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## Replication Report: Did Unconventional Interventions Unfreeze the Credit Market?

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No. 187

I4R DISCUSSION PAPER SERIES

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**December 2024**

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I4R DP No. 187

# Replication Report: Did Unconventional Interventions Unfreeze the Credit Market?

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# Replication Report: Did Unconventional Interventions Unfreeze the Credit Market?<sup>†</sup>

Mattia Coppo, Shijia Luo, and Francisco Vazquez<sup>‡</sup>

## Abstract

Tong and Wei (2020) study the impact of unconventional monetary interventions on credit markets during the 2008 global financial crisis. They find that stock prices increase on intervention days, particularly for firms operating in sectors perceived to be more reliant on external funding. Moreover, they report a positive effect of unconventional interventions on firms' subsequent investment, employment, and R&D expenditure, and find that bank recapitalizations are more effective than other interventions. We replicated the reported findings using the data and programs provided by the authors. However, the results did not hold when using the Rajan-Zingales (1998) metric of firms' external financing needs for capital expenditure—one of the two liquidity measures proposed by Tong and Wei (2020). Furthermore, the results do not hold for U.S. and European firms, and they appear driven by a small subset of Canadian firms operating in the extraction of gold and silver ore. These findings raise questions on the results and policy implications proposed in the original paper.

<sup>†</sup> Hui Tong and Shang-Jin Wei (2020), “Did Unconventional Interventions Unfreeze the Credit Market”, *American Economic Journal: Macroeconomics* 2020, 12(2): 284–309.

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## 1. Introduction

This report attempts to replicate the findings of Tong and Wei (2020) using their processed data and programs. The original paper analyzes the impact of unconventional monetary policies implemented in response to the 2008 global financial crisis, on the severity of financial constraints facing nonfinancial companies. Tong and Wei (2020) conclude that *“on average, stock prices of nonfinancial firms rise when government interventions are implemented. Moreover, interventions have a greater impact on firms in sectors that have higher intrinsic liquidity needs for working capital”* (pp. 285). It then goes on to establish a channel operating through the banking system, and tries to measure its long-term impact on the investment, employment, and R&D expenses of nonfinancial firms. In this regard, Tong and Wei (2020) conclude: *“In countries that have had an effective intervention based on our methodology, we find that ex ante liquidity-constrained firms experience a greater expansion in a range of real activities, such as capital expenditure, R&D, and employment, than unconstrained firms from 2007 to 2012”* (pp. 286). Furthermore, Tong and Wei (2020) find that *“the banking sector channel is particularly strong when the intervention is done through bank recapitalization”* (pp. 286).

Tong and Wei (2020) combine a novel dataset that tracks the announcement of unconventional monetary policies in 16 countries during 2008–10 with the stock returns of 7,873 nonfinancial corporations on the days of the policy announcements.<sup>1</sup> The unconventional monetary policies analyzed comprise five types of intervention: central bank purchase of toxic assets from banks, bank recapitalization programs, extraordinary liquidity support to banks, government guarantees on bank debt, and enhancement of deposit protection in commercial banks. Data on the announcement of these policies are gathered from the electronic news database Factiva, and from reports from the

<sup>1</sup> The paper focuses on 16 countries with unconventional intervention announcements during 2008–10 and with more than 50 firms included in the Worldscope database. The list comprises Canada, France, Germany, Greece, India, Indonesia, Italy, Japan, Singapore, South Korea, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

International Monetary Fund. In turn, financial and firm-level data come from Datastream and Compustat.

Tong and Wei (2020) build on the hypothesis that unconventional monetary policies implemented in the US and elsewhere during the 2008 global financial crisis were effective in alleviating supply-side credit constraints on non-financial corporations. This hypothesis is tested by using an event study “plus” approach: *“That is, on top of an event study specification, we simultaneously perform a cross-country, cross-sector analysis that explores interactions between cross-sector differences in the intrinsic liquidity needs for working capital and cross-country differences in the timing of intervention announcements”* (pp. 291). In short, Tong and Wei (2020) analyze the stock market returns of non-financial corporations, classified by their three-digit SIC codes, on the announcement days of unconventional monetary policies. The identification strategy exploits the cross-sectional variation in the degree of dependence on external financing between firms operating in different economic sectors. Under the null, and assuming efficient capital markets, the stock prices of firms that operate in sectors more heavily dependent on bank credit would be expected to display higher returns on the announcement days.

The measurement of sector-level dependence on external financing, which is crucial to the study, is implemented in two ways: by computing a cash conversion index (CCC) used by Raddatz (2006) and a financial dependence index proposed by Rajan and Zingales (1998). In both cases, firm-level index values obtained for US companies are aggregated at the three-digit SIC by taking the median during 1990–2006. The sectoral results obtained for US firms are then applied to firms incorporated in other countries.

In a set of baseline specifications, Tong and Wei (2020) find that average stock returns on announcement days are positive, especially for firms that operate in sectors that are more heavily dependent on external financing. These results are then extended in various ways for robustness. More importantly, as noted above, Tong and Wei (2020) seek to identify a casual channel operating from banks to nonfinancial corporations. To that end, they explore whether abnormally high returns on bank stocks on the announcement days are positively correlated with abnormally high returns on sectors with higher liquidity

needs.<sup>2</sup> Tong and Wei (2020) also seek to compare the effectiveness of the five intervention measures and finds that only bank recapitalizations matter. Finally, they explore the long-term impact of policy interventions on firms' investment, employment, and R&D expenditures, by running a set of regressions of the firm-level growth of each of these variables during 2007–12 on the interaction between abnormal bank returns and the sectoral liquidity needs.

In our main replication tests we replace the CCC measure of firm's liquidity needs with the Rajan-Zingales (1998) metric. The latter is arguably a more structural measure of firms' dependence on external financing, and therefore more appropriate to the focus of the paper. In fact, while Tong and Wei (2020) recognize the usefulness of Rajan-Zingales (1998) metric and include the series in the database. All the results presented in the paper are based on the CCC metric.

