Agglomeration Advantages in the Developing World: Identification and Micro-mechanisms

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PRELIMINARY

The research questions

- How large are agglomeration advantages in manufacturing?
- In particular, what are the advantages experienced by incumbent firms when a large FDI plant is added to a local labor market?
- What is the relative importance of alternative microeconomic mechanisms that can account for these advantages?

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- Mythical exchange of ideas over beers, availability of specialized intermediate inputs, sharing of a labor pool, better matching, plant-to-plant labor mobility...
- Little credible evidence on overall magnitude of agglomeration advantages in less-developed countries (particularly Africa)

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- literature on foreign direct investment (FDI) [Aitken and Harrison (1999), Javorcik (2004), Arnold and Javorcik (2009), Fons-Rosen (2012)]

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- Nick & Marc Francis' *When China met Africa*
- Manufacturing was the top business function in the region by capital investment in 2015, 33% of FDI (Financial Times, Africa Investment Report)

What we do/plan to do

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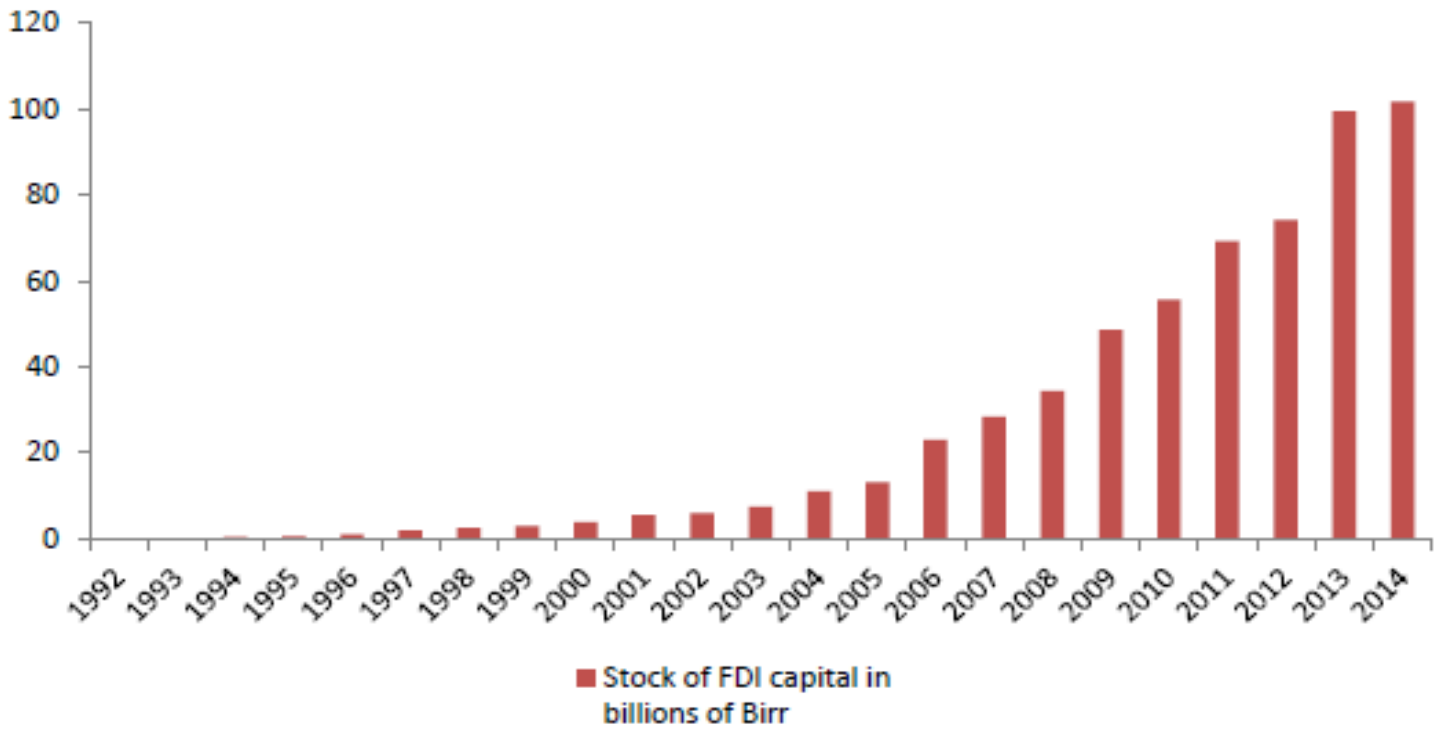
- Study effects of entry of large FDI plants on local labor markets (LLMs)
- Three identification strategies to deal with endogeneity of location decision for new plant
- Preliminary results from one of the three strategies, which exploits government designation of locations

*An interesting laboratory

- Since the late 1990s, the Ethiopian government has made the expansion of the manufacturing sector a priority.
- FDI has been viewed by the government as critical to technology upgrading in this sector.
- As a result, a variety of incentives were put in place to attract FDI and Ethiopia's new investment code was translated into English and publicized widely in 2002

Figure 1.Annual FDI stock in Ethiopia from 1992 to 2014.

