The Economic Geography of Innovation

Peter H. Egger[1], Nicole Loumeau[2]
[1]ETH Zurich, CEPR, CESifo, GEP, WIFO; [2]ETH Zurich

1 This Paper

- Assess the **importance** of country-level **R&D- investment incentives**.
- Formulate and calibrate a **multi-region general equilibrium model** of trade and factor mobility (Desmet et al. 2017, Allen and Arkolakis 2014).
- Consider a **productivity shifter** for workers employed in **innovation.**
- **Structurally estimate** this productivity shifter using region-specific patent registrations and country-specific R&D- investment incentives.
- Conduct a **counterfactual analysis** for a scenario where all investment incentives are abandoned.

2 Model

- Each region is unique in terms of **amenities**, **geography**, **productivity.**
- Firms **produce** product varieties, **innovate**, and **trade** subject to iceberg transport costs under perfect local competition.
- **Benefits** from innovation last only for **one period**, then technology diffuses.

Technology

- Firm's productivity is determined by its decision to innovate (ϕ_{rt}) and an exogenous good-specific productivity shifter (z_{rt}).
- Firm's efficiency level, τ_{rt}, is evolving according to

$$\tau_{rt} = \phi_{rt-1}^{\gamma_1\theta}\left[\frac{1}{S}\int_S \tau_{st-1}\,ds\right]^{1-\gamma_2} \tau_{rt-1}{}^{\gamma_2} \qquad (1)$$

Innovation

- To innovate, a firm has to employ

$$L_{rt}^{inno} = \nu\phi_{rt}^{\xi}h_{rt}^{-1} \qquad (2)$$

Utility of a representative worker

$$u_{rt} = \bar{a}_{rt}\,\bar{L}_{rt}^{-\lambda}\left[\int_0^1 c_{rt}(\omega)^{\frac{\sigma-1}{\sigma}}d\omega\right]^{\frac{\sigma}{\sigma-1}} \qquad (3)$$

3 Calibration

Calibrate the model to **5,633 REGPAT regions** (see Figure 1).

We estimate

- Amenity-function parameters $(\lambda, \bar{a}_{rt})$.
- Technology and production-evolution parameters (γ_1, γ_2).
- Trade costs (FM transportation costs, correspondance to regional level, consideration of discontinuities at national borders).
- Productivity shifter for innovation workers (h_{rt}).

Estimation of h_{rt}

- Assumption: $\phi_{rt}^{\xi} = Patents_{rt}^{\tilde{\xi}} = \frac{\gamma_1}{\tilde{\xi}\nu[\mu+\gamma_1/\tilde{\xi}]}\,\bar{L}_{rt}h_{rt}$ (4)
- Parametrize h_{rt}

$$h_{rt} = \exp(\boldsymbol{D_{rt}}\beta + |lat_r|\boldsymbol{D_{rt}}\gamma) \qquad (5)$$

  - $\boldsymbol{D_{rt}}$ is a vector of binary R&D policy indicators: *patent box*, *grants*, *super deduction*, *other deduction*, *tax holidays*, *tax credit*, *EATR R&D* (Boesenberg and Egger, 2016)
  - Interaction of each binary policy indicator with absolute value of latitude (Theil and Chen, 1995; Hall and Jones, 1997).

Estimation Results (negative binominal regression, year=2005)

- Dependent variable: registered patents (inventors), avg 2000-2010.
- Population is instrumented with regional remoteness index.
- All policy instruments have a positve marginal effect on registered patents (except for *patent box*).
- Overall fit: 0.71

4 REGPAT Regions

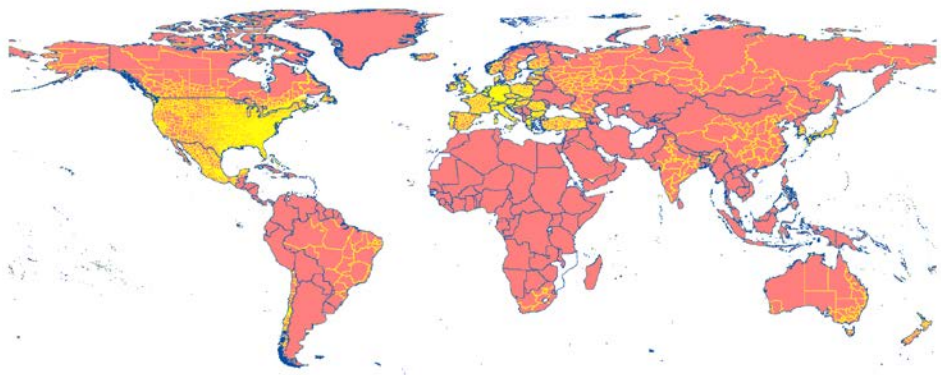

Figure 1: REGPAT Regions

5 Counterfactual Analysis & Main Results

Counterfactual scenario: All investment incentives towards innovation are abandoned, i.e. $h_{rt}^{c} = 1, \;\; \forall\, r \in S$.

