Is Tourism good for Locals? Evidence from Barcelona

Treb Allen$^1$  Simon Fuchs$^3$  Sharat Ganapati$^4$
Alberto Graziano$^2$  Rocio Madera$^5$  Judit Montoriol-Garriga$^2$

$^1$Dartmouth College
$^2$CaixaBank Research
$^3$FRB Atlanta
$^4$Georgetown University
$^5$Southern Methodist University

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Tourism is important

- Big part of the economy
  - 7% of global exports
  - In Spain: Tourism amounts to 50% of total goods exports

- Growing part of the economy
  - 50% increase in past 10 years
  - In Spain: Second fastest growing sector

- If tourism improves terms of trade for locals, should be welfare improving
Local Backlash against Tourism

Figure: Protests about Tourism in Barcelona
This Paper: Three Contributions

1. **(Big) Data** on spatial expenditures
   - 500M transactions across 1,000 census blocks (origin-destination-product-month)

2. **Specific factor trade model** in a rich urban geography
   - Complex spatial patterns of consumption and production
   - Intuitive analytical expression enabling intra-city welfare analysis

3. **“Hybrid” empirical approach** marrying applied & general equilibrium tools
   - Use GE theory to design non-parametric regressions
   - Use plausibly exogenous variation in tourist composition to estimate them
Literature

Urban Quantitative Spatial Economics

Big Data Spatial Economics
- Athey et al. (2018), Athey et al. (2020), Couture (2016), Couture et al. (2020), Davis et al. (2019), Agarwal et al. (2017), Carvalho et al. (2020)

Impact of Tourism

Ricardo-Viner trade models
Outline

1. Data & Stylized Facts
2. Theory
3. Empirics & Welfare effects
Data & Stylized Facts
A new Spatial Dataset for Barcelona

- Electronic transaction data from Caixa Bank (CXBK)
  - Account data for customers + point-of-sale data
  - Annually: 165+M transactions, 3B euros of value
  - 50% of all electronic transactions, 3% of all GDP
  - January 2017 - December 2019

- Our data aggregates to:
  - Locals: 1095 residential tiles × 1095 consumption tiles × 20 sectors × 36 months
  - Tourists: country of origin × 1095 consumption tiles × 20 sectors × 36 months

- Other data:
  - Commuting data (from mobile phone locations)
  - Housing prices (from “Spanish Zillow”)
Fact 1: Tourist and Local consumption geographies differ
Fact 2: Local’s consumption geographies differ by residence
Fact 3: Tourist’s consumption geographies differ by their origin
Fact 4: Tourist consumption crowds out local consumption
Theory
A Specific factors trade model with rich urban geography

- Specific factors
  - Production requires local labor and a (externally owned) specific factor.

- Trade Model
  - Numeraire sector $s = 0$ costlessly traded.
  - Sectors $s \in 1, \ldots, S$ consumed by locals and tourists.
  - Total tourism expenditure exogenously given (tourist “shock”).

- Rich urban geography
  - $N$ locations. A good is a sector $\times$ location.
  - A local residing in block $n$ chooses what goods to consume, produce.
Intuitive analytical expression for intra-city welfare analysis

**Theorem (Welfare Effect)**

Consider a representative local with homothetic preferences residing in block $n$. Applying envelope theorem to consumption, production optimization problems yields:

$$d \ln u_n = \sum_i \sigma_{ni} \frac{\partial}{\partial \ln w_{is}} - \sum_{i,s} \pi_{nis} \frac{\partial}{\partial \ln p_{is}}.$$

- Estimating the welfare effects of tourism requires:
  - Commuting data $\{\sigma_{ni}\}_{n=1,i=1}^{N,N}$
  - Spatial Expenditure data $\{\pi_{ni,s}\}_{n=1,i=1,s=0}^{N,N,S}$
  - Estimates of key elasticities: $\left\{ \frac{\partial \ln p_{is}}{\partial \ln F_i^T}, \frac{\partial \ln w_i}{\partial \ln F_i^T} \right\}_{i=1,s=0}^{N,S}$
Empirics & Welfare effects
Empirics

1. A “deductive” approach: Simple regressions
   - Advantage: Atheoretical
   - Disadvantage: Average treatment effects only

2. An “inductive” approach: Theoretical predictions
   - Advantage: Heterogeneous treatment effects for welfare
   - Disadvantage: Additional assumptions (e.g. market clearing, functional form)

