Local Crowding Out in China*

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Abstract

In China, between 2006 and 2013 local public debt crowded out the investment of private firms by tightening their funding constraints, while leaving state-owned firms' investment unaffected. We establish this result using a novel, purpose-built dataset for Chinese local public debt. The investment of private firms is inversely correlated with city-level public debt, and this result is stronger for private firms that depend more heavily on external funding. Moreover, in cities where public debt is high, private firms' investment is more sensitive to internal cash flow, also when cash-flow sensitivity is estimated jointly with the probability of being credit-constrained.

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1 Introduction

In China, between 2006 and 2013 local government debt almost quadrupled from 5.8% to 22% of GDP. For the most part, this was the product of the fiscal stimulus program carried out after 2008, worth US$590 billion, coupled with much-reduced reliance on central government debt and transfers to local governments. Building on a novel, purpose-built public debt database for prefecture-level Chinese cities in 2006-13, we test whether this increase in local debt crowded out firm investment in the corresponding cities by inducing banks to tighten credit supply to local firms, and – if so – whether the credit crunch spared state-owned enterprises, leading to a reallocation of capital from private to public firms. As private firms are the most dynamic component of the Chinese economy, such a reallocation would exacerbate the detrimental growth effects of crowding-out, with public debt issuance not only curtailing firm investment, but also hindering its efficient allocation.

The Chinese financial market provides an ideal setting to test this local crowding-out hypothesis, because of its geographical segmentation and regulation. In an integrated nationwide financial market, there would be no reason to expect local government debt to affect local investment: its issuance would trigger an increase in local interest rates, drawing in capital from the rest of the country, besides possibly causing an increase in local saving. Eventually, the greater stock of local public debt would be held by investors throughout the country, and any crowding-out of private investment would occur at national level.[1] But if financial markets are geographically segmented, the imbalance and its impact on investment are localized. In China, where local governments are typically funded by banks, their debt issuance ends up being absorbed by local banks. Furthermore, in a credit market with interest rate ceilings, like the Chinese one, such issuance does not trigger a rise in local interest rates and a consequent offsetting response of local saving. Thus, unless local saving increases for other reasons (e.g., due to greater public spending), placing additional local public debt with local banks should entail a tightening of credit to local firms.

Not all borrowers should be affected equally, however. If banks maximize profits, they will tighten credit more vis-à-vis riskier borrowers, such as those with less collateral to pledge and higher monitoring costs (as modeled by Broner, Erce, Martin and Ventura, 2014, in a

[1] The hypothesis of segmentation would not be necessary if external investors had a limited appetite for a certain jurisdiction. In a study of 15 emerging market countries, Ağca and Celasun (2012) show that external public debt can crowd out external borrowing by private corporations.

cross-country setting). If instead banks allocate credit preferentially to politically connected clients, such as state-owned firms, then firms with no political ins will be rationed more strictly. And these two criteria may well coincide, as state-owned firms are generally assisted by government guarantees.[2] Moreover, in China state-owned firms are less dependent on bank credit, having almost exclusive access to bond financing.[3]

We bring a varied set of complementary firm-level evidence to bear on this local crowding-out hypothesis. First, we show that local government debt is negatively correlated with private manufacturing investment, but not with that of state-owned manufacturers. Next, we use different approaches to assess whether this relationship is causal and to establish a possible mechanism through which local government debt affects investment. While we experiment with city-level instrumental variable estimates, our central results are based on firm-level data and empirical strategies aimed at uncovering whether local government debt amplifies credit constraints for private manufacturing firms.

One such strategy is to test whether local government debt affects more the investment of firms whose technology requires more external funding. This approach, akin to that of Rajan and Zingales (1998), allows us to investigate whether government debt affects investment by tightening credit constraints, and mitigates problems of endogeneity by permitting the inclusion of city-year and industry-year effects. Again, local government debt turns out to be associated with less investment by financially dependent private manufacturing firms but not with investment by financially dependent state-owned firms.

Next, we test whether local government debt affects the sensitivity of firms' investment to internally generated funds. By focusing on within-firm and within-city-year variation, this approach overcomes concerns about reverse causality from investment to local government debt. Unlike the Rajan-Zingales approach, this methodology – reminiscent of that used by Love (2003) to test whether country-level financial depth attenuates credit constraints – needs no assumptions about the external financing requirements of firms in different industries. We find that local government debt increases the sensitivity of investment to internally generated

[2] Dobson and Kayshap (2006, p. 133) quote a Chinese bank manager as follows: "If I lend money to an SOE and it defaults, I will not be blamed. But if I make a loan to a privately-owned shoe factory and it defaults, I will be blamed."

[3] Chinese corporate debt is issued overwhelmingly by enterprises whose majority (and often sole) shareholder is an organ of the central or local government (Lin and Milhaupt, 2016, p. 16).

funds for domestic private firms, but not for state-owned firms.

To take account of the critique of this methodology put forward by Kaplan and Zingales (2000), we use a switching regression model with endogenous sample separation, where firms' investment sensitivities are estimated jointly with their likelihood of being credit-constrained (as in Hu and Schiantarelli, 1998, and Almeida and Campello, 2007). Consistently with the previous estimates, local government debt affects cash-flow investment sensitivity for credit-constrained firms but for not unconstrained ones, and private firms are significantly more likely to be credit-constrained than state-owned ones.

This paper is related to the vast literature on the impact of government debt on investment and growth. While there is evidence of a negative correlation between public debt and growth (see Reinhart and Rogoff, 2011, and Reinhart, Reinhart and Rogoff, 2012, among others), establishing the causal nexus has been more difficult, as international comparisons are plagued by such problems as reverse causality, omitted variables, and limited degrees of freedom (Mankiw, 1995).[4] As noted above, the geographical segmentation and interest rate ceilings of China's financial market enable us to identify a local crowding-out channel whereby government debt may reduce growth. Specifically, we show that higher local government debt crowds out investment by tightening the financing constraints on private manufacturing firms. As such, our work also relates to the vast corporate finance literature turning on the thesis that the investment of credit-constrained firms is more sensitive to internal cash flow than that of unconstrained firms.

We also contribute to the strand of research inquiring into the effects of the Chinese fiscal stimulus in the wake of the global financial crisis (see Deng, Morck, Wu and Yeung, 2015, Ouyang and Peng, 2015, and Wen and Wu 2014, among others). The stimulus plan appears to have exacerbated a long-standing feature of China's economy, namely that high-productivity private firms fund their investment out of internal savings while low-productivity state-owned firms survive thanks to easier access to credit (Song, Storesletten and Zilibotti, 2011): under the stimulus plan, new bank credit went disproportionately to state-owned firms rather than more productive private firms (Cong, Gao, Ponticelli and Yang, 2017; Ho, Li, Tian, and Zhu, 2016).[5] According to Bai, Hsieh, and Song (2016), funding the stimulus plan via local gov-

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

[5] Papers on capital misallocation in China include Bai, Hsieh, and Qian (2006), Chang, Liao, Yu, and

ernment financing vehicles induced a credit reallocation in favor of politically well-connected firms, probably with negative effects on long-run productivity growth. Such reallocation is consistent with our finding that public debt issuance constrained the investment of private firms but not that of state-owned enterprises, which are by definition politically connected. Indeed our estimates of the extent of such credit reallocation are necessarily conservative, since the private firms examined include some politically connected ones that may have been spared by the reallocation, and may even have gained from it.[6]

Finally, our paper adds to existing knowledge about local government debt in China. Previous studies either estimate total local government debt with no geographical breakdown (Zhang and Barnett, 2014, National Audit Office, 2011, 2013, and Wu, 2015), or only focus on bond issuances, which account for a small part of total borrowing by local government financing vehicles (Ang, Bai and Zhou, 2015, Ambrose, Deng and Wu, 2015, Liang, Shi, Wang, and Xu, 2016). Instead, we build detailed data on total borrowing by local government financing vehicles (LGFVs) in 261 prefecture-level cities between 2006 and 2013. The only other recent comprehensive study of China's local government debt is Gao, Ru and Tang (2016), who document that distressed local governments prefer to default on commercial bank loans rather than on politically-sensitive policy bank loans.

The paper is organized as follows. Section 2 sets out our data. Section 3 describes the drivers of geographical segmentation in the Chinese financial market. Section 4 shows that investment by private-sector manufacturing firms is negatively correlated with local government debt. Section 5 discusses endogeneity concerns. Section 6 documents that local government debt is particularly harmful for industries that need more external financial resources. Section 7 shows that local government debt increases investment sensitivity to cash flow for credit-constrained firms. Section 8 corroborates the results of Section 7 by using an endogenous switching model that jointly estimates the likelihood of being constrained and investment sensitivity to cash-flow. Section 9 concludes.

Ni (2014), Chong, Lu, and Ongena (2013), Cull and Xu (2003), and Song and Wu (2015). Moreover, there is a vast literature on the connections between economic growth and finance in China, focusing on the transformation of the state sector (Hsieh and Song, 2016), the role of government credit (Ru, 2017), bank competition (Ru, Townsend, and Yan, 2017), and the side effects of financial interventions (Brunnermeier, Sockin, and Xiong, 2016).

[6]Unfortunately, it is impossible to measure political connections for our sample of more than 350,000 private firms.

2 The data

As mentioned above, a key element of our study is the purpose-built data set of Chinese local government debt. Our data are at the level of prefecture-level cities, the second tier of Chinese local government bodies, below provinces. These cities are administrative units that include continuous urban areas and their surrounding rural areas, comprising smaller towns and villages.[7] While we build debt data for all 293 prefecture-level cities for 2006-13, our statistical analysis is limited to 261 cities, as for 32 macroeconomic data are lacking.

Prefecture-level cities (henceforth, just "cities") tend to be large. Populations range from 200,000 to 33 million, and 196 of our sample cities (75% of the sample) have at least 2.5 million inhabitants, with a median population of 3.8 million. Our sample also includes 100 cities with over 5 million inhabitants and 25 cities with more than 8 million.

The cities in our sample had a total population of 1.2 billion in 2013, or 91% of China's total population. Total GDP for the 261 cities came to 60.7 trillion yuan, which was actually more than China's estimated GDP that year of 58.8 trillion yuan. The discrepancy depends in part on the incentive for local politicians to overestimate economic growth (Koch-Weser, 2013) but in part also on double-counting due to the difficulty 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 the corresponding central government figures.[8] Dividing 60.7 trillion by 1.1 yields 55.2 trillion, which suggests that the cities in our sample produce about 93% of China's GDP.

2.1 Local government debt in China

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

Before going into details, it is worth briefly recounting the manner in which Chinese local

[7] Prefecture-level cities are further divided into a third tier, namely counties or county-level cities. Cities in the strict sense of the term (i.e., contiguous urban areas) are called urban areas (shìqû in Chinese).

[8] For an article in the Financial Times documenting this discrepancy, see: 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

governments issue debt. Municipalities cannot borrow from banks or issue bonds directly, but can set up local government financing vehicles (LGFVs), transfer assets to them (usually land), and instruct them to borrow from banks or issue bonds, possibly posting the transferred assets as collateral (Ambrose, Deng and Wu, 2015). Our measure of local government debt is the volume of loans and bonds issued by these LGFVs.

As LGFVs are not generally required to disclose their financial information, efforts to collect data on local government debt from publicly available sources have generally looked at bond issuance by these entities (Ambrose, Deng and Wu, 2015; Ang, Bai and Zhou, 2015). While bond issuance has grown dramatically in recent years (from 6% of total LGFV debt in 2006 to 21% in 2013), the volume of bonds outstanding is far less than the total debt, which actually consists mostly of bank loans (Figure 1).

To estimate the 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 disclose their balance sheets for the current and at least the three previous years. So, if an entity issues a bond in year t, we have data on its total outstanding debt back to year $t-3$. As the number of LGFVs issuing bonds soared between 2007 and 2014, this method provides a much more accurate and comprehensive lower bound for local government debt than bond issuance alone. Appendix A describes our methodology in detail and shows that our data match the aggregate figures published by the National Audit Office (see Table A5).

Our data show that municipal debt grew rapidly in the wake of the global financial crisis, when local governments were asked to contribute to the central government's massive fiscal stimulus but were not accorded additional fiscal resources with which to do so (Lu and Sun, 2013, and Zhang and Barnett, 2014). Between 2006 and 2010, outstanding local government debt jumped six-fold, from 1.2 trillion to 7.2 trillion yuan (Table 1); in proportion to GDP it trebled from 5.8% to 18.1%. And it continued to grow thereafter, reaching 12.5 trillion yuan or 22% of Chinese GDP in 2013. The share of cities with some debt outstanding rose from less than half in 2007 to nearly 100% in 2011, while their average debt expanded from 7 billion to 28 billion yuan.

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 GDP, total bank loans, population, and economic growth. The final dataset produced by merging the two sources covers 261 cities from 2006 to 2013.

Our firm-level data come from the Annual Survey of Industrial Firms (ASIF), also known as the Chinese Industrial Enterprise Database (CIED). This database covers the universe of manufacturing firms with annual sales above 5 million yuan until 2009 (about $750,000 at the 2009 exchange rate) and 20 million yuan thereafter ($3,200,000 at the 2015 exchange rate). ASIF reports firms' location, ownership structure, and balance-sheet variables. This survey has been used, among others, by Bai, Hsieh and Song (2016), 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% in 2013. This very broad coverage reflects the fact that it is compulsory for firms larger than the above threshold sizes to file detailed annual reports to their local statistics bureaus. The data are transmitted to the National Bureau of Statistics (NBS), which aggregates them in the China Statistical Yearbook. Our sample spans the period from 2005 to 2013 and contains the same number of observations as the NBS during these years. Unfortunately, however, the survey is not available for 2010, depriving us of three years' worth 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 also data for 2012, because our regressions include lagged variables.[9]

To compensate for this loss of information, we merge our ASIF data with the Annual Tax Survey (ATS), conducted by the Ministry of Finance between 2007 and 2011. The ATS gives detailed financial statements for manufacturing firms but also for agriculture, construction, and services. By exploiting the overlap in coverage between the two databases, we retrieve data for a large number of firms; however, our sample for 2010-12 still remains considerably smaller, on average, than for 2006-9 or 2013 (61,000 against 387,000 firms per year).

