Relaxing Parametric Assumptions in General Equilibrium Trade Models

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Stanford and NBER

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Answering "What if?" Questions

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- But what do we say to a skeptical colleague who asks: "What features of the data *identify* the answer?"

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1. Sometimes, standard data simply don't allow the first step
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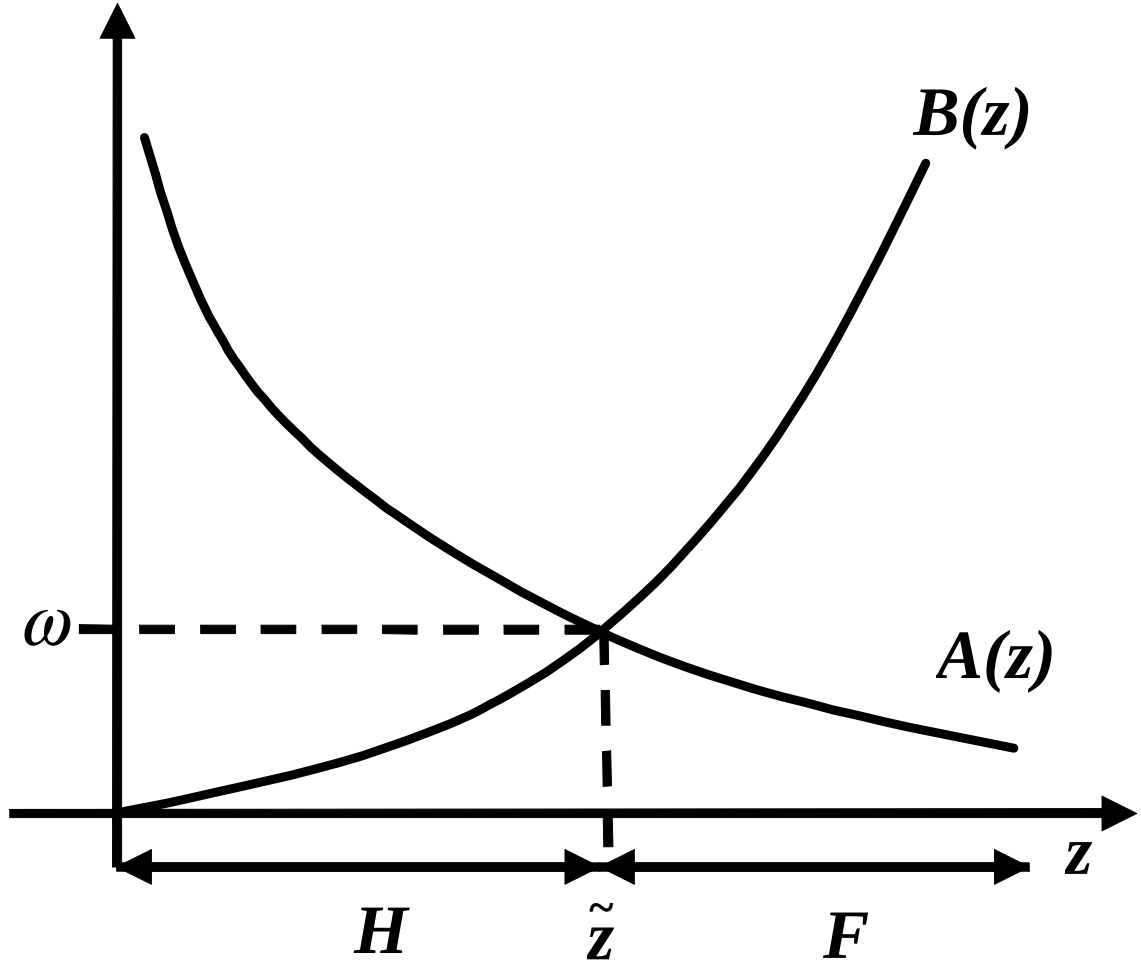
How Will an Economy Respond to a Foreign Shock?

- Answer depends on on reallocation of factors of production towards different economic activities
- But how could we know how productive a factor is at doing something it is (deliberately) not doing?
  - e.g. (Deardorff, 1984) pattern of trade can't be predicted (absent data from autarky)

Example: Dornbusch, Fischer and Samuelson (1977)