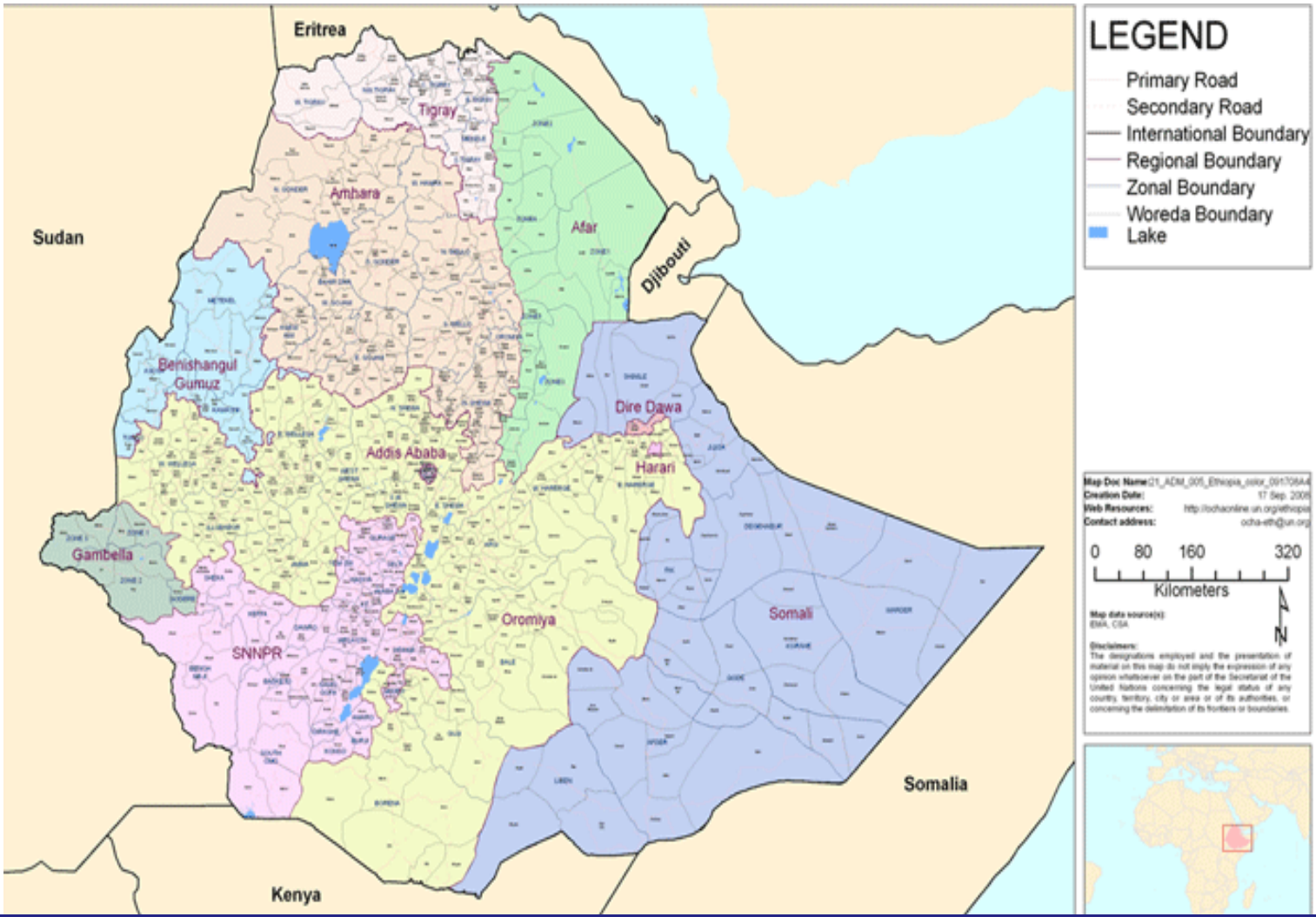


Notes: 1 birr = 0.047 US Dollar

Data

- Central Statistical Agency (CSA) manufacturing plant-level data
- link up plants over time
- Median plant $\sim$ 20 employees
- LLM: Woreda; Country Subdivisions: Regions, Zones, Woreda (districts), Kebele (municipalities)

