Credit Expansion and Markups

YiLi Chien, Hyungsuk Lee, and Junsang Lee

This article documents new empirical facts about the effects of credit expansion on the aggregate markup and markup dispersion in the United States. We use U.S. macroeconomic data and Jordà's local projection and single-equation estimation methods. The results for both methods show that the aggregate markup and markup dispersion increase in response to both a firm debt shock and a household debt shock. The previous literature mostly focused on the effect of firm debt financing on firm markups. Extending previous research, our study shows that household credit expansion also plays a role in firm markups. This finding calls for further theoretical and analytical studies to understand the underlying mechanism regarding the effect of household credit expansion on firm markups. (JEL E31, E51, L11)

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1 INTRODUCTION

There has been burgeoning interest in the linkages between macroeconomic fundamentals and firm market power in the United States. In July 2021, U.S. President Biden issued Executive Order 14036 to encourage competition within the U.S. economy to lower prices. Moreover, U.S. data show that the correlation between fluctuations in the aggregate markup and household debt has increased since the Great Recession. The correlation coefficient is 0.16—only slightly positive—from 1980 to 2020, but the value increases to 0.50 from 2007 to 2020.[1] These facts motivate us to investigate the dynamic effects of credit expansion on firm markups.

How does credit expansion affect firm market power?[2] We try to answer this question empirically by using U.S. quarterly time-series data. By using Jordà's (2005) local projection and single-equation estimation methods, our work studies the dynamic effects of credit expansion on the first and second moments of markup distribution. Our empirical findings show that both the aggregate markup and markup dispersion increase in response to a rise in private debt, the sum of household

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debt and non-financial firm debt. In addition, our findings are robust to replacing private debt with either non-financial firm debt or household debt. Namely, firm markups not only respond to changes in firm debt but also to variation in household debt. While the previous literature mostly focuses on the effect of firm debt financing on firm markups, our study makes an additional and novel contribution: Household credit expansion could also play a crucial factor in determining firm markups.

Growing evidence indicates that firm markups and market concentration have increased in the United States and in other advanced countries.[3] Loecker, Eeckhout, and Unger (2020) estimate a sharp increase in U.S. markups and link it to several macroeconomic phenomena, including declines in the labor share. Hall (2018) presents evidence of heterogeneous rises in firm market power in U.S. industries. Gutiérrez and Philippon (2017) show a clear increase in the concentration rates of firms in the United States and its adverse macroeconomic consequences.

Previous studies mostly use a corporate finance perspective to focus on firm markups. Our empirical finding is consistent with Chevalier and Scharfstein (1996a,b), who suggest empirically that liquidity-constrained firms tend to raise markups over a downturn, to gain additional consumer surplus and hence boost their firms' liquidity reserves. Campello (2003) also shows that firms use this pricing strategy because firms heavily rely on debt financing to delay investment in response to negative shocks.

Our novel finding suggests that there is also a positive relationship between household debt and markups. One plausible explanation is that credit expansion helps relax the household budget constraint and hence increases household demand, which then induces firms to adjust their price strategies in response to the amount of household expenditure. Consistent with this explanation, Chiu, Dong, and Shao (2018) show that high consumption by credit users raises the price level in a new monetarist model: Households with higher credit spend more, resulting in higher prices. According to Wang (2016), firms post different prices as buyers bring less money with higher inflation. Because buyer demand becomes less sensitive, imperfect competitive firms have incentives to post higher markups. Our empirical results suggest that further theoretical and analytical research is required to reveal the effect of household credit expansion on markups.

The remainder of the article is organized as follows. Section 2 presents the data. Section 3 describes the econometric specifications: local projection and single-equation estimation. Section 4 provides the empirical results. Section 5 considers the effects of non-financial firm and household debt on markups. Section 6 concludes, and an appendix follows.

2 DATA

Our U.S. data are at a quarterly frequency from 1980:Q1 to 2020:Q3 and include private non-financial firms, household debt, the aggregate markup, markup dispersion, real gross domestic product (GDP), nominal GDP, and currency. Table 1 shows the data sources and sample periods. The summary statistics are provided in Appendix A3.

2.1 Private Debt: Household Debt and Non-Financial Firm Debt

We obtained data on U.S. household and non-financial firm debt from the Bank for International Settlements (BIS).[4] Our use of private debt is defined as the sum of household debt and non-financial

Table 1

Data Sources and Coverage

	Sample period	Source
Aggregate markup	1980:Q1-2020:Q3	Compustat
Markup dispersion	1980:Q1-2020:Q3	Compustat
Private debt-to-GDP ratio	1980:Q1-2020:Q3	BIS
Household debt-to-GDP ratio	1980:Q1-2020:Q3	BIS
Non-financial firm debt-to-GDP ratio	1980:Q1:2020:Q3	BIS
Currency/NGDP	1980:Q1-2020:Q3	FRED®
Real GDP	1980:Q1-2020:Q3	FRED®

NOTE: NGDP, nominal GDP.

firm debt. The private debt-to-GDP ratio is denoted by d_t^{PD}. Moreover, the difference in the private debt-to-GDP ratio from period $t-k$ to period t is denoted by $\Delta_k d_t^{PD}$.

2.2 The Aggregate Markup and Markup Dispersion

For markups, we use quarterly Compustat data, which is publicly listed U.S. firm balance sheets. The firm-level markups are computed based on a production approach that closely follows Hall (1988) and Loecker, Eeckhout, and Unger (2020): Markups are estimated from optimal firm decisions for cost minimization. Denote the markup of firm i in period t as μ_{it}. Appendix A1 shows that the optimal decision of a firm implies the aggregate markup μ_{it} is given by

$$\mu_{it} = \theta_{it}^{V} \frac{P_{it} Q_{it}}{P_{it}^{V} V_{it}}, \tag{2.1}$$

where θ_{it}^{V}, P_{it}, Q_{it}, P_{it}^{V}, and V_{it} represent output elasticity, the output price, the output quantity, price of the variable inputs, and variable inputs of the variable inputs of firm i in period t, respectively. The revenue share of the variable inputs, $\frac{P_{it} Q_{it}}{P_{it}^{V} V_{it}}$, is readily available in Compustat data. Following Loecker, Eeckhout, and Unger (2020), the output elasticity is set to be time-invariant at 0.85.[5]

The aggregate markup, denoted by μ_t, is calculated by $\mu_t = \sum m_{it} \mu_{it}$, where m_{it} represents the weight of each firm and we use the share of sales in the data as the weight. Following Meier and Reinelt (2021), markup dispersion, v_t is defined as a weighted variance of log markups:

$$v_t = \sum_i m_{\text{it}} \left(\log(\mu_{\text{it}}) - \log(\mu_t) \right)^2. \tag{2.2}$$

2.3 Currency, Nominal GDP, and Real GDP

Currency, real GDP, and nominal GDP data are taken from the Federal Reserve Bank of St. Louis FRED® database. The currency data we use is a specific component of M1, which is sometimes called "money stock currency."[6]

3 ECONOMETRIC SPECIFICATION

This section describes the econometric method used to investigate the dynamic relationships between private debt and markups. In Section 3.1, we first use the local projection method developed by Jordá (2005). In Section 3.2, we then present a single-equation estimation to further explore the dynamic effect of private debt on markups.

3.1 Jordà's (2005) Local Projection

We use the Jordá (2005) local projection method to investigate the impulse responses of a private debt, d^{PD}, shock to the aggregate markup and markup dispersion. Compared with standard vector-autoregression analysis, impulse responses from the local projection method are well suited for evaluating the validity of the dynamic relationships, since that method has been found to be more robust to misspecification, and readily allow for inclusion of the control variables. Following Ramey (2016), we employ the following econometric specification to estimate the impulse response function for each variable z at each horizon h:

$$z_{t+h} = \alpha_h + \theta_h shock_t + \varphi_h(L)\gamma_{t-1} + \text{quadratic trend} + \epsilon_{t+h}, \tag{3.1}$$

where z is the variable of interest and $shock_t$ is the identified shock. θ_h is the estimate of the impulse response of z at horizon h to a $shock_t$. γ_t is a vector of control variables, $\varphi_h(L)$ represents a polynomial in the lag operator, and α_h is the constant. All regressions include two lags of the shock based on information criteria, the private debt-to-GDP ratio (d^{PD}), log real GDP ($\log y_t$), [7] the log markup ($\log \mu_t$), markup dispersion (v_t), and the currency-to-GDP ratio ($\frac{m}{y}$).

