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FIEs and the Transmission of Global Financial Uncertainty: Evidence from China

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Abstract

This article provides micro-level evidence for the role of foreign-invested enterprises (FIEs) in the cross-border transmission of global financial uncertainty shocks. Using Chinese firm-level data, we find that rising uncertainty has a significantly larger contractionary effect on real investment for FIEs than their local counterparts. This effect is more pronounced for firms faced with greater investment irreversibility or financial constraints. The contractionary effect is mainly driven by downside uncertainty, whereas upside uncertainty is modestly expansionary. Similar effects are found for other firm-level performances. There is also a spillover effect to local private firms with FIEs concentrated in downstream sectors.

I. Introduction

Cross-border spillover of financial shocks is a central topic in international finance and is crucial for policymaking in many emerging and developing countries. A great deal of attention has been paid to the international transmission of global financial uncertainty shocks (GFUs) in the wake of the global financial crisis (GFC). A growing literature (e.g., Carrière-Swallow and Céspedes (2013), Rey (2015), (2016), Bhattarai, Chatterjee, and Park (2020), and Miranda-Agrippino and Rey (2020)) has provided convincing *macro*-level evidence that global financial uncertainty is the key driver of global financial cycles and has significant impacts on the global economy. However, *micro*-level evidence on the international spillover of GFUs and its underlying channels remains quite limited.

Meanwhile, existing studies in the broad international shock transmission literature have largely centered on cross-border portfolio flows or banking flows facilitated by *financial* institutions (e.g., Frankel, Schmukler, and Servén (2004), Obstfeld, Shambaugh, and Taylor (2005), Cetorelli and Goldberg (2012), Aizenman, Chinn, and Ito (2016), and Huang, Panizza, and Portes (2018)). Less attention has been paid to the role of *nonfinancial* multinational companies in the cross-border transmission of shocks. Given the fact that many emerging and developing

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countries impose strict restrictions on portfolio flows but are highly open to inward foreign direct investment flows, understanding how foreign-invested enterprises (FIEs) propagate global shocks to the host economies is thus of great importance to safeguarding the local economy against external shocks.

In this study, we use the firm-level data from China over the period of 2006–2015 to investigate the role of nonfinancial FIEs in transmitting GFUs to the local economy, despite tight capital controls on cross-border portfolio flows. The institutional and economic environment in China provides an ideal setting for us to uncover the FIE-based transmission channel. On the one hand, there is a substantial difference in accessing international credit markets between FIEs and their local counterparts in China. While local private firms are restricted from borrowing abroad due to capital control policies, FIEs in China enjoy preferential policy treatment of accessing the international credit market.[1] As such, FIEs tend to have greater exposure to global shocks than their local counterparts in China. We thus leverage the differential real responses to global uncertainty shocks across firms to shed light on the role of FIEs in transmitting shocks to the host economy.

On the other hand, like many developing countries, China has been tirelessly attracting foreign direct investment to promote growth over the past several decades. So far, FIEs have played an indispensable role in the Chinese real economy. The data from the National Bureau of Statistics (NBS) of China reveal that FIEs have, on average, contributed to more than 26% of the above-scale industrial production and sales revenue in China between 2003 and 2015. Therefore, disturbances to FIEs' real operation originating from global shocks can have potentially serious knock-on effects on the local economy in China.

A key challenge in our empirical analysis, however, is to distinguish the effect of GFUs from the confounding effects associated with contemporaneous movements in macroeconomic conditions and volatility globally and domestically. To that end, we pursue three strategies. The first one is to explicitly control for FIE's differential responses to variations in realized volatility (RV) of stock market returns and changes in the U.S. monetary policy in the baseline specification. Second, we measure global financial uncertainty with the structural shocks that are identified from a vector autoregression (VAR) model and orthogonal to various global economic and financial variables. The third strategy is to further verify the robustness of our results to the inclusion of additional interaction effects with a rich set of global and domestic economic and financial factors.

Another related issue in identifying the causality is to ensure that the differential real responses to GFUs across firms are indeed driven by foreign ownership rather than some other firm-level characteristics. To deal with this issue, we adopt two strategies. One is to include the interactions between firm-level characteristics and uncertainty as additional controls. The other is to apply propensity score matching methods to match FIEs with their comparable local counterparts and reestimate the baseline specification in matched samples.

[1] According to China's foreign debt management policy, to borrow from foreign markets, FIEs only need to register, whereas their local counterparts must obtain approvals from the National Development and Reform Commission. The data from the State of Administration of Foreign Exchange show that FIEs hold about 13 times as much foreign debt as domestically owned firms in China over the period of 1998–2013.

In addition, we also perform a placebo test by randomly assigning the FIE dummy across firms and log VIX across time, and then reestimate the baseline specification using the artificially generated data. To the extent that the estimated coefficient on our interested variable from this placebo test is statistically insignificant and close to 0, this would make us more confident that the unobserved firm-level heterogeneities correlated with foreign ownership or/and other shocks correlated with the VIX are unlikely to be driving our main results.

Overall, we find robust evidence that an increase in global financial uncertainty causes a substantially larger contractionary effect on real investment for FIEs than local private firms. Furthermore, this differential impact on investment is more pronounced for firms that face greater investment irreversibility, rely more heavily on external finance, or are in financially less developed provinces. When distinguishing downside uncertainty from upside uncertainty, we find that the downside uncertainty is the main driving force behind the contractionary effect on investment, whereas the upside uncertainty is mildly expansionary.

Finally, we also extend our analysis to other aspects of firm performance and explore potential spillover effects to local private firms via production networks. Our estimates suggest that heightened global financial uncertainty leads to significantly worse performance in sales growth, employment growth, liquidity conditions, and intangible asset growth for FIEs relative to their local counterparts. Moreover, the negative effects of global uncertainty shock can propagate to local private firms along the production chain. We show that at times of rising global financial uncertainty, local private firms are more likely to suffer from declines in investment, sales growth, and intangible asset growth when their downstream is characterized by a higher concentration of FIEs.

Our study contributes to the literature in several ways. First, our *micro*-level evidence for the cross-border propagation of global financial uncertainty contributes to the burgeoning literature on the spillover effect of GFUs (e.g., Carrrière-Swallow and Céspedes (2013), Rey (2015), (2016), Bhattarai et al. (2020), and Miranda-Agrippino and Rey (2020)). We identify an FIE-based real economy channel for propagating shocks across borders, which expands the existing literature on international shock transmission that has largely focused on the financial channels associated with cross-border portfolio flows or banking flows (e.g., Frankel et al. (2004), Obstfeld et al. (2005), Cetorelli and Goldberg (2012), Aizenman et al. (2016), and Huang et al. (2018)).[2]

Second, we also add to the literature on uncertainty shocks (e.g., Bernanke (1983), Abel and Eberly (1994), Caballero and Pindyck (1996), Bertola, Guiso, and Pistaferri (2005), Bloom (2009), (2014), Gilchrist, Sim, and Zakrajšek (2014), Bloom, Floetotto, Jaimovich, Saporta-Eksten, and Terry (2018), and Berger, Dew-Becker, and Giglio (2020)). Our results that the contractionary effect of global financial uncertainty for FIEs is amplified in industries with greater investment irreversibility or higher external finance dependence lend strong support to the two

[2]Until recently, researchers start to pay attention to the role of nonfinancial firms in transmitting shocks across borders (e.g., Desai, Foley, and Hines (2009), Lin and Ye (2018), and Bena, Dinc, and Erel (2020)). Our evidence from the Chinese firm-level data underscores the important role of nonfinancial multinationals in the transmission of global uncertainty and thus corroborates this new strand of studies.

leading channels identified in the literature (the real-option channel associated with investment irreversibility and the credit channel associated with financial market frictions) for understanding the effects of uncertainty shocks on the macroeconomy. Moreover, our finding of the substantially large contractionary effect of downside uncertainty yet mildly expansionary effect of upside uncertainty also provides some new insights into the effects of uncertainty shocks on economic fluctuations.

Last, our study is also related to the recent literature on the propagation of financial shocks through production networks (e.g., Acemoglu, Carvalho, Ozdaglar, and Tahbaz-Salehi (2012), Ozdagli and Weber (2017), Ru (2018), and Luo (2020)). Although existing work in the literature focuses on the domestic propagation of local liquidity shocks, we examine the cross-border propagation of GFUs through the presence of foreign-owned firms along the production chain.

