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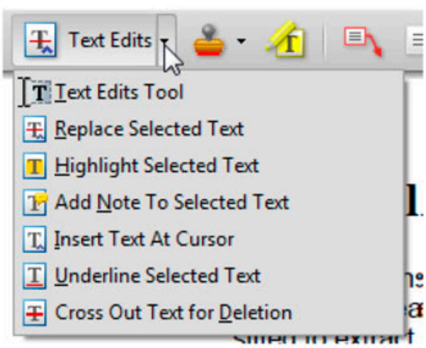

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Does government investment crowd out private investment in China?

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This paper asks whether government investment “crowds out” or “crowds in” private investment in China. We divide government capital expenditures into two types: (1) investment that serves to provide public goods and infrastructure, and (2) investment in private industry and commerce. The results of structured vector auto-regressive analysis suggest that government investment in *public* goods in China “crowds in” private investment significantly, while government investment in private goods, industry and commerce, mainly through state-owned enterprises, “crowds out” private investment significantly.

AQ2

Keywords: government investment; private investment; crowding out; structural vector auto regression models

JEL Classifications: E22, H54

The relationship between governmental and private investment is a central issue in both macroeconomics and development economics (Aschauer 1989). A key question is does government investment crowd in or crowd out private investment? The answer to this question is critical for long-term development strategies and short-term stabilization programs. It also potentially exerts a great influence on the growth of a country’s private economy and thus long-term economic growth.

Most empirical studies that examine the long-run relationship between public and private investment mainly focus on developed countries. However, in China, since 1997 when the Chinese Government began to implement an expansionary fiscal policy, the impact of government investment on private investment has become one of the central issues in policy debates. In particular, after the global financial crisis in 2008, the Chinese Government planned an economic stimulus project, including government investment spending of 4 trillion renminbi (RMB), or $576 billion at that time, equaling 13% of GDP. How should such a huge amount of government spending, 23% of total investment in China take place? Will public capital crowd out private capital? These issues are the subject of intense debate among Chinese scholars and policy-makers.

The substitutability or complementarity between public and private investment is the key issue. On the one hand, an increase of government investment may directly and indirectly crowd out private investment. Firstly, a rise of government investment needs to be financed, which means the government sector will compete with the private sector for funds in the capital markets, causing the interest rate to rise. Therefore, it reduces the amount of loanable funds available for private investors, thus lowering

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private investment. This is the classical Keynesian “financial crowding out” theory (Hicks 1937). Secondly, Ricardian equivalence (Ricardo 1820) provides another explanation for the “crowding out” effect. According to Ricardo, government spending must be financed, now or in the future, by taxes. The more taxes imposed by the government in the future, the less disposable income for the private sector, negatively affecting private investment. On the other hand, public investment can, again directly or indirectly, create favorable conditions for private investment, for instance, by providing infrastructure such as roads, highways, sewage systems, and harbors. Better facilities may increase the productivity of private investment and reduce the cost of production of the private sector, a positive impact on the profitability of private investment. This would result in a “crowding-in” effect on private investment. Furthermore, government spending itself may directly crowd in private investment, by contracting directly with private. State enterprises can also subcontract to private firms, directly increasing private investment.

Empirically, there is no clear result regarding the impacts of changes in taxes, government investment, and deficits on private consumption, investment and gross domestic product. Many results support the “crowding out” hypothesis. Baily (1971) finds that public investment crowds out a fraction of private investment, supporting the substitutability hypothesis. Examining the economic effects of government spending financed by taxes, Barro (1990) finds that higher taxes reduce the real profit of the private investment and thus crowd out private investment. Knot and de Haan (1995) detect that the fiscal deficit indeed leads to higher interest rates in five European countries. Knot and de Haan (1999) identity a positive correlation between Germany’s budget deficits and interest rates, implying a crowding out effect of public investment on private investment. Serven (1996) finds that, in India, government investment in non-infrastructure projects crowds out private investment in the long run. In China, Liu and Ma (2001) state that China’s fiscal deficit did not produce a “crowding out” effect, while Dong (2006) finds that fiscal expenditure “crowds out” private investment in the short term, and in the long-term “crowds in” private investment. Mitra (2006) concludes that government investment crowds out private investment in the short run in India. Afonso and Miguel (2008) find that the crowding-out effects of public investment on private investment vary in magnitude across countries. Eduardo and Daude (2011) analyze the relationship between public and private investment in developing countries with both time series and cross-sectional data for 116 developing countries, finding that the crowding-out effect is significant. Other studies find crowding out as well. (Aschauer 1985; Barro 1981; Monadjiemi 1993; Pradhan, Ratha, and Sharma 1990; Sahu and Panda 2012).