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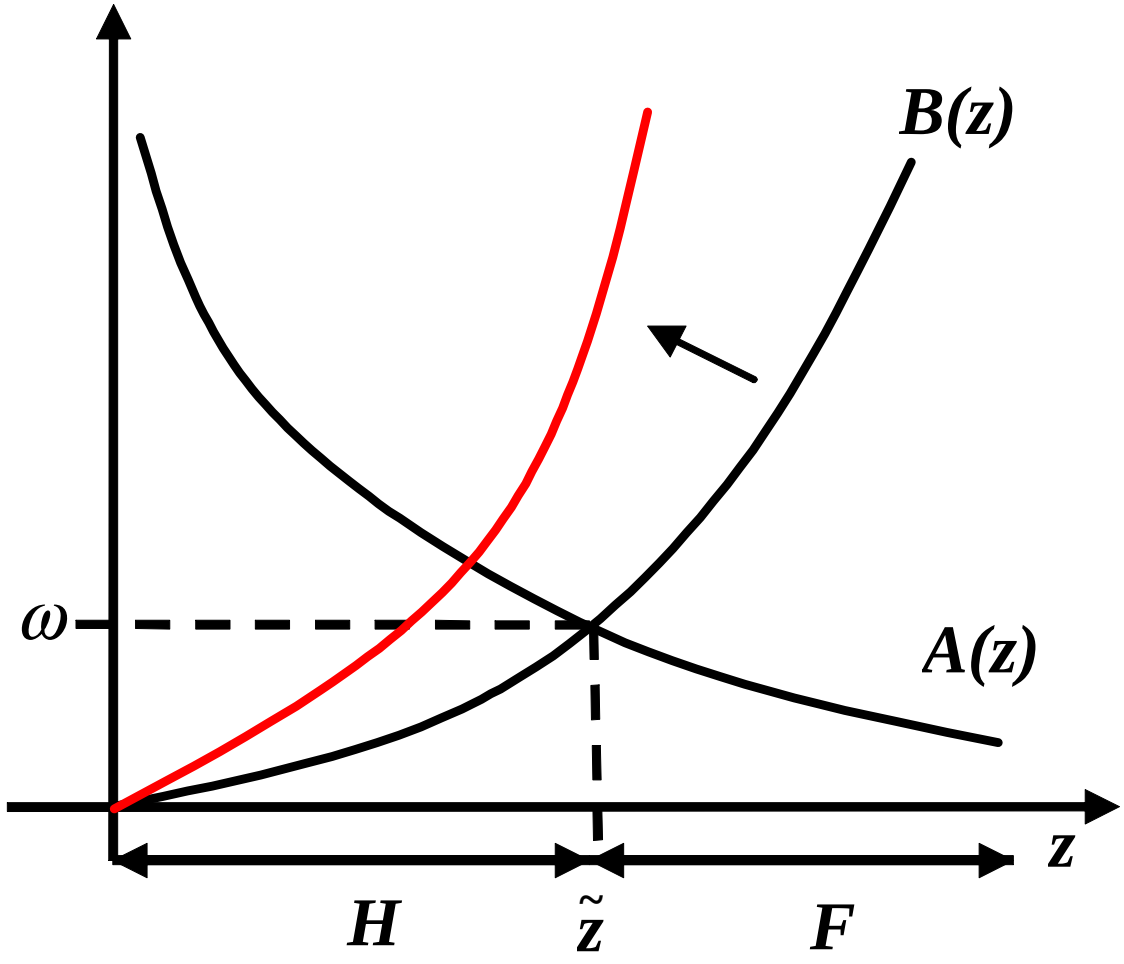

How Could We Know the $A(z)$ Function?

