Evidence of Investor Sentiment Contagion across Asset Markets

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Abstract

This study explores investor sentiment contagion across asset markets and relates specific asset market sentiments to other asset markets. The analysis reveals four main findings. First, investor sentiment highly correlates between equity markets. Second, investor sentiment in one asset market can affect those in other markets; for example, sentiments in the bond markets, particularly the US bond market, significantly Granger cause equity market sentiment, but not vice versa. Investor sentiments in the USD–JPY exchange market can Granger cause those in the Euro–USD, gold, and crude oil markets. Third, investor sentiments in the US asset markets have the largest contagion effects on asset markets given the resultant fluctuations in sentiments across other countries. Fourth, US asset market sentiments, especially bond market sentiment, can explain returns in other asset markets in different countries.

Keywords: investor sentiment; contagion; asset return

JEL classification codes: G10; G15; F30; G40

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1. Introduction

The effect of investor psychology on financial markets is a well-known phenomenon. In fact, the literature on the impact of investor sentiments on asset markets dates back to at least Keynes (1936). In a series of seminal works, Baker and Wurgler (2006, 2007) employed the principal component approach to construct an investor sentiment index in the US stock market. They conclude that investor sentiment is a powerful indicator of stock returns. Following their methods, Chen et al. (2010) and Chong et al. (2017) constructed investor sentiment indices for China and Hong Kong, respectively. They used the sentiment index as a threshold variable in a threshold VAR model to classify stock markets in three regimes. Huang et al. (2015) constructed a new index using the same variables as Baker and Wurgler (BW) (2006, 2007), but with partial least squares. Their results show that their new index has stronger predictive power than the BW index in the US equity market.

Another common measure is the consumer confidence index. Although the surveyors are not directly asked their opinion about security markets, the index has been shown to be a good proxy for investor sentiment. Jansen and Nahuis (2003), Otoo (1999), Lemmon and Portniaguina (2006), and Schmeling (2009) provide examples of the use of the confidence index. All of them find, in line with the US case, that sentiment negatively forecasts aggregate stock market returns in the next period across countries. Still other measures are used to proxy investor sentiment—the closed-end fund discount (Neal and Wheatley, 1998; Swaminathan, 1996) and the buy-sell imbalance (Kumar and Lee, 2002), for example. All of them show that sentiment has strong explanatory power for stock returns.

According to certain scholars (e.g. Saunders, 1993; Hirshleifer and Shumway, 2003), weather conditions can affect an investor's mood, causing them to make different portfolio selections and decisions. Such effects further influence asset market returns and trading volume. In their recent seminal work, Baker and Wurgler (2012) constructed indices for investor sentiment—which they classify as global and local—in six stock markets. A key finding of their study is that investor sentiment propagates across countries. Hudson and Green (2015) further confirm that US investor sentiment can help predict UK equity returns.

Most existing research tends to focus on investor sentiment in stock markets, although a few studies have examined other asset markets. They tend to construct sentiment indices using specific variables or use a survey-based 'consumer' index to proxy the investor sentiment. However, to the best of the authors' knowledge, no study discusses the contagion of investor sentiment across different asset classes, and very few studies use investor-based survey indices.

In this study, we investigate contagion in investor sentiment by conducting a Granger causality test. More specifically, it not only investigates investor sentiment within a specific country or asset class, but also emphasises sentiment contagion across different asset classes, which the literature has not yet fully discussed. We select 11 assets as the sample, and find evidence to show that investor sentiment affects other asset markets. Moreover, we provide *new* evidence to show that investor sentiment in a particular market can have strong exploratory power for other asset markets.

Our results deliver four main conclusions. First, investor sentiment highly correlates between equity markets. However, the same does not hold for other asset classes. Second, investor sentiments in one asset market affect those in other markets; for example, sentiments in the bond markets, particularly the US bond market, significantly Granger cause those in the equity markets, but not vice versa, possibly because of different investor characteristics. Institutional investors are major investors in the bond market, while stock markets have more individual investors. Hence, this contagion may come from institutional to individual investors. The sentiment towards the USD–JPY exchange rate could Granger cause the Euro–USD, gold, and crude oil market sentiments. Third, sentiments in the US asset markets are crucial to the asset market sentiments of other countries, since they cause fluctuations in the investor sentiments of other countries. Fourth, we provide some evidence to show that investor sentiment in specific asset markets could affect the return in other markets. A high market sentiment in the US equity market usually means lower future returns in the Chinese, Japanese, Euro, US, and German stock markets. US bond market sentiment can explain the return in other equity markets, as well as the Euro bond and USD–JPY exchange markets. Its impact on bond market returns is completely contrary to that on the equity and exchange rate markets.

The remaining paper is organised as follows. Section 2 presents data sources and basic correlation analysis. Sections 3 and 4 provide the econometric methods and report empirical evidence. Section 5 concludes the paper.

2. Data and initial analysis

We apply the sentiment indices of Sentix, a German private company that specialises in behavioural finance, to measure sentiment, covering the period from 23 February 2001 to 23 February 2018 (total 852 weekly observations). Sentix provides a series of sentiment indices for specific countries and asset classes. We use the sentiment index for the following asset classes: large US equities, large Chinese equities, large Euro equities, German equities, large Japanese equities, 10-year Euro bonds, 10-year US bonds, gold, crude oil, USD–JPY exchange rates, and EUR–USD exchange rates. These indices utilise data from surveys of 1,600 financial participants where about 25% are institutional responses and, thus, reflect the general investor sentiment. A distinct feature of Sentix's ISI is its use of zero as the normal state. When the index value is positive, it reflects optimism; however, if it is below zero, it denotes pessimism. Figure 1 presents patterns of sentiment indices for each sample asset.

Table 2 reports the correlation among sentiment indices. We highlight instances in which the correlation is greater than 0.5 or less than −0.5. We find three interesting results: equity investors' sentiments highly correlate, with all reported values greater than 80%, and the investor sentiment in Euro and US highly correlate at over 85%. However, the investor sentiment for the USD–JPY has strong negative correlation with Euro–USD sentiment.

