Learning to Compete: Industrial Development and Policy in Africa

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Clustering, competition and spillover effects: Evidence from Cambodia

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Overview of paper

‣ Investigate the pattern of firm clustering in the setting of Cambodia and explore the extent to which it leads to productivity gains for different types of firms in different sectors

‣ We consider both competition and technology spillover channels in explaining the pattern of clustering observed

‣ Four main questions:

  I. Are firms more or less productive where there is greater clustering of economic activities?

  II. Are different types of firms impacted differently by the clustering of economic activities?

  III. Are there productivity spillovers associated with clustering?

  IV. Are different types of firms affected differently by productivity spillovers?

Motivation

- The geographic clustering of firms can impact on productivity in different ways (Marshall, 1920; Krugman, 1991; Fugita et al, 1999):
    - Reduced transport costs
    - Access to a common pool of labor
    - Technology spillovers / learning effects
    - Increased competitive pressure

- Little evidence in developing country contexts:
    - Exceptions include: Fan and Scott, 2003; Howard et al., 2011; Siba et al., 2012; Fafchamps and Soderbom, 2011

- Why should clustering be given special consideration in developing countries?
    - Already given prominence in industrial policy with little evidence base
    - There may be different mechanisms at work compared with developed countries that are less well understood

Why might clustering and its impact be different in developing countries?

- Firms in developing countries potentially have more to gain from clustering:
  - Starting from a lower technological base, spillovers of new technologies and innovations are likely to have a greater impact on productivity and survival probability

- But…. competitive pressures are likely to be more pronounced in developing countries that are at the early stages of industrialization:
  - If physical infrastructure is still underdeveloped producers will exclusively rely on customers in local markets
  - This may prevent small firms from growing, act as a deterrent to firms to locate close together or may act as a barrier to entry for small firms

- Composition of clusters in developing countries might be different:
  - Service sector firms make up a large proportion of small firms - competitive pressures even more pronounced given that consumption of the service must take place at the point of sale
  - Informal firms also make up a large proportion of small firms – do they respond differently in clusters?

Description of mechanisms

▸ **Competition effect:**

The more firms in close proximity the tougher competition (Cournot result)

  ▸ Firms forced to cut slack and use costs more efficiently
  ▸ Firms should appear more productive in markets with more competitors

▸ **Productivity effect:**

Firms might experience spillover effects from other firms located nearby

▸ This will depend on the characteristics of the cluster and the firm

  ▸ Technology transfers through the movement of labor between firms. E.g. large firms, in high-technology sectors
  ▸ Spillovers through the copying or sharing of technologies diffused through local networks

    ▸ Technological complementarities – e.g. electronic transactions
    ▸ Less likely for close competitors - greater incentive to protect productivity advantage

Identification issues

▸ **Difficult to identify causal effect on productivity of clustering:**

  ▸ Natural advantages – firms may be more productive in large clusters due to natural advantages that attracted large numbers of firms there in the first instance

  ▸ Endogenous location choice – more productive firms select into more productive sectors making impact of clusters difficult to identify

  ▸ The 'reflection problem' makes separating out correlations in the productivity levels in clusters that are due to competition or spillover effects from correlated effects that are as a result of common shocks associated with other unobserved factors

▸ **Problems exacerbated when using cross-sectional variations in data**

Identification strategy

▸ Step 1: Controlling for natural advantages:
  ▸ Control for the density of firms within clusters
  ▸ Firms are likely to locate in naturally advantageous areas (e.g. urban centers, where there is better infrastructure)

▸ Step 2: Isolating competition effects:
  ▸ Use the proportion of firms in the cluster that are in the same sector
  ▸ Positive coefficient suggests competition effects make firms more efficient (use costs more effectively or cut slack)
  ▸ Possible with cross sectional data that we see a negative effect – lower profits due to competition with reallocations happening at a lag

Identification strategy

▶ Step 3: Controlling for endogenous location choice:

  ▶ Control for the average productivity of all other firms in the cluster

  ▶ Captures whether more productive firms locate in higher productivity clusters

▶ Step 4: Isolating productivity spillover effects:

  ▶ Use the average productivity of all other firms in the cluster that are in the same sector

  ▶ Positive coefficient suggests spillover effects

  ▶ Isolated through the inclusion of controls for the density of the cluster, competition effects and selection effects

Identification strategy

▸ **Step 5: Controlling for common shocks:**

  ▸ Include control for change in the total size of the cluster (number of firms)

  ▸ Include control for change in the proportion of firms in the cluster that come from the same sector

  ▸ A change in the size of a cluster or in the importance of a particular sector within a cluster is suggestive of a positive or negative shock common to all firms in that cluster

  ▸ Including these variables will therefore control for correlated effects that underpin the reflection problem

  ▸ For each firm, we compute cluster level productivity by excluding the information on the individual firm in question to minimize reverse causation due to the construction of the variables.