These specifications also correspond to the standard vector-autoregression approach for identifying when the private debt shock appears before other macroeconomic variables in the Cholesky decomposition. This order reflects the identifying assumption that the measure of the private debt $shock_t$ does not respond contemporaneously to innovations in z_t. One potential problem with the Jordá (2005) method is the serial correlation of the error terms. To address these challenges, we employ Newey-West correction for the confidence interval.

To test a robustness check of our approach, we adopt a different specification of the local projection, following Mian, Sufi, and Verner (2017), and include a dummy variable for the Great Recession because there was large variation in household debt before and after the Great Recession. The robustness results are reported in Appendix B2.

3.2 Single-Equation Estimation

Following Mian, Sufi, and Verner (2017), we use single-equation estimation as an additional robustness check. The model specifications are

$$\begin{aligned} \Delta_2 \log \mu_{t+k} &= \alpha + \beta_{PD}\Delta_2 d_{t-1}^{PD} + \beta_y \Delta_2 \log y_{t-1} + \beta_v \Delta_2 v_{t-1} \\ &\quad + \beta_{\frac{m}{y}} \Delta_2 \frac{m}{y}_{t-1} + u_{t+k}, \text{for } k = 0,1,2,3, \end{aligned} \tag{3.2}$$

(3.3)
$$\Delta_2 v_{t+k} = \alpha + \beta_{PD}\Delta_2 d_{t-1}^{PD} + \beta_y \Delta_2 \log y_{t-1} + \beta_\mu \Delta_2 \log \mu_{t-1} + \beta_{\frac{m}{y}} \Delta_2 \frac{m}{y}_{t-1} + u_{t+k}, \text{for } k = 0,1,2,3,$$

where $\Delta_2 d_{t-1}^{PD}$, $\Delta_2 y_{t-1}$, $\Delta_2 v_{t-1}$, $\Delta_2 \mu_{t-1}$, and $\Delta_2 \frac{m}{y}_{t-1}$ are the change in the private debt-to-GDP ratio, real GDP, markup dispersion, aggregate markup, and currency-to-GDP ratio, respectively, from three quarters ago to last quarter. Given that the right-hand-side variables are the change from three-quarters ago to last quarter, we vary the main variables of interest on the left- hand side from a contemporaneous period to further into various future periods. For example, with $k = 3$, β_{PD} captures the effect of a rise in the private debt-to-GDP ratio from three-quarters ago to last quarter on the aggregate markup or markup dispersion from next quarter to three quarter into the future.

4 EMPIRICAL RESULTS

This section presents the estimated impulse responses of the aggregate markup and market dispersion to a private debt shock.

4.1 Results of Local Projection Method

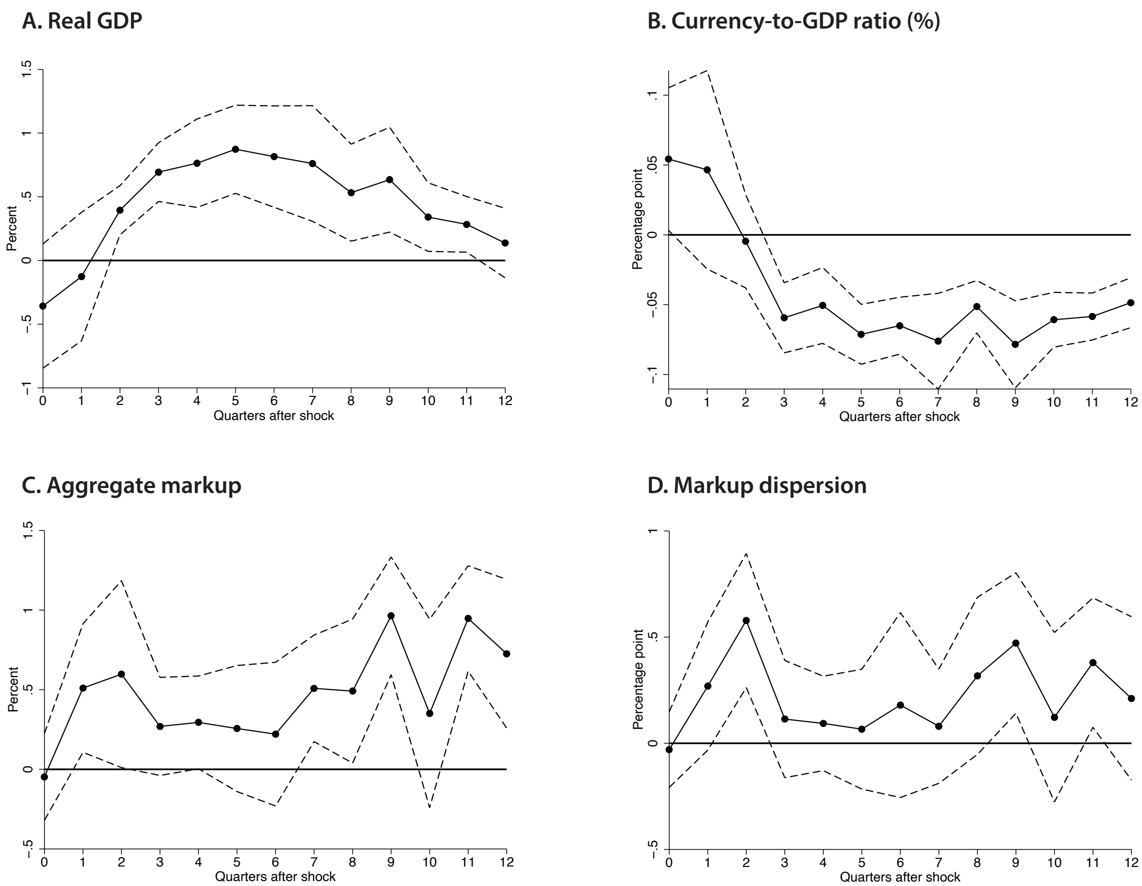
Figure 1 plots the impulse responses of real GDP, the aggregate markup, markup dispersion, and the currency-to-GDP ratio to a positive private debt shock and shows 90 percent confidence intervals. The shock is set as a 1-percentage-point increase in the private debt-to-GDP ratio, and the confidence intervals are 90 percent bands based on Newey-West correction of standard errors. As indicated by Panel A of Figure 1, real GDP rises when credit expands in the short-term and exhibits a hump-shaped pattern. The estimates are statistically significant from the second quarter to the eleventh quarter within the 90 percent confidence level. This result is in line with the empirical result of Mian, Sufi, and Verner (2017), who use country-level panel data to show that credit expansion raises real GDP in the short term.

Panel B of Figure 1 reports that the currency-to-GDP ratio declines in response to a positive private debt shock. From the third quarter after the shock, the estimates are statistically significant within the 90 percent confidence level. This empirical result indicates that credit and cash (money) are substitutes, a result consistent with Gillman (1993). Gillman (1993) documents that the consumer substitutes away from cash by using credit until the marginal cost of avoiding inflation equals the marginal inflation tax on the cash user. Berentsen, Menzio, and Wright (2011) also show that introducing credit leads to a downward shift in money demand. Berentsen, Hube, and Marchesiani (2015) argue that credit expansion lowers money demand and suggest that financial innovations can influence household money holding because consumers hold less money by using credit services.

Panel C of Figure 1 shows that, in response to a positive private debt shock, the aggregate markup starts to increase one quarter after the shock. The increases are statistically significant in some quarters after the shock. This result suggests that credit services to economic agents could raise firm market power. Panel D of Figure 1 plots the impulse responses for markup dispersion. Similar to the result for the aggregate markup, markup dispersion increases starting one quarter since a private credit expansion shock.

Figure 1

Local Projection Impulse Responses: Private Debt Shock



NOTE: The shock is set as a 1-percentage-point increase in the private debt-to-GDP ratio. The dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

For a robustness check, we use a dummy variable for the Great Recession period, which we define as 2008:Q1 to 2010:Q2—since the NBER dates are December 2007 to June 2009. The results are reported in Appendix B1 and in Figure B1. In short, the directions and the degrees of the responses and significance are almost identical to those shown in Figure 1. These findings support and validate our main results.