3. Granger causality analysis

We conduct Toda and Yamamoto's (1995) Granger causality test to determine whether investor sentiments in certain markets affect the sentiments in other markets. The specification of the traditional Granger causality test is as follows:

$$y_t = C_1 + \sum_{l=1}^{L} \varphi_l y_{t-l} + \sum_{k=1}^{K} \beta_k x_{t-k} + \mu_t, (1)$$

$$x_t = C_2 + \sum_{l=1}^{L} \delta_l x_{t-l} + \sum_{k=1}^{K} \vartheta_k y_{t-k} + \varepsilon_t, (2)$$

Here, y_t is the sentiment of investors in one market at time *t* and x_t is the sentiment in another market at time *t*. If the joint hypothesis of $\beta_k = 0$ for any k is rejected, causality from one investor sentiment, x_t, to another, y_t, exists.

Following Toda and Yamamoto's (1995) procedure, the first step is to determine the maximum order of integration, *dmax*, for the two time series using unit root. If one series is *I(0)* and the other is *I(1)*, *dmax* = 1. Second, we estimate a k^{th} optimal lag-order VAR model in levels, irrespective of integration order. The optimal lag is selected using the Akaike information criterion. Third, extra *dmax* lags are added to the preferred VAR model as exogenous variables. Finally, we conduct a Wald test to check for lags in the endogenous variables and find that its statistic has an asymptotically chi-squared distribution when VAR (k + *dmax*) is estimated.

Before performing the Granger causality test, we employ the augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests to examine the stationarity of variables. Table 2 shows that all variables for investor sentiment significantly reject the unit root null. This indicates that all variables are stationary in their level form, so the Granger causality test does not need to take the first-differenced form.

Table 3 reports the Granger causality test results where the *p*-values are reported. We discuss the results in each row. In row 1, investor sentiments in the US equity market can affect those in the Chinese and Japanese equity markets at a 1% significance level as the *p*-values in both cases are obviously smaller than 0.01. Similarly, investor sentiments in the Euro and German equity markets Granger cause those in the Chinese and Japanese equity markets. In other words, US, Euro, and German investor sentiments are useful predictors of Chinese and Japanese equity market sentiments. Further, investor sentiments in Japan's equity market Granger cause China's stock market sentiments. However, investor sentiments in China's equity market do not affect those in other markets. An interesting finding is that the Granger causality of sentiments runs from Japan's equity market to the USD–JPY, possibly because the USD–JPY exchange is generally a safe asset, and USD–JPY exchange market sentiments are, thus, likely to be higher when the equity market is in turmoil.

Euro–USD sentiment does not Granger cause other variables, whereas the USD–JPY affects investor sentiments in the commodity and foreign exchange markets. This has a significant influence, at the 5% level, on sentiment changes in the gold and crude oil markets. In addition, it Granger causes the Euro–USD market. Sentiments in commodity markets, including gold and crude oil, do not seem to affect those in other asset classes.

Finally, we examine whether investor sentiments move from bond to other markets. The results reveal strong one-way causality from bond markets to equity markets. Further, investor sentiments in the US bond market affect those in the US, Euro, China, and German stock markets at the 5% level, while those in the Euro bond market influence the US, Euro, and German market sentiments at the 10% significance level. Investor sentiments in the US bond market also Granger cause those in the USD–JPY exchange and EU bond markets. In sum, investor sentiments in US asset markets have the largest contagion effects on global asset markets.

4. Impacts on asset return

4.1 Evidence from impulse responses

To test our hypothesis that we can use the sentiment in one asset market to predict asset returns in other markets, we estimate asset returns for specific sentiments. Here, we mainly focus on the predictability of other asset market returns based on sentiment in US asset markets. The conventional VAR models could be biased and misleading when the underlying data-generating process cannot be well approximated by a VAR(p) process. Therefore, we estimate a new set of values for each horizon, h, by regressing the dependent variable vector at $t+h$ on the information set at time t, using a local projections method in line with Jordà (2005, 2009). In the process, we avoid escalating misspecification errors through non-linear calculations of a standard VAR-based impulse response technique. In other words, the *projections* of forward values of the dependent variable vector on the information set are *local* to each horizon. Impulse responses generated by this method are simply a subset of the estimated slope coefficients of the projections.

We first examine the impacts of US equity market sentiment on other equity returns, and the results are shown in Figure 2. The response of the Chinese stock market to shocks from US equity market sentiment is positive in *period 1* and fluctuates thereafter, showing that high US equity market sentiment may increase Chinese stock returns in the first week. The impacts of US equity sentiment on US, Japan, German, and Euro Zone stock returns are significant in some, but not all, horizons.

Figure 3 reports the impulse response of other asset returns to shocks from US bond sentiment. The results clearly show that a positive shock from US bond sentiment would increase returns in the US and Euro bond markets, but decrease those in other markets initially. The responses quickly converge to zero in *period 2*. When investor sentiment in the US bond market generates a positive shock, the S&P500, Stoxx50, DAX, and CSI300 index returns tend to drop by about 0.7, 0.8, 1.0, and 0.3 percentage points, respectively, whereas US and Euro bond returns tend to increase by 0.16 and 0.28 percentage points, respectively. This situation may arise from different investment characteristics in bond and stock markets. When investors are more optimistic about bond markets relative to stock markets, they may adjust their asset allocation, and shift money from the stock to the bond market. The return on the USD–JPY exchange rate similarly decreases significantly, by 0.4 percentage points, indicating that the USD depreciates relative to the JPY in response to shock in the US bond market. A little counterintuitively, if investors buy more USD–nominated bonds, the demand for the USD would increase, leading to appreciation of the USD. From an asset allocation perspective, however, a crowd-out effect also occurs so that investors might allocate more bond and decrease USD–JPY exchange rate holdings.

Figure 4 provides selected responses to the shock of USD–JPY investor sentiment. The results are similar to those of US equity sentiment responses. The responses of gold, crude oil, and USD–JPY returns oscillate. Although we observe significant impacts on these market returns at some periods, the responses in most periods show no significant impacts from USD–JPY investor sentiment.