*Geography of Ethiopia



*Industry Mix

Largest 10 sectors

ISIC Activity (2-digit)	All plants	FDI plants	FDI plants as share of all
Manufacture of food products and beverages	464	54	12%
Manufacture of other non-metallic mineral products	399	77	19%
Manufacture of furniture	233	34	15%
Tanning and dressing of leather; manufacture of luggage handbags saddlery harness and footwear	102	24	24%
Manufacture of fabricated metal products except machinery and equipment	101	18	18%
Manufacture of rubber and plastics products	85	21	25%
Manufacture of chemicals and chemical products	84	23	27%
Publishing printing and reproduction of recorded media	73	10	14%
Manufacture of wood and of products of wood and cork except furniture; manufacture of articles of straw and plaiting materials	54	9	17%
Manufacture of textiles	47	16	34%

Source: Own calculations with data from CSA

Survey module

- supply-linked domestic plants: if they generate 25 % or more of their revenues from directly selling to FDI plants
- labor-linked: if they have employed former workers of FDI companies

*Linkages by Industry

Table 4. Linkages by industry type in the manufacturing sector (percent of firms in 2013)

	In supply relationship		Employed labor from FDI firms	
	No	Yes	No	Yes
Manufacture of textiles	96.8	3.2	83.9	16.1
Manufacture of wearing apparel	92.3	7.7	69.2	30.8
Manufacturing of leather and leather products including footwear	96.1	3.9	89.6	10.4
Manufacture of rubber and plastics products	87.5	12.5	73.4	26.6
Manufacture of chemicals and chemical products	91.8	8.2	88.5	11.5
Manufacture of fabricated metal products, except machinery and equipment	92.8	7.2	92.8	7.2
Manufacture of food products and beverages	98.5	1.5	95	5
Manufacture of other non-metallic mineral products	98.8	1.3	95.6	4.4
Manufacture of furniture	96.4	3.6	96.4	3.6
Number of observations	1206	41	1159	88

Source: Author's compilation based on CSA manufacturing census 2013/14.

FDI-domestic plants linkages

	In supply relationship		Employed labor from FDI firms	
	No	Yes	No	Yes
	(1)	(2)	(3)	(4)
% of plants				
Adopted production processes by observing FDI firms	12.13	26.09***	10.69	37.76***
Use technology licensed from FDI firm	9.99	15.22	8.54	31.63***
Total number of observations	1352	46	1300	98

Source: Authors' compilation based on CSA manufacturing census 2013/14.
Note: *, **, *** are significant at 10 %, 5 % and 1 % respectively.

Labor Linkages

	Employed labor from FDI firms	
	No	Yes
	(1)	(2)
% of plants		
Competition from FDI in the local labor market	4.15	28.6***
Lost skilled workers to FDI firms	5.08	41.8***
Employed skilled workers from FDI firms	0	100
Changed production technologies	n/a	65.31
Managerial practices	n/a	7.14
Organizational structure	n/a	7.14
Knowledge of how to export	n/a	9.18
Other benefits	n/a	11.22
Total number of observations	1300	98

Source: Authors' compilation based on CSA manufacturing census 2013/14. Note: *, **, *** are significant at 10 %, 5 %

Survey module: summary/big picture

Knowledge Transfer through labor mobility

- ∼7% of plants have hired employees who have worked in FDI plants before
- Local plants perceive these workers are making positive contributions
- In line with Fosfuri, Motta and Rønde (2001), Glass and Saggi (2002), Dasgupta (2012); Balsvik (2011), Poole (2013); Serafinelli (2015)

- Vertical linkages (Local suppliers) :

- technology transfers from FDI plants aimed at improving production processes and product design

- Horizontal linkages:

- In $\sim$15% of plants, Δ in prod. Techniques
- Of these, $\sim$60% report having observed/copied FDI plants
- And most of them ($\sim$80%) have not perceived FDI plants tried to prevent this