From the policy perspective, our evidence from China indicates that GFUs can be propagated even to countries that have managed to insulate their local financial systems from external shocks by imposing capital controls on portfolio flows. In particular, our findings reveal that the presence of FIEs can be a backdoor through which financially isolated countries like China remain directly vulnerable to external shocks. Furthermore, our results also suggest that domestic policy measures for reducing capital adjustment frictions and financial market frictions can help enhance local economic resilience to external shocks and threats.

The remainder of the article is organized as follows: Section II describes our data set and discusses our empirical strategy. Section III presents the main empirical results. Section IV explores the underlying mechanisms. Section V extends the analysis to other firm-level performance and explores the spillover effect to local firms via production networks. Section VI offers our concluding remarks.

II. Data and Methodology

A. Firm-Level Data

Our firm-level data are obtained from the Bureau van Dijk's Orbis database. It contains detailed information on the ownership structure and balance sheet for Chinese manufacturing firms over the period of 2006–2015.

To avoid potential errors arising from misreporting or mismeasurement of accounting data, we follow the conventional data cleaning procedure to exclude firm-year observations whose total assets, long-term assets, the sum of total liabilities and equities, and sales are either missing or nonpositive. We also exclude Chinese state-owned firms from the estimation sample as they have been widely documented to enjoy soft budget constraints and seek operational objectives other than profit maximization (e.g., Dollar and Wei (2007), Manova, Wei, and Zhang (2015), and Lin and Ye (2018)). In addition, we also remove FIEs from Hong Kong, Macau, and Taiwan as well as those from offshore financial centers, such as the Bahamas, the Cayman Islands, and the British Virgin Islands, as they are more likely to be afflicted by the "round-trip FDI" problem (Wei (1996), Huang (2003)).[3] In doing so, there are a total of 23,926 firms included in the estimation sample. All firm-level financial variables are winsorized at the top and bottom 1% of their respective distributions.

A nice feature of the Orbis data is that it provides information about not only firms' global ultimate owners (GUOs) but also their countries of origin. We consider a firm to be foreign-owned if its GUO is in other countries than China. Among the 23,926 firms included in the estimation sample, there are a total of 5,131 FIEs.

As for the firm-level outcome variables, we focus primarily on the firm's real investment, measured as the change in fixed assets scaled by total assets from the previous period. In addition, we also extend our analysis to other aspects of the firm-level performance including sales growth, employment growth, changes in cash holdings, and intangible asset growth. Detailed variable definitions and data sources are provided in Table A1 in the Appendix. Summary statistics of key variables are reported in Table A2 in the Appendix.

B. Empirical Strategy

To examine the differential investment responses to GFUs between foreign-owned and local private firms, we estimate the following model specification:

$$Y_{i,j,p,t} = \alpha + \beta(\text{FIE}_i \times \text{GFU}_t) + \delta X_{i,j,t} + \mu_i + v_{j,t} + \omega_{p,t} + \varepsilon_{i,j,p,t}, \tag{1}$$

where i stands for firm, j for industry, p for province, and t for time. FIE is a foreign ownership dummy that equals 1 if a firm is owned by a foreign entity, and equals 0 otherwise. $\boldsymbol{X}$ is a vector of control variables. μ_i is the firm fixed effects that absorb all time-invariant firm-level heterogeneities.[4] $v_{j,t}$ is the time-varying industry fixed effects, capturing all industry-specific shocks over time. $\omega_{p,t}$ is the time-varying province fixed effects, controlling for all province-specific shocks over time.

GFU is a proxy for the global financial uncertainty shock. Following the literature (e.g., Bloom (2009), (2014), Carrière-Swallow and Céspedes (2013), and Bhattarai et al. (2020)), we use the Chicago Board of Options Exchange VIX index as the primary proxy for ex ante global financial uncertainty. The VIX index is constructed using the 30-day implied volatility on the S&P 500 stock market index and represents the market's expectation of volatility over the next 30 days. To facilitate interpretation, we use the standardized log VIX in our empirical analysis. Moreover, we also consider several alternative measures of global financial uncertainty as robustness checks.

We are particularly interested in the interaction term between the FIE dummy and the GFU variable as its coefficient, β, captures the FIE's differential investment response to global financial uncertainty relative to their local counterparts. The level effect of the GFU is submerged by the time-varying fixed effects.

[3]Including the FIEs from Hong Kong, Macau, and Taiwan in our estimation sample yields similar results.

[4]Since the information on the firm's global ultimate owner in the Orbis has no time variation during the sample period, the foreign ownership dummy does not vary over time, and its level effect is absorbed by the firm fixed effects.

A key challenge in identifying the causal effect of GFUs on firm performance is to isolate the impact of uncertainty shocks from other confounding effects associated with contemporaneous movements in global economic and financial conditions. For example, it has been well documented that the U.S. monetary policy stance exhibits strong comovement with the VIX index and has been an important driving force behind the fluctuations in the VIX (e.g., Miranda-Agrippino and Rey (2020)). Meanwhile, it has also been argued (e.g., Berger et al. (2020)) that the movements in the VIX capture both level shocks to current RV (the first-moment shocks) and uncertainty news shocks to future movements in conditional variances (the second-moment shocks), with only the latter being consistent with the theoretical uncertainty shock literature.

We address this identification concern in three ways. First, we explicitly control for the interaction effects of the FIE dummy with the U.S. monetary policy stance and RV of global financial markets in our baseline specification. Specifically, we measure the U.S. monetary policy stance as the effective federal funds rate (EFFR) and compute the RV as the sum of daily squared returns on the S&P 500 index for each year.[5] We then interact the FIE dummy with the two global factors and include them in the vector $\boldsymbol{X}$, along with a set of firm-level covariates, such as firm's size, age, leverage, profitability, and liquidity ratio.

Second, we also extract the VAR-based structural shocks to uncertainty and evaluate their impacts on a firm's real economic activities. Specifically, following Berger et al. (2020), we estimate a VAR model with 5 variables, including log RV, log VIX, federal funds rate, log industrial production, and log employment. We then identify the structural uncertainty shock from the VAR model, which is orthogonal to current economic conditions and current volatility, and include its interaction with the FIE dummy in the regression. Meanwhile, we also control for the interaction term of the FIE dummy with the RV shock identified from the VAR model.

Third, to further ensure that the effect of global financial uncertainty is not driven by other contemporaneous movements in global and China's domestic economic conditions, we also check the robustness of our results to the inclusion of additional interaction terms between the FIE dummy and a rich set of global and domestic economic factors.

A remaining concern is that the differential response to uncertainty between FIEs and their local counterparts may be driven by other firm-level characteristics than foreign ownership. We pursue two strategies to deal with this concern. The first way is to further control for the interactions of GFUs with a set of firm-level characteristics, such as firm's asset size, age, leverage, labor productivity (i.e., log sales per worker), and employment size. The second strategy is to generate a matched sample that consists of FIEs and their comparable local counterparts and then reestimate our baseline specification using the matched samples. More concretely, we match each FIE with a local private firm within the same industry for each year based on the firm's size, age, leverage, profitability, and liquidity ratio. To ensure robustness, we employ two types of propensity score matching methods:

[5]We replace the effective federal funds rates during the zero-lower-bound period with the Wu–Xia shadow federal funds rate (Wu and Xia (2016)). Using the official effective federal funds rate, however, does not affect our results.

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One is the nearest neighbor matching, and the other is the Mahalanobis distance matching.

Finally, we also conduct a placebo test by randomly assigning the foreign ownership across firms and log VIX, the primary measure of global financial uncertainty, over time, and then reestimate the baseline specification using these randomly generated data. We repeat this process 500 times and plot the distribution of the estimated coefficient on the interaction between the FIE dummy and log VIX to assess the potential omitted variable bias. To the extent that the estimated coefficient of β from this placebo test is statistically insignificant and close to 0, this would further ensure us that the unobserved firm-level heterogeneities correlated with foreign ownership and/or other aggregate shocks correlated with the VIX are unlikely to be driving our main results.

