EIEF WORKING PAPER SERIES

Einaudi Institute for Economics and Finance

EIEF Working Paper 16/11
August 2016

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July 2015
(This version: August 2016)

Abstract

In China, local public debt issuance between 2006 and 2013 crowded out investment by private manufacturing firms by tightening their funding constraints, while it did not affect state-owned and foreign firms. Using novel data for local public debt issuance, we establish this result in three ways. First, local public debt is inversely correlated with the city-level investment ratio of domestic private manufacturing firms. Instrumental variable regressions indicate that this link is causal. Second, local public debt has a larger negative effect on investment by private firms in industries more dependent on external funding. Finally, in cities with high government debt, firm-level investment is more sensitive to internal funding, also when this sensitivity is estimated jointly with the firm's likelihood of being credit-constrained. Altogether, these results suggest that, by curtailing private investment, the massive public debt issuance associated with the post-2008 fiscal stimulus sapped long-term growth prospects in China.

Keywords: Investment, Local public debt, Crowding out, Credit constraints, China.
JEL Codes: E22, H63, H74, L60, O16.

*We are grateful to Harald Hau, Haizhou Huang, Maury Obstfeld, Hélène Rey, Tao Zhang and participants at the 2014 CEPR International Conference on Financial Market Reform and Regulation in China and seminars at the People's Bank of China, the China Banking Regulatory Commission for insightful comments and suggestions. We thank Gewei Wang, Jianwei Xu, Li Zhang, Ye Zhang, and Titi Zhou for sharing their data with us. The usual caveats apply.

1 Introduction

In China, local government debt almost quadrupled as a fraction of GDP between 2006 and 2013, rising from 5.8% to 22%. This massive increase largely resulted from the US$ 590 billion post-2008 fiscal stimulus, coupled with much reduced reliance on central government debt issuance and transfers to local governments. Due to the geographically segmented nature of Chinese credit markets, this additional supply of local public debt created imbalances in local credit markets: to underwrite the debt issued by local governments, banks curtailed funding to private domestic firms, forcing them to reduce their investment. Such "local crowding-out" of private investment was greater in cities that issued more public debt. Public firms were shielded from this scarcity of funding by their preferential access to bank credit and by their almost exclusive access to bond financing (Lin and Milhaupt, 2016).[1] So were foreign firms, which could access their home countries' capital markets. We document this city-level crowding-out of private investment by relying on a newly built data set of local government debt for prefectural-level Chinese cities in 2006-13. As private firms are the most dynamic segment of the Chinese economy, our results suggest that the massive local public debt issuance associated with the post-2008 fiscal stimulus sapped long-term growth prospects in China.

Our research strategy and findings crucially hinge on the geographical segmentation and regulation of Chinese capital markets. In an integrated domestic capital market, there would be no reason to expect the issuance of local government debt to affect local private investment: a local government's abnormally large issuance of debt would trigger an incipient increase in local interest rates, and the latter would attract capital from the rest of the country, beside possibly triggering an increased supply of local saving. Eventually, the increased stock of public debt would be held by investors throughout the country, and any resulting crowding-out of private investment would be at the national level. In contrast, if capital markets are geographically segmented, the imbalance and its impact on investment

[1] "In China, corporate debt instruments are issued overwhelmingly by enterprises whose majority (and perhaps sole) shareholder is an organ of the central or local government" (Lin and Milhaupt, 2016, p. 16).

will be localized. Since in China policy and commercial banks are the main financiers of local governments (Gao, Ru and Tang, 2016), local public debt issuance ends up being absorbed by local banks. Furthermore, in a credit market with interest rate ceilings as the Chinese one, such issuance does not trigger a rise of local interest rates and thus an offsetting response of local saving. Unless local saving rises for other reasons (e.g., due to increased public spending), placing additional local public debt with local banks requires a one-for-one tightening of credit supply to the local private sector.

Hence, in these circumstances increased local public debt issuance – and its placement with local banks, for instance underwriting local government financial vehicles – can be expected to translate directly into tighter credit constraints in the local capital market. Not all borrowers need be equally affected, however. If banks maximize profits, they will tighten credit more severely to riskier borrowers, e.g. those with less collateral to pledge. If instead banks allocate credit preferentially to politically connected clients, for instance state-owned firms, unconnected firms will be more severely rationed. The two criteria may in fact coincide, as state-owned firms are generally assisted by government guarantees. Hence, banks will cut down on lending to private borrowers that require costly monitoring and information gathering, crowding out the latter's investment – a mechanism modelled by Broner, Erce, Martin and Ventura (2014) in a cross-country setting.

We bring several complementary types of evidence to bear on this "local crowding-out hypothesis". First, we regress city-level aggregate investment by manufacturing firms over local government debt, and show that local government debt is negatively correlated with the investment ratio of private manufacturing firms in the corresponding cities, while it is uncorrelated with that of state-owned and foreign-owned manufacturing firms. We control for the endogeneity of public debt issuance by using an instrumental variable strategy. While these city-level regressions provide *prima facie* evidence for a causal relationship from local public debt issuance to local investment, they do not establish that causality operates via a differential tightening of credit constraints on private domestic firms. To do so, we resort to empirical strategies based on increasingly disaggregated data.

One such strategy is akin to that used by Rajan and Zingales (1998): we test whether local government debt is particularly damaging for industries that for technological reasons need more external funding. This methodology allows us to investigate whether government debt affects investment by tightening credit constraints, and it also reduces endogeneity problems by allowing us to control for city-year and industry-year effects. Again, we find that local government debt is associated with lower investment of domestically-owned private manufacturing firms but not with investment of state-owned and foreign-owned manufacturing firms. A limitation of this approach is that it measures only the differential effect of government debt on firms that belong to industries featuring different dependence on external funding, rather than measuring the total effect of local government debt on investment: "the interaction term is akin to a second derivative" (Rajan and Zingales, 1998, p. 574).

Next, we use firm-level data to test whether local government debt affects the sensitivity of investment to internally generated funds. This approach, pioneered by Fazzari, Hubbard and Petersen (1988) and used by Love (2003) to test whether country-level financial depth attenuates credit constraints, focuses on within-firm and within-city-year variation, and thus rules out any concern of reverse causality from investment to local government debt. With respect to the Rajan and Zingales (1998) regressions, this methodology has the advantage of not requiring any assumption about the needs of external finance by firms in different industries. We find that local government debt affects the sensitivity of investment to internally generated funds for domestic private manufacturing firms but not for state-owned and foreign-owned manufacturing firms.

Finally, to take into account Kaplan and Zingales' (2000) critique of this methodology, we use a switching regression model with unknown sample separation to jointly estimate investment sensitivities and the likelihood of being a constrained firm (as in Hu and Schiantarelli, 1998, and Almeida and Campello, 2007). Consistently with our previous estimates, local government debt appears to affect cash-flow investment sensitivity for credit-constrained firms but not for unconstrained firms.

This paper is related to the vast empirical literature that studies the effects of government debt on investment and growth. While there is evidence of a negative correlation between public debt and growth (see, among others, Reinhart and Rogoff, 2011, Reinhart, Reinhart and Rogoff, 2012, and Cecchetti, Mohanty and Zampolli, 2011), establishing a causal nexus has been more difficult so far, as cross-country studies are plagued by problems of reverse causality, omitted variables, and limited degrees of freedom (Mankiw, 1995).[2] As explained above, the geographical segmentation and interest rate ceilings of China's credit market allow us to identify a "local crowding-out" channel through which local government debt may reduce growth: specifically, we show that higher levels of local government debt crowd out investment by tightening the financing constraints faced by private manufacturing firms. As in the presence of interest-rate ceiling such local crowding out should occur via tighter credit rationing, our work is also related to the vast corporate finance literature based on the idea that in credit-constrained firms investment responds more to internal cash flow than in unconstrained firms (see Section 5).

We also contribute to the literature aimed at describing and explaining the characteristics of economic growth in China. For instance, our paper is related to work on the transformation of the state sector in China by Hshei and Song (2016), on China's fiscal stimulus in the aftermath of the global financial crisis by Deng, Morck, Wu and Yeung (2015), Ouyang and Peng (2015), and Wen and Wu (2014), and on capital misallocation in China by Song and Wu (2015). Our findings are in line with the main assumptions by Song, Storesletten and Zilibotti (2011), who show that the main stylized facts of China's economic transition are well explained by a calibrated version of a growth model in which high-productivity private-sector firms finance investments through internal savings, while low-productivity state-owned firms survive because of better access to credit. Our results also accord with the evidence reported by Cong and Ponticelli (2016) that under China's economic stimulus plan new bank credit was allocated disproportionately to low-productivity state-owned firms rather than to more productive private firms.

[2] Panizza and Presbitero (2013, 2014) survey the literature on debt and growth with particular emphasis on causality and measurement issues.

Last but not least, our paper contributes to knowledge about local government debt in China: existing studies either estimate total local government debt without providing a detailed geographical breakdown (Zhang and Barnett, 2014, National Audit Office, 2011, 2013, and Wu, 2015), or only focus on bond issuances, which form a minor part of total borrowing by local government financing vehicles (Ang, Bai and Zhou, 2015, and Ambrose, Deng and Wu, 2015). In contrast, we build detailed data on total borrowing by local government financing vehicles in 261 prefectural-level cities over the period 2006-13. The only other recent study that comprehensively investigates China's local government debt is by Gao, Ru and Tang (2016), who explore the default probability of local governments using individual loan data, and find that distressed local governments prefer to default on commercial bank loans rather than on policy bank loans, which are crucial to local politicians' promotions.

The paper is organized as follows. Section 2 describes our data. Section 3 uses city-level data to show that local government debt is negatively correlated with investment by private-sector manufacturing firms and an instrumental variable strategy to show that this relationship appears to be causal. Section 4 uses industry-level data to show that local government debt is particularly harmful for industries that need more external financial resources. Section 5 uses firm-level data to show that local government debt increases investment sensitivity to cash flow for credit constrained firms. Section 6 concludes.

2 Data

In this section we provide a brief description of our data, with special focus on the local government debt data set built for this paper. Further information is provided in Appendix A and in Table A5.

Our analysis focuses on prefecture-level cities. In the Chinese local government structure, prefecture-level cities form the second tier, provinces being the first tier. These cities are administrative units that include continuous urban areas and their surrounding rural areas comprising smaller towns and villages.[3] While we build debt data for all 293 prefecture-level cities for the 2006-13 period, our statistical analysis focuses on 261 cities, as we do not have macroeconomic data for the remaining 32 cities.

Prefecture-level cities (henceforth, cities) tend to be large. While their population ranges from 200,000 to 33 million, 75% of cities included in our sample (196 cities) have a population of at least 2.5 million, with median population of 3.8 million. Our sample also includes 100 cities with a population of at least 5 million and 25 cities with a population greater than 8 million.

In 2013, the cities included in our sample had a total population of 1.2 billion, corresponding to 91% of China's total population. In 2013, total GDP for the 261 cities in our sample added up to RMB60.7 trillion. This figure actually exceeds total Chinese GDP in 2013 (estimated at RMB58.8 trillion). The discrepancy is partly driven by local politicians' incentives to overestimate local economic growth (Koch-Weser, 2013) but also by double-counting due to the difficult of tracking value added across city borders. According to the head of the Chinese National Statistics Bureau, in 2011 local government GDP numbers were about 10% higher than Central Government figures.[4] Dividing 60.7 trillion by 1.1 yields 55.2 trillion, suggesting that the cities in our sample produce approximately 93% of China's GDP.

2.1 Local Government Debt in China

There have been many attempts to estimate the total amount of local government debt in China (e.g., Zhang and Barnett, 2014), but there is no public source providing time series data for either city-level or province-level government debt. One contribution of this paper is to build such series.

Before going into details, it is worth explaining how Chinese local governments issue

[3] Prefecture-level cities are further divided into counties or county-level cities, which form the third tier of China's administrative structure. In China, cities in the strict sense of the term (i.e., contiguous urban areas) are called "urban areas" (shìqū in Chinese).

[4] A Financial Times article documenting this discrepancy is available at: http://blogs.ft.com/beyond-brics/2012/02/15/chinese-gdp-doesnt-add-up/. The original Chinese source is available at: http://finance.china.com.cn/news/gnjj/20120215/534298.shtml

debt. In China, municipalities cannot borrow from banks or issue bonds directly, but can set up local government financing vehicles (LGFVs), transfer assets (usually land) to these vehicles, and instruct LGFVs to borrow from banks or issue bonds, possibly using the assets transferred by the municipality as collateral (Ambrose, Deng and Wu, 2015). Our measure of local government debt is based on the loans and bonds issued by these LGFVs.

As LGFVs are not generally required to disclose their financial information, past attempts to collect data on local government debt on the basis of publicly available information focused on bond issuances by these entities (Ambrose Deng and Wu, 2015; Ang, Bai and Zhou, 2015). While bond issuances have grown dramatically over the past few years (rising from 6% of total LGFV debt in 2006 to 21% in 2013), outstanding bonds greatly underestimate LGFV debt, which consists mostly of bank loans (Figure 1).

To estimate total financial liabilities of LGFVs, we exploit the fact that all entities that request an authorization to issue a bond in a given year are required to publicly disclose their current and previous balance sheets, at least for the previous three years. Hence, if an entity decides to issue a bond in year t, we have information on its total outstanding debt back to year $t-3$. As the number of LGFVs that issue bonds increased dramatically over 2007-14, this methodology provides a lower bound for total local government debt that is much more accurate and comprehensive than figures based only on bond issuance data. Appendix A provides details on our methodology and shows that our data match the aggregate official debt figures published by the National Audit Office.

Our data show that local government debt started growing rapidly after the global financial crisis, when local governments were asked to contribute to the massive fiscal stimulus implemented by the Chinese government but were not given additional fiscal resources (Lu and Sun, 2013, and Zhang and Barnett, 2014). Between 2006 and 2010, outstanding local government debt grew six-fold, going from RMB1.2 to RMB7.2 trillion (Table 1), and trebled relative to GDP, from 5.8% to 18.1%. After 2010, it continued to grow, reaching 12.5 trillion in 2013, corresponding to 22% of Chinese GDP. The share of cities with outstanding debt went from less than 50% in 2007 to nearly 100% in 2011. Over the same period, average city-level debt increased from RMB7 to RMB28 billion.

2.2 Other City-Level and Firm-Level Data

We draw data for other city-level variables from the China City Statistical Yearbook, which provides time series on a vast array of city-level economic variables, including city-level GDP, total bank loans, population, and economic growth. The resulting city-level data set obtained by merging these two sources contains information for 261 cities from 2006 to 2013.