Estimating agglomeration advantages

Effects of the entry of large FDI plants

$$\begin{aligned} \ln(Y_{pijt}) &= \beta_K \ln(K_{pijt}) + \beta_L \ln(L_{p_{pijt}}) + \beta_M \ln(M_{pijt}) + \delta 1(entry)_j + \\ +\kappa 1(\tau &\geq 0)_t + \varphi[1(entry)_j \cdot 1(\tau \geq 0)_t] + \alpha_p + \mu_{it} + \varepsilon_{pijt} \end{aligned} \quad (1)$$

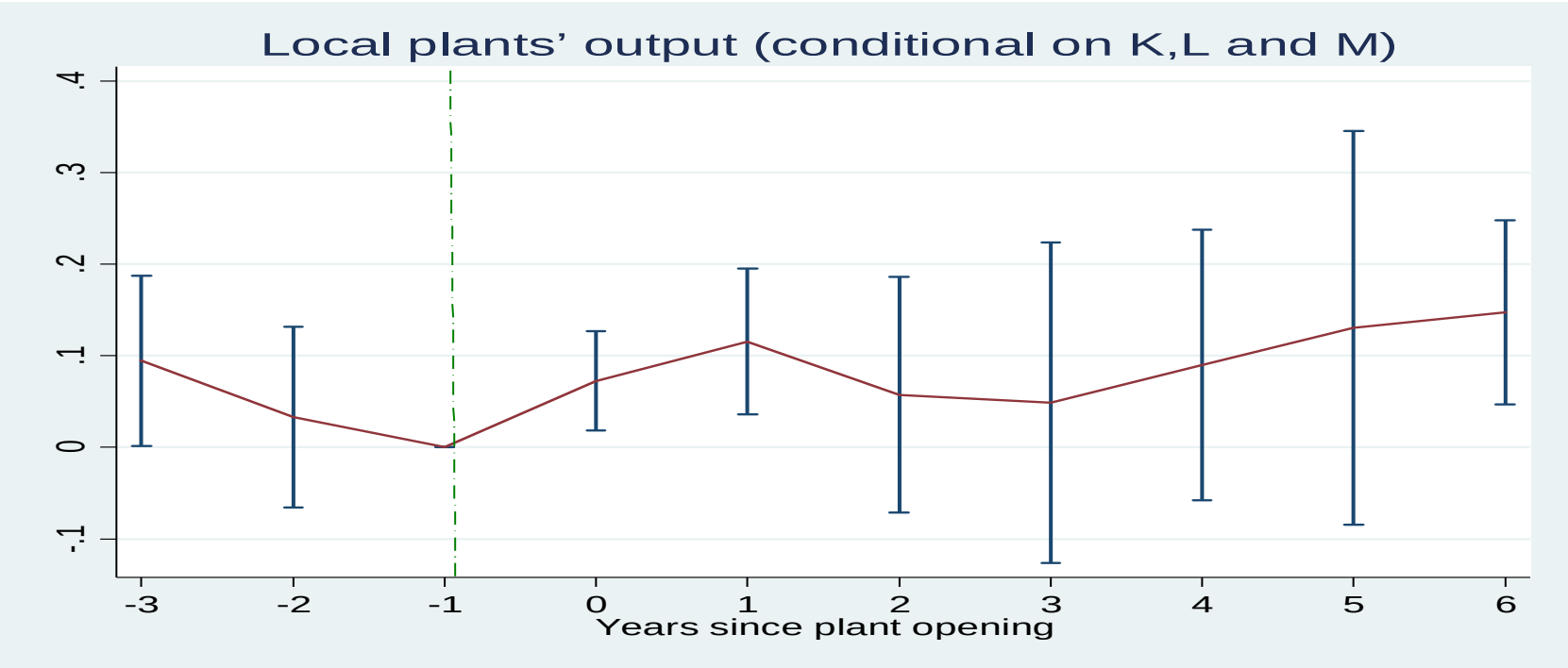
- Y_{pit} : value of total production for plant p (i references industry, j locality, t year).
- dummy $1(entry)_j$ equal to 1 if plant located in a locality that experiences the entry of large FDI plant
- τ denotes year, but it is normalized so that the assigned year of the large FDI plant opening is $\tau = 0$.
- production factors are employees L, capital K and materials M
- We also experimented adding firm specific trends as controls.