Aschauer (1989) puts forward a new perspective that government spending serves as factors of production for private sector, so it is complementary to private capital. Ramirez (1994), Greene and Villanueva (1990) find that public and private investments are complementary. Voss (2002) use a vector auto-regression (VAR) model to re-examine the research of Aschauer (1989), reaching the opposite conclusion, i.e. crowding out. Atukeren (2006) demonstrates that public fixed capital investments may crowd in private investments, depending on the economic, political, and legal environment of business in individual countries. Li and Wei (2009) use a time-varying parameter model to study the effects of Chinese fiscal expenditure on private investment since the reform and opening up of China over three decades ago, beginning in 1978. They find that government expenditure crowds in private investment. In addition, Vijverberg and Vijerberg (1997), Fisher and Turnovsky (1998) draw the same conclusion, namely that government spending exerts a positive effect on private investment.

Barro (1990) also divides government spending into non-productive expenditure on government consumption, and productive expenditure, which includes infrastructure construction and the protection of property rights. He finds that non-productive government spending has a negative relationship on private investment, while productive expenditure has a positive role on private investment. Serven (1996) also divides government investment into infrastructure investment and non-infrastructure investment, suggesting that infrastructure investment crowds in private investment while non-infrastructure investment crowds out private capital formation. Xu and Guo (2009) find that construction and administrative expenditure in China crowd in private investment, while other government expenditure impedes private investment.

In the context of China, the conventional "financial crowding-out" effect of government borrowing on the cost of funds to the private sector may not be directly applied. Zeng (2000) and Liu and Ma (2001) argue that the real interest rate in China is not completely market determined since the lending rate and credit rationing is controlled by the People's Bank of China. Thus, interest rates do not reflect the supply of and demand for funds accurately. Therefore, the transmission mechanism of the "financial crowding out" effect is not easily measured in China.

The literature mainly focuses on *aggregate* government investment, ignoring the effects of different kinds of government investment on private investment. Empirically, this approach may be adequate for some highly developed countries, like the USA, where the government sector is seldom involved in conventional industrial and commercial activities. However, this is not the general case in developing countries, especially in the countries like China where state-owned enterprises (SOEs) are frequently involved in multiple activities, such as manufacturing, banking and commerce. So in developing countries, the government not only serves as a provider of public goods and infrastructure services, but also exerts a great influence on industrial and commercial activities. In this case, it is hard to identify a meaningful relationship between aggregate government investment and private investment because the different *types* of government investment may have different effects on private sector activity. In general, we presume that government investment in infrastructure and public goods tends to raise the profitability of private production and thereby boost private investment. On the other hand, government projects in more conventional activities, where SOEs basically replicate the actions of private firms, might be expected to crowd out private investment by competing with the private sector in goods and factor markets.

For over three decades, China embarked on a state-led economic development strategy. Its key ingredient was rapid industrialization focused on heavy, capital intensive industries, under the guidance of the public sector. Thus, it is no surprise that, in China, the public sector expands into most spheres of economic activity, encompassing not only those usually reserved for the state – infrastructure, education, and energy – but also industrial and commercial activities in which public firms competed with private firms such as mining, manufacturing, real estate, telecommunications, commercial banking, and construction.