Overall, we find that the original results cannot be replicated with the Rajan-Zingales (1998) metric. In various tests, the target coefficients become insignificant or even switch sign, eroding the validity of the reported results. We also fail to replicate the results for a set of relevant sub-samples, including for US and European firms that were at the center of the 2008 financial crisis. In fact, the results appear driven by a small subset of Canadian firms operating in extractive industries (SIC 104). The rest of this report discusses our replication attempts in more detail.

## **2. Focus of the Replication**

In this report, we commence with a cursory exploration of the data and then carry out two distinct replication exercises. First, we assess computational reproducibility. That is, we try to reproduce the results presented in Tong and Wei (2020) using their processed data and programs. Second, we focus on robustness replicability. That is, we carry out a series of replication attempts with the same processed data and methods implemented in Tong and Wei (2020), while using the Rajan-Zingales liquidity measure (instead of the CCC).

<sup>2</sup> Deviations from normal returns for nonfinancial firms and banks are computed applying a CAPM to historic data at the country level.

We also implement a set of filters to assess the impact of selected subsamples on the results. Specifically, we use the processed data used in the original paper and try to replicate the results using the same regression specifications after excluding selected subsamples, to assess the robustness and generality of the results.

In terms of computational reproducibility, all the results presented in Tong and Wei (2020) were easily replicated using the final data and programs provided by the authors. As for robustness replicability, we carried out the set of checks presented in Table 1 to assess the stability of the results both in qualitative and in quantitative terms. Given the relatively large number of replication exercises, this report focuses on the three main findings of Tong and Wei (2020), as presented in the abstract:

1. *“Stock prices increase when the interventions are announced, particularly for firms with greater intrinsic need for external capital.”*
2. *“This pattern is corroborated by subsequent expansions in firm investment, R&D expenditure, and employment.”*
3. *“Among various forms of interventions, recapitalization of banks appears particularly effective in channeling the intervention effects from financial to nonfinancial sectors.”*

Table 1. Robustness Replicability

- 
- |   |
|---|
| <ol style="list-style-type: none"> <li>1. Redo the regressions using the Rajan-Zingales financial dependence index and the gross stock returns of non-financial corporations.</li> <li>2. Redo the regressions dropping individual countries, one by one.</li> <li>3. Redo the regressions dropping specific sectors, one by one.</li> <li>4. Redo the regressions excluding the extreme values of the abnormal stock market returns.</li> <li>5. Split sample by years, or censor specific years.</li> </ol> |
|---|
- 

This table presents the set of replication exercises carried out in this report, using the data and regression specifications proposed by the authors of the original paper.

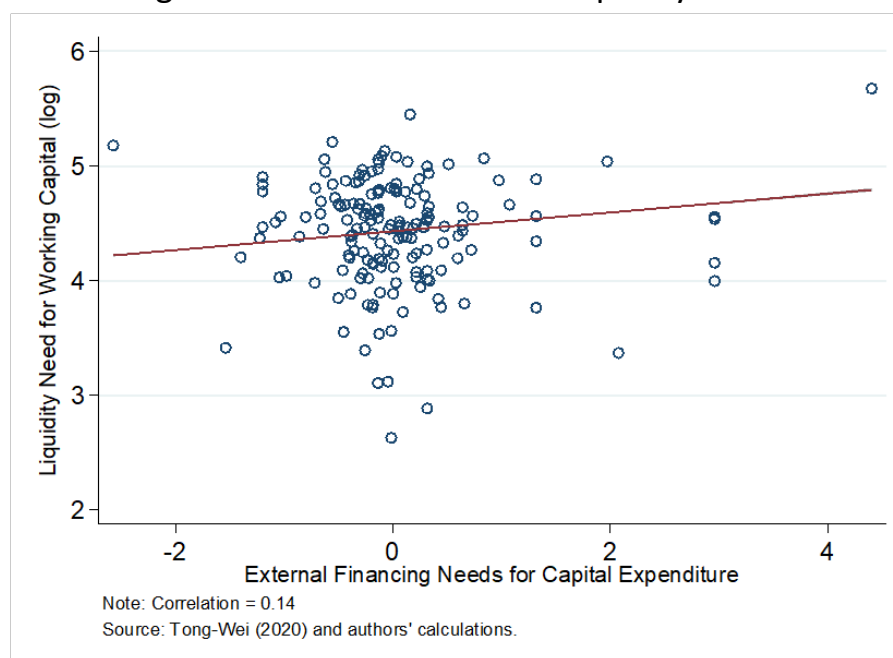
In what follows, we do some descriptive analysis of the data and discuss the replication of these three claims, one at a time.



### ***A Cursory Look at the Data***

This section focuses on the summary statistics of the two key variables: the measures of firms' liquidity needs, and the firms' stock market returns on the announcement days. Regarding the former, Tong and Wei (2020) propose two measures computed at the three-digit SIC level: the Rajan-Zingales and the CCC, without making any attempts to compare the two series or to offer an economic interpretation of the resulting values. We note that the two series display a rather low but still positive correlation (0.14) as illustrated in Figure 1. As noted above, we try to replicate the results using the Rajan-Zingales (1998) metrics. Arguably, that metric conveys a more structural, medium-term external financing needs and therefore appears more relevant to the focus of Tong and Wei (2020).

