetary policy surprises on exchange rates and foreign economies' bond and stock markets (Albagli et al., 2019; Ammer et al., 2010; Ehrmann and Fratzscher, 2009; Hausman and Wongswan, 2011; Swanson, 2021; Wongswan, 2009). Compared to their event study regressions, our monthly VAR approach has the advantage that it can explicitly distinguish between cash flow news and discount rate news as the channels through which US monetary policy surprises affect foreign stock markets.[3] This distinction is important because cash flow effects are persistent, whereas discount rate effects are transitory (Campbell, 1991).[4] We thus contribute to the literature by showing that US monetary policy surprises persistently affect foreign stock markets because they lead to revisions in expectations about future dividends.

Second, our paper contributes to and is consistent with the growing literature on the emergence of a global financial cycle and its importance for the valuation of assets. Miranda-Agrippino and Rey (2020) show that one global risk factor accounts for non-negligible amounts of the variation in a broad set of risky asset prices around the world. This global factor in asset prices responds to US monetary policy changes. Dées and Galesi (2021) show that network effects play an important role in this respect. Jiang et al. (2020) provide a theoretical mechanism for this empirical finding. The mechanism is based on the notion that there is special demand for USD-denominated safe assets from financial intermediaries worldwide. US monetary policy, e.g. LSAP, affects the supply of these safe assets, such that the risk-bearing capacity and hence the risk appetite of financial intermediaries are affected. Our results of a statistically significant link between US monetary policy surprises and unexpected variation in the stock market returns of both developed and emerging countries are consistent with this economic mechanism.

3. Economic background: decomposing unexpected variation in stock market returns

Our empirical assessments of the effects of US monetary policy surprises on foreign stock markets build on a decomposition of unexpected variation in stock market returns into different components. This decomposition relies on a loglinear approximation of the dynamic accounting identity that relates asset returns to expected cash flows and discount rates (Campbell and Shiller, 1988; Campbell, 1991).

Following Ammer and Mei (1996), we focus on the foreign stock return denominated in USD in excess of the US short-term interest rate, *frx*.

The innovation in foreign excess stock returns can be expressed as

$$frx_{t+1} - E_t frx_{t+1} = (E_{t+1} - E_t)\left[\sum_{j=0}^{\infty}(\rho^*)^j \Delta d^*_{t+1+j} - \sum_{j=0}^{\infty}(\rho^*)^j rr_{t+1+j} - \sum_{j=0}^{\infty}(\rho^*)^j \Delta q_{t+1+j} - \sum_{j=1}^{\infty}(\rho^*)^j rx^*_{t+1+j}\right] \quad (1)$$

in which an asterisk marks foreign (non-US) variables, d denotes dividends, rr represents the short-term real interest rate, rx denotes the risk premium term and q represents the real exchange rate, which is denominated in foreign currency as a unit of domestic currency (USD). E is the expectation operator conditional on information at time t.

For the purpose of notational convenience, we rewrite Eq. (1) as

$$f^T_{t+1} = f^{cf}_{t+1} - f^{rr}_{t+1} - f^{q}_{t+1} - f^{rx}_{t+1} \quad (2)$$

in which $f^T_{t+1} \equiv frx_{t+1} - E_t frx_{t+1}$ denotes the unexpected foreign stock market excess return denominated in USD, $f^{cf}_{t+1} \equiv (E_{t+1} - E_t)\sum_{j=0}^{\infty}(\rho^*)^j \Delta d^*_{t+1+i}$ is the news of current and future foreign cash flows (dividends), $f^{rr}_{t+1} \equiv (E_{t+1} - E_t)\sum_{j=0}^{\infty}(\rho^*)^j rr_{t+1+j}$ represents the news about current and future US real interest rates, $f^{q}_{t+1} \equiv (E_{t+1} - E_t)\sum_{j=0}^{\infty}(\rho^*)^j \Delta q_{t+1+i}$ gives the news about current and future real exchange rate changes and finally $f^{rx}_{t+1} \equiv (E_{t+1} - E_t)\sum_{j=1}^{\infty}(\rho^*)^j rx^*_{t+1+j}$ denotes the news about future foreign excess returns.

A positive surprise movement in the foreign excess stock market return is associated with positive dividend news, lower than expected US real interest rates, lower than expected future excess returns or an arbitrary combination of the three. The

[3] In principle, one could conduct the return decompositions in VARs using data at the daily frequency (Kroencke et al., 2021). In our view, however, running the VAR decomposition at the monthly frequency has two advantages. First, at the monthly frequency we are able to work with real variables, which allows to distinguish between US real interest rates, expected future excess returns on foreign stock markets and the real exchange rate as potential discount rate channels through which US monetary policy surprises spill over to foreign stock markets. We find that this distinction is important. Our results suggest that some of the US monetary policy surprises affect expected future excess returns on emerging stock markets but influence discount rates on developed stock markets mainly via real interest rate news. Second, decomposing daily returns into cash flow and discount rate news requires predictors of daily stock market returns, which are rare even for the US (Kroencke et al., 2021) and barely exist for other economies.

[4] The cash flow news has a persistent impact on asset returns as it reflects revisions in expectations about the entire stream of dividends. Discount rate/expected return news has a temporary effect because the expectation of higher returns in the future will compensate for a capital loss due to negative discount rate news today.

intuition behind the negative sign on exchange rate news f^q is that, ceteris paribus, news about a USD appreciation must have an adverse impact on the returns of foreign assets denominated in USD.