III. Main Results

A. Basic Results

Column 1 of Table 1 presents the estimation results from the baseline specification, using log VIX as a proxy for global financial uncertainty. The estimated coefficient on FIE's interaction with log VIX is negative and statistically significant at the 1% level, indicating that greater global financial uncertainty is associated with

TABLE 1

Basic Results

Table 1 estimates firm's investment responses to changes in global financial uncertainty using different samples and uncertainty measures. Column 1 estimates the baseline specification using log VIX as a proxy for global financial uncertainty. Column 2 estimates the model using an expanded sample that also includes the state-owned enterprises. Column 3 uses the financial uncertainty index developed by Jurado et al. (2015) as a proxy for global financial uncertainty. Column 4 uses a jump indicator for the VIX index to measure large global financial uncertainty shocks (GFUs). Column 5 uses the variance risk premium component for the U.S. stock market (GFU_ZHOU) derived in Zhou (2018) as a measure of global financial uncertainty. Column 6 measures the GFU by using the structural shock to global financial uncertainty (GFU_BDG) in a VAR model (Berger et al. (2020)). All regressions include a constant term, firm-level controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Firm-level controls are size, age, leverage, profitability, liquidity ratio, and the FIE dummy. Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	VIX	VIX	FUI	JUMP	GFU_ZHOU	GFU_BDG
	1	2	3	4	5	6
FIE × GFU	−0.026***	−0.026***	−0.018***	−0.041***	−0.022***	−0.013***
	(0.007)	(0.007)	(0.007)	(0.011)	(0.005)	(0.002)
FIE × RV	0.011*	0.010	0.004	0.006	0.005	−0.005**
	(0.006)	(0.006)	(0.007)	(0.005)	(0.005)	(0.002)
FIE × EFFR	−0.007***	−0.007***	−0.008***	−0.008***	−0.007***	−0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
SOE × GFU		−0.015				
		(0.012)				
SOE × RV		−0.001				
		(0.011)				
SOE × EFFR		−0.002				
		(0.002)				
N	96,500	104,083	96,500	96,500	96,500	96,500
R^2	0.351	0.348	0.351	0.351	0.351	0.351
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes	Yes	Yes	Yes

a sharper decline in investment for FIEs than for their local counterparts in China. Moreover, the differential investment response to global financial uncertainty is also economically sizable. A 1-standard-deviation increase in log VIX would lower FIEs' investment by 2.6 percentage points more than that of their local counterparts, equivalent to about a 40% decrease relative to the average investment rate in the sample.

As for the control variables included in the regression, the estimated coefficient on the FIE's interaction with the EFFR is negative and statistically significant at the 1% level. This indicates that the FIEs in China are also more exposed to changes in the U.S. monetary policy stance than their local counterparts. The estimated coefficient on the interaction with RV is positive and marginally significant. Overall, the above two interaction effects are largely consistent with the notion that FIEs are more sensitive to global shocks. In addition, we also notice that firms tend to invest significantly more when they are larger (in asset size), younger, less leveraged, and more profitable.

In column 2 of Table 1, we expand our primary sample by including the state-owned enterprises (SOEs) and augment the baseline specification in equation (1) by further introducing the interactions of the SOE dummy with the GFC measure, the RV, and the U.S. EFFR. Our estimation results from this exercise show that including the SOEs in the estimation sample does not affect our main results on the FIE's differential response to the GFU. We continue to find a negative and statistically significant coefficient on the interaction between the FIE dummy and the global financial uncertainty measure. As for the newly included interaction terms involving the SOE dummy, their estimated coefficients are all negative but statistically insignificant.

B. Alternative Measures of Uncertainty

In the remaining columns of Table 1, we consider four alternative measures of global financial uncertainty to ensure the robustness of our results on the one hand and to further establish the causality on the other hand. In column 3, we replace log VIX with the financial uncertainty index developed by Jurado, Ludvigson, and Ng (2015) and constructed by extracting information from hundreds of financial indicators in the United States. A larger value of the financial uncertainty index indicates heightened uncertainty in global financial markets.

In column 4 of Table 1, we use a jump indicator for the VIX index to capture the effect of large GFUs. Following Bloom (2009), we identify jump events in the monthly VIX series, where the Hodrick–Prescott filtered VIX index value exceeds the mean by more than 1.65 standard deviations. Our VIX jump indicator takes on the value of 1 if a year witnessed at least 1 jump event, and 0 otherwise.[6]

In the finance literature, the variance risk premium component of the implied volatility is usually attributable to macroeconomic and financial uncertainty (e.g., Bollerslev, Tauchen, and Zhou (2009), Zhou (2018)) or Knightian uncertainty

[6]We also count the number of jump events for each year and include this annual count variable as an alternative jump indicator in the regression. This yields a significantly negative interaction effect similar to that from our baseline specification. For the sake of brevity, the estimation result from this exercise is not reported but available from the authors.

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(Drechsler (2013)). In column 5 of Table 1, we use the variance risk premium component for the U.S. stock market derived in Zhou (2018) as an alternative measure of global financial uncertainty.

To further isolate the effect of uncertainty shocks from other confounding effects of contemporaneous factors, in the last column of Table 1, we also follow Berger et al. (2020) to identify structural shock to global financial uncertainty in a VAR model. In doing so, the identified GFUs are thus orthogonal to current economic conditions and current volatility. We then interact the structural uncertainty shock with FIE and include it in the regression. This thus allows us to better identify the causal impact of GFUs on firms' real investment.[7]

As evident from columns 3–6 of Table 1, the estimated coefficient on the interaction between FIE and the uncertainty measure is always negative and statistically significant at the 1% level. That is, regardless of the global financial uncertainty measure used, heightened global financial uncertainty is always associated with a significantly sharper decline in investment for FIEs than for their local counterparts.

C. Additional Controls

1. Global Confounding Factors

To further rule out the possibility that our results are driven by some concurrent changes in global economic and financial conditions, in Table 2, we interact the FIE dummy with a set of covariates for contemporaneous global economic and financial conditions and include them, respectively, in the regression.

Column 1 of Table 2 considers the growth rate of the U.S. dollar broad index given that the U.S. dollar is the key funding and invoicing currency in international markets and its exchange rate movement can potentially affect firm performance through both trade and finance channels. In columns 2 and 3, we control for FIE's interaction with two indicators for global demand: One is world economic recession, measured as the deviation from the long-term trend in world's real GDP growth multiplied by -1, and the other is global commodity inflation. In column 4, we add the interaction with the news-based U.S. economic policy uncertainty index (Baker, Bloom, and Davis (2016)) to control for the effect of potential risks associated with economic policy changes. To address the concern that our results may be driven by the sharp increase in global financial uncertainty during the GFC period, in column 5, we also control for the interaction between the FIE dummy and the GFC indicator which takes on the value of 1 for the GFC period (2007–2009) and the value of 0 otherwise.[8]

Including these additional interaction terms does not affect the results. The estimated coefficients on the interaction of the FIE dummy with log VIX remain

[7]In column 5 of Table 1, we also extract the structural shock to realized volatility from the VAR and substitute it for the realized volatility in the baseline specification.

[8]We also exclude the GFC period from our estimation sample and reestimate the baseline specification using the non-GFC periods only. Excluding the GFC period does not affect our result. We continue to find a negative and statistically significant coefficient on the interaction of the FIE dummy with log VIX. For the sake of brevity, the estimation result from this exercise is not reported but available from the authors.

TABLE 2

Additional Controls for Global Conditions

Table 2 examines the robustness to additional controls of global economic and financial conditions. ΔUSDBI is the change in the U.S. dollar broad index. $RECESSION_W$ is the world's real GDP growth rate multiplied by −1. $INFLATION_W$ is the percentage change in global commodity price. BBD_MPU is the U.S. monetary policy uncertainty developed in Baker et al. (2016). GFC is a dummy variable that takes on the value of 1 for the global financial crisis period. All regressions include a constant term, baseline controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Baseline controls include a firm's size, age, leverage, profitability, liquidity ratio, the FIE dummy, its interaction with the S&P 500 realized volatility, and its interaction with the effective federal funds rate. Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	ΔUSDBI	$RECESSION_W$	$INFLATION_W$	BBD_MPU	GFC
	1	2	3	4	5
FIE × log VIX	−0.038***	−0.034***	−0.039***	−0.026***	−0.028***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
FIE × ΔUSDBI	0.003***				
	(0.000)				
FIE × $RECESSION_W$		0.002			
		(0.002)			
FIE × $INFLATION_W$			−0.0004***		
			(0.0001)		
FIE × BBD_MPU				−0.002	
				(0.002)	
FIE × GFC					0.007
					(0.009)
N	96,500	96,500	96,500	96,500	96,500
R^2	0.352	0.351	0.351	0.351	0.351
Baseline controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes	Yes	Yes

significantly negative in all regressions. These results thus make us more confident that our findings on FIEs' differential responses to global financial uncertainty are not fully driven by contemporaneous movement in global economic or financial conditions. As for the newly included interaction terms, most of them are statistically insignificant except that FIEs tend to experience a strong investment boom when the U.S. dollar appreciates but suffer more when global commodity inflation rises as compared to their local counterparts.