- Recent papers draw on agronomic data (FAO/IIASA GAEZ dataset) to measure comparative advantage
    1. Testing Ricardian comparative advantage: Costinot and Donaldson (AER P&P, 2012)
    2. How large are the gains from US historical market integration? Costinot and Donaldson (wp, 2015)
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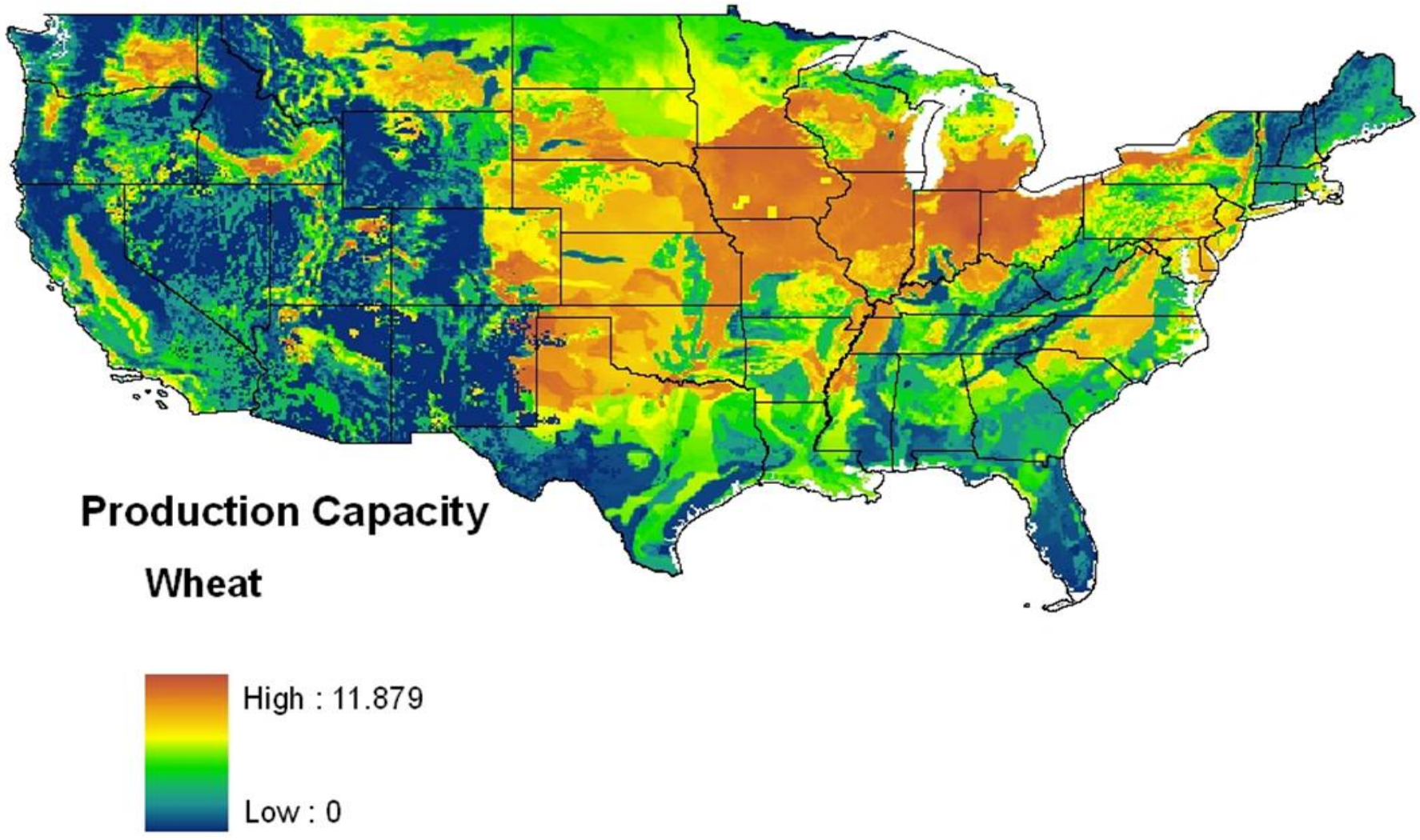
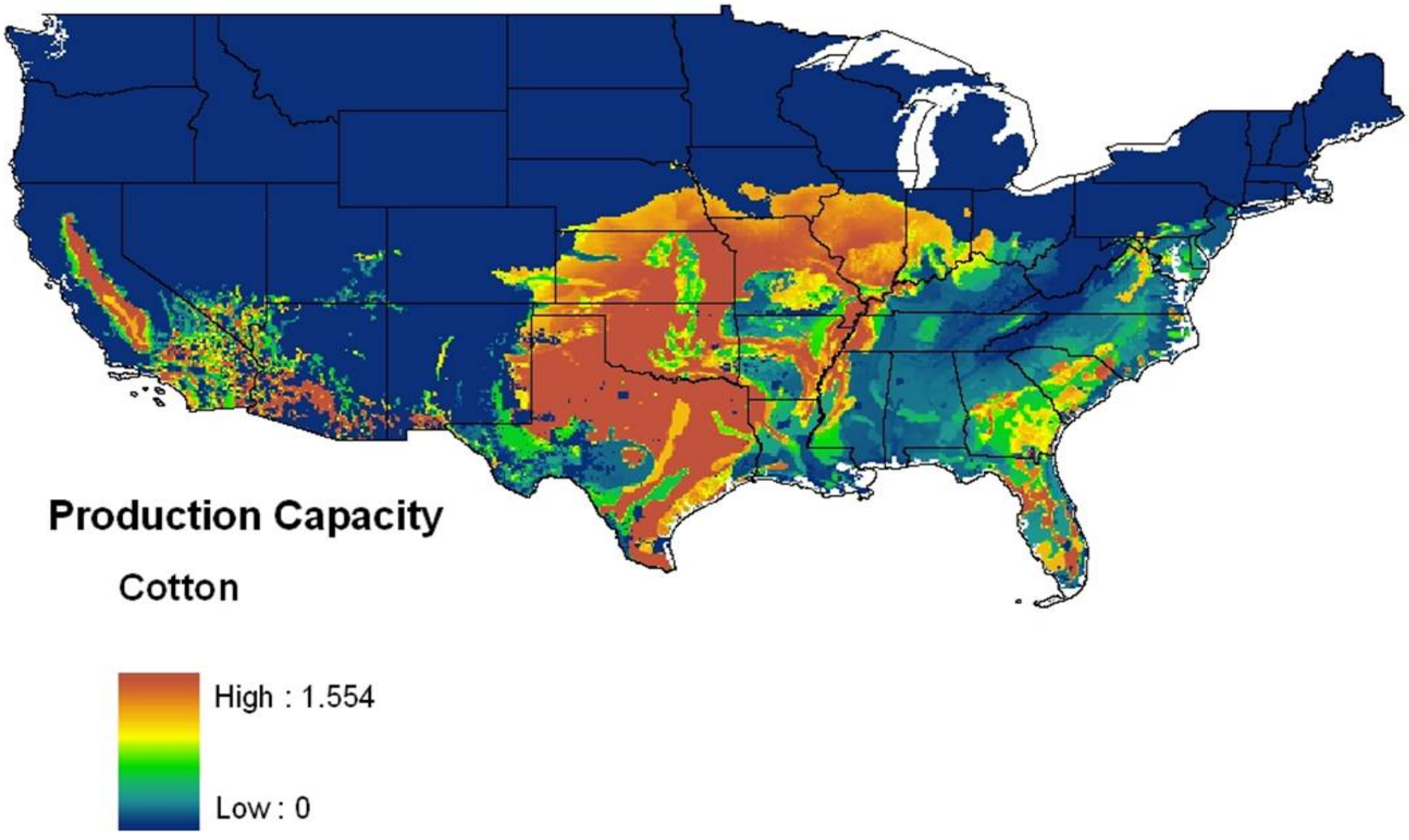
Productivity in Wheat (FAO GAEZ)

Production Capacity = possible yield (in tonnes/ha)