Dropping observations for firms with negative assets and those in the top and bottom 1%

[9] 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.

of the revenue distribution, and applying a 5% winsorization for all our firm-level variables, we are left with 1,150,340 observations on 387,781 firms, and 1,281 city-years. Shanghai has the most observations (61,347), Jiayuguan City the fewest (167). The sample includes 30 cities with at least 10,000 observations, and 90% of the sample cities have over 1,700 observations. The median is 1,970 observations, the mean 4,407.

3 Geographical segmentation

As noted above, the geographical segmentation of China's financial markets is key to our empirical strategy. The financial system is heavily bank-based, with three policy banks, one postal bank, five large commercial banks, 12 joint-stock commercial banks, 40 locally incorporated foreign banks, 133 city commercial banks, and more than 2000 rural banks or credit cooperatives. Policy banks hold some 10% of total Chinese banking assets, large commercial banks about 40%, joint-stock commercial banks 19%, and local banks (city-level and rural banks and credit cooperatives) 30%. Foreign banks control the remaining 1% (China Banking Regulatory Commission, 2015).[10]

Geographical segmentation arises from two characteristics of the banking system. First, city and rural financial institutions rarely operate outside their own city or province. Until 2006, local banks were prohibited from doing business outside their province of origin. And although reforms between 2006 and 2009 allowed them to operate across provincial boundaries, only a very few inter-province licenses have actually been approved. The city commercial banks that have been so authorized typically have branches only in a few of the wealthiest cities (Shanghai, Beijing, Tianjin, Hangzhou, and Ningbo).

Second, even the policy banks and large commercial banks, which are present throughout China and together account for 50% of total bank assets, still conduct business on a local basis: Dobson and Kayshap (2006, p. 132) describe the large banks as holding companies with separate legacy organizations for every province, each with its own information and human resource system and power base. The consequence is a fragmented banking system in which local branches have substantial decision-making power and autonomy with respect

[10]For details on the Chinese banking and capital markets see, among others, Allen, Qian, and Qian (2005), Allen, Qian, Zhang, and Zhao (2012), Ayyagari, Demirgüç-Kunt, and Maksimovic (2010), Bailey, Huang, and Yang (2011), and Berger, Hasan, and Zhou (2009).

to headquarters. In such a decision-making process, local politics and the pressure to lend to local governments and local state-owned enterprises play an important role. According to Roach (2006), local Communist Party officials, through their influence on bank branches, often have a bigger say in investment project approval than the credit officers at the head offices of the major banks in Beijing. The impact of local branches dwarfs the role of regulators and central bankers. Local authorities, furthermore, are crucial to bank managers' career advancement, and may thus influence lending decisions.[11]

There are several reasons why the interbank market does not contribute to smoothing local funding gaps. First of all, financial regulation prevents Chinese banks to lend more than 75% of their deposits (Chen, Ren, and Zha, 2015) and until 2013-14 non-traditional funding sources (including access to the interbank market) did not count towards this ratio (Elliott, Kroeber, and Qiao, 2015). Second, the repo market is dominated by the four largest Chinese banks, which use their market power to limit competition from smaller banks (Achem and Song, 2017). The limited ability of small banks to access the interbank market leads many of these institutions to seek funding with off balance sheet wealth management products whose funding costs on average exceed the interbank market rate (Acharya, Qian, and Yang, 2016). Finally, the People's Bank of China sets absolute caps on individual bank lending volumes, which constrain the lending capacity of most banks even further (Elliott, Kroeber, and Qiao, 2015). For banks that face such constraints, underwriting additional local public debt requires a one-for-one tightening of credit to the local private sector.

The geographical segmentation of the Chinese financial system and its distortionary effects on capital allocation are documented by many studies (Boyreau-Debray and Wei, 2004, 2005; Allen, Qian and Qian, 2005; Brandt and Zhu, 2007; Dollar and Wei, 2007; Firth, Lin, Liu and Wong, 2009). And evidence of such segmentation is present in our data as well: we find that the interest rates of LGFV bonds at issue vary significantly and persistently between cities, controlling for default risk (credit rating) and other bond characteristics.[12]

[11] Ho, Li, Tian and Zhu (2015) quote the following observation by a Chinese bank manager: "When my superior is thinking of promoting someone out of several equally good candidates from sub-branches, he might consult his friends in the local branch of the People's Bank of China, the local branch of the China Bank Regulatory Commission and the local government. Therefore, we have to manage the relationships with these government departments very carefully and skillfully. Otherwise, it will ruin our career since the senior will not promote a bank manager who is unwelcomed by his friends in the related fields, which in turn might endanger his career" (p.10).

[12] With data for nearly 9,000 such bonds, we first regress the interest rate at issue on credit rating, face

Moreover, these municipal bond yield differentials are positively correlated with local government debt. When our measure of local government debt is included as a further explanatory variable in interest rate regressions, the point estimate of the relevant coefficient implies that a 10% increase in local government debt is associated with an 80-basis-point increase in the local interest rate. While this finding is not evidence of a causal effect running from local government debt to interest rates, it is consistent with city-level financial markets being not only segmented, but also forced to absorb a disproportionate amount of local public debt (see also Chen, He, and Liu, 2016).

Another characteristic of China's financial market is the presence of interest rate ceilings on both deposits and loans. Such regulation was a factor in the rapid growth of a shadow banking sector, whose assets increased from 4.5 trillion yuan (14% of GDP) in 2008 to 11 trillion (27%) in 2010 (Elliot, Kroeber, and Qiao, 2015), partly as a result of the 2009 stimulus package itself (Chen, He, and Liu, 2016). The doubling in size of the sector coincided with the jump in the spread between the shadow lending rate and the official lending rate following the post-crisis fiscal stimulus (Figure A3). Whereas in the US shadow banking is channeled mostly through money market and hedge funds, in China it operates via a wide array of (often opaque) financial instruments: for instance, informal lending accounts for 17% of the total, and entrusted loans (i.e., loans from a non-financial corporation to another via a bank as servicing agent) constitute almost a third (Allen, Qian, Tu and Yu, 2016).[13] Most shadow banking transactions have a limited geographical scope: for instance, Allen, Qian, Tu and Yu (2016) show that, other things being equal, entrusted loans between firms located in the same city carry a significantly lower interest rate (by more than 1 percentage point) than transactions between firms in different cities. So the growing shadow banking sector presumably contributes further to the fragmentation of the Chinese financial market and amplifies the distortions generated by the pre-existing geographical segmentation.

value (in log), maturity (in years), the Chinese interbank rate (Shibor) on the issue date, and year fixed effects: this regression accounts for 50 percent of the variance of the interest rate. Including city fixed effects, the regression's adjusted R^2 rises to 60 percent. We also estimate separate regressions for each year in our dataset. The adjusted R^2 of the regressions that do not control for city fixed effects ranges between 29 percent (for 2013) and 65 percent (for 2010); for those that do, the range is from 38 percent (for 2013) and 74 percent (for 2010). Always the adjusted R^2 of the regressions that control for city fixed effects is at least 10 percentage points higher than of those that do not.

[13] On the Chinese shadow banking sector see also: Acharya , Qian, and Yang (2016), Chen, Ren, and Zha (2015), Chen, He and Liu (2016), Hachem and Song (2016), and Wang, Wang, Wang, and Zhou (2016).

4 Local crowding out: preliminary evidence

We start the empirical analysis with evidence of the correlation between firm-level investment and local government debt. In subsequent sections we pin causality and transmission channels down more firmly, but these regressions already provide preliminary evidence consistent with the hypothesis of local crowding-out. We start by estimating the following specification:

$$I_{i,c,t} = \beta LGD_{c,t} + X_{i,c,t}\Gamma + \alpha_i + \tau_t + \varepsilon_{i,c,t}, \tag{1}$$

where $I_{i,c,t}$ is the ratio of investment to assets in firm i, city c and year t, $LGD_{c,t}$ is the ratio of local government debt to local GDP in city c, year t, $X_{i,c,t}$ are a set of firm-level controls, and α_i and τ_t are respectively firm and year fixed effects. This specification implicitly controls for city fixed effects, which are a sub-set of firm fixed effects. In estimating Equation (1), we double-cluster the standard error at the firm and city-year level (the latter being the source of variation for our main variable of interest).

Column 1 of Table 2 presents the result of specification (1) controlling for the lagged investment ratio, revenue growth over total assets, and lagged cash flow. The correlation between total manufacturing investment and local government debt is negative and statistically significant. The point estimate indicates that a 1-standard-deviation increase in the debt-to-GDP ratio (14 percentage points) is associated with a 0.6 percentage-point decrease in the investment ratio (whose sample average is 8%). Column 2 shows that the results are unchanged including a dummy variable that controls for state-owned firms. Since the specification includes firm fixed effects, this dummy captures the effect of firms that change ownership status. The negative point estimate suggests that privatization is associated with higher investment levels.

The specification of column 3 includes also the interaction between the debt-GDP ratio and the state ownership dummy, so that β measures the correlation between local government debt and investment of private firms, the interacted variable measures the difference between private and state-owned firms, and the sum of the two coefficients measures the correlation between local government debt and investment for state-owned firms. The coefficient of the interacted variable is positive, statistically significant, and approximately equal to β in absolute value. The sum of the two coefficients is close to zero and not statistically significant, indicating that investment is negatively correlated with investment only for private manufacturing firms. Column 3 of Table 2 implies that in cities with no local government debt the difference between the investment of private and state-owned firms is three times larger than in the average city (the implied estimate of the state ownership coefficient dropping from -0.2 to -0.6).

The last column of Table 2 reports the results of a model in which city and year fixed effects are replaced by city-year fixed effects. This specification does not allow estimating the main effect of local government debt, but yields an estimate of how local government debt correlates with the difference between the investment ratio of private and state-owned firms, while controlling for all the shocks that are specific to a given city in a given year. This differences-in-differences specification corroborates our previous result that the correlation between investment and local government debt is significantly lower for state-owned firms.

If the negative correlation between local government debt and investment documented in Table 2 is driven by the presence of financing constraints, we should also find a negative correlation between local government debt and the leverage of private manufacturing firms. Table A2 in the appendix shows that this is the case. The table also shows that there is no correlation between leverage and local government debt for state-owned firms.

We subject these correlations to a battery of robustness checks and show that the baseline results of Table 2 are robust to estimating the model with the system and difference GMM estimators of Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998), to controlling for additional time-varying city-level variables (size of the banking sector, GDP per capita, and GDP growth) and to controlling for additional firm-level variables (firm size, leverage, marginal product of capital, export status, and firm age). The results are also robust to replacing the debt-to-GDP ratio with the change in debt over GDP, and to replacing total local public debt with local public debt funded by banks, net of bond debt. Interestingly, in regressions where local public debt does not include bonds, its coefficient is larger in absolute value than in those where it is measured as total debt (-0.46 instead -0.36), consistently with the idea that the bond market is less segmented than bank credit.[14] The results are qualitatively unchanged if all variables are aggregated at the city-year level, resulting in a single observation for each city-year, with the dependent variable being the weighted average of the investment-to-asset ratios for each city's manufacturing firms (Tables B7 and B8 of the online appendix).

[14]The results are reported in Tables B1-B6 of the online appendix.

Next, we estimate Equation (1) allowing the coefficient β to vary across our 261 cities. Table 3 describes the distribution of these coefficients (dropping an outlier equal to 108). The coefficients range from -6.25 to 9.31, with a mean value of -0.06, a median of -0.03, and a standard deviation of 1.19. We find that most cities (56%) feature a negative β, and for 30% of them β is both negative and statistically significant. Only 15% of cities in our sample have a positive and statistically significant coefficient. In the sample of cities with at least 1,000 observations, the average β drops to -0.16 and its median to -0.05, respectively, and they become more homogeneous (the standard deviation decreases from 1.19 to 1.11). In this sample, β is negative in 61% of the cities, negative and statistically significant in 40%, and positive and statistically significant only in 16% of them.

Finally, we explore whether β is correlated with city-level characteristics (averaged over the sample period), and find that the only variable significantly correlated with β is the city-level excess interest rate (EIR) recovered from the fixed effects of the bond-level regressions described in Section 3, as illustrated by Figure 2.[15] Hence, the cities where private investment is negatively correlated with local government debt are those where interest rates exceed the level predicted by bond and issuer characteristics (such as maturity, face value, and rating), consistently with the local crowding-out hypothesis.

5 Endogeneity

While the results of Table 2 accord with the thesis that local government debt crowds out private manufacturing investment, these are simple correlations, likely to suffer from endogeneity bias. The direction of the bias is unclear. On the one hand, local politicians may respond to negative shocks to private investment by instructing LGFV managers to borrow and invest more, so that the negative correlation could be due to reverse causality from investment to local public debt.[16] On the other hand, common shocks – such as spending on public infrastructure, which increases both private firms' profitability and public debt

[15] There is no evidence of a statistically significant correlation with city-level budget balance, size of the banking system, the debt-to-GDP ratio, the log of income per capita, GDP growth, the log of population size, average land prices, and the share of branches of national bank over total bank branches in a given city.

[16] While column 4 of Table 2 controls for all possible city-year shocks, it does not fully address the endogeneity problem becuase it is possible that cities that implement a countercyclical policy also ask state-owned firms to invest more.

issuance – could be driving both variables, biasing the estimates in the opposite direction.

To see this, suppose that the equation capturing the effect of local government debt (D) on private investment (I) is $I = \alpha + \beta D + \varepsilon$, but public debt reacts to private investment according to the equation $D = a + bI + e$. In estimating the parameter β, two endogeneity problems arise: first, it may be that $b \neq 0$ (for instance, $b < 0$ due to countercyclical local fiscal policy), second, there may be positive correlation $\rho_{\varepsilon e}$ between ε and e (growth and local public debt being positively correlated in Table A4).[17] The bias of the OLS estimator of β is:

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

Under the natural assumption $b\beta < 1$,[18] the direction of the bias depends on the relative importance of reverse causality ($b < 0$) and common unobservable shocks ($\rho_{\varepsilon e} > 0$).