4. Empirical framework

We illustrate the empirical framework from the perspective of one foreign country to ease the exposition. In our empirical analyses, we exploit that this framework can easily be extended to a panel setup that improves the precision of our estimates (Vuolteenaho, 2002). The online appendix provides an overview of country-level results, which were the focus of the working paper versions of this paper. The online appendix also presents additional results and robustness checks.

4.1. The VAR

Estimates of all news terms defined in Section 3 can be computed using a VAR that includes the excess return on a stock market, information about the stock price, e.g., in the form of the dividend-price ratio (Engsted et al., 2012), and variables that predict returns. In the literature, this has been done by a VAR specification as in Eq. (3).[5]

$$z_{t+1} = \Gamma z_t + \epsilon_{t+1} \tag{3}$$

Here, z_{t+1} is a vector of the endogenous variables, Γ denotes the companion matrix and ϵ is an i.i.d. error vector. As we are interested in the link between the monetary policy surprises, abbreviated as M^u_t, with the different news terms, we include the surprise series as exogenous variables in the VAR

$$z_{t+1} = \Gamma z_t + \phi M^u_{t+1} + \Psi_{t+1}, \tag{4}$$

where ϕ captures the response of the endogenous variables in the VAR to the contemporaneous monetary policy surprises, and Ψ_{t+1} is the new error term. This error term is, by construction, orthogonal to our monetary policy surprise series M^u. This splits our baseline error term ϵ_{t+1} in Eq. (3) into innovations in monetary policy and innovations in all other factors unrelated to monetary policy.

The estimated regression model has the form

$$A(L)y_{t+1} - \phi M^u_{t+1} = y_{t+1} - \sum_{l=0}^{p-1} A_{l+1} y_{t-l} - \phi M^u_{t+1} = \Psi_{t+1}, \tag{5}$$

where $A(L)$ is a polynomial of order p and $y_{t+1} = [y_{1,t+1}, y_{2,t+1}, \ldots, y_{K-1,t+1}, y_{K,t+1}]\prime$ is a column vector with K endogenous variables in the VAR.

4.2. The news

As a benchmark for the return decompositions of foreign countries' USD-denominated stock market returns, we first assess the link between the US monetary policy surprises and the news components of the US stock market return. To estimate the US news terms, we stack four endogenous variables into the VAR. The first variable is the US stock market excess return rx_{t+1}, the second variable is the US real interest rate rr_{t+1}, the third variable is the US yield spread ys_{t+1} and the fourth variable is the dividend-price ratio δ_{t+1}.[6] In addition, M^u_{t+1} summarizes the three Swanson (2021) monetary policy surprise series.

Based on the approach proposed by Ammer and Mei (1996), we stack seven endogenous variables into our baseline VAR for foreign stock market returns to estimate foreign news terms $f^T, f^{cf}, f^{rr}, f^{rx}$ and f^q. In addition to the four US variables, we include the foreign stock market excess return rx^*_{t+1}, the change in the log real exchange rate Δq_{t+1} and the foreign dividend-price ratio δ^*_{t+1}. The variables are ordered such that $z_t = [rx_{t+1}, rx^*_{t+1}, rr_{t+1}, \Delta q_{t+1}, \delta^*_{t+1}, ys_{t+1}, \delta_{t+1}]'$.[7] Using Γ and ϕ, one can then calculate the different news terms as follows

$$f^T_{t+1} = \Lambda_2' \epsilon_{t+1} \tag{6}$$

$$f^{rx}_{t+1} = \Lambda_2' \rho^* \Gamma (I - \rho^* \Gamma)^{-1} \epsilon_{t+1} \tag{7}$$

$$f^{rr}_{t+1} = \Lambda_3' (I - \rho^* \Gamma)^{-1} \epsilon_{t+1} \tag{8}$$

$$f^q_{t+1} = \Lambda_4' (1 - \rho^*)(I - \rho^* \Gamma)^{-1} \epsilon_{t+1} \tag{9}$$

$$f^{cf}_{t+1} = f^T_{t+1} + f^{rx}_{t+1} + f^{rr}_{t+1} + f^q_{t+1} \tag{10}$$

[5] For notational flexibility, this process is stated in first order. This notation also represents a higher-order process written as a first-order VAR in companion form.

[6] The data section presents the exact definitions of the variables.

[7] The ordering of the variables does not affect the results.

Here, we define $\Lambda_2 = [0,1,0,0,0,0,0]'$ to pick rx^* and define Λ_3 and Λ_4 in an analogous fashion.

We need rx^*_{t+1}, rr_{t+1} and Δq_{t+1} to estimate the different news components. Moreover, we need information about the foreign stock price levels in the VAR as well as variables that are predictors of foreign stock market returns (Engsted et al., 2012).