From Table 1, Chinese Government investment has a heterogeneous nature. Part of the government investment spending takes the form of infrastructure capital in areas such as transport, telecommunications and electricity and also standard public sector activities such as public administration, social security and social welfare. However, a substantial amount of government investment is devoted to industrial and commercial

Table 1. Fixed asset investment by stated-owned enterprises and private firms by sectors in 2010.

Sector	State investment/total investment (%)	Private investment/total investment (%)
Agriculture, forestry, and fishery	52	48
Mining	59	41
Manufacturing	19	81
Electricity, gas and water production and supply	83	17
Construction	66	34
Transportation, storage and postal services	91	9
Information transmission, computer services and software	87	13
Wholesale and retail trade	15	85
Accommodation and catering	17	83
Financial sector	84	16
Banking	94	6
Real estate	27	73
Leasing and business Services	62	38
Scientific research, technical services and geological prospecting	70	30
Water conservation, and public facilities	92	8
Residential and other services	42	58
Education	89	11
Health, social security and social welfare	89	11
Culture, sports and entertainment	64	36
Public administration and social organizations	92	8
Total	49	51
	State investment	Private investment
Total (USD millions)	$1463,300	$1502,729
Percent of GDP	24%	25%

Source: *Chinese Statistical Yearbook* 2011.

activities, notably in manufacturing, banking, construction and real estate, which are usually undertaken by the private sector in market economies. For example, in banking, leasing and business service areas in which the private sector should play an extremely important role, the ratio between stated-owned investment and total investment reached 94 and 62%, respectively. From Table 1, government investment is involved in virtually every sector, competing with the private industry.

Owing to the “intimate relationship” between state-owned enterprise and government, the government is inclined to favor SOEs. This impedes the development of the private sector by administrative roadblocks and procedures as well as restricted approval and forbidding private enterprise to enter some productive areas. Private investors have to face a complex regulatory system in China, which involves comprehensive licensing of firms’ entry, expansion and diversification plans; reservation of entire productive sectors for the state; and mandatory credit allocation schemes imposed on the banking system. Therefore, public capital in those areas may crowd out the private capital. Thus, government investment in private goods might compete with private firms in factor, product, and capital markets. On the other hand, government investment in fields traditionally reserved to the state, such as public goods[1] and infrastructure, can result in raising the profitability of private production and thus have a crowding-in effect on private investment. The main idea of this paper is to investigate the relationship between government investment and private investment in China, taking into account the type of government investment.

Usually, gross fixed capital formation of public investment is used to represent government investment in empirical research. In the case of China, however, this aggregate measure is not a good proxy for government investment because it excludes most investment by SOEs. It thus underestimates true government investment in China. However, SOEs are under the control of the government and are therefore part of the government.

Methodology

We measure government and private investment in the following way: We use fixed assets investment[2] of SOEs as the proxy of government investment. Then private investment can be estimated by total fixed assets investment minus the fixed assets investment by state enterprises. Within government investment, we measure the sum of fixed assets investment of state-owned sector in power, water and sewage, transportation, postal services, scientific research, education, health, social security and social welfare as government investment in traditional public goods and infrastructure. Then the remainder of government investment is defined as government investment involved in the private goods. After dividing government investment into public goods and private goods, we examine empirically the relationship between government investment spending and private investment in China.

We use the VAR framework (Sims 1980) to estimate the model for several following reasons. In the first place, the VAR overcomes the problem of endogeneity and nonstationarity. In the VAR system, all variables entering the equations system are assumed to be endogenous. This means that all variables affect, and in turn are affected by, all other variables. Also, the variables' stationarity is not a prerequisite for obtaining accurate estimates and reliable hypothesis testing. In the second place, VAR models investigate the dynamic relationship between government and private investment, not depending upon a fully specified structural model of investment. Since the unrestricted VAR model cannot reflect instantaneous impacts among the variables, we choose a structured VAR (SVAR) model to estimate the coefficients that depict the relationship between private investment and government investment.