We use two strategies to address the endogeneity problem. The first strategy is based on an instrumental variables (IV) approach: the resulting estimates of the coefficient β are again negative, and in fact indicate that the OLS overestimates it. While these estimates address causality issues to some extent, they do not provide ironclad evidence for a causal interpretation. Hence, we relegate them to the online appendix (Section D).

Our second strategy is to focus on the channel through which public debt can affect private investment, namely to document that public debt tightens credit constraints on private firms, but not on state-owned firms. Specifically, we test whether higher levels of government debt tighten credit constraints for firms that either need more external financial resources (Rajan and Zingales, 1998) or are more likely to face these constraints (Fazzari, Hubbard and Petersen, 1988; Almeida and Campello, 2007). These two approaches are respectively presented in the next two sections.

[17] 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 $E(\epsilon u) = 0$.

[18] 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 solving these two equations to be positive.

6 Investment, public debt and external financial needs

As explained in the introduction, given the institutional features of China's financial market, it is reasonable to expect that in cities with more public debt banks allocate more funds to the public sector, and tighten credit constraints on private firms, while state-owned firms are spared the crunch. One way of testing whether the data are consistent with this thesis is to determine whether government debt reduces investment more in industries that for technological reasons need more external funds – an approach similar to that of Rajan and Zingales (1998). Formally, we estimate the following model:

$$I_{ijct} = \beta I_{ijct-1} + \delta \left(EF_j \times LGD_{ct} \right) + \alpha_i + \kappa_{jt} + \theta_{ct} + \zeta_{cj} + X_{ijct-1}\Gamma + \varepsilon_{ijct}, \tag{3}$$

where I_{ijct} is the investment ratio in firm i belonging to industry j, located in city c and measured in year t, EF_j is a time-invariant measure of industry j's dependence on external finance, LGD_{ct} is local government debt scaled by GDP in city c and year t, α_i, κ_{jt}, θ_{ct}, and ζ_{cj} are firm, industry-year, city-year, and city-industry fixed effects respectively, and X_{ijct-1} are firm-level time-varying controls.

The parameter δ measures the incremental impact of local government debt on the investment of firms belonging to industries that depend more heavily on external finance. Due to the inclusion of firm, industry-year, city-year, and city-industry fixed effects, the specification (3) controls for any industry- or city-level time-varying factor. Therefore, it does not suffer from any obvious problem of reverse causality from city-level investment to local public debt issuance. The estimate of δ could be biased only if Equation (3) omitted some source of credit constraints that is itself correlated with local government debt. We address this potential problem by expanding specification (3) and controlling for city-level time-varying variables that might be jointly correlated with local government debt and credit constraints, such as measures of the depth of the local credit market.

Rajan and Zingales (1998) create their index of external financial dependence by calculating the industry median ratio of capital expenditures *minus* operating cash flow to total capital expenditure for a sample of US firms in the 1980s. They use data for US firms as these are least likely to be credit-constrained, owing to the high degree of US financial development. Hence, the amount of external funds used by US firms is likely to be a good measure of their unconstrained demand for external financing. To adapt the Rajan-Zingales measure to our sample, one must consider that the technological parameters of Chinese firms are likely to be very different from those of the large US firms. Hence, we construct an industry-level measure of external financial dependence in China using data from the four cities with the most developed financial markets (Beijing, Shanghai, Hangzhou, and Wenzhou)[19] and then use this measure to estimate equation (3) for the remaining 257 cities in our sample.

The estimates, shown in Table 4, indicate that the coefficient δ of the interaction between external financial dependence and local government debt is negative and statistically significant: hence, local crowding-out is particularly severe for firms that belong to industries that need more external financial resources. Column 2 of Table 4 show that interacting the index of external financial needs with other time-varying city-level characteristics (bank loans over GDP, the log of GDP per capita, and GDP growth) strengthens this result. Columns 3 and 4 show that the coefficient is statistically significant only for private sector firms: for state-owned firms the interaction between external financial needs and local government debt is never statistically significant.

To gauge the economic significance of the magnitude of δ, we use the point estimates of column 2 of Table 4 to evaluate its effect for the industries at the 25^{th} percentile (paper) and the 75^{th} percentile (battery production) of the distribution of the index of external financial dependency.[20] The left panel of Figure 3 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 remains at a level not significantly different from the average. Conversely, the right panel of Figure 3 shows the relationship at the 75^{th} percentile of the distribution, benchmarking it against the average investment ratio for this industry (the horizontal line at 10.5%). As local government debt rises, in this more financially dependent industry the investment ratio decreases sharply: when local public debt exceeds 15% of GDP, the ratio falls significantly below its 10.5% industry average, and when the debt climbs to 50% the investment ratio drops to about 6%.

[19] Among the large Chines cities, these are the cities with the highest ratios of bank loans to GDP.

[20] Industries with indexes of external financial dependency close to the paper industry include cigarette manufacturing and glass manufacturing. Those with indexes similar to batteries include transmission, distribution and control equipment, and communication equipment.

One potential concern with the estimates of Table 4 is that they rely on *ad hoc* decision (based on our institutional knowledge of China) in choosing the cities for which we computed the Rajan and Zingales index of external financial dependence. It is, however, possible that even in these cities with large financial sectors firms are credit-constrained. Indeed, in these cities the correlation between firm-level investment and local government debt was estimated to be negative and statistically significant in Section 4. To address this concern, we use the results described in Table 3 to recompute the index of external financial dependence based on data from the three largest cities where the correlation between investment and local government debt is estimated to be positive and statistically significant (namely, Guangzhou, Foshan, and Dongguan). Our results are robust to the use of this alternative measure of external financial dependence (see Table B11 of the online appendix).

Finally, it should be noticed that, unlike in the Rajan-Zingales approach, our estimation is based on firm-level data instead of industry-level data. While our inference is correct as standard errors are clustered at the city-industry-year (which is the source of variation of the variable of interest in Equation 3), Tables B12 and B13 of the online appendix show that our results are robust to aggregating the data at the industry-city-year level, as suggested by Bertrand, Duflo and Mullainathan (2004).

7 Cash-flow sensitivity with exogenous sample split

The Rajan-Zingales approach enables us to identify credit rationing as the economic channel through which local crowding-out operates, but is based on strong assumptions about the determinants of firms' external funding needs. For instance, it assumes that the external financing requirement of a paper-producing firm in Beijing is comparable to that of a paper producer in a small, isolated city. However, manufacturers in the same industry may well adapt their technologies to local conditions, so as to save on external funding. This would lead us to underestimate the impact of local government debt on manufacturing investment.[21]

To overcome this limitation, we adopt an empirical strategy that relies on firm-level estimates of cash flow sensitivity to test whether government debt tightens the financing

[21] The impact of local government debt on investment could also be underestimated inasmuch as the Rajan-Zingales methodology measures only the differential impact of government debt on firms that belong to industries characterized by different degrees of dependence, not the total effect of local government debt on investment.

constraints of private firms. Fazzari, Hubbard and Petersen (1988) were the first to exploit the idea that investment sensitivity to internally generated funds should be greater for credit-constrained firms.[22] Love (2003) extended this approach to an international data set and showed that financial market depth can attenuate financing constraints by reducing the sensitivity of investment to internal funds, especially for firms more likely to be constrained. Applying a variant of this approach to our sample of 261 Chinese cities, we demonstrate that local government debt tightens the financing constraints on private-sector manufacturing firms. We also confirm confirming Love's (2003) finding that financial depth reduces the sensitivity of investment to firms' cash flow.

The sensitivity of investment to cash flow has been criticized as a measure of financing constraints (Kaplan and Zingales, 2000), in that cash flow may proxy for investment opportunities and the sensitivity could be driven by influential outliers or by firm distress.[23] We address this criticism in two ways. The first is to split the sample in subsamples of constrained and unconstrained firms using an exogenous sample separation rule, as suggested by Fazzari, Hubbard and Petersen (2000). In the Chinese case, it is natural to base such a sample split on private vs. state ownership, considering that state-owned firms enjoy preferential treatment by banks and therefore are less likely to be credit-constrained. Then the prediction is that investment should be more sensitive to cash flow in private firms than in state-owned ones, and that such sensitivity should be greater the larger is the debt-GDP ratio in the city where the firm is located.

Second, we endogenize the sample separation rule by estimating a switching regression model of investment in which the probability of a firm's facing financing constraints is estimated jointly with firms' cash-flow investment sensitivity, along the lines of Hu and Schiantarelli (1998) and Almeida and Campello (2007). This approach does not hinge on a predetermined sample separation between constrained and unconstrained firms.

[22] They proxied credit constraints by average dividend payout. Bond and Meghir (1994) used the same proxy of credit constraints, while others applied a similar methodology using other measures of financing constraints (Hoshi et al.,1991; Oliner and Rudebusch, 1992; Whited, 1992; and Gertler and Gilchrist, 1994).

[23] Fazzari et al. (2000) rebut Kaplan and Zingales (2000). Hadlock and Pierce (2010) criticize the Kaplan-Zingales index of financial constraints and suggest that firm size and age are the variables most closely correlated with the presence of such constraints.

7.1 Baseline regressions

Many studies model the impact of financing constraints on investment in the context of an Euler equation, i.e., the optimality condition for a firm that maximizes the present value of dividends subject to adjustment costs and external financial constraints (see, for instance, Whited, 1992, Hubbard and Kashyap, 1992, Calomiris and Hubbard, 1995, and Gilchrist and Himmelberg, 1998).[24] In particular, Love (2003) shows that linearizing the Euler equation yields a specification in which the investment-asset ratio depends on its lagged value, sales, cash flow, the interaction between cash flow and a measure of credit availability (i.e., an inverse measure of financing constraints), and a set of fixed effects.[25] We use a similar model, but with city-level government debt as a measure of financing constraints:

$$I_{i,c,t} = \beta I_{i,c,t-1} + \delta REV_{i,c,t-1} + (\gamma_1 + \gamma_2 LGD_{c,t})\, CF_{i,c,t-1} + \alpha_i + \theta_{ct} + \varepsilon_{i,c,t}, \tag{4}$$

where I, REV and CF are fixed capital investment, 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 variables).

In the presence of financing constraints, investment will be positively correlated with internally generated funds (proxied by cash flow), yielding a positive value for γ_1. A positive value for γ_2, instead, is consistent with the hypothesis that government borrowing crowds out private investment by tightening financing constraints. This is the main hypothesis to be tested here.

As equation (4) exploits only within-firm and within-city-year variation in investment, cash flow, and in the interaction between local public debt and cash flow, it does not suffer from any obvious problem of reverse causality. However, there could be an omitted variable bias if the equation failed to control for sources of credit constraints correlated with local government debt. We deal with this concern in the robustness analysis.

[24] The alternative approach by Hayashi (1982), based on the Q-theory of investment, requires share prices, and therefore cannot be used using our sample, which is mostly composed of unlisted firms.

[25] The model in Love (2003) does not allow for borrowing, and the external financial constraint consists in the condition that the firm cannot pay negative dividends. Allowing for borrowing complicates the model but does not alter the first-order conditions for investment.

When equation (4) is estimated on the full sample, the coefficient of γ_1 is positive and significant (column 1 in Table 5). The point estimate suggests that a 1-standard-deviation increase in cash flow is associated with a 1.4 percentage-point increase in the investment ratio. This is consistent with the presence of financing constraints for the average firm in a city with no public debt, but it may also result from cash flow capturing investment opportunities not captured by other control variables (Kaplan and Zingales, 2000).[26] More important for our purposes, the estimate γ_2 is positive and statistically significant: this result is consistent with the hypothesis that local government debt crowds out investment via tighter financial constraints, and is immune to the Kaplan-Zingales critique. The point estimate implies that a 1-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 4 plots the sensitivity of investment to cash flow at different levels of local government debt: the elasticity rises from 6.7 with zero government debt to 8.1 with a 50% debt ratio.

If local public debt crowds out private investment by tightening local credit availability, this effect should be weaker for state-owned enterprises, which presumably have access to privileged credit channels or the national financial market. Hence, we divide firms into two groups: private domestic (henceforth, private) firms and state-owned firms.

When equation (4) is estimated for the group of private firms (column 2 of Table 5), the results are essentially the same as for the whole sample but with tighter confidence intervals (see the top right panel of Figure 4). For state-owned firms, the results are dramatically different. State-owned firms are less credit-constrained than the average (γ_1 decreases from 6.7 to 4.3, column 3 of Table 5), and the severity of the constraint is inversely correlated with local government debt, so that they become essentially unconstrained when local public debt reaches 20 per cent of GDP; above that threshold, the correlation between cash flow and investment is no longer statistically significant (bottom-left panel of Figure 4). This suggests that at least some of the funds raised by Chinese cities via public debt issuance is actually channeled to local state-owned firms, mitigating or eliminating any credit constraints that they would otherwise face.

These specifications may however omit an important variable, namely the interaction

[26] 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 a sample like ours, with over 380,000 firms.

between cash flow and total bank loans as a ratio to GDP. Bank loans are likely to belong in equation (4) because they are correlated both with local government debt (see Tables B19 and A4) and with credit to the private sector, a variable that other studies have found to relax credit constraints (Love, 2003). As bank loans are correlated directly with local government debt and inversely with credit constraints, their exclusion from the model should generate a downward bias in the estimate of γ_2.[27] And this is exactly what we find when specification (4) is expanded by including the interaction between cash flow and bank loans as an explanatory variable. The point estimate of γ_2 almost trebles (from 0.03 in column 1 of Table 5 to 0.08 in column 1 of Table 6): a 1-standard-deviation rise in local government debt is thus associated with an increase of 13 percentage points in the elasticity of investment to cash flow. As expected, more bank lending also reduces the sensitivity of investment to cash flow, consistent with the thesis that bank loans can proxy for local financial depth and thus relax credit constraints, as found by Love (2003).

Column 2 of Table 6 shows that these results are robust to restricting the sample to private firms, while column 3 shows that government debt and bank loans have no statistically significant effect on the correlation between cash flow and investment in state-owned firms.

7.2 Robustness

We now check to see whether our baseline results are robust to additional controls, alternative sub-samples, and different estimation techniques. As we shall see, none of the robustness checks alter our main finding, namely that higher local government debt increases the sensitivity of investment to cash flow in private firms. The coefficient of the interaction between local government debt and cash flow is always positive, statistically significant and almost equal to that in our baseline estimates. All the regressions also control for the interaction between cash flow and bank loans, though the results persist when dropping it.