4.2 Results from Single-Equation Estimation

The results from single-equation estimation are reported in Table 2 and indicate that the rise in private debt is positively correlated with the aggregate markup and markup dispersion and negatively correlated with the currency-to-GDP ratio. The increase in private debt over the previous two quarters is positively related to the markup not only contemporaneously (as shown in Column 1) but also in two-quarter rolling windows in various future quarters (as shown in Columns 2 and 4). The estimates are all statistically significant below the 5 percent level. For markup dispersion, the

Table 2

Results from Single-Equation Estimation

	Dependent variable: $\Delta_2 \log \mu_{t+k}, k = 0,1,2,3$					Dependent variable: $\Delta_2 \nu_{t+k}, k = 0,1,2,3$			
	(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
	$\Delta_2 \log \mu_t$	$\Delta_2 \log \mu_{t+1}$	$\Delta_2 \log \mu_{t+2}$	$\Delta_2 \log \mu_{t+3}$		$\Delta_2 \nu_t$	$\Delta_2 \nu_{t+1}$	$\Delta_2 \nu_{t+2}$	$\Delta_2 \nu_{t+3}$
$\Delta_2 d^{PD}_{t-1}$	**0.141**** (0.033)	**0.243**** (0.003)	**0.262***** (0.003)	**0.200**** (0.024)	$\Delta_2 d^{PD}_{t-1}$	**–0.026** (0.681)	**0.119** (0.134)	**0.175**** (0.025)	**0.063** (0.432)
$\Delta_2 \log y_{t-1}$	0.040 (0.767)	–0.029 (0.848)	0.162 (0.307)	0.089 (0.585)	$\Delta_2 \log y_{t-1}$	–0.056 (0.649)	0.046 (0.752)	0.135 (0.343)	0.049 (0.739)
$\Delta_2 \frac{m}{y_{t-1}}$	2.009 (0.124)	1.793 (0.306)	2.790 (0.129)	1.354 (0.471)	$\Delta_2 \frac{m}{y_{t-1}}$	–1.590 (0.187)	–0.568 (0.735)	2.053 (0.214)	1.572 (0.352)
$\Delta_2 \nu_{t-1}$	0.581*** (0.001)	0.327*** (0.001)	–0.147* (0.089)	–0.117 (0.189)	$\Delta_2 \log \mu_{t-1}$	0.494*** (0.001)	0.108 (0.132)	–0.222*** (0.002)	–0.181* (0.013)
R^2	0.323	0.145	0.077	0.042	R^2	0.292	0.039	0.081	0.042
Observations	160	159	158	157	Observations	160	159	158	157

NOTE: Bold numbers indicate the β_{PD} in equations (3.2) and (3.3). *P*-values are in parentheses and dually clustered. *, **, *** present significance at the 0.1, 0.05, and 0.01 percent levels, respectively. A constant is included but not reported. The data cover 1980:Q1 to 2020:Q3.

correlations (shown in the right panel of Table 2 are) are generally positive but less significant than those for markups . These results support our main argument that there is a positive dynamic relationship between private debt and markups.

5 RESULTS OF PRIVATE DEBT: HOUSEHOLD DEBT AND NON-FINANCIAL FIRM DEBT

Our measure of private debt is composed of household debt and non-financial firm debt. Obviously, household debt, such as consumer credit, is more related to the demand side of final goods and services. However, non-financial firm debt, such as commercial loans, directly affects the supply side of the economy. In this section, in order to show the dynamic effects of these two debt types on the aggregate markup separately, we estimate impulse responses caused by either a non-financial firm debt shock or a household debt shock. For both shocks, the econometric specification is identical to equation (3.1) except the shock variable is replaced.

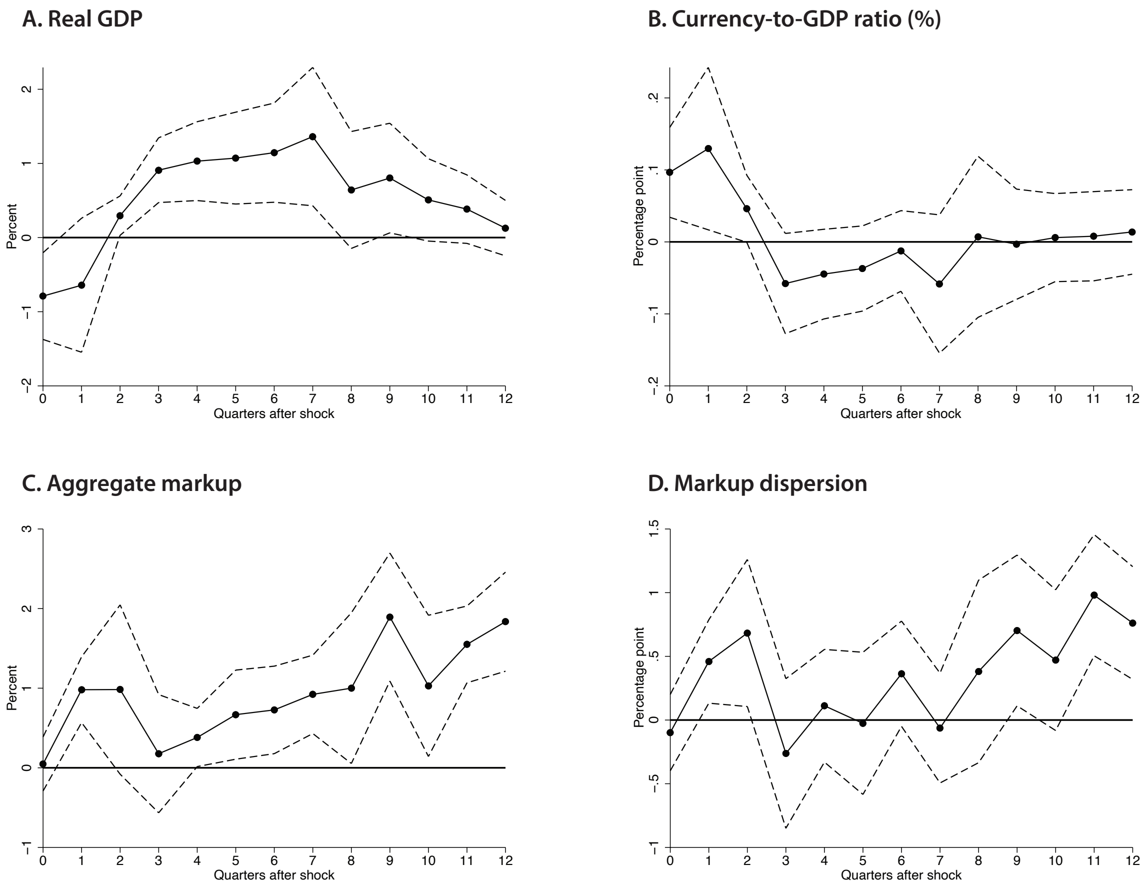
5.1 Non-Financial Firm Debt

This subsection presents the estimated impulse responses of our main four variables of interest to a non-financial firm debt shock. Similar to the previous figure, Figure 2 also includes a 90 percent confidence interval for each variable. The shock is set as a 1-percentage-point increase in the non-financial firm debt-to-GDP ratio.

Panel C of Figure 2 demonstrates that an increase in the non-financial debt-to-GDP ratio raises the aggregate markup: The estimates are statistically significant for 10 of the 12 quarters. Panel D of Figure 2 also indicates that such a shock positively impacts markup dispersion: The estimates are statistically significant 1, 2, 9, 11, and 12 quarters after the shock. Our empirical finding is con-

Figure 2

Local Projection Impulse Responses: Non-Financial Firm Debt Shock



NOTE: The shock is set as a 1-percentage-point increase in the non-financial firm debt-to-GDP ratio. The dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

sistent with that of Chevalier and Scharfstein (1996a,b), who suggest that indebted firms raise their markup during a recession to earn additional profit to boost their liquidity reserves. Additionally, Campello (2003) suggests that firms heavily dependent on external debt financing raise their prices to postpone investment during a downturn.