The choice of variables in our VAR system for all of the foreign (non-US) stock markets reflects our aim of making the results comparable across national stock markets by using similar VAR systems for all of the stock markets under study. That is why, for example, we do not include foreign markets' yield spreads into the system, because data on government bond yields for a sufficiently long time span are not available for most of the emerging markets in our sample.[8]

To address criticisms of the VAR-based decompositions of stock returns (Chen et al., 2009), we follow Engsted et al. (2012) and include foreign stock markets' dividend-price ratios in the VAR systems because Engsted et al. (2012) show that by including the dividend-price ratio (and thus the stock price) into the VAR system, it does not matter whether cash flow news or discount rate news is obtained directly from the VAR estimates.[9]

Against this background, we chose to obtain cash flow news as a residual to avoid the well-known issue of seasonality in dividend payments. In this case, the return decomposition requires the presence of variables that provide additional predictive power for stock returns to the dividend-price ratio. Therefore, we keep the excess return on the US stock market in the VAR system of the foreign stock market returns because Rapach et al. (2013) show that US stock market returns predict foreign stock market returns. More generally, their results suggest that US financial market variables observed today are informative about future foreign stock market returns but not necessarily vice versa. Hence, we also keep the two other US variables in the VAR system to have a consistent set of predictors for the US stock market return and all of the foreign stock markets.

4.3. The effect of monetary policy surprises

To assess what news components (revisions in expectations) account for the reaction of foreign stock market excess returns to the US monetary policy surprises, we exploit that the error ϵ_{t+1} from our baseline VAR in Eq. (3) can be decomposed into innovations in monetary policy M^u_{t+1} and innovations related to all possible factors other than monetary policy, Ψ_{t+1}. This allows us to rewrite Eqs. (6) to (10) such that we can back out the effects of US monetary policy surprises on the different news components. For example, Eq. (6) becomes

$$f^T_{t+1} = \Lambda_2'(\phi M^u_{t+1} + \Psi_{t+1}) \tag{11}$$

Then the effect of US monetary policy surprises on current unexpected excess returns on foreign stock markets (f^T_{t+1}) is

$$\Lambda_2'\phi. \tag{12}$$

The sources that account for this stock market reaction are the effects of US monetary policy surprises on the news terms that reflect revisions about the discounted sums of expected future excess returns, real interest rates, real exchange rate changes, and cash flows. The response of excess return news to US monetary policy surprises is

$$\Lambda_2'\rho^*\Gamma(I - \rho^*\Gamma)^{-1}\phi, \tag{13}$$

the response of real interest rate news is

$$\Lambda_3'(I - \rho^*\Gamma)^{-1}\phi, \tag{14}$$

the response of real exchange rate news is

$$\Lambda_4'(1 - \rho^*)(I - \rho^*\Gamma)^{-1}\phi, \tag{15}$$

and finally, the response of cash flow news is

$$\left[\Lambda_2' + \Lambda_2'\rho^*\Gamma(I - \rho^*\Gamma)^{-1} + \Lambda_3'(I - \rho^*\Gamma)^{-1} + \Lambda_4'(1 - \rho^*)(I - \rho^*\Gamma)^{-1}\right]\phi. \tag{16}$$

4.4. The pooled-panel VAR

The VAR in (4) allowed us to back out country-specific effects of US monetary policy surprises. In order to focus on the average effects of US monetary policy surprises on foreign stock markets and to improve the precision of estimates of the sensitivities of the return news to monetary policy surprises, our baseline analysis follows Vuolteenaho (2002) in estimating

[8] Including foreign yield spreads for those countries for which these data are available does not affect the qualitative results.

[9] To ease concerns about our approach (and the general approach in this literature), the online appendix OA.2 presents a country-by-country comparison of the sensitivities of directly estimated cash flow news to the US monetary policy surprises with their counterparts from our baseline VAR. The qualitative results are unaffected.

a pooled-panel VAR. This panel VAR pools the data otherwise used in country-level VARs and stacks them into a VAR of the following structure:

$$\begin{bmatrix} z_{i,t+1} \\ x_{us,t+1} \end{bmatrix} = \Gamma \begin{bmatrix} z_{i,t} \\ x_{us,t} \end{bmatrix} + \phi M^{u}_{t+1} + u_{i,t+1} \tag{17}$$

where index i represents a specific non-US country. The vector $z_{i,t}$ consists of the three country-specific endogenous variables, while the vector $x_{us,t}$ consists of the four US variables.[10] We restrict the coefficients in Γ to be homogeneous across markets. Given this restriction, the news term decomposition is the same, irrespective of whether we estimate a country-specific VAR or the panel VAR.

We employ a bootstrap procedure to assess the statistical significance of the responses of foreign stock markets' news components to the US monetary policy surprises, because we need to take into account that the news terms are estimated variables and depend on the VAR parameters. The online appendix provides the details of the bootstrap procedure.

5. Data

This section briefly describes the data that we use in our empirical assessments. We base our main results on US monetary policy surprises from Swanson (2021), who identifies US monetary policy surprises from movements in eurodollar interest rate futures in short time windows around FOMC announcements during the period from 1991 to 2019. The surprises are interpretable as reflecting surprises related to the Fed funds rate, forward guidance and large-scale asset purchases (see figure OA.5.1 in the online appendix). We additionally provide robustness checks using a unified measure of US monetary policy surprises from Bu et al. (2021) in the online appendix.

We use data measured at the monthly frequency in our empirical assessments. To perform the VAR-based decompositions, we convert the event-day monetary policy surprise data into periodic time series data at the monthly frequency as in Gertler and Karadi (2015).

We use end-of-month values of USD-denominated MSCI stock market indices to compute log returns on the 40 developed and emerging economies' stock markets in our sample. Table OA.6.1 in the online appendix provides an overview of the economies under study and the start and end dates of the stock market return data.

