ROYAL INSTITUTE OF TECHNOLOGY

The effects of transport infrastructure on regional economic development.

Analysis with a Spatial Overlapping Generations model

Ioannis Tikoudis
Marcus Sundberg
Anders Karlström

Motivation and Research question

Motivation

- **Primary effects**: Travel time savings, safety etc.
- **Secondary**: Labor matching, Economic growth etc.

Research questions

- What is the mechanism that translates transport infrastructure investment into regional growth?
- How much of this growth comes from labor market efficiency?

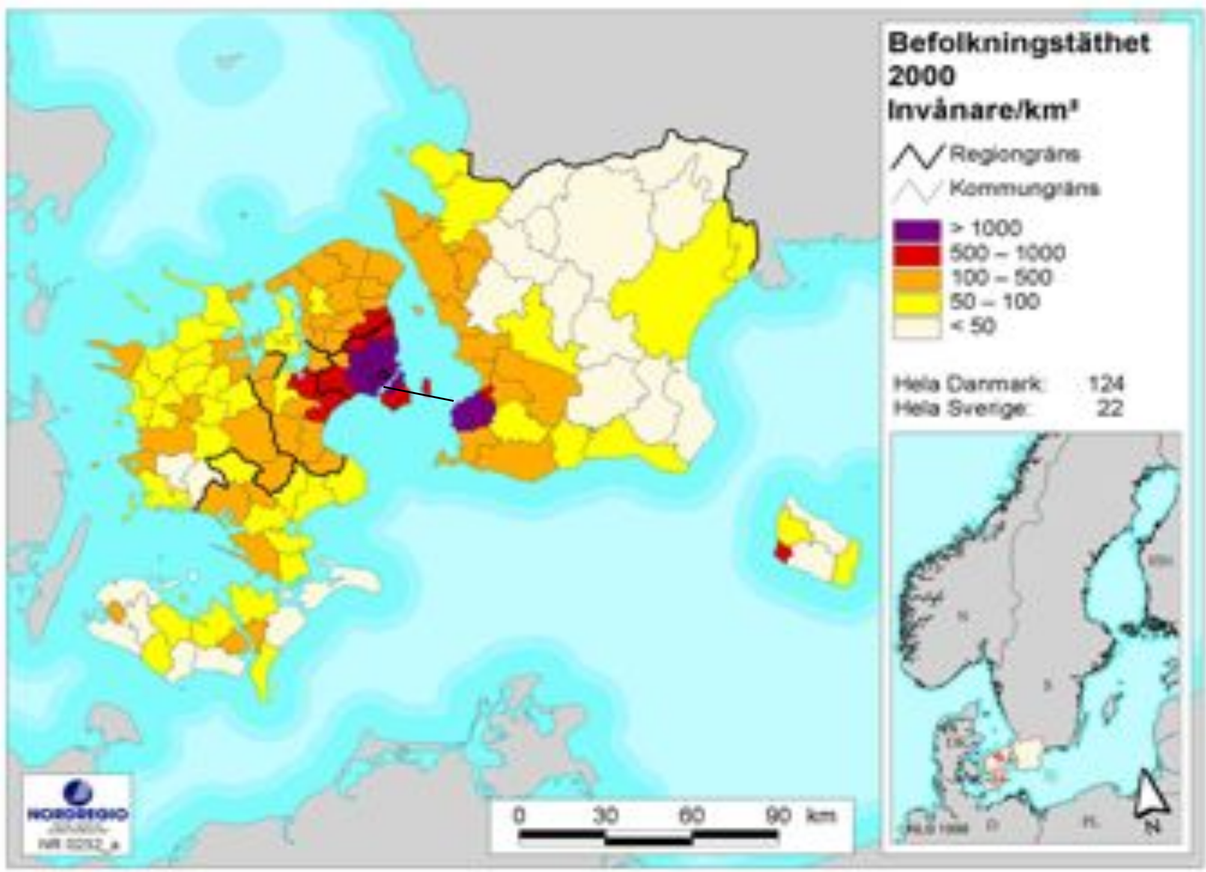
Paper

A