Consider a VAR given by

$$y_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + \varepsilon_t, \quad t = 1, 2, \ldots, T \tag{1}$$

Where y_t denote the (3 × 1) vector of the three endogenous variables, p is the lag length of the endogenous variables $y_{t-1}, \ldots, y_{t-p}$, A_0, …, A_p is the matrix of autoregressive coefficients, ε_t is the vector of random disturbances which contains the reduced form *OLS* residuals.

The SVAR model is actually a structured model of VAR, where the SVAR(p) is expressed as:

$$B_0 y_t = \Gamma_0 + \Gamma_1 y_{t-1} + \Gamma_2 y_{t-2} + \ldots + \Gamma_p y_{t-p} + u_t, \quad t = 1, 2, \ldots, T \tag{2}$$

where $B_0 = \begin{bmatrix} 1 & \cdots & -b_{1k} \\ \vdots & \ddots & \vdots \\ -b_{1k} & \cdots & 1 \end{bmatrix}$, $\Gamma_i = \begin{bmatrix} \gamma_{11}^{(i)} & \cdots & \gamma_{1k}^{(i)} \\ \vdots & \ddots & \vdots \\ \gamma_{1k}^{(i)} & \cdots & \gamma_{kk}^{(i)} \end{bmatrix}$,

$$u_t = \begin{bmatrix} u_{it} \\ \vdots \\ u_{kt} \end{bmatrix}, \quad i = 1, 2, \ldots p.$$

In order to identify the SVAR model, we need to impose $k(k - 1)/2$ restrictions according to the Cholesky decomposition, thereby reducing the numbers of coefficients that need to be estimated. In fact, we need to identify the model. The Cholesky decomposition of the matrix of covariance of the residuals requires all elements above the principal diagonal to be zero. This provides the necessary additional three restrictions necessary to exactly identify the system.

Inverting B_0 from (1) and (2), we have:

$$y_t = B_0^{-1}\Gamma_0 + B_0^{-1}\Gamma_1 y_{t-1} + B_0^{-1}\Gamma_2 y_{t-2} + \ldots + B_0^{-1}\Gamma_p y_{t-p} + B_0^{-1}u_t = A_0 + A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_p y_{t-p} + \varepsilon_t \quad (3)$$

Thus, the coefficient matrix of the structured VAR model is:

$$\Gamma_0 = B_0 A_0, \Gamma_1 = B_0 A_1, \ldots \Gamma_p = B_0 A_p, \quad u_t = B_0 \varepsilon_t \quad (4)$$

Data and results

Data

We use annual data in China from 1980 to 2011. Because of some inconsistent records, Chinese data are rather complicated. In order to solve this problem, we use data of fixed asset investment in China which are consistently recorded. The variables in the VAR framework are:

Ipr = private fixed asset investment.
Gpb = government fixed asset investment in the public goods and state infrastructure.
Gpr = government fixed asset investment in private goods, mainly through SOEs.

All variables are transformed into real values using the price deflator of GDP and the price deflator of the gross fixed capital formation. The variables are then expressed in natural logarithms. The data are from the *Chinese Statistics Yearbook*[3].

Unit root and cointegration tests

We use an augmented Dickey-Fuller (ADF) test to determine the degree of integration of the variables. From the unit root test results presented in Table 2, we find that all variables are non-stationary at levels and stationary at first-differences, thus the variables are I(1). This prompts us to use Johansen's technique to test for cointegration between the variables. Generally, a well-defined long-run relationship exists among them only when the series are cointegrated. Table 3 reports the results of Johansen's likelihood ratio cointegration tests. The first column of Table 3 lists the number of

Table 2. Unit root tests using an augmented Dickey-Fuller test.