Our firm-level data are instead drawn from the Annual Survey of Industrial Firms (ASIF, also known as the Chinese Industrial Enterprise Database, CIED), which covers the universe of manufacturing firms with annual sales above RMB5 million until 2009 (approximately US$ 750,000 at 2009 exchange rate) and RMB20 million after 2009 (approximately US$ 3,200,000 at 2015 exchange rate). It contains firm-level data on location, ownership structure, and main balance sheet variables. This survey has been used, among others, by Bai, Hsieh and Song (2015), Brandt, Van Biesebroeck and Zhang (2012), Hsieh and Song (2015), Song, Storesletten and Zilibotti (2011), and Song and Wu (2015).

ASIF covered 90% of China's manufacturing output in 2004 (Brandt, Van Biesebroeck and Zhang, 2012) and 70% of China's manufacturing output in 2013. Its wide coverage is due to the fact that firms that meet the above-mentioned criteria are required to file detailed annual reports to their local statistics bureaus. The data are then sent to the National Bureau of Statistics (NBS), which aggregates them in the China Statistical Yearbook. Our sample spans the 2005-13 period and contains the same number of observations used by NBS during these years. However, unfortunately the survey is not available for 2010, so that we lose three years of data from this source: besides 2010, we lose observations for 2011 because we need data at time $t-1$ in order to compute investment at time t, and data for 2012 because of the presence of lagged variables in our regressions.[5]

To compensate for this loss of information, we merge ASIF data with data from the

[5] We compute investment in year t as fixed assets in year t plus depreciation in year t minus fixed assets in year $t-1$. We compute cash flow as net profits (profits minus taxes) plus depreciation.

Annual Tax Survey (ATS) conducted by the Chinese Ministry of Finance between 2007 and 2011. ATS reports detailed financial statement for manufacturing firms but also firms in the agriculture, construction, and service sectors. Exploiting the overlap in coverage between the ATS and ASIF databases, we could recover information for a large number of firms; however, at an average of 61,000 firms, the sample of firms for 2010-12 remains smaller than the average for 2006-9 and 2013 (about 195,000 firms per year on average).

After dropping observations with negative assets and for firms in the upper and bottom 1% of the distribution by revenue, and applying a 5% winsorization for all our firm-level variables, we are left with a sample of 1,150,340 observations covering 387,781 firms, and 1,281 city-years. Shanghai is the city with the largest number of observations (61,347), while Jiayuguan City is that with the fewest (167). The sample includes 30 cities with at least 10,000 observations, and 90% of the cities in the sample have more than 1,700 observations. The median city has 1,970 observations, and, on average, we have 4,407 observations per city.

3 Local Government Debt and City-Level Investment

We start by aggregating our data at the city-year level and estimate a simple regression that relates city-level investment ratios to local government debt:

$$I_{c,t} = \beta LGD_{c,t} + X_{c,t}\Gamma + \alpha_c + \tau_t + \varepsilon_{c,t}, \qquad (1)$$

where $I_{c,t}$ is the ratio of investment to the assets of manufacturing firms in city c and year t, $LGD_{c,t}$ is the ratio of local government debt to GDP in city c and year t, $X_{c,t}$ are a set of city-level controls (bank loans over GDP, local government balance over GDP, GDP growth, log of GDP per capita, log of population, and average land price), and α_c and τ_t are city and year fixed effects. Variants of this specification are estimated first measuring the dependent variable $I_{c,t}$ for the whole manufacturing sector of city c in year t (as the weighted average of the investment-to-asset ratios for all manufacturing firms in the city), and then separately for the investment-asset ratio of private-sector, state-owned, and foreign-owned manufacturing firms.

Table 2 presents estimates of specification (1) without macro controls (i.e., setting $\Gamma = 0$): the relationship between total investment by manufacturing firms and local government debt is negative and statistically significant. The point estimate in column 1 indicates that a one-standard deviation increase in the debt-GDP ratio (13 percentage points) is associated with a 1 percentage point decrease in the investment ratio (the average investment ratio in our sample being 8%). The correlation between government debt and investment is slightly higher (in absolute value) for private-sector manufacturing firms (column 2) and is not statistically significant for state-owned and foreign-owned manufacturing firms (columns 3 and 4). When the investment ratios of all three types of manufacturing firms are pooled together (column 5), the correlation is only statistically significant for private sector firms, as in columns 2-4.[6] The tests at the bottom of the table show that the private sector coefficient is always significantly different from the coefficients for state-owned and foreign-owned firms.

In Table 3 the specification of Table 2 is expanded to include additional city-level controls: total bank loans scaled by GDP (BL, which include loans to local governments), local government budget balance scaled by GDP (GB, i.e. the unconsolidated budget balance of the city, which does not include the balance of the relevant local government financing vehicles), city GDP growth (GR), log of city GDP capita ($ln(GDP\ PC)$), log of city population ($ln(POP)$), and log of city average land prices (LP). Controlling for these variables does not affect the baseline results of Table 2: local government debt remains negatively correlated with the investment ratio of private sector manufacturing firms and is not significantly correlated with the investment ratio of state- and foreign-owned firms.[7]

[6] In column 5 of Table 2 and Table 3 we estimate the following model: $I_{c,t,o} = LGD_{c,t}(\beta_1 PRI + \beta_3 SOE + \beta_3 FOR) + X_{c,t}\Gamma + \alpha_c + \tau_t + \varepsilon_{c,t}$. Where $I_{c,t,o}$ is the average investment ratio of firms with ownership o (private, state-owned, and foreign-owned) in city c, year t (we thus have 3 observations for each city-year) and PRI, SOE, and FOR are dummy variables that equal 1 for private, state-owned, and foreign-owned firms, respectively, and 0 otherwise.

[7] Most of the additional controls are not significantly correlated with the investment ratios of private- and public-owned domestic firms (the exceptions being GDP growth which has a positive and statistically significant coefficients in columns 1, 2, 3, and 5). Instead, government balance, GDP per capita and populations

Although the results of Tables 2 and 3 are consistent with the idea that local government debt has a negative effect on the investment of private manufacturing firms, these are simple correlations that are likely to suffer from endogeneity bias. The direction of this bias is not clear. On the one hand, local politicians may respond to negative shocks to private investment by instructing managers of local government financing vehicles to borrow and invest more: such reverse causality from investment to local public debt could account for the negative correlation found in the data. On the other hand, common shocks – for instance, spending on public infrastructures that raise both private firms' profitability and public debt issuance – may jointly drive the two variables and bias the estimates in the opposite direction.

More specifically, consider the following two equations: $I = \alpha + \beta D + \varepsilon$, and $D = a + bI + e$. The first equation describes how local government debt (D) affects private investment (I). This is the equation being estimated and β is the parameter of interest. The second equation describes how local government debt reacts to private investment. We wish to estimate β, but face two endogeneity problems. The first arises from the possibility that $b \neq 0$ ($b < 0$ being consistent with countercyclical fiscal policy) and the second from a positive correlation $\sigma_{\varepsilon e}$ between ε and e (growth and local government debt being positively correlated in Table A3).[8] The bias of the OLS estimator of β is:

$$E(\widehat{\beta}) - \beta = \frac{1 - b\beta}{\sigma_D^2} \left(b\sigma_\varepsilon^2 + \sigma_{\varepsilon e} \right). \tag{2}$$

Under the natural assumption $b\beta < 1$,[9] the direction of the bias depends on the relative importance of reverse causality (captured by $b < 0$) and the presence of common unobservable shocks (captured by $\sigma_{\varepsilon e} > 0$). If $\sigma_{\varepsilon,e}$ is large enough, it may dominate $b\sigma_\varepsilon^2$ even if $b < 0$: in this case, the OLS estimates of β are upward biased. To deal with this bias, we turn to an

size are statistically significant in the regression for foreign-owned manufacturing firms.

[8] If we assume that D is positively correlated with investment by LGFVs, the positive correlation between ε and e could be driven by common shocks to private and public investment. In other words, we could have $\varepsilon = \zeta + \epsilon$ and $e = \zeta + u$, with $E(\epsilon u) = 0$.

[9] This assumption obviously holds if β and b differ in sign. If instead they have the same sign, the assumption $b\beta < 1$ is necessary for the level of I and D that solve these two equations to be positive.

instrumental variable strategy.

3.1 Instrumental Variable Estimates

A first strategy to assess the causal effect of local government debt on private manufacturing investment is based on a political economy argument: cities with stronger political connections with the national government may have more leeway to issue debt and start public investment projects (Shih, Adolph and Liu, 2012, and Zhu, 2014), and may also be deemed safer borrowers, being more likely to be bailed out if they cannot service their debt obligations (Ambrose, Deng and Wu, 2015). Therefore, we instrument local government debt with the number of top national policy-makers (at the ministerial level or above) who were born in the city that issued the debt.[10]

One problem with this instrument is that national politicians who have close links with a city may have other means (besides allowing it to borrow more) to favor this city: an obvious way to favor a city is to increase central government transfers to the city. We address this issue by directly controlling for transfers.[11] This strategy solves one endogeneity problem but may create a new one, as transfers are partly driven by local economic conditions: other things equal, underperforming cities tend to receive larger transfers. Hence, they are endogenous with respect to private investment. We address this endogeneity problem by building the following simulated instrument for transfers:

$$STR_{c,t} = \frac{TR_{c,2005}}{TT_{2005}} TT_t, \tag{3}$$

[10] We build the instrument using biographical information originally collected by Zhou (2014) on members of the Central Committee of the Chinese Communist Party over 2006-13. We exclude the military and members who work in local governments and tally up the total number of members at the ministerial level or above who were born in a given city. Zhou collects information on the members of the 16^{th},17^{th} and 18^{th} Central Committee from official websites including the *Chinese Bureaucracies and Leaders Database* (http://politics.people.com.cn/GB/8198/351134/index.html), *Chinese Government Public Information Online* (http://202.106.125.57/guotu/PeopleLook.aspx), and the *Chinese Political Elites Database* constructed and maintained by the National Chengchi University (http://ics.nccu.edu.tw/chinaleaders/index.htm and http://faculty.washington.edu/cadolph/index.php?page=61).

[11] We hand-collect data for 2005-13 from the *Fiscal Statistics for Prefectures, Municipalities and Counties* and the *Statistical Yearbook of China*. Total transfers include national general transfers, special purpose transfers, tax rebate transfers, and province transfer. However, we exclude tax rebate transfers and province transfers to limit endogeneity problems.

where $TR_{c,2005}$ measures total transfer income received by city c in the year 2005 and TT_t is the total amount of transfers from China's central government to all cities in year t.[12] $STR_{c,t}$ is exogenous with respect to time-varying local conditions because its within-city variance is driven by changes in total transfers at the national level.

Instrumental variable estimates are shown in the top panel of Table 4: they confirm our previous findings of a negative effect of local government debt on private investment but no effect of local government debt on investment by state-owned or foreign-owned manufacturing firms. The bottom panel of the table reports the first stage estimates and shows that the instruments are correlated with the endogenous variables and are not weak: the Cragg-Donald Wald F statistic has a value of 11.4 and is well above the Stock-Yogo (2005) 10% critical value of 7.03.

The point estimates of the IV regressions are nearly ten times larger (in absolute value) than the OLS estimates of Tables 2 and 3. This difference in magnitude may be partly due to the fact that instrumental variable regressions correct for the presence of measurement error in the debt-to-GDP ratio (which bias the OLS estimates toward zero), but is also consistent with the idea that the OLS regressions of Tables 2 and 3 suffer from a upward bias, due to common unobserved shocks creating positive covariance of private investment and local indebtedness.

As the regressions of Table 4 are exactly identified, we cannot perform an overidentification test to check the validity of the instruments. A way around this problem is to find a truly exogenous variable affecting city-level investment and, after including it in the regression, build additional instruments by exploiting potential heteroskedasticity in the model's residuals.[13] The overidentified model can then be efficiently estimated with GMM and the

[12] There are a few cities for which the transfer data start after 2005. For these cities we replace 2005 with the first available year. For a discussion of the properties of simulated instruments see Moffitt and Wilhelm (2000), Gruber and Saez (2002), and Dahl and Lochner (2012). Li and Kai-Sing Kung (2015) use simulated instruments to study the fiscal incentives of Chinese local governments.

[13] Rigobon (2003) and Lewbel (2012) developed estimators that allow identifying causal relationships through heteroskedasticity. As identification through heteroskedasticity is not well-known, we provide the intuition for this estimation technique. Assume that we are interested in estimating the model: $Y_1 = a + \beta_1 X + \gamma_1 Y_2 + \varepsilon_1$,but have an endogeneity problem because $Y_2 = a + \beta_2 X + \gamma_2 Y_1 + \varepsilon_2$. Besides the standard assumptions that $E(X\varepsilon_1) = E(X\varepsilon_2) = cov(X, \varepsilon_1\varepsilon_2) = 0$, further assume that there is heteroskedasticity in the data (i.e., $cov(X, \varepsilon_2^2) \neq 0$). Then, $X\varepsilon_2$ can be used as an instrument for Y_2. This is a good instrument

validity of the overidentifying assumptions assessed with Hansen's J test. As additional exogenous variable we build a measure of industry-weighted investment in other cities, i.e. the total investment by firms located in other cities weighed by the lagged share of industry j's investment over total investment in city c:

$$EXT_{c,t} = \sum_j \frac{I_{j,c,t-1}}{\sum_j I_{j,c,t-1}} \sum_{v \neq c} I_{j,v,t}. \tag{4}$$

The exogeneity of this variable is based on the idea that the investment of private firms in industry j is driven by that industry's country-wide profitability, but – after netting out the investment of city c – is unaffected by the public indebtedness of city c.

We find that EXT is positively correlated with city-level total investment and that the results of the IV regressions of Table 4 are robust to controlling for EXT (columns 1, 3, 5, and 7 of Table 5). Next, we build additional instruments using heteroskedasticity in the model's residual. The point estimates decrease (in absolute value) by about 30% relative to the previous IV specification but the effect of local government debt on private investment remains negative, statistically significant, and much larger (in absolute value) than the OLS estimates of Tables 2 and 3. As before, there is no statistically significant effect of local government debt on investment by state-owned or foreign-owned manufacturing firms.

Another possible concern is that national politicians may favor their cities of origins in other ways, besides allowing more borrowing and directly transferring resources. For instance, powerful politicians could steer government contracts towards cities with which they have close connections (see Cohen, Coval and Malloy, 2011, for US evidence). Insofar as this creates a positive correlation between our instrument and private firm investment, it

because the assumption that $cov(X, \varepsilon_1\varepsilon_2) = 0$ guarantees that $X\varepsilon_2$ is uncorrelated with ε_1, and the presence of heteroskedasticity ($cov(X, \varepsilon_2^2) \neq 0$) guarantees that $X\varepsilon_2$ is correlated with ε_2 and thus with Y_2. If X includes more than one variable, the condition $cov(X, \varepsilon_2^2) \neq 0$ needs to hold only for a subset Z of the X matrix. If this subset Z includes more than one element, the model will be overidentified and can be efficiently estimated with GMM. Note that the assumptions $E(X\varepsilon_1) = E(X\varepsilon_2) = cov(X, \varepsilon_1\varepsilon_2) = 0$ are standard, and their validity can be tested with Hansen's J test. The only non-standard assumption required for identification is the presence of heteroskedasticity ($cov(X, \varepsilon_2^2) \neq 0$). If $cov(X, \varepsilon_2^2)$ is close to zero, then $X\varepsilon_2$ is a weak instrument, leading to imprecise estimates. This footnote draws from Arcand et al. (2015); full details and derivations are in Lewbel (2012).

should induce a positive bias in the estimate of the coefficient of interest. We address this issue by focusing only on investment by firms with low exposure to government spending.[14] We add up city-level total investment of industries that belong to the bottom 25% of the distribution of the index of government exposure and then re-estimate the regressions of Tables 2-5 by only using investment by industries with low exposure to government expenditure (Table 6). Focusing on this subset of industries strengthens our previous results, consistently with the idea of a positive bias in the previous results.