Empirical Model

$$ln\,out_{isj} = \beta_0 + \beta_1 density_j + \beta_2 propfirm_{sj} + \beta_3 avprod_j + \beta_4 avprod_{sj}$$

$$+\beta_5 \Delta density_j + \beta_6 \Delta dpropfirm_{sj} + \mathbf{\delta Z}_{isj} + \theta_s + \phi_r + e_{isj}$$

▸ *lnout* is the log of firm output; Z are firm specific control variables including inputs and firm characteristics; sector specific fixed effects; regional fixed effects (district and commune)

▸ Output is based on revenue and so model captures impact of agglomeration on productivity and mark-ups

▸ Competitive sectors: model allows us to identify the effect of agglomeration on productivity given that firms will be operating with zero mark-ups

▸ Non-competitive sectors: model will pick up the extent to which agglomeration erodes mark-ups

▸ This consideration will be made in the interpretation of the result.

Data and Cambodian Context

▸ Cambodian Nation-Wide Establishment Listing (EL2009) and the Cambodian Economic Census (EC2011) covering all establishments

▸ EC2011 provides financial information along with firm characteristics: the legal form of the firm, the nationality of owner and manager, characteristics of employees, etc.

▸ EL2009 only contains only basic information on firms as its purpose was primarily to develop a census frame for the EC2011

▸ Both contain location of firm (village)

▸ A total of 376,761 establishments are covered by the EL2009 employing a total of 1,469,712 individuals

▸ The EC2011 includes information on 505,134 establishments employing a total of 1,676,263 individuals

Data and Cambodian Context

- Most establishments are very small:
    - 3.32 employees on average
    - 80 percent of firms employ less than two people
    - 13,170 establishments employ ten or more
    - 787 firms with more than 100 employees
- Most are single unit firms (98%)
- The majority are service sector firms (85%)
- 75,031 firms in the manufacturing sector in 2011 employing 539,134 people – larger on average than service firms
- 8% of firms are registered - most operate in the informal sector of the economy
- 65% of firms are categorized as home businesses located in the residence of the owner
- 1% of firms are foreign owned

Data and Cambodian Context

‣ Location pattern
‣ 15% percent of firms are located in urban areas

‣ 308 firms on average per village
‣ On average 22% are from same ISIC4 sector
‣ A high concentration of business activities within villages

‣ 967 firms on average per commune
‣ On average 15 percent are from the same ISIC4 sector

Pattern of clustering

Number of firms
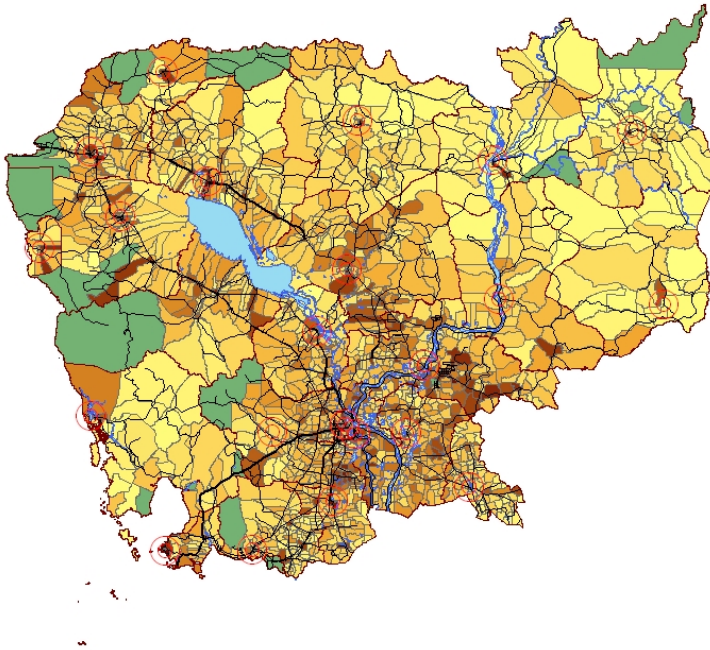
Numbers employed
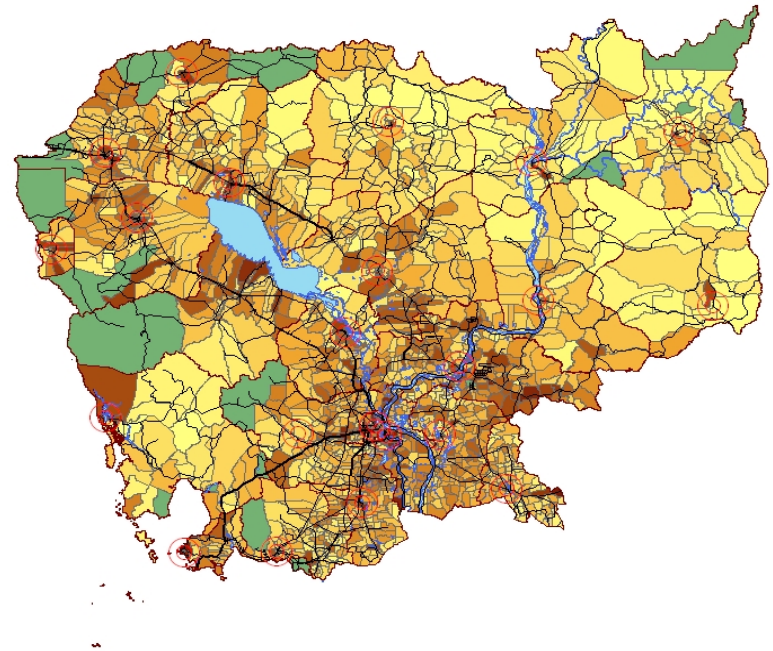
Source: Authors' own calculations