2. Local Confounding Factors

Apart from the global factors, one may also worry that our results are driven by some contemporaneous movements in local economic and financial conditions in China that are correlated with log VIX and FIEs' differential investment responses. In Table 3, we address this concern by controlling for the interactions between the FIE dummy and a set of local macroeconomic and financial factors.

First, we further control for the potential confounding effects associated with China's domestic credit conditions in the regression. Column 1 of Table 3 controls for the interaction with China's M2 growth rate, commonly considered as an important proxy for China's monetary policy stance. Column 2 includes the interaction with China's domestic credit gap, which is typically viewed as an indicator of economic overheating.

Second, to control for the effects of local business cycle fluctuations and local economic policy uncertainty, we also include the interaction of the FIE dummy with

TABLE 3

Additional Controls for Local Conditions in China

Table 3 examines the robustness to additional controls of local economic and financial conditions in China. $M2G_{CN}$ is the growth rate of China's M2 money stock. $CREDITGAP_{CN}$ is the difference between the credit-to-GDP ratio and its long-term trend in China. $SLOWDOWN_{CN}$ is China's real GDP growth multiplied by −1. EPU_{CN} is China's economic policy uncertainty. TAX is firm's taxes to profit ratio. $\Delta REER_{CN}$ is the percentage change in the real effective exchange rate (REER) of the CNYes. $VOLREER_{CN}$ is the log standard deviation of the monthly REER within a year. $STIMULUS_{CN}$ is the indicator for the period 2008–2010 when China implemented the 4-trillion stimulus package. All regressions include a constant term, baseline controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Baseline controls include a firm's size, age, leverage, profitability, liquidity ratio, the FIE dummy, its interaction with the S&P 500 realized volatility, and its interaction with the effective federal funds rate. Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	$M2G_{CN}$	$CREDITGAP_{CN}$	$SLOWDOWN_{CN}$	EPU_{CN}	TAX	$REER_{CN}$	$STIMULUS_{CN}$
	1	2	3	4	5	6	7
FIE × log VIX	−0.028**	−0.027***	−0.027***	−0.030***	−0.042***	−0.019**	−0.026***
	(0.012)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
FIE × $M2G_{CN}$	0.013						
	(0.109)						
FIE × $CREDITGAP_{CN}$		0.0002					
		(0.0004)					
FIE × $SLOWDOWN_{CN}$			0.012***				
			(0.003)				
FIE × EPU_{CN}				0.008***			
				(0.002)			
FIE × TAX					−0.018		
					(0.056)		
FIE × $\Delta REER_{CN}$						0.003***	
						(0.001)	
FIE × $VOLREER_{CN}$						−0.006*	
						(0.004)	
FIE × $STIMULUS_{CN}$							−0.001
							(0.008)
N	96,500	96,500	96,500	96,500	65,422	96,500	96,500
R^2	0.352	0.351	0.351	0.351	0.383	0.351	0.351
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

a measure of a local economic growth slowdown, which is constructed as the real GDP growth rate multiplied by −1, in column 3 of Table 3 and the interaction with the news-based index of economic policy uncertainty for China (Baker, Bloom, Davis, and Wang (2013), Baker et al. (2016)) in column 4.

Third, given that China has reformed its corporate income tax since 2008, which eliminated most of the preferential tax treatment previously enjoyed by the FIEs and applied a unified corporate income tax rate to all firms regardless of their ownership, one concern would be that the FIE's differential response to the tax reform may be responsible for our results. To address this concern, we compute the firm-level effective tax rate as total tax payment divided by pretax income and include the interaction of the FIE dummy with the effective tax rate, along with the effective tax rate, as additional controls in column 5 of Table 3.

Fourth, following China's exchange rate reform in 2005, the Chinese Yuan (CNY) exchange rate has witnessed more fluctuations. To ensure that our results are not driven by firms' differential responses to the CNY exchange rate movements in levels and volatility, in column 6 of Table 3, we control for FIE's interaction with the percentage change in the real effective exchange rate (REER) of CNY and with log REER volatility, computed as the log standard deviation of the monthly REER within a year, respectively.

Last, one may argue that our results could simply reflect the differential investment responses between foreign and domestic firms to China's 4-trillion stimulus package that were implemented by the Chinese government between 2008 and 2010 to counteract the disruption caused by the GFC. To rule out this possibility, we also control for the interaction between the FIE dummy and a binary indicator for the stimulus period (2008–2010) in the last column of Table 3.

After controlling for the confounding effects associated with China's domestic economic and financial factors, we continued to find a significantly negative coefficient on FIE's interaction with log VIX, confirming a stronger impact of global financial uncertainty on FIEs' investment. These results make us feel confident that our results are unlikely to be fully driven by contemporaneous changes in local conditions but informative about the causal linkage between global financial uncertainty and FIE's differential response.

As for the newly included interaction terms with local factors, the estimated coefficients on the interaction terms with the local economic slowdown, local economic policy uncertainty, and the CNY exchange rate are statistically significant, whereas others are not. In general, we find FIEs' investment to be more resilient to local economic and financial shocks relative to local firms. FIEs tend to have significantly better investment performance than their local counterparts when the local economy experiences a growth slowdown or is faced with rising economic policy uncertainty. These results are largely consistent with previous findings in the literature (e.g., Aguiar and Gopinath (2005), Desai, Foley, and Forbes (2008)) that FIEs are less subject to local shocks and serve as a stabilizer when the host economy is in turmoil. Apart from that, we also notice that FIEs have better investment performance than their local counterparts when CNY appreciates or is less volatile.

D. Foreign Ownership

As foreign ownership is also key to our identification, in this subsection, we make more efforts to rule out the possibility that our findings of the differential investment response to GFU are driven by some other firm-level characteristics than the foreign ownership. In Panel A of Table 4, we add to the regression the interactions of log VIX with a set of firm-level characteristics, including the firm's asset size, age, leverage, labor productivity, and employment size. We find that our main result of larger contractionary investment effect of uncertainty for FIEs remains unchanged. As for the included additional interaction terms, our results show that firms with larger asset size, higher labor productivity, or smaller employment size are less exposed to the adverse impact of global financial uncertainty, whereas the interaction of log VIX with firms' age or leverage does not have a significant effect.

In addition, we also reestimate our baseline model specification using the matched samples obtained from the nearest neighbor matching as well as the

TABLE 4

The Role of Foreign Ownership

Table 4 deals with the potential endogeneity associated with the FIE dummy. Panel A controls for the interactions of log VIX with other firm-level characteristics and is estimated using the entire sample. Panel B estimates the baseline specification using the matched samples. All regressions include a constant term, baseline controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Baseline controls include a firm's size, age, leverage, profitability, liquidity ratio, the FIE dummy, its interaction with the S&P 500 realized volatility, and its interaction with the effective federal funds rate. Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Panel A. Interaction with Firm Characteristics					*Panel B. Matched Sample*	
	SIZE	AGE	LEVERAGE	PRODUCTIVITY	EMPLOYMENT	NEAREST	MAHALANOBIS
	1	2	3	4	5	6	7
FIE × log VIX	−0.028***	−0.026***	−0.026***	−0.039***	−0.037***	−0.027***	−0.023**
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.010)	(0.011)
log VIX × SIZE	0.003***						
	(0.001)						
log VIX × AGE		−0.001					
		(0.003)					
log VIX × LEVERAGE			0.0003				
			(0.0002)				
log VIX × PRODUCTIVITY				0.005***			
				(0.001)			
log VIX × EMPLOYMENT					−0.003***		
					(0.001)		
N	96,500	96,500	96,500	63,419	63,419	40,420	34,181
R^2	0.352	0.351	0.351	0.406	0.406	0.384	0.386
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Mahalanobis distance matching, respectively.[9] As evident from Panel B of Table 4, the estimated coefficient on the interaction term between FIE and log VIX remains significantly negative at the 1% level, with a similar magnitude as our baseline estimate in Table 1. This thus makes us more confident that it is indeed foreign ownership that drives the differential investment responses to global uncertainty shocks across firms.

E. Placebo Test

Finally, to further rule out the concern that some unobserved firm-level heterogeneities correlated with foreign ownership and/or other aggregate shocks correlated with the VIX may be responsible for our results, we perform a placebo test by randomly reshuffling the FIE dummy across firms and log VIX across time. We then reestimate the baseline specification using the artificially generated data.