4.2 OLS regressions

OLS regressions offer another perspective to examine the impacts of market sentiment on returns. We use the following standard regression analysis to achieve this goal:

$$R_{i,t} = \alpha + \beta_1 S_t + \beta_2 S_{t-1} + \sum_m \gamma_m Control_{i,t}^m + \varepsilon_{i,t} \quad (3)$$

Here, $R_{i,t}$ is the weekly return of asset *i* at week *t*. Here, we mainly focus on the predictability of other asset market returns based on US asset market sentiments; therefore, $S_{i,t}$ denotes the investor sentiment index of the corresponding US asset markets. $Control_{i,t}^m$ is a set of control variables, including lagged asset class returns (up to four) and a sentiment index in local asset markets. The local asset market sentiment refers to the corresponding sentiment in the dependent asset market. For example, if we investigate the impacts of US equity market sentiment on China's equity returns, then the local sentiment refers to the sentiment in the Chinese equity market. Our primary interest is to test the significance of β_1 and β_2 in Eq. (3). The null hypothesis is that the sentiments in other markets are not predictable based on US market sentiment, that is, $\beta_1 = 0$ and $\beta_2 = 0$. We expect that either β_1 or β_2 has predicative power and significantly differs from zero. Table 4 presents the corresponding asset market indices used to examine the return. Note that in order to maintain consistency between the stock and commodity market indices, we use Barclay aggregate bond market indices to calculate bond returns as they can reflect returns in the bond market.

We first examine the predictability of other countries' equity returns based on US equity sentiment (Table 5). The Newey–West standard error based on Newey and West (1987) are reported to remove the heteroskedasticity and autocorrelation. We observe that a high level of

US equity sentiment significantly increases US equity returns regardless of whether control variables are used. It has a positive effect on stock returns initially, but its lagged term has a negative impact on stock returns. It has a significant positive impact on equity returns in the Euro Zone even if we control for local sentiment. The lagged term of investor sentiment negatively affects Euro stock market returns, showing that, when the sentiment is high, future stock returns tend to be lower. We observe a similar situation in the German and Japanese stock markets. The results of lagged sentiment impacts are in line with Baker and Wurglar (2006, 2007) and Schmeling (2009), who show that future stock returns tend to be lower when the sentiment is high. However, we complement these studies by showing that investor sentiment would have these effects not only in the same stock market, but also in other stock markets. This means that investor sentiment in a specific market would affect the sentiment, and thereby the returns, in other markets. We observe an interesting phenomenon in China. The current sentiment in the US equity market has strong positive effects that, however, become (strongly) negative after controls are added. This indicates that the effects of US equity sentiment on Chinese stock returns are mixed and sensitive to model specifications. This also implies that local investor sentiment and US equity sentiment may contain similar information sets, and therefore the sign of US equity coefficients changes when local sentiment is included.

Turning to US bond sentiment, we examine its respective impacts on the returns in the US equity, Euro Zone equity, Chinese equity, German equity, USD–JPY exchange, and Euro bond markets. In general, it has a contemporaneous negative impact, but positive lagged effect, on equity returns. As with the results of impulse response, bond and equity sentiments have contrasting effects on equity returns probably because of the negative correlation between bond and stock returns in the sample period. The US bond market sentiment has a contemporaneous positive effect and lagged negative effect on bond returns, in line with the impact of US equity sentiment on equity markets. This means high sentiment leads to lower future returns in the bond market as well. Again, an interesting finding in China is that β_1 is significantly negative, but becomes positive after controls are added, whereas the lagged effects (β_2) change from insignificantly negative to significantly positive. This shows that both the US equity and bond markets affect the aggregate stock returns in China, but the mixed effects are linear. Moreover, one observes a consistent strong effect in the USD–JPY: that is, the high level of US bond sentiment initially decreases the return in USD–JPY, indicating that the USD tends to appreciate relative to the JPY when US bond sentiment is high. However, US bond sentiment tends to increase the next-period return in the USD–JPY market.

Finally, we examine the impact of USD–JPY sentiment on commodity returns. The results show that USD–JPY sentiment has a significant impact on gold returns, but not on crude oil returns. The lagged term of USD–JPY sentiment positively increased gold returns, and the effects are robust to the addition of controls. For the crude oil market sentiment, the effect from USD–JPY market sentiment is large and positive, but not significant.

Overall, subsections 4.1 and 4.2 illustrate that the sentiment index in one asset market is strongly associated with contemporaneous returns, and predicts future short-term return reversals in other asset markets. From a comparison of the sample markets selected, investor sentiment in the US bond market has the strongest explanatory power for other asset returns as it is associated with Euro bond returns, countries' aggregate equity returns, and USD–JPY exchange rate returns.

4.3 Subperiod analysis

Examining the predictability of asset market returns during business cycles could shed light on their fundamental driving forces and is, therefore, important from an economic viewpoint (García, 2013). Following Rapach et al. (2010), Henkel et al. (2011), and Jiang et al. (forthcoming), we compute R^2 statistics separately for economic recessions and expansions:

$$R_k^2 = 1 - \frac{\sum_{t=1}^{T} D_t^k \left(\hat{\varepsilon}_{i,t}\right)^2}{\sum_{t=1}^{T} D_t^k (R_t^m - \bar{R}^m)^2} \quad \mathrm{k} = \mathrm{rec}, \exp$$

Here, D_t^{rec} (D_t^{exp}) is a dummy variable that takes a value of one when time *t* is in an NBER-defined recession (expansion) period, and zero otherwise. Note that R_k^2 can be positive or negative. $\bar{R}^m$ is the full-sample mean of R_t^m and R_t^m is market return.

Panel A of Table 8 reports estimated R_k^2 statistics for the predictability of other asset returns based on US equity market sentiment. We find large differences in predictive power between recessions and expansions. For instance, the R_{exp}^2 for US, European, and German stock returns is more than 40%. In contrast, the R_{rec}^2 in those markets is lower, at most 30%. This finding contradicts García (2013) and Huang et al. (2015), who conclude that investor sentiment is a stronger predictor in recessions. One exception is in China, where US equity market sentiment has greater predictive power during US recessions.