Figure 1. Measures of Firms' liquidity needs



Regarding the stock returns, a visual inspection to Figure 2 suggests that data have been materially, and unevenly winsorized across countries. The winsorization appears substantial, as indicated by the heavy mass of observations at the extremes of the distributions of the gross stock returns and the abnormal stock returns. In the case of the abnormal returns, for example, the limits are  $-15.2$  and  $14.6$  percent, as shown in Table 2. Furthermore, the limits imposed on the abnormal stock returns seem to be asymmetric across panels. Specifically, the abnormal stock returns of US companies (or a subset of them) were not subject to winsorization, but Tong and Wei (2020) do not explain the

reasons for the exclusion of these data and the criteria applied. In what follows, we discuss the results of the proposed replication attempts.

Figure 2. Measures of Stock Returns



Table 2. Summary Statistics of Abnormal Returns by Country, in percent

Country	Country Code	Mean	Min.	Median	Max.	Number Obs.
CANADA	156	-0.393	-15.159	-0.434	14.578	5,177
FRANCE	132	-0.626	-15.159	-0.273	14.578	2,713
GERMANY	134	0.181	-15.159	0.120	14.578	8,392
GREECE	174	0.261	-15.159	-0.022	14.578	1,710
INDIA	534	1.200	-15.159	1.194	14.578	558
INDONESIA	536	-1.083	-8.474	-0.497	7.539	104
ITALY	136	-0.383	-15.159	-0.292	14.578	1,901
JAPAN	158	-0.114	-15.159	-0.009	14.578	19,494
SOUTH KOREA	542	2.047	-15.159	1.346	14.578	4,079
SINGAPORE	576	-0.446	-15.159	0.055	14.578	1,331
SPAIN	184	-0.133	-15.159	-0.238	14.578	818
SWEDEN	144	-0.286	-15.159	-0.114	14.578	3,975
SWITZERLAND	146	1.231	-15.159	1.192	14.578	534
TURKEY	186	-1.818	-14.407	-1.689	14.578	272
UNITED KINGDOM	112	-0.086	-15.159	0.153	14.578	13,895
UNITED STATES	111	-0.510	-24.963	-0.303	24.863	30,839

This table presents selected summary statistics of the abnormal stock returns by country.

### *Unconventional Interventions and Liquidity Constraints*

The primary finding of Tong and Wei (2020) is that stock returns are positive on the days of intervention announcements, particularly for firms operating in sectors deemed more reliant on external financing. This claim is backed by the results presented in Table 3 of Tong and Wei (2020) (pp. 296), which are broadly stable across the specifications displayed in columns [2] to [5]. In all these regressions, the dependent variable is the abnormal stock returns of nonfinancial firms on the announcement days, and the explanatory variable is a measure of the intrinsic liquidity needs for working capital (CCC), computed at the three-digit sector level. The regressions include a set of firm-level controls as well as intervention fixed effects. To keep our analysis compact, we focus on the replication of the results of the specification presented in Tong and Wei (2020), Table 3 column [3] (pp. 296).

Table 3. Sensitivity of Results to Sequential Addition of Control Variables

Variables	(1) Firm abnormal return	(2) Firm abnormal return	(3) Firm abnormal return	(4) Firm abnormal return	(5) Firm abnormal return
Liquidity needs	0.075** [0.043]	0.072* [0.053]	0.074** [0.043]	0.075** [0.042]	0.075** [0.043]
Firm size	0.005 [0.533]		0.004 [0.605]	0.005 [0.538]	0.005 [0.533]
Demand sensitivity	-0.020 [0.289]			-0.019 [0.293]	-0.020 [0.289]
Book-to-market ratio	0.012 [0.760]				0.012 [0.760]
Constant	-0.522*** [0.006]	-0.473*** [0.005]	-0.530*** [0.003]	-0.514*** [0.006]	-0.522*** [0.006]
Observations	95,792	95,792	95,792	95,792	95,792
R-squared	0.057	0.057	0.057	0.057	0.057

Robust pval in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Notes: The dependent variable is the abnormal stock returns of nonfinancial firms between the announcement day (t) and the previous trading day (t – 1). Liquidity needs denote intrinsic liquidity needs for working capital at the sector level.

The first replication attempt seeks to check robustness of the results presented in Table 3 column [3] of Tong and Wei (2020) through the sequential addition of control variables (i.e., firm size, demand sensitivity and book-to-market ratio). Overall, the original results of Tong and Wei (2020), appear robust to the inclusion of various controls (Table 3 columns [2-4]) and are easy to replicate (Table 3 column [5]).

Table 4. Regressions Using Alternative Liquidity Measures

	(1)	(2)	(3)	(4)
	Paper: y=Excess returns; x=CCC	y=Exces s returns; x=Rajan- Zingales	y=Stock Returns; x=CCC	y=Stock Returns; x=Rajan- Zingales
x	0.075** [0.043]	-0.011 [0.698]	0.132** *	-0.042 [0.196]
Firm size	0.005 [0.533]	0.003 [0.689]	0.063** *	0.059** *
Demand sensitivity	-0.020 [0.289]	-0.019 [0.373]	0.031 [0.166]	0.032 [0.205]
Book-to-market ratio	0.012 [0.760]	0.013 [0.749]	0.158** *	0.158** *
Constant	0.522** * [0.006]	-0.166 [0.134]	1.251** * [0.000]	0.603** * [0.000]
Observations	95,792	95,792	95,792	95,792
R-squared	0.057	0.057	0.264	0.264