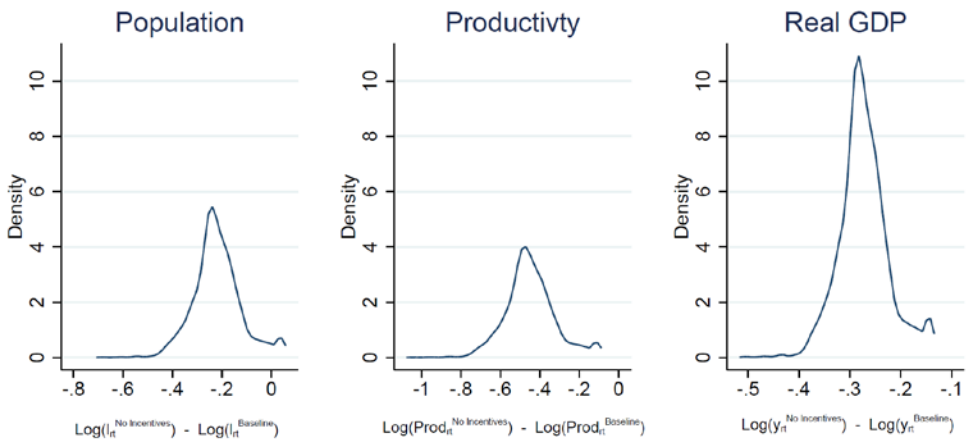

Figure 2: Density Estimates of Counterfactual Change, T=100

- R&D investment incentives are **globally beneficial.**
- Abandoning all R&D investment incentives causes substantial log-run **relocation effects.**

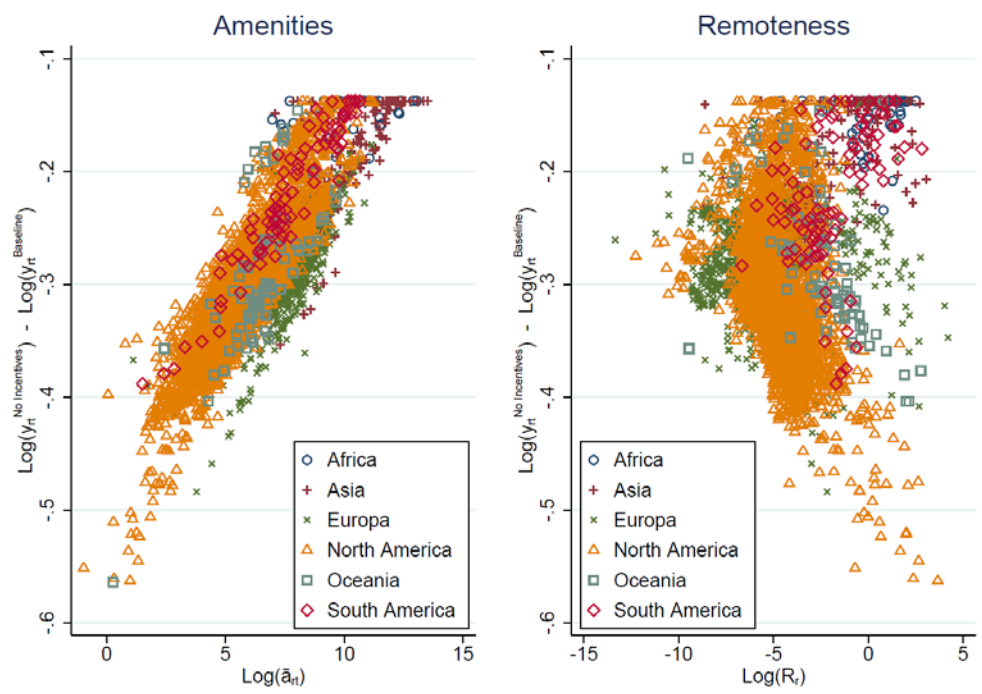

Figure 3: Role of Amenities and Remoteness for Welfare Response, T=100

- Particularly, regions with **high amenities** and a **low** degree of **transport remoteness** benefit from innovation incentives.