The predictability of asset returns based on US bond sentiment does not seem to have specific concentration in recessions or expansions (Panel B). The predictive power of US bond sentiment for US stock returns, Chinese stock returns, and Euro bond returns is greater during recessions. In contrast, bond sentiment has a larger R_{exp}^2 for German equity returns, USD–JPY returns, Euro equity returns, and US bond returns during economic expansions. Similarly, USD–JPY investor sentiment (Panel C) has no specific concentration in predicting commodity returns. It has greater predictive power for gold returns during expansions and crude oil returns during recessions.

5. Conclusions

This study investigated contagion effects among investor sentiments. We summarise this analysis by reviewing the key results. First, investor sentiment highly correlates between equity markets. However, the same does not hold for other asset classes. Second, investor sentiments in one asset market affect those in other markets; for example, sentiments in the bond markets, particularly the US bond market, significantly Granger cause those in the equity markets, but not vice versa. The sentiment in the USD–JPY exchange rate could Granger cause the Euro–USD, gold, and crude oil market sentiments, possibly because of different investor characteristics. Institutional investors are major investors in the bond market, while stock markets have more individual investors. Hence, so this contagion may come from institutional to individual investors. Third, sentiments in the US asset markets are crucial to the asset market sentiments of other countries, since they cause fluctuations in the investor sentiments of other countries. Fourth, we provide some evidence to show that investor sentiment in specific asset markets could affect the return in other markets. A high market sentiment in the US equity market usually means lower future returns in the Chinese, Japanese, Euro, US, and German stock markets. US bond market sentiment can explain the return in other equity markets, as well as the Euro bond and USD–JPY exchange markets. Its impact on bond market returns is completely contrary to that on the equity and exchange rate markets.

Ours is one of the very few articles that explore investor sentiment contagion across markets. This study complements Baker et al.'s (2012) findings by using survey-based indices and confirms the contagion effect between sentiments, which can be used to predict returns. There is considerable scope for research on this issue, such as investigating sentiment effects on volatility. One might also explore whether institutional investor sentiment could influence individual investor sentiment.

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Table 1. Unconditional correlations

	US Equity	EU Equity	CN Equity	JP Equity	DE equity	Euro-USD	USD-JPY	Gold	Oil	US Bond	EU Bond
US Equity	1.00										
EU Equity	**0.945**	1.00									
CN Equity	**0.807**	**0.799**	1.00								
JP Equity	**0.874**	**0.870**	**0.824**	1.00							
DE Equity	**0.954**	**0.992**	**0.800**	**0.872**	1.00						
Euro-USD	0.040	0.084	0.103	-0.016	0.054	1.00					
USD-JPY	0.286	0.263	0.246	0.421	0.260	**-0.537**	1.00				
Gold	-0.112	-0.129	-0.071	-0.251	-0.124	0.303	-0.459	1.00			
Oil	0.401	0.377	0.387	0.297	0.363	0.364	-0.148	0.328	1.00		
US Bond	-0.439	-0.453	-0.420	-0.455	-0.439	-0.010	-0.169	0.138	-0.249	1.00	
EU bond	-0.457	-0.448	-0.435	-0.465	-0.435	-0.197	-0.059	0.066	-0.394	**0.861**	1.00

Notes: Bold entries indicate strong correlation (greater than 0.5 or less than -0.5) between variables. US, EU, CN, JP, and DE stand for United States, Euro Zone, China, Japan, and Germany, respectively.

Table 2. Unit root test results

	ADF		PP	
	Constant	Constant and trend	Constant	Constant and trend
US Equity	**-11.401**	**-13.657**	**-19.269**	**-19.294**
EU Equity	**-11.415**	**-11.439**	**-19.815**	**-19.809**
CN Equity	**-6.069**	**-6.066**	**-9.229**	**-9.218**
JP Equity	**-7.521**	**-7.549**	**-16.882**	**-16.929**
DE Equity	**-10.223**	**-11.553**	**-19.762**	**-19.780**
Euro-USD	**-7.466**	**-9.627**	**-13.375**	**-14.486**
USD-JPY	**-2.806**	**-5.151**	**-10.964**	**-13.149**
Gold	**-10.884**	**-11.274**	**-10.775**	**-11.257**
Crude Oil	**-5.457**	**-7.916**	**-9.731**	**-10.571**
US Bond	**-4.407**	**-4.843**	**-20.177**	**-20.159**
EU bond	**-9.200**	**-9.673**	**-16.689**	**-16.931**

Notes: *t*-statistics are reported. Bold entries indicate significance at the 10% level or less.
US, EU, CN, JP, and DE stand for United States, Euro Zone, China, Japan, and Germany, respectively.

Table 3. Granger test results

Independent Variable	US Equity	EU Equity	CN Equity	JP Equity	DE equity	Euro-USD	USD-JPY	Gold	Oil	US Bond	EU Bond
US Equity	--	0.361	**0.000**	**0.002**	0.646	0.916	0.153	0.844	0.611	0.442	0.270
EU Equity	0.624	--	**0.000**	**0.000**	0.496	0.999	0.130	0.999	0.809	0.330	0.177
CN Equity	0.287	0.442	--	0.176	0.452	0.910	0.580	0.299	0.706	0.184	0.296
JP Equity	0.988	0.510	**0.000**	--	0.833	0.972	**0.078**	0.687	0.980	0.770	0.231
DE Equity	0.764	0.522	**0.001**	**0.006**	--	1.000	0.111	0.983	0.830	0.551	0.237
Euro-USD	0.305	0.525	0.721	0.533	0.532	--	0.100	0.841	0.292	0.520	0.780
USD-JPY	0.624	0.932	0.576	0.980	0.910	**0.012**	--	**0.000**	**0.015**	0.600	0.956
Gold	0.386	0.598	0.179	0.158	0.586	0.972	0.526	--	0.627	0.182	0.864
Crude Oil	0.859	0.805	0.366	0.497	0.869	0.116	0.622	0.710	--	0.177	0.343
US Bond	**0.047**	**0.049**	**0.035**	0.572	**0.039**	0.501	**0.005**	0.327	0.202	--	**0.035**
EU bond	**0.073**	**0.053**	0.120	0.770	**0.041**	0.994	0.177	0.298	0.282	0.372	--

Notes: *P*-values are reported. Bold entries indicate significance at the 10% level or less.

US, EU, CN, JP, and DE stand for United States, Euro Zone, China, Japan, and Germany, respectively.