Identification Strategy #1

$$\begin{aligned} \ln(Y_{pijt}) &= \beta_K \ln(K_{pijt}) + \beta_L \ln(L_{p_{pijt}}) + \beta_M \ln(M_{pijt}) + \delta 1(entry^G)_j + \\ &+\kappa 1(\tau \geq 0)_t + \varphi[1(entry^G)_j \cdot 1(\tau \geq 0)_t] + \alpha_p + \mu_{it} + \varepsilon_{pijt} \end{aligned} \quad (2)$$

- We asked plants why they chose a given location for the production facility
- Consider large ($\geq$ 1% of local workforce) FDI plants that report "Did not choose the location, was allocated by the authorities" ($entry^G$)
- In a way, this contributes to growing literature on place-based policies (e.g. Kline 2010, Kline and Moretti 2013)

"The Ministry of Industry only provides advise as to which area is best suited for a particular project. If the potential investor is interested in the options of locations provided, the Ministry contacts the Regional officials to facilitate land. The region then provides information on the land availability and locations and arrange visits. Then if the investor is interested, negotiations takes place on the price and terms of lease. "Allocation" of land by Regional Governments/City administrations follow their own master plans or industrial development designated areas. Therefore, allocation of land is not random and it is not a forced measure but based on choice and negotiation." (General Director of Policy and Program Studies)



Note: Bands around point estimates are 90 percent cluster-robust confidence intervals. Event time indicator "-3" set to 1 for periods up to and including 3 periods prior to the event and 0 otherwise. Event time indicator "+6" set to 1 for all periods 6 periods after the event and 0 otherwise. We drop LLMs that experience the entry of a large FDI plant without government designation. We also drop incumbent foreign plants and observations outside the 1%–99% range of L.

Treatment Effects on Local Plants' Output

Conditional on K,L and M

Contemporaneous	Short Run	Long Run	Average
.073 **	.082 *	.090 *	.086 **

Note: Dependent variable is the log of value of total production. Standard errors clustered at the LLM level. Short-run effect refers to the average of the coefficients in periods $\tau = 0$, 1, and 2. Long-run effect refers to the average of the coefficients in periods $\tau = 3$, 4, and 5. Average effect refers to the average of coefficients in periods 0 through 5. 11525 observations. 128 Woredas. 3275 firms.

Comments, and Next steps

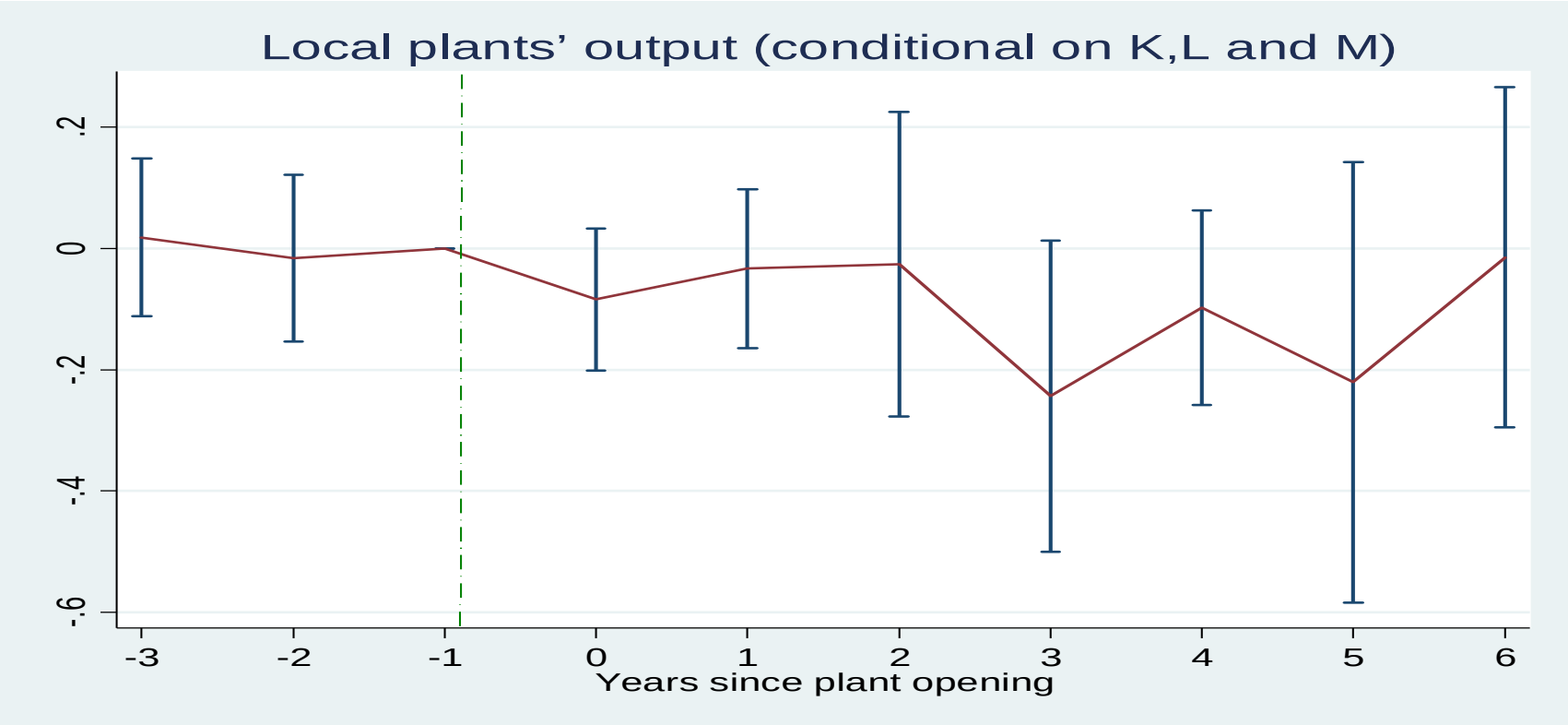
- Point estimates larger than Greenstone et al; U.S. data, only a subset of new entrants owned by a foreign company, smaller entrants
- Changes in the price of output? [$\sim$ 3% of domestic plants are supply-linked]
- Public investment: increase in worker training funds and infrastructure investments
- Intensity of capital usage (use ratio of value of energy usage to the capital stock)