We distinguish between developed and emerging markets, which is an implicit distinction between liquid (developed) and less liquid (emerging) stock markets. According to the MSCI classification, there are differences between developed and emerging stock markets with respect to liquidity, the size and the extent to which capital can freely flow into these stock markets.

The MSCI indices are also used to compute log dividend-price ratios.[11] We employ the MSCI World index (comprising only developed markets) and the MSCI Emerging Market index at the daily frequency in local projections. The daily data are only available from January 2001 onward. The MSCI indices can be obtained from the MSCI website.

Excess returns are the difference between the log stock market return and the one-month US treasury bill rate. The US yield spread is defined as yield on ten-year US government bonds minus the one-month treasury bill rate. US real interest rates are calculated as the one-month treasury bill rate in t minus realised consumer price inflation in month t. Real USD exchange rates are constructed from nominal, bilateral USD exchange rates measured at the end of the month and monthly consumer price indices. The source for the exchange rate, interest rate and consumer price series is the IMF' s International Financial Statistics.

We assess whether other country characteristics than the distinction between developed and emerging stock markets are associated with differences in the sensitivities of the stock market return news to US monetary policy surprises. Therefore, we use monthly indicators of the de facto flexibility of exchange rates and an indicator of whether the USD is an anchor currency for a particular country from Ilzetzki et al. (2019). Moreover, we employ an indicator of stock market investment restrictions for foreigners (Fernandez et al., 2016) as an additional country characteristic. Finally, we exploit recent work by Hassan et al. (2021) to assess whether changes in the perceptions of country risks affect sensitivities to US monetary policy surprises.

6. Benchmark results: USA

To set the stage, this section provides a short overview of the results for the US and compares these estimates with earlier results of Bernanke and Kuttner (2005). Here and in the sub-sequence, all monetary policy surprises are normalised in such a way that positive (negative) values indicate restrictive (expansionary) surprises.

[10] The country-specific endogenous variables are (1) the foreign stock market excess return rx^{*}_{t+1}, (2) the change in the log real exchange rate Δq_{t+1} and (3) the foreign dividend-price ratio δ^{*}_{t+1}. The four exogenous US variables are (1) the US excess return rx_{t+1}, (2) the US real interest rate rr_{t+1}, (3) the US yield spread ys_{t+1} and (4) the dividend-price ratio δ_{t+1}.

[11] We compile the log dividend-price ratio as the log of the sum of monthly dividends over the past twelve months minus the log of this month' s MSCI price index. Dividend series are obtained from the difference between the returns on the MSCI gross (total return) index and the returns on the MSCI price index.

Table 1
Reaction of US stock market news to US monetary policy surprises.

	Bernanke and Kuttner (2005): 1989 to 2002			
	Total	CF	ER	RIR
FF	−11.01***	−6.96**	3.29	0.77*
	Own estimates: Swanson (2021) from 1991 to 2019			
	Total	CF	ER	RIR
FFR	−4.14	−0.82	2.66	0.65*
FG	0.32	−0.73	−0.43	−0.62*
LSAP	−5.46*	−5.87**	0.43	−0.84***

The upper panel of Table 1 reports the estimates of the sensitivities of the different return news components to unanticipated changes in Fed funds futures from Bernanke and Kuttner (2005). Their estimates suggest that restrictive Fed funds rate surprises (FF) in the period from 1989 to 2002 were associated with negative unexpected US stock market returns. Restrictive FF surprises constituted bad news for the US stock market because they lowered expectations about future cash flows. This estimate is significant at the 5% level. In addition, a restrictive FF surprise also increased the discount rate through revisions in expectations about real interest rates. However, the main impact of the Fed monetary policy surprise on US stock markets came from cash flow news. Lakdawala and Schaffer (2019) find similar results in their assessment of the US stock market responses to exogenous and delphic US monetary policy shocks derived from interest rate futures.

The lower panel of Table 1 displays our estimates of the sensitivities of the different return news components to the Swanson (2021) surprises. Our estimates suggest that restrictive US monetary policy surprises constitute adverse news for US stock markets. However, the channels and the extent to which the different facets of US monetary policy affect stock markets differ.

Restrictive FFR surprises significantly increase expectations about the discount rate through their impact on real interest rate news. This finding is similar to Bernanke and Kuttner (2005) in their shorter sample period. However, this effect is not strong enough to significantly affect the total unexpected variation in US stock market excess returns because cash flow news and expected excess return news are mainly responsible for variation in unexpected stock market excess returns.

FG surprises have little influence on US stock market news. Only the real interest rate news component exhibits a significant association with FG surprises. However, in this case, restrictive FG surprises actually lower the discount rate by lowering expectations about current and future real interest rates. This finding might reflect that market participants expect restrictive monetary policy indicated by the FG surprise to cool the economy in the longer term. This expected dampening effect on growth seems to be associated with expectations of lower real interest rates in the longer term.

By contrast, restrictive LSAP surprises lower US stock market excess returns. Similar to the evidence by Bernanke and Kuttner (2005), this effect primarily reflects the impact of LSAP surprises on expectations about future cash flows. In that sense, our results corroborate Swanson (2021), who argues that LSAP worked very much like the Fed funds rate when it was constrained by the lower bound on policy rates.