4 Industry-Level Evidence

The previous section shows a strong and robust negative correlation between local government debt and city-level private investment in the manufacturing sector, and the IV regressions of Tables 4-6 suggest that this relationship can be interpreted as causal, with higher local government debt leading to lower investment by private manufacturing firms. While these city-level regressions do not reveal the channel through which such causal relationship operates, the granularity of our data allows us to dig deeper in this direction. In this section, we start doing so by lowering the level of aggregation of the analysis from city level to industry-city level. In the next section we will lower it even further, to firm-level.

As explained in the introduction, we hypothesize that, given the institutional features of China's capital market, the channel through which local public debt issuance leads to lower private investment is a "local credit-rationing" mechanism: in cities that issue more debt, more funding is allocated to the public sector, and therefore the credit constraints faced by private manufacturing firms become tighter, while publicly owned ones are spared the crunch. One way to test whether the data are consistent with this idea is to aggregate them

[14] Since most LGFVs manage public infrastructure projects, the exposure index is based on the assumption that the sectors directly affected by LGFVs expenditure are: (i) electricity production and distribution; (ii) heat production and distribution; (iii) gas distribution; (iv) water distribution and sewage treatment; (v) construction; (vi) environmental management; and (vii) public facilities management. We match these sectors with the input-output table constructed by China's National Statistics Bureau and build exposure indexes to the seven sectors listed above for the 135 sectors covered in the input-output tables (We follow Tang et al. (2014) and use the input-output table for 2007). Finally, we match these exposure indexes to the manufacturing firms in our survey.

at the industry-city-year level, and use a methodology akin to that developed by Rajan and Zingales (1998) to assess whether government debt has a stronger negative effect on investment in industries that for technological reasons need more external funds. Formally, we estimate the following model:

$$I_{j,c,t} = \beta I_{j,c,t-1} + \delta \left(EF_j \times LGD_{c,t} \right) + \alpha_{j,t} + \theta_{c,t} + \varepsilon_{j,c,t}, \tag{5}$$

where $I_{j,c,t}$ is the investment-asset ratio in industry j, city c and year t, EF_j is a time-invariant measure of the external fund dependence of industry j, $LGD_{c,t}$ is local government debt scaled by GDP in city c and year t, and $\alpha_{j,t}$ and $\theta_{c,t}$ are industry-year and city-year fixed effects. The parameter δ measures the extent to which local government debt affects investment more in industries that depend more on external finance. Due to the inclusion of industry-year and city-year fixed effects, the specification (5) controls for any industry- or city-level time-varying factor, and therefore does not suffer from any obvious reverse causality problem. The estimate of δ could be biased only if specification (5) omits a source of credit constraints that is correlated with local government debt. We address this potential problem by expanding specification (5) and controlling for variables that might be jointly correlated with local government debt and credit constraints.

Rajan and Zingales (1998) create their index of external financial dependence by calculating the industry median of the ratio between capital expenditures minus cash flow from operations and capital expenditures for a sample of US firms for the 1980–1990 decade. They use data for US firms as these are least likely to be affected by credit constraints due to the high degree of US financial development. Hence, the amount of external finance used by US firms is likely to be a good measure of their unconstrained demand for external funds.

To adapt the Rajan-Zingales measure of external financial dependence to our sample of Chinese firms, one has to take into account that the technological parameters of these firms are likely to be very different from those of the large US firms used to build the

Rajan-Zingales measure of external financial dependence (Furstenberg and Kalckreuth, 2006, 2007). Hence, we build an industry-level measure of external financial dependence using data from the 4 Chinese cities with the most developed credit markets (Beijing, Shanghai, Hangzhou, and Wenzhou) and then use this measure to estimate equation (5) for the remaining 257 cities in our sample.[15]

The estimates, shown in Table 7, indicate that the coefficient δ of the interaction between external financial dependence and local government debt is negative and statistically significant both when investment is defined as total manufacturing investment (column 1) and when it is defined as the investment of domestic private manufacturing firms (column 2), while it is not statistically significant for the investment of state-owned and foreign-owned manufacturing firms (columns 3 and 4). These results are robust to controlling for other city-level variables (bank loans, log of GDP per capita, GDP growth, and log of average land price) that may be jointly correlated with local government debt and credit constraints (Table 8).

To illustrate the economic significance of the magnitude of δ, we use the point estimates of column 2 of Table 8 to evaluate its effect for the industries at the 25^{th} and 75^{th} percentile of the distribution of the index of external financial dependence (the paper and batteries production industries, respectively).[16] The left panel of Figure 2 shows the relationship between local government debt and the investment ratio for the industry at the 25^{th} percentile of the distribution of the external financial dependence index. It also shows the average investment ratio in this industry (8% of total assets, corresponding to the solid horizontal line). As the public debt-GDP ratio increases from its 10% nationwide average, the investment ratio in this industry featuring low financial dependence rises slightly (as in this industry the index of external financial dependence is negative), but is never significantly different from the average. Conversely, the right panel of Figure 2 shows the

[15] Among all large Chinese cities, Beijing, Shanghai, Hangzhou, and Wenzhou are the four cities with the highest bank loans to GDP ratios.

[16] Industries with indexes of external financial dependence close to paper include cigarette manufacturing and glass manufacturing. Industries with indexes of external financial dependence close to batteries include transmission, distribution and control equipment and communication equipment.

relationship between debt and the investment ratio in the industry at the 75^{th} percentile of the distribution of the external financial dependence index, comparing it with the average investment ratio for this industry (the horizontal line at 10.5%). As local government debt rises, in this financially dependent industry the investment ratio decreases rapidly: it becomes significantly lower than its 10.5% industry average once local public debt exceeds 15% of GDP, and drops to about 9% when local public debt climbs to 50%.

5 Firm-Level Evidence

While the Rajan-Zingales approach allows us to identify credit rationing as the economic channel through which local crowding-out operates, this methodology relies on strong assumptions about the technological determinants of firms' external funding needs. For instance, it assumes that the external financial needs of a paper-producing firm in Beijing are similar to those of a paper producer in a small and isolated city. However, manufacturing firms in the same industry may adapt their production technologies to local conditions, so as to save on external funding. This would lead us to underestimate the impact of local government debt issuance on investment.[17]

To overcome this limitation, the empirical strategy described in this section relies on firm-level estimates of cash flow-sensitivity to test whether government debt tightens the financing constraints faced by private manufacturing firms. Fazzari, Hubbard and Petersen (1988) were the first to empirically exploit the idea that investment sensitivity to internally generated funds should be higher for credit constrained firms, proxying credit constraints by average dividend payouts.[18] Love (2003) extended this approach to a cross-country setting and showed that deeper financial markets can ameliorate financing constraints by reducing investment sensitivity to internal funds, especially for firms more likely to be

[17] The impact of local government debt on investment could also be underestimated because the Rajan-Zingales methodology only measures the differential effect of government debt on firms that belong to industries featuring different dependence on external funding, rather than the total effect of local government debt on investment.

[18] Bond and Meghir (1994) used the same proxy of credit constraints. Papers with a similar methodology but based on other measures of financing constraints include Hoshi et al. (1991), Oliner and Rudebusch (1992), Withed (1992), Gertler and Gilchrist (1994), and Harris et al. (1994).

constrained. We apply a variant of this approach to our sample of 261 prefectural-level cities and show that local government debt tightens the financing constraints faced by private-sector manufacturing firms, besides confirming Love's result that financial depth reduces investment cash-flow sensitivity.

The use of investment sensitivity to cash flow as a measure of financing constraints has been criticized by Kaplan and Zingales (2000) who pointed out that cash flow may proxy for investment opportunities or that the sensitivity of investment to cash flow may be driven by influential outliers or by firm distress.[19] We address this criticism in two ways.

First, we follow Fazzari, Hubbard and Petersen (2000) who suggest that the presence of credit constraints can be inferred from large differences in investment cash-flow sensitivity across subsamples of constrained and unconstrained firms obtained using *a priori* criteria. Our baseline firm-level regressions show that local government debt does not affect cash-flow investment sensitivity for state- and foreign-owned firms, while it does for private domestic firms. Since state-owned firms are not credit constrained due to their preferential treatment by banks over private firms, and foreign firms are able to tap their national (or international) credit market, our findings are consistent with the idea that high local government debt is especially problematic for firms that face financing constraints.

Second, we follow Hu and Schiantarelli (1998) and Almeida and Campello (2007) and use a switching regression model of investment in which the likelihood that a firm faces investment constraints is endogenously determined. This approach addresses Kaplan and Zingales' (2000) critique because it does not focus on a simple comparison of predetermined samples of constrained and unconstrained firms. Instead, it jointly estimates investment sensitivities and the likelihood of being a constrained firm.

[19] Fazzari et al. (2000) provide a rebuttal to Kaplan and Zingales (1997). Hadlock and Pierce (2010) criticize the Kaplan and Zingales index of financial constraints and suggest that firm size and age are the variables most closely correlated with the presence of such constraints.

5.1 Baseline Regressions

The literature has used two different approaches to study financing constraints (Schiantarelli, 1996, and Hubbard, 1998). The first approach is based on Tobin (1969) and Hayashi's (1982) Q-theory of investment. The second approach is based on the estimation of an Euler equation in which investment is optimally determined by setting the marginal cost of investing in one period equal to the cost of waiting one extra period to invest (see, for instance, Whited, 1992, Hubbard and Kashyap, 1992, Calomiris and Hubbard, 1995, and Gilchrist and Himmelberg, 1998).

As our sample includes non-listed firms for which there are no data for stock market prices, we cannot use Q-theory. Therefore, we follow Love (2003) who derives the Euler equation for a firm that maximizes the present value of future dividends subject to adjustment costs and external financial constraints,[20] and upon linearizing the Euler equation obtains an empirical model in which investment (scaled by total assets) depends on lagged investment, sales, cash-flow, the interaction between cash-flow and a measure of (lack of) financial constraints (credit to the private sector), and a set of fixed effects. We use a similar model but replace the measure of financial constraints with city-level government debt:

$$I_{i,c,t} = \beta I_{i,c,t-1} + \delta REV_{i,c,t-1} + (\gamma_1 + \gamma_2 LGD_{c,t})\, CF_{i,c,t-1} + \alpha_i + \theta_{ct} + \varepsilon_{i,c,t}, \qquad (6)$$

where I, REV, and CF are investment in fixed capital, revenue growth and cash flow of firm i, in city c and year t (all scaled by beginning-of-year total assets), and LGD is local government debt scaled by GDP in city c and year t. The specification also includes firm-level fixed effects (α_i) and city-year effects (θ_{ct}). The latter control for the direct effect of local government debt on firm-level investment (as well as for any other city-level macroeconomic variable).

In the presence of financing constraints, investment will be positively correlated with

[20] In Love's (2003) model there is no borrowing and the external financial constraint is given by the fact that the firm cannot pay negative dividends. Allowing for borrowing complicates the model but does not alter the first order conditions for investment at the basis of Love's empirical model.

internally generate funds (proxied by cash flow) yielding a positive value for γ_1. A positive value for γ_2, instead, would be consistent with the hypothesis that government borrowing crowds out private investment by tightening the financing constraints faced by private firms. This is the main hypothesis tested in this section.

As equation (6) exploits only within-firm variation in investment and cash-flow and within-city-year variation in local public debt, it does not suffer from any obvious reverse causality problem. However, there could be an omitted variable bias if equation (6) does not control for sources of credit constraints that are correlated with local government debt. We discuss this possibility in the robustness analysis.

When equation (6) is estimated on the full sample of firms, the estimate of γ_1 is positive and statistically significant (column 1 in Table 9). The point estimate suggests that a one-standard deviation increase in cash-flow is associate with a 1.4 percentage point increase in the firm's investment ratio, which is consistent with the presence of financing constraints for the average firm in a city with no public debt. However, it could also be driven by the fact that cash flow acts as a proxy for investment opportunities not captured by other control variables (Kaplan and Zingales, 2000).[21] More important for our purposes, we find that γ_2 is positive and statistically significant. This finding supports the hypothesis that local government debt crowds out investment by tightening financial constraints, and is immune to the Kaplan-Zingales critique. The point estimate implies that a one-standard deviation increase in local government debt is associated with a 6% increase in the elasticity of investment to cash flow. The top-left panel of Figure 3 plots the sensitivity of investment to cash flow at different levels of local government debt: the elasticity rises from 6.7 in city-years with zero government debt to 8.1 in city-years with a 50% debt ratio.

If local government debt crowds out private investment by tightening local credit markets, this effect should be less relevant for state-owned enterprises that have access to privileged credit channels or may be able to tap the national credit market; the same reasoning

[21] Kaplan and Zingales (2000) also suggest that the positive correlation between investment and cash flow could be driven by influential outliers or by a few firms in debt distress. However, such outliers are unlikely to be relevant in our sample which includes more than 380,000 firms.

applies to foreign-owned firms. Hence, we divide firms into three groups: (i) private-sector domestically-owned (henceforth, private); (ii) state-owned, and (iii) foreign firms.

When equation (6) is estimated for the group of private firms (column 2 of Table 9), the results are essentially identical to the estimates for the whole sample but with tighter confidence intervals (see the top right panel if Figure 3). The results are dramatically different for the other two groups of firms. State firms are less credit constrained than the average firm (γ_1 decreases from 6.7 to 4.3, column 3 of Table 9), and the severity of their credit constraints is negatively associated with local government debt, so that they become essentially unconstrained when local public debt reaches 20 per cent of GDP, the correlation between cash flow and investment being no longer statistically significant once local debt exceeds that threshold (bottom-left panel of Figure 3). This finding suggests that at least some of the funding raised by Chinese cities via public debt issuance is actually channeled to local state-owned firms, and therefore mitigates or even eliminates any credit constraints that they would otherwise face. For foreign-owned firms, the correlation between cash flow and investment is always negative and never statistically significant (column 4 of Table 9 and bottom-right panel of Figure 3).

The last column of Table 9 uses all observations but allows for separate coefficients for state-owned and foreign-owned firms. The coefficients of the interaction between cash flow and local government debt are significantly lower (with respect to private-sector domestically-owned firms) for state-owned and foreign-owned firms and the total effects for these two types of firms (reported in the bottom panel of the table) are always negative but not statistically significant (as found also in columns 3 and 4).