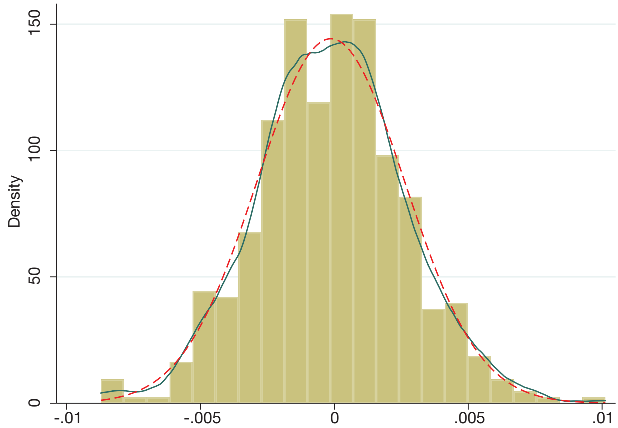
In Figure 1, we graph the distribution of the estimated coefficient on the interaction term between the FIE dummy and log VIX from the 500 repetitions.

[9]Comparisons of firm's size, age, leverage, profitability, and liquidity ratio between FIEs and their matched local counterparts indicate a good balance in the matched samples. The standardized mean differences in the covariates are mostly much smaller than the recommended threshold of 0.1 (Normand, Landrum, Guadagnoli, Ayanian, Ryan, Cleary, and McNeil (2001)), and the variance ratios for the firm-level covariates are close to 1.

FIGURE 1

Distribution of Estimates in the Placebo Test

Figure 1 plots the distribution of the estimated coefficients on the interaction between the FIE dummy and log VIX from a placebo test. The placebo test is conducted by randomly assigning the FIE dummy across firms and log VIX across time, and reestimate the baseline specification using the randomized data. This simulation is repeated 500 times. The dashed line plots the normal distribution. The solid line plots the kernel density estimates produced using the Epanechnikov kernel.



Overall, these estimates are statistically insignificant and close to 0 in magnitude, with a mean of −0.0001 and a standard deviation of 0.0028. Notably, the baseline estimate (−0.026) from column 1 of Table 1 is well below the 1st percentile (−0.0072) of the 500 estimates. Hence, the results from this placebo test provide another piece of evidence that omitted variables correlated with foreign ownership and/or and the VIX alone are not driving our main results.[10]

IV. Underlying Mechanisms

Having established the fact that global financial uncertainty causes a stronger decline in real investment for FIEs than their local counterparts in China, in this section, we further explore the underlying mechanisms through which GFUs affect a firm's investment behavior.

A. Investment Irreversibility

The irreversibility of investment has been considered in the uncertainty literature as an important channel through which aggregate uncertainty shocks reduce investment. Due to capital adjustment frictions, firms with irreversible investment tend to take the "wait-and-see" stance in the face of heightened uncertainty, and would delay their investment projects until the uncertainty is

[10]We also tried to randomly assign the uncertainty shock across time only or randomly assign foreign ownership across firms only and found very similar results. The estimated coefficients of β from these 2 placebo tests are statistically insignificant and close to 0. Due to space limitations, results from these 2 placebo tests are not reported but available from the authors.

resolved (e.g., Bernanke (1983), Abel and Eberly (1994), Caballero and Pindyck (1996), Bertola et al. (2005), Bloom (2009), (2014), and Bloom et al. (2018)). Combining this irreversibility-based "real-option" channel with the fact that FIEs are more exposed to global uncertainty than local firms, we would expect the adverse impact of uncertainty shocks on investment to be more pronounced for FIEs with greater investment irreversibility.

To investigate the empirical relevance of this mechanism, we rely on the variations in investment irreversibility across industries and introduce a triple interaction term of FIE with log VIX and the investment irreversibility measure to the baseline specification:

$$(2)\quad Y_{i,j,p,t} = \alpha + \beta(\text{FIE}_i \times \text{GFU}_t) + \gamma\left(\text{FIE}_i \times \text{GFU}_t \times \text{IR}_j\right) + \delta X_{i,j,t} + \mu_i + \nu_{j,t} + \omega_{p,t} + \varepsilon_{i,j,p,t},$$

where IR_j is the investment irreversibility for industry j. In the vector $\boldsymbol{X}$, we include the baseline firm-level controls, FIE's interactions with the U.S. EFFR, RV of S&P 500, and investment irreversibility. The level effect of investment irreversibility per se and the interaction effect between investment irreversibility and the FIE dummy are submerged with the firm fixed effects (μ_i), whereas the interaction effect between the global financial uncertainty and investment irreversibility is absorbed by the time-varying industry fixed effects ($\nu_{j,t}$).

Here, we measure investment irreversibility with the industry-level asset redeployability index developed in Kim and Kung (2017). Based on the detailed asset-specific information available in the Bureau of Economic Analysis capital flow table as well as firm-level information from the Compustat, Kim and Kung (2017) first compute the redeployability score for each asset category as the proportion of firms that use the given asset and then construct the industry-level asset redeployability index as the value-weighted average of the asset-level redeployability score. A smaller value of the redeployability index is viewed as an indication of more costly capital redeployment and hence a higher degree of investment irreversibility. Given that the index is based on the U.S. firms, which are generally viewed to be the least likely to suffer from capital adjustment frictions relative to firms in all other countries, it is reasonable to assume that the same ranking of intrinsic investment irreversibility applies to firms in all other countries, including China. We compute the average value of the asset redeployability index over the period of 1996–2005 and use it as the predetermined indicator of industry-specific investment irreversibility in our analysis.

We are particularly interested in the coefficient on the triple interaction term (γ), which reflects the role of investment irreversibility in shaping FIE's differential investment response to GFUs. Estimation results from this exercise are reported in Table 5. The redeployability index in column 1 is constructed using the market capitalization of Compustat firms by industry each year as the weight. Column 2 uses the redeployability index that further incorporates the correlation of output within industries to capture the deleterious effects of potential buyers' illiquidity on asset redeployability. Column 3 uses the redeployability index that assigns equal weight to each industry each year.

No matter which redeployability index is used, we always find the coefficient on the triple interaction term involving FIE, log VIX, and investment

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TABLE 5

Mechanism: Investment Irreversibility

Table 5 explores the role of investment irreversibility in foreign-invested enterprises' differential investment response to uncertainty. IR is the industry-level investment irreversibility, measured as the negative of the industry's asset redeployability index that uses the market capitalization of Compustat firms by industry each year as the weight. IR_R2 is an alternative measure of industry-level investment irreversibility, measured as the negative of industry's asset redeployability index that uses the market capitalization of Compustat firms by industry each year as the weight and incorporates the correlation of output within industries. IR_RW is another measure of industry-level investment irreversibility, measured as the negative of the industry-level asset redeployability index that assigns the equal weight to each industry-year. All regressions include a constant term, baseline controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Baseline controls include a firm's size, age, leverage, profitability, liquidity ratio, the FIE dummy, its interaction with the S&P 500 realized volatility, and its interaction with the effective federal funds rate. Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	IR	IR_R2	IR_EW
	1	2	3
FIE × log VIX	−0.024***	−0.024***	−0.025***
	(0.007)	(0.007)	(0.007)
FIE × log VIX × IR	−0.007**		
	(0.003)		
FIE × log VIX × IR_R2		−0.006**	
		(0.003)	
FIE × log VIX × IR_EW			−0.005**
			(0.003)
N	96,500	96,500	96,500
R^2	0.351	0.351	0.351
Baseline controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes

irreversibility to be negative and statistically significant at the 5% level. The results suggest an amplified contractionary effect of uncertainty for FIEs with a higher degree of investment irreversibility, which is in line with the theoretical predictions on the relationship between uncertainty, irreversibility, and investment. To make sense of the magnitude, we take the estimated coefficient in column 1 of Table 5 for instance. Holding other things constant, a 1-standard-deviation increase in the irreversibility measure results in an additional decline of 0.7 percentage points, equivalent to a 10% drop relative to the sample average investment, in FIE's relative investment.