First, we consider whether our results may not be driven by the omission of potentially

[27] Suppose that the true model is

$$y = \alpha + \beta LGD + \gamma BL + \epsilon,$$

where BL denotes bank loans, with $\gamma < 0$ and $\sigma_{LGD,BL} > 0$. If instead one estimates $y = a + bLGD + e$, the bias is

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

relevant variables that are also correlated with local government debt. We start with the local government budget balance relative to GDP. This variable is not correlated mechanically with our measure of local government debt. The balance reflects the direct income and expenditure of the local government, while our measure of debt refers to LGFVs, which are extra-budgetary entities. Yet, more profligate local governments may have over-indebted LGFVs, or else LGFVs backed by financially sound governments may be able to borrow more. In fact, Table A4 shows that there is a positive and statistically significant correlation between debt and the municipal budget balance. However, when our baseline model is expanded to include this variable, its interaction with cash flow is never statistically significant and the baseline results are robust to including the interaction (column 1, Table 7).

The same occurs if the specification is expanded to include the interaction between cash flow and the log of the city's per capita GDP: the additional variable is not significant and its inclusion does not alter our baseline result (column 2, Table 7). When one controls for GDP growth (which in Table A4 is positively correlated with local government debt), the financing constraint appears to be tighter in city-years characterized by slow growth, but again the baseline results are robust.

One may expect land prices to be a potentially important omitted variable: high land prices may ease the collateral constraints of land-owning firms (Chaney, Sraer and Thesmar, 2012), but may also induce banks to lend to collateral-rich local public governments and 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 7). This is not surprising, considering that land is the main collateral for LGFVs' debt, and land sales constitute local governments' main source of income (Cai, Henderson and Zhang, 2009). In fact, both local government debt and the municipal budget balance are positively correlated with land prices (the correlations range between 0.3 and 0.4 and are always statistically significant at the 1% confidence level).

Upon estimating a specification that includes all these additional control variables, we find some evidence that faster economic growth and higher per capita GDP relax financing constraints, while a larger municipal budget tightens them. More important for our purposes, including these variables has no effect on the baseline result that local government debt tightens financing constraints.

Another concern is that firms may differ in their exposure to projects funded by LGFVs: when local governments undertake large infrastructure projects, suppliers to these projects are likely to need less external funding, as they may discount invoices or borrow directly from the LGFVs they supply.[28] Indeed, the estimates in Table 8 show that private firms more exposed to LGFV-funded projects are less credit-constrained than less exposed firms, the coefficient of the interaction between exposure and cash flow being negative and statistically significant. However, all our baseline results are robust to controlling for exposure to LGFV-funded projects (see column 2 in Table 8), even though including the exposure index entails losing nearly 200,000 observations. Exposure to government funded projects has no separate impact on the crowding-out effect of local government debt: the coefficient of the triple interaction is not statistically significant.

The results are also robust if the estimation is restricted to private firms (column 3), for which greater exposure to government-funded projects mitigates the credit constraints arising from 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 on state-owned firms (column 4). As a final experiment, we convert our continuous variable of exposure to government-funded projects into a discrete variable ($HEXP$), equal to 1 for industries with above-median exposure and 0 for the others: this discrete measure of exposure does not alter our baseline results (Column 6, Table 8).

If local government debt affects credit constraints, it should only affect firms that participate in the credit market. In our sample more than 95% of firms have positive debt and dropping firms that do not have debt does no alter our results. If, instead, we concentrate our analysis to leveraged firms (defined as those with a debt to asset ratio of at least 30%), we find that the coefficient of the interaction between local government debt and cash-flow investment sensitivity increases by more than 10% (from 0.075 to 0.084) (Table 9). This is consistent with the idea that higher government debt is more damaging for leveraged firms.

One possible source of concern with the regressions shown in Tables 5-8 is that lagged investment correlates negatively with current investment. This sign reversal is likely to be due to the downward bias generated by firm-level fixed effects (Nickell, 1981). A standard

[28]Inasmuch as large infrastructure projects are positively correlated with local government debt, not controlling for exposure to them would produce a downward bias in the estimate of the correlation between local government debt and the sensitivity of investment to cash flow. The construction of the index of exposure to LGVF-funded projects is described in Section 4.

solution to this problem is to apply the difference and system estimators used in Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998).[29] The top panel of Table 10 reports the results obtained using the system estimator of Arellano and Bover (1995) and Blundell and Bond (1998): the coefficient of the lagged dependent variable becomes positive (although not statistically significant), and the point estimates for the variables of interest (cash flow, the interaction between cash flow and local government debt, and the interaction with bank loans) are essentially identically to the baseline estimates of Tables 5 and 6. The bottom panel of Table 10 reports standard fixed effect estimations (i.e., the same models as in Tables 5 and 6) based on the sample of the top panel. Although the lagged dependent variable in these fixed effects estimations is always negative and significant, the results for our variables of interest are essentially identical. Another way of addressing the same problem is to exclude the lagged dependent variable.[30] Table B16 in the online appendix shows that our results are robust to this estimation method.

As a further battery of robustness tests, we explore whether our results are driven by firms located in the provinces for which our debt measure exceeds the official debt as published by the National Audit Office (see Appendix A for details), namely Beijing, Tianjin, and fourteen other cities located in Jiangsu and Zhejiang provinces. We find that our results are robust to dropping these cities and also to restricting the sample to 212 medium-sized cities (population of 1-10 million). They are also robust to the IV strategy described in the online appendix. Finally, our results keep holding also when the estimation is restricted to the period after 2007, when local government borrowing began to soar, and only to data drawn from the Annual Survey of Industrial Firms.[31]

[29] 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 the size of our sample, due to its unbalanced nature. Second, while system GMM estimations of equation (MOD) generally satisfy the specification tests developed by Arellano and Bond (1991), they do so only just barely, and small changes in the lag structure often lead to different values of these tests (the point estimates, instead, tend to be stable).

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

[31] The results of these robustenss tests are in Tables B14-B18 of the online appendix.

8 Cash flow sensitivity with endogenous sample split

In the regressions presented so far, a firm's financing status – credit-constrained or not – is identified by exogenously splitting the sample on the basis of ownership. There are two problems with this approach (Hu and Schiantarelli, 1998): first, it does not jointly control for the various factors that affect the substitution of external funds with internal ones by firms; second, it does not allow for firms to change status from credit-constrained to unconstrained or viceversa.

We address these issues by estimating an endogenous switching regression model with unknown sample separation. As in Hu and Schiantarelli (1998) and Almeida and Campello (2007), at each point in time a firm is assumed to operate in one of two regimes: credit-constrained, where investment is sensitive to internal funds; or unconstrained, where it is not. The probability of being in one or the other is determined by a switching function that depends on firm characteristics capturing the severity of the agency problems faced by the firm at a given point in time.

Formally, we jointly estimate the following three equations:

$$W^*_{i,c,t} = M_{i,c.t}\psi + u_{i,c,t}, \tag{5}$$

$$I_{1,i,c,t} = X_{i,c,t}\alpha_1 + \epsilon_{1,i,c,t}, \tag{6}$$

$$I_{2,i,c,t} = X_{i,c,t}\alpha_2 + \epsilon_{2,i,c,t}, \tag{7}$$

where W^* is a latent variable capturing the probability that firm i in period t will be in one of the two regimes and equation (5) is the selection equation that estimates the likelihood that the firm will be in the unconstrained regime 1 ($I_{i,c,t} = I_{1,i,c,t}$ if $W^*_{i,c,t} < 0$) or in the constrained 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 into 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 for firm type (1 for private domestic firms, 0 otherwise), and local government debt.[32] A firm's likelihood

[32] Almeida and Campello (2007) also consider dividend payments, bond ratings, short-term and long-term debt, and financial slack. Unfortunately, our dataset does not contain these variables. In building the Z-score we use emerging market-specific weights as suggested by Altman (2005). Specifically, we set

of being credit-constrained is expected to decrease with age, size, distance to default, and asset tangibility, and to increase with private ownership and local government debt.

Equations (6) and (7) are the investment equations, respectively for unconstrained and for constrained firms. Their specification is the same as in the baseline model of Equation (4), but allows for different coefficients in the two financing regimes.[33] The regimes are not observable but are determined endogenously by the system of equations (5)-(7).

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 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 the firm characteristics that determine the regime.

Column 1 of Table 11 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 unconstrained is increasing in firm age, size, distance to default, and asset tangibility; and it is lower for private-sector firms and in city-years with high local government debt.

The investment equations (panel B) show that for 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 internal resources, probably because unconstrained firms are mostly state-owned and so enjoy more generous funding from local governments that issue large amounts of debt. For credit-constrained firms, instead (column 1.2), the correlation between investment and cash flow is positive and increasing in the level of government debt, confirming the results obtained in the previous sections. Again, this reflects the fact that credit-constrained firms are disproportionately private.

Column 2 of Table 11 reports the results for a model that includes city-year fixed effects, which absorb the variation in local government debt in the regime selection equation. The probability of being unconstrained is again estimated to be lower for private-sector firms and increasing 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

$Z = 3.25 + 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$, where $X_1 = \frac{(Current\ Assets - Current\ Liabilities)}{Total\ Assets}$; $X_2 = \frac{Retained\ Earnings}{Total\ Assets}$; $X_3 = \frac{EBIDTA}{Total\ Assets}$; and $X_4 = \frac{Book\ Value\ of\ Equity}{Total\ Liabilities}$. In the literature there is an lively debate as to which are the true determinants of financial constraints (Farre-Mensa and Ljungqvist, 2016).

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

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. For credit-constrained firms, the opposite holds: the sensitivity of investment to cash flow is much greater and is again increasing in local government debt (column 2.2).

Finally, in column 3 we estimate a specification including city-year fixed effects and industry-year fixed effects, which absorb the effect of asset tangibility (defined at the industry-level). The results are almost identical to those of column 2.

9 Conclusions

China reacted to the global financial crisis with a massive fiscal stimulus package, mainly funded by the issuance of local government debt and mostly focused on investment. In 2009 the growth rate of fixed capital formation was nearly twice its pre-crisis rate, and fixed investment's contribution to Chinese GDP growth came to almost 90% (Wen and Wu, 2014). This surge in investment was achieved by injecting enormous financial resources into state-owned firms: the leverage of state-owned manufacturing firms rose from 57.5% in 2008Q1 (pre-crisis) to 61.5% in the first quarter of 2010, while for private-sector manufacturing firms it slipped from 59% to 57% (Wen and Wu, 2014).

At first glance, the stimulus was a resounding success. China escaped the Great Recession and became one of the main drivers of world economic growth (Wen and Wu, 2014). Our estimates suggest, however, that this policy suffered from a major drawback: the massive increase in local government debt had a powerful adverse impact on investment by private manufacturing firms. As these have much higher productivity than their state-owned counterparts (Song, Storesletten and Zilibotti, 2011), this reallocation of investment from the private to the public sector is likely to undercut China's long-run growth potential, especially in the areas where local governments have issued the largest amount of debt. Moreover, by increasing the share of public debt in banks' asset portfolios, this policy has further strengthened the bank-sovereign nexus in China, which threatens in the future to generate serious risks to systemic stability, as the euro-area sovereign debt crisis has so forcefully demonstrated (see Acharya, Drechsler and Schnabl, 2014; Acharya and Steffen, 2015; Altavilla, Pagano and Simonelli, 2017, among others).

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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: **Correlation between Local Government Debt and 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 lagged investment (I_{t-1}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), a dummy variable that takes value one for state-owned firms ($STATE$), local government debt over city-level GDP (LGD), and the interaction between LGD and $STATE$. Columns 1-3 control for firm, city, and year fixed effects. Column 4 controls for firm and city-year fixed effects.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.265***	-0.265***	-0.265***	-0.267***
	(0.006)	(0.006)	(0.006)	(0.006)
REV_{t-1}	2.229***	2.229***	2.229***	2.097***
	(0.044)	(0.044)	(0.044)	(0.040)
CF_{t-1}	4.086***	4.086***	4.086***	3.481***
	(0.291)	(0.291)	(0.291)	(0.283)
$STATE$		-0.204*	-0.623***	-0.323**
		(0.119)	(0.155)	(0.148)
LGD	-0.039***	-0.039***	-0.041***	
	(0.009)	(0.009)	(0.009)	
$STATE \times LGD$			0.035***	0.021***
			(0.007)	(0.006)
N. Obs.	1,150,340	1,150,340	1,150,340	1,150,340
N. Firms	387,781	387,781	387,781	387,781
N. Cities	261	261	261	261
Firm FE	YES	YES	YES	YES
City FE	YES	YES	YES	NO
Year FE	YES	YES	YES	NO
City-Year FE	NO	NO	NO	YES
$LGD + CF_{t-1} \times LGD$			-0.006	
P value			0.56	

Robust s.e. clustered at the firm and city-year level in parenthesis

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

Table 3: **Distribution of Firm-level Correlation Between Local Government Debt and Investment Across Chinese Cities**

This table reports the distribution of β obtained by estimating a variant of Equation (1) that allows β to vary across 260 cities in our sample (we drop one outlier from the distribution). The top panel reports the summary statistics for the full sample and for cities with at least 1000 observations. The bottom panel describes the share of cities with positive and negatives values of β and also with positive and negative values of β which are also statistically significant.

Sample	N.obs	Mean	Std. Dev.	Median	25^{th} pctile	75^{th} pctile
Full	260	-0.06	1.19	-0.03	-0.37	.15
At least 1000 obs	157	-0.16	1.11	-0.05	-0.32	.08
	Share with positive and negative coefficients				Min	Max
	$\beta > 0$	$\beta > 0$ & SS	$\beta < 0$	$\beta < 0$ & SS		
Full	44%	15%	56%	30%	-6.25	9.31
At least 1000 obs	38%	16%	61%	40%	-6.25	4.44

Table 4: **Local Government Debt and Investment: Rajan-Zingales Estimates**

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). The regressions control for initial investment (I_{t-1}) and the interaction between each of local government debt over GDP (LGD), bank loans over GDP (BL), log of GDP per capita ($ln(GDPPC)$), and GDP growth (GR) and the Rajan-Zingales index of external financial dependence (EF) computed on firms in Beijing, Shanghai, Hangzhou, and Wenzhou. Columns 3 and 4 present separate coefficients for private and state-owned firms.