Variables	*ADF*	Test critical values:	*p* value	Intercept, trend, lag selection	Variable type
ln*Ipr*	−2.15	−3.57	0.50	(C, *T*, 2)	*I*(1)
dln*Ipr*	−3.66	−2.96	0.01	(C, 0, 0)	*I*(0)
ln*Gpr*	−2.74	−3.57	0.23	(C, *T*, 1)	*I*(1)
dln*Gpr*	−5.40	−1.95	0.00	(0, 0, 0)	*I*(0)
ln*Gpb*	−1.38	−3.56	0.85	(C, *T*, 0)	*I*(1)
dln*Gpb*	−5.00	−2.96	0.00	(C, 0, 0)	*I*(0)

Note: C denotes the intercept, *T* denotes trend, *N* is the optimum lag length determined by the Schwartz Information Criterion (SBC).

Table 3. Johansen cointegration test.

Trace test				
Hypothesized no. of CE(s)	Eigen value	Trace statistic	0.05 critical value	Prob.**
None*	0.61	38.81	29.80	0.00
At most 1	0.30	10.55	15.49	0.24
At most 2	0.00	0.05	3.84	0.83
Maximum Eigen value test				
Hypothesized no. of CE(s)	Eigenvalue	Max-Eigen statistic	0.05 critical value	Prob.**
None*	0.61	28.30	21.13	0.00
At most 1	0.30	10.51	14.26	0.18
At most 2	0.00	0.05	3.84	0.83

AQ11 Note: Lag length 1. *Denotes rejection of the hypothesis at the 0.05 level.

AQ3 cointegrating vectors under the null hypothesis that the variables are not cointegrated. The hypothesis of no cointegration is rejected at the 5% level, as reported in column 4.

Identification and estimation of the SVAR model

Generally, we can estimate the coefficient of SVAR model through the unrestricted VAR model. But, we first need to determine the lag length p. According to the AIC and SC standards, we choose $p = 1$. The unrestrictive VAR model is estimated in Table 4.

Table 4. Estimated VAR model for ln*Ipr,* ln*Gpb* and ln*Gpr.*

Regressor	ln*Ipr*	ln*Gpb*	ln*Gpr*
ln*Ipr* (−1)	0.85	0.07	0.18
	(10.67)***	(1.11)	(1.94)*
ln*Gpb* (−1)	0.27	0.92	–0.21
	(2.54)**	(10.48)***	(–1.72)*
ln*Gpr* (−1)	–0.11	0.01	0.82
	(–1.93)*	(–0.16)	(12.07)***
Intercept	0.09	0.20	1.61
	(0.22)	(0.60)	(3.43)***

Note: *t*-statistics are in parenthesis.
*Significance at 10% level.
**Significance at 5% level.
***Significance at 1% level.

The determinants of private investment are estimated to be[4]:

$$\ln Ipr = 0.09 + 0.85 \ \ln Ipr_{-1} + 0.27 \ \ln Gpb_{-1} - 0.11 \ \ln Gpr_{-1} \quad (5)$$

$$\begin{matrix} [0.40] & [0.08] & [0.10] & [0.06] \\ (0.21) & (10.67)^{***} & (2.54)^{**} & (-1.93)^{*} \end{matrix}$$

$$R^2 = 0.997 \quad \text{S.E of equation} : 0.09 \quad \text{Sample} : 1981 - 2011 \quad n = 31$$

The main result of the unrestrictive VAR model is generally effective since the "t" value of most coefficients is significantly greater than 0. Also, various testing related to residual indicate that the model is well defined. From Equation (5), we can see that, with a one-period lag, government investment in the public goods "crowds in" private investment significantly, while government investment in the industry and commerce "crowds out" private investment at a 10% significance level.

Next we estimate the SVAR model. Since there are three endogenous variables in the VAR framework, we need to impose three restrictions to completely identify the model. The use of a Cholesky decomposition of the matrix of covariances of the residuals provides the necessary additional three restrictions, and the system is then exactly identified.