*Sensitiviy analysis (done)

- Number of leads and lags
- Drop observations with unusually high or low values of input and ouptut values (outside the 1%–99% range)
- Value Added specification

Entry of domestic plants

with government designation of locations



Note: 11329 observations. 126 Woredas. 3184 firms.

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- use different control groups (LLM with no FDI, FDI small with gov. des.; FDI small no gov. des.)

*Identification Strategy #2

- (Variant of Greenstone et al.) Compare "winning" districts that attracted a large FDI plant and "losing" districts that were the new plant's runner-up choice.
- We obtained phone and email addresses of large FDI plants; we will *ask plants directly* whose location was not allocated by the government: *what other two locations was the plant considering before deciding to invest in the current production site?*

*Identification Strategy #3

- comparison of geographic locations surrounding 'planned' investments to geographic locations that received 'actual' investments
- Timing: Pre-Implementation, Implementation, Operation.
- Why delays? bureaucratic hurdles, financing issues, foreign currency shortages, land and infrastructure problems frequently cited

What have we learned?

Summary

- Descriptive evidence from the survey module responses overall suggests improvements via: (1) labor flows from foreign to domestic plants, (2) knowledge spillovers, (3) linkages between domestic suppliers and foreign plants.
- Potential for a credible design-based analysis to estimate magnitude of agglomeration advantages/effect of a place-based policy

THANK YOU

Future

- Further explore rich survey module data (f.i. *"Has the location choice for your production been affected by the presence of foreign plants?"; "which advantages did you expect to enjoy by locating close to foreign plants?"' "Did you expect that many more producers would be located in this site?";* see Krugman, 1991; Davis and Weinstein, 2002; Kline, 2010)

