Increasing Returns and Economic Prosperity: How Can Size Not Matter?

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October 1st, 2010 (VERY PRELIMINARY)
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Counterfactual implication: strong scale effects
Jones assumes $\dot{A} = A^{\gamma s_l L}$, $\gamma < 1$, which implies $g = A^{\gamma -1 s_l L}$.
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When $A \to \infty$ then $A^{\gamma - 1} \to 0$ and $g \to 0$. But a growing $L$ can overcome this effect.
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In steady state,

$$g = \frac{1}{1 - \gamma} \cdot g_L$$
More generally, Semi-Endogenous Growth Model (SEGM) implies

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Jones '02: \( g = 0.01 \) and \( g_L = 0.048 \), hence \( \varepsilon = 0.21 \)
The Belgium Puzzle

- Now we have

\[ y_n \sim L_n^{0.21} \]
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Data entails

\[ \frac{L_{US}}{L_{BEL}} = 45 \]

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- But data entails
  \[ \frac{y_{BEL}}{y_{US}} = 0.89 \]
## The Belgium Puzzle (I)

<table>
<thead>
<tr>
<th></th>
<th>$y_{belgium} / y_{US}$</th>
</tr>
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<tbody>
<tr>
<td>Isolation</td>
<td>0.45</td>
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Solving the Puzzle

Two main solutions have been proposed:

1. Countries are not fully isolated from the rest of the world.
2. Countries are not fully integrated domestically.
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Do these solutions solve the Belgium Puzzle?
From Jones to Kortum

- The economy’s technology frontier is determined by the best idea available for the production of each good
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  - formally, $z$ is drawn from a Fréchet distribution with parameters $\lambda$ and $\theta$,

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\Pr(Z \leq z) = e^{-\lambda z^{-\theta}}
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- Letting \( P^{1-\sigma} = \int p(u)^{1-\sigma} du \) and assuming \( \sigma < 1 + \theta \) then

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w/P \sim \lambda^{1/\theta}
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- Letting $P^{1-\sigma} = \int p(u)^{1-\sigma} du$ and assuming $\sigma < 1 + \theta$ then

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- The growth rate is then

$$g = \frac{1}{\theta} \cdot g_L$$
Quantitative Version

- Intermediate goods are used to produce intermediate goods - labor share $\beta$ (EK 2002)
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Now, the growth rate in real output per worker is

$$g = \left(1 + \frac{1 - \alpha}{\beta}\right) \cdot \frac{1}{\theta} \cdot g_L$$
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- Growth comes from technological change in intermediate goods, $\eta g_L/\theta$, and in final goods, $g_L/\theta$, with

$$g/g_L = 1/\theta + \eta/\theta$$

$$0.21 = 0.07 + 0.14$$
Now we consider $I$ countries, with labor endowment $L_n$. 
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Iceberg trade costs $d_{ni} \geq 1$

Productivities in intermediates and final goods are independently drawn from a Fréchet distribution, with parameters $\lambda_n$ and $\theta$
Gains from Trade in Eaton and Kortum

- Real wage is:

\[
\frac{w_n}{P_{fn}} = \lambda_n^{(1+\eta)/\theta} \cdot GT
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where gains from trade are:

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GT = \left( \frac{X_{nn}}{\sum_l X_{nl}} \right)^{-\eta/\theta}
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- We assume \( \lambda_n = T_n L_n \), where \( T_n \) is the stock of ideas per person.
Then real wage is:

\[
\frac{w_n}{P_{fn}} = \left( \frac{T_n L_n}{\eta w_n L_n} \right)^{(1+\eta)/\theta} \left( \frac{X_{nn}}{\eta w_n L_n} \right)^{-\eta/\theta}
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Then real wage is:

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\frac{w_n}{P_{fn}} = \left(\frac{T_n L_n}{\theta}\right)^{1+\eta/\theta} \left(\frac{X_{nn}}{\eta \bar{w}_n L_n}\right)^{-\eta/\theta}
\]