3. Hybrid Approach: Theory predicts the welfare effects, data validates.
Empirics

1. Deductive Approach

2. Inductive Approach

3. Hybrid Approach
Deductive Approach

- Deductive Approach: Recover average treatment effects from regressions

\[
\Delta \ln p_{ismt} = \gamma_{is} + \gamma_{ts} + \beta_s^p \times \Delta \log E_{itm}^T + \epsilon_{ismt},
\]

\[
\Delta \ln w_{imt} = \gamma_{it} + \gamma_{im} + \gamma_{tm} + \beta^w \times \Delta \log E_{itm}^T + \epsilon_{imt},
\]

- Recover prices from gravity fixed effects, i.e. \( \Delta \ln p_{ismt} = \frac{1}{1-\sigma_s} \Delta \ln \delta_{istm} \)

- Recover wages from gravity commuting model, i.e. \( w_{imt} = \sum_{n=1}^{N} \left( \frac{L_{ni}}{R_n} \right) v_{nmt} \)

- Bartik decomposes expenditures into group composition and seasonal demand
Average Price effects by Sector
Is tourism good for the locals (on average)?

- Can aggregate to welfare using a simplified version of welfare results

\[
\frac{d \ln u_n}{\partial \ln E_T} \ = \ \frac{\partial \ln \bar{w}}{\partial \ln E_i^{T}} - \sum_s \pi_{ns} \frac{\partial \ln \bar{p}_s}{\partial \ln E_i^{T}}
\]

- Results
  - Price Index elasticity: -0.23
  - Wage elasticity: 0.05
  - Welfare elasticity: -0.18
  - Average increase between February and July ≈ 70.3pc
  - Implies net welfare deterioration 12.67pc
Empirics

1. Deductive Approach

2. Inductive Approach

3. Hybrid Approach
Analytical Expression for Price and Wage effects

- Impose market clearing conditions (prices adjust so that supply = demand).
- Derive “short run” elasticities, holding labor allocations & expenditure shares constant

\[
\frac{\partial \ln p_{is}}{\partial \ln E^T} = \frac{X_{is}^T}{y_{is}} + \sum_n \nu_n \pi_{nis} \sum_j \sigma_{nj} \frac{\partial \ln w_j}{\partial \ln E^T}
\]

\[
\frac{\partial \ln w_i}{\partial \ln E^T} = \frac{\sum_s X_{is}^T}{\sum_s y_{is}} + \sum_j \sum_s \sum_n \nu_n \pi_{nis} \sigma_{nj} \left( \frac{\sum_s X_{js}^T}{\sum_s y_{js}} \right) + \ldots
\]

- Zero-degree elasticities:

\[
\frac{\partial \ln p_{is}}{\partial \ln E^T} = \frac{X_{is}^T}{y_{is}} \quad \frac{\partial \ln w_i}{\partial \ln E^T} = \frac{\sum_s X_{is}^T}{\sum_s y_{is}}
\]

- Note: In paper we do long run elasticities too using “exact hat”
Empirics

1. Deductive Approach
2. Inductive Approach
3. Hybrid Approach
Hybrid Approach

- Hybrid Regression Approach

\[ \Delta \ln p_{ismt} = \gamma_{is} + \gamma_{ts} + \beta_{s}^{p, high} \times 1_{i_s}^{p, high} \times \Delta \log E_{imt}^T + \beta_{s}^{p, low} \times 1_{i_s}^{p, low} \times \Delta \log E_{imt}^T + \epsilon_{ismt} \]

\[ \Delta \ln w_{imt} = \gamma_{i} + \gamma_{t} + \beta_{s}^{w, high} \times 1_{i}^{w, high} \times \Delta \log E_{imt}^T + \beta_{s}^{w, low} \times 1_{i}^{w, low} \times \Delta \log E_{imt}^T + \epsilon_{imt} \]

- where

\[ 1_{i_s}^{p, high} = 1 \left\{ \eta_{is}^{p} > \text{median} \left( \eta_{is}^{p} \right) | s \right\} \]

\[ 1_{i_s}^{p, low} = 1 \left\{ \eta_{is}^{p} \leq \text{median} \left( \eta_{is}^{p} \right) | s \right\} \]

- \( \eta_{is}^{p} \) is predicted by

1. 'Zero-degree' elasticities
2. Short Run Elasticities

- Non-parametrically identifies heterogenous treatment effects
Heterogeneous Price Effects by Sector

ATE (from separate regression)

HTE - Low Model-Implied Elasticity (95% CI)

HTE - High Model-Implied Elasticity (95% CI)

POOLED

$\beta_{\text{HIGH}} = 0.190$

$\beta_{\text{LOW}} = 0.158$
## Heterogeneous Income Effects

<table>
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</table>

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Hybrid: SR Price and Income Effects
Hybrid: SR Welfare Effects
Is tourism good for locals?