Robust pval in brackets

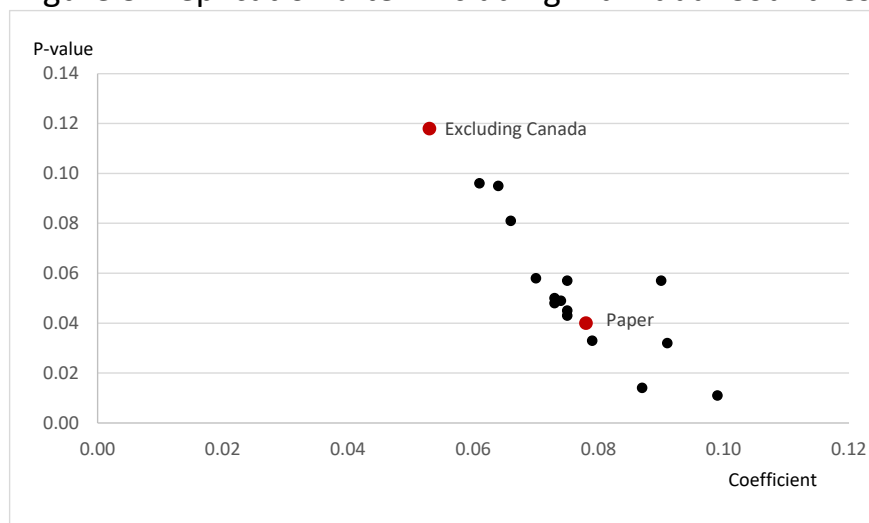
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Note: The original results are presented in column [1].

The second replication attempt involves substituting the intrinsic liquidity needs for working capital (CCC) with the Rajan-Zingales (1998) measure. In addition, we try to reproduce the results using observed stock returns, as an alternative dependent variable, as opposed to the excess stock returns. Notably, none of the findings presented in Tong and Wei (2020) (Table 4 column [1]) hold for the Rajan-Zingales (1998) liquidity measure. The sign of the target coefficient turns negative and becomes statistically insignificant in both regressions (Table 4 columns [2] and [4]). Conversely, the results obtained using observed stock returns as the dependent variable exhibit coefficients twice as large as those reported in Tong and Wei (2020),

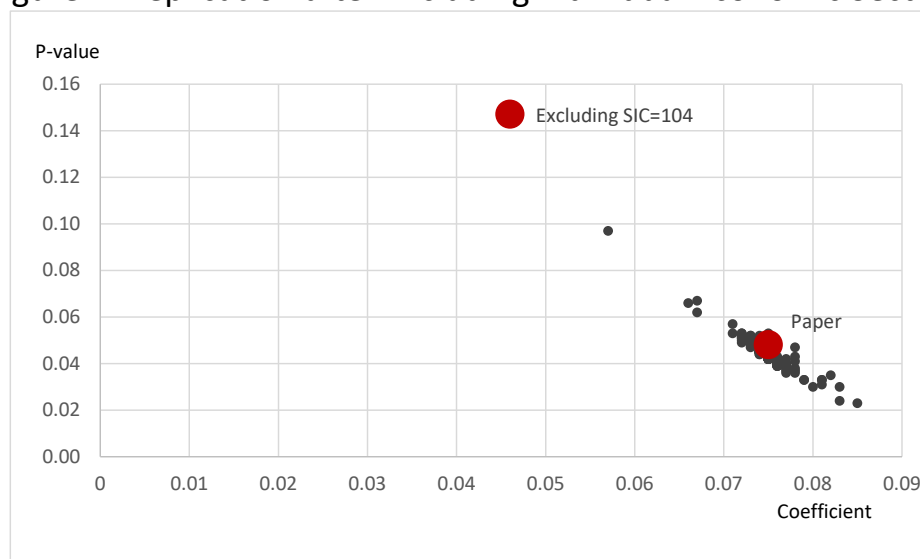
and they are statistically significant at the one percent level, as evidenced by the CCC coefficient in Table 4 column [3].

Figure 3. Replication after Excluding Individual Countries



This figure plots the coefficients and p-values of the variable "Liquidity Needs" in the regression presented in Tong and Wei (2020) Table 3, column [3]. Each point is the result of a re-estimated regression, after removing individual countries from the sample, one-by-one. The result presented by Tong and Wei (2020) is labeled "Paper", and the result from the drop of Canada is also highlighted. The figure suggests that the findings presented in Tong and Wei (2020) are driven by the sub-sample of Canadian firms.

Figure 4. Replication after Excluding Individual Economic Sectors



This figure plots the coefficients and p-values of the variable "Liquidity Needs" in the regression presented in Tong and Wei (2020) Table 3, column [3]. Each point is the result of a re-estimated regression, after removing individual economic sectors from the sample, one-by-one. The result presented by Tong and Wei (2020) is labeled "Paper", and the result from the drop of SIC 104 is also highlighted. The figure suggests that the findings presented in Tong and Wei (2020) are driven by the sub-sample of firms operating in SIC 104 (extraction of gold and silver ore).

We further explore the robustness of the results by re-estimating the regression presented in Tong and Wei (2020) Table 3, column [3] on a set of restricted sub-samples. Specifically, we try to replicate the regression after systematically excluding one country at a time, and one economic sector at a time. A comparison of the point estimates of the coefficient associated with the intrinsic liquidity needs, together with the corresponding p-values, are presented in Figures 3 and 4. These regressions indicate that the results reported in the original paper are driven by the sub-samples of Canadian firms, and by the subsamples of firms operating in the extraction of gold and silver (SIC 104). The regressions of the three prominent cases are summarized in Table 5 and the full set of regressions are presented in Appendix 1. This finding poses a notable challenge to the underlying hypothesis of the paper, since Canada did not experience severe financial distress during the global financial crisis, particularly compared with the financial dislocations observed in the U.S. and Europe. Moreover, the extraction of gold and silver ore is not a prevalent sector in industrial countries and holds minimal macroeconomic significance. It is also important to note that the intersection of these two subsamples is small, accounting for just 1.3 percent of the total sample.