Table 4. Summary for the indices used in this study

Asset class	Corresponding asset market index	Sample period
US Equity	S&P 500	23 Feb, 2001 to 23 Feb, 2018
EU Equity	Euro Stoxx 50	23 Feb, 2001 to 23 Feb, 2018
CN Equity	Shanghai Shenzhen CSI 300	30 Oct, 2009 to 23 Feb, 2018
JP Equity	Nikkei 225	23 Feb, 2001 to 23 Feb, 2018
DE Equity	DAX index	23 Feb, 2001 to 23 Feb, 2018
EURO-USD	EURO-USD exchange rate	23 Feb, 2001 to 23 Feb, 2018
USD-JPY	USD-JPY exchange rate	23 Feb, 2001 to 23 Feb, 2018
Gold	COMEX Gold Futures	15 Sep, 2006 to 23 Feb, 2018
Crude Oil	Brent Oil Futures	15 Sep, 2006 to 23 Feb, 2018
US Bond	Barclays US Aggregate	23 Feb, 2001 to 23 Feb, 2018
EU bond	Barclays Europe Aggregate	23 Feb, 2001 to 23 Feb, 2018

Notes: US, EU, CN, JP, and DE stand for United States, Euro Zone, China, Japan, and Germany, respectively.

Table 5. The predictability of asset returns based on US equity market sentiment

	US Equity		EU Equity		CN Equity		JP equity		DE equity	
S_t^{US}	**8.966** (0.367)	**8.941** (0.366)	**9.685** (0.541)	**6.25**0 (1.320)	**2.901** **(0.711)**	**-6.066** **(1.341)**	**8.462** (0.577)	-0.404 (0.845)	**12.375** (0.625)	**5.872** (1.718)
S_{t-1}^{US}	**-4.764** (0.366)	**-4.900** (0.446)	**-5.029** (0.470)	**-4.230** (0.518)	0.927 (0.649)	-0.966 (0.852)	**-2.964** (0.536)	**-1.885** (0.558)	**-5.778** (0.573)	**-5.555** (0.616)
S_t^{Local}				**3.216** (1.234)		**13.645** **(1.388)**		**10.742** (0.823)		**6.105** (1.561)
$Return_{t-1}$		0.041 (0.032)		**-0.068** (0.033)		**-0.122** **(0.046)**		**-0.130** (0.032)		0.005 (0.033)
$Return_{t-2}$		0.015 (0.027)		0.002 (0.028)		**-0.105** **(0.045)**		**-0.093** (0.029)		0.023 (0.027)
$Return_{t-3}$		**-0.108** (0.027)		**-0.115** (0.028)		-0.001 (0.045)		**-0.090** (0.028)		**-0.106** (0.026)
$Return_{t-4}$		-0.015 (0.027)		-0.009 (0.028)		**-0.099** **(0.045)**		**-0.094** (0.028)		-0.011 (0.026)
Constant	-0.028 (0.072)	-0.005 (0.064)	**-0.163** (0.077)	**-0.212** (0.077)	-0.014 (0.134)	-0.380 (0.143)	-0.088 (0.102)	**-0.389** (0.090)	-0.097 (0.099)	**-0.193** (0.091)
R^2	0.415	0.427	0.376	0.395	0.037	0.244	0.226	0.363	0.425	0.445
Observations	851	847	851	847	851	420	851	847	851	847

Notes: Bold entries indicate significance at the 10% level or less. The standard errors are given in parentheses.
US, EU, CN, JP, and DE stand for United States, Euro Zone, China, Japan, and Germany, respectively.
Subscript t stands for contemporaneous variables, while t-1, t-2, t-3, and t-4 denote a one-month lag, two-month lag, three-month lag, and four-month lag, respectively. S_t^{Local} refers to asset market itself investor sentiment

Table 6. The predictability of asset returns based on US bond market sentiment

	US bond		US Equity		EU Equity		CN Equity		DE equity		USD-JPY		EU bond	
S_t^{US}	**1.840**	**1.853**	**-4.764**	**-0.909**	**-5.500**	**-1.287**	**-1.590**	1.062	**-6.747**	**-1.121**	**-2.610**	**-2.185**	**1.574**	**0.608**
	(0.093)	(0.093)	(0.514)	(0.486)	(0.582)	(0.551)	**(0.756)**	(1.168)	(0.671)	(0.640)	(0.342)	**(0.300)**	(0.089)	(0.133)
S_{t-1}^{US}	**-0.794**	**-0.699**	**1.957**	**1.536**	**2.340**	**1.526**	-0.049	**2.225**	**2.306**	1.726	**1.069**	**0.917**	**-0.684**	**-0.842**
	(0.093)	(0.110)	(0.514)	(0.456)	(0.582)	(0.522)	(0.796)	(1.088)	(0.771	(0.605)	**(0.342)**	(0.306)	(0.095)	(0.086)
S_t^{Local}				**7.150**		**7.349**		**8.697**		**9.606**		**2.328**		**1.447**
				(0.400)		(0.431)		**(0.904)**		(0.486)		(0.217)		(0.152)
$Return_{t-1}$		**-0.096**		**-0.126**		**-0.187**		**-0.085**		**-0.142**		**-0.136**		-0.001
		(0.034)		(0.030)		(0.030)		(0.046)		(0.029)		(0.033)		(0.009)
$Return_{t-2}$		**0.053**		-0.043		-0.043		**-0.088**		-0.026		-0.038		0.011
		(0.030)		(0.028)		(0.029)		(0.046)		(0.027)		(0.032)		(0.009)
$Return_{t-3}$		**0.055**		**-0.150**		**-0.145**		0.025		**-0.134**		**-0.066**		0.006
		(0.028)		(0.028)		(0.028)		(0.045)		(0.027)		(0.031)		(0.009)
$Return_{t-4}$		0.005		**-0.047**		-0.030		-0.070		-0.037		**-0.075**		-0.005
		(0.028)		(0.028)		(0.029)		(0.045)		(0.027)		(0.031)		(0.009)
Constant	**0.142**	**0.145**	-0.018	0.047	**-0.154**	**-0.320**	0.039	-0.261		**-0.311**	-0.076	**-0.157**	**0.137**	**0.093**
	(0.015)	(0.017)	(0.083)	(0.071)	(0.092)	(0.081)	(0.150)	(0.164)		**(0.094)**	(0.052)	**(0.048)**	(0.015)	(0.014)
R^2	0.317	0.330	0.092	0.353	0.095	0.348	0.007	0.208	0.090	0.396	0.076	0.198	0.273	0.346
Observations	851	847	851	847	851	847	851	420	851	847	851	847	851	847

Notes: Bold entries indicate significance at the 10% level or less. The standard errors are given in parentheses.