- Welfare evaluation using the expression for welfare changes, i.e.

\[
\frac{d \ln u_n}{\partial \ln E^T} = \sum_i \sigma_{ni} \frac{\partial \ln w_i}{\partial \ln E^T_i} - \sum_{i,s} \pi_{nis} \frac{\partial \ln p_{is}}{\partial \ln E^T_i}
\]

- Results
  - On average: Welfare deterioration of 12%
  - Substantial heterogeneity (Preferred results: Hybrid SR)
    - 10th percentile: -14%
    - 90th percentile: +2%
Conclusion

- **New Data:** New intra-city spatial patterns of consumption for locals and tourists
- **New Theory:** Urban Ricardo-Viner model for intra-urban welfare analysis
- **New Methodology:** Estimate welfare effects by “hybrid” approach
- **New Insights:** On average tourism hurts locals, but large heterogeneity
**URL:** https://ideas.repec.org/p/nbr/nberwo/23616.html

**URL:** https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA10876

**URL:** https://ideas.repec.org/p/red/sed016/301.html


**URL:** https://www.aeaweb.org/articles?id=10.1257/pandp.20181031


Appendix
Additional Data

- Idealista imputed data on housing price trends (Euro/m2)
  - Frequency: Monthly
  - Time Period: January 2010- June 2020
  - Spatial Resolution: Neighborhoods in Barcelona (Barrios)
  - Available for rental rates and housing prices
Consumption of Locals

- Nested CES preferences across sectors and locations with elasticities \( \{\sigma_s, \eta\} \)

\[
 u_n = \frac{v_n}{\left( \sum_{s=0}^{S} \alpha_s \left( \left( \sum_{i=1}^{N} \gamma_{is} \tau_{isn} p_{is}^{1-\sigma_s} \right)^{1-\eta} \right)^{\frac{1}{1-\eta}} \right)^{1-\eta}} B_n
\]

- Demand function,

\[
 X_{isn} = \left( \frac{\tau_{isn}^{1-\sigma_s} p_{is}^{1-\sigma_s}}{\sum_j \tau_{jsn}^{1-\sigma_s} p_{js}^{1-\sigma_s}} \right) \alpha_{n,s} v_n
\]

where \( \alpha_{n,s} \) corresponds to the nested CES sectoral expenditure share
Consumption of Tourists

- For tourists we abstract from bilateral trade costs and define symmetrically,

\[
X_{is}^T = \left( \frac{\gamma_{is}^T p_{is}^{1-\sigma_s}}{\sum_j \gamma_{js}^T p_{js}^{1-\sigma_s}} \right) \alpha_s^T E^T,
\]

where \( \alpha_s^T \) corresponds to the nested CES sectoral expenditure share.
Production and Labor supply

- Production with a Cobb-Douglas production function with a specific factor,
  \[ Q_{is} = A_{is}L_{is}^{\beta_s}K_{is}^{1-\beta_s}. \]

- Labor Supply is defining disposable income,
  \[ v_n = \left( \sum_i \mu_{ni}^{-\theta} w_i^{\theta} \right)^{\frac{1}{\theta}} \]

  which generates
  \[ L_{ni} = \frac{\mu_{ni}^{-\theta} w_i^{\theta}}{\sum_{i,s} \mu_{ni}^{-\theta} w_i^{\theta}} L_n \]
Equilibrium

For any initial distribution of residential labor endowment \( \{R_i\} \), a given level tourist expenditures \( \{E^T\} \), a given level of sector-location factor endowment \( \{M_{is}\} \), parameters defining the preference and production structure \( \{\sigma_s, \eta, \alpha_s, \beta_s, \theta\} \), and geography \( \{A_{i,s}, \gamma_{is}, \gamma_{i,s}^T, \tau_{nis}, \mu_{ni}\} \), an equilibrium is \( \{w_i, p_{is}\} \) s.t.

1. Sector-location specific market clearing

\[
p_{is} Q_{is} = \sum_n \left( \frac{\tau_{isn}^{1-\sigma_s} p_{is}^{1-\sigma_s}}{\sum_j \tau_{jsn}^{1-\sigma_s} p_{js}^{1-\sigma_s}} \right) \alpha_s \left( \sum_i \mu_{ni} w_i^\theta \right)^{\frac{1}{\theta}} + X_{is}^T
\]