Empirical Results

β_2

Are firms more productive where there is more clustering of economic activity?

Dependent Variable: lnsales	(1)	(2)	(3)	(4)
Number of firms in cluster	0.0002***	0.0002***	0.0001***	0.0001***
Proportion of firms in same sector	-0.411***	-0.384***	-0.319***	-0.278***
Firm Characteristics	Yes	Yes	Yes	Yes
ISIC 3 Controls	Yes	Yes	Yes	Yes
Regional Controls	Province	District	Province	District
Clustering	Village	Village	Commune	Commune
R-squared	0.369	0.391	0.365	0.388
n	515,323	515,323	515,323	515,323

β_1

Are different types of firms impacted differently by the clustering of economic activities?

	(1)	(2)	(3)
Number of firms in cluster	0.0002***	0.0002***	0.0001***
Proportion of firms in same sector	-0.365***	-0.311***	-0.542***
Registered	0.447***		
Registered*Number	0.000		
Registered*Proportion	-0.729***		
Manufact		0.405***	
Manufact*Number		-0.0001***	
Manufact*Proportion		-0.338***	
Small			-0.726***
Small*Number			0.00006
Small*Proportion			0.166
Firm Characteristics	Yes	Yes	Yes
ISIC 3 Controls	Yes	Yes	Yes
Regional Controls	District	District	District
Clustering	Village	Village	Village
R-squared	0.391	0.391	0.394
n	515,323	515,323	515,323

Are there productivity spillovers associated with clustering?

	(1)	(2)	(3)	(4)
Average prod of firms in cluster	0.001	0.001	0.037***	0.034***
Average prod of firms in same sector	0.001*	0.001	0.001	0.001**
Number of firms in cluster	0.0003***	0.0002***	0.0001***	0.0001***
Proportion of firms in same sector	-0.383***	-0.382***	-0.108	-0.090
Change no. firms in cluster	0.000	-0.00001	0.000	0.000
Change prop. firms in same sector	-0.068***	-0.036	-0.281***	-0.242***
Regional Controls	Province	District	Province	District
Clustering	Village	Village	Commune	Commune
R-squared	0.370	0.391	0.368	0.391
n	514,594	514,594	515,323	515,323

β_1

Are different firms affected differently by productivity spillovers?

	(1) Registered	(2) Registered	(3) Unregist.	(4) Unregist.
Av prod firms in cluster	0.008***	0.002	-0.0001	0.038***
Av prod firms in same sector	-0.001	0.002**	0.002**	0.002*
Number firms in cluster	0.0002	0.0001	0.0003***	0.0001***
Proportion firms in same sector	-1.310***	-0.999*	-0.344***	-0.061
Ch. no. firms in cluster	0.000	0.000	0.000	0.000
Ch. prop. firms in same sector	0.181	-0.240**	-0.040*	-0.236***
Regional Controls	District	District	District	District
Clustering	Village	Commune	Village	Commune
R-squared	0.601	0.599	0.357	0.357
n	37,351	37,426	477,243	477,897

Are different firms affected differently by productivity spillovers?

	(1) Manufact.	(2) Manufact.	(3) Services	(4) Services
Av prod firms in cluster	0.018***	0.089***	0.0004	0.028***
Av prod firms in same sector	0.045***	0.017	0.001	0.001**
Number firms in cluster	-0.00002	0.0001	0.0003***	0.0001***
Proportion firms in same sector	-0.736***	-0.240**	-0.276***	0.119*
Ch. no. firms in cluster	0.000	0.000	-0.0001	0.000
Ch. prop. firms in same sector	-0.036	-0.321***	-0.053**	-0.243***
Regional Controls	District	District	District	District
Clustering	Village	Commune	Village	Commune
R-squared	0.496	0.492	0.325	0.325
n	70,951	71,033	438,632	439,252

Are different firms affected differently by productivity spillovers?