As in the case of the FG surprise, we also observe a lowering in the expected discount rate through real interest rate expectations in response to a restrictive LSAP surprise. This observation, in combination with the effect on cash flow news, could reflect that market participants revise their economic growth expectations downward in response to restrictive LSAP surprises. This leads to both downward revisions in expectations about future cash flows and downward revisions in expectations about future real interest rates. The effect of lower expectations of future cash flows dominates the news of a lower discount rate such that the total unexpected excess return falls in response to a restrictive LSAP surprise.

In sum, these results highlight that restrictive US monetary policy surprises lead to unexpectedly lower stock market returns. This finding holds true irrespective of the type of surprise as shown by the robustness checks in table OA.6.2 of the online appendix. However, we also observe differences in the channels through which the different policy surprises affect US stock markets. The next sections evaluate whether these results pertain to foreign stock markets as well.

7. Foreign stock market reactions to US monetary policy news

This section presents our main results. We start by differentiating our sample of stock markets between liquid (developed) and illiquid (emerging) stock markets based on the classification of MSCI. In a second step, we evaluate whether other specific country characteristics, mainly related to exchange rate flexibility, also affect the sensitivities of stock market return news to US monetary policy surprises.

7.1. Developed versus emerging markets

7.1.1. Local projections

We start our empirical assessments with running local projections (Jordà, 2005) of changes in daily log stock prices on the Swanson (2021) measures of monetary policy surprises.

The local projections help us to assess the persistence of the effects of the policy surprises on developed and emerging stock market indexes for different time horizons. They take the following form

$$\Delta X_{t+h} = \eta \Delta X_{t-1} + \beta_h FFR_t + \gamma_h FG_t + \delta_h LSAP_t + \epsilon_{t,h} \tag{18}$$

in which ΔX_{t+h} is the daily change in log values of the MSCI World Index (capturing only developed stock markets) and the MSCI Emerging Market Index between the day of the US monetary policy announcement (t) until $t+h$. We show the local projection coefficients for time horizons $h = 1, \ldots, 90$ working days. The sample period runs from January 2001 to June 2019. The beginning of the sample period is restricted by the availability of the stock index data at the daily frequency.

One of the advantages of the local projection is that it allows the responses of stock prices to the monetary policy surprises to vary across the projection horizons. Fig. 1 shows that this functional flexibility of local projections matters in the present context. While all types of restrictive US monetary policy surprises eventually lower foreign stock prices (negative local projection coefficients), the time it takes a specific monetary policy surprise to be fully transmitted to stock prices depends on the type of surprise.

FFR surprises (top row of Fig. 1) have their biggest impact on stock returns of developed markets (left) after about 20 working days and after approximately 30 working days for emerging markets (right). The responses are insignificant for short time horizons (e.g. one day) and for longer time horizons of more than 40 working days.

By contrast, FG surprises (middle row of Fig. 1) have significant short-term and longer-term effects on returns on developed and emerging stock markets. However, these effects appear to be insignificant at the time horizons at which FFR surprises tend to significantly affect foreign stock markets.

LSAP surprises only show a significant association with stock price changes at time horizons of 40 working days or more. This is true for both developed and emerging markets.

Taken together, the local projections show that restrictive (expansionary) US monetary policy surprises lower (raise) foreign stock prices irrespective of the distinction between developed and emerging markets. However, we observe differences with respect to the time horizons at which the different types of surprises affect foreign stock prices.

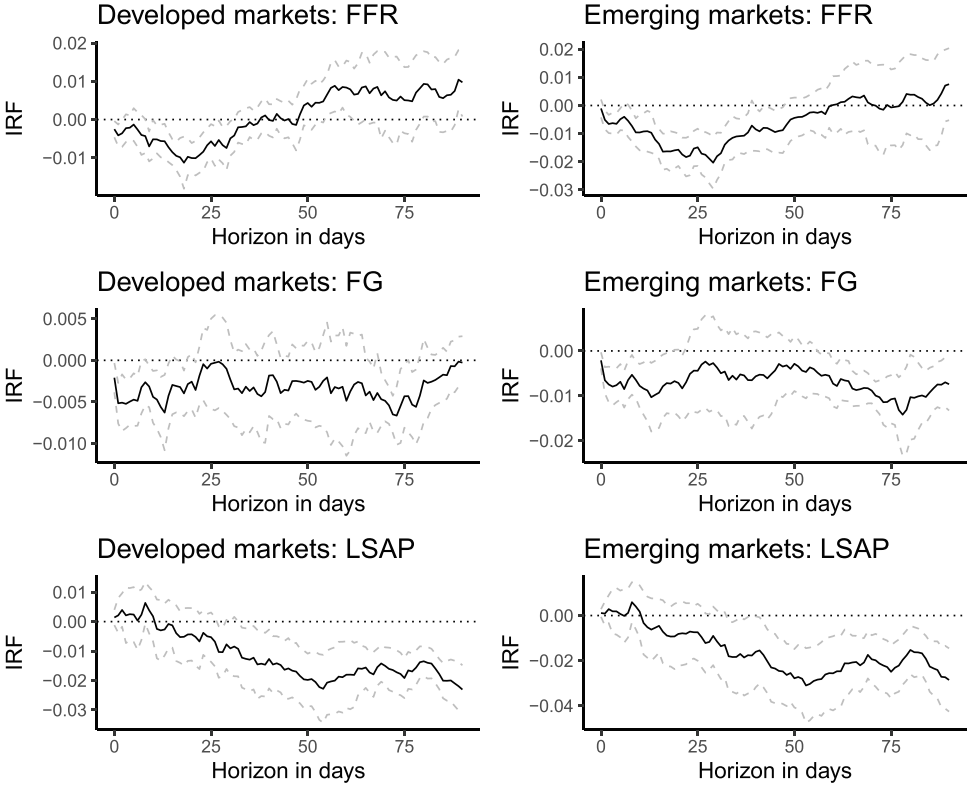

Fig. 1. Local projections: responses of developed (left column) and emerging (right column) market stock prices to US monetary policy surprises. *Notes:* The first row provides the responses to the FFR surprises. The middle row depicts the responses to the FG surprises and the last row presents the responses to the LSAP surprises. Dashed lines represent 90% confidence bands. Time horizons between one and ninety working days. The sample period runs from January 2001 to June 2019.