B. Financial Market Frictions

Another potential explanation for the adverse impact of uncertainty shocks on investment is financial market frictions. For instance, amid heightened uncertainty about future movements in financial markets, investors would require larger risk premia, raising the costs of external financing and eventually leading to a drop in investment (e.g., Christiano, Motto, and Rostagno (2014), Gilchrist et al. (2014), and Arellano, Bai, and Kehoe (2019)). To the extent that constrained firms are more subject to financial market frictions, we would expect a stronger effect of uncertainty shocks on them. To that end, we use cross-industry variations in financial constraints exogenously determined by production technology and augment the baseline specification by adding a triple interaction of FIE and log VIX with the industry-level financial constraint:

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$$Y_{i,j,p,t} = \alpha + \beta(\text{FIE}_i \times \text{GFU}_t) + \gamma\left(\text{FIE}_i \times \text{GFU}_t \times \text{FC}_j\right) + \delta X_{i,j,t} + \mu_i + v_{j,t} + \omega_{p,t} + \varepsilon_{i,j,p,t}, \quad (3)$$

where FC_j is the degree of financial constraints faced by firms in industry j, and the vector $\boldsymbol{X}$ includes the baseline firm-level controls, FIE's interactions with the U.S. EFFR, RV of S&P 500, and financial constraint. The coefficient on the triple interaction term (γ) captures the extent to which FIE's relative investment response to global uncertainty depends on the degree of financial constraints. The effects of the industry-level financial constraint measure per se and its interaction with the foreign dummy are absorbed by the firm fixed effects, whereas the interaction effect between industry-level financial constraint and global financial uncertainty is absorbed by the time-varying industry fixed effects ($v_{j,t}$).

We consider four industry-level measures of financial constraint widely used in the literature (e.g., Rajan and Zingales (1998), Raddatz (2006), and Manova et al. (2015)). The first two measures are external finance dependence for investment and external equity finance dependence for investment. Both measures are developed by Rajan and Zingales (1998) and employed widely in the literature as measures of industries' intrinsic and exogenous dependence on external finance for long-term investment. The other two measures are the inventories to sales ratio and the cash conversion cycle at the industry level. They are constructed by Raddatz (2006) as measures of an industry's intrinsic dependence on external finance for short-term working capital.[11]

The first 4 columns of Panel A of Table 6 present the estimation results from this cross-industry heterogeneity test. We find that the estimated coefficient on the triple interaction term is always negative and statistically significant. These findings suggest that the relative investment reduction effect of GFUs is more pronounced for financially constrained firms. This thus supports the theoretical prediction that financial market frictions play an important role in generating the contractionary effect of uncertainty shocks on investment.

Next, we also rely on the cross-province variation in local financial development to provide further evidence for the financial friction channel. The logic is straightforward: If the financial frictions channel is indeed at work, the differential investment response to global financial uncertainty between foreign and domestic firms should be stronger in provinces with less developed local financial markets, where raising external funds is particularly hard. To test this idea, we measure the degree of local financial development as the ratio of the sum of loans and deposits to GDP at the province level and replace the industry-level financial constraint variable in equation (3) with the provincial financial development measure. The effects of the provincial financial development variable and its interaction with global financial uncertainty are submerged with the time-varying province fixed effects ($\omega_{p,t}$). As shown in the last column of Panel A of Table 6, the estimated coefficient

[11]Following the literature, the 4 indicators for the industry's financial constraints are computed as the within-industry median ratios using all U.S. firms covered by the Compustat database over the period of 1996–2005.

TABLE 6

Mechanism: Financial Constraints

Panel A of Table 6 examines the role of financial constraints in foreign-invested enterprises' (FIEs) differential investment response to uncertainty by exploring the heterogeneity across industries and provinces. The first 4 columns rely on the cross-industry variations in financial constraints. The last column uses the cross-province variation in local financial development proxied by the provincial loan and deposit to GDP ratio. Panel B examines the differential effect of global financial uncertainty on the firm-level financial constraints between FIE and local firms. The dependent variables are the firm's cash conversion cycle, inventory to sales ratio, the Whited and Wu index, and the financial constrained firm indicator, respectively. All regressions include a constant term, baseline controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Baseline controls include a firm's size, age, leverage, profitability, liquidity ratio, the FIE dummy, its interaction with the S&P 500 realized volatility (RV), and its interaction with the effective federal funds rate (EFFR). Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Heterogeneity Across Industries and Provinces

	EFD	EEF	ISR	CCC	PROVFD
	1	2	3	4	5
FIE × log VIX	−0.024***	−0.025***	−0.026***	−0.026***	−0.035***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
FIE × log VIX × EFD	−0.005**				
	(0.002)				
FIE × log VIX × EEF		−0.004**			
		(0.002)			
FIE × log VIX × ISR			−0.007*		
			(0.004)		
FIE × log VIX × CCC				−0.006*	
				(0.003)	
FIE × log VIX × PROVFD					0.003**
					(0.001)
N	96,500	96,500	96,500	96,500	95,885
R^2	0.351	0.351	0.351	0.351	0.351
Baseline controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes	Yes	Yes

Panel B. The Effect on Firm-Level Financial Constraints

	Cash Conversion Cycle	Inventory to Sales Ratio	Whited and Wu Index	Constrained Firm Indicator
	1	2	3	4
FIE × log VIX	9.162***	0.019***	0.004***	0.029***
	(2.265)	(0.004)	(0.001)	(0.009)
N	94,821	96,483	76,378	76,378
R^2	0.691	0.705	0.821	0.780
Baseline controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes	Yes

on the triple interaction term between the FIE dummy, log VIX, and provincial financial development is positive and statistically significant, indicating that the global uncertainty shock has a stronger adverse impact on FIE's investment in provinces with a lower degree of financial development. This thus lends further support to the financial friction channel.

Finally, to shed more light on the financial friction channel, we also test for the differential impacts of global financial uncertainty on firms' financial constraints between the FIE and their local counterparts. According to the financial friction channel, we would expect financial constraints to be tighter for foreign firms relative to domestic ones in times of heightened global financial uncertainty.

To verify this, we consider four different proxies for firm-level financial constraints. The first two are the cash conversion cycle and inventory to sales ratio, both of which are used as gauges of a firm's liquidity conditions in the literature (e.g., Raddatz (2006)). A longer cash conversion cycle or a higher inventory to sales ratio is typically viewed as an indication of increased liquidity constraints for firms. The third measure is the Whited and Wu (2006) index, with a larger value indicating a higher degree of financial constraint. The last one is a binary indicator for firms being financially constrained. In particular, we follow the finance literature (e.g., Farre-Mensa and Ljungqvist (2016)) to classify firms ranked at the top tercile of the Whited and Wu index as being constrained. We then reestimate our baseline specification by replacing the dependent variable with these firm-level financial constraint measures and report the estimation results in Panel B of Table 6. Overall, the results from this exercise deliver a consistent message – in times of heightened global financial uncertainty, FIEs face relatively tighter financial constraints than their local counterparts in China. This thus provides an additional piece of supportive evidence for the financial friction channel.

C. Downside Versus Upside Uncertainty

Recent development in the literature (e.g., Morley and Piger (2012), Adrian, Boyarchenko, and Giannone (2019), and Salgado, Guvenen, and Bloom (2019)) has highlighted the role of asymmetry in fundamental shocks in driving economic fluctuations and provided evidence for the prevalence of negative skewness in business cycle movements. Built upon these insights, we test whether there is an asymmetry in the investment effect of global financial uncertainty for FIEs relative to their local counterparts. Would the effect of a downside uncertainty shock (i.e., the uncertainty associated with the left tail of the return distribution) differ from that of an upside uncertainty shock (i.e., the uncertainty associated with the right tail of the return distribution)?

To that end, we decompose the aggregate global uncertainty into the downside and upside uncertainty components and include their respective interaction terms with FIE in the following specification:

$$(4)\qquad Y_{i,j,p,t} = \alpha + \beta_1\left(\text{FIE}_i \times \text{GFU}_t^{\text{DOWN}}\right) + \beta_2\left(\text{FIE}_i \times \text{GFU}_t^{\text{UP}}\right) + \delta X_{i,j,t} + \mu_i + \nu_{j,t} + \omega_{p,t} + \varepsilon_{i,j,p,t},$$

where GFU^{DOWN} is the downside uncertainty and GFU^{UP} is the upside uncertainty. Specifically, following the decomposition method in Berger et al. (2020), we measure the *downside* uncertainty by the average of log VIX over negative-return days and the *upside* uncertainty by the part of log VIX that is orthogonal to the downside uncertainty. Furthermore, we also apply the same decomposition method to RV of S&P 500 and include their respective interactions with FIE, along with the baseline firm-level controls and FIE's interaction with the federal funds rate, in the vector $\boldsymbol{X}$.

