

# Spillover Effects of Public Investment: Implications for the Formal and Informal Sector Firms in India

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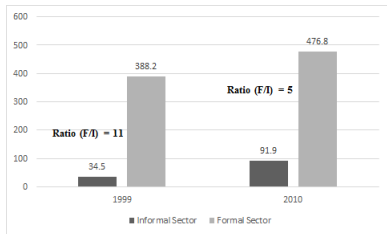
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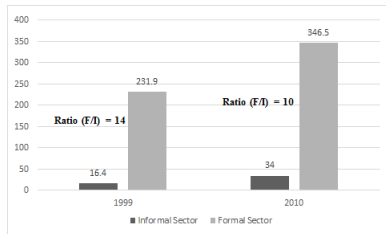
## Definitions

- ▶ ***Informal sector*** is a firm-based concept. It comprises of small-scale activities
  - ▶ Unregistered and incorporated under the Factories Act, 1948
  - ▶ Operate at a low level of organization and technology

Figure 1.1: Sectoral Capital Intensity and Labor Productivity, 1999 and 2010

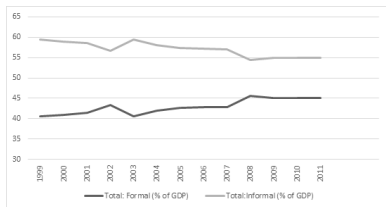


(a)  $K/L$  ratio

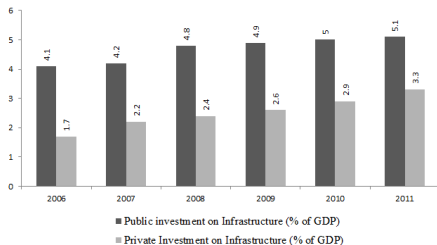


(b)  $Y/L$  ratio

**Figure 1.2: Informal Sector and Infrastructure Spending (% of GDP)**



**(a) Share of Informal Sector in GDP, 1999-2010**



**(b) Share of Infrastructure spending in GDP, 2006-2010**

## Motivation

- ▶ Government's provision of public infrastructure may serve as an input in the firm's production process
- ▶ Public spending on infrastructure may have complementary spillovers for private factors of production
  - ▶ May help alleviate the credit and labor market constraints that firms typically face
- ▶ This paper: We use two large firm-level datasets on formal and informal production in the manufacturing sector in India
  - ▶ Examine the sectoral consequences of government investment in public infrastructure

## Contribution

- ▶ Aschauer (1989): productivity benefits of public investment in infrastructure
  - ▶ Bom and Ligthart (2014) provide a survey of the recent empirical literature
- ▶ Literature on the informal sector has focused on issues related to:
  - ▶ Measurement: Schneider and Enste (2000), Porta and Shleifer (2008, 2014), Gomis-Porqueras et al. (2014))
  - ▶ Tax policy and enforcement: (Rauch (1991), Ihrig and Moe (2004), Turnovsky and Basher (2009)
- ▶ Datta (2012) and Ghani et al. (2015) examine the spatial role of India's recent expansion of its interstate system on plant-level production
- ▶ First Contribution: Examining the sectoral benefits of public investment for private production in the formal and informal sectors
- ▶ Second Contribution: Estimate sectoral productivity benefits at the level of the individual firm

## Data

- ▶ Formal Sector: The 2010 ASI survey covers 52,243 formal sector firms in 2010.
  - ▶ 93.7 percent of manufacturing firms
- ▶ Informal sector: The 2010 NSSO survey of the informal sector covers 334,474 firms
  - ▶ 30 percent manufacturing, 36 percent trading activities, and 34 percent services
- ▶ We restrict the coverage to only manufacturing firms in both sectors
  - ▶ This gives us a sample of 32,388 formal-sector firms and 82,748 informal-sector firms in 2010

## Data

- ▶ Public investment: State Finances Database of the Reserve Bank of India
- ▶ State-level data on public expenditures for two categories:
  - ▶ Economic Services: transport, communications, and energy
  - ▶ Social Services: health, education, water and sanitation, and other welfare programs
  - ▶ Total Development = Economic + Social
- ▶ Per capita Stock and Flow measures spending by state



**Table 1.1: Summary Statistics for Formal and Informal Sectors, 2010**

	Formal		Informal	
	mean	sd	mean	sd
Gross value added (GVA)*	97603.0	677048.7	86.7	158.0
Net Fixed Assets (K)*	169607.2	2021480.7	231.8	840.7
Total workers (L)	192.2	697.1	2.2	1.7
$K/L$ (in thousand Rs)	476.8	2771.8	91.9	221.1
$Y/L$ (in thousand Rs)	346.5	3029.7	34.0	33.9
Rural	0.4	0.5	0.5	0.5
Age of firm	17.1	13.0	12.3	9.4
Registered (Y)?	.	.	0.2	0.4
Observations	32388		82748	

\*(in 000 Rs)