	(1)	(2)	(3)		(4)	
	All	All	Private	SOE	Private	SOE
$EF \times LGD$	-0.629**	-0.860**	-0.637**	0.518	-0.881**	0.310
	(0.304)	(0.392)	(0.315)	(0.547)	(0.394)	(0.655)
$EF \times BL$		-0.037			-0.0547	0.165
		(0.174)			(0.174)	(0.249)
$EF \times ln(GDPPC)$		0.805*			0.818*	0.734*
		(0.431)			(0.430)	(0.435)
$EF \times GR$		-0.001			-0.001	-0.001
		(0.012)			(0.012)	(0.021)
I_{t-1}	-0.270***	-0.270***	-0.270***		-0.270***	
	(0.003)	(0.003)	(0.003)		(0.003)	
CF_{t-1}	3.738***	3.735***	3.738***		3.736***	
	(0.246)	(0.249)	(0.246)		(0.249)	
REV_{t-1}	2.105***	2.109***	2.105***		2.109***	
	(0.036)	(0.037)	(0.036)		(0.037)	
N. Obs.	520,585	511,111	520,585		511,111	
N. Firms	136,674	132,235	136,674		132,235	
Firm FE	YES	YES	YES		YES	
City-Year FE	YES	YES	YES		YES	
Industry-Year FE	YES	YES	YES		YES	
City-Industry FE	YES	YES	YES		YES	

Robust s.e. clustered at the firm and city-industry-year level in parenthesis

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

Table 5: **Sensitivity of Investment to Cash Flow: 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 includes all manufacturing firms, column 2 only private sector domestically owned manufacturing firms, and column 3 only state-owned manufacturing firms.

	(1)	(2)	(3)
I_{t-1}	-0.273***	-0.280***	-0.371***
	(0.002)	(0.002)	(0.008)
REV_{t-1}	3.773***	3.799***	2.398***
	(0.031)	(0.034)	(0.167)
CF_{t-1}	6.725***	7.334***	4.328***
	(0.231)	(0.256)	(1.190)
$CF_{t-1} \times LGD$	0.028**	0.029**	-0.097
	(0.011)	(0.013)	(0.055)
N. Obs.	1,150,340	975,454	61,755
N. Firms	387,781	353,434	32,103
N. Cities	261	261	261
Firm FE	YES	YES	YES
City-Year FE	YES	YES	YES
Sample	All	Private	State

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

Table 6: **Sensitivity of Investment to Cash Flow: 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 the following variables: local government debt over GDP (LGD) and bank loans over GDP (BL). The first column includes all manufacturing firms, column 2 only private sector domestically owned manufacturing firms, and column 3 only state-owned manufacturing firms.

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

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

Table 7: **Sensitivity of Investment to Cash Flow: 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 the following variables: 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).

	(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 8: **Sensitivity of Investment to Cash Flow: 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 include all manufacturing firms, column 3 only private sector domestically owned manufacturing firms, column 4 only state-owned manufacturing firms. Column 5 uses a discrete measure of exposure to government expenditure.

	(1)	(2)	(3)	(4)	(5)
I_{t-1}	-0.277***	-0.278***	-0.283***	-0.375***	-0.278***
	(0.002)	(0.002)	(0.002)	(0.009)	(0.002)
REV_{t-1}	3.757***	3.756***	3.786***	2.368***	3.756***
	(0.035)	(0.035)	(0.038)	(0.192)	(0.035)
CF_{t-1}	9.049***	8.455***	9.515***	7.913***	8.553***
	(0.442)	(0.421)	(0.487)	(2.360)	(0.477)
$CF_{t-1} \times LGD$	0.090***	0.079***	0.106***	0.029	0.083***
	(0.017)	(0.016)	(0.020)	(0.079)	(0.020)
$CF_{t-1} \times BL$	-0.021***	-0.021***	-0.024***	-0.031	-0.021***
	(0.004)	(0.004)	(0.005)	(0.022)	(0.004)
$CF_{t-1} \times EXP$	-4.632***		-2.065*	-6.877***	
	(1.009)		(1.236)	(2.128)	
$CF_{t-1} \times EXP \times LGD$	-0.064		-0.125**	-0.111	
	(0.046)		(0.052)	(0.105)	
$HEXP \times LGD$	-0.034**		-0.039**	-0.056	
	(0.0134)		(0.016)	(0.038)	
$CF_{t-1} \times HEXP$					-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	935,255
N. Firms	323,914	323,914	295,448	26,065	323,914
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	Private	State	All

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

Table 9: **Sensitivity of investment to cash flow: leveraged firms**

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 sample is restricted to firms with a leverage ratio of at least 33 percent. The first column includes all manufacturing firms, column 2 only private sector domestically owned manufacturing firms, and column 3 only state-owned manufacturing firms.

	(1)	(2)	(3)
I_{t-1}	-0.269***	-0.275***	-0.366***
	(0.002)	(0.002)	(0.009)
REV_{t-1}	3.486***	3.520***	2.397***
	(0.036)	(0.0393)	(0.190)
CF_{t-1}	6.271***	7.177***	3.489
	(0.461)	(0.508)	(2.309)
$CF_{t-1} \times LGD$	0.084***	0.095***	-0.087
	(0.017)	(0.0191)	(0.08)
$CF_{t-1} \times BL$	-0.022***	-0.026***	-0.009
	(0.004)	(0.005)	(0.024)
N. Obs.	769,781	640,522	34,757
N. Firms	215,889	185,978	12,703
N.Cities	261	261	256
Firm FE	YES	YES	YES
City-Year FE	YES	YES	YES
Sample	All	Private	State

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

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

Table 10: **System GMM Regressions**

The top panel of this table estimates the models of Table 6 using the system GMM estimator of Arellano and Bover (1995) and Blundell and Bond (1998). The set of instruments includes all available lags. The bottom panel reports standard fixed effects estimations that use the same sample as the top panel. The first column includes all manufacturing firms, column 2 only private sector domestically owned manufacturing firms, and column 3 only state-owned manufacturing firms.

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

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

Table 11: **Switching Regression Model**

This table reports the switching regression model described in Equations (5)-(7). 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 1 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 revenue 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).

	(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.

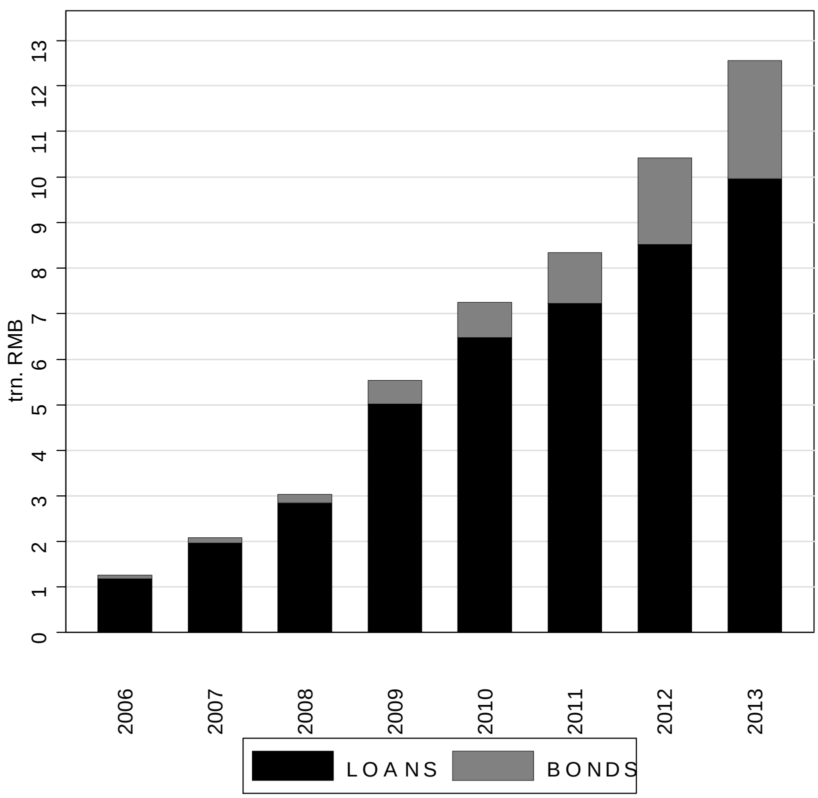


Figure 2: **Beta and city characteristics**

This figure plots the correlation between the β coefficients described in Table 3 and various city-level characteristics averaged over the sample period.

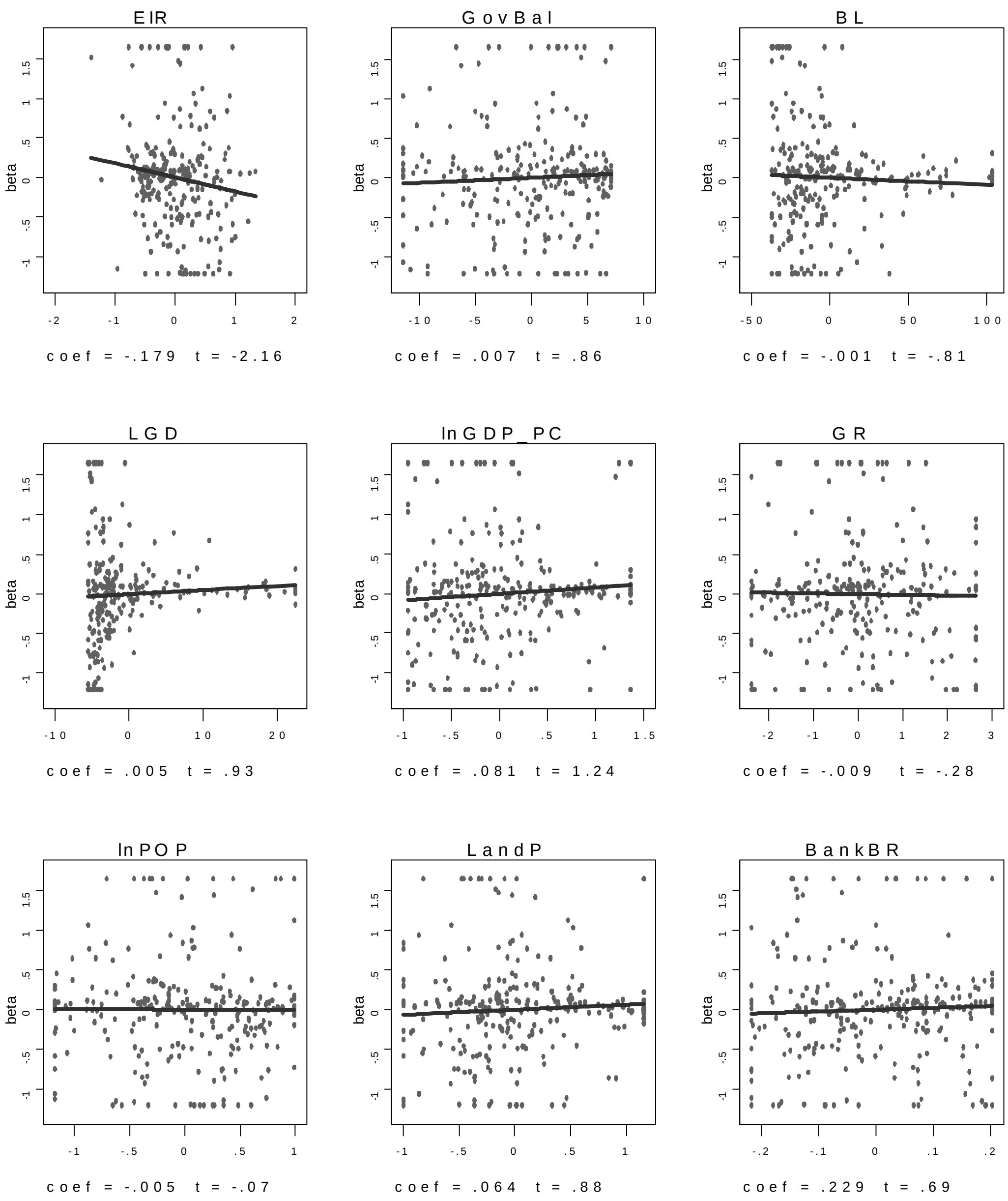


Figure 3: **Local Government Debt and Investment Ratios in Different Industries**. This figure plots how investment ratios vary with the level of government debt for manufacturing firms in the paper industry (25th percentile of the distribution of the index of external financial dependence) and the battery industry (75th percentile of the distribution of the index of external financial dependence). The graphs are based on the the estimations of column 2, Table 4. The dashed lines are 95% confidence intervals and the horizontal lines are the average investment ratios in the two industries (8.3% for paper and 10.6% for batteries).