Table 5. Replication on Selected Sub-Samples

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Paper	Excluding Canada	Excluding SIC=104	Excluding Canada and SIC=104	Excluding pct1 and pct100
Liquidity needs	0.075** [0.043]	0.053 [0.118]	0.046 [0.147]	0.040 [0.226]	0.044 [0.182]
Firm size	0.005 [0.533]	0.004 [0.543]	0.005 [0.569]	0.005 [0.478]	-0.016** [0.030]
Demand sensitivity	-0.020 [0.289]	-0.032** [0.038]	-0.042*** [0.006]	-0.042*** [0.006]	-0.016 [0.254]
Book-to-market ratio	0.012 [0.760]	0.001 [0.981]	0.016 [0.703]	0.008 [0.847]	0.023 [0.493]
Constant	-0.522*** [0.006]	-0.377** [0.027]	-0.345* [0.063]	-0.312* [0.082]	-0.026 [0.891]
Observations	95,792	90,615	92,788	88,866	94,095
R-squared	0.057	0.054	0.055	0.055	0.067

Robust pval in brackets

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Finally, the results become statistically insignificant after the exclusion of the percentiles 1 and 100, which is likely influenced by the data censoring, raising questions on the possible role of outliers.

Since the US played a pivotal role in the global financial crisis and the substantial representation of US firms in the sample, we conducted separate regressions for US and non-US firms to discern potential variations. Consistent with the previous discussion, the results do not hold for US firms, as shown in Table 6.

Table 6. Replication for US and non-US Firm

	(1)	(2)	(3)
VARIABLES	Paper	Non-US	US
Liquidity needs	0.075** [0.043]	0.090* [0.057]	0.030 [0.671]
Firm size	0.005 [0.533]	-0.011 [0.168]	0.026* [0.093]
Demand sensitivity	-0.020 [0.289]	-0.007 [0.780]	-0.056* [0.088]
Book-to-market ratio	0.012 [0.760]	0.004 [0.907]	0.027 [0.762]
Constant	-0.522*** [0.006]	-0.233 [0.386]	-0.889** [0.027]
Observations	95,792	64,953	30,839
R-squared	0.057	0.089	0.012

Robust pval in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Lastly, we perform two additional tests on selected sub-samples. First, we exclude the year of 2008, considered the climax of the global financial crisis when credit market distress reached its zenith. Second, we exclude instances of bank recapitalization, an unconventional policy geared towards addressing bank solvency issues. In both cases the results fail to hold, as shown in Table 7.

Table 7. Sensitivity to Time of Crisis and  
Unconventional Intervention Types

	(1)	(2)	(3)
VARIABLES	Paper	Excluding 2008	Excluding Bank Recapitalization
Liquidity needs	0.075** [0.043]	0.026 [0.567]	0.043 [0.335]
Firm size	0.005 [0.533]	0.003 [0.711]	0.023* [0.091]
Demand sensitivity	-0.020 [0.289]	-0.010 [0.669]	0.002 [0.939]
Book-to-market ratio	0.012 [0.760]	-0.099*** [0.004]	0.028 [0.550]
Constant	-0.522*** [0.006]	-0.017 [0.944]	-0.546** [0.046]
Observations	95,792	46,925	63,486
R-squared	0.057	0.045	0.055

Robust pval in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

### ***Is There a Channel for Alleviation of a Credit Crunch?***

A more substantial attempt to connect abnormal bank stock returns on the days of intervention announcements and firms' business decisions on investment expenditures, R&D and employment is presented in Table 8 of Tong and Wei (2020) (pp. 304). The specifications comprise three sets of regressions where the dependent variables are the log changes of firm-level capital expenditure, R&D, and employment, between 2007–12. The target regressors are the interactions between the abnormal bank returns accumulated over the intervention dates during 2008–10 and the intrinsic liquidity needs for working capital at the three-digit sector level. The regressions include fixed effects both at the country and at the sector level. Under the proposed specifications, a set of positive coefficients are consistent with the null of a causal channel operating through the banking system. For brevity, we focus our work on the replication of the results presented in Table 8 columns [1] to [3] of Tong and Wei (2020).



Consistent with our previous findings, the results reported in Tong and Wei (2020) vanish when we use of the Rajan-Zingales (1998) liquidity measure. All the target coefficients become negative and insignificant (Table 8).

The replication attempts excluding Canadian companies and excluding SIC 104 yield point estimates that are broadly consistent with those reported in Tong and Wei (2020), albeit less significant for the regressions on capital expenditure and R&D expenses (Table 9).

In turn, the partition of the sample between US and non-US companies produces somewhat more mixed results. In the capital expenditure regression, the target coefficient is negative in the US subsample, while positive and an order of magnitude larger than the reported coefficient in the non-US subsample. Thus, the coefficient obtained in Tong and Wei (2020) appears to reflect a cross-country effect that is of no relevance for the hypothesized mechanism. Next, in the R&D and employment regressions, the target coefficients are all positive and significant, with one exception.

Table 8. Replication of Regressions of Real Variables to  
Rajan-Zingales Liquidity Measure

VARIABLES	Paper			Rajan-Zingales liquidity measure		
	(1) Change of capital expenditure	(2) Change of R&D	(3) Change of Employment	(4) Change of capital expenditure	(5) Change of R&D	(6) Change of Employment
Bank abnormal return*liquidity needs	0.360* [0.081]	0.285* [0.096]	0.220* [0.077]			
Bank abnormal return*financing needs for capital expenditure				-3.591 [0.258]	-1.320 [0.522]	-0.319 [0.871]
Constant	-50.237* [0.057]	-22.417 [0.316]	-26.042 [0.100]	-3.517 [0.331]	15.135** [0.000]	2.121 [0.134]
Observations	5,730	2,960	4,309	5,730	2,960	4,309
R-squared	0.083	0.129	0.110	0.083	0.128	0.109

Robust pval in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 9. Replication of Regressions of Real Variables to Selected Sub-Samples