These specifications may omit an important variable, namely, the interaction between cash flow and total bank loans over GDP. Bank loans are likely to belong in equation (6) because they are positively correlated both with local government debt (see Tables A2 and A3) *and* with credit to the private sector, a variable which in other studies has been found to relax credit constraints (Love, 2003). As bank loans are positively correlated with local government debt and negatively correlated with credit constraints, their exclusion from the model should lead to a downward bias in the estimate of γ_2.[22] This is precisely what one finds if specification (6) is expanded by adding the interaction between cash flow and bank loans to the explanatory variables. The point estimate of γ_2 almost trebles (from 0.03 in column 1 of Table 9 to 0.08 in column 1 of Table 10), implying that a one-standard deviation increase in local government debt is associated with a 13 percentage point increase in the elasticity of investment to cash flow. As expected, we also find that higher bank lending reduces the sensitivity of investment to cash flow – a result in line with the idea that bank loans proxy for local financial depth and with Love's (2003) finding that financial depth relaxes credit constraints.

Column 2 of Table 10 shows that these results are robust to restricting the sample to private firms and columns 3 and 4 show that government debt and bank loans have no statistically significant effect on the correlation between cash flow and investment in state-owned and foreign firms. In all subsequent regressions we keep controlling for the interaction between cash flow and bank loans. However, all our results are robust to dropping this interaction.

5.2 Robustness

In this section we test whether our baseline results are robust to additional controls, alternative sub-samples, and estimation techniques.

First, we check whether our results are driven by the omission of potentially relevant variables which are also correlated with local government debt. Before discussing these variables in detail, we note that none of these robustness tests affects on our main finding that local government debt increases the sensitivity of private investment to cash flow.

[22] Suppose that the true model is $y = \alpha + \beta LGD + \gamma BL + \varepsilon$, where BL denotes bank loans, with $\gamma < 0$ and $\sigma_{LGD,BL} > 0$. If instead one estimates $y = a + bLGD + e$, the expected value of b is:

$$E(b) = \beta + \gamma \frac{\sigma_{LGD,BL}}{\sigma^2_{LGD}},$$

and the bias is

$$E(b) - \beta = \gamma \frac{\sigma_{LGD,BL}}{\sigma^2_{LGD}} < 0.$$

The interaction between local government debt and cash flow remains positive, statistically significant and almost equal to that found in our baseline estimates.

We start with local government balance over city-level GDP. This variable is not mechanically correlated with our measure of local government debt, because the government balance reflects the direct income and expenditure of the local government and our measure of local government debt refers to debt issued by local government financing vehicles, which are extra-budgetary entities. However, it is possible that profligate local governments own overindebted LGFVs; it is also possible that LGFVs backed by financially sound governments are able to borrow more. In fact, Tables A2 and A3 show that there is a positive and statistically significant correlation between local government debt and city budget balance. However, when our baseline model is expanded to include the city budget balance, the interaction between the budget balance and cash flow is never statistically significant and the baseline results are robust to including this interaction in the model (column 1, Table 11).

Next, we augment the baseline model with the interaction between cash flow and the log of city-level GDP per capita. Also in this case we find that the added variable is not statistically significant and that its inclusion does not alter our baseline result (column 2, Table 11).

When instead we control for GDP growth (which in Table A3 is positively correlated with local government debt), the financing constraint appear to be tighter in city-years characterized by slow economic growth, but again the baseline results are robust to controlling for this variable.

We also explore the role of land prices. Land is the main collateral against LGFVs' debt, and land sales are also local governments' main source of income (Cai, Henderson and Zhang, 2009). In fact, both local government debt and city budget balance are positively correlated with land prices (the correlations ranging between 0.3 and 0.4, always statistically significant at the 1 percent confidence level). The expected effect of land price on financing constraints is ambiguous. On the one hand, high prices may relax collateral constraints of land-owning firms (Chaney, Sraer and Thesmar, 2012). On the other hand, the presence of high land prices may induce banks to lend to collateral-rich land developers rather than to manufacturing firms that require intensive screening (Manove, Padilla and Pagano, 2001; Chakraborty , Goldstein and MacKinlay, 2016). Our results are consistent with the latter interpretation (column 4, Table 11).

Finally, we jointly include all the control variables described above, finding some evidence that economic growth and GDP per capita relax financing constraints and that city budget balances tighten them. More important for our purposes, including these variables has no effect on the baseline result that local government debt tightens financing constraints.

We also check whether our results are robust to controlling for firm exposure to projects funded by LGFVs. Firms may self-select into cities with large public infrastructure projects, and being a supplier for these infrastructure projects may relax credit constraints as firm may discount invoices or obtain direct credit from the LGFVs they supply.[23] Indeed, the estimates in Table 12 show that private firms that are more exposed to LGFVs' funded projects are less constrained than non-exposed firms, the interaction between exposure and cash flow being negative and statistically significant. However, all our baseline results are robust to controlling for exposure to LGFVs' funded projects, and exposure to government funded projects has no separate impact on the crowding out effect of local government debt, the coefficient of the triple interaction being not statistically significant.

When the model is augmented with this exposure index, we lose nearly 200,000 observations, but the estimates of column 2 of Table 12 show that our baseline results persist in this reduced sample. Our results are also robust to restricting the estimation to private firms (column 3), but private firms with greater exposure to government-funded projects are less negatively affected by local government debt (the triple interaction being negative and significant in this case). As before, there is no evidence that local government debt affects financing constraints in state-owned and foreign-owned firms (columns 4 and 5). As a final experiment, we transform our continuous variable of exposure to government-funded

[23] Inasmuch large infrastructure projects are positively correlated with local government debt, not controlling for exposure to these projects would lead to a downward bias in the estimate of how local government debt affects the sensitivity of investment to cash flow. The construction of the index of exposure to LGVF-funded project is described in Section 3.

projects into a discrete variable ($HEXP$) equal to 1 for industries with above-median exposure and 0 otherwise, and find that using this discrete measure of exposure does not alter our baseline results (Column 6, Table 12).

One possible source of concern with the regressions of Tables 9-12 is that lagged investment is negatively correlated with current investment. This sign reversal is likely to be due to the Nickell (1981) downward bias introduced by the presence of firm-level fixed effects. A standard solution for this problem is to use the difference and system estimators introduced by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998).[24] The top panel of Table 13 reports the results obtained using the system estimator of Arellano and Bover (1995) and Blundell and Bond (1998): the lagged dependent variable becomes positive (albeit not statistically significant) and the point estimates for the variables of interest (cash flow and the interaction between cash flow and each of local government debt and bank loans) are essentially identically to our baseline estimates of Tables 9 and 10. The bottom panel of Table 13 reports standard fixed effects estimations (i.e., the same models used in Tables 9 and 10) based on the sample of the top panel. Although in the fixed effects estimations the lagged dependent variable is always negative and statistically significant, the results for our variables of interest are essentially identical. Another way to address the same problem is to exclude the lagged dependent variable from the model.[25] Table A6 in the appendix shows that our results are robust to estimating the model without lagged investment.

Next, we explore whether our results are driven by firms located in the provinces for which our debt measure exceeds the official debt measure published by the National Audit Office (see Appendix A for details). In the first column of Table 14 we drop Beijing, Tianjin, and other 14 cities located in the Jiangsu and Zhejiang provinces. In column 2 of the same

[24] We do not use these estimation methods in our baseline specification for two reasons. First, they require at least three consecutive years of observations for each firm – a requirement that would greatly reduce our sample size due to its unbalanced nature. Second, while system GMM estimations of equation (6) generally satisfy the specification tests developed by Arellano and Bond (1991), they barely satisfy them and small changes in the lag structure often lead to different values of these tests (the point estimates, instead, tend to be stable).

[25] This is a common approach in the finance literature (e.g., Cohen et al., 2011) which, however, often controls for Tobin's Q, a variable that does not exist for our sample of unlisted firms.

table, we restrict our sample to 212 "medium-sized" Chinese cities, with population ranging between 1 and 10 millions. The results are similar to the baseline of Table 10.

We also check whether our results are robust to the IV strategy described in Section 3.1 and implemented in Table 4. While we cannot instrument local government debt (or any other city-level variable) because its main effect is fully absorbed by the city-year fixed effects, we can augment our model with the interaction between cash flow and transfers and instrument this interaction term and the interaction between cash flow and local government debt with the interaction between cash flow and the share of top politicians, as well as with the simulated transfer (3). Table 15 shows that the instruments are strong (the bottom panel reports the Cragg-Donald F tests) and that our baseline results are robust to the IV strategy.

Finally, our results are also robust to focusing on post-2007 data when borrowing by local government debt started growing rapidly and to only using data from the Annual Survey of Industrial Firms (Tables A7 and A8 in the Appendix).

5.3 Switching Regressions

In the regressions shown so far, the financing regime of firms – credit constrained or unconstrained – is identified by exogenously partitioning the sample on the basis of firm ownership. There are two problems with this approach (Hu and Schiantarelli, 1998): first, this approach does not allow to jointly control for the various factors that affect how firms can substitute internal with external funds; second, using ownership to classify firms does not allow them to switch across regimes (from credit-constrained to unconstrained or viceversa), as their ownership status never changes in the sample.

We address these issues by estimating an endogenous switching regression model with unknown sample separation. Specifically, we follow Hu and Schiantarelli (1998) and Almeida and Campello (2007) and assume that at each point in time a firm operates in one of two regimes: a constrained regime where investment is very sensitive to internal funds, and an unconstrained regime where it is not. The probability of being in one of the two regimes is determined by a switching function that depends on firm characteristics that capture the severity of the agency problems faced by the firm at a specific point in time.

Formally, we jointly estimate the following three equations:

$$W^*_{i,c,t} = M_{i,c.t}\psi + u_{i,c,t}, \tag{7}$$

$$I_{1,i,c,t} = X_{i,c,t}\alpha_1 + \epsilon_{1,i,c,t}, \tag{8}$$

$$I_{2,i,c,t} = X_{i,c,t}\alpha_2 + \epsilon_{2,i,c,t}, \tag{9}$$

where W^* is a latent variable capturing the probability that firm i in period t is one of the two regimes and equation (7) is the selection equation that estimates the likelihood that the firm is in regime 1 ($I_{i,c,t} = I_{1,i,c,t}$ if $W^*_{i,c,t} < 0$) or regime 2 ($I_{i,c,t} = I_{2,i,c,t}$ if $W^*_{i,c,t} \geq 0$) as a function of a set of variables M that proxy for financial strength and other factors that may amplify agency problems and therefore tighten financing constraints. Following the literature, we model selection in the two regimes as a function of the log of firm age, the log of total assets, distance to default (Altman Z-score), a time invariant measure of industry-level asset intangibility, a dummy variable that equals 1 if the firm is private and domestic and 0 otherwise, and local government debt.[26] A firm's likelihood of being credit-constrained is expected to be decreasing in firm age, size, distance to default, and asset tangibility, and increasing in private ownership and local government debt.

Equations (8) and (9) are the investment equations, which are identical to our baseline model of Equation (6) but allow for different coefficients for firms that are in the two regimes.[27] The regimes are not observable but endogenously determined by the system of equations (7)-(9).

As in Hu and Schiantarelli (1998), the parameters ψ, α_1, and α_2 are jointly estimated by maximum likelihood, under the assumption that the error terms of the switching and

[26] Almeida and Campello (2007) also consider dividend payments, bond ratings, short and long term debt, and financial slack. Unfortunately, our dataset does not contain information for these variables. In building the Z-score we use emerging market-specific weights as suggested by Altman (2005). Specifically, we set $Z = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$, where $X_1 = \frac{(Current\ Assets - Current\ Liabilities)}{Total\ Assets}$; $X_2 = \frac{Retained\ Earnings}{Total\ Assets}$; $X_3 = \frac{EBIDTA}{Total\ Assets}$; and $X_4 = \frac{Book\ Value\ of\ Equity}{Total\ Liabilities}$.

[27] The switching regression model does not converge when we include firm fixed effects.

investment equations are jointly normally distributed with zero mean and a covariance matrix that allows for non-zero correlation between shocks to investment and shocks to firm characteristics that determine the regime.

Column 1 of Table 16 reports the results for a specification that includes city and year fixed effects. As expected, the selection equation (panel A) shows that the likelihood of being credit constrained is decreasing in firm age, size, distance to default, and asset tangibility. The likelihood of being credit constrained is instead higher for private-sector firms and for firms located in city-years with high local government debt.

The investment equations (panel B) show that in unconstrained firms the correlation between cash flow and investment is decreasing in local government debt (column 1.1): local public debt issuance allows these firms to decouple their investment even more from their internal resources, probably because unconstrained firms are predominantly state-owned and therefore can benefit from more generous funding from local governments that issue large amounts of debt. The correlation between investment and cash flow is instead positive and increasing in the level of government debt for credit constrained firms (column 1.2), a result that confirms those obtained in the previous sections. Again, this reflects the fact that credit-constrained firms are disproportionately private and domestic.

Column 2 of Table 16 reports the results for a model that includes city-year fixed effects, which absorb the effect of local government debt on a firm's probability of being credit-constrained. The likelihood of being credit constrained is again estimated to be higher for private-sector firms and is decreasing in firm age, size, distance to default, and asset tangibility. Moreover, in unconstrained firms the sensitivity of investment to cash flow is again decreasing in local government debt. The point estimates in column 2.1 show that, for unconstrained firms the sensitivity of investment to cash flow is positive in city-years with no local government debt, but drops to zero when local government debt reaches 5% of GDP. The opposite is true for constrained firms, for which the sensitivity of investment to cash flow is much higher and is again increasing in local government debt (column 2.2).

Finally, we estimate a model that controls for city-year fixed effects and industry-year fixed effects, which absorb the effect of asset tangibility (defined at the industry-level). The results are essentially identical to those of column 2.

6 Conclusions

China reacted to the global financial crisis with a massive fiscal stimulus. In November 2008 the Chinese government announced a RMB4 trillion (approximately USD590 billion) stimulus package. Implementation was immediate and mostly channeled via local governments. In 2009 city-level debt increased by RMB1.7 trillion (based on our estimates, see Table 1), while central government debt increased by RMB700 billion (going from 5.3 to 6 trillion, based on CICC).

The stimulus package focused on investment. Over 2009 the growth rate of fixed capital formation almost doubled with respect to its pre-crisis growth. In the same year, the contribution of fixed investment to Chinese GDP growth was close to 90% (Wen and Wu, 2014). This remarkable increase in investment was achieved by injecting enormous financial resources into state-owned firms. The leverage ratio of Chinese state-owned manufacturing firms went from a pre-crisis level of 57.5% in 2008Q1 to 61.5% on 2010Q1. Over the same period, the leverage ratio of private-sector manufacturing firms went from 59 to 57% (Wen and Wu, 2014).