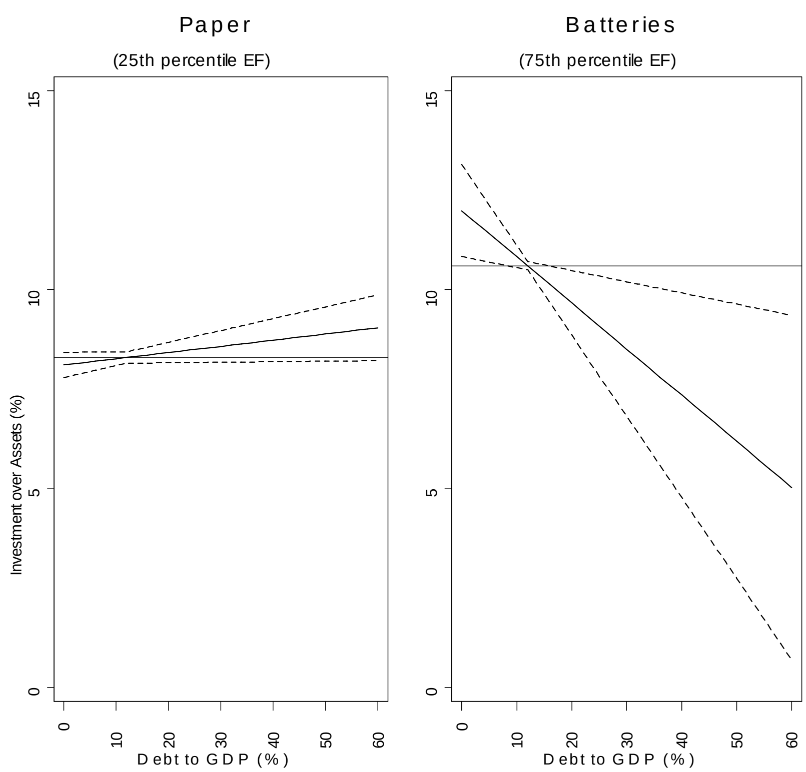
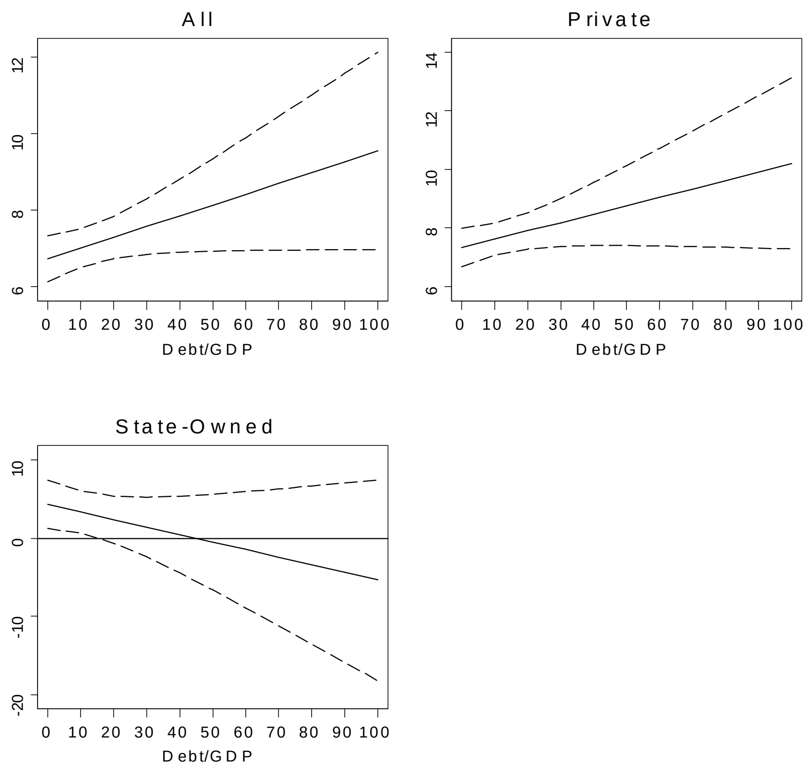


Figure 4: **Sensitivity of Investment to Cash Flow**.

The figures plot how the sensitivity of investment to cash flow changes with the level of local government debt. These marginal effects are based on the estimates reported in columns 1-3 of Table 5.



Appendix

A Construction of the data set

A.1 Local public debt data

To estimate the 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 authorized LGFVs. At the end of 2013, the CBRC database had data on LGFVs in 293 cities across all provinces of China.

Next, we use the Wind Information Co. (WIND) database to retrieve balance-sheet data for the entities listed by CBRC. When an entity listed by CBRC is not available in the WIND database, we get the needed balance-sheet data manually. We estimate total debt of each LGFV by adding up its short-term and long-term debt.[34]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. This measure also includes the (rare) cases in which the central government issued special bonds for the local government.

In constructing our aggregate measure of debt, we avoid double counting by excluding issues of LGFVs that belong to a holding group (in which case we factor in only the total debt of the 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, when local governments were asked to take part in the massive fiscal stimulus package but not given additional fiscal resources (Lu and Sun, 2013, and Zhang and Barnett, 2014).

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

Figure A1 plots the evolution of total local government debt on the basis of our data and the official data (from the National Audit Office, NAO, and China International Capital Corporation Limited, CICC). While our estimates are slightly lower than the official figures (as explained above, we can only set a lower bound for total government debt, not local debt), we match the trend in the official data. In 2012 and 2013 our totals are close to the official figures, within 5%.

[34]Short-term debt, in turn, is 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.

We were also able to obtain province-level official data from the NAO surveys in 2012 and 2013. Accordingly, we aggregated our 293 cities into the 30 Chinese provinces for comparison with the NAO's figures. The NAO breaks local government debt down into three components: (i) direct debt (NAO 1 in Table A1); (ii) debt guaranteed by local governments (NAO 2 is equal to NAO 1 plus this second component); and (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).[35] Summing the first two components (NAO 2 in Table A1), one gets a stock of total outstanding government debt that is close to the figure generated by our own data (the column labeled HPP). The correlation between our data aggregated at province level and the NAO figures is always above 65% (often above 70%) and statistically significant at the 1% confidence level.

Figure A2 illustrates the close correlation between our province-level aggregates and the official data for NAO 2. It also shows that our measure can effectively serve as a lower bound for total local government debt, with most points lying below the 45-degree line. There are four exceptions: Beijing, Tianjin, Jiangsu and Zhejiang. Beijing and Tianjin, which are both cities and provinces, are 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, in the Pearl River delta, is also close to Shanghai. For Beijing and Tianjin, our data on outstanding local government debt are far higher than those of the NAO, possibly because of the two cities' special status: as they are under direct control of the central government, some issuance that we assign to them could actually be central government liabilities. For Jiangsu and Zhejiang, our estimates are slightly higher than those of the NAO, but the difference is moderate, ranging from 5% to 15%. Our results are robust to dropping the observations for these cities.

A.2 City-level correlates of local government debt

Table B19 reports the overall correlations (between and within cities) between local government debt and a set of city-level variables: debt is positively correlated with per capita income ($\ln(GDP\,PC)$), population ($\ln(POP)$), total income ($\ln(GDP)$), the local government budget balance (GB, i.e. the unconsolidated budget balance of the city itself, thus excluding the LGFVs that issued the debt, scaled by city GDP), bank loans (BL, i.e. total bank loans, including credit to local governments, scaled by city GDP), and two measures of the average price of land ($LP1$, the log of an average of auction prices and administered prices set by the local government, and $LP2$, the log of the auction price).[36] However, the correlation between local government debt and economic growth (GR) is negative if one does

[35] The NAO observes that analysts and researchers should be careful in adding up these three components.

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

not control for other city-level variables (column 4 of Table B19), but becomes positive and statistically significant if one controls jointly for the latter (column 9 of Table B19).

As most of our analysis consists in within-city regressions, Table A4 shows the within-city correlation of the variables described above (i.e., we control for city-fixed effects). In this case, local government debt has no correlation with per capita income, total income, or population, but it has a positive and statistically significant correlation with growth, with budget balance, with bank loans, and with land prices.

The positive correlation between local government debt and growth suggests that, rather than conducting counter-cyclical city fiscal policy, LGFVs 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 correlation of local government debt with bank loans and land prices is instead likely to reflect the fact that lending to local governments is part of total bank lending and that land is commonly posted as collateral by LGFVs.

Table A1: **Local Government Debt in China, Comparison with the 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 direct obbligations of local governments, NAO 2 is equal to NAO 1 plus debt guaranteed by local governments, and NAO 3 is equal to NAO 2 plus debt that may create contingent liabilities ("some responsibility of assistance" to use NAO's language). The table also reports the correlation between HPP data aggregated at the provice level and the NAO's three different defintions of local goverment debt.

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: **Firm Leverage and Local Government Debt**

This table reports the results of a set of regressions where the dependent variable is the firm-level leverage, and the explanatory variables are local government debt over GDP (LGD), Bank loans over GDP (BL), budget balance (GB), log of GDP per capita ($ln(GDPPC)$), GDP growth (GR), land price (LP), and firm size ($SIZE$) The first column includes all manufacturing firms, column 2 only private sector domestically owned manufacturing firms, and column 3 only state-owned manufacturing firms.

	(1)	(2)	(3)
LGD	-0.009**	-0.013***	-0.001
	(0.004)	(0.004)	(0.015)
BL	0.025***	0.029***	-0.006
	(0.001)	(0.002)	(0.007)
GB	-0.067***	-0.063***	-0.234***
	(0.020)	(0.022)	(0.069)
$ln(GDPPC)$	-2.610***	-2.776***	-0.278
	(0.214)	(0.238)	(0.821)
GR	0.058***	0.065***	-0.121***
	(0.011)	(0.013)	(0.044)
LP	0.163***	0.0573	0.735***
	(0.060)	(0.070)	(0.230)
$SIZE$	-0.454***	-1.245***	-1.677***
	(0.050)	(0.057)	(0.264)
N. Obs.	875,694	713,918	55,543
N. Firms.	357,790	312,876	30,117
N. Cities	261	261	261
Sample	All	Private	State
Firm FE	YES	YES	YES
Year FE	YES	YES	YES

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

Table A3: **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 thousands units.

Table A4: **Within-city Correlates of Local Government Debt in China**

This table reports the within-city correlations between local government debt and each of the following variables: 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 prices ($LP1$ is an average of auction prices and administered prices fixed by the local government; $LP2$ is the auction price).

	(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

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 period. 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. Firms in which the public sector or foreigners own less than 30 percent of total shares are classified as private.
State	Dummy variable that takes a value of 1 if the firm is government 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 are classified as state-owned.
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 and Resources*, 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 and Resources*, 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 Yearbook 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 requirements computed as the industry median of the ratio between capital expenditures minus cash flow from operations and capital expenditures for all firms based in Beijing, Shanghai, Hangzhou, and Wenzhou. Source: own elaboration based on ASIF and ATS data.

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).

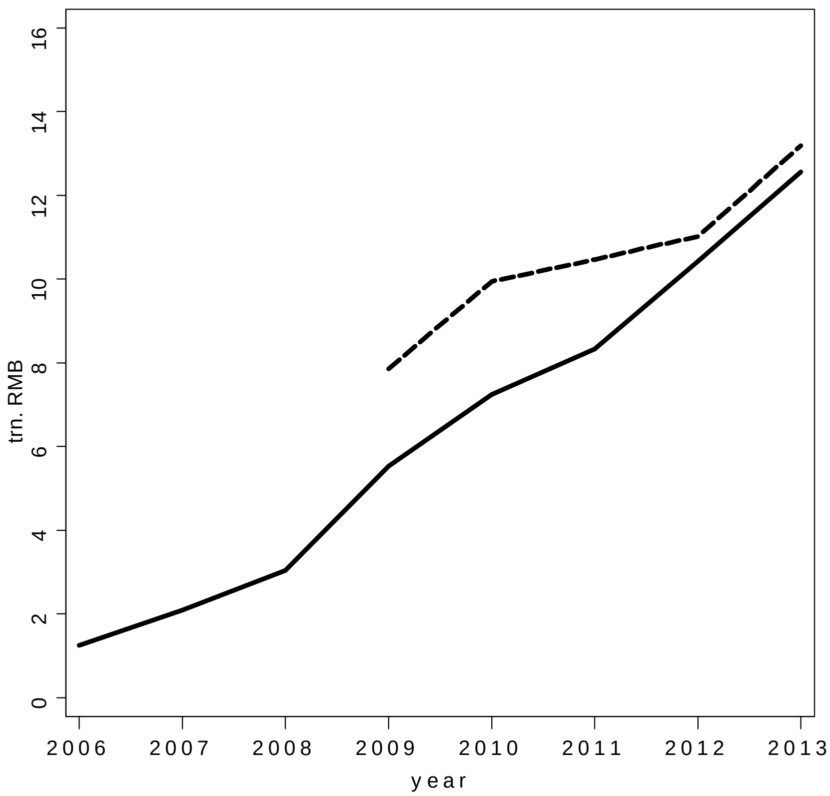


Figure A2: **Local Government Debt in Chinese Provinces**.
These figures compare our local government debt data (HPP) aggregated at the province level with official data from the National Audit Office (NAO) for the years 2012 and 2013.

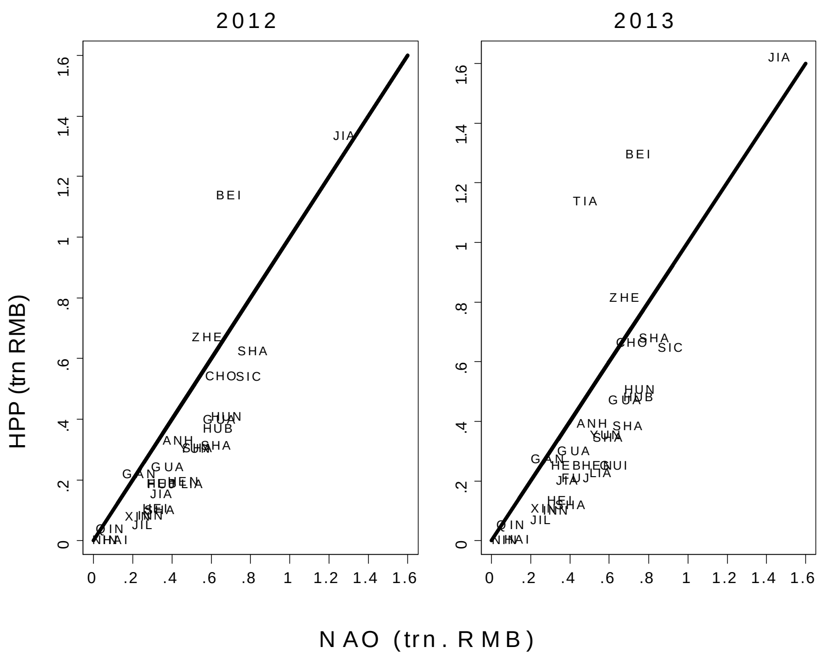
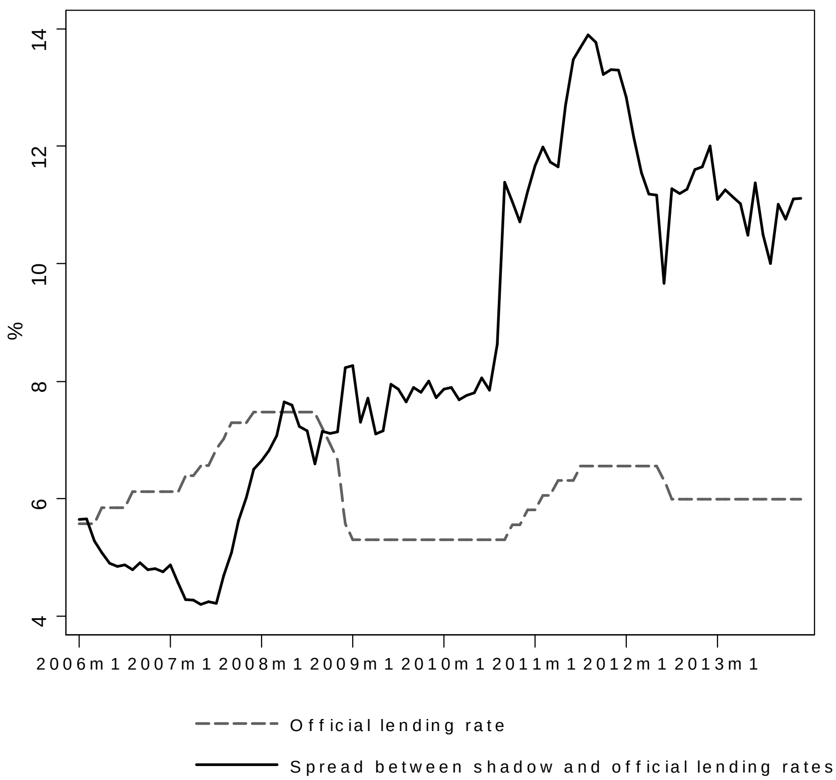


Figure A3: **Official and Shadow Lending Rates**.