Data used:

- We make \(T_n\) proportional to the percentage of the population in the R&D sector.
- \(L_n\) is equipped labor.
- Bilateral trade in intermediates in the model = manufacturing trade from \(i\) to \(n\) (STAN, avg. 90s).
Gains from openness in Eaton Kortum (2002)

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## The Belgium Puzzle (II)

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- Productivities in intermediates and final goods are independently drawn from a Fréchet distribution, with parameters $\lambda_n$ and $\theta$
Real wage with Trade and MP

- Real wage is now:

\[ \frac{w_n}{P_{fn}} = \left( T_n L_n \right)^{(1+\eta)/\theta} \cdot GT \cdot GMP \]

where gains from MP are:

\[ GMP = \left( \frac{Y_{gnn}}{\sum_i Y_{gni}} \right)^{-\eta/\theta} \left( \frac{Y_{fnn}}{\sum_i Y_{fni}} \right)^{-1/\theta} \]
Real wage with Trade and MP

- Additional data used:
Real wage with Trade and MP

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  - Bilateral MP in the model = gross value of production of affiliates from $i$ in $I$ (UNCTAD, avg. 90s)
The Belgium puzzle (III)

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Adding domestic frictions

- Country \( n \) has \( N_n \) identical towns. Every town has labor equal to \( \bar{L} \). Then \( L_n = T_n \bar{L} \)
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Adding domestic frictions

- Country $n$ has $N_n$ identical towns. Every town has labor equal to $\bar{L}$. Then $L_n = T_n \bar{L}$
- As before, intermediate goods are tradable and final goods are not tradable.
- Trade costs among different towns in a country has cost $d_{nn} > 1$. International trade costs as above.
Adding domestic frictions

- Firms from a town can locate their production in other towns, in the same country or in another country.
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- Firms from a town can locate their production in other towns, in the same country or in another country.

- For any final or intermediate good, any town in country \(i\) can produce in a particular (random) town of country \(l\) with productivity \(z_{li}\).
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- For now we assume $d_{nn} = h_{nn}$. 
The model implies that the ratio of expenditure of a town on goods from any other town within the country to expenditure of a town on goods from the same town is equal to $d_{\theta \theta}$. We use data of shipments for the United States in the Commodity Flow Survey (2002) to compute this ratio for towns as states. Given $\theta = 7.2$ then $d_{\theta \theta} = 1.572$. 

Estimation of local trade costs in United States
The model implies that the ratio of

- (1) expenditure of a town on goods from any other town within country to
- (2) expenditure of a town on goods from the same town

is equal to \( \frac{d}{\theta} \).

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Given $\theta = 7.2$ then $d_{nn} = 1.572$
Real wage with domestic frictions

- Real wage is:

$$\frac{w_n}{P_{fn}} = (T_n L_n)^{(1+\eta)/\theta} \cdot (D_n)^{\eta/\theta} \cdot (H_n)^{1/\theta} \cdot GT \cdot GMP$$

where

$$D_n \equiv \left( \frac{1}{N_n} + \frac{(N_n - 1)}{N_n} d_{nn}^{-\theta} \right) < 1$$

and

$$H_n \equiv \left( \frac{1}{N_n} + \frac{(N_n - 1)}{N_n} h_{nn}^{-\theta} \right) < 1$$
The Belgium Puzzle (IV)

<table>
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<th></th>
<th>$\frac{y_{\text{belgium}}}{y_{\text{US}}}$</th>
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<tbody>
<tr>
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<td>$d_{nn} = 1$</td>
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Calibration results

- 5 countries with smaller size ($T_n L_n$)

<table>
<thead>
<tr>
<th>Country</th>
<th>Isolation</th>
<th>$GT$, $GMP$</th>
<th>$d_{nn} = h_{nn} &gt; 1$</th>
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<tbody>
<tr>
<td>New Zealand</td>
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Data vs Full Model

- Full model with $GT$, $GMP$, and $d_{nn} = h_{nn} = 1.5$