We can then impose an upper triangular structure to B_0, and the result is in Table 5:

From the results, we can see that all the coefficients are significantly greater than 0, since P value is 0.01, 0.04 and 0.05, respectively.

$$\text{So} \quad B_0 = \begin{bmatrix} 1 & -0.50 & 0.30 \\ 0 & 1 & -0.24 \\ 0 & 0 & 1 \end{bmatrix} \quad (6)$$

Therefore, we are able to deduce the SVAR model through the equation:

$$B_0 y_t = \Gamma_0 + \Gamma_1 y_{t-1} + U_t.$$

Thus, the private investment equation in the SVAR model can be estimated as follows:

$$\ln Ipr = 0.47 + 0.50 \ \ln Gpb - 0.30 \ \ln Gpr + 0.87 \ \ln Ipr_{-1} - 0.26 \ \ln Gpb_{-1} + 0.14 \ \ln Gpr_{-1} \quad (7)$$

$$\begin{matrix} [0.45] & [0.22] & [0.16] & [0.08] & [0.23] & [0.14] \\ (1.04) & (2.45)^{**} & (-2.05)^{**} & (10.93)^{***} & (-1.05) & (0.95) \end{matrix}$$

$$R^2 = 0.998 \quad \text{S.E of equation} : 0.08 \quad \text{Sample} : 1981 - 2011 \quad n = 31$$

The main result suggests again that government investment in public goods and infrastructure significantly crowds "in" private investment. A 1% increase in Gpb raises

Table 5. Estimation of the coefficients of matrix B_0.

	Coefficient	Std. Error	z Statistic	Prob.
C(1)	−0.50	0.20	−2.45	0.01
C(2)	0.30	0.15	2.05	0.04
C(3)	−0.24	0.12	−1.97	0.05

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private investment by 0.5% contemporaneously and is significant at the 5% level. However, government investment in the private goods crowds "out" private investment contemporaneously with the elasticity of coefficient 0.3. However, with a one-period lag, the coefficients are not significant.

Granger causality tests

An important application of the VAR model is to analyze the causal relationship between endogenous variables. We test for causality using Granger (1969) tests, also developed by Sargent (1976). Generally, if *present* values of y can be predicted more accurately, *ceterus paribus*, by using *past* values of x, we can say that variable x is a Granger cause of y. Formally, this can be tested by using an F-test or the Lagrange Multiplier (LM) in an autoregressive equation of y in which *all* parameters on lagged values of x act as explanatory variables.

Granger test results are reported in Table 6. Results indicate that $\ln Ipr_t$ does not Granger cause $\ln Gpb_t$, while $\ln Gpb_t$ and $\ln Gpr_t$ do Granger cause $\ln Ipr_t$, with p values of 0.01 and 0.05, respectively. The estimated Granger equation for Ipr on lagged Gpb and lagged Ipr is as follows:

$$\ln Ipr = -0.53 + 0.79\ \ln Ipr_{-1} + 0.30\ \ln Gpb_{-1} \tag{8}$$

$$\begin{matrix} [0.26] & [0.08] & [0.11] \\ (-2.02)^{**} & (10.26)^{***} & (2.76)^{**} \end{matrix}$$

$$R^2 = 0.997 \quad \text{SE of equation}: 0.09 \quad \text{Sample}: 1981-2011 \quad n = 31$$

The estimated Granger equation for Ipr on lagged Gpr and lagged Ipr is:

$$\ln Ipr = 0.81 + 1.05 \ln Ipr_{-1} - 0.14\ \ln Gpr_{-1} \tag{9}$$

$$\begin{matrix} [0.31] & [0.02] & [0.06] \\ (2.61)^{**} & (46.11)^{***} & (-2.17)^{**} \end{matrix}$$

$$R^2 = 0.997 \quad \text{SE of equation}: 0.09 \quad \text{Sample}: 1981-2011 \quad n = 31$$

Total government investment is about 25% of GDP, roughly half in the public sector goods and infrastructure, and half in private sector goods. The government thus plays a major role in economic development.

Table 6. Granger tests for causality.