US, EU, CN, JP, and DE stand for United States, Euro Zone, China, Japan, and Germany, respectively.

Subscript t stands for contemporaneous variables, while t-1, t-2, t-3, and t-4 denote a one-month lag, two-month lag, three-month lag, and four-month lag, respectively. S_t^{Local} refers to asset market itself investor sentiment

Table 7. The predictability of asset returns based on USD-JPY bond market sentiment

	USD-JPY		Gold		Crude Oil	
S_t^{US}	**5.932** (0.396)	**5.890** (0.323)	**-5.046** (0.696)	-0.763 (0.703)	-1.649 (1.911)	1.788 (1.297)
S_{t-1}^{US}	**-4.546** (0.398)	**-4.510** (0.346)	**3.454** (0.668)	**2.026** (0.678)	0.159 (1.924)	0.068 (1.287)
S_t^{Local}				**11.301** (0.490)		**17.055** **(0.898)**
$Return_{t-1}$		-0.025 (0.032)		**-0.328** (0.032)		**-0.248** (0.035)
$Return_{t-2}$		0.024 (0.030)		**-0.214** (0.030)		**-0.128** (0.034)
$Return_{t-3}$		0.002 (0.030)		**-0.175** (0.030)		**-0.133** (0.033)
$Return_{t-4}$		-0.028 (0.029)		**-0.113** (0.029)		**-0.090** (0.033)
Constant	-0.051 (0.041)	-0.056 (0.043)	**0.284** (0.077)	**-1.297** (0.111)	0.213 (0.190)	**-0.755** (0.167)
R^2	0.292	0.290	0.073	0.533	0.006	0.393
Observations	851	847	851	578	608	578

Notes: Bold entries indicate significance at the 10% level or less. The standard errors are given in parentheses.
US, EU, CN, JP, and DE stand for United States, Euro Zone, China, Japan, and Germany, respectively.
Subscript t stands for contemporaneous variables, while t-1, t-2, t-3, and t-4 denote a one-month lag, two-month lag, three-month lag, and four-month lag, respectively. S_t^{Local} refers to asset market itself investor sentiment

Table 8. Subperiod analysis

	Expansion R^2_{exp}	Recession R^2_{rec}
Panel A: Impacts of US equity market sentiment		
US Equity	0.476	0.334
EU Equity	0.460	0.253
CN Equity	0.031	0.061
JP Equity	0.233	0.210
DE Equity	0.489	0.304
Panel B: Impacts of US bond market sentiment		
US Bond	0.329	0.283
US Equity	0.090	0.100
EU Equity	0.114	0.070
CN equity	0.006	0.023
DE equity	0.115	0.077
USD-JPY	0.078	0.072
Euro Bond	0.265	0.320
Panel C: Impacts of USD–JPY market sentiment		
USD-JPY return	0.286	0.315
Gold	0.081	0.052
Crude Oil	0.009	0.010