At first glance, the stimulus was a resounding success. China was able to escape the great recession and became one of the main drivers of world economic growth in the post-crisis period (Wen and Wu, 2014). Our estimates suggest that, however, this policy suffered from a major drawback: the massive increase in local government debt in the post-crisis period had a substantial negative effect on investment of private manufacturing firms. As private manufacturing firms have much higher levels of productivity than state-owned manufacturing firms (Song, Storesletten and Zilibotti, 2011), this reallocation of investment from private to state-owned firms is likely to have negative effects on China's long-run growth potential, especially in the areas where local governments have issued the largest amount of debt. Moreover, by boosting the fraction of public debt in banks' portfolios, this policy has further strengthened the bank-sovereign nexus in China – a nexus that going forward may generate serious systemic stability risks, as illustrated by the Euro-area sovereign debt crisis (Acharya, Drechsler and Schnabl, 2014; Acharya and Steffen, 2015; Altavilla, Pagano and Simonelli, 2015; Battistini, Pagano and Simonelli, 2014; Popov and van Horen, 2013).

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Table 1: **Local Government Debt in China**

This table summarizes our data for local government debt. Columns 2-5 are based on city-level variables. Columns 6 and 7 report year totals in RMB and as a percent of China's GDP.

Year	μ	σ	Min.	Max.	Total China		N. Cities	
		Bill. RMB			Bill. RMB	(% GDP)	All	D>0
2006	4.3	18.1	0.0	173	1,255	5.8	293	92
2007	7.1	27.6	0.0	268	2,087	7.9	293	144
2008	10.4	38.4	0.0	383	3,036	9.7	293	189
2009	18.9	62.8	0.0	589	5,535	16.2	293	248
2010	24.7	80.5	0.0	789	7,249	18.1	293	281
2011	28.5	93.7	0.0	951	8,336	17.6	293	291
2012	35.6	113.0	0.0	1,145	10,425	20.1	293	292
2013	42.9	132.1	0.0	1,303	12,556	22.1	293	292

Table 2: **Local Government Debt and Investment: City-Level Regressions**

This table reports the results of a set of regressions where the dependent variable is the city-level investment ratio of the manufacturing sector (computed as the weighted average of investment over total assets of all manufacturing firms in city c year t) and the dependent variable is local government debt over GDP (LGD). Column 1 uses all manufacturing firms, column 2 only includes private sector manufacturing firms, column 3 focuses on state-owned manufacturing firms, column 4 focuses on foreign-owned manufacturing firms, and column 5 includes all types of firms but estimates separate effects by interacting local government debt with private sector (PRI), state-owned (SOE), and foreign-owned (FOR) dummies. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)
LGD	-0.083***	-0.089***	-0.017	0.017	
	(0.026)	(0.0289)	(0.029)	(0.052)	
$LGD \times PRI$					-0.090***
					(0.031)
$LGD \times SOE$					-0.029
					(0.028)
$LGD \times FOR$					0.0154
					(0.033)
N. Obs.	1,861	1,859	1,658	1,146	4580
N. Cities	261	261	261	245	261
Year FE	YES	YES	YES	YES	YES
City FE	YES	YES	YES	YES	YES
Sample	All	Private	State	Foreign	All
$LGD \times PRI - LGD \times SOE$					-0.060*
p-value					(0.06)
$LGD \times PRI - LGD \times FOR$					-0.105***
p-value					(0.01)
$LGD \times SOE - LGD \times FOR$					-0.045
p-value					(0.13)

Robust s.e. clustered at the city level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 3: **Local Government Debt and Investment: City-Level Regressions**

This table reports the results of a set of regressions where the dependent variable is the city-level investment ratio of the manufacturing sector (computed as the weighted average of investment over total assets of all manufacturing firms in city c year t) and the dependent variables are local government debt over GDP (LGD), bank loans over GDP (BL), local government balance over GDP (GB), GDP growth (GR), the log of GDP per capita ($GDP\ PC$), the log of population (POP), and the log of land price (LP). Column 1 uses all manufacturing firms, column 2 only includes private sector manufacturing firms, column 3 focuses on state-owned manufacturing firms, column 4 focuses on foreign-owned manufacturing firms, and column 5 includes all types of firms but estimates separate effects by interacting local government debt with private sector (PRI), state-owned (SOE), and foreign-owned (FOR) dummies. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)
LGD	-0.093***	-0.104***	-0.029	0.032	
	(0.028)	(0.030)	(0.040)	(0.053)	
$LGD \times PRI$					-0.095***
					(0.031)
$LGD \times SOE$					-0.024
					(0.028)
$LGD \times FOR$					0.019
					(0.033)
BL	-0.012	-0.002	-0.027	0.012	-0.004
	(0.014)	(0.014)	(0.024)	(0.033)	(0.015)
GB	0.020	0.028	-0.139	-0.484*	-0.169
	(0.153)	(0.168)	(0.209)	(0.252)	(0.137)
GR	0.409***	0.332**	0.632***	-0.206	0.288***
	(0.127)	(0.135)	(0.164)	(0.190)	(0.104)
$ln(GDP\ PC)$	4.506	6.394*	-5.851	14.93**	4.544
	(3.283)	(3.752)	(4.408)	(5.875)	(2.893)
$ln(POP)$	7.506*	9.374**	-5.674	15.32**	6.026*
	(3.821)	(4.295)	(5.511)	(6.371)	(3.308)
$ln(LP)$	0.598	0.505	-0.411	2.005*	0.537
	(0.629)	(0.694)	(0.979)	(1.124)	(0.612)
N. Obs.	1,805	1,803	1,658	1,109	4,420
N. Cities	261	261	261	242	261
Firms	All	Private	State	Foreign	All
Year FE	YES	YES	YES	YES	YES
City FE	YES	YES	YES	YES	YES
$LGD \times PRI - LGD \times SOE$					-0.071**
p-value					(0.04)
$LGD \times PRI - LGD \times FOR$					-0.114***
p-value					(0.01)
$LGD \times SOE - LGD \times FOR$					-0.043
p-value					(0.15)

Robust s.e. clustered at the city level in parenthesis

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

Table 4: **Local Government Debt and Investment: City-Level IV Regressions**

This table reports the results of a set of instrumental variable regressions where the dependent variable is the city-level investment ratio of the manufacturing sector (computed as the weighted average of investment over total assets of all manufacturing firms in city c year t) and the endogenous explanatory variables are local government debt over GDP (LGD) and transfers over GDP (TR). The top panel reports the reduced form regressions and the bottom panel the first stage regressions in which LGD and TR are instrumented with number of national politicians who originate from city c and simulated transfers STR. Column 1 uses all manufacturing firms, column 2 only includes private sector manufacturing firms, column 3 only includes state-owned manufacturing firms, and column 4 only includes foreign-owned manufacturing firms. The regressions cover up to 261 cities for the period 2006-2013.

	Second Stage							
	(1)		(2)		(3)		(4)	
LGD	-0.789**		-0.779**		-0.446		-0.210	
	(0.368)		(0.383)		(0.310)		(0.277)	
TRI	0.454*		0.467*		0.0883		-0.131	
	(0.258)		(0.272)		(0.258)		(0.244)	
	First Stage							
	(1.1)	(1.2)	(2.1)	(2.2)	(3.1)	(3.2)	(4.1)	(4.2)
	LGD	TRI	LGD	TRI	LGD	TRI	LGD	TRI
TOP	0.13	2.48***	0.12	2.49***	0.03	2.75***	-0.23	3.11***
	(0.41)	(0.81)	(0.4)	(0.82)	(0.44)	(0.89)	(0.43)	(1.02)
STRI	0.39***	0.27	0.39***	0.28	0.40***	0.27	0.40***	0.23
	(0.07)	(0.25)	(0.07)	(0.24)	(0.08)	(0.26)	(0.08)	(0.27)
N. Obs.	1,861		1,859		1,575		1,127	
N. Cities	261		261		261		226	
CD F test	11.44		11.93		11.92		12.66	
City FE	YES		YES		YES		YES	
Year FE	YES		YES		YES		YES	
Sample	All		Private		State		Foreign	

Robust s.e. clustered at the city level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 5: **Local Government Debt and Private Investment: Identification through Heteroskedasticity**

This table reports the results of a set of instrumental variable regressions where the dependent variable is the city-level investment ratio of the manufacturing sector (computed as the weighted average of investment over total assets of all manufacturing firms in city c year t), the endogenous explanatory variables are local government debt over GDP (LGD) and transfers over GDP (TR), the exogenous explanatory variable is the external shock described in the text (EXT). The endogenous variables are instrumented with the number of national politicians who originate from city c (TOP), simulated transfers (STR), and heteroskedasticity-based instruments. Columns 1 and 2 use all manufacturing firms, columns 3 and 4 only include private sector manufacturing firms, columns 5 and 6 only include state-owned manufacturing firms, and columns 7 and 8 only include foreign-owned manufacturing firms. Columns 1, 3, 5, and 7 use standard IV estimates. Columns 2, 4, 6, and 8 use GMM estimations and identification through heteroskedasticity. The regressions cover up to 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LGD	-0.775**	-0.537**	-0.764**	-0.517*	-0.445	-0.445	-0.208	-0.0738
	(0.363)	(0.249)	(0.378)	(0.265)	(0.309)	(0.273)	(0.275)	(0.205)
TRI	0.453*	0.337*	0.466*	0.349	0.0888	0.183	-0.133	-0.0586
	(0.257)	(0.196)	(0.271)	(0.214)	(0.258)	(0.227)	(0.243)	(0.266)
EXT	2.488*	2.130*	2.581*	2.224*	0.406	0.0984	1.088	-0.304
	(1.353)	(1.249)	(1.428)	(1.326)	(2.200)	(2.261)	(2.786)	(2.295)
N. Obs	1,861	1,861	1,859	1,859	1,575	1,575	1,127	1,127
N. Cities	261	261	261	261	237	237	226	226
F test	11.6	10.4	11.7	10.5	11.99	11.05	13.04	11.68
Sargan test (p value)		0.51		0.54		0.81		0.69
Est.	IV	IV IH	IV	IV IH	IV	IV IH	IV	IV IH
City FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Sample	All		Private		State		Foreign	

Robust s.e. clustered at the city level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 6: **Local Government Debt and Private Investment: Only Firms with Low Exposure to Government Expenditure**

This table reproduces the results of columns 1 of Tables 2 and 3, column 1 of Table 4, and columns 1 and 2 of table 5 by only focusing on investment by firms with low exposure (bottom 25 percentile of the distrbution) to government expenditure. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)
LGD	-0.089***	-0.103***	-0.938*	-0.932*	-0.653**
	(0.034)	(0.0378)	(0.502)	(0.498)	(0.304)
BL		-0.011			
		(0.018)			
GB		0.048			
		(0.205)			
GR		0.292*			
		(0.154)			
ln(*GDP PC*)		7.857*			
		(4.645)			
ln(*POP*)		7.571*			
		(4.381)			
LP		1.712*			
		(0.929)			
TR			0.700**	0.699**	0.563**
			(0.342)	(0.342)	(0.239)
EXT				0.879	0.284
				(1.725)	(1.453)
N. Obs.	1,820	1,764	1,820	1,820	1,820
N. Cities	261	261	261	261	261
F test			11.4	11.6	10.9
J test (p value)					0.47
Est.	LSDV	LSDV	IV	IV	IV IH
City FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES

Robust s.e. clustered at the city level in parenthesis

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

Table 7: **Industry-Level Regressions**

This table reports the results of a set of regressions where the dependent variable is the investment ratio (computed as investment over total assets at the beginning of the period) aggregated at the city-industry-year level. The regressions control for initial investment (I_{t-1}) and the interaction between local government debt over GDP (LGD) and the Rajan-Zingales index of external financial dependence(EF) computed using firms from Beijing, Shanghai, Hangzhou, and Wenzhou. The first column uses all manufacturing firms, column 2 only includes private sector manufacturing firms, column 3 only includes state-owned manufacturing firms, and column 4 only includes foreign-owned manufacturing firms. The regressions cover 257 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.273***	-0.271***	-0.426***	-0.396**
	(0.006)	(0.006)	(0.034)	(0.16)
$EF \times LGD$	-0.015***	-0.019***	0.016	0.007
	(0.005)	(0.006)	(0.017)	(0.042)
N. Obs	57,054	53,262	6,249	2,550
N. Cities	15,768	14,906	3,252	1,121
City-Year FE	YES	YES	YES	YES
Ind.-Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 8: **Industry-Level Regressions: Additional Interactions**

This table reports the results of a set of regressions where the dependent variable is the investment ratio (computed as investment over total assets at the beginning of the period) aggregated at the city-industry-year level. The regressions control for initial investment (I_{t-1}) and the interaction between the Rajan-Zingales index of external financial dependence (EF) computed using firms from Beijing, Shanghai, Hangzhou, and Wenzhou and each of local government debt over GDP (LGD), bank loans over GDP (BL), the log of GDP per capita ($GDP\ PC$), GDP growth (GR), and the log of average land price (LP). The first column uses all manufacturing firms, column 2 only includes private sector manufacturing firms, column 3 only includes state-owned manufacturing firms, and column 4 only includes foreign-owned manufacturing firms. The regressions cover 257 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)
I(t-1)	-0.272***	-0.271***	-0.427***	-0.398***
	(0.006)	(0.006)	(0.03)	(0.164)
$EF \times LGD$	-0.018***	-0.023***	0.018	0.008
	(0.005)	(0.006)	(0.011)	(0.04)
$EF \times BL$	0.001	0.001	-0.003	-0.003
	(0.001)	(0.001)	(0.003)	(0.016)
$EF \times ln(GDP\ PC)$	0.227	0.186	0.679	-0.382
	(0.19)	(0.196)	(0.942)	(3.08)
$EF \times GR$	0.0286*	0.0338	0.0646	0.0191
	(0.016)	(0.019)	(0.09)	(0.312)
$EF \times LP$	-0.129	-0.131	-0.230	0.018
	(0.107)	(0.114)	(0.528)	(1.443)
N. Obs	56,209	52,503	6,065	2,520
N. Cities	15,693	14,839	3,194	1,115
City-Year FE	YES	YES	YES	YES
Ind.-Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust s.e. clustered at the city-indutry level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 9: **Firm-Level Regressions: Firm and City-Year FE**