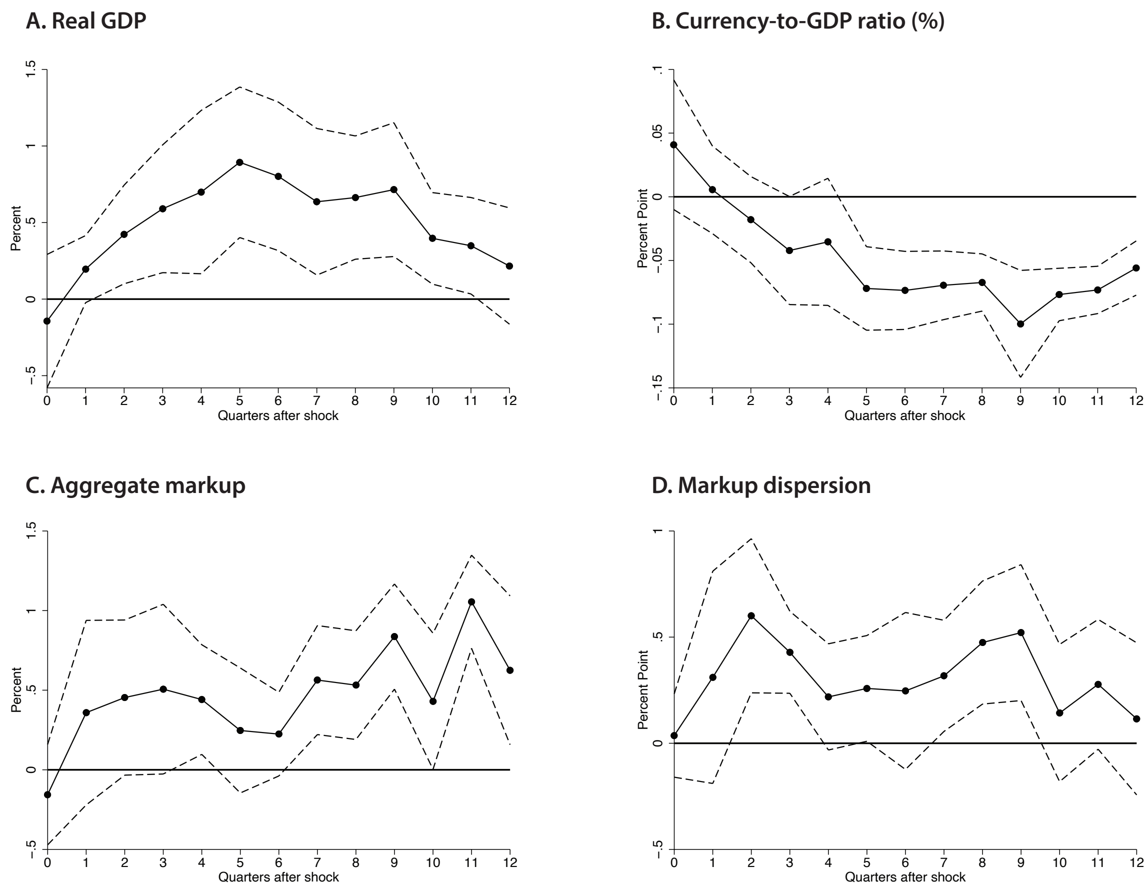
We also perform a corresponding robustness check for this result by including a dummy variable for the Great Recession period. The results are reported in Figure B2 in Appendix B. In brief, the directions, sizes, and significance levels of the impulse responses remain roughly unchanged.

5.2 Household Debt

This subsection presents the estimated impulse responses to a household debt shock. Figure 3 demonstrates the results along with 90 percent confidence intervals. As indicated by Panel C of Figure 3, the aggregate markup increases in response to a positive household debt shock: The estimates are statistically significant for 7 of the 12 quarters. Panel D of Figure 3 shows a positive

Figure 3

Local Projection Impulse Responses: Household Debt Shock



NOTE: The shock is set as a 1-percentage-point increase in the household debt-to-GDP ratio. The dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

dynamic association between household credit expansion and markup dispersion: The estimates are statistically significant for 6 of the 12 quarters after the shock.

As in previous research, our empirical results imply that household credit expansion raises firm market power. To the best of our knowledge, this empirical result is a novel empirical finding in the literature. Several fundamental factors could explain such a result, and narrowing them down is beyond the scope of our study. However, one possible mechanism is firms adjusting their price strategies in response to economic agents' expenditure. As borrowers relax their budget constraint to purchase more goods and services, firms can exploit their market power to optimally set markups for profit maximization.

This explanation is in line with the theoretical results found by Chiu, Dong, and Shao (2018) and Wang (2016). Chiu, Dong, and Shao (2018) show that higher consumption by buyers who take out credit drives up prices. Additionally, Wang (2016) documents that firms certainly post different prices as buyers bring less money to trade with inflation. As buyers hold less money and their demand becomes inelastic, firms with market power tend to post higher markups. Our result also suggests that further theoretical and analytical research is required on the dynamic effect of household credit expansion on markups. Further studies could complement previous literature, which mainly concentrates on the effect of non-financial firm credit on firm markups.

Finally, Figure B3 in Appendix B presents the results of the robustness check that includes a dummy for the Great Recession. Once again, the directions and degrees of the responses are almost identical to the results found in Figure 3.

6 CONCLUSION

Using U.S. macro data, we study the effects of credit expansion on the aggregate markup and markup dispersion. Our empirical results show that credit expansion raises the aggregate markup and markup dispersion. Many studies try to understand the cause of rising markups (e.g., Loecker, Eeckhout, and Unger, 2021; Meier and Reinelt, 2021; and Lu and Yu, 2015). The previous literature mostly focuses on the effect of firm debt financing on firm markups. Our study makes an additional empirical contribution: Household credit expansion could also play a crucial factor in determining firm markups.

Furthermore, our empirical results imply that managing excessive indebtedness is crucial not only for macro-prudential policy but also for minimizing welfare costs. Intuitively, higher firm market power could erode consumer welfare as well as reduce labor demand. It could also potentially dampen investment in capital (Loecker, Eeckhout, and Unger, 2020), raise income and asset inequality (Han and Pyun, 2021), and discourage innovation. Given the important role played by firm markups, a better understanding of the underlying factors of the positive relationship between the aggregate markup and credit expansion found in this article is a first step in improving the quality and efficacy of conducting government policy to improve social welfare. Our novel empirical result, then, calls for more theoretical and empirical causal analysis. ■

APPENDIX A1 THE AGGREGATE MARKUP: A PRODUCTION APPROACH

In each period t, consider a firm i that minimizes the cost given the production function, $Q_{it} = Q_{it}(\Omega_{it}, V_{it}, K_{it})$, where V_{it} is the vector of the variable inputs of production (intermediate inputs, including labor, and materials), Ω_{it} is productivity, and K_{it} is the capital stock. The key assumption is that within one period, variable inputs adjust, whereas capital is subject to adjustment costs and other frictions. The Lagrangian objective function related with firm cost minimization is then given by

$$\mathcal{L}\left(V_{it}, K_{it}, \lambda_{it}\right) = P_{it}^{V} V_{it} + r_{it} K_{it} + F_{it} - \lambda_{it}\left(Q_{it}\left(\cdot\right) - \overline{Q}_{it}\right),$$

where P^V represents the price of the variable inputs, r presents the user cost of capital, F is the fixed cost, $\bar{Q}$ is a fixed output target, and λ presents the Lagrange multiplier. Then, the first-order condition with respect to the variable inputs V_{it} is derived as

$$P_{it}^{V} - \lambda_{it} \frac{\partial Q\left(\cdot\right)}{\partial V_{it}} = 0.$$

Multiplying the equation above by $\frac{V_{it}}{Q_{it}}$ and rearranging terms yields an expression for the output elasticity of inputs V, denoted by θ_{it}^{v}:

$$\theta_{it}^{v} = \frac{\partial Q\left(\cdot\right)}{\partial V_{it}} \frac{V_{it}}{Q_{it}} = \frac{1}{\lambda_{it}} \frac{P_{it}^{V} V_{it}}{Q_{it}},$$

where the Lagrange multiplier λ is a direct measure of the marginal cost. By defining the aggregate markup as the price marginal-cost ratio, the above equation can be rewritten as

$$\mu \equiv \frac{P_{it}}{\lambda_{it}} = \theta_{it}^{v} \frac{P_{it}}{P_{it}^{V}} \frac{Q_{it}}{V_{it}}.$$

The aggregate markup is derived without specifying conduct or a particular demand system. By using this approach to estimate the markup, there are, in principle, multiple first-order conditions that yield an expression for the aggregate markup. Despite which variable inputs of production are used, two key ingredients are needed to measure the aggregate markup: the output elasticity of the variable inputs, θ_{it}^{v}, and the revenue share of the variable inputs, $\frac{P_{it}^{V}}{P_{it}} \frac{V_{it}}{Q_{it}}$.