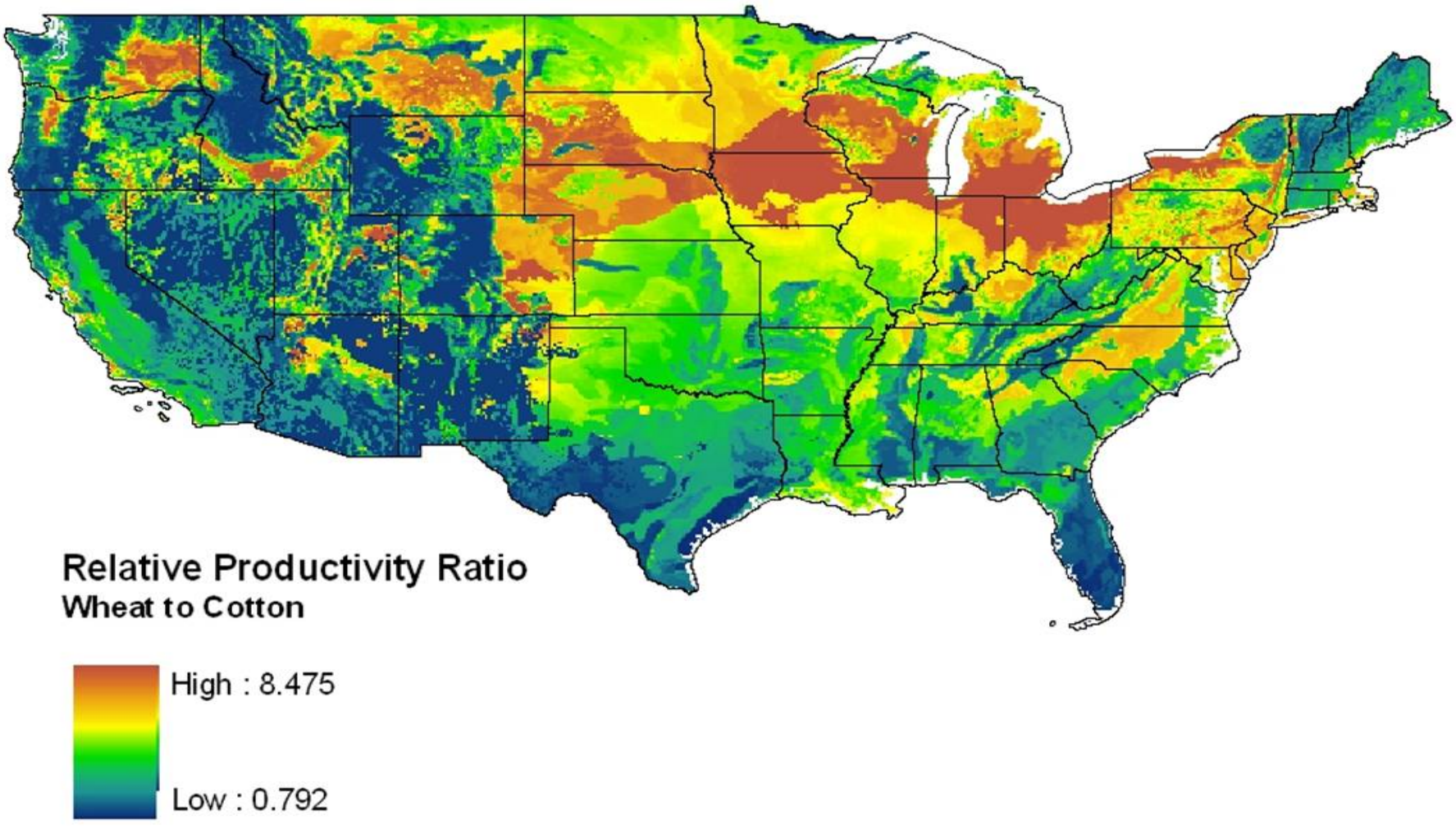


Productivity in Cotton (FAO GAEZ)

Production Capacity = possible yield (in tonnes/ha)



Relative Wheat-to-Cotton Productivity



How large are the gains from US historical market integration? Step 1

(a) Assume that $A_{it}^{fk} = \alpha_{it}^{k} \cdot A_{i,GAEZ}^{fk}$ for any:

- grid cell f (5 arc-minute)
- U.S. county i ($N \sim 1500$)
- year t from 1880-1997 (Census years)
- crop k (16 most important in 1997, plus 1 extra)
- (This assumption has an $R^2 = 0.80$ across GAEZ scenarios)

(b) Use U.S. Census data on aggregate output and area cropped for each crop k, county i, and year t

(c) Using above, identify the local farm-gate price p_{it}^{k} that farmers appear to have been facing

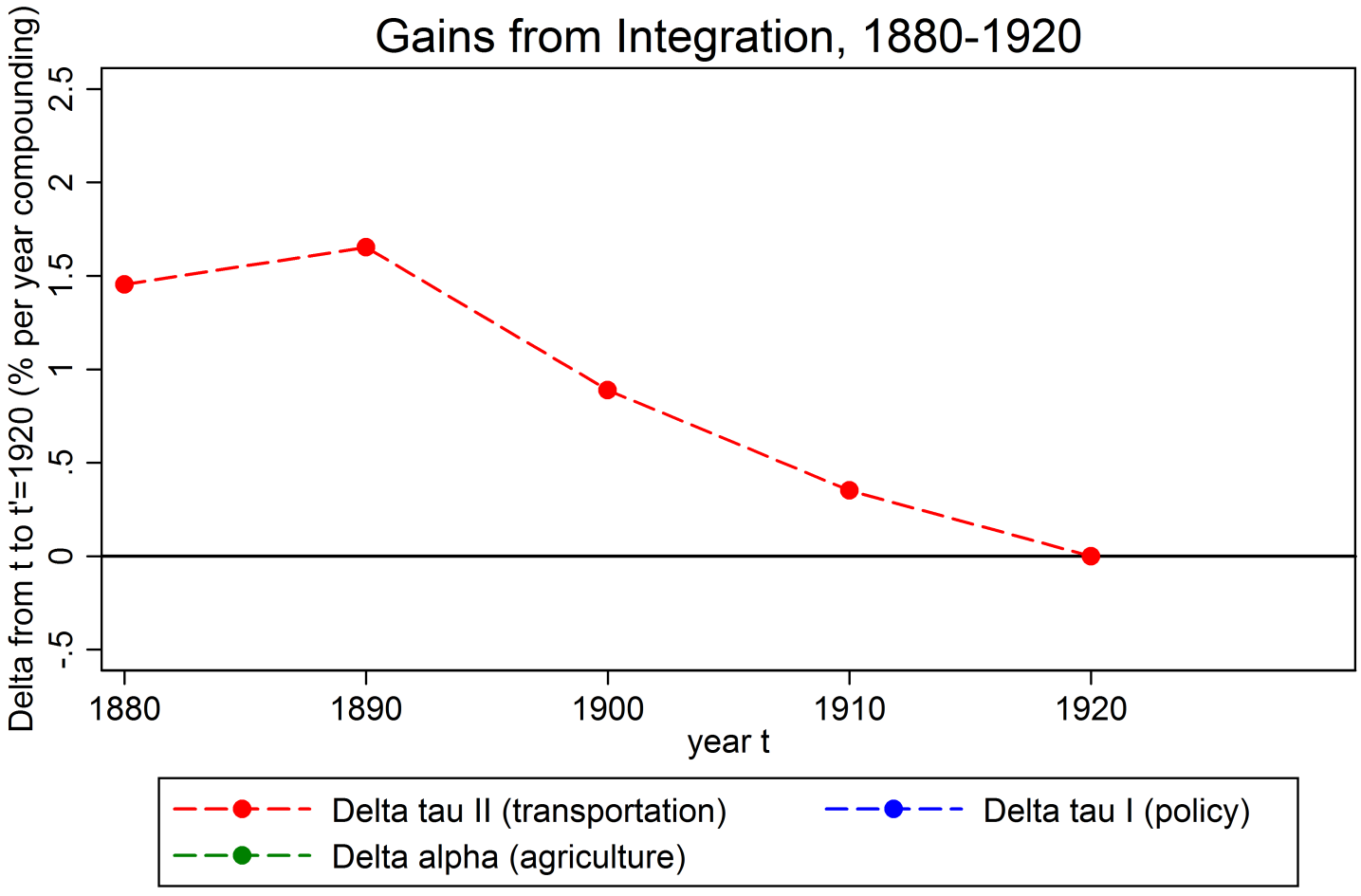
How large are the gains from US historical market integration? Step 2