This table reports the results of a set of regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are lagged investment (I_{t-1}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and local government debt over GDP (LGD). The first column uses all manufacturing firms, column 2 only includes private sector domestically owned manufacturing firms, column 3 only includes state-owned manufacturing firms, column 4 only includes foreign-owned manufacturing firms, and column 5 uses all observations and allows state-owned and foreign-owned firms to have different coefficients for the interaction between local government debt and cash flow. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)
I_{t-1}	-0.273***	-0.280***	-0.371***	-0.282***	-0.273***
	(0.002)	(0.002)	(0.008)	(0.011)	(0.002)
REV_{t-1}	3.773***	3.799***	2.398***	2.942***	3.77***
	(0.031)	(0.034)	(0.167)	(0.220)	(0.031)
CF_{t-1}	6.725***	7.334***	4.328***	-0.253	6.70***
	(0.231)	(0.256)	(1.190)	(1.534)	(0.231)
$CF_{t-1} \times LGD$	0.028**	0.029**	-0.097	-0.07	0.038***
	(0.011)	(0.013)	(0.055)	(0.05)	(0.012)
$CF_{t-1} \times LGD \times State$					-0.080**
					(0.036)
$CF_{t-1} \times LGD \times Foreign$					-0.091***
					(0.024)
N. Obs.	1,150,340	975,454	61,755	33,784	1,150,340
N. Firms	387,781	353,434	32,103	15,950	387,781
N. Cities	261	261	261	261	261
Firm FE	YES	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES	YES
Sample	All	Private	State	Foreign	All
$CF_{t-1} \times LGD + CF_{t-1} \times LGD \times State$					-0.042
p-value					0.26
$CF_{t-1} \times LGD + CF_{t-1} \times LGD \times Foreign$					-0.053
p-value					0.11

Robust s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 10: **Firm-Level Regressions: Controlling for Bank Loans**

This table reports the results of a set of regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are lagged investment (I_{t-1}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of local government debt over GDP (LGD) and bank loans over GDP (BL). The first column uses all manufacturing firms, column 2 only includes private sector domestically owned manufacturing firms, column 3 only includes state-owned manufacturing firms, and column 4 only includes foreign-owned manufacturing firms. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.274***	-0.281***	-0.371***	-0.281***
	(0.002)	(0.002)	(0.008)	(0.011)
REV_{t-1}	3.770***	3.796***	2.393***	2.933***
	(0.031)	(0.033)	(0.168)	(0.220)
CF_{t-1}	8.343***	9.141***	6.020***	-2.973
	(0.374)	(0.411)	(1.893)	(2.665)
$CF_{t-1} \times LGD$	0.075***	0.083***	-0.045	-0.110*
	(0.014)	(0.016)	(0.068)	(0.058)
$CF_{t-1} \times BL$	-0.022***	-0.025***	-0.023	0.028
	(0.004)	(0.004)	(0.019)	(0.019)
N. Obs.	1,150,340	975,454	61,755	33,784
N. Firms	387,781	353,434	32,103	15,950
N. Cities	261	261	261	261
Firm FE	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust s.e. clustered at the firm level in parenthesis

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

Table 11: **Firm-Level Regressions: Additional Controls**

This table reports the results of a set of regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are lagged investment (I_{t-1}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of local government debt over GDP (LGD), bank loans over GDP(BL), local government budget balance over GDP(GB), city-level log of GDP per capita ($GDP\ PC$), GDP growth (GR), and the log of average land prices (LP). The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)
I_{t-1}	-0.274***	-0.274***	-0.274***	-0.273***	-0.274***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
REV_{t-1}	3.771***	3.771***	3.796***	3.763***	3.787***
	(0.031)	(0.031)	(0.032)	(0.032)	(0.032)
CF_{t-1}	8.137***	9.150***	18.60***	2.039	19.15***
	(0.426)	(0.492)	(0.799)	(1.482)	(2.399)
$CF_{t-1} \times LGD$	0.075***	0.072***	0.052***	0.055***	0.051***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
$CF_{t-1} \times BL$	-0.021***	-0.024***	-0.026***	-0.025***	-0.021***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$CF_{t-1} \times GB$	-0.038				0.093*
	(0.042)				(0.052)
$CF_{t-1} \times ln(GDP\ PC)$		0.539**			-0.794**
		(0.237)			(0.332)
$CF_{t-1} \times GR$			-0.739***		-0.802***
			(0.051)		(0.056)
$CF_{t-1} \times LP$				1.047***	-0.105
				(0.247)	(0.316)
N. Obs.	1,150,340	1,150,340	1,123,318	1,142,536	1,115,514
N. Firms	387,781	387,781	385,540	387,037	384,720
N. Cities	261	261	261	261	261
Firm FE	YES	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES	YES
Sample	All	All	All	All	All

Robust s.e. clustered at the firm level in parenthesis

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

Table 12: **Firm-Level Regressions: Exposure to Government Expenditure**

This table reports the results of a set of regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are lagged investment (I_{t-1}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), the interaction between CF_{t-1} and bank loans over GDP (LGD), and the interaction between CF_{t-1} and local government debt over GDP (LGD) further interacted with exposure to government expenditure (EXP). The first two columns use all manufacturing firms, column 3 only includes private sector domestically owned manufacturing firms, column 4 only includes state-owned manufacturing firms, and column 5 only includes foreign-owned manufacturing firms. Column 6 uses a discrete measure of exposure to government expenditure. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)	(6)
I_{t-1}	-0.277***	-0.278***	-0.283***	-0.375***	-0.304***	-0.278***
	(0.002)	(0.002)	(0.002)	(0.009)	(0.01)	(0.002)
REV_{t-1}	3.757***	3.756***	3.786***	2.368***	2.738***	3.756***
	(0.035)	(0.035)	(0.038)	(0.192)	(0.259)	(0.035)
CF_{t-1}	9.049***	8.455***	9.515***	7.913***	2.994	8.553***
	(0.442)	(0.421)	(0.487)	(2.360)	(3.410)	(0.477)
$CF_{t-1} \times LGD$	0.0895***	0.0785***	0.106***	0.029	-0.109	0.083***
	(0.0172)	(0.0156)	(0.020)	(0.079)	(0.086)	(0.020)
$CF_{t-1} \times BL$	-0.021***	-0.021***	-0.024***	-0.031	0.006	-0.021***
	(0.004)	(0.004)	(0.005)	(0.022)	(0.024)	(0.004)
$CF_{t-1} \times EXP$	-4.632***		-2.065*	-6.877***	-16.94	
	(1.009)		(1.236)	(2.128)	(11.24)	
$CF_{t-1} \times EXP \times LGD$	-0.064		-0.125**	-0.111	0.166	
	(0.046)		(0.052)	(0.105)	(0.481)	
$HEXP \times LGD$	-0.034**		-0.039**	-0.056	-0.071	
	(0.0136)		(0.0159)	(0.0384)	(0.0680)	
$CF_{t-1} \times HEXP$						-0.197
						(0.451)
$CF_{t-1} \times HEXP \times LGD$						-0.009
						(0.024)
$HEXP \times LGD$						0.003
						(0.004)
N. Obs.	935,255	935,255	796,947	50,192	24,087	935,255
N. Firms	323,914	323,914	295,448	26,065	11,790	323,914
N. Cities	261	261	261	261	261	261
Firm FE	YES	YES	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES	YES	YES
Sample	All	All	Private	State	Foreign	All

Robust s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 13: **System GMM Regressions**

The top panel of this table estimates the models of Table and 10 using the system GMM estimator of Arellano and Bover (1995) and Blundell and Bond (1998). The set of instruments include all available lags. The bottom panel reports standard fixed effects estimations that use the same sample of the top panel. The first column uses all manufacturing firms, column 2 only includes private sector domestically owned manufacturing firms, column 3 only includes state-owned manufacturing firms, and column 4 only includes foreign-owned manufacturing firms. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)
	SYS GMM			
I_{t-1}	0.018	0.002	0.372	-0.404*
	(0.024)	(0.026)	(0.216)	(0.244)
REV_{t-1}	9.709***	9.756***	3.977	-0.607
	(0.365)	(0.407)	(3.882)	(3.494)
CF_{t-1}	9.69***	11.04***	36.15**	46.93*
	(2.41)	(2.69)	(17.48)	(22.80)
$CF_{t-1} \times LGD$	0.052***	0.037***	-0.044	0.056
	(0.011)	(0.012)	(0.046)	(0.123)
$CF_{t-1} \times BL$	-0.065***	-0.035	-0.066	-0.187*
	(0.020)	(0.023)	(0.106)	(0.170)
AR1 (p-value)	0.00	0.00	0.03	0.04
AR2 (p-value)	0.07	0.03	0.15	0.30
Sargan (p-value)	0.15	0.07	0.00	0.00
	Standard FE on same sample			
I_{t-1}	-0.242***	-0.251***	-0.339***	-0.206***
	(0.002)	(0.003)	(0.015)	(0.018)
REV_{t-1}	4.18***	4.24***	2.82***	1.07***
	(0.04)	(0.04)	(0.31)	(0.33)
CF_{t-1}	12.93***	12.87***	7.55**	15.32***
	(0.49)	(0.56)	(3.11)	(3.56)
$CF_{t-1} \times LGD$	0.018***	0.018***	0.005	0.021
	(0.002)	(0.002)	(0.013)	(0.013)
$CF_{t-1} \times BL$	-0.066***	-0.063***	-0.085***	-0.110***
	(0.005)	(0.006)	(0.030)	(0.027)
N. Obs.	797,314	623,837	53,657	18,848
N. Firms	190,451	261,525	19,136	6,028
N. Cities	261	261	261	261
Firm FE	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust (Windmeijer) s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 14: **Firm-Level Regressions: Different Samples**

This table reports the results of a set of regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are lagged investment (I_{t-1}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of local government debt over GDP (LGD) and bank loans over GDP (BL). Column 1 excludes Beijing, Tianjin and all cities in the provinces of Jiangsu and Zhejiang. Column 2 only uses firms located in cities with a population that ranges between 1 and 10 millions. The regressions cover up to 235 cities for the period 2006-2013.

	(1)	(2)
I_{t-1}	-0.282***	-0.278***
	(0.0018)	(0.0016)
REV_{t-1}	3.955***	3.793***
	(0.037)	(0.033)
CF_{t-1}	7.928***	8.352***
	(0.416)	(0.420)
$CF_{t-1} \times LGD$	0.057***	0.076***
	(0.019)	(0.017)
$CF_{t-1} \times BL$	-0.015***	-0.020***
	(0.004)	(0.004)
N. Obs.	781,670	1,003,337
N. Firms	264,914	340,510
N. Cities	235	212
Firm FE	YES	YES
City-Year FE	YES	YES
Sample	Excluding 4 provinces where HPP>Off.	1m<POP<10m

Robust s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 15: **Local Government Debt and Investment: Firm-Level IV Regressions**
This table reports the results of a set of instumental variable regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are lagged investment (I_{t-1}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of local government debt over GDP (LGD), central government transfers over GDP (TR), and bank loans over GDP (BL). The interactive terms $CF_{t-1} \times LGD$ and $CF_{t-1} \times TR$ are treated as endogenous and are instrumented with the interaction between cash flow and the number of national politicians who originate from city c and simulated transfers STR (this is the same IV strategy of Table 4). Column 1 uses all manufacturing firms, column 2 only includes private sector manufacturing firms, column 3 only includes state-owned manufacturing firms, and column 4 only includes foreign-owned manufacturing firms.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.291***	-0.296***	-0.370***	-0.291***
	(0.002)	(0.002)	(0.009)	(0.024)
REV_{t-1}	3.659***	3.682***	2.358***	3.073***
	(0.032)	(0.035)	(0.180)	(0.464)
CF_{t-1}	23.65***	28.07***	20.08	2.736
	(1.647)	(2.314)	(14.09)	(5.895)
$CF_{t-1} \times LGD$	2.638***	3.188***	2.176	1.829
	(0.286)	(0.392)	(2.232)	(1.310)
$CF_{t-1} \times BL$	-0.342***	-0.427***	-0.310	-0.154
	(0.035)	(0.050)	(0.289)	(0.115)
$CF_{t-1} \times TR$	-0.637***	-0.720***	-0.594	-0.824
	(0.076)	(0.097)	(0.614)	(0.619)
N. Obs.	928,772	775,250	43,617	19,130
N. Cities	261	261	256	2243
N. of firms	258,338	223,566	15,739	6,807
CD F test	415.1	242.2	22.2	29.1
City FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust s.e. clustered at the city level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table 16: **Firm-Level Regressions: Switching Regression Model**

This table reports the switching regression model described in Equations (7)-(9). The selection equation (Panel A) controls for the log of firm age ($ln(Age)$), the log assets ($ln(Assets)$), distance to default ($Zscore$), a time-invariant industry-level measure of the share of tangible assets over total assets ($Tangible$), a dummy that takes a value of one if the firm is neither foreign owned or state-owned ($Private$), and time-variant measures of city-level local government debt (LGD). The investment equation (Panel B) controls for lagged cash flow (CF), the interaction between lagged cash flow and local government debt (LGD), lagged investment (not reported), and revenues growth (not reported). Model 1 includes city and year fixed effects, Model 2 includes city-year fixed effects, and Model 3 includes city-year and industry-year city-year fixed effects. For each model we report separate investment equations for firms that are not credit-constrained (regime 1) and credit-constrained firms (regime 2). The regressions cover 261 cities for the period 2006-2013.

	(1)		(2)		(3)	
	A. Selection Equation					
$ln(Age)$	10.93***		7.236***		8.532***	
	(0.077)		(0.721)		(0.066)	
$ln(Assets)$	0.077**		0.725***		1.706***	
	(0.034)		(0.030)		(0.026)	
$Zscore$	0.110***		0.049***		0.033***	
	(0.008)		(0.008)		(0.007)	
$Private$	-9.340***		-5.09***		-4.339***	
	(0.142)		(0.013)		(0.012)	
$Tangible$	7.898***		4.62***			
	(0.279)		(0.026)			
LGD	-0.012*					
	(0.008)					
N. Obs	1,060,404		1,060,404		1,060,404	
	B. Investment Equation					
	(1.1)	(1.2)	(2.1)	(2.2)	(3.1)	(3.2)
	Not Constr.	Constr.	Not Constr.	Constr.	Not Constr.	Constr.
CF_{t-1}	1.62***	0.40***	0.31***	0.81***	0.14***	0.71***
	(0.03)	(0.02)	(0.03)	(0.02)	(0.03)	(0.02)
$CF_{t-1} \times LGD$	-0.042***	0.014***	-0.063***	0.052***	-0.033***	0.011***
	(0.005)	(0.003)	(0.01)	(0.01)	(0.01)	(0.004)
LGD	-0.012***	-0.041***				
	(0.001)	(0.004)				
N. Obs.	306,175	754,229	274,822	785,222	231,925	828,479
City FE	YES		NO		NO	
Year FE	YES		NO		NO	
City-Year FE	NO		YES		YES	
Ind-Year FE	NO		NO		YES	

Robust s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Figure 1: **Local Government Debt in China: Bonds and Loans**. This figure plots the composition of total local government debt in China divided between oustanding bonds and other financial liabilities.

