Do “binding constraints” exist?

Workshop
Small Adaptations, Large Impact
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A basic observation, a general principle, and a law

- "Policies that work wonders in some places may have weak, unintended, or negative effects in others."

  Serra, N., & Stiglitz, J. E. (Eds.). (2008). *The Washington consensus reconsidered: Towards a new global governance*. Oxford University Press on Demand.

- Anna Karenina's Principle:
  "Happy families are all alike; every unhappy family is unhappy in its own way."

  Anna Karenina, L. Tolstoy

- von Liebig's Law of the Minimum:
  "The productivity of a field is in direct relation to the necessary constituent contained in smallest quantity."

  von Liebig, J. *Die Chemie in inhrer Anwendung auf Agricultur and Physiologie*, 7e Aufl., vol. II, Braunschweig: F. Vieweg und Sohn, 1962.

Figure inspired from:
Hausmann, R., Klinger, B., & Wagner, R. (2008). *Doing growth diagnostics in practice: a'Mindbook'* (No. 177). Center for International Development at Harvard University

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Some literature

Literature on Agriculture and Liebig's Law:

- Paris, Q. (1992). The von Liebig hypothesis. *American Journal of Agricultural Economics*, *74*(4), 1019-1028.

- Sperfeld, E., Martin-Creuzburg, D., & Wacker, A. (2012). Multiple resource limitation theory applied to herbivorous consumers: Liebig's minimum rule vs. interactive co-limitation. *Ecology Letters*, *15*(2), 142-150.

Literature on "Growth Diagnostics":

- Serra, N., & Stiglitz, J. E. (Eds.). (2008). *The Washington consensus reconsidered: Towards a new global governance*. Oxford University Press.

Two questions

- What type of world do we live in?
  i.e., Do “binding constraints” exist?

- What is the strategy (conditional on the world we live in)?

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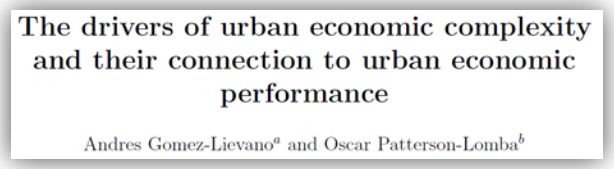

The drivers of urban economic complexity and their connection to urban economic performance

Andres Gomez-Lievano[a] and Oscar Patterson-Lomba[b]

https://arxiv.org/abs/1812.02842

- What is the strategy (conditional on the world we live in)?

Horizontal vs Vertical staves in the barrel

- A question about the *shape* of the production function in economics.

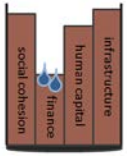
A general, agnostic model

- Getting a job in economic activity ***f*** requires a set of **five** specific factors:

a1	a2	a3	a4	a5	a6	a7	a8	a9	a10
1	0	0	**1**	0	**1**	**1**	**1**	0	0

- Linear World:
  Person ***i*** gets a job if she has ***any*** of the factors.

- Liebig's World:
  Person ***i*** gets a job if she has ***all*** of the factors.



She has to learn to do the job by acquiring the relevant factors given the following three parameters

- She learns/acquires factors from her exposure to the city ***c*** with probability r_c
- And then she can learn/acquire the remaining factors on her own with probability s_i

f =

a1	a2	a3	a4	a5	a6	a7	a8	a9	a10
1	0	0	1	0	1	1	1	0	0

$\longrightarrow M_f = 5$

	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	Linear World	Liebig's World
Person 1	1	0	0	1	0	1	1	1	0	0	employed	employed
Person 2	1	0	0	1	0	1	1	1	0	0	employed	employed
Person 3	1	0	0	1	0	1	1	1	0	0	employed	unemployed
Person 4	1	0	0	1	0	1	1	1	0	0	unemployed	unemployed

- Predictions of the models:

$$\Pr\{employed\} \approx \begin{cases} M_f(r_c + s_i) & \text{in Linear World} \\ e^{-M_f(1-r_c)(1-s_i)} & \text{in Liebig's World} \end{cases}$$

  - In Linear World, **log(**employment rate**)** decouples the economic activity from city+person effects.
  - In Liebig's World, -**log(**-**log(**employment rate**))** decouples all the effects (from the activity, the city, and the person).