VARIABLES	Excluding Canada			Excluding SIC 104		
	(1) Change of capital expenditure	(2) Change of R&D	(3) Change of Employment	(1) Change of capital expenditure	(2) Change of R&D	(3) Change of Employment
Bank abnormal return*liquidity needs	0.334 [0.113]	0.281 [0.102]	0.253** [0.044]	0.280 [0.171]	0.296* [0.080]	0.243* [0.052]
Constant	-46.827* [0.086]	-22.059 [0.327]	-30.531* [0.056]	-40.070 [0.129]	-24.012 [0.277]	-29.323* [0.066]
Observations	5,384	2,925	4,216	5,594	2,958	4,277
R-squared	0.091	0.133	0.097	0.087	0.130	0.106

Robust pval in brackets

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

Table 10. Replication of Regressions of Real Variables across US and non-US Firm

VARIABLES	Excluding the US			Only US		
	(1) Change of capital expenditure	(2) Change of R&D	(3) Change of Employment	(4) Change of capital expenditure	(5) Change of R&D	(6) Change of Employment
Bank abnormal return*liquidity needs	1.635*** [0.001]	1.124 [0.104]	0.600** [0.019]	-0.116 [0.657]	0.498*** [0.006]	0.411** [0.042]
Constant	-76.858*** [0.000]	-27.929 [0.369]	-25.574** [0.020]	10.905 [0.744]	-47.917** [0.042]	-48.272* [0.062]
Observations	4,431	2,168	3,271	1,299	792	1,038
R-squared	0.104	0.172	0.134	0.107	0.110	0.169

Robust pval in brackets

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

### ***Differential Effects by Intervention Types***

Tong and Wei (2020) also carry out a horse race between the unconventional interventions studied with the help of intervention dummies and concludes that bank recapitalizations appear to be the most effective policy. This conclusion is backed by the results of two regressions presented in Table 7 (pp. 303) of Tong and Wei (2020). In both specifications, the dependent variable is the abnormal stock returns of nonfinancial firms on the announcement days, and the target regressors are given by the interaction

between the abnormal bank returns on intervention dates with the intrinsic liquidity needs of firms' working capital at the three-digit sectorial level and a set of unconventional intervention dummies. We focus on the results presented in Tong and Wei (2020) Table 7 column [1] (pp. 303).

Table 11. Regressions Using Alternative Liquidity Measures

VARIABLES	(1) Paper y=Instrumented bank return; x=CCC	(2) y=Instrumented bank return; x=Rajan-Zingales
Bank abnormal return × liquidity needs × recapitalization	0.521*** [0.187]	0.095 [0.115]
Bank abnormal return × liquidity needs × debt guarantee	0.422 [0.258]	-0.040 [0.138]
Bank abnormal return × liquidity needs × asset purchase	0.091 [0.187]	0.234** [0.100]
Bank abnormal return × liquidity needs × deposit insurance	0.475 [0.611]	0.481 [0.373]
Bank abnormal return × liquidity needs × liquidity support	0.088 [0.140]	-0.178** [0.080]
Constant	-1.512* [0.780]	-1.023 [0.752]
Observations	72,748	71,758
R-squared	0.057	0.056

Robust standard errors in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

First, following from previous sections, we compare the original results to those obtained using the Rajan-Zingales (1998) measure of liquidity needs instead of the CCC. Here Tong and Wei (2020) show that the relationship between liquidity needs and the instrumented bank abnormal returns is statistically significant only in the case of bank recapitalization. For the other four intervention types, the coefficients are positive but comparatively smaller and statistically insignificant. The authors point out that these results align with the theoretical propositions of Philippon and Schnabl (2013), who posit that recapitalization proves more effective in mitigating liquidity constraints arising from the private information issue in asset quality (referred to as the "lemons problem") coupled with the debt-overhang predicament. However, using the Rajan-Zingales (1998) measure

of liquidity needs, the prevalence of recapitalization as an effective measure fades in favor of other measures, namely asset purchases and liquidity support, which show statistically significant coefficients, as shown in Table 11. Interestingly, in this case liquidity support appears to be detrimental as a measure, evidenced by the negative sign of its coefficient.

Next, we attempt to replicate the results presented in Tong and Wei (2020) Table 7 (p. 303) after excluding specific sub-samples. For this test, results are very consistent throughout, both in terms of magnitude of the effects and significance levels. Perhaps the only sample modification that yields any change to the results is excluding the bottom and top 1 percentiles, which leads to an estimated effect of recapitalization on abnormal returns somewhat smaller than the original regression. Overall, it doesn't appear that any specific sub-sample is driving the results of this part of the paper.

Table 12. Sensitivity to Alternative Sub-Samples

VARIABLES	(1) Paper	(2) Excluding Canada	(3) Excluding SIC=104	(4) Excluding Canada and SIC=104	(5) Excluding pct1 and pct100
Bank abnormal return × liquidity needs × recapitalization	0.521*** [0.005]	0.510*** [0.006]	0.530*** [0.005]	0.512*** [0.007]	0.304** [0.048]
Bank abnormal return × liquidity needs × debt guarantee	0.422 [0.102]	0.128 [0.566]	0.260 [0.271]	0.154 [0.489]	0.320 [0.178]
Bank abnormal return × liquidity needs × asset purchase	0.091 [0.624]	0.029 [0.862]	0.302* [0.095]	0.133 [0.432]	0.072 [0.635]
Bank abnormal return × liquidity needs × deposit insurance	0.475 [0.437]	0.474 [0.437]	0.332 [0.585]	0.312 [0.607]	0.488 [0.386]
Bank abnormal return × liquidity needs × liquidity support	0.088 [0.531]	0.085 [0.512]	0.072 [0.583]	0.124 [0.343]	0.066 [0.587]
Constant	-1.512* [0.052]	-1.241 [0.126]	-1.574** [0.042]	-1.312 [0.107]	-0.635 [0.383]
Observations	72,748	67,779	70,171	66,447	71,459
R-squared	0.057	0.053	0.055	0.054	0.065

Robust pval in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Conclusion

The inability to replicate with the Rajan-Zingales (1998) metric appears to challenge the claims and policy implications presented in the original paper. Arguably, the Rajan-Zingales (1998) metric provides a more structural, medium-term measure of firms' external financing needs than the CCC measure of liquidity needs for working capital. Medium-term business decisions regarding capital expenditures, employment, and investment in R&D are likely to be more deeply influenced by structural liquidity factors.