2. Labor Market clearing

\[
L_i \sum_s \frac{1}{\beta_s} w_i \left( \frac{L_{is}}{L_i} \right) = \sum_s \sum_n \left( \frac{\tau_{isn}^{1-\sigma_s} p_{is}^{1-\sigma_s}}{\sum_j \tau_{jsn}^{1-\sigma_s} p_{js}^{1-\sigma_s}} \right) \alpha_s \left( \sum_i \mu_{ni} w_i^\theta \right)^{\frac{1}{\theta}} + \sum_s X_{is}^T
\]
<table>
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<tr>
<td>S.In Tourists Expenditures</td>
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<td>Group Bartik</td>
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Standard errors in parentheses

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Inductive Approach: Exact Hat Algebra

- Goods market clearing condition

\[
\hat{p}_{is}^{1-\beta_s} \hat{w}_i^{1-\beta_s} = \sum_n \left( \frac{X_{nis}}{y_{is}} \right) \frac{\left( \left( \sum_{i=1}^{N} \pi_{nis} \hat{p}_{is}^{1-\sigma_s} \right)^{\frac{1}{1-\sigma_s}} \right)^{1-\eta}}{\sum_{s=0}^{S} \left( \pi_{n,s} \left( \left( \sum_{i=1}^{N} \pi_{nis} \hat{p}_{is}^{1-\sigma_s} \right)^{\frac{1}{1-\sigma_s}} \right)^{1-\eta} \right)} \frac{\hat{p}_{is}^{1-\sigma_s}}{\sum_j \pi_{jsn} \hat{p}_{js}^{1-\sigma_s}} \hat{E}_T^T, 
\]

- Labor Market clearing condition,

\[
\sum_s \left( \frac{\beta_s y_{is}}{\sum_s \beta_s y_{is}} \right) \hat{p}_{is}^{1-\beta_s} \hat{w}_i^{1-\beta_s} = \sum_n \sigma_{ni} \left( \frac{R_n w_i}{\sum_s \beta_s y_{is}} \right) \hat{w}_i^{1+\theta} \frac{\hat{w}_i^{1+\theta}}{\sum_j \sigma_{nj} \hat{w}_j^\theta}.
\]
Inductive Approach: Calibration

- Factor share of labor, $\beta_s = .66$

- Labor Supply elasticity $\theta = 3.3$ (Monte et al.; 2018)

- Lower nest elasticity of substitution $\sigma_s = 3.9$ (Hottman et al.; 2016)

- Upper nest elasticity of substitution $\eta = 1.8$
Bartik

- Local Expenditure growth can be decomposed into,

\[ g_i^T = \sum_g \zeta_{i,g|i} \times g_E^T + \sum_g \sum_s \zeta_{i,s,g|i} \times g_{\kappa,s,g} \]

- initial group composition and initial consumption shares are given by,

\[ \zeta_{i,s,g|i} = \frac{E_i^{T,s,g}}{E_i^T} \quad \zeta_{i,g|i} = \frac{E_i}{E_i^T} \]

- and where changes in total group’s income and in within-group category spending are given by,

\[ g_E^T = \frac{\Delta E_i^{T,s,g}}{E_i^T} \quad g_{\kappa,s}^T = \frac{\Delta \kappa_{\kappa,s}^T}{\kappa_{\kappa,s}^T} \]

- Initial Shares exogenous i.e. orthogonal to local amenity shifts (Goldsmith-Pinkham et al.; 2018)
\[ \Delta \ln w_{imt} = \gamma_{it} + \gamma_{im} + \gamma_{tm} + \beta^w \times \Delta \log E_{itm}^T + \epsilon_{imt}, \]

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Standard errors in parentheses
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Estimate gravity equation for commuting flows

\[ \log(\sigma_{ij}) = \alpha \log(\tau_{ni}) + \gamma_n + \delta_i + \epsilon_{ni} \]

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</table>

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Simple Theory: Overview

- Change in utility can be expressed as,

$$d \ln u_i = \partial \ln v_i - \sum_s \pi_{is} \partial \ln p_{is}$$

- Applying an envelope condition we can further simplify,

$$d \ln u_i = \sum_s (\sigma_{is} - \pi_{is}) \partial \ln p_{is}$$

- Tourism is beneficial if $i$ is a net producer of the tourist sector

- If residents allocate their labor to maximize income, we obtain,

$$d \ln v_n = \sum_{i,s} \sigma_{nis} \partial \ln w_{is},$$
Inductive Approach: Outline

- Quantitative Urban Ricardo-Viner model in exact hat algebra

- Calibration using literature values

- Two exercises:
  - Short-run impact: Adjustment of consumption only
  - Long-run impact: Adjustment of both consumption and labor allocations
Estimate gravity equation for consumption flows

$$\log \pi_{nis} = \phi_s \log \tau_{ni} + \log \delta_{n,s} + \log \delta_{i,s} + u_{ni,s},$$