Food services and drinking places
Administrative and support services
Ambulatory health care services
Professional and technical services
Hospitals
Specialty trade contractors
Merchant wholesalers, durable goods
Educational services
Food and beverage stores
General merchandise stores
Social assistance
Nursing and residential care facilities
Credit intermediation and related activities
Merchant wholesalers, nondurable goods
Insurance carriers and related activities
Motor vehicle and parts dealers
Accommodation
Management of companies and enterprises
Real estate
Amusements, gambling, and recreation
Personal and laundry services
Fabricated metal product manufacturing
Clothing and clothing accessories stores
Membership associations and organizations
Transportation equipment manufacturing
Truck transportation
Repair and maintenance
Construction of buildings
Building material and garden supply stores
Computer and electronic product manufacturing
Food manufacturing
Health and personal care stores
Machinery manufacturing
Securities, commodity contracts, investments
Miscellaneous store retailers
Chemical manufacturing
Gasoline stations
Telecommunications
Publishing industries, except internet
Heavy and civil engineering construction
Warehousing and storage
Sporting goods, hobby, book and music stores
Support activities for transportation
Couriers and messengers
Plastics and rubber products manufacturing
Electronics and appliance stores
Electronic markets and agents and brokers
Crop production
Transit and ground passenger transportation
Miscellaneous manufacturing
Printing and related support activities
Air transportation
Performing arts and spectator sports
Furniture and home furnishings stores
Motion picture and sound recording industries
Nonstore retailers
Utilities
Agriculture and forestry support activities
Rental and leasing services
Waste management and remediation services
Nonmetallic mineral product manufacturing
Broadcasting, except internet
Primary metal manufacturing
Furniture and related product manufacturing
Paper manufacturing
Private households
Support activities for mining
Data processing, hosting, and related services
Electrical equipment and appliance mfg
Beverage and tobacco product manufacturing
Wood product manufacturing
Other information services
Oil and gas extraction
Apparel manufacturing
Unclassified
Museums, historical sites, zoos, and parks
Animal production and aquaculture
Petroleum and coal products manufacturing
Textile product mills
Mining, except oil and gas
Textile mills
Water transportation
Pipeline transportation
Scenic and sightseeing transportation
Forestry and logging
Leather and allied product manufacturing
Lessors of nonfinancial intangible assets
Fishing, hunting and trapping
Postal service
Funds, trusts, and other financial vehicles
Rail transportation