This figure compares the official lending rate for 12-month loans and the spead between the average shadow lending rate and the official lending rate.



Online Appendix

A Introduction

This online appendix reports various robustness checks and a set of instrumental variable estimates that corroborate the results reported in the main text

B Correlation between investment and local government debt: Robustness analysis

Tables B1-B6 show that the baseline correlations of Table 2 are robust to estimating the model with the system and difference GMM estimators of Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998), to controlling for additional time-varying city-level variables (size of the banking sector, GDP per capita, and GDP growth) and to controlling for additional firm-level variables (firm size, leverage, marginal product of capital, export status, and firm age). The results are also robust to using the change in debt over GDP instead of the debt-to-GDP ratio and to replacing total local government with government debt extends by banks (i.e., not considering bonded debt).

C City-level regressions

Tables B7 and B8 show that the baseline correlations of Table 2 are robust to aggregating the data at the city-year level. Specifically, we estimate the following specification:

$$I_{c,t} = \beta LGD_{c,t} + X_{c,t}\Gamma + \alpha_c + \tau_t + \varepsilon_{c,t}, \tag{B.1}$$

where $I_{c,t}$ is the ratio of investment to assets for manufacturing firms in city c and year t, $LGD_{c,t}$ is the ratio of local government debt to local GDP, $X_{c,t}$ 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 price of land), and α_c and τ_t are city and year fixed effects. Variants of this specification are estimated, first taking as dependent variable $I_{c,t}$ for the entire manufacturing sector of city c in year t (as the weighted average of the investment-to-asset ratios for all the manufacturing firms), and then separately for private-sector and state-owned manufacturing firms. Table B7 presents estimates of specification (1) without macro controls (i.e., setting $\Gamma = 0$): the correlation between total manufacturing investment and local government debt is negative and statistically significant. 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 firms (column 3). Table B8 expands the specification of Table B7 by including additional city-level controls: total bank loans scaled by GDP (BL, which includes loans to local governments), local government budget balance scaled by GDP (GB, i.e. the unconsolidated budget balance of the city, excluding LGFVs), local GDP growth (GR), log of per capita GDP ($ln(GDP\,PC)$), log of population ($ln(POP)$), and log of average land price (LP). Controlling for these variables does not affect the baseline results of Table B7: local government debt remains negatively correlated with the investment ratio of private sector manufacturing firms and is not significantly correlated with those of state-owned firms.

D Instrumental variable estimates

Our instrumental variable strategy is based on an argument from political economy: that is, cities with stronger political connections with the national government may have more leeway to issue debt and initiate investment projects (Shih, Adolph and Liu, 2012, and Zhu, 2014); and they may also be deemed to be less risky borrowers, more likely to be bailed out if they should fail to meet their obligations (Ambrose, Deng and Wu, 2015). This is the basis for instrumenting local government debt with the number of top national policy-makers (at ministerial level or above) who were born in the city.[37] Since the instrument is defined at the city-year level, all IV regressions are estimated using city-year level observations.

A problem with this instrument is that national leaders with close links to a city may have other means of favoring it besides allowing it to borrow more. One obvious way is increasing central government transfers. Accordingly, we control directly for transfers, a method that solves one endogeneity problem but may create another, in that transfers are driven partly by local economic conditions. Other things being equal, underperforming cities tend to receive larger transfers. Hence, transfers are endogenous with respect to private investment. We address this endogeneity problem by building the following simulated instrument for transfers:

$$STR_{c,t} = \frac{TR_{c,2005}}{TT_{2005}} TT_t, \tag{B.2}$$

[37] We construct this instrument on the basis of biographical information originally collected by Zhou (2014) on members of the Central Committee of the Chinese Communist Party from 2006 to 2013. 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).

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.[38] $STR_{c,t}$ 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.

The top panel of Table B9 shows instrumental variable estimates, which confirm our previous findings of a negative effect of local government debt on private investment but no effect on investment by state-owned. The bottom panel reports the first stage estimates, showing that the instruments are correlated with the endogenous variables, and that the correlations are not weak.

The point estimates of the IV regressions are nearly ten times larger (in absolute value) than the OLS estimates of Tables B7 and B8. 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 B7 and B8 suffer from a upward bias, due to common unobserved shocks creating positive covariance of private investment and local indebtedness.

As the regressions of Table B9 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 heteroscedasticity in the model's residuals.[39] The overidentified model can then be efficiently estimated with GMM and the 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

[38] There are a few cities for which the transfer data start after 2005. For these cities we replace 2005 with the first available year. Li and Kai-Sing Kung (2015) use simulated instruments to study the fiscal incentives of Chinese local governments.

[39] 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 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).

investment over total investment in city c:

$$EXT_{c,t} = \sum_j \frac{I_{j,c,t-1}}{\sum_j I_{j,c,t-1}} \sum_{v \neq c} I_{j,v,t}. \tag{B.3}$$

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 B9 are robust to controlling for EXT (columns 1, 3, and 5 of Table B10). Next, we build additional instruments using heteroscedasticity 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 B7 and B8. As before, there is no statistically significant effect of local government debt on investment by state-owned manufacturing firms.

Another possible concern is that national politicians may favor their native city in still other ways, beyond additional borrowing capacity and direct transfers. For instance, powerful politicians could steer government contracts towards cities where they have close connections (see Cohen, Coval and Malloy, 2011, for evidence to this effect in the US). Insofar as this generates a positive correlation between our instrument and private investment, it should induce a positive bias in the estimate (i.e., it may bias our point estimate, which is negative, towards zero). We address this issue by restricting the estimate to the investment of firms with limited exposure to government spending.[40] We calculate total city-level investment of the industries in the bottom 25% of the government exposure index and then re-estimate the regressions of Tables B7-B9 for investment of the low-exposure industries only. For this subset of industries our results are stronger, which is consistent with the existence of a positive bias in the previous results.

E Rajan-Zingales estimates: robustness checks

Table B11 shows that the baseline results of Table 4 are robust to using an alternative measure of external financial dependence using data from Guangzhou, Foshan, and Dongguan.

[40]Since most LGFVs manage public infrastructure projects, the exposure index takes as sectors directly affected by LGFV expenditure: (i) electricity production and distribution; (ii) heat production and distribution; (iii) gas distribution; (iv) water supply and sewage treatment; (v) construction; (vi) environmental management; and (vii) public facilities management. We match these sectors with the input-output table constructed by the National Statistics Bureau and construct indexes of exposure to these seven sectors for the 135 sectors covered in the input-output tables (following Tang et al. (2014), we use the input-output table for 2007). Finally, we match these exposure indexes with the manufacturing firms in our survey.

Tables B12 and B13 show that the baseline results are robust to aggregating the data at the city-industry-year level. These tables report estimates of the following model:

$$I_{j,c,t} = \beta I_{j,c,t-1} + \delta \left(EF_j \times LGD_{c,t} \right) + \kappa_{j,t} + \theta_{c,t} + \zeta_{c,j} + \varepsilon_{j,c,t}, \tag{B.4}$$

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-finance dependency of industry j, $LGD_{c,t}$ is local government debt scaled by GDP in city c and year t, and and $\kappa_{j,t}$, $\theta_{c,t}$, and $\zeta_{c,j}$ are industry-year, city-year, and city-industry fixed effects. $\alpha_{j,t}$ and $\theta_{c,t}$ are industry-year and city-year fixed effects.

F Sensitivity of investment to cash-flow: Additional results

Tables B14-B18 report a series of robustness check that corroborate the finding that local government debt increases the sensitivity of investment to cash flow for private sector firms. These tables show that the results are robust to dropping Beijing, Tianjin, and fourteen other cities located in Jiangsu and Zhejiang provinces, they are also robust to restricting the sample to 212 medium-sized cities (population of 1-10 million). The results are also robust to the IV strategy in Section D of this online appendix. Finally, the results are robust to restricting the data to the period after 2007, when local government borrowing began to soar, and to using data only from the Annual Survey of Industrial Firms.

Table B1: **Correlation between firm-level investment and local government debt: SYS and DIFF GMM estimations**

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}), a dummy variable that takes value one for state-owned firms ($STATE$), local government debt over city-level GDP (LGD), and the interaction between LGD and $STATE$. Columns 1-4 use the system GMM estimator and columns 5-8 use the difference GMM estimator.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I_{t-1}	-0.066***	-0.066***	-0.066***	-0.067***	-0.062***	-0.062***	-0.063***	-0.056***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
REV_{t-1}	1.961***	1.968***	1.971***	1.764***	1.009***	1.013***	1.026***	0.732***
	(0.034)	(0.034)	(0.034)	(0.035)	(0.059)	(0.059)	(0.059)	(0.061)
CF_{t-1}	3.885***	3.937***	3.967***	3.238***	-4.051***	-4.030***	-3.950***	-5.044***
	(0.232)	(0.232)	(0.231)	(0.243)	(0.427)	(0.427)	(0.427)	(0.440)
$STATE$		0.440**	0.0256	0.747***		1.297***	2.175***	1.676***
		(0.180)	(0.235)	(0.241)		(0.332)	(0.375)	(0.382)
LGD	-0.0347***	-0.035***	-0.035***		-0.191***	-0.190***	-0.195***	
	(0.001)	(0.001)	(0.002)		(0.009)	(0.009)	(0.009)	
$STATE \times LGD$			0.0038	0.009			0.092***	0.074***
			(0.003)	(0.007)			(0.016)	(0.016)
N. Obs.	622,561	622,561	622,561	622,561	353,544	353,544	353,544	353,544
N. Firms	250,481	250,481	250,481	250,481	177,166	177,166	177,166	177,166
N. Cities	261	261	261	261	261	261	261	261
AR1 p value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR2 p value	0.24	0.23	0.24	0.23	0.79	0.8	0.82	0.54
Sargan test p value	0.28	0.17	0.11	0.07	0.25	0.22	0.25	0.13
Estimation method		SYS GMM				DIFF GMM		

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

Table B2: **Correlation between firm-level investment and local government debt**

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}), a dummy variable that takes value one for state-owned firms ($STATE$), local government debt over city-level GDP (LGD), bank loans over city-level GDP (BL), log of city-level GDP per capita ($ln(GDPPC)$), city-level GDP growth (GR) and the interaction between each of LGD, BL, $ln(GDPPC)$, and GR and $STATE$. All regressions include city, year, and firm fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I_{t-1}	-0.265***	-0.265***	-0.266***	-0.266***	-0.265***	-0.265***	-0.266***	-0.266***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
REV_{t-1}	2.229***	2.224***	2.216***	2.215***	2.229***	2.223***	2.215***	2.215***
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
CF_{t-1}	4.082***	4.037***	4.043***	4.032***	4.081***	4.036***	4.043***	4.032***
	(0.291)	(0.292)	(0.297)	(0.298)	(0.292)	(0.292)	(0.297)	(0.298)
$STATE$	-0.202*	-0.193	-0.146	-0.143	-0.985***	-0.255	0.848**	0.448
	(0.119)	(0.120)	(0.127)	(0.126)	(0.236)	(0.225)	(0.420)	(0.524)
LGD	-0.036***	-0.039***	-0.044***	-0.041***	-0.036***	-0.041***	-0.046***	-0.042***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
BL	-0.012***			-0.010**	-0.012***			-0.009**
	(0.004)			(0.004)	(0.004)			(0.004)
$ln(GDPPC)$		0.999**		0.353		0.976**		0.345
		(0.413)		(0.378)		(0.413)		(0.378)
GR			0.146***	0.134***			0.152***	0.140***
			(0.028)	(0.028)			(0.029)	(0.029)
$STATE \times LGD$					0.024***	0.029***	0.028***	0.019**
					(0.008)	(0.007)	(0.007)	(0.008)
$STATE \times BL$					0.005**			0.004
					(0.002)			(0.002)
$STATE \times ln(GDPPC)$						0.275*		0.049
						(0.142)		(0.157)
$STATE \times GR$							-0.098***	-0.085***
							(0.029)	(0.030)
N. Obs.	964,608	963,360	937,331	936,083	964,608	963,360	937,331	936,083
N. Firms	260,057	259,674	256,689	256,306	260,057	259,674	256,689	256,306
N. Cities	261	261	261	261	261	261	261	261
$LGD + STATE \times LGD$					-0.012 [0.25]	-0.012 [0.27]	-0.018 [0.11]	-0.023 [0.04]
$LGD + STATE \times BL$					-0.007 [0.16]			-0.005 [0.27]
$LGD + STATE \times ln(GDPPC)$						1.251 [0.00]		0.394 [0.32]
$LGD + STATE \times GR$							0.054 [0.13]	0.055 [0.14]