APPENDIX A2 U.S. MARKUP DATA

We use quarterly firm-level balance sheet data for listed U.S. firms for the period 1980:Q1 to 2020:Q3 from Compustat North America. Following Loecker, Eeckhout, and Unger (2020), we use the North American Industry Classification System. Particularly, we observe measures of input expenditure and sales, detailed industry activity classifications, and capital stock information. We will utilize to measure the variable input which is the cost of goods sold (COGS). It bundles all expenses directly related to the production of the goods sold by the firm and includes materials and intermediate inputs, labor costs, and energy.

Table A1

Summary Statistics

	N	Mean	Median
$\Delta \log y$ (Log real GDP)	162	0.62	0.69
Δd^{PD} (Private debt-to-GDP ratio)	162	0.38	0.40
Δd^{HH} (House debt-to-GDP ratio)	162	0.18	0.20
Δd^{NFD} (Non-financial firm debt-to-GDP ratio)	162	0.20	0.20
$\Delta \log \mu$ (Log aggregate markup)	162	0.28	0.08
$\Delta \nu$ (Markup dispersion)	162	0.16	0.22
$\Delta \frac{m}{y}$ (Currency-to-GDP ratio)	162	0.03	0.02

NOTE: Changes in log and ratios are multiplied by 100 to present changes in percent or percentage points. The data cover 1980:Q1 to 2020:Q3.

APPENDIX A3 DATA SUMMARY STATISTICS

Table A1 shows summary statistics for the variables considered in our study. The table shows that the total private debt-to-GDP ratio, d_t^{PD}, which is the sum of household and non-financial firm debt, increased by 0.38 percentage points a quarter on average, while the household debt-to-GDP ratio and non-financial firm debt-to-GDP ratio increased by 0.18 and 0.20 percentage points, respectively. The aggregate markup and markup dispersion increased by 0.28 percentage points and 0.16 percentage points a quarter on average, respectively.

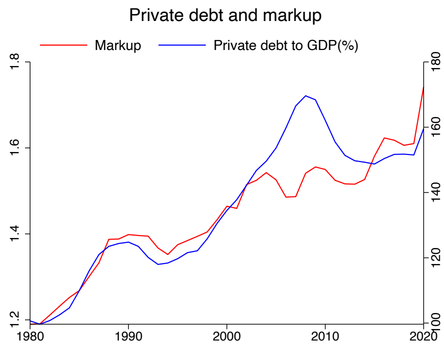
In addition, the evolution of private debt, the aggregate markup, and markup dispersion are plotted in Figure A1. Similar to Loecker, Eeckhout, and Unger (2020) and Meier and Reinelt (2021), the aggregate markup and markup dispersion show clear increasing patterns. According to Loecker, Eeckhout, and Unger (2020), the increase in the aggregate markup is driven mainly by the upper tail of the markup distribution, while the median is unchanged. There is also a strong positive correlation between markup dispersion and private debt, since the 1980s. Figure A1 also plots the aggregate markup and markup dispersion with the private debt series. As shown in the figure, there is a strong positive correlation between markups and private debt. Since 1980, the aggregate markup, markup dispersion, and private debt have all exhibited upward trends.

As shown in Figure A1, the non-financial firm debt-to-GDP ratio is highly correlated with both the aggregate markup and markup dispersion. The household debt-to-GDP ratio relates positively to both markups and markup dispersion until 2009. After 2009, the household debt-to-GDP ratio decreases while both the aggregate markup and markup dispersion continue to trend upward. The decline in household debt is driven mainly by the decline in mortgage debt caused by the housing crash of the Great Recession.