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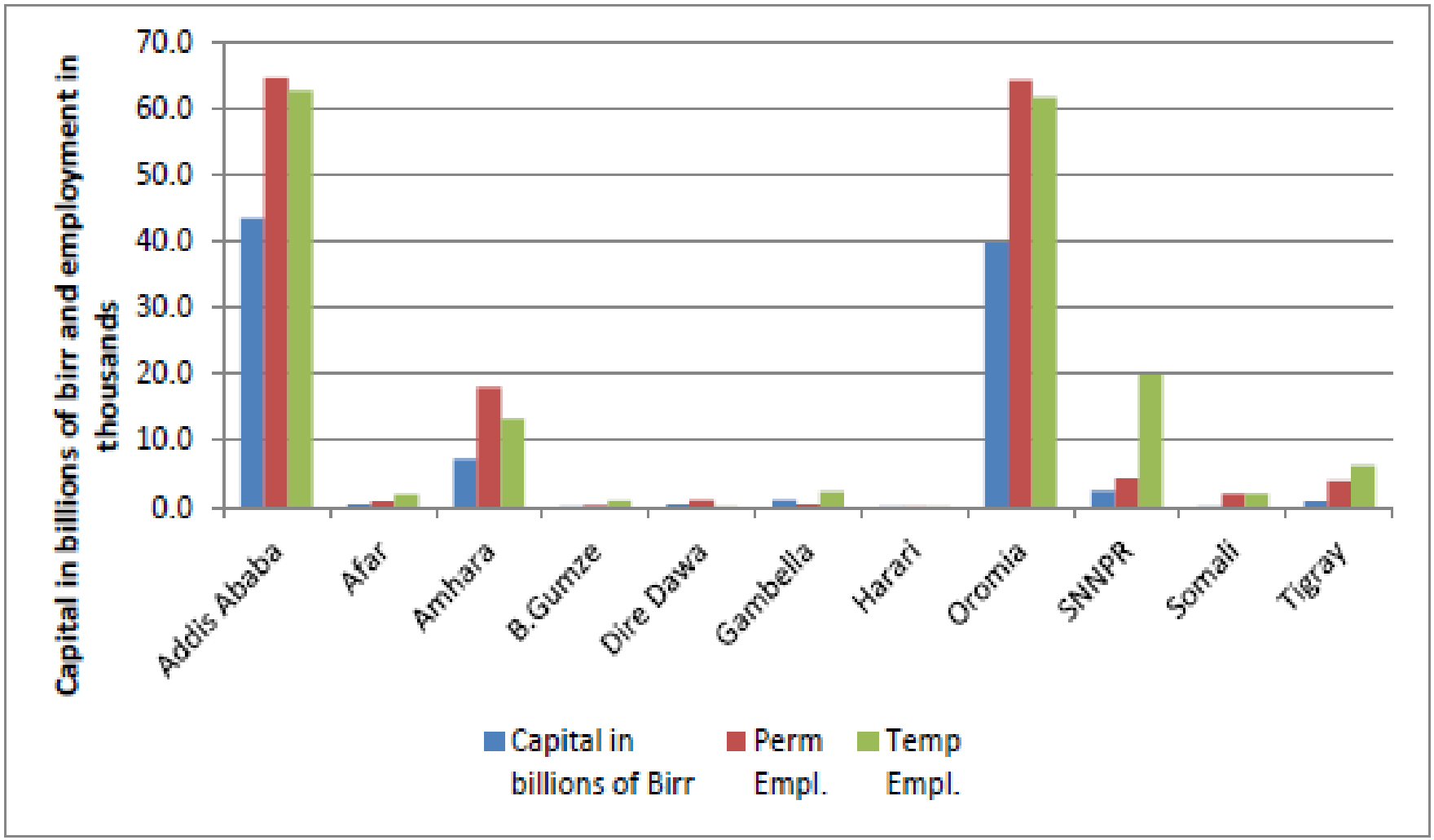
- Use them in combination with econometric analysis (SUGGESTIONS WELCOME!)
- Further "sociological" investigation in Ethiopia

Regional distribution of FDI stock aggregated from 1992 to 2014

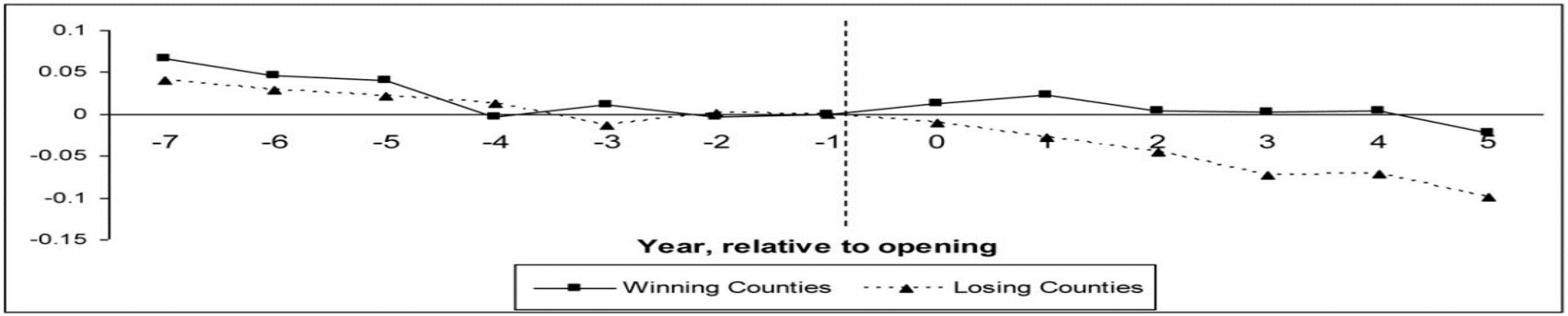


Country of Origin	Percent
China	27.29
India	9.28
Turkey	5.57
China/Ethiopia	4.91
Saudi Arabia/Ethiopia	3.28
Sudan	2.95
India/Ethiopia	2.51
Italy/Ethiopia	2.29
USA/Ethiopia	1.64
Saudi Arabia	1.42
Britain	1.42
USA	0.98