The next section assesses why foreign stock markets react to the US monetary policy surprises by analysing excess returns instead of simple price changes in a vector autoregressive framework (VAR) to differentiate between different components of the unexpected excess returns on foreign stock markets.

7.1.2. Vector autoregressions

Our estimates suggest that US monetary policy surprises primarily affect foreign stock markets because they constitute cash flow news. This finding pertains to both developed and emerging markets but seems to be more pronounced for emerging, i.e., less liquid, stock markets. Moreover, it depends to some extent on the type of US monetary policy surprise.

Table (2) summarises the baseline results from panel VARs estimated with a lag of one month as suggested by standard information criteria. The upper panel presents the results for the developed markets for the full sample period from 1991 to 2019 and for three subsample periods distinguishing between the period before the FFR hit the ZLB, the ZLB period, and the post-ZLB period. The lower panel gives the corresponding results for emerging markets.

The estimates for the panel of developed markets show that all three monetary policy surprises from Swanson (2021) significantly affect unexpected variation in foreign stock market returns over the full sample period. In addition, the estimates in the column "total" show that a more restrictive than expected monetary policy in the US leads to a decline in unexpected excess returns on foreign stock markets.

When we zoom in on the responses to the three different Swanson (2021) monetary policy surprises, we find that a one-standard-deviation surprise increase (decline) in the FFR is associated with a 4.3% p.a. decrease (increase) in monthly unexpected stock market excess returns. Note that the response of total unexpected variation in stock market excess returns to the US monetary policy surprises is the difference between the response of cash flow news and the three components of the discount rate news. Hence, roughly 50% of this overall effect on excess returns on developed stock markets reflects that the FFR surprises significantly affect expectations about current and future real interest rates and lead to revisions in expectations about future excess returns. However, in contrast to the US evidence, they do not affect cash flow news in a statistically significant way. Using the metrics of the size of surprises from Swanson (2021), this estimate translates into a fall of monthly, unexpected foreign stock market returns of 12.9% p.a. as a response to a surprise increase of the fed funds rate by 25 bp. When we look at the different subsample periods, then the full sample results seem to be mostly driven by the pre-ZLB period. In the post-ZLB period, our panel estimates suggest that FFR surprises are mainly associated with real interest rate and

Table 2
Reaction of stock market news to US monetary policy surprises based on panel VAR.

Developed markets					
	Total	CF	ER	RIR	RFX
Full period					
FFR	−4.33***	−2.43	1.43***	0.48***	−0.01
FG	−3.79***	−4.92***	−0.71	−0.50***	0.07***
LSAP	−6.61***	−7.54***	−0.24***	−0.69***	0.00***
Pre-ZLB period					
FFR	−4.54***	−3.13	0.97***	0.43***	0.01**
FG	−5.16***	−5.29***	−0.24	0.01	0.10***
ZLB period					
FG	20.56***	−1.17	−20.65***	−1.14***	0.06
LSAP	−15.79***	−10.07***	5.43**	0.31	−0.01***
Post-ZLB period					
FFR	10.67	−17.92	−35.12	5.23***	1.31***
FG	2.48	0.64	−0.55*	−1.22***	−0.07
LSAP	21.72***	5.10*	−16.64**	−0.02***	0.05**
Emerging markets					
	Total	CF	ER	RIR	RFX
Full period					
FFR	−9.91***	−9.63***	−0.22**	0.44***	0.06***
FG	−5.35***	−4.72**	1.13***	−0.55***	0.05**
LSAP	−9.33***	−5.80***	4.17**	−0.69***	0.04***
Pre-ZLB period					
FFR	−6.48***	−6.53***	−0.51	0.42***	0.03***
FG	−5.25***	−5.60***	−0.35	−0.08**	0.08***
ZLB period					
FG	19.31***	3.09***	−15.01	−1.19***	−0.02**
LSAP	−17.43***	−4.09***	13.01***	0.33	0.00***
Post-ZLB period					
FFR	−23.03*	−103.75***	−87.97**	5.94***	1.31**
FG	−15.00***	−1.97	14.23***	−1.26***	0.06
LSAP	7.87	−6.41	−14.44	0.26***	−0.10**

real exchange rate news, but do not affect unexpected variation in current foreign stock market returns in a statistically significant way. That said, the subsample results are based on VAR estimates from small samples and are thus noisy.