Robust s.e. clustered at the firm and city-year level in parenthesis, p-values in brackets

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

Table B3: **Correlation between firm-level investment and local government debt**

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}), log total assets ($SIZE$), debt over assets ($LEVERAGE$), marginal product of capital (MPK), exports over sales ($EXPORTS$), firm age (AGE), dummy variable that takes value one for state-owned firms ($STATE$), local government debt over city-level GDP (LGD), and the interaction between each of LGD, BL, $ln(GDPPC)$, and GR and $STATE$.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.320***	-0.320***	-0.320***	-0.321***
	(0.006)	(0.006)	(0.006)	(0.006)
REV_{t-1}	3.143***	3.143***	3.142***	2.974***
	(0.051)	(0.051)	(0.051)	(0.048)
CF_{t-1}	8.780***	8.780***	8.776***	7.456***
	(0.399)	(0.399)	(0.399)	(0.366)
$SIZE$	-3.829***	-3.829***	-3.823***	-4.114***
	(0.146)	(0.146)	(0.146)	(0.137)
$LEVERAGE$	-0.917***	-0.915***	-0.921***	-0.700***
	(0.194)	(0.194)	(0.194)	(0.181)
MPK	-7.610***	-7.609***	-7.611***	-7.728***
	(0.166)	(0.166)	(0.166)	(0.169)
$EXPORTS$	0.593***	0.593***	0.592***	0.655***
	(0.133)	(0.133)	(0.133)	(0.127)
AGE	-0.098***	-0.097***	-0.095***	-0.068***
	(0.015)	(0.015)	(0.015)	(0.015)
$STATE$		-0.209	-0.744***	-0.341*
		(0.146)	(0.191)	(0.178)
LGD	-0.057***	-0.057***	-0.061***	
	(0.016)	(0.016)	(0.017)	
$STATE \times LGD$			0.049***	0.021***
			(0.010)	(0.007)
N. Obs.	638,073	638,073	638,073	638,015
N. Firms	204,987	204,987	204,987	204,970
N. Cities	261	261	261	261
Firm FE	YES	YES	YES	YES
City FE	YES	YES	YES	NO
Year FE	YES	YES	YES	NO
City-Year FE	NO	NO	NO	YES
$LGD + STATE \times LGD$			-0.012	
P value			0.37	

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

Table B4: **Correlation between firm-level investment and local government debt**

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}), a dummy variable that takes value one for state-owned firms ($STATE$), local government debt over city-level GDP computed by excluding local government bonds($LGDBNK$), and the interaction between $LGDBNK$, and $STATE$.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.265***	-0.265***	-0.265***	-0.267***
	(0.006)	(0.006)	(0.006)	(0.006)
REV_{t-1}	2.230***	2.229***	2.229***	2.097***
	(0.044)	(0.044)	(0.044)	(0.040)
CF_{t-1}	4.080***	4.081***	4.079***	3.481***
	(0.291)	(0.291)	(0.291)	(0.283)
$STATE$		-0.209*	-0.620***	-0.316**
		(0.119)	(0.155)	(0.149)
$LGDBNK$	-0.046***	-0.046***	-0.048***	
	(0.011)	(0.011)	(0.011)	
$STATE \times LGDBNK$			0.039***	0.023***
			(0.007)	(0.007)
N. Obs.	964,608	964,608	964,608	964,586
N. Firms	260,057	260,057	260,057	260,052
N. Cities	261	261	261	261
Firm FE	YES	YES	YES	YES
City FE	YES	YES	YES	NO
Year FE	YES	YES	YES	NO
City-Year FE	NO	NO	NO	YES
$LGDBNK + STATE \times LGDBNK$			-0.009	
P value			0.45	

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

Table B5: **Correlation between firm-level investment and local government debt**

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}), a dummy variable that takes value one for state-owned firms ($STATE$), the chnage in local government debt over city-level GDP (ΔLGD), and the interaction between ΔLGD, and $STATE$.

	(1)	(2)	(3)	(4)
I_{t-1}	-0.285***	-0.285***	-0.285***	-0.287***
	(0.008)	(0.008)	(0.008)	(0.007)
REV_{t-1}	2.329***	2.329***	2.329***	2.166***
	(0.050)	(0.050)	(0.050)	(0.045)
CF_{t-1}	3.709***	3.709***	3.706***	3.085***
	(0.332)	(0.332)	(0.332)	(0.321)
$STATE$		-0.182	-0.470**	-0.259
		(0.159)	(0.188)	(0.175)
ΔLGD	-0.051***	-0.051***	-0.057***	
	(0.0132)	(0.0132)	(0.0137)	
$STATE \times \Delta LGD$			0.073***	0.038*
			(0.023)	(0.0201)
N. Obs.	769,452	769,452	769,452	769,430
N. Firms	0.420	0.420	0.420	0.433
N. Cities	236,885	236,885	236,885	236,880
Firm FE	YES	YES	YES	YES
City FE	YES	YES	YES	NO
Year FE	YES	YES	YES	NO
City-Year FE	NO	NO	NO	YES
$\Delta LGD + STATE \times \Delta LGD$			0.02	
P value			0.38	

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

Table B6: **Correlation between firm-level investment and local government debt**

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}), a dummy variable that takes value one for state-owned firms ($STATE$), local government debt over city-level GDP (LGD), bank loans over GDP (BL), the log of city-level GDP per capita ($ln(GDPPC)$), city-level GDP growth (GR)and the interaction between each of LGD, BL, $ln(GDPPC)$, GR, and $STATE$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I_{t-1}	-0.267***	-0.267***	-0.268***	-0.268***	-0.267***	-0.267***	-0.268***	-0.268***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
REV_{t-1}	2.097***	2.096***	2.098***	2.097***	2.097***	2.096***	2.098***	2.097***
	(0.040)	(0.040)	(0.041)	(0.0407)	(0.040)	(0.040)	(0.041)	(0.041)
CF_{t-1}	3.480***	3.483***	3.500***	3.501***	3.480***	3.482***	3.499***	3.501***
	(0.283)	(0.284)	(0.287)	(0.287)	(0.283)	(0.284)	(0.287)	(0.287)
$STATE$	-0.506**	-0.357*	0.642	0.281	-0.508**	-0.327	0.674	0.323
	(0.233)	(0.217)	(0.415)	(0.508)	(0.234)	(0.216)	(0.411)	(0.507)
$STATE \times LGD$	0.016**	0.022***	0.016***	0.013*	0.017**	0.023***	0.018**	0.015*
	(0.007)	(0.007)	(0.006)	(0.007)	(0.009)	(0.007)	(0.007)	(0.009)
$STATE \times BL$	0.002			0.003	0.002			0.002
	(0.002)			(0.002)	(0.002)			(0.002)
$STATE \times ln(GDPPC)$		-0.027		-0.146		-0.009		-0.137
		(0.136)		(0.148)		(0.136)		(0.147)
$STATE \times GR$			-0.064**	-0.066**			-0.067**	-0.067**
			(0.028)	(0.030)			(0.029)	(0.029)
N. Obs.	964,586	963,338	937,309	936,061	964,586	963,338	937,309	936,061
N. Firms	260,052	255,664	256,684	256,301	260,052	255,664	256,684	256,301
N. Cities	261	261	261	261	261	261	261	261
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
City-Year FE	YES	YES	YES	YES	YES	YES	YES	YES
LGD is	Total debt				Total debt exended by banks			

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

Table B7: **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 includes all manufacturing firms, column 2 only private sector manufacturing firms, and column 3 state-owned manufacturing firms.

	(1)	(2)	(3)
LGD	-0.083***	-0.089***	-0.017
	(0.026)	(0.0289)	(0.029)
N. Obs.	1,861	1,859	
N. Cities	261	261	261
Year FE	YES	YES	YES
City FE	YES	YES	YES
Sample	All	Private	State

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

Table B8: **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 the price of land (LP). Column 1 includes all manufacturing firms, column 2 only private sector manufacturing firms, and column 3 only state-owned manufacturing firms.

	(1)	(2)	(3)
LGD	-0.093***	-0.104***	-0.29
	(0.028)	(0.030)	(0.040)
BL	-0.012	-0.002	-0.027
	(0.014)	(0.014)	(0.024)
GB	0.020	0.028	-0.139
	(0.153)	(0.168)	(0.209)
GR	0.409***	0.332**	0.632***
	(0.127)	(0.135)	(0.164)
$ln(GDP\ PC)$	4.506	6.394*	-5.851
	(3.283)	(3.752)	(4.408)
$ln(POP)$	7.506*	9.374**	-5.674
	(3.821)	(4.295)	(5.511)
$ln(LP)$	0.598	0.505	-0.411
	(0.629)	(0.694)	(0.979)
N. Obs.	1,805	1,803	1,658
N. Cities	261	261	261
Firms	All	Private	State
Year FE	YES	YES	YES
City FE	YES	YES	YES

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

Table B9: **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 includes all manufacturing firms, column 2 only private sector manufacturing firms, and column 3 only state-owned manufacturing firms.

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

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

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

Table B10: **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, and columns 5 and 6 only include state-owned manufacturing firms. Columns 1, 3, and , use standard IV estimates. Columns 2, 4, and 6 use GMM estimations and identification through heteroskedasticity.

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

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

Table B11: **Investment and Local Government Debt: Rajan and Zingales Regressions**

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). The regressions control for initial investment (I_{t-1}) and the interaction between each of local government debt over GDP (LGD), bank loans over GDP (BL), log of GDP per capita ($ln(GDPPC)$), and GDP growth (GR) and the Rajan-Zingales index of external financial dependence (EF) computed on firms in Guangzhou, Foshan, and Dongguan. Columns 3 and 4 present separate coefficients for private and state-owned firms.

	(1)	(2)	(3)		(5)	
			Private	SOE	Private	SOE
$EF \times LGD$	-0.384*	-0.399*	-0.405*	0.0802	-0.411*	-0.0553
	(0.217)	(0.229)	(0.218)	(0.369)	(0.232)	(0.530)
$EF \times BL$	0.0609			0.0589	0.131	
		(0.0869)			(0.0874)	(0.171)
$EF \times ln(GDPPC)$		-0.0109			-0.013	0.001
		(0.275)			(0.275)	(0.279)
$EF \times GR$		-0.001			-0.001	-0.011
		(0.007)			(0.007)	(0.015)
I_{t-1}	-0.273***	-0.273***	-0.273***		-0.273***	
	(0.003)	(0.003)	(0.003)		(0.003)	
CF_{t-1}	3.695***	3.739***	3.695***		3.739***	
	(0.225)	(0.231)	(0.225)		(0.231)	
REV_{t-1}	2.122***	2.126***	2.122***		2.126***	
	(0.034)	(0.035)	(0.034)		(0.035)	
N. Obs.	647,589	626,563	520,585		511,111	
N. Firms	168,725	165,773	168,725		165,773	
Firm FE	YES	YES	YES		YES	
City-Year FE	YES	YES	YES		YES	
Industry-Year FE	YES	YES	YES		YES	
City-Industry FE	YES	YES	YES		YES	

Robust s.e. clustered at the firm and city-industry-year level in parenthesis
*** p<0.01, ** p<0.05, * p<0.1

Table B12: **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 on firms in Beijing, Shanghai, Hangzhou, and Wenzhou. The first column includes all manufacturing firms, column 2 only private sector manufacturing firms, and column 3 only state-owned manufacturing firms.

	(1)	(2)	(3)
I_{t-1}	-0.273***	-0.271***	-0.426***
	(0.006)	(0.006)	(0.034)
$EF \times LGD$	-0.015***	-0.019***	0.016
	(0.005)	(0.006)	(0.017)
N. Obs	57,054	53,262	6,249
N. Cities	257	257	257
City-Year FE	YES	YES	YES
Ind.-Year FE	YES	YES	YES
Sample	All	Private	State

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

Table B13: **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 on firms in Beijing, Shanghai, Hangzhou, and Wenzhou and each of the following variables: 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 private sector manufacturing firms, and column 3 only state-owned manufacturing firms.

	(1)	(2)	(3)
I_{t-1}	-0.272***	-0.271***	-0.427***
	(0.006)	(0.006)	(0.03)
$EF \times LGD$	-0.018***	-0.023***	0.018
	(0.005)	(0.006)	(0.011)
$EF \times BL$	0.001	0.001	-0.003
	(0.001)	(0.001)	(0.003)
$EF \times ln(GDP\ PC)$	0.227	0.186	0.679
	(0.19)	(0.196)	(0.942)
$EF \times GR$	0.0286*	0.0338	0.0646
	(0.016)	(0.019)	(0.09)
$EF \times LP$	-0.129	-0.131	-0.230
	(0.107)	(0.114)	(0.528)
N. Obs	56,209	52,503	6,065
N. Cities	257	257	257
City-Year FE	YES	YES	YES
Ind.-Year FE	YES	YES	YES
Sample	All	Private	State

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

Table B14: **Sensitivity of investment to cash-flow: 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 the following variables: 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 includes firms located in cities with population of 1-10 million.

	(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 B15: **Sensitivity of investment to cash-flow: 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 the following variables: 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 as in Table B9). Column 1 includes all manufacturing firms, column 2 only private sector manufacturing firms, and column 3 only state-owned manufacturing firms.

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

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

Table B16: **Sensitivity of investment to cash-flow: 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 revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of the following variables: local government debt over GDP (LGD) and bank loans over GDP(BL). The first includes uses all manufacturing firms, column 2 only private sector domestically owned manufacturing firms, and column 3 only state-owned manufacturing firms.

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

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

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

Table B17: **Sensitivity of investment to cash-flow: 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}), revenue growth over total assets (REV_{t-1}), lagged cash flow (CF_{t-1}), and the interaction between CF_{t-1} and each of the following variables: local government debt over GDP (LGD) and bank loans over GDP (BL).

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

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

Table B18: **Sensitivity of investment to cash-flow: Only Data from ASIF**

This table estimates the models of Table 6 restricting the sample to the observations available in the ASIF survey.

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

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

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

Table B19: **The Correlates of Local Government Debt in China**

This table reports the overall city-level correlations between local government debt and each of the following variables: 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 prices ($LP1$ is an average of auction prices and administered prices fixed by the local government; $LP2$ is the auction price).

	(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