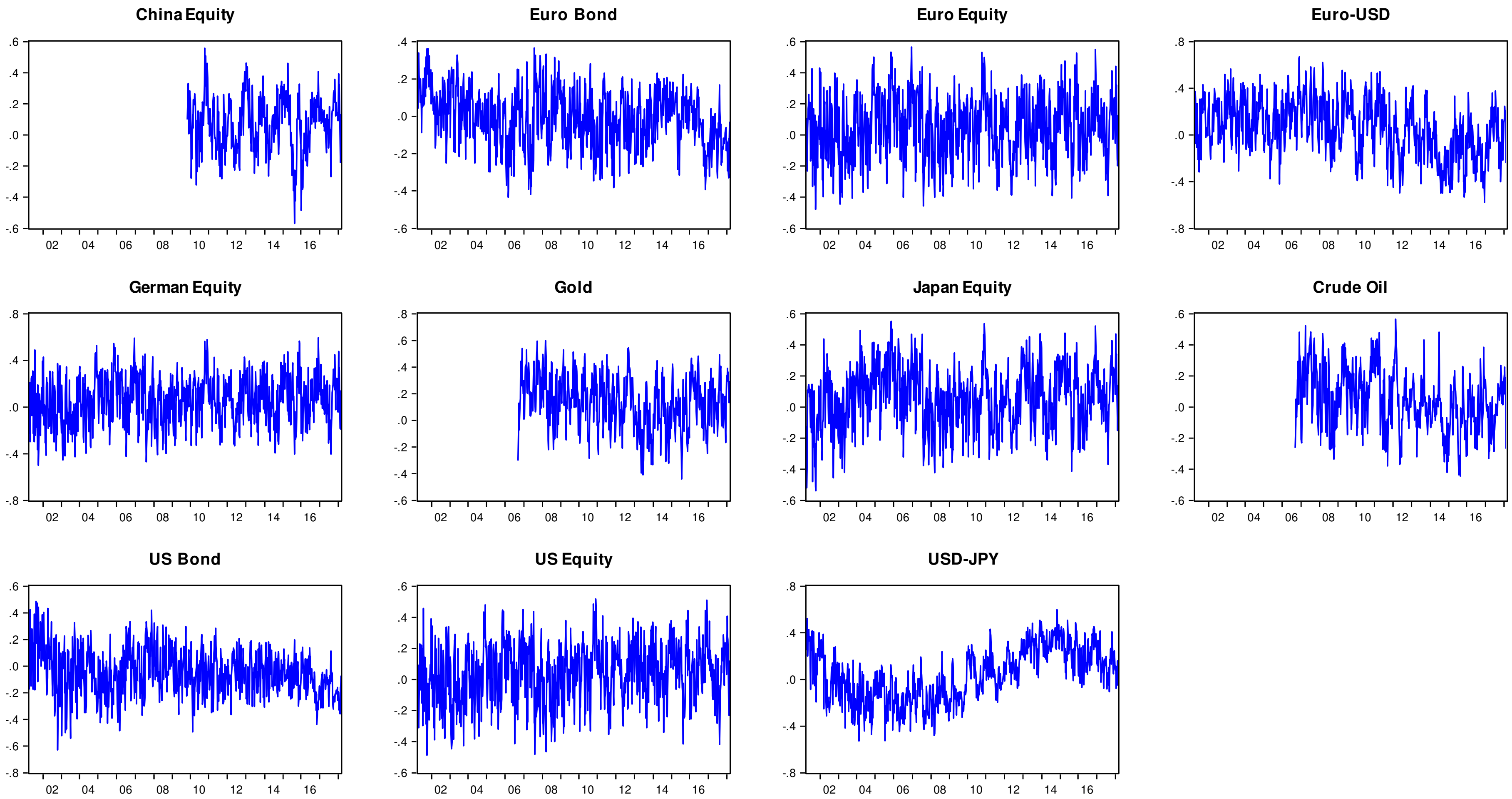

Figure 1. The fluctuations of investor sentiment

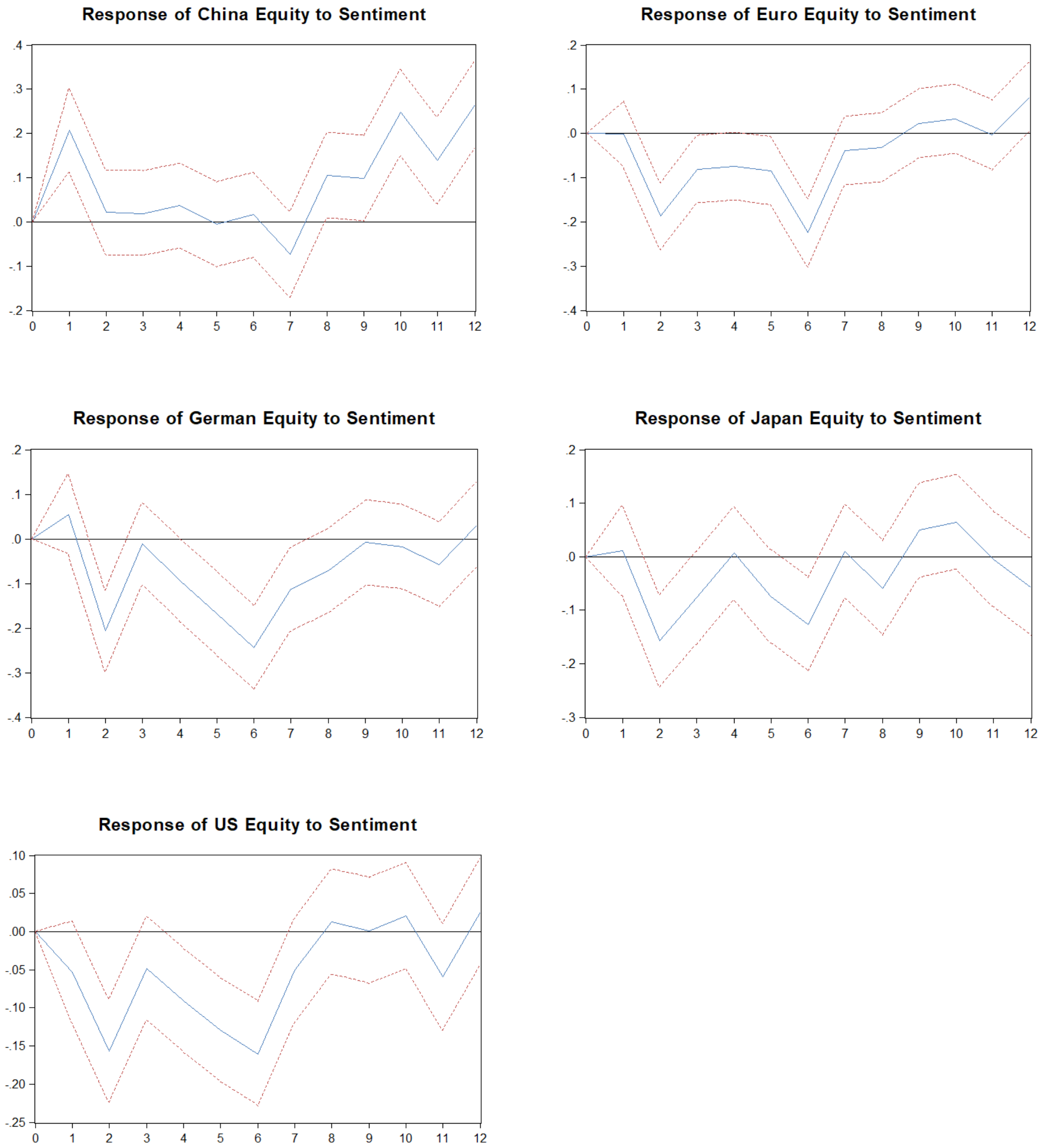

Figure 2. Responses to US Equity Market Sentiment

Notes: The solid line is the impulse responses estimated by the local projections with one-standard deviation error bands (area between two dashed lines). X-axis indicates the period after the shock