Moreover, we find a statistically significant association between the return news of developed markets and FG surprises. According to the metrics provided by Swanson (2021), a FG surprise that leads to a surprise 25 bp rise in the expected fed funds rate one year ahead is associated with a decline in unexpected, monthly excess returns on foreign stock markets by 16.6% p.a. in our full sample period. Forward guidance surprises affect foreign stock markets predominantly because of their association with cash flow news, i.e., news about the long-term economic outlook. More restrictive than expected FG is associated with negative cash flow news and hence unexpectedly lower stock market excess returns. We also find that surprisingly restrictive FG leads to expectations of lower real interest rates in the future. This finding suggests that FG affects developed markets mainly because of its impact on expectations about the long-term economic outlook. However, the subsample analysis additionally highlights that tighter than expected FG constituted good news for foreign stock markets in the ZLB period and primarily transmitted through revisions in expectations of future excess returns, i.e., risk premia. This finding might reflect that market participants interpreted restrictive FG surprises as good news in terms of risk assessment of the Fed (Cieslak and Schrimpf, 2019) during this time period which was characterised by the global financial crisis and the sovereign debt crisis in the euro area. However, the small subsample sizes make the estimation of the VARs noisy.

Furthermore, our estimates suggest that restrictive LSAP surprises are associated with unexpectedly low total excess return news. This response primarily reflects the impact of LSAP surprises on expectations about future cash flows, suggesting that LSAP affected expectations about the long-term economic outlook. Consistent with this interpretation, we also find that tighter than expected LSAP are associated with lower than expected current and future real interest rates. This finding is most pronounced in the ZLB period.

What about emerging stock markets? Hoek et al. (2022) show that the responses of asset prices in emerging economies depend on the underlying economic reason (monetary versus non-monetary) of unexpected changes in the Fed funds rate. Hence, it is not clear a priori what effects of US monetary policy surprises we should observe on emerging stock markets.

The lower panel of Table (2) reports our estimates of the sensitivities of stock market return news to US monetary policy surprises for the panel of emerging markets. The full sample results suggest that US monetary policy surprises are not only associated with the long-term economic outlook of emerging markets but also affect investors' expectations about future risk premia. This finding applies to FG and LSAP surprises. The positive signs of the sensitivities to these two surprises highlight that tighter than expected US monetary policy increases expectations about the future risk premium and thus the discount rate applied to the cash flows of the emerging stock markets. In addition, the panel results show that FFR surprises constitute cash flow news for emerging markets. Hence, all three dimensions of US monetary policy in our sample significantly affect the long-term real economic outlook of emerging markets. Furthermore, the estimates show that US monetary policy surprises are associated with revisions in expectations about future real exchange rates. Even though real exchange rate news only explains a small proportion of the unexpected variation in stock market returns, this does not necessarily mean that the overall exchange rate effects of US monetary policy surprises on emerging markets are negligible. Finally, the size of the coefficients suggests that the emerging stock markets reacted more sensitively to US monetary policy surprises than the developed stock markets when we use the Swanson (2021) surprises as measures of US monetary policy surprises. This latter result reflects that restrictive FG and LSAP surprises do not only lower expectations about the future stream of dividends but also lead to higher expected excess returns, i.e., discount rates.

The online appendix shows that the qualitative results also pertain to the informationally-robust policy surprise of Bu et al. (2021). In addition, it illustrates that the VAR results are robust to variation in the VAR setup, i.e., variation in the lag length and variables included in the VAR system.

7.2. Other country characteristics and their impact on responses to US monetary policy surprises

So far, our main empirical results leave the impression that there are differences between emerging and developing markets in their sensitivity to measures of US monetary policy surprises. According to the MSCI classification, developed markets are bigger, more liquid and easier for foreign investors to access than emerging stock markets. These differences in stock market characteristics seem to be a play a role in the extent and in the persistence to which foreign stock markets react to US monetary policy surprises.

This section assesses whether other country characteristics than the liquidity of the respective stock market lead to cross-sectional differences in responses of unexpected excess returns on foreign stock markets to US monetary policy surprises. For example, the distinction between developed and emerging stock markets does not capture differences in foreign exchange rate regimes. However, Hausman and Wongswan (2011) find that global stock market responses to US monetary policy decisions depend on the flexibility of the exchange rate. The more flexible the exchange rate, the less pronounced the stock market response to US monetary policy surprises in their event study regressions. By contrast, Dedola et al. (2017) document in a Bayesian VAR with macroeconomic and financial variables that country characteristics, such as the exchange rate regime, do not lead to significant cross-sectional differences in the responses of foreign stock prices to US monetary policy shocks.

We revisit this question in the context of our paper and assess whether the exchange rate regime or other country characteristics influence the sensitivity of unexpected variation in stock market returns to US monetary policy surprises. We run pooled ordinary least squares (OLS) regressions of the following form:

Table 3
Country characteristics and Swanson (2021) monetary policy surprises.