We report the estimation results from this decomposition exercise in the first column of Table 7. The estimated coefficient on the interaction of FIE with the downside uncertainty is negative and significant at the 1% level, whereas that on the

TABLE 7
Downside Versus Upside Uncertainty

Table 7 decomposes the global financial uncertainty into upside and downside uncertainty and examines their respective effects on firms' differential investment responses. All regressions include a constant term, baseline controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Baseline controls include a firm's size, age, leverage, profitability, liquidity ratio, the FIE dummy, its interaction with the S&P 500 realized volatility, and its interaction with the effective federal funds rate. Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3
FIE × log VIX^{DOWN}	−0.028***	−0.026***	−0.026***
	(0.007)	(0.007)	(0.007)
FIE × log VIX^{UP}	0.005**	0.004	0.003
	(0.002)	(0.003)	(0.003)
FIE × log VIX^{DOWN} × IR		−0.006**	
		(0.003)	
FIE × log VIX^{UP} × IR		0.003	
		(0.003)	
FIE × log VIX^{DOWN} × EFD			−0.004*
			(0.002)
FIE × log VIX^{UP} × EFD			0.004
			(0.003)
N	96,500	96,500	96,500
R^2	0.351	0.351	0.351
Baseline controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes

interaction with the upside uncertainty is positive and significant at the 5% level. Judging from the magnitude of the effects of two distinct types of uncertainty, the investment effect of the downside uncertainty is almost 6 times as large as that of the upside uncertainty. Taken together, our results suggest that downside uncertainty shocks have a sizeable contractionary effect on real investment, whereas upside uncertainty shocks tend to have a modestly expansionary effect for FIEs relative to local firms. This is consistent with the findings from a recent macro-level analysis by Forni, Gambetti, and Sala (2021), where downside real uncertainty associated with an expansion of the left tail of the GDP growth forecast distribution is contractionary, yet the upside real uncertainty originating from a widening of the right tail is mildly expansionary.

In the remaining 2 columns of Table 7, we further explore whether the differential responses to downside (upside) uncertainty vary with the investment irreversibility or financial constraints across industries. To that end, we augment the specification in equation (4) by including triple interaction terms of the FIE dummy, the downside (upside) uncertainty, and the industry-level investment irreversibility (financial constraints). We find that the estimated coefficients on the triple interaction terms involving the downside uncertainty are both negative and statistically significant, whereas those on the triple interaction terms involving the upside uncertainty are statistically insignificant. These results not only confirm that the downside uncertainty shock plays a more important role in shaping firms' investment decisions than the upside uncertainty shock, but also suggest that FIEs' differential investment response to downside uncertainty shocks is more pronounced in industries with higher investment irreversibility or greater financial constraints.

V. Extensions

A. Other Performance Outcomes

In this subsection, we extend our analysis to other firm-level performance outcomes, such as sales growth, employment growth, liquidity conditions measured as the change in cash holdings, and R&D activities proxied by the growth of intangible assets. We reestimate the baseline specification using the above four outcomes as dependent variables and report the estimation results in the first 4 columns of Table 8.

We find that the estimated coefficient on the interaction between the FIE dummy and log VIX is always negative, suggesting that as global financial uncertainty rises, FIEs tend to experience a steeper decline in sales and employment growth, have fewer cash holdings, and invest less in intangible assets. The negative effects of global financial uncertainty are statistically significant in all cases except for employment growth. Overall, the evidence confirms that relative to local firms, greater global financial uncertainty has a stronger contractionary effect on the FIEs' real economic activities.

Next, we also decompose the global financial uncertainty into the downside and upside components and test for the difference in the impacts of "bad" and "good" uncertainty on these firm performance outcomes. As shown in columns 5–8 of Table 8, the estimated coefficient on the interaction with downside uncertainty is always negative and significant, whereas that on the interaction with upside uncertainty is largely positive, although statistically insignificant. These results thus confirm that it is downside uncertainty that causes the contractionary effects on a firm's sales growth, employment growth, cash holdings, and R&D activities.

TABLE 8

The Effects on Other Performance Outcomes

Table 8 examines the differential effects of global financial uncertainty on other firm performance outcomes. The dependent variables are firm-level sales growth rate (ΔSALES), employment growth (ΔEMP), growth of cash holdings (ΔCASH), and the growth rate of intangible assets (ΔINTASSETS). All regressions include a constant term, controls, firm fixed effects, province-year fixed effects, and industry-year fixed effects. Baseline controls include a firm's size, age, leverage, profitability, liquidity ratio, the FIE dummy, its interaction with the effective federal funds rate, and its interaction with the realized volatility of S&P 500. Clustered standard errors at the firm level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	ΔSALES	ΔEMP	ΔCASH	ΔINTASSETS	ΔSALES	ΔEMP	ΔCASH	ΔINTASSETS
	1	2	3	4	5	6	7	8
FIE × log VIX	−0.056***	−0.016	−0.085***	−0.243**				
	(0.014)	(0.015)	(0.030)	(0.112)				
FIE × log VIX^{DOWN}					−0.035**	−0.053***	−0.095***	−0.275**
					(0.014)	(0.016)	(0.031)	(0.116)
FIE × log VIX^{UP}					−0.008	0.010	0.004	0.032
					(0.005)	(0.006)	(0.010)	(0.041)
N	96,500	56,502	93,199	96,500	96,500	56,502	93,199	96,500
R^2	0.375	0.286	0.216	0.180	0.375	0.286	0.217	0.180
Baseline controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind × year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

B. Spillover Effects

So far, we have provided evidence that GFUs have a stronger contractionary effect on real economic activities for FIEs than their local counterparts in China. Existing studies in the FDI literature have well documented that FIEs can generate technology spillover to local firms via production linkage (e.g., Javorcik (2004), Bwalya (2006), Kugler (2006), Blalock and Gertler (2008), (2009), and Lu, Tao, and Zhu (2017)). Would the presence of FIEs in the upstream or downstream production process also propagate GFUs to their local counterparts through production networks? To test for this potential spillover effect of global financial uncertainty along the production process, we focus on domestic private firms only and estimate the following model specification:

$$Y_{i,j,p,t} = \theta_0 + \theta_1 \left(\text{UP\_FIE}_j \times \text{GFU}_t\right) + \theta_2 \left(\text{DOWN\_FIE}_j \times \text{GFU}_t\right) + \theta_3 \left(\text{HORIZ\_FIE}_j \times \text{GFU}_t\right) + \delta' X_{i,j,t} + \mu_i + \omega_{p,t} + \varepsilon_{i,j,p,t}, \quad (5)$$

where UP_FIE, DOWN_FIE, and HORIZ_FIE represent the FIE intensity in the upstream, in the downstream, and horizontally, respectively. $X_{i,j,t}$ is a vector that includes the baseline firm-level controls and the industry's exports to sales ratio. As before, μ_i and $\omega_{p,t}$ are the firm fixed effects and the time-varying province fixed effects, respectively.

We follow Javorcik (2004) to construct the FIE intensity in the upstream, downstream, and horizontally for each industry. Specifically, for local private firms in industry j, its upstream FIE intensity is computed as the weighted average of FIE output share across upstream industries with the weights equal to the share of each upstream industry's output supplied to industry j. Similarly, the downstream FIE intensity for industry j is calculated as the weighted average of FIE output share across downstream industries with the weights equal to the share of each downstream industry's input purchased from industry j. The horizontal FIE intensity for industry j is simply the FIE output share in the industry. Based on the industry-level FIE output share from the NBS of China and the upstream and downstream linkage from China's input–output tables, we compute the averages of the FIE intensity in the upstream, in the downstream, and horizontally over the sample period, and then include their respective interactions with global financial uncertainty in the specification. Here, we are particularly interested in the coefficients on the interaction terms with the upstream and downstream FIE concentration measures, θ_1 and θ_2. They reflect the extent to which the effect of global financial uncertainty on local private firms depends on the intensity of FIEs in the upstream and downstream production processes. Since the upstream, downstream, and horizontal linkages are defined at the industry level, we cluster standard errors at the industry level (Cameron and Miller (2015)).

We present the estimation results for real investment, sales growth, and intangible assets growth in Table 9. The first 3 columns use log VIX as the measure of global financial uncertainty. To further rule out the potential confounding effects associated with contemporaneous movements in other global factors, in the last 3 columns, we also use the structural shocks to global financial uncertainty, which are identified from the VAR model and orthogonal to shocks to current volatility and economic conditions.