(a) Measure price gap $(1 + \tau_{it}^k)$ as difference between farm-gate price and price in central wholesale markets

(b) Compute value of national output in year t if factual gap τ_{it}^k replaced by year counterfactual gap $\tau_{it'}^k$ from $t' > t$

- Either: "transportation cost" interpretation of national output (gaps reflect lost resources)
- Or: "policy" interpretation of national output (gap revenue redistributed lump-sum)
- Truth surely lies between these bounds

Agricultural Productivity Growth Due to Increasingly Exploited Gains from Trade



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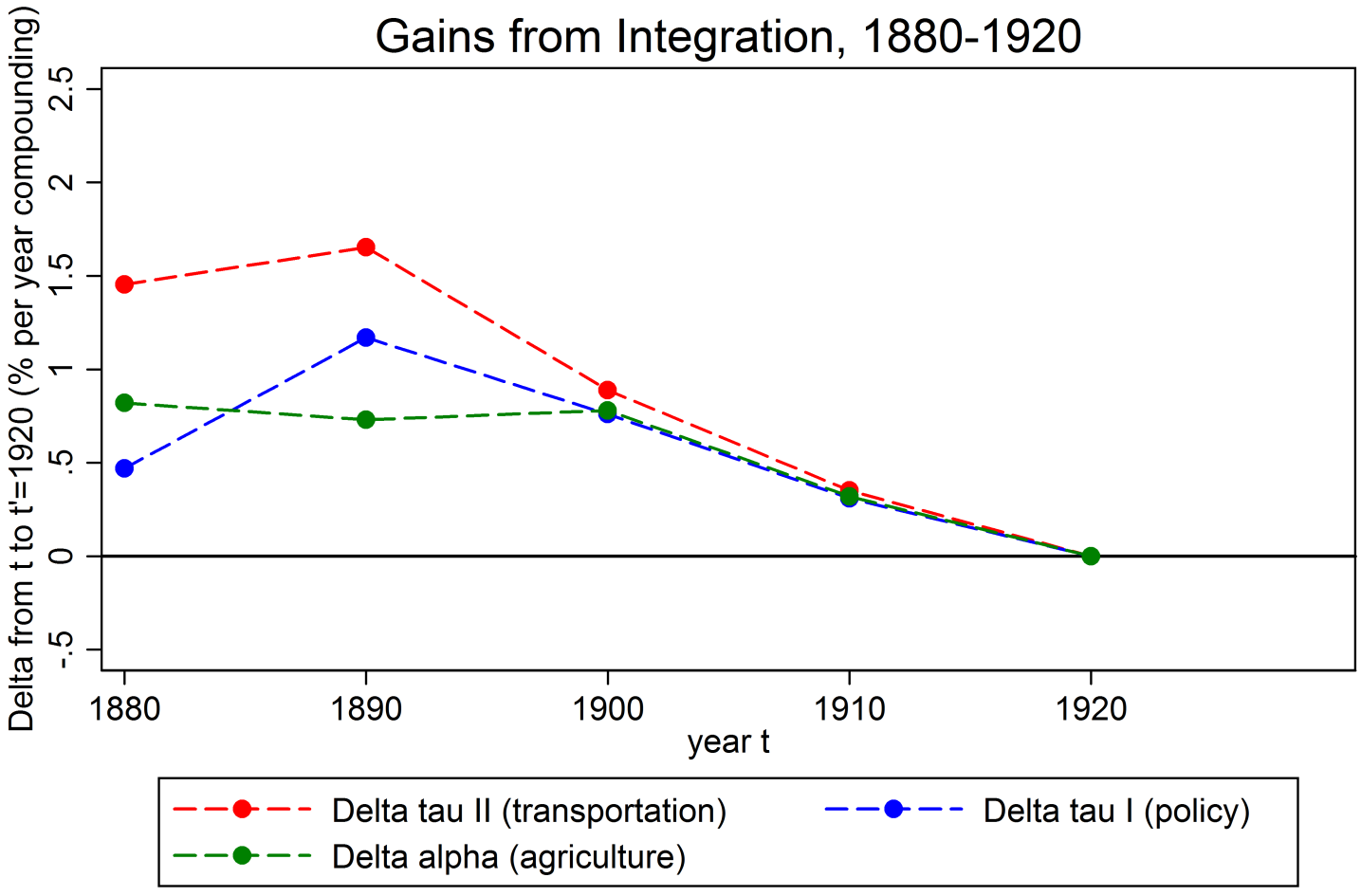