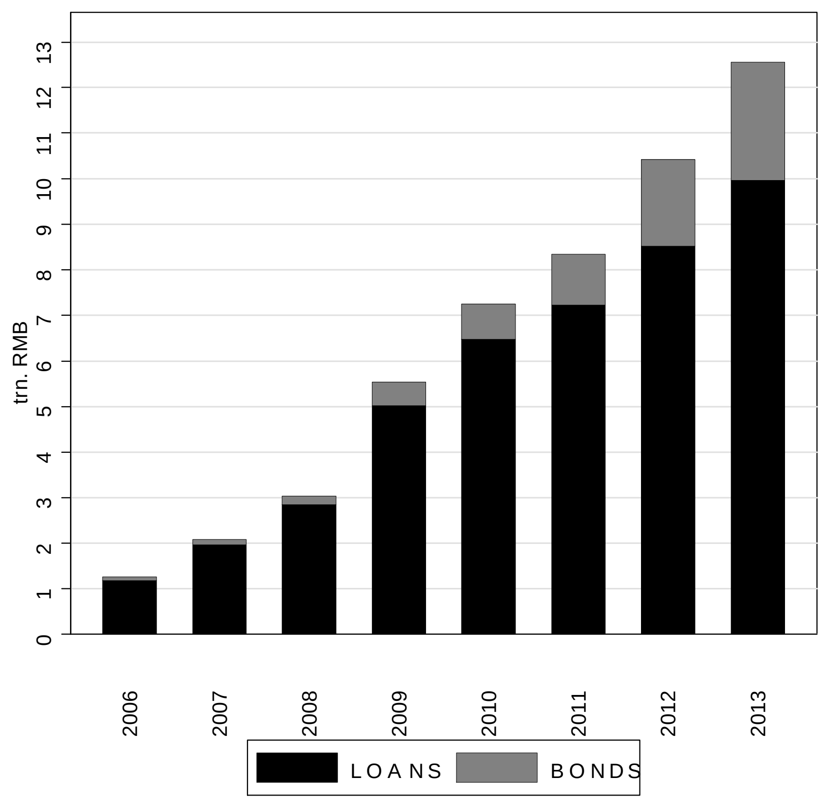


Figure 2: **Local Government Debt and Investment Ratios in Different Industries**. This figure plots how investment ratios vary with the level of government debt for private sector manufacturing industries in the paper (25th percentile of the distribution of the index of external financial dependence) and batteries (75th percentile of the distribution of the index of external financial dependence) sectors. The graphs are based on the the estimations of column 2 Table 7. The dashed lines are 95% confidence intervals and the horizontal lines are the average investment ratios in the two sectors (8.3% for paper and 10.6% for batteries).

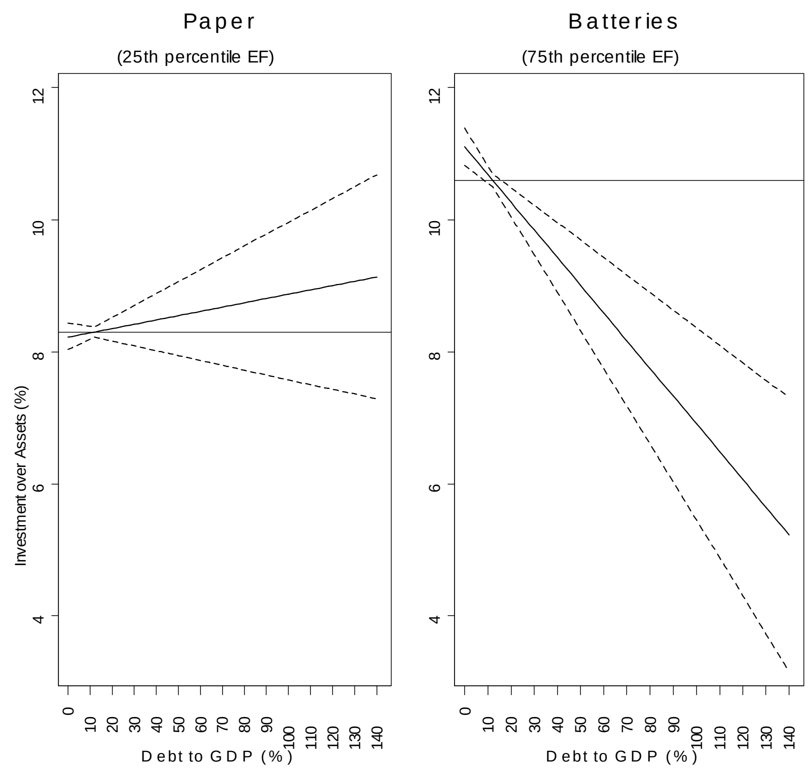
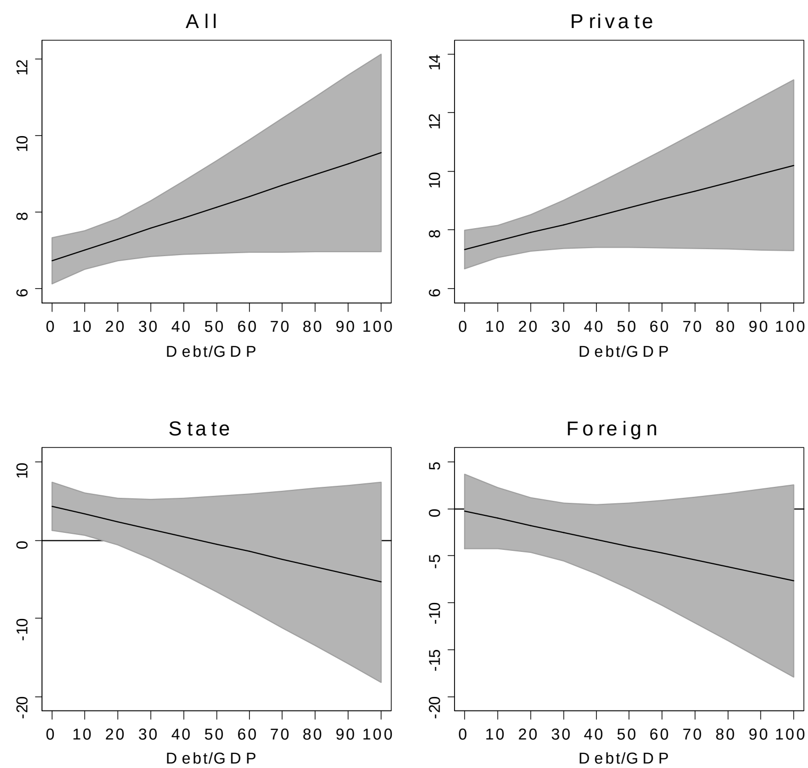


Figure 3: **Sensitivity of Investment to Cash Flow**.

The figures plot how the sensitivity of investment to cash flow changes with the level of local government debt. These marginal effects are based in the estimates reported in columns 1-4 of Table 9.



Appendix

A Construction of the Data Set

A.1 Local Public Debt Data

To estimate total financial liabilities of LGFVs, we use the balance sheet data disclosed by all entities that requested an authorization to issue bonds, proceeding as follows. First, we obtain from the China Banking Regulatory Commission (CBRC) the list of all LGFVs authorized to issue bonds. At the end of 2013, the CBRC database contained information for LGFVs located in 293 cities across all provinces of China.

Next, we use the Wind Information Co. (WIND) database to recover balance sheet data for the entities listed by CBRC. When an entity listed by CBRC is not available in the WIND database, we manually collect the needed balance sheet information. We estimate total debt of each LGFV by adding up its short-term and long-term debt.[28]

Finally, we add up total debt (and its subcomponents) of all LGFVs located in a given city to obtain our measure of city-level local government debt. In this measure we also include the (rare) cases in which the Central Government has issued special bonds for the local government.

In building our aggregate measure of debt, we avoid double counting by excluding debt issued by LGFVs that belong to a holding group (in which case we only include total debt of the holding group), and do not duplicate information for LGFVs with multiple issues in a given year.

The data show that local government debt started growing rapidly after the global financial crisis. This is when local governments were asked to contribute to the massive fiscal stimulus implemented by the Chinese government but were not given additional fiscal resources (Lu and Sun, 2013, and Zhang and Barnett, 2014).

Between 2006 and 2010, outstanding local government debt grew six-fold going from 1.2 to 7.2 trillion RMB (Table 1), and trebled relative to GDP, from 5.8% to 18.1%. After 2010, it continued to grow, reaching 12.5 trillion in 2013, corresponding to 22% of Chinese GDP. Over the same period, average city-level debt increased from 7 to 28 billion RMB.

Figure A1 plots the evolution of total local government debt using both our data and official data (from National Audit Office and China International Capital Corporation Limited -CICC). While our estimates slightly underestimate the official figures (as explained above, we can only build a lower bound for total government debt), we are able to match the trend in the official data. In 2012 and 2013 our totals are very close to the official figures, the difference being less than 5%.

We were also able to obtain province-level official data from the surveys conducted by that National Audit Office (NAO) in 2012 and 2013. We thus aggregate our 293 cities into the 30 Chinese provinces to compare our data with province-level NAO figures. NAO breaks down local government debt into three components: (i) direct debt of local governments (NAO 1 in Table A1); (ii) debt guaranteed by local governments (NAO 2 is equal to NAO 1

[28]In turn, short-term debt equals short-term borrowing plus notes payable, non-current liabilities due within one year, other current liabilities and short-term bonds payable. Long-term debt equals long-term borrowing plus bonds payable.

plus this second component); (iii) debt that is not guaranteed by the local government but may create contingent liabilities (NAO 3 is equal to NAO 2 plus this third component).[29] By adding up the first two components (NAO 2 in Table A1), one obtains a stock of total outstanding government debt that is close to the figure that we obtain by adding up our data (the column labelled HPP). Moreover, the correlation between our data aggregated at the province level and the NAO figures is always above 65% (often above 70%) and statistically significant at the 1 percent confidence level.

Figure A2 visually shows the close correlation between our province-level aggregates and the official NAO data (the Figure uses the NAO 2 definition). The figure also shows that our measure is indeed a lower bound for total local government debt, with most points lying below the 45 degree line. There are four exceptions to this patterns: Beijing, Tianjin, Jiangsu and Zhejiang. Beijing and Tianjin are both cities and provinces and two of the four Chinese municipalities under the direct control of the central government; Jiangsu, located just north of Shanghai, is the province with the largest stock of outstanding local government debt; and Zhejiang, located in the Pearl River delta, is also close to Shanghai. For Beijing and Tianjin, our data indicate a stock of outstanding local government debt far exceeding that reported by NAO, possibly because of the special status of these two cities: as they are under direct control of the central government, some issuances that we assign to these cities may actually be Central Government liabilities. In the cases of Jiangsu and Zhejiang, our estimates slightly exceed those of NAO, but the difference is not very large (it ranges between 5 and 15%). Our results are robust to dropping the observations for these cities.

A.2 City-level correlates of local government debt

Table A2 reports the overall (across and within cities) correlations between local government debt and a set of city-level variables: debt is positively correlated with city-level income per capita ($ln(GDP\ PC)$), population size ($ln(POP)$), total income ($ln(GDP)$), local government budget balance over GDP (GB, i.e. the unconsolidated budget balance of the city itself, which does not include the activities of the local government financing vehicles that issued the debt), city-level bank loans over GDP (BL, i.e. total bank loans that include credit to local governments), and two measures of average land price ($LP1$ being the log of an average of auction prices and administered prices fixed by the local government, $LP2$ being the log of the auction price).[30] The correlation between local government debt and city-level economic growth (GR) is instead negative if one does not control for other city-level variables (column 4 of Table A2), but becomes positive and statistically significant if one jointly controls for other city-level variables (column 9 of Table A2).

As most of our analysis focuses on within city regressions, Table A3 shows the within-city correlation of the variables described above (i.e., we control for city-fixed effects). In this case, there is no correlation between local government debt and each of income per capita, total income and population size. There is also a positive and statistically significant correlation between local government debt and each of growth, budget balance, bank loans,

[29] NAO mentions that analysts and researchers should be careful in adding up these three components.

[30] Data on land price are from the Chinese Yearbook of Land Resource published by the Ministry of Land and Resources. For details on China's land market see Cai et al. (2009).

and land prices.

The positive correlation between local government debt and growth suggests that, rather than engaging into city-level counter-cyclical fiscal policy, local government financing vehicles are more likely to issue debt to finance infrastructure projects when the local economy is booming and tax revenues are high. This finding also explains the positive correlation between local government debt and the city budget balance.

The positive correlations between local government debt, bank loans and land prices is instead likely to be due to the fact that lending to local governments is part of total bank loans and that land is often used as collateral by LGFVs.

Table A1: **Local Government Debt in China, Comparison with Official Data**

This table compares our data (HPP) with data from the National Auditing Office (NAO). NAO 1 refers to debt that NAO classifies as a direct obbligation of local governments, NAO 2 is equal to NAO 1 plus debt guaranteed by local governments, NAO 3 is equal to NAO2 plus debt which may create contingent liabilities (some responsability of assistance in NAO's language). The table also reports the correlation between HPP data aggregated at the provice level and the three different defintions of local goverment debt of the National Auditing Office.

Year	NAO 1	NAO 2	NAO 3	HPP
		2012		
Total China (Billion, RMB)	8,835	11,025	14,563	10,425
Province-level correlation with HPP data				
Correlation	0.76	0.71	0.79	
p-value	0.00	0.00	0.00	
		2013		
Total China (Billion, RMB)	10,591	13,186	17,432	12,556
Province-level correlation with HPP data				
Correlation	0.66	0.65	0.73	
p-value	0.00	0.00	0.00	

Table A2: **The Correlates of Local Government Debt in China**

This table reports the overall city-level correlations between local government debt and each of the log of GDP per capita ($ln(GDP\ PC)$), the log of population size ($ln(POP)$), the log of total GDP (GDP), GDP growth (GR), unconsolidated budget balance over GDP (GB, this is the budget of the city government and does not include the activities of the local government financing vehicles that issue the debt), total bank loans over GDP (BL these are local bank loans and include lending to local government financing vehicles), and two measures of land price ($LP1$ is an average of auction prices and administered prices fixed by the local government and $LP2$ is the auction price). All regressions include data for 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$ln(GDP\ PC)$	5.78***								2.71***
	(0.37)								(0.50)
$ln(POP)$		3.52***							2.23***
		(0.42)							(0.44)
$Ln(GDP)$			5.62***						
			(0.29)						
GR				-0.21**					0.21***
				(0.09)					(0.08)
GB					0.48***				0.04
					(0.05)				(0.05)
BL						0.15***			0.13***
						(0.005)			(0.005)
$LP1$							7.46***		1.81***
							(0.35)		(0.45)
$LP2$								7.09***	
								(0.36)	
Constant	15.48***	-13.00***	-17.76***	10.43***	11.62***	-6.151***	-38.18***	-37.76	-26.96***
	(0.57)	(2.50)	(2.50)	(1.33)	(1.25)	(0.49)	(2.12)	(2.33)	(3.04)
Observations	2,080	2,080	2,093	2,064	2,093	2,089	2,063	2,063	2,022
R-squared	0.11	0.03	0.16	0.002	0.04	0.37	0.18	0.16	0.39
City FE	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year FE	NO	NO	NO	NO	NO	NO	NO	NO	NO

Robust standard errors clustered at the city-level in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A3: **Within-city Correlates of Local Government Debt in China**

This table reports the within-city correlations between local government debt and each of the log of GDP per capita ($ln(GDP\ PC)$), the log of population size ($ln(POP)$), the log of total GDP (GDP), GDP growth (GR), unconsolidated budget balance over GDP (GB, this is the budget of the city government and does not include the activities of the local government financing vehicles that issue the debt), total bank loans over GDP (BL these are local bank loans and include lending to local government financing vehicles), and two measures of land price ($LP1$ is an average of auction prices and administered prices fixed by the local government and $LP2$ is the auction price). All regressions include data for 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$ln(GDP\ PC)$	-0.578								0.44
	(0.84)								(1.85)
$ln(POP)$		0.73							0.69
		(0.96)							(2.05)
$Ln(GDP)$			0.04						
			(1.64)						
GR				0.15***					0.19***
				(0.05)					(0.06)
GB					0.30***				0.35***
					(0.08)				(0.08)
BL						0.05***			0.06***
						(0.008)			(0.008)
$LP1$							1.15***		1.01***
							(0.37)		(0.37)
$LP2$								0.50	
								(0.34)	
Observations	2,080	2,080	2,093	2,064	2,093	2,089	2,063	2,063	2,022
N. Cities	261	261	261	261	261	261	261	261	261
City FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors clustered at the city-level in parenthesis. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Figure A1: **Evolution of Local Government Debt in China: Comparison with Official Data**.