TABLE 9

Spillover Effects Through Production Networks

Table 9 examines the spillover effects of global financial uncertainty on local firms through production networks. The estimation sample consists of domestic private firms only. All regressions include a constant term, controls, firm fixed effects, and province-year fixed effects. Controls include a firm's size, age, leverage, profitability, liquidity ratio, and industry-level exports intensity. Clustered standard errors at the industry level are reported in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	log VIX			BDG Shock		
	INVESTMENT	ΔSALES	ΔINTASSETS	INVESTMENT	ΔSALES	ΔINTASSETS
	1	2	3	4	5	6
UP_FIE × GFU	0.067	−0.034	0.517	0.057	0.080	1.395
	(0.070)	(0.074)	(0.299)	(0.074)	(0.135)	(0.857)
DOWN_FIE × GFU	−0.051*	−0.101*	−0.824***	−0.065***	−0.101*	−0.570*
	(0.027)	(0.050)	(0.177)	(0.022)	(0.049)	(0.283)
HORIZ_FIE × GFU	−0.011	0.003	0.088	0.008	−0.053	−0.308
	(0.042)	(0.059)	(0.179)	(0.037)	(0.061)	(0.382)
N	72,653	72,653	72,653	72,653	72,653	72,653
R^2	0.350	0.370	0.182	0.350	0.370	0.182
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Prov × year FE	Yes	Yes	Yes	Yes	Yes	Yes

In general, we find a significant and negative coefficient on the interaction with the downstream FIE concentration, whereas the coefficients on the interactions of global financial uncertainty with the upstream and horizontal FIE intensities are statistically insignificant. The results suggest that when local private firms have more FIEs as their downstream customers, they tend to experience weaker performance in real investment, sales growth, and intangible asset investment amid heightened global financial uncertainty. This is not hard to comprehend as greater global financial uncertainty causes a severer contraction in the downstream operations where FIEs are more prevalent, leading to lower demand for the local firm's products.

VI. Conclusions

In this article, we investigate the role of FIEs in propagating GFUs across borders from a micro perspective. Using the firm-level data from China over the period of 2006–2015, we find strong evidence that global financial uncertainty causes a significantly larger reduction in investment for FIEs than their local counterparts. The results are quite robust when using alternative measures of global financial uncertainty, controlling for the contemporaneous movements in RV, global liquidity condition, and macroeconomic conditions, as well as concurrent changes in China's domestic economic and financial conditions, and employing matched samples for FIEs.

We also make efforts to explore underlying mechanisms that lead to the relatively larger contractionary effect of uncertainty for FIEs. We first test for the heterogeneity in the investment effect of global financial uncertainty by industry. We find a substantially larger contractionary effect of uncertainty on investment for FIEs with higher investment irreversibility or greater dependence on external finance. These findings thus confirm that two important mechanisms highlighted

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in the theoretical models on uncertainty (the real-option channel associated with investment irreversibility and the credit channel associated with financial market frictions) are both at work. In addition, we also decompose the global uncertainty shock into downside and upside uncertainty components and show that downside uncertainty has a significantly larger contractionary effect on investment for FIEs than local firms, whereas upside uncertainty has a modestly expansionary effect for FIEs relative to their local counterparts.

Going beyond the investment effect, we also extend our analysis to other aspects of firm-level real economic activities. We again find a larger adverse effect of GFU on sales growth, employment growth, cash holdings, and investment in intangible assets for FIEs than local firms, which is largely driven by downside uncertainty shocks. In the end, we also examine the potential spillover effect of GFUs to local firms through the presence of FIEs in upstream and downstream production processes. We show that in times of rising global financial uncertainty, local firms with more FIEs in downstream sectors would experience a steeper contraction in their real economic activities.

From the policy perspective, our findings on the role of nonfinancial firms, especially FIEs, in the cross-border transmission of global shocks have important implications and can help policymakers, especially those in developing countries, to better formulate and design policies to safeguard domestic economic and financial stability against external shocks. Furthermore, our evidence also suggests that domestic policy measures for reducing capital adjustment frictions and financial market frictions can enhance local economic resilience to external shocks and threats.

Appendix

TABLE A1

Variable Definitions and Sources

FIE: Foreign ownership indicator, set to 1 if a firm is foreign-owned and 0 otherwise. Source: Orbis.

INVESTMENT: Change in fixed assets, scaled by total assets from the previous period.

ΔSALES: Percentage change in sales revenue.

ΔEMP: Percentage change in employment size.

ΔCASH: Percentage change in cash and cash equivalents.

ΔINTASSETS: Percentage change in intangible assets.

SIZE: The natural logarithm of total assets.

AGE: The natural logarithm of the number of years a firm has established.

LEVERAGE: Total liabilities/equities.

PROFIT: Profit/sales revenue.

LIQUIDITY_RATIO: Current assets/current liabilities.

TAX: Tax payments scaled by profit.

VIX: The Chicago Board of Options Exchange VIX index. Source: FRED II.

EFFR: The U.S. effective federal funds rate.

RV: The natural logarithm of the sum of squared daily S&P 500 return.

JUMP: Uncertainty jump indicator that equals to 1 if there is at least 1 VIX jump event, and 0 otherwise.

GFU_BDG: Structural shocks to log VIX identified from a VAR model (Berger et al. (2020)).

RV_BDG: Structural shocks to log realized volatility identified from a VAR model (Berger et al. (2020)).

ΔUSDBI: Percentage change in the U.S. dollar broad index.

$\Delta REER_{CN}$: Percentage change in the real effective exchange rate of the CNY.

$VOLREER_{CN}$: The standard deviation of the monthly real effective exchange rate of the CNY within a year (in natural logarithm).

VIX^{DOWN}: Downside uncertainty, measured as the average of the VIX on negative return days. Source: FRED II, Authors' calculation.

VIX^{UP}: Upside uncertainty, measured as the part of the VIX that is orthogonal to the downside component.

GFU_ZHOU: Variance risk premium from Zhou (2018). Source: Zhou (2018).

RV_ZHOU: Realized volatility from Zhou (2018).

FUI: Annual average of the monthly financial uncertainty index developed by Jurado et al. (2015). Source: Jurado et al. (2015).

$RECESSION_W$: World's real GDP growth rate, multiplied by −1. Source: WEO.

$INFLATION_W$: The growth rate of global commodity price.

BBD_MPU: The U.S. monetary policy uncertainty. Source: https://www.policyuncertainty.com/.

EPU_{CN}: The economic policy uncertainty in China.

$M2G_{CN}$: Percentage change in China's M2 stock. Source: CEIC.

$SLOWDOWN_{CN}$: China's real GDP growth, multiplied by −1.

$CREDITGAP_{CN}$: The difference between the credit-to-GDP ratio and its long-term trend in China. Source: BIS.

IR: The negative of the industry-level asset redeployability index that uses the market capitalization of Compustat firms by industry each year as the weight. Source: Kim and Kung (2017).

IR_R2: The negative of the industry-level asset redeployability index that uses the market capitalization of Compustat firms by industry each year as the weight and incorporates the correlation of output within industries.

IR_EW: The negative of the industry-level asset redeployability index that assigns the equal weight to each industry-year.

EFD: Industry's dependence on external finance for investment. Source: Rajan and Zingales (1998), Compustat.

(continued on next page)

TABLE A1 (continued)

Variable Definitions and Sources

EEF: Industry's dependence on external equity finance for investment.

ISR: Industry's median inventory to sales ratio. Source: Raddatz (2006), Compustat.

CCC: Industry's median cash conversion cycle.

PROVFD: The ratio of the sum of loans and deposits to GDP at the province level. Source: CEIC.

EXP: Industry's exports share of total sales

DOWN_FIE: The degree of FIE concentration in downstream. Source: CEIC, Authors' calculation, WIOD.

UP_FIE: The degree of FIE concentration in the upstream.

HORIZ_FIE: The FIE output share in the industry.

GFC: The indicator for the global financial crisis period (2007–2009). Source: Authors' calculation.

$STIMULUS_{CN}$: The indicator for the period (2008–2010) when China implements its 4-trillion stimulus package.

TABLE A2

Summary Statistics of Key Variables

	N	Mean	Std. Dev.	Min.	Max.
INVESTMENT	96,500	0.065	0.255	−0.452	1.632
ΔSALES	96,500	0.147	0.507	−1.705	2.576
ΔEMP	61,831	0.052	0.364	−1.495	1.662
ΔCASH	93,570	0.155	0.916	−3.001	3.536
ΔINTASSETS	96,500	0.189	3.248	−10.003	10.062
SIZE	96,500	11.731	1.556	7.836	15.564
AGE	96,500	2.294	0.498	0.693	3.332
LEVERAGE	96,500	2.976	5.715	0.034	43.708
PROFIT	96,500	0.166	0.124	−0.094	0.641
LIQUIDITY	96,500	1.845	2.208	0.209	17.013
FIE	96,500	0.239	0.426	0.000	1.000
log VIX	96,500	3.007	0.317	2.550	3.487
EFFR	96,500	−0.308	2.045	−2.736	5.019
RV	96,500	2.859	0.443	2.305	3.717

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