The use of an asymmetric filter to winsorize data across countries in the original paper raises concerns, as its rationale and implementation are not discussed in the original paper. Tong and Wei (2020) also apply various criteria to filter out specific data points, but we were not able to assess the impact of these filters since the excluded observations are not provided in the database. In addition, the lack of replicability for US and European firms, which were at the center of the 2008 global financial crisis, raises questions on the validity of the proposed mechanism, or on the method used for testing. Finally, the reliance of the results on specific and inconsequential subsamples raises doubts about the validity and robustness of the results presented.

It is also important to acknowledge that our replications neglect significant cross-checks and comparisons that could potentially be pertinent. First, the paper builds on firm-level data and generates aggregated metrics of firms' reliance on external funding sources at the sectoral level. Unfortunately, we cannot attempt to replicate this crucial step since the authors were not able to share the original data from Compustat due to commercial licensing restrictions. Additionally, the estimation of sectorial reliance on external funding is based on data for US firms and extrapolated to other countries, but we do not make any attempt to assess the empirical validity of this treatment.

## References

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- Raddatz, Claudio (2006). “liquidity needs and Vulnerability to Financial Underdevelopment” *Journal of Financial Economics* 80 (3): 677–722.
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## Appendix 1

Table A1. Replication after Excluding Individual Countries

	Liquidity need	
	Coefficient	P-Value
Original Paper	0.075**	[0.043]
Countries excluded:		
Canada	0.053	[0.118]
France	0.087**	[0.014]
Germany	0.075*	[0.057]
Greece	0.066*	[0.081]
India	0.073*	[0.050]
Indonesia	0.073**	[0.048]
Italy	0.078**	[0.040]
Japan	0.091**	[0.032]
Korea (South)	0.064*	[0.095]
Singapore	0.070*	[0.058]
Spain	0.079**	[0.033]
Sweden	0.061*	[0.096]
Switzerland	0.074**	[0.049]
Turkey	0.075**	[0.045]
United Kingdom	0.099**	[0.011]
United States	0.090*	[0.057]

Robust pval in brackets

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

This table explores the sensitivity of the results presented in Table 3 column [3] of the paper to the exclusion of individual countries, one-by-one. The table reports the point estimates and p-values of the coefficient associated with the intrinsic liquidity needs for working capital (CCC). The original results, presented in row [1], appear driven by Canadian firms.