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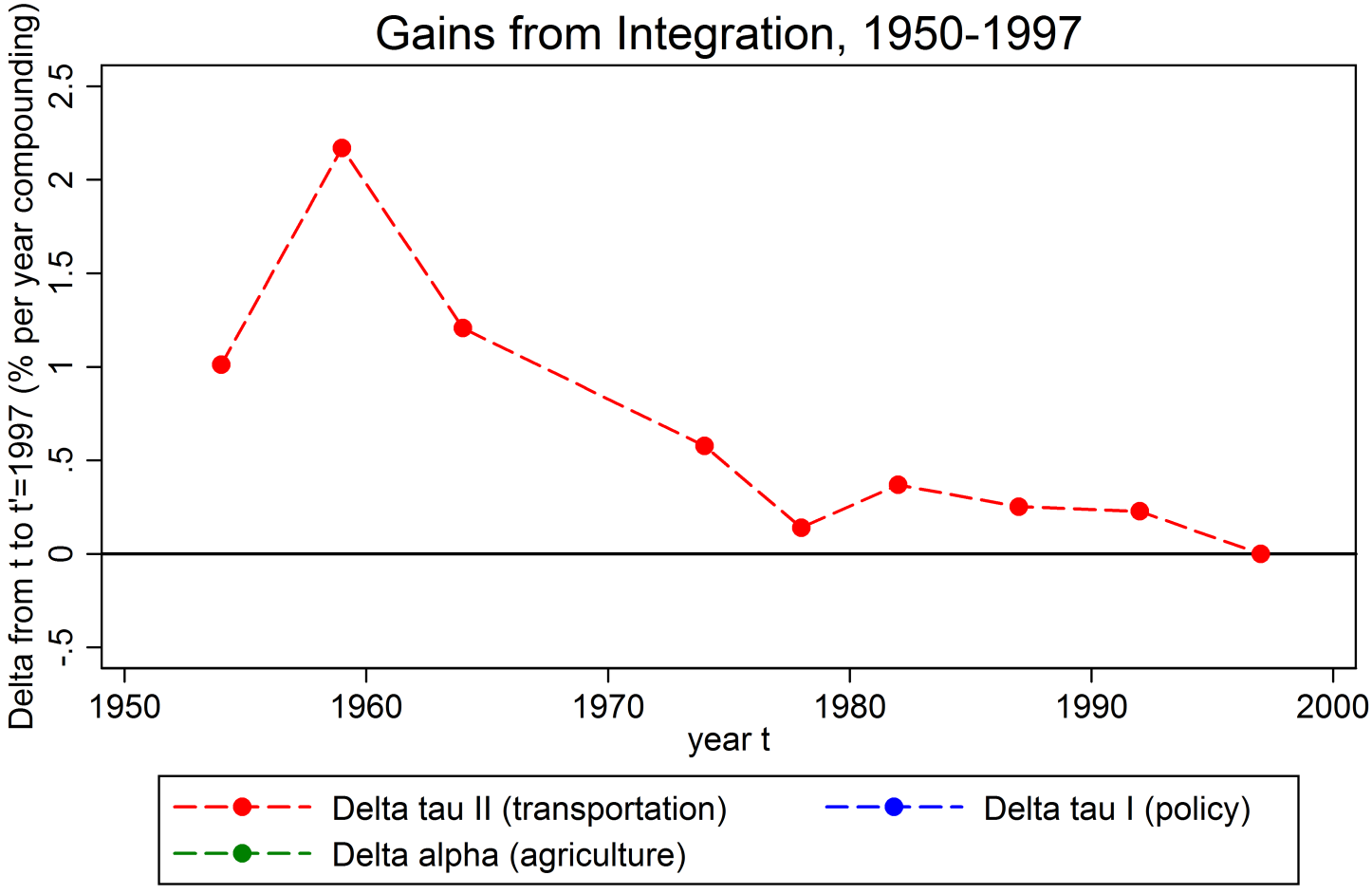

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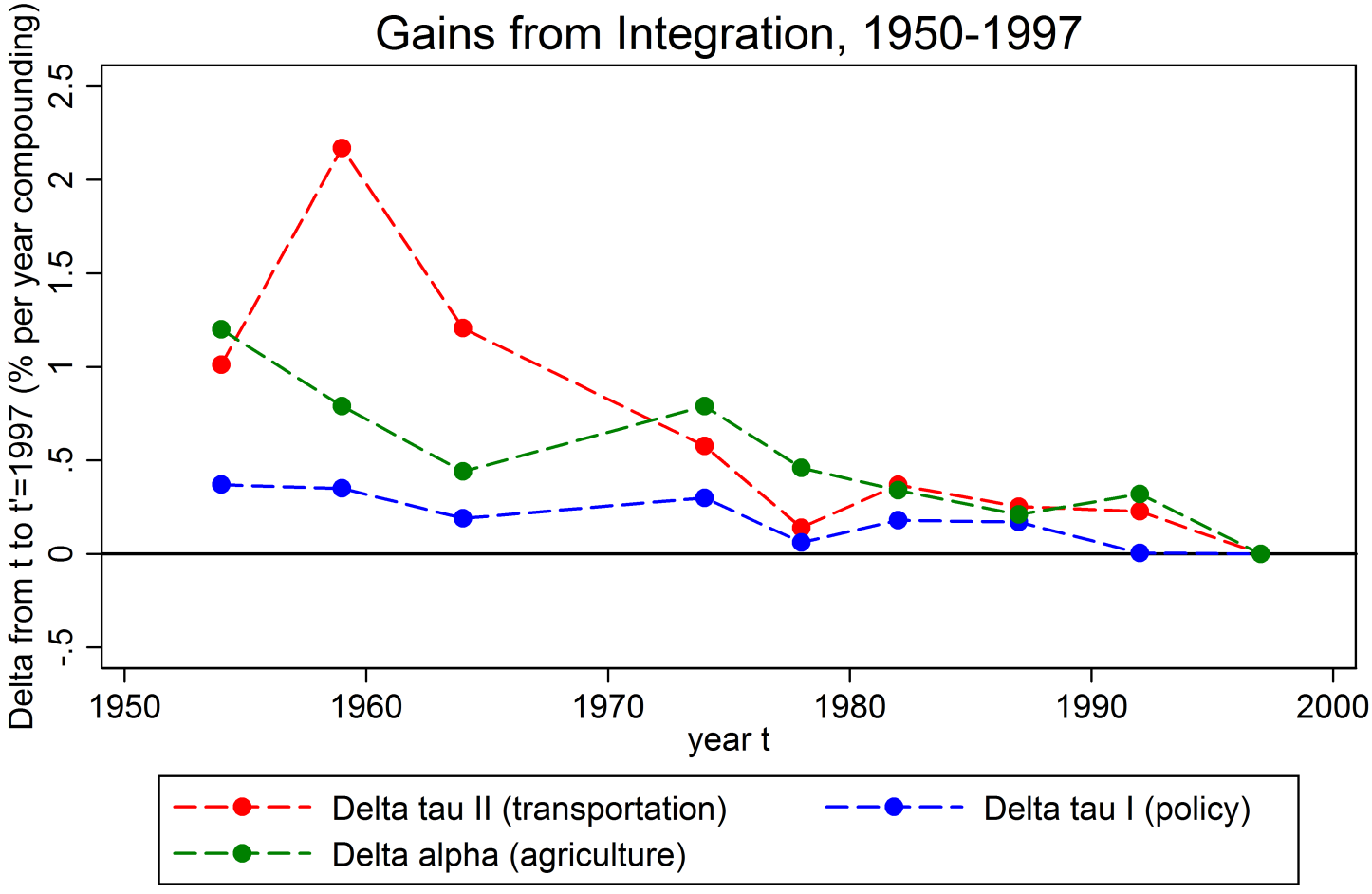