Table 2.2: State-wise Public Development Expenditures  
(in 2004-05 Rs)

States	Per Capita		% of NSDP	
	Flow	Stock	Flow	Stock
MANIPUR	4300.6	27782.9	19.0	118.8
GOA	3885.6	29143.2	3.7	24.8
JAMMU AND KASHMIR	3259.2	24831.3	13.0	86.6
DELHI	3031.7	28272.2	3.6	29.4
NAGALAND	2828.0	27375.2	9.0	83.3
TRIPURA	2188.0	23749.5	7.6	75.0
HIMACHAL PRADESH	2008.9	19594.7	4.9	41.4
KARNATAKA	1468.8	11592.6	3.9	26.5
MEGHALAYA	1435.0	16247.4	4.5	47.5
ANDHRA PRADESH	1340.1	12681.2	3.7	29.8
HARYANA	1324.9	10843.5	2.4	16.2
TAMIL NADU	1267.6	9046.4	2.8	16.5
GUJARAT	1247.1	11935.2	2.7	21.5
MAHARASTRA	1176.1	11968.2	2.3	20.4
MADHYA PRADESH	1075.1	8280.3	5.3	36.5
UTTAR PRADESH	849.6	6284.0	5.1	33.4
PUNJAB	800.4	8486.8	1.8	16.5
RAJASTHAN	744.3	7390.6	2.9	23.5
ORISSA	645.8	6075.6	2.6	21.7
ASSAM	622.2	6225.4	3.1	26.6
BIHAR	618.1	4856.5	5.6	35.9
KERALA	590.6	5246.2	1.4	10.8
WEST BENGAL	344.3	4711.1	1.2	14.2
<b>Mean</b>	<b>1611.0</b>	<b>14027.0</b>	<b>4.9</b>	<b>37.3</b>
<b>S.D</b>	<b>1119.6</b>	<b>8626.3</b>	<b>4.1</b>	<b>27.6</b>
Observations	23	23	23	23

## Empirical Specification

$$\ln GVA_{ist} = \alpha \ln L_{ist} + \beta \ln K_{ist} + \gamma \ln G_{st} + \theta_{ist} Z_{isi} + \theta_{st} Z_{st} + \varepsilon_{ist} \quad (1.1)$$

$$\varepsilon_t = \omega_t + \eta_t \quad (1.2)$$

- ▶ Departure from earlier studies: Public capital is exogenous to the firm
- ▶ Capital and labor are endogenous to the firm:
  - ▶ Levinson and Petrin (2003); Sivadasan (2009) [▶ Appendix](#)

**Table 1.3: Estimation of Production Function,  
Flow Measure of Public Investment**

Dep. var: <i>ln GVA</i>	Formal		Informal	
	OLS	LP-S	OLS	LP-S
<i>ln L</i>	0.778*** (0.005)	0.664*** (0.005)	0.820*** (0.005)	0.628*** (0.005)
<i>ln K</i>	0.325*** (0.003)	0.369*** (0.002)	0.252*** (0.002)	0.317*** (0.003)
<i>ln Development Exp. per capita</i>	0.034*** (0.015)	0.088*** (0.015)	-0.002 (0.006)	0.027*** (0.006)
Constant	5.364*** (0.295)	7.851*** (0.495)	5.998*** (0.147)	8.031*** (0.314)
State-level Controls	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
N	32388	32388	82748	82748

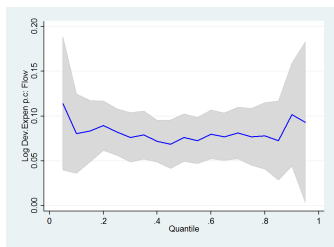
\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

**Table 1.4: Estimation of Production Function,  
Stock Measure of Public Investment**

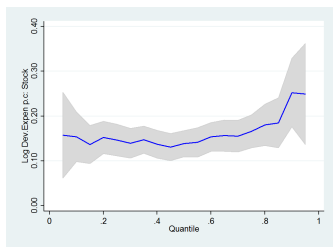
<b>Dep. var.: <i>ln GVA</i></b>	Formal	Informal
	LP-S	LP-S
<i>ln L</i>	0.664*** (0.005)	0.628*** (0.005)
<i>ln K</i>	0.369*** (0.002)	0.317*** (0.003)
<i>ln Development exp. per capita</i>	0.173*** (0.019)	0.024*** (0.008)
Constant	7.400*** (0.499)	8.016*** (0.317)
State-level Controls	Yes	Yes
Firm-level controls	Yes	Yes
Industry dummies	Yes	Yes
N	32388	82748

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Figure 1.3: Quantile Output Elasticity of Public Investment, Formal Sector