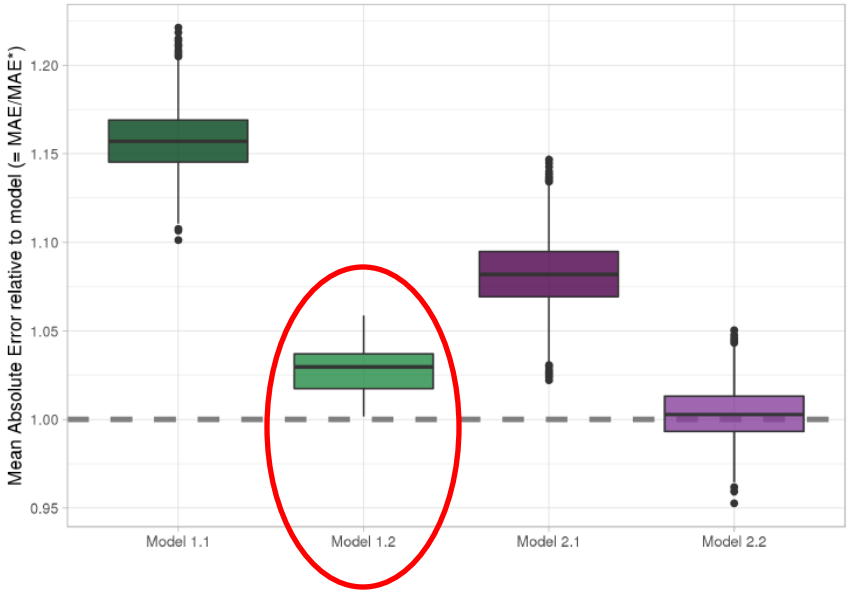
5
4
3
2
1
0

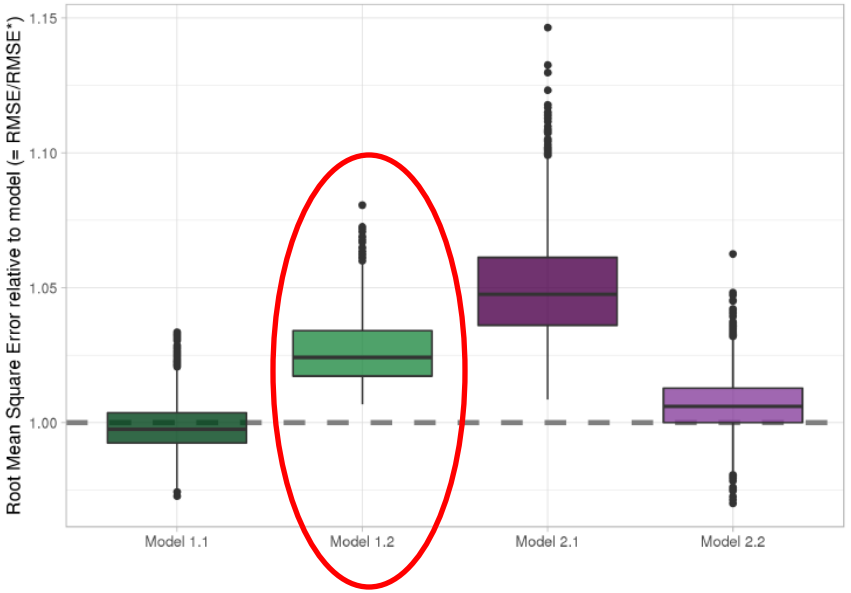
- Which model explains/reproduces the patterns the best?
- What can we learn?

Bootstrap cross-validation:

Fitting on train → Predicting on test → Evaluate MAE and RMSE

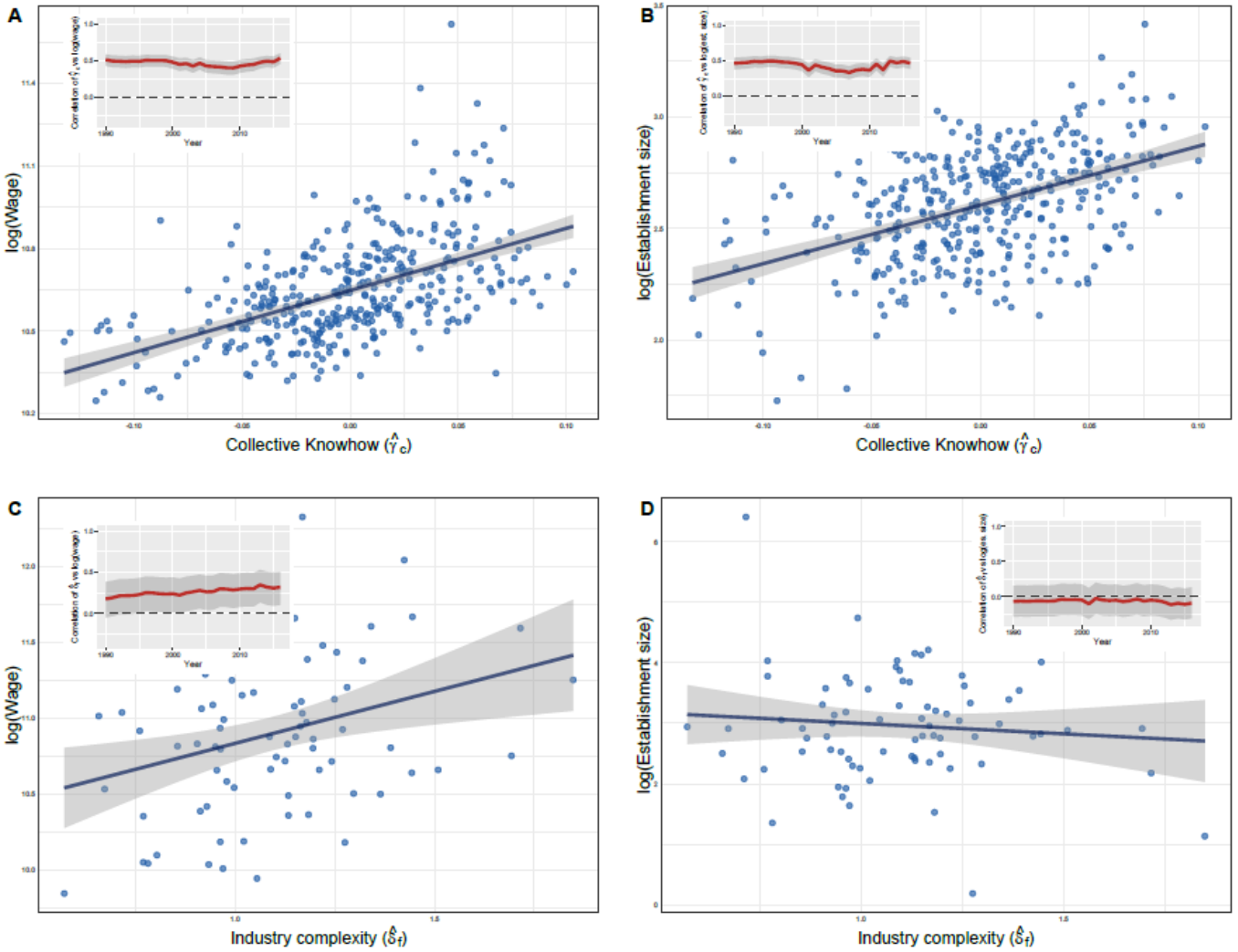
$$
\begin{aligned}
\text{Model 1.1 (comparison):} \quad & y_{c,f} && = \gamma_c + \delta_f + \varepsilon_{c,f} \\
\text{Model 1.2 (Linear World):} \quad & \ln(y_{c,f}) && = \gamma_c + \delta_f + \varepsilon_{c,f} \\
\text{Base (Liebig's World):} \quad & -\ln(-\ln(y_{c,f})) && = \gamma_c + \delta_f + \varepsilon_{c,f}
\end{aligned}
$$