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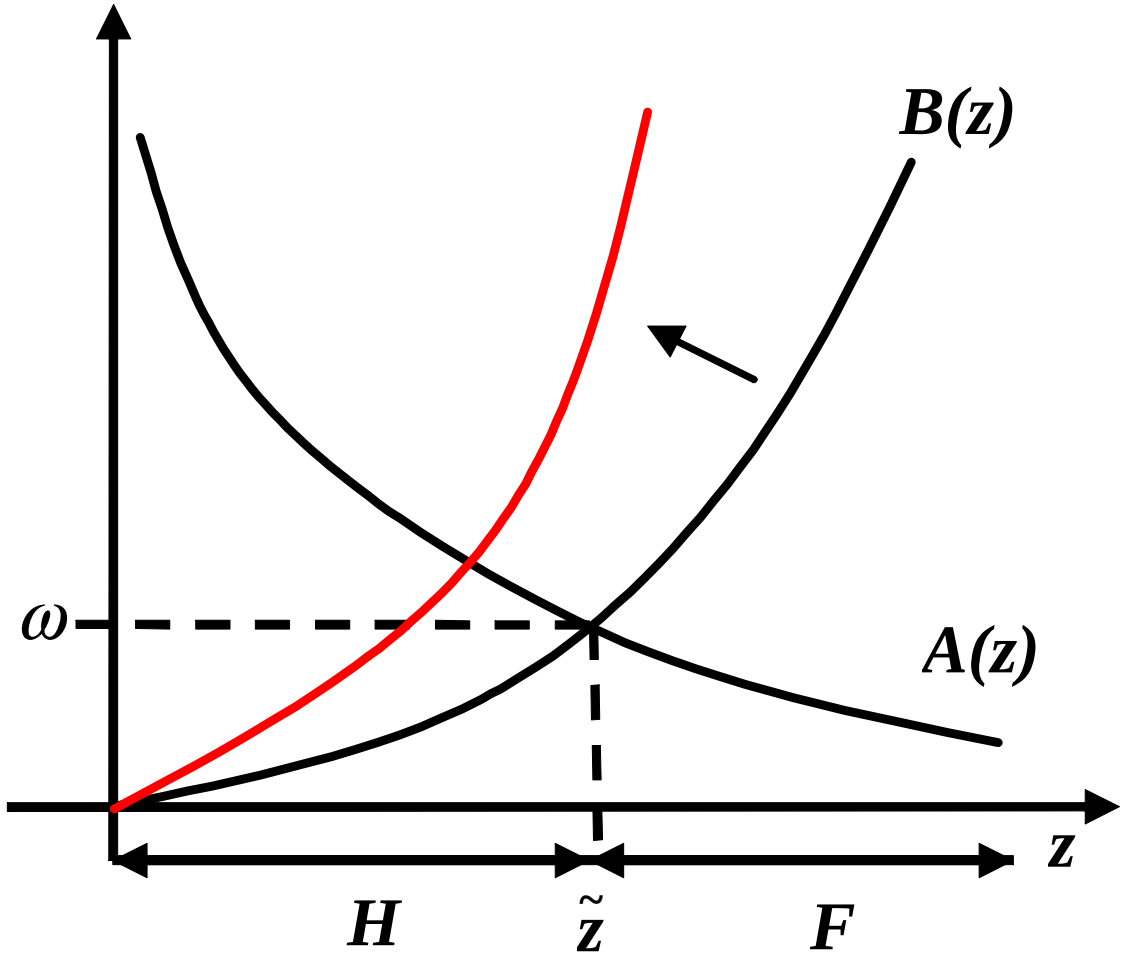
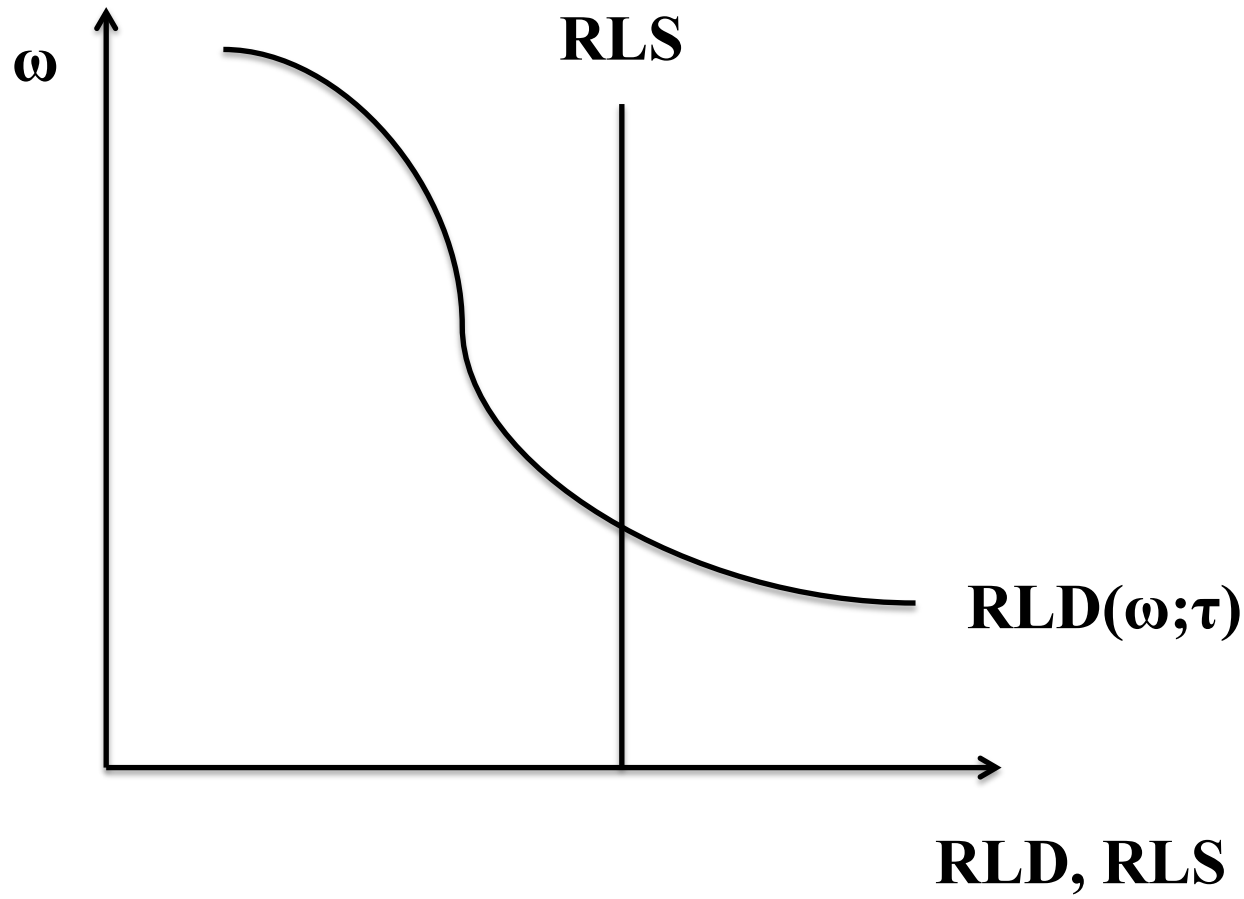