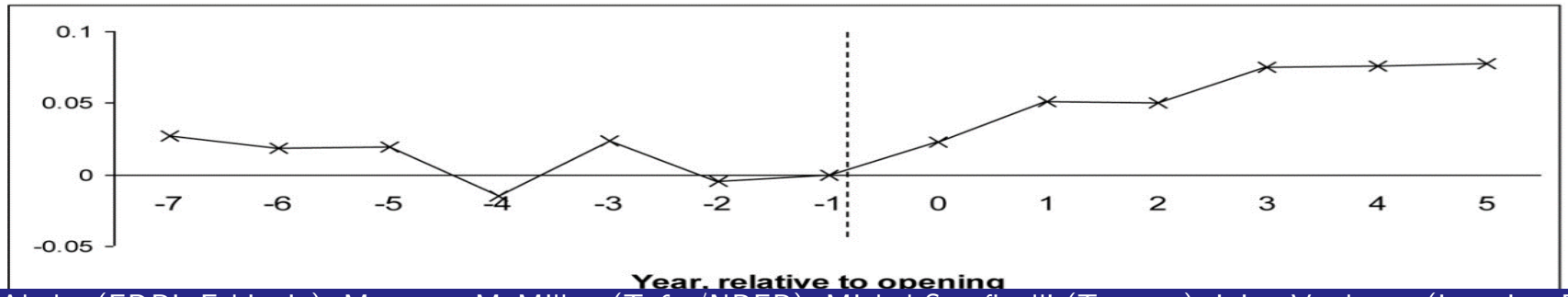
Source: Bloomberg Businessweek (July 2014)

Greenstone, Hornbeck and Moretti (2010)

All Industries: Winners vs. Losers



Difference: Winners – Losers



Changes in the Price of Output?

- The sample is composed of manufacturing plants that generally produce goods traded outside the LLM
- To explore this possibility further we can use distance traveled by a good between production and consumption (Weiss, 1972; GHM)
- But if an industry is very strongly localized, product demand effects might still be relevant
- measure industry localization (f.i. ratio between the number of plants in a LLM and total Ethiopian plants in a given 4-digit industry)

Greenstone, Hornbeck and Moretti (2010)

- Incumbent plants choose their amount of labor, L, capital, K, and land, T, to maximize the following expression:

$$\max_{L,K,T} f(A, L, K, T) - wL - rK - qT$$

- A is a productivity shifter and depends on the density of economic activity in an area:
- $A = A(N)$
- where N is the number of plants that are active in a county. We define agglomeration spillovers as the case in which A increases in N: $\frac{\partial A}{\partial N} > 0$.

- Let starred variable denote the optimal level of inputs given input prices.
- For instance $L^*(w, r, q)$ is the optimal level of labor inputs, given the prevailing wage, cost of capital and cost of industrial land

- $w(N)$: When a new plant opens in county c, wages there start rising and some workers find it optimal to move to county c
- $q(N)$: supply of land is fixed because of geography or land-use regulations....
- Alternatively, it may not be completely fixed, but it is possible that the best industrial land has already been developed, so that the marginal land is of decreasing quality or is more expensive to develop.

- If all plants are price takers and all factors are paid the marginal product:

$$\frac{\partial \Pi}{\partial N}^{*} = (\frac{\partial f}{\partial A} \times \frac{\partial A}{\partial N}) - (\frac{\partial w}{\partial N} L^{*} + \frac{\partial q}{\partial N} T^{*})$$

- $(\frac{\partial f}{\partial A} \times \frac{\partial A}{\partial N}) > 0$: positive spillovers
- $-[(\frac{\partial w}{\partial N} L^{*} + \frac{\partial q}{\partial N} T^{*})] < 0$ (because $\frac{\partial w}{\partial N} > 0$ and $\frac{\partial q}{\partial N} > 0$) : negative effect from increase in the cost of production