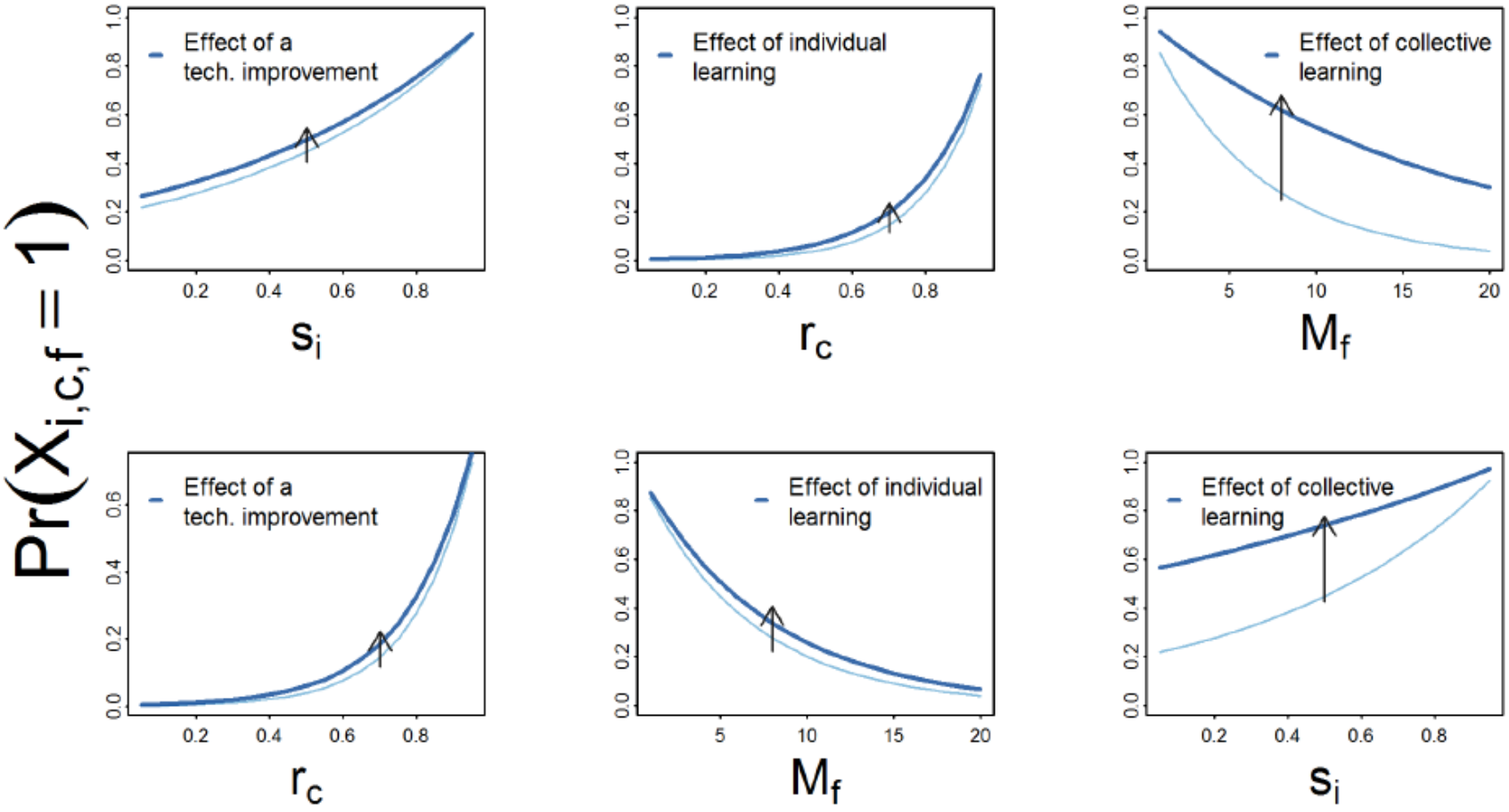


These city- and industry-fixed effects are predictive of average individual wages and average size of establishments!

(see details and controls in paper)



$$\Pr\{X_{i,c,f} = 1\} = e^{-M_f(1-s_i)(1-r_c)}$$



. . . Unfortunately, γ_c and δ_f are not actionable quantities; they are collective properties and there are no specific policies to change them.

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Some intuitions for identifying binding constraints:

- We should observe the tightness of the constraint in the price society is willing to pay for the scarce resource.
- Movements (in time) in the constraint should produce significant movements in the outcome variable/production/objective function.
- Agents less intensive in the constraint should be more likely to survive and thrive

Concluding remarks

- There is some evidence that we live in a world of “binding constraints”.
- Probably, different people/places have different “binding constraints”
- The dream is a methodology allowing us:
  To go for interventions that alleviate the most binding constraints.

THANK YOU

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Relevant References:

- Serra, N., & Stiglitz, J. E. (Eds.). (2008). *The Washington consensus reconsidered: Towards a new global governance*. Oxford University Press on Demand.
- Hausmann, R., Klinger, B., & Wagner, R. (2008). *Doing growth diagnostics in practice: a'Mindbook'* (No. 177). Center for International Development at Harvard University
- Rodrik, D. (2010). Diagnostics before prescription. *Journal of Economic Perspectives*, *24*(3), 33-44.
- Sperfeld, E., Martin-Creuzburg, D., & Wacker, A. (2012). Multiple resource limitation theory applied to herbivorous consumers: Liebig's minimum rule vs. interactive co-limitation. *Ecology Letters*, *15*(2), 142-150.
- Gomez-Lievano, A., & Patterson-Lomba, O. (2018). Uncovering the drivers behind urban economic complexity and their connection to urban economic performance. *arXiv preprint arXiv:1812.02842*.