DFS (1977)—A different way of seeing things



Adao, Costinot and Donaldson (2016)

- **Basic idea:** Neoclassical models are exactly equivalent to a *reduced factor exchange economy* for the purpose of answering any counterfactual question concerning:
  - Factor content of trade
  - Factor prices
  - Welfare of factor owners

- **Corollary:** *Reduced factor demand system* sufficient for counterfactual analysis of this sort

Scope and Limitations

- **Scope:**
  - Arbitrary tastes
  - Arbitrary non-increasing returns to scale technologies (but no joint production)
  - Arbitrary product space (quality, firms, variety)
  - Arbitrary trade costs (taxes or transport costs)
  - Arbitrary input-output linkages (global/local)
  - Perfect competition (or monopolistic competition with CES preferences)
  - Factor mobility can be incorporated

- **Limitations:**
  1. Only useful if change (to technology, trade costs, endowments) of interest is somewhat aggregate (across products) in nature
  2. If change in environment alters distortions, can't infer *welfare* effect (without more information)

Who Cares? Reduced Factor Exchange Economies are Just Simpler

1. As simple as possible for the question at hand
2. Simply an *exchange* economy (Edgeworth Box)
3. Only unknown object is simply a (factor) demand system, so:
   (a) Can focus estimation on achieving credible (factor) demand estimation: need supply-side instruments
   (b) Can draw on understanding of identification and estimation in wide field of applied consumer demand analysis
   (c) Welfare analysis simply involves computing area beneath demand curve

Related ideas

- **Gravity models (simplest possible reduced factor demand model—CES):**
  - Arkolakis, Costinot and Rodriguez-Clare (2013)
  - Armington (1969), Eaton and Kortum (2002), Krugman (1980), Melitz (2003) with Pareto
- **Use of factor content of trade:**
  - For counterfactuals to autarky in a Cobb-Douglas economy: Deardorff and Staiger (1988)
  - For testing HO model: Vanek (1968)
- **"Reduced" trade analysis (qualitative):**
  - Meade (1952), Woodland (1980), Wilson (1980), Neary and Schweinberger (1986),
- **Computation:**
  - Helpman (1976)

Empirical Practicalities

1. How to estimate *reduced factor demand system*?
   - Focus on factor content of trade data (not goods content of trade data)
   - Standard exclusion restrictions (exogenous trade costs) nonparmetrically identify factor demand system

2. Do commonly applied "gravity" tricks still apply?
   - Can we use calibrated share form (Rutherford, 1995; Dekle, Eaton and Kortum, 2009)? Yes, iff demand system is *invertible*.
   - Can we measure trade costs from trade residuals (Head and Ries, 2001)? Yes, iff demand is invertible.

Concluding Remarks

- Answering inherently GE counterfactual questions is hard
  - Limited quasi-experimental variation
  - Inherently high-dimensional empirical problem
  - Spillovers across "treatment" units (no SUTVA, Rubin 1990)

- Many economists therefore skeptical of even best answers to these questions

- We can improve credibility of answers by:
  1. Acknowledging lack of nonparametric identification when it exists, and finding ways (e.g. new data) to overcome it
  2. Focusing only what is sufficient for required answer

THANK YOU!

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