This figure plots total local government debt in China. The solid line plots our data and the dashed line plots data from China International Capital Corporation Limited (CICC).

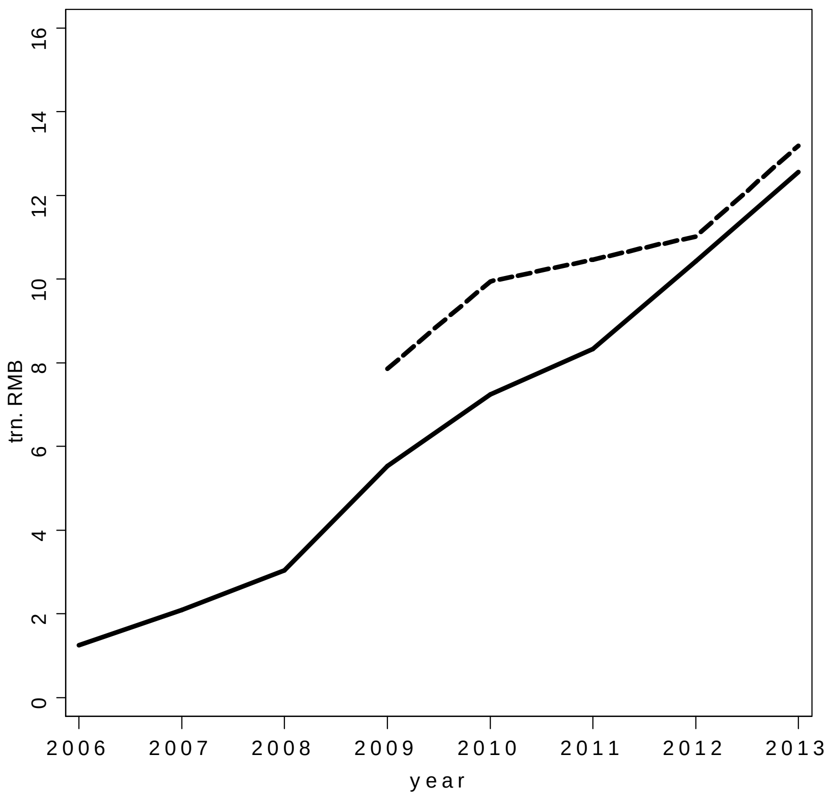
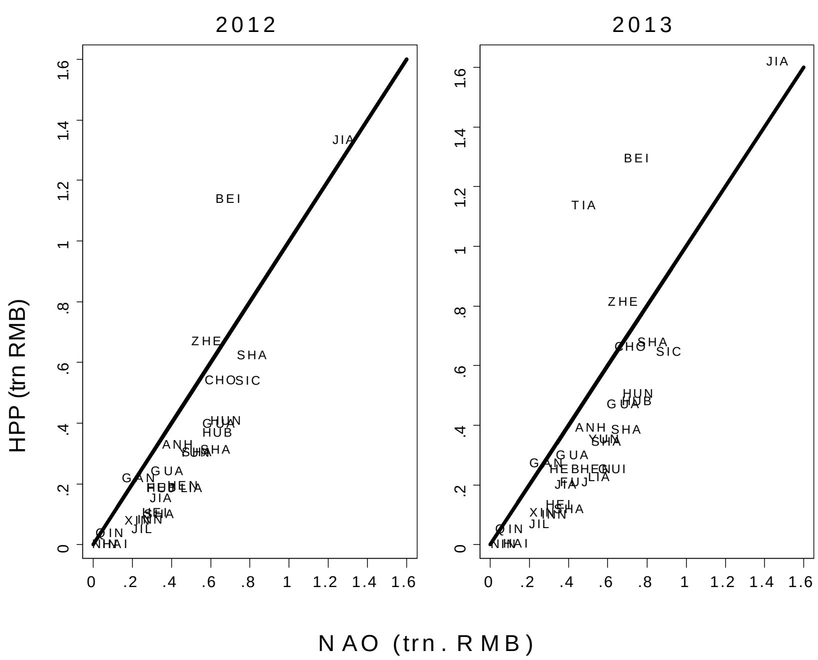


Figure A2: **Local Government Debt in Chinese Provinces**.

These figures compare our local government debt data (HPP) aggregated at the province level with official data from the National Audit Office (NAO) for the years 2012 and 2013.



B Additional tables

Table A4: **Summary Statistics**

	Mean	Median	Std. Dev.	P25	P75	Min	Max	N. Obs
				Firm-level variables				
I	8.63	1.77	19.87	0.10	9.53	-1.86	74.68	1,150,340
REV	0.47	0.14	1.16	0.09	0.64	0..00	4.33	1,150,340
LCF	0.14	0.07	0.21	0.02	0.18	0.00	0.81	1,150,340
AGE	9.1	8	4.99	5	12	1	20	1,150,340
$Assets$	144,916	28,488	674,096	11,369	83,282	0	1.4e+08	1,150,340
$Z-score$	6.81	5.57	5.73	3.35	8.89	0	23	1,078,981
				City-year variables				
LGD	8.12	3.56	14.38	1.28	7.67	0	147.81	2,093
BL	92.40	79.31	52.10	55.36	112.98	7.53	381.31	2,093
GB	-8.30	-6.85	6.07	-11.89	-3.59	-22.00	5.00	2,089
GR	13.02	13.24	3.36	11.19	15.10	5.00	24.00	2,064
$GDP\ PC$	3.8	2.6	4.3	1.6	4.4	0.5	51.0	2,080
GDP	1,653	926	2,247	529	1766	85	21,602	2,093
POP	4.498	3,775	3,249	2,427	8,061	154	33,829	2,080
$LP1$	617.7	438.8	562.1	274.4	746.3	50	3300	2,063
$LP2$	777.3	539.6	775.6	353.0	881.6	75	4899.9	2,063
TOP	0.38	0	0.80	0	1	0	6	2,063
TR	7.53	5.71	9.24	3.16	9.63	1.16	181.8	2,063
EXT	7.00	6.97	0.57	6.61	7.38	5.65	9.08	2,090

LGD, BL, BB, GR are percent of GDP, $GDP\ PC$, GDP and POP are in 1,000 units.

Table A5: **Data Description and Sources**

Variable	Description and Sources
I	Fixed investment over beginning of the year total assets. Fixed investment is computed as total fixed assets at historical price in year t minus total fixed assets at historical price in year $t-1$. Data are from ASIF and ATS.
REV	Change in operating revenues over total assets at the beginning of the periods. Data are from ASIF and ATS.
CF	Cash flow over total assets at the beginning of the period. Cash flow is computed as profits minus taxes plus depreciation. Data are from ASIF and ATS.
Age	Firm Age. Data are from ASIF and ATS.
Assets	Firm total assets. Data are from ASIF and ATS.
Z-score	Firm distance to default computed as: $Z = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$, where $X_1 = \frac{(Current\ Assets - Current\ Liabilities)}{Total\ Assets}$; $X_2 = \frac{Retained\ Earnings}{Total\ Assets}$; $X_3 = \frac{EBIDTA}{Total\ Assets}$; and $X_4 = \frac{Book\ Value\ of\ Equity}{Total\ Liabilities}$. Data are from ASIF and ATS.
Private	Dummy variable that takes a value of 1 if the firm belongs to the private sector and is not foreign-owend. We classify as private firms in which the public sector or foreigners own less that 30 percent of total shares.
State	Dummy variable that takes a value of 1 if the firm is government owned. We classify as state-owned firms in which the public sector owns more than 30 percent of total shares and foreigners own less than 30 percent of total shares.
Foreign	Dummy variable that takes a value of 1 if the firm is foreign-owned. We classify as foreign-owned firms in which foreigners own more than 30 percent of total shares.
LGD	City-level local government debt over city-level GDP. The construction of the local government debt variable is described in Section 2.
BL	City-level bank loans over city-level GDP. Both variables are from the from the *China City Statistical Yearbook*.
GDP PC	City-level GDP per capita. Source: *China City Statistical Yearbook*.
GR	City-level GDP growth. Source: *China City Statistical Yearbook*.
GB	City-level budget balance over GDP. Source: *China City Statistical Yearbook*.
LP1	City-level land prices computed as average of auction prices and administered prices fixed by the local government. Source: *Chinese Yearbook of Land Resource*, published annually by the Ministry of Land and Resources.
LP2	City-level land prices computed as average of auction prices. Source: *Chinese Yearbook of Land Resource*, published annually by the Ministry of Land and Resources.
TR	City-level measure of transfers computed by adding up national general transfers and special purpose transfers. Sources: *Fiscal Statistics for Prefectures, Municipalities and Counties* and *Statistical Yearbooks of China*.
TOP	City-level measure of links to national policymakers. TOP is the number of members of the Central Committee of the Chinese Communist Party born in a given city who are at the ministerial level or above. The total does not include the military and members who work in local governments. We complement data originally collected by Zhou (2014) and based on *Chinese Bureaucracies and Leaders Database*, *Chinese Government Public Information Online* with the *Chinese Political Elites Database* constructed and maintained by the National Chengchi University.
EXT	City-level external shock computed as $EXT_{c,t} = \sum_j \frac{I_{j,c,t-1}}{\sum_j I_{j,c,t-1}} \sum_{v \neq c} I_{j,v,t}$. Source: own elaboration based on ASIF and ATS data.
EXP	Industry-level exposure to government expenditure computed by matching firms in seven sectors (electricity production and distribution; heat production and distribution; gas distribution; water distribution and sewage treatment; construction; environmental management; and public facilities management) with the input-output table constructed by China's National Statistics Bureau.
EF	Industry-level index of external finance needs computed as computed as the industry median of the ratio between capital expenditures minus cash floow from operations and capital expenditures for all firms based in Beijing, Shanghai, Hangzhou, and Wenzhou. Source: own elaboration based on ASIF and ATS data.

Table A6: **Firm-Level Regressions: Without Lagged Investment**

This table reports the results of a set of regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are revenues growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of local government debt over GDP (LGD) and bank loans over GDP(BL). The first column uses all manufacturing firms, column 2 only includes private sector domestically owned manufacturing firms, column 3 only includes state-owned manufacturing firms, and column 4 only includes foreign-owned manufacturing firms. The regressions cover 261 cities for the period 2006-2013.

	(1)	(2)	(3)	(4)
REV_{t-1}	3.901***	3.936***	2.634***	2.910***
	(0.032)	(0.035)	(0.179)	(0.233)
CF_{t-1}	-9.433***	-9.196***	-17.35***	-20.72***
	(0.378)	(0.416)	(1.981)	(2.762)
$CF_{t-1} \times LGD$	0.106***	0.116***	-0.045	-0.077
	(0.014)	(0.016)	(0.071)	(0.060)
$CF_{t-1} \times BL$	-0.004	-0.008*	-0.014	0.069***
	(0.004)	(0.004)	(0.021)	(0.020)
N. Obs	1,161,298	985,432	62,386	33,888
N. Firms	392,157	357,642	32,403	16,005
N. Cities	261	261	261	261
Firm FE	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust s.e. clustered at the firm level in parenthesis

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

Table A7: **Firm-Level Regressions: Post 2007**

This table reports the results of a set of regressions where the dependent variable is the firm-level investment ratio (computed as investment over total assets at the beginning of the period), and the explanatory variables are lagged investment (I_{t-1}), revenues growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of local government debt over GDP (LGD) and bank loans over GDP (BL). The regressions cover 261 cities for the period 2008-2013.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.312***	-0.319***	-0.496***	-0.380***
	(0.002)	(0.002)	(0.013)	(0.015)
REV_{t-1}	4.409***	4.395***	2.753***	2.531***
	(0.0434)	(0.0465)	(0.260)	(0.289)
CF_{t-1}	11.18***	11.61***	10.73***	-2.722
	(0.499)	(0.544)	(2.815)	(3.267)
$CF_{t-1} \times LGD$	0.164***	0.167***	0.123	-0.115**
	(0.016)	(0.018)	(0.092)	(0.057)
$CF_{t-1} \times BL$	-0.074***	-0.074***	-0.114***	0.020
	(0.004)	(0.005)	(0.026)	(0.022)
N. Obs.	742,976	647,711	25,998	23,922
N. Firms	349,597	317,265	16,427	13,404
N. Cities	261	261	261	261
Firm FE	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table A8: **Firm-Level Regressions: Only Data from ASIF**

This table estimates the models of Table 10 by restricting the sample to the observations available in the ASIF survey.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.207***	-0.218***	-0.293***	-0.206***
	(0.003)	(0.003)	(0.013)	(0.015)
REV	0.973***	1.052***	0.497**	1.178***
	(0.040)	(0.0458)	(0.231)	(0.272)
CF_{t-1}	9.719***	9.894***	7.180***	3.539
	(0.406)	(0.476)	(1.981)	(2.211)
$CF_{t-1} \times LGD$	0.440***	0.469***	0.149	-0.0565
	(0.034)	(0.040)	(0.145)	(0.142)
$CF_{t-1} \times BL$	-0.263***	-0.275***	-0.222***	-0.0952***
	(0.007)	(0.009)	(0.036)	(0.032)
N. Obs.	572,075	455,958	36,619	20,055
N. Firms	274,190	231,252	20,561	10,791
N. Cities	261	261	261	238
Firm FE	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES
Sample	All	Private	State	Foreign

Robust s.e. clustered at the firm level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1