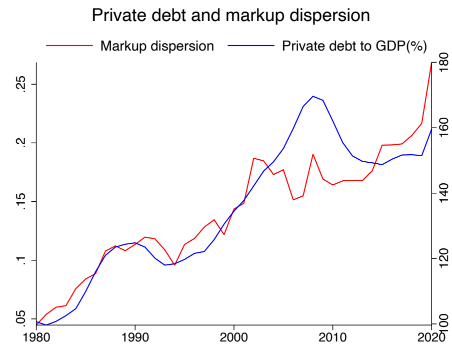
Figure A1

The Aggregate Markup, Markup Dispersion, and Debt Series

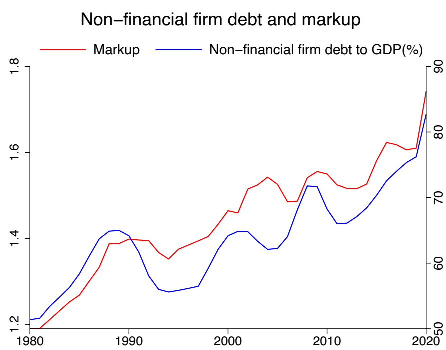
A. The evolution of d^{PD} and μ



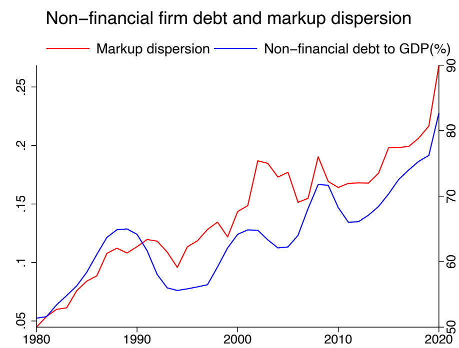
B. The evolution of d^{PD} and ν



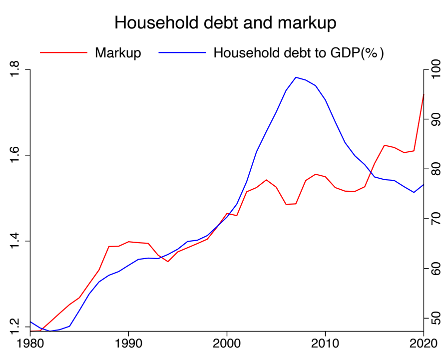
C. The evolution of d^{NFD} and μ



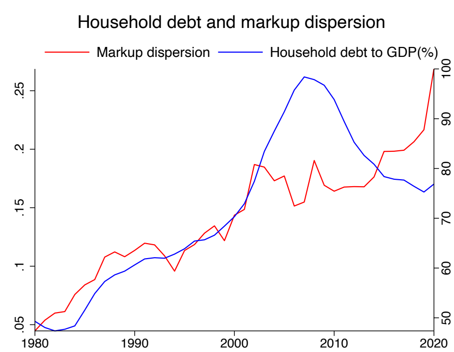
D. The evolution of d^{NFD} and ν



E. The evolution of d^{HHD} and μ



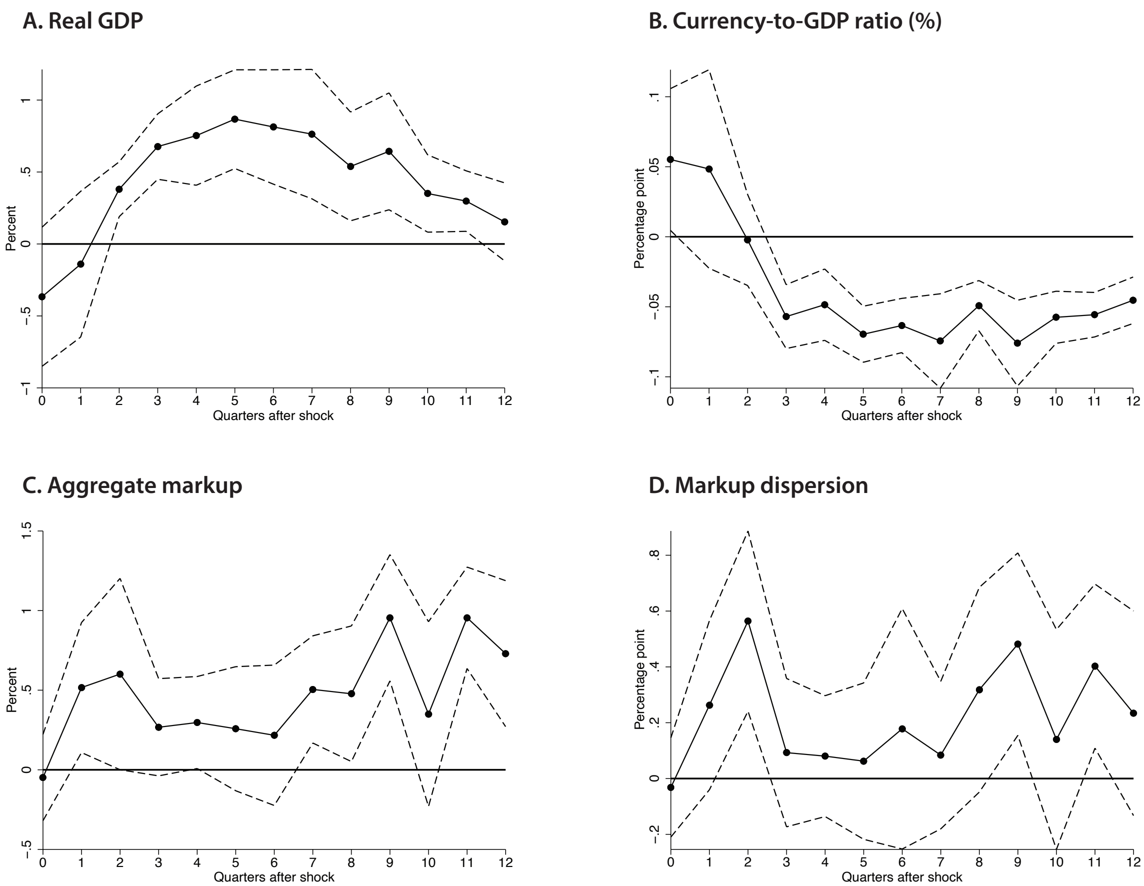
F. The evolution of d^{HHD} and ν



NOTE: The data cover 1980:Q1 to 2020:Q3. d^{PD}, d^{NFD}, and d^{HHD} are the private debt-to-GDP ratio, non-financial firm debt-to-GDP ratio, and household debt-to-GDP ratio, respectively.

Figure B1

Impulse Responses with Dummy Variable: Private Debt Shock



NOTE: The shock is measured as a 1-percentage-point increase in the private debt-to-GDP ratio. Dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

APPENDIX B1 ROBUSTNESS TEST

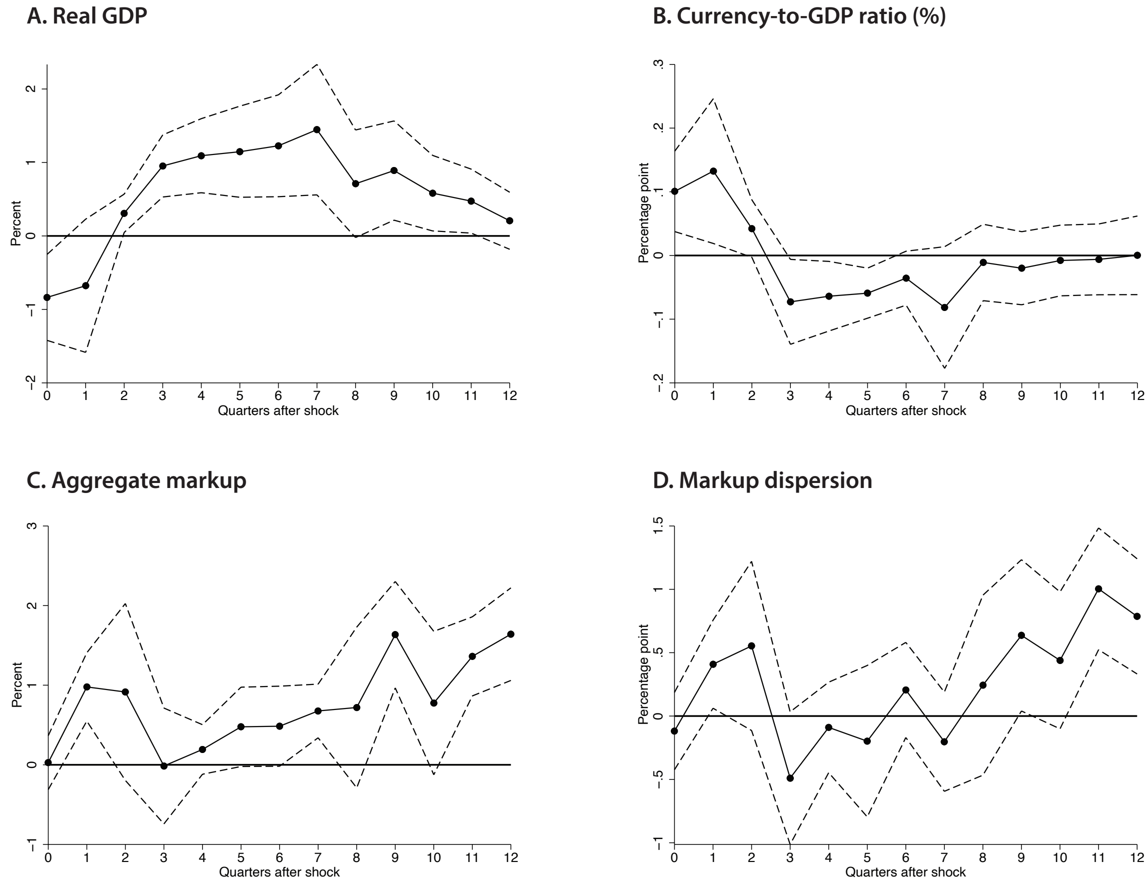
In this appendix, we report the results of robustness tests. First, we employ the dummy variable for the Great Recession period, since that period had an unusual increase in U.S. household debt. Second, we use an alternative model specification of the local projection method that follows closely Mian, Sufi, and Verner (2017).

B1.1 Dummy Variable for the Great Recession

Figure B1 presents the response for an increase in private debt on our variables of interest, which include a dummy variable for the Great Recession. The shock is measured as a 1-percentage-point increase in the private debt-to-GDP ratio. The directions and degrees of the responses are almost identical to the main results in Figure 1. These results, therefore, provide support for the robustness of the main results.