	(1) Small	(2) Small	(3) Medium-Large	(4) Medium-Large
Av prod firms in cluster	0.001	0.035***	0.003	0.019**
Av prod firms in same sector	0.001	0.001**	0.001**	0.0006
Number firms in cluster	0.0003***	0.0001***	-0.0001	-0.00005
Proportion firms in same sector	-0.363***	-0.070	-0.031	0.290
Ch. no. firms in cluster	0.000	0.000	0.0002	0.0001**
Ch. prop. firms in same sector	-0.040*	-0.240***	-0.077	-0.219
Regional Controls	District	District	District	District
Clustering	Village	Commune	Village	Commune
R-squared	0.353	0.353	0.635	0.635
n	504,784	505,513	9,810	9,810

Robustness checks

‣ Further checks for endogenous location choice of firms

‣ Limit our analysis to older firms, i.e. firms that were in existence in 2009

‣ Excludes firms that could have made their location choice on the basis of the current productivity levels of other firms in that location

‣ The results that remain robust :

‣ Evidence for positive productivity spillovers for informal firms, manufacturing firms and large firms but only when clustering is defined at the village level

‣ Suggestive of technology complementarities

‣ Commune level clustering effects no longer hold.

Summary of key findings

▸ Competition effects:

▸ There are negative competition effects associated with clustering suggesting an erosion of mark-ups and profitability that may (eventually) lead to reallocations

▸ Productivity spillovers:

▸ Some evidence of productivity spillovers but depend on extent of competition between firms.

▸ The firms facing the greatest competitive pressures are formally registered enterprises, service sector firms and small firms – they do not experience productivity spillovers within villages but do within broader commune level definition.

▸ Informal firms, firms in the manufacturing sector and large firms, experience productivity spillovers within villages suggesting that there are technology transfers taking place

▸ These effects appear to be due to the fact that these firms are less likely to directly compete with each other within clusters

▸ Some care should be taken in inferring causality but a number of important controls to tighten our identification strategy have been considered including controls for selection bias and correlated effects

Preliminary conclusions

▸ There are observed benefits to firm performance from the clustering of economic activity but they do not outweigh the negative impact of competitive pressures and only appear possible where firms are not directly competing with each other

▸ The effectiveness of an industrial policy that creates incentives for similar firms to locate near each other will depend on the extent to which unnecessary costs and constraints to business can be removed.

▸ For example, introducing more flexibility (looking at why it is more difficult to compete if formal), diversification of the customer base of firms, ensuring supply of necessary inputs, etc

Thank you

Questions and comments most welcome

APPENDIX

Variable name	Description	Mean	Std. Dev.
Dependent variables:			
lnsales	Log of annual sales	8.516	1.285
lnlabprod	Log of labor productivity (sales/numbers employed)	7.820	1.619
Independent variables:			
lnlabor	Log of total numbers employed	0.574	0.683
register	Dummy = 1 if firm is registered with a ministry or agency	0.084	0.278
owner_foreign	Dummy = 1 if firm is owned by a foreign national	0.011	0.105
owner_male	Dummy =1 if firm is owned by a male	0.357	0.479
urban	Dummy = 1 if firm is in urban area	0.150	0.357
foreign	FDI firm	0.0002	0.013
state	State owned firm	0.024	0.153
Business type:			
kind_1	Street business	0.082	0.274
kind_2	Home business	0.645	0.478
kind_3	Apartment building	0.027	0.161
kind_4	Traditional market	0.177	0.382
kind_5	Modern shopping centre	0.001	0.039
kind_6	One exclusive block/building	0.053	0.225
kind_7	Other	0.014	0.119
area	Total area of business in square metres	11.33	16.52
single	Dummy =1 if firm is one single unit	0.982	0.133

Variable name	Description	Mean	Std. Dev.
Cluster measures:			
Nr_firm_vill	Number of firms in the village	308	552
Prop_firm_vill_sec	Proportion of firms in the village in the same sector	0.217	0.231
Nr_firm_comm	Number of firms in the commune	967	1,165
Prop_firm_comm_sec	Proportion of firms in the commune in the same sector	0.152	0.176
Lnlabprod_vill	Average labor productivity of firms in the village	9.32	11.95
Lnlabprod_vill_sec	Average labor productivity of firms in the village in the same sector	7.84	14.33
Lnlabprod_comm	Average labor productivity of firms in the village	8.27	1.77
Lnlabprod_comm_sec	Average labor productivity of firms in the village in the same sector	9.36	15.29