	dependent variable (f^T_{t+1}):				
	(1)	(2)	(3)	(4)	(5)
FFR	−5.904***	−4.669	−6.906***	−7.982***	−7.202
	(1.819)	(3.079)	(1.242)	(1.297)	(8.129)
FG	−4.283***	−4.064	−4.570***	−3.734***	−4.463
	(1.172)	(3.031)	(1.159)	(1.050)	(5.588)
LSAP	−9.278***	−7.464**	−7.827***	−8.461***	−9.889**
	(0.979)	(3.037)	(1.171)	(1.112)	(4.274)
countryrisk:FFR	−188.921***				−184.912***
	(39.313)				(39.467)
countryrisk:FG	−27.074				−24.879
	(18.496)				(18.649)
countryrisk:LSAP	20.885				22.213
	(22.723)				(22.613)
FXR:FFR		−0.648			−0.031
		(1.028)			(2.330)
FXR:FG		−0.090			0.402
		(0.939)			(1.549)
FXR:LSAP		−0.001			0.403
		(0.957)			(1.165)
USDAnchor:FFR			0.664		1.019
			(1.953)		(3.481)
USDAnchor:FG			0.543		−1.092
			(1.798)		(2.416)
USDAnchor:LSAP			0.842		0.894
			(1.797)		(1.953)
equity_restric:FFR				0.530	2.277
				(3.057)	(5.470)
equity_restric:FG				−1.310	−1.543
				(2.609)	(3.664)
equity_restric:LSAP				−0.624	−3.013
				(2.401)	(2.908)
Constant	5.131***	2.818	−1.418	2.766**	10.926**
	(1.082)	(2.894)	(1.135)	(1.076)	(4.929)
Observations	7,140	12,454	12,455	11,439	6,929
R^2	0.039	0.012	0.012	0.015	0.040
Adjusted R^2	0.038	0.011	0.011	0.015	0.037

$$f^T_{t,i} = \alpha + \beta M^u_t + \gamma M^u_t X_{t-1,i} + e_{t,i} \tag{19}$$

in which we regress the unexpected foreign stock market excess returns $f^T_{t,i}$ on the monetary surprises and the interaction of the surprise series with country characteristics. These characteristics, $X_{t-1,i}$, vary across countries with country index i and over time with index t.

As characteristics we use the coarse exchange rate regime classification of Ilzetzki et al. (2019) which assigns values between one (fixed exchange rate) and six (floating) to exchange rate regimes. In addition to the exchange rate regime classification, Ilzetzki et al. (2019) provide an indicator variable of the importance of a currency for a given country, i.e., whether a currency is the de facto anchor currency. If the USD is the anchor currency of a country, then the indicator takes a value of one and zero otherwise. Moreover, we use an indicator of equity investment restrictions from Fernandez et al. (2016) as country characteristic to check whether the impact of US monetary policy surprises depends on the opportunities to invest in a stock market in the first place. This indicator takes decimal values between zero and one. A value of zero means that there are no investment restrictions. Finally, we assess whether differences in changes of perceived country risk from Hassan et al. (2021) explain differences in the sensitivities of unexpected excess foreign stock market returns to US monetary policy surprises.

Table 3 summarizes the results. Columns (1) to (4) provide the regression results when we include one of the four country characteristics one at a time. Column (5) gives the outcome of the kitchen sink regression in which we include all four characteristics at the same time.[12]

The first three rows of Table 3 show the sensitivities of the unexpected variation in foreign stock market excess returns (total return news) to the three Swanson (2021) surprises. The following rows display the estimates of the interaction terms

[12] The regressions include the country characteristics as such. We do not show them in the table to focus on the interaction terms with the monetary policy surprises, but these estimates are available upon request. For example, changes in country risk exhibit a negative and significant coefficient suggesting that increasing country risk is associated with unexpectedly lower excess returns. This finding confirms the estimates of Hassan et al. (2021) who find that rising country risk is associated with falling stock prices.

between the policy surprises and the country characteristics. Significant interaction terms suggest that the responses of the total return news depend on this characteristic.

The estimates of the sensitivities of the total excess return news on the three policy surprises are negative. This observation confirms our previous results and indicates that restrictive policy surprises are bad news for foreign stock markets.

As shown in column (1), the interaction term of the FFR surprise with changes in country risk is negative and statistically significant. This finding suggests that restrictive FFR surprises (positive values) and increasing country risk are associated with lower foreign stock market excess returns. Hence, cross-sectional differences in the perceived country risk help to explain cross-sectional differences in the sensitivities to FFR surprises among the foreign stock markets under study.

However, the interaction terms of the US monetary policy surprises with the other country characteristics are all statistically indistinguishable from zero. This finding corroborates Dedola et al. (2017). Country characteristics related to the flexibility of the exchange rate or the importance of the USD for a given country do not have a significant impact on the sensitivity of foreign stock markets to US monetary policy surprises. The same is true for equity investment restrictions.

8. Conclusions

This paper first uses local projections to show that restrictive US monetary policy surprises are associated with falling stock prices in both developed and emerging stock markets. We then employ a VAR-based decomposition of unexpected variation in the stock market returns into cash flow news and different components of discount rate news to assess why foreign stock markets react to US monetary policy surprises. We distinguish between surprises related to the Fed funds rate, forward guidance and large-scale asset purchases proposed by Swanson (2021).

Our empirical findings suggest that US monetary policy surprises influence foreign stock markets through their impact on expectations about the long-term economic outlook because US monetary policy surprises mainly constitute cash flow news for foreign stock markets and seem to affect long-term expectations about real interest rates as well.

Effects of US monetary policy surprises on expectations about discount rates play a bigger role for emerging stock markets than for developed stock markets because they influence expectations about future excess returns.

Finally, we document that the response of foreign stock markets to US monetary policy surprises depends to some extent on stock market liquidity (implicitly assessed by distinguishing between developed and emerging stock markets) and country risks. However, the sensitivities to the policy surprises do not depend on the flexibility of the exchange rate or the general importance of the USD for a given country.

Taken together, our main results are in line with theory and evidence of a global financial cycle that is influenced by US monetary policy and affects risky asset prices worldwide.

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jimonfin.2023.102866.

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