Figure B2

Impulse Responses with Dummy Variable: Non-Financial Firm Debt Shock

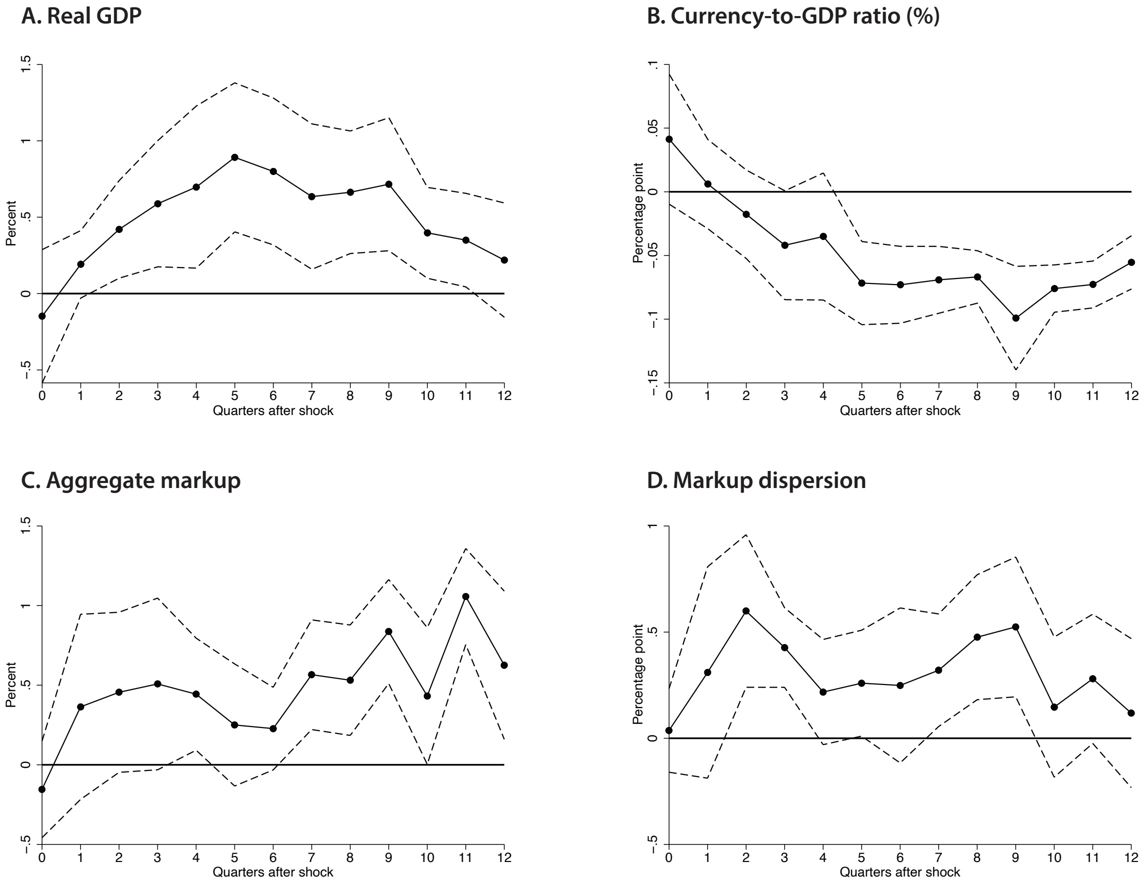


NOTE: The shock is measured as a 1-percentage-point increase in the non-financial firm debt-to-GDP ratio. Dashed lines present 90 percent confidence intervals computed using Newey-West standard errors.

Figures B2 and B3 present the impulse responses of an increase in non-financial firm and household debt to our variables of interest, respectively. The directions and degrees of the responses are almost identical to the main results in Figures 1 and 2.

Figure B3

Impulse Responses with Dummy Variable: Household Debt Shock



NOTE: The shock is measured as a 1-percentage-point increase in the household debt-to-GDP ratio. Dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

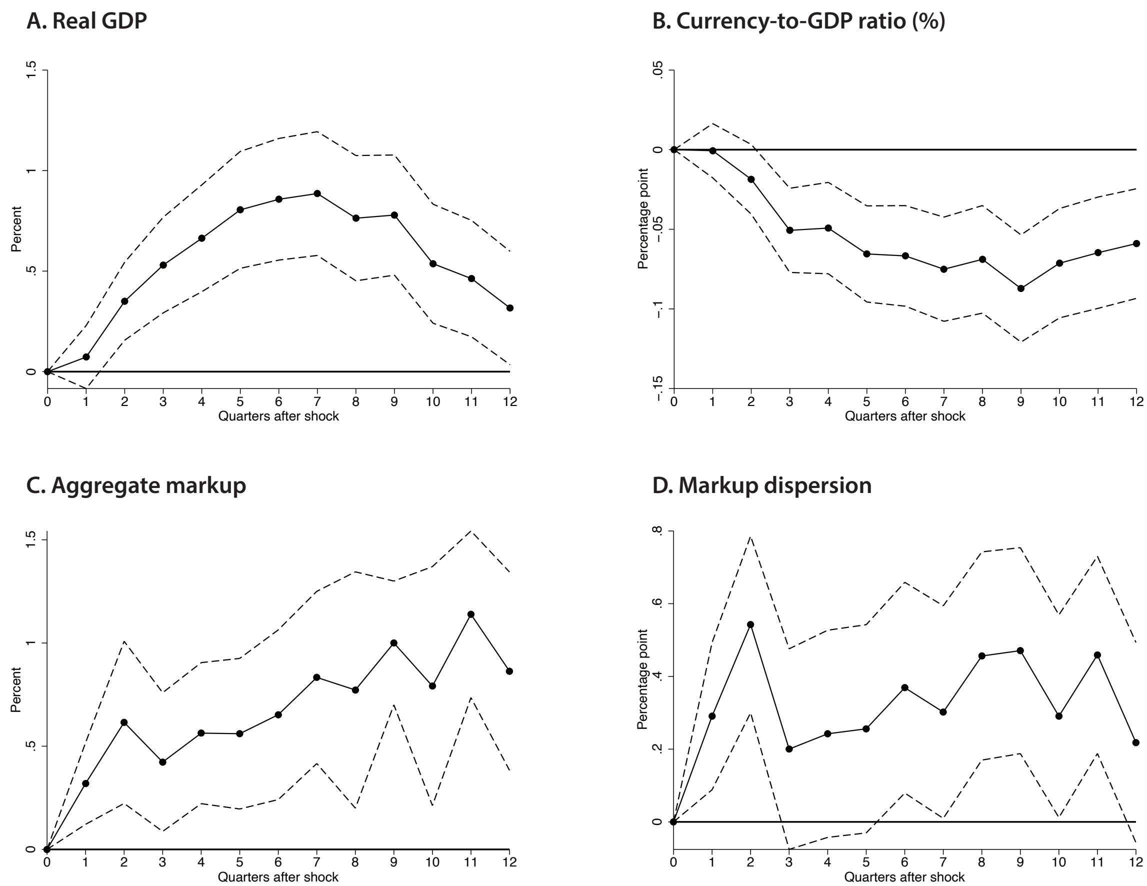
B2.2 Alternative Specification of Local Projection Following Mian, Sufi, and Verner (2017)

Following Mian, Sufi, and Verner (2017), we construct an alternative specification of the local projection method, which includes five variables: the private debt-to-GDP ratio (d^{PD}), the log of real GDP ($\log y_t$), the log of the aggregate markup ($\log \mu_t$), markup dispersion (v_t), and the currency-to-GDP ratio ($\frac{m}{y}$). The impulse responses are given by the sequence of coefficients $\{\beta_{PD}\}$ estimated from the following specification, for $h = 1,\ldots,12$:

(B1)
$$x_{t+h-1} = \alpha^h + X_{t-1}T^h + \sum_{j=1}^{p}\beta^h_{PD,j}d^{PD}_{t-j} + \sum_{j=1}^{p}\beta_{y,j}\log y_{t-j} + \sum_{j=1}^{p}\beta_{\mu,j}\log \mu_{t-j} + \sum_{j=1}^{p}\beta_{v,j}v_{t-j} + \sum_{j=1}^{p}\beta^h_{cur,j}\frac{m}{y}_{t-j} + \epsilon^h_{t+h-1},$$

Figure B4

Impulse Responses in the Alternative Specification: Private Debt Shock



NOTE: The shock is measured as a 1-percentage-point increase in the private debt-to-GDP ratio. Dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

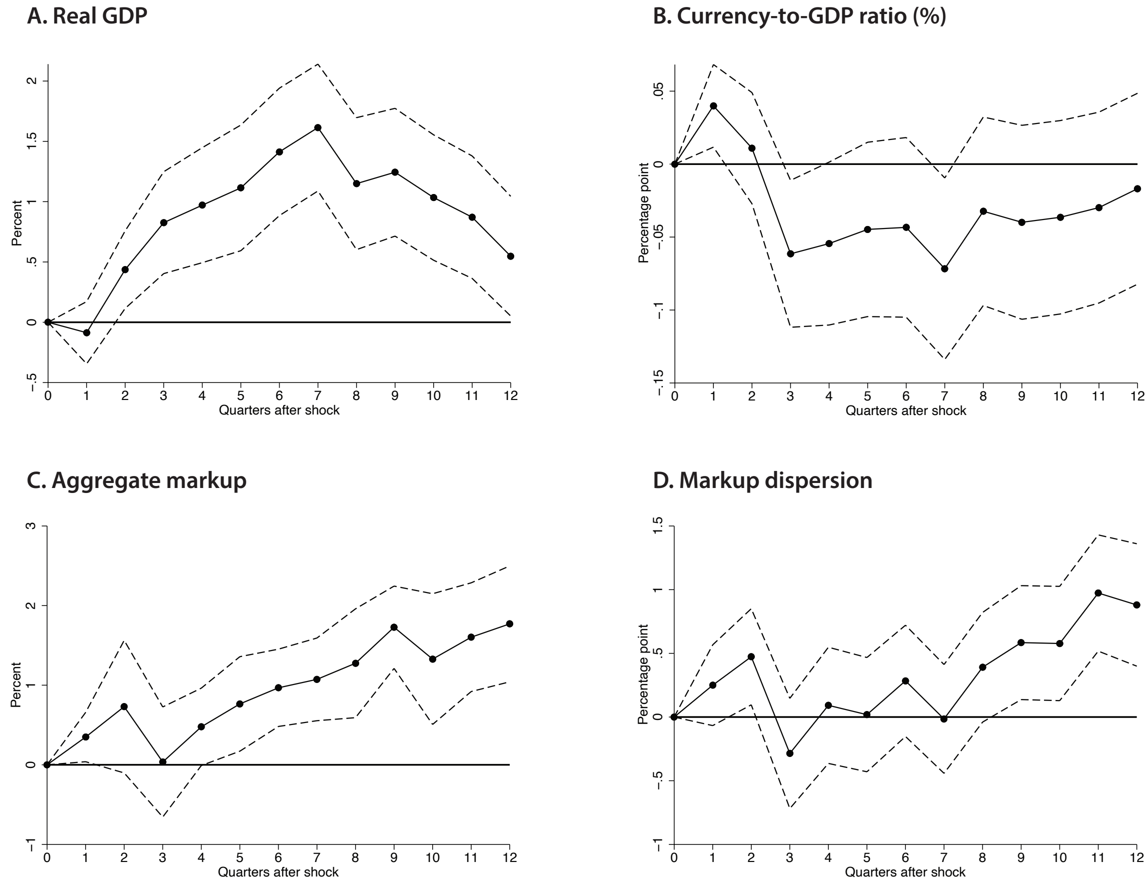
where x_t is our variables of interest: the log aggregate markup and log markup dispersion. X_t is a vector of control variables, and T^h is vector of coefficients. X_t includes additional control variables, such as lagged polynomials for the dependent variable, in the spirit of local projection. Based on the information criterion, we set $p = 2$ To correct the serial correlation of the error terms, we employ Newey-West correction for the confidence intervals. We control for the effects of past shocks by including lags of the dependent variable. Mirroring our main analysis, we implement the impulse responses to the private debt, non-financial firm, and household debt-to-GDP shocks.