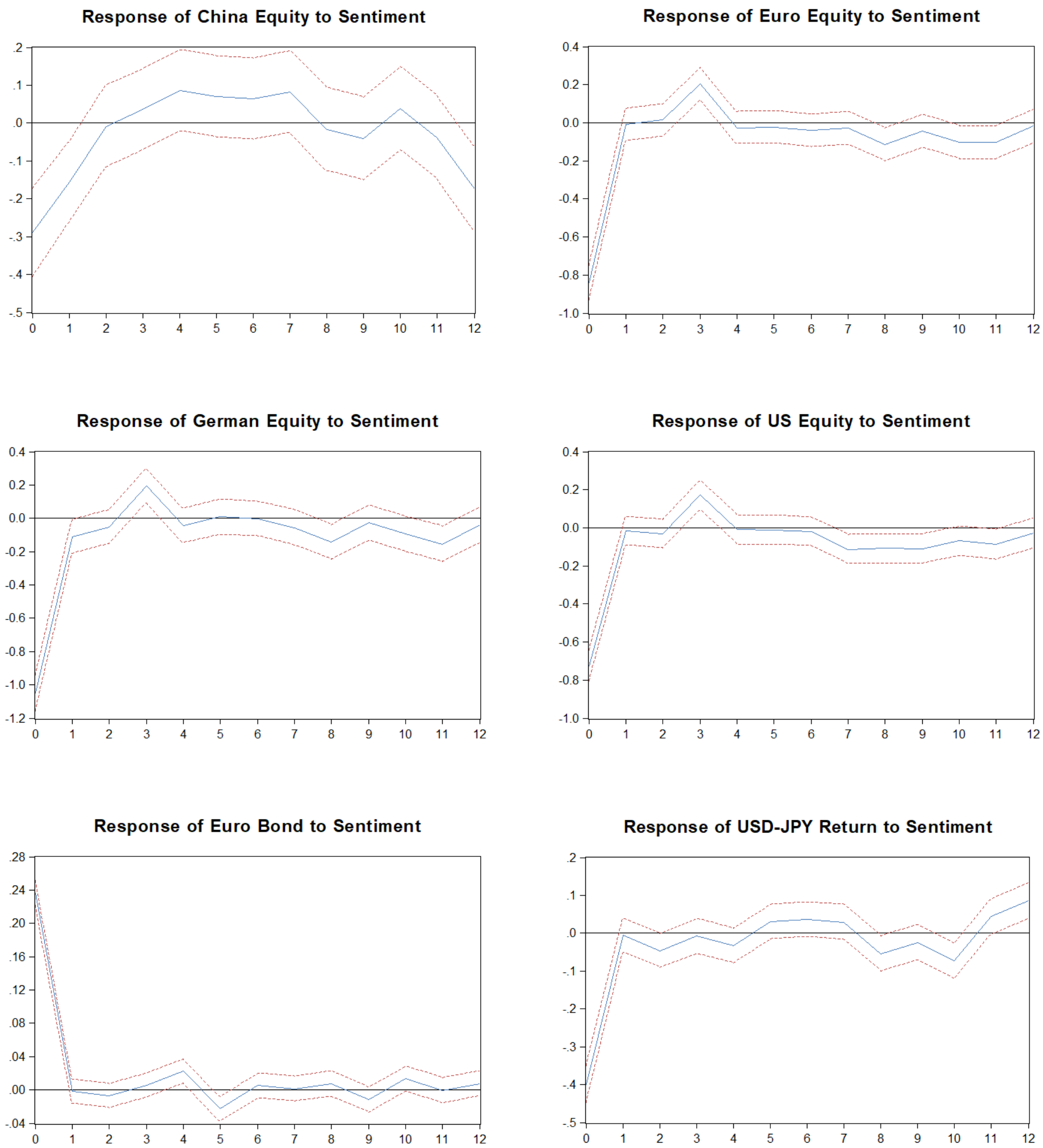

Figure 3. Responses to US Bond Market Sentiment

Notes: The solid line is the impulse responses estimated by the local projections with one-standard deviation error bands (area between two dashed lines). X-axis indicates the period after the shock

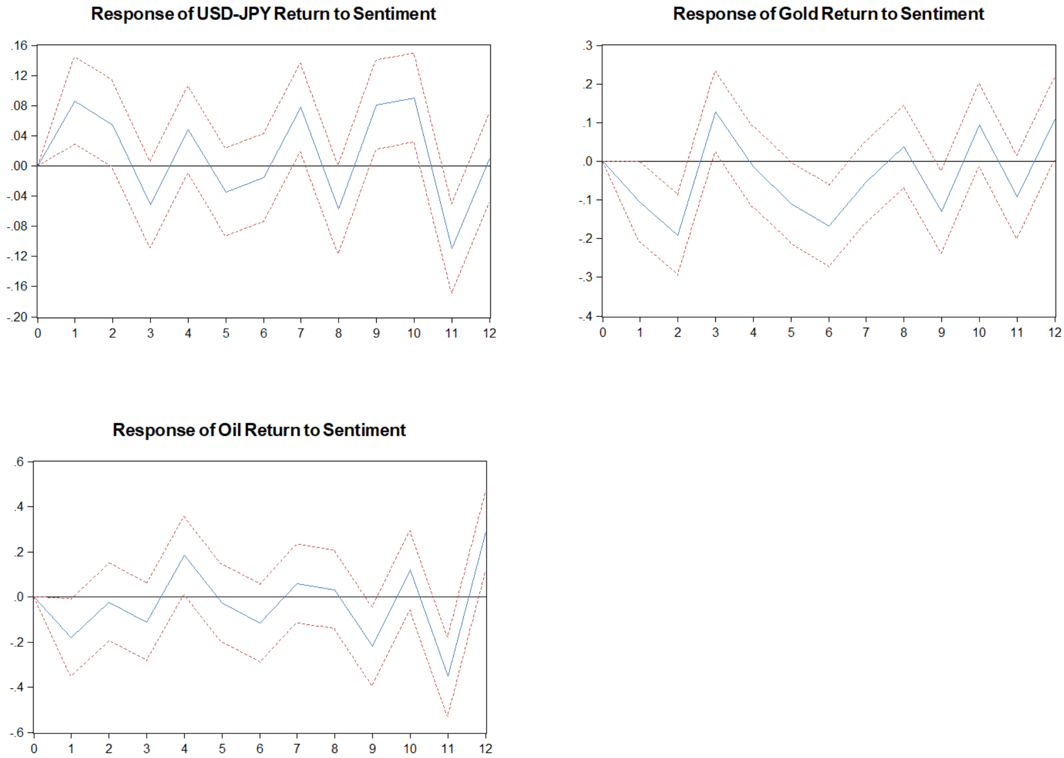

Figure 4. Responses to USD-JPY Exchange Market Sentiment

Notes: The solid line is the impulse responses estimated by the local projections with one-standard deviation error bands (area between two dashed lines). X-axis indicates the period after the shock