Null hypothesis	χ^2 statistic	p value
$\ln Gpb_t$ cannot Granger cause $\ln Ipr_t$	6.47	0.01
$\ln Ipr_t$ cannot Granger cause $\ln Gpb_t$	1.22	0.27
$\ln Gpr_t$ cannot Granger cause $\ln Ipr_t$	3.73	0.05
$\ln Ipr_t$ cannot Granger cause $\ln Gpr_t$	3.77	0.05
$\ln Gpb_t$, $\ln Gpr_t$ cannot simultaneously Granger cause $\ln Ipr_t$	12.09	0.00
$\ln Ipr_t$, $\ln Gpr_t$ cannot simultaneously Granger cause $\ln Gpb_t$	1.31	0.52
$\ln Gpb_t$, $\ln Ipr_t$ cannot simultaneously Granger cause $\ln Gpr_t$	4.10	0.13

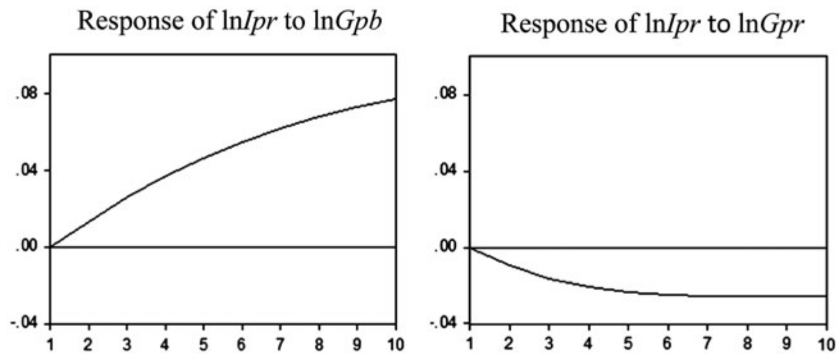

Figure 1. Response to Cholesky One S. D. Innovations.

Impulse response function (IRF) and variance decompositions (VDC)

In addition to Granger causal tests, we want to examine the dynamic interactions among the variables and the relative importance of various shocks, so we use impulse response functions and variance decompositions. IRF is used to examine the positive or negative response of private investment to changes in public investment (lnGpb_t and lnGpr_t). This function accounts for the dynamic response of private investment to a one standard deviation shock of public investment. In Figure 1, we find that government investment in the public goods has a positive effect on the private investment. Giving the lnGpb_t one unit shock will raise nearly 1% of the private investment in the long run, showing the strong crowding in effect. But private investment responses negatively to one unit shock in lnGpr_t, indicating the negative relationship between the two variables.

The results suggest that government investment in the public goods explains a large ratio of the variance of private investment (nearly 35% in the long run) while government investment involved in the private goods is a relatively less important variable in explaining the forecast error in the variance of private investment. The results suggest that the government should investment more in public goods rather than SOEs in order to stimulate the development of the private economy.

Conclusion

Few previous studies draw the distinction between government investments in public goods vs. private goods. We divide government investment in China from 1980 to 2011 into two types: first, investment that serves to provide public goods and infrastructure, and second, the investment in the private goods. We then examine the relationship between government investment of these two types and private investment by SVAR analysis.

The results suggest that government investment in public goods “crowds in” private investment significantly, while government investment in the private goods, mainly by SOEs, “crowds out” private investment. This suggests that for future growth, the Chinese Government should increase public investment and reduce investment in sectors that compete directly with the private sector.

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Notes

1. Public goods are not strictly defined here as in Samuelson (1954), but rather by sector as state enterprise investment in public sector goods and infrastructure. State enterprise investment in private goods is defined as the residual: total state enterprise investment less investment in public sector goods.
2. Fixed Asset Investment is the total cost of the construction and purchase of fixed assets, including capital equipment, real estate and infrastructure.
3. Data resource: *Chinese Statistical Yearbook 2011*. Web link: http://data.stats.gov.cn/.
4. The figures in the brackets in each equation indicate the *t*-values of the respective coefficients. The *t*-values, *indicates significance at 10% level whereas, **indicates significance at 5% level and ***indicates significance at 1% level.

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