B2.1 Private Debt Shock. Figure B4 shows the response results under this alternative specification. Compared with the main analysis (see Figure 1), the overall significance level of the responses becomes stronger. The directions and degrees of the responses to the private debt shock are similar to those in our main results. These alternative results, therefore, support our main findings.

B2.2 Non-Financial Firm Debt Shock. Figure B5 plots the responses for our main variables of interest in response to a positive non-financial firm debt shock. The econometric specification is

Figure B5

Impulse Responses in the Alternative Specification: Non-Financial Firm Debt Shock



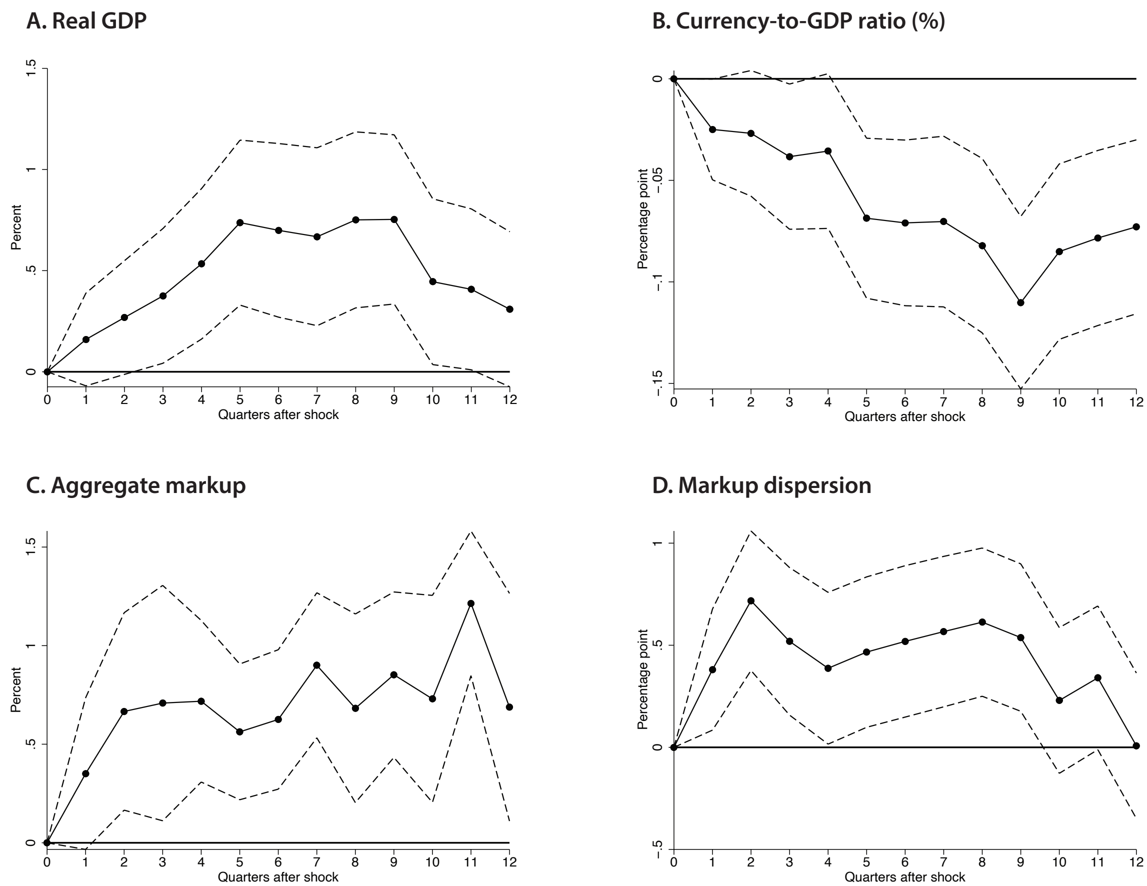
NOTE: The shock is measured as a 1-percentage-point increase in the non-financial firm debt-to-GDP ratio. Dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

identical to equation (B1) except we substitute private debt with non-financial firm debt. Both the aggregate markup and markup dispersion clearly increase in response to the shock. The significance level for real GDP improves, while the directions and degrees of the responses to a private debt shock are similar to those in our main results in Figure 2.

B2.3 Household Debt Shock. The results for responses to a positive household debt shock are shown in Figure B6: Both the aggregate markup and markup dispersion are positive. In comparison with the main analysis in Figure 3, the significance levels for the aggregate markup and markup dispersion obviously improve. Moreover, the directions and degrees of the responses to a household debt shock are similar to those in our main results.

Figure B6

Impulse Responses in the Alternative Specification: Household Debt Shock



NOTE: The shock is measured as a 1-percentage-point increase in the household debt-to-GDP ratio. Dashed lines present 90 percent confidence intervals computed using Newey-West standard errors. The data cover 1980:Q1 to 2020:Q3.

NOTES

1 We use the Hodrick-Prescott filter on markup and household debt data to compute the cyclical correlation. Household debt data comes from the Bank for International Settlements (BIS). We compute the quarterly markup data by using Compustat, following Loecker, Eeckhout, and Unger (2020). See the details in Section 2.

2 According to Pindyck and Rubinfeld (2013) and Goolsbee, Levitt, and Syverson (2016), market power is a firm's ability to adjust the prices of the products it sells.

3 Although the magnitude of this increase, and whether it can readily be interpreted as evidence of rising corporate market power, remains debated (Basu, 2019; Hall, 2018; and Reenen, 2018).

4 Credit is defined as sum of loans and debt securities from banks and non-bank financial institutions.

5 Loecker, Eeckhout, and Unger (2020) document that the pattern of a markup with fixed output elasticity at 0.85 is similar to that of a markup with estimated output elasticities. Furthermore, Meier and Reinelt (2021) assume that firms within the same two-digit industry quarter have a common output elasticity.

6 Currency: https://fred.stlouisfed.org/series/CURRNS; nominal GDP: https://fred.stlouisfed.org/series/GDP; and real GDP: https://fred.stlouisfed.org/series/GDPC1.

[7] Ramey (2016) argues that even if there is a deterministic and stochastic trend or cointegration relationship between the variables, employing a log-level variable can give consistent estimates. Sims, Stock, and Watson (1990) demonstrate that even though variables can show stochastic trends and might be cointegrated, the log of levels specification gives consistent and stable estimates. While one might be tempted to pre-test the variables and impose the cointegration relationships and unit root to efficiency. Following Ramey (2016) and the recent literature, we take the log of GDP, including the time trend.

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