Table A2. Replication after Excluding Individual Economic Sectors

Original Paper	Liquidity need		Excluded Sector:	Liquidity need		Excluded Sector:	Liquidity need		Excluded Sector:	Liquidity need	
	Coefficient	P-Value		Coefficient	P-Value		Coefficient	P-Value		Coefficient	P-Value
	0.075**	[0.043]									
Excluded Sector:											
SIC Number 101	0.076**	[0.042]	SIC Number 241	0.074**	[0.045]	SIC Number 321	0.075**	[0.043]	SIC Number 372	0.076**	[0.043]
SIC Number 102	0.076**	[0.042]	SIC Number 242	0.073*	[0.050]	SIC Number 322	0.075**	[0.042]	SIC Number 373	0.077**	[0.039]
SIC Number 104	0.046	[0.147]	SIC Number 243	0.078**	[0.037]	SIC Number 323	0.074**	[0.047]	SIC Number 374	0.075**	[0.043]
SIC Number 106	0.077**	[0.037]	SIC Number 245	0.075**	[0.043]	SIC Number 324	0.075**	[0.043]	SIC Number 375	0.075**	[0.043]
SIC Number 109	0.073**	[0.049]	SIC Number 249	0.075**	[0.044]	SIC Number 325	0.075**	[0.045]	SIC Number 376	0.075**	[0.043]
SIC Number 122	0.081**	[0.031]	SIC Number 251	0.075**	[0.043]	SIC Number 326	0.077**	[0.038]	SIC Number 379	0.073**	[0.047]
SIC Number 138	0.078**	[0.047]	SIC Number 252	0.073**	[0.050]	SIC Number 327	0.074**	[0.047]	SIC Number 381	0.074**	[0.045]
SIC Number 140	0.075**	[0.043]	SIC Number 253	0.075**	[0.044]	SIC Number 328	0.075**	[0.043]	SIC Number 382	0.083**	[0.030]
SIC Number 142	0.075**	[0.043]	SIC Number 254	0.075**	[0.043]	SIC Number 329	0.075**	[0.042]	SIC Number 384	0.057*	[0.097]
SIC Number 145	0.075**	[0.043]	SIC Number 261	0.076**	[0.041]	SIC Number 331	0.075**	[0.043]	SIC Number 385	0.074**	[0.045]
SIC Number 149	0.077**	[0.040]	SIC Number 262	0.074**	[0.046]	SIC Number 332	0.075**	[0.042]	SIC Number 386	0.076**	[0.042]
SIC Number 152	0.081**	[0.033]	SIC Number 263	0.076**	[0.040]	SIC Number 333	0.075**	[0.043]	SIC Number 387	0.076**	[0.039]
SIC Number 153	0.078**	[0.043]	SIC Number 265	0.075**	[0.043]	SIC Number 334	0.075**	[0.042]	SIC Number 391	0.073**	[0.049]
SIC Number 154	0.073*	[0.052]	SIC Number 267	0.077**	[0.040]	SIC Number 335	0.075**	[0.044]	SIC Number 393	0.074**	[0.047]
SIC Number 161	0.075**	[0.042]	SIC Number 271	0.075*	[0.053]	SIC Number 336	0.075**	[0.043]	SIC Number 394	0.077**	[0.036]
SIC Number 162	0.075**	[0.045]	SIC Number 272	0.074*	[0.051]	SIC Number 339	0.076**	[0.041]	SIC Number 395	0.077**	[0.038]
SIC Number 171	0.076**	[0.042]	SIC Number 273	0.075**	[0.043]	SIC Number 341	0.074**	[0.045]	SIC Number 396	0.074**	[0.045]
SIC Number 173	0.072**	[0.049]	SIC Number 274	0.078**	[0.038]	SIC Number 342	0.072*	[0.051]	SIC Number 399	0.075**	[0.044]
SIC Number 174	0.075**	[0.043]	SIC Number 275	0.072*	[0.052]	SIC Number 343	0.075**	[0.042]	SIC Number 521	0.074**	[0.045]
SIC Number 179	0.076**	[0.039]	SIC Number 276	0.075**	[0.043]	SIC Number 344	0.074**	[0.044]	SIC Number 525	0.075**	[0.043]
SIC Number 201	0.076**	[0.040]	SIC Number 277	0.073**	[0.048]	SIC Number 345	0.074**	[0.045]	SIC Number 526	0.075**	[0.043]
SIC Number 202	0.075**	[0.045]	SIC Number 278	0.075**	[0.043]	SIC Number 346	0.075**	[0.042]	SIC Number 527	0.075**	[0.043]
SIC Number 203	0.075**	[0.044]	SIC Number 279	0.075**	[0.043]	SIC Number 347	0.079**	[0.033]	SIC Number 531	0.076**	[0.042]
SIC Number 204	0.077**	[0.039]	SIC Number 281	0.077**	[0.039]	SIC Number 348	0.074**	[0.045]	SIC Number 533	0.075**	[0.044]
SIC Number 205	0.083**	[0.024]	SIC Number 282	0.075**	[0.042]	SIC Number 349	0.072*	[0.053]	SIC Number 539	0.075**	[0.048]
SIC Number 206	0.075**	[0.044]	SIC Number 283	0.067*	[0.067]	SIC Number 351	0.076**	[0.040]	SIC Number 541	0.085**	[0.023]
SIC Number 207	0.073**	[0.050]	SIC Number 284	0.076**	[0.039]	SIC Number 352	0.076**	[0.040]	SIC Number 549	0.077**	[0.042]
SIC Number 208	0.081**	[0.033]	SIC Number 285	0.075**	[0.043]	SIC Number 353	0.071*	[0.053]	SIC Number 551	0.076**	[0.041]
SIC Number 209	0.074*	[0.052]	SIC Number 286	0.072*	[0.053]	SIC Number 354	0.080**	[0.030]	SIC Number 552	0.075**	[0.044]
SIC Number 211	0.075**	[0.044]	SIC Number 287	0.075**	[0.044]	SIC Number 355	0.078**	[0.041]	SIC Number 553	0.075**	[0.043]
SIC Number 221	0.076**	[0.039]	SIC Number 289	0.075**	[0.044]	SIC Number 356	0.073*	[0.052]	SIC Number 555	0.075**	[0.044]
SIC Number 222	0.075**	[0.043]	SIC Number 291	0.082**	[0.035]	SIC Number 357	0.072*	[0.050]	SIC Number 556	0.079**	[0.033]
SIC Number 225	0.075**	[0.044]	SIC Number 295	0.075**	[0.042]	SIC Number 358	0.074**	[0.045]	SIC Number 557	0.075**	[0.043]
SIC Number 226	0.076**	[0.041]	SIC Number 299	0.076**	[0.041]	SIC Number 359	0.072*	[0.052]	SIC Number 561	0.075**	[0.043]
SIC Number 227	0.075**	[0.042]	SIC Number 301	0.075**	[0.042]	SIC Number 361	0.073*	[0.050]	SIC Number 562	0.078**	[0.036]
SIC Number 228	0.075**	[0.043]	SIC Number 302	0.075**	[0.042]	SIC Number 362	0.076**	[0.041]	SIC Number 563	0.074**	[0.044]
SIC Number 229	0.075**	[0.045]	SIC Number 305	0.075**	[0.043]	SIC Number 363	0.076**	[0.039]	SIC Number 564	0.075**	[0.044]
SIC Number 231	0.075**	[0.042]	SIC Number 306	0.075**	[0.042]	SIC Number 364	0.074**	[0.047]	SIC Number 565	0.072*	[0.051]
SIC Number 232	0.075**	[0.042]	SIC Number 308	0.075**	[0.044]	SIC Number 365	0.074**	[0.046]	SIC Number 566	0.075**	[0.042]
SIC Number 233	0.076**	[0.040]	SIC Number 311	0.075**	[0.044]	SIC Number 366	0.071*	[0.057]	SIC Number 569	0.075**	[0.044]
SIC Number 234	0.076**	[0.041]	SIC Number 314	0.076**	[0.041]	SIC Number 367	0.076**	[0.040]	SIC Number 571	0.076**	[0.041]
SIC Number 236	0.075**	[0.042]	SIC Number 316	0.075**	[0.043]	SIC Number 369	0.066*	[0.066]	SIC Number 572	0.074**	[0.045]
SIC Number 238	0.076**	[0.041]	SIC Number 317	0.076**	[0.041]	SIC Number 371	0.067*	[0.062]	SIC Number 573	0.076**	[0.041]
SIC Number 239	0.075**	[0.042]									

Robust pval in brackets

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1

This table explores the sensitivity of the results presented in Table 3 column [3] of the paper to the exclusion of economic sectors one-by-one. The table reports the point estimates and p-values of the coefficient associated with the intrinsic liquidity needs for working capital (CCC). The original results, presented in row [1], appear driven by firms operating in the extraction of ore and silver ore (SIC 104).