(a) Flow



(b) Stock

Figure 1.4: Quantile Output Elasticity of Public Investment, Informal Sector

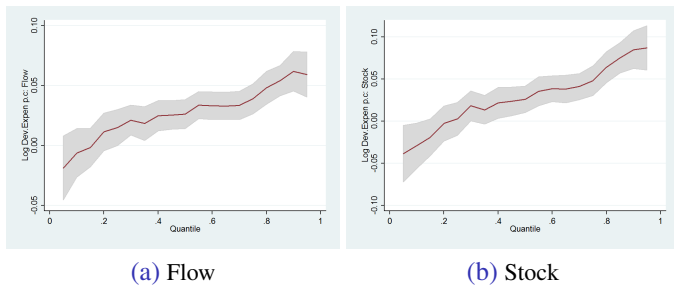
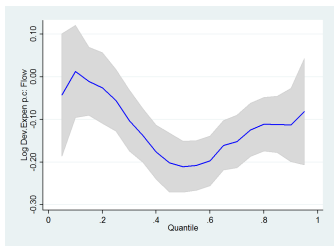
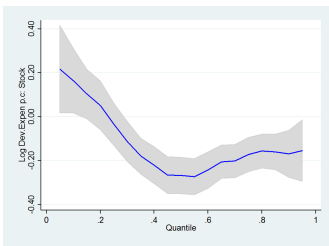


Figure 1.5: Public Investment and Firm-level Capital Intensity, Formal Sector



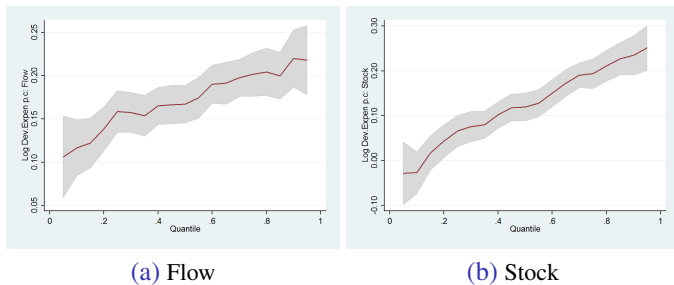
(a) Flow



(b) Stock



Figure 1.6: Public Investment and Firm-level Capital Intensity, Informal Sector



## Summary of Results

- ▶ Flow measure: output elasticity of public investment for an informal sector firm is lower than that of its formal counterpart by a factor of about 3
- ▶ Stock measure: this difference increases to a factor of 7
- ▶ Formal sector firms: little variation in the output elasticity of public investment across their size distribution
- ▶ Informal sector: output elasticity strictly increasing in firm size
- ▶ Strong complementarities may exist between private inputs and public investment in informal production

## Conclusions

- ▶ From a policy perspective, our results suggest that firms in the informal sector do indeed benefit significantly from public investment
  - ▶ Benefits are relatively smaller on average than their counterparts in the formal sector
- ▶ The largest firms in the informal sector benefit the most from public investment
  - ▶ Both with respect to the overall output elasticity as well as their capital intensity
- ▶ An effective way to increase the productivity and capital usage of informal sector firms might be to send more public investment goods to the largest firms in that sector
- ▶ Added advantage of lowering the relative size of the informal sector, by helping to formalize the largest and most productive firms, rather than a one-size-fits-all approach

## Appendix: LP-S Method

$$m_t = m(\omega_t, K_t) \quad (1.3)$$

$$\omega_t = \omega(m_t, K_t) \quad (1.4)$$

$$\omega_t \equiv \omega(m_t, K_t) = \sum_{i=0}^3 \sum_{j=0}^{3-i} \delta_{ij} m_t^j K_t^i \quad (1.5)$$

$$\ln GVA_t = \alpha \ln L_t + \gamma \ln G_t + \theta Z + \phi(m_t, K_t) + \eta_t \quad (1.6)$$

$$E[\xi_t K_t] = E[K_t \{ \omega_t - E(\omega_t | \omega_{t-1}) \}] \quad (1.7)$$

$$\omega_t = E(\omega_t | \bar{\omega}_{t-1}) + \xi_t \quad (1.8)$$

## Appendix: LP-S Method

1. Run the first stage regression given by (1.1)
2. From the first stage regression, obtain:  $\hat{\phi} = \ln \hat{GVA} - \alpha l - \gamma \ln G - \theta Z$
3. Start with a candidate estimate for  $\beta$  ( $\beta^*$ ) and compute:  $\hat{\omega}_t = \hat{\phi} - \beta^* k$
4. Compute the average productivity ( $\widehat{\bar{\omega}}_{t-1}$ ) for each cell
5. Regress  $\hat{\omega}_t$  on  $\widehat{\bar{\omega}}_{t-1}$  and  $\widehat{\bar{\omega}}_{t-1}^2$  and use the predicted values to form  $E(\hat{\omega}_t | \widehat{\bar{\omega}}_{t-1})$
6. Obtain  $v_{it}^* = \ln GVA - \alpha l - \gamma \ln G - \theta Z$
7. Regress  $v_{it}^*$  on  $k$  and  $E(\hat{\omega}_t | \widehat{\bar{\omega}}_{t-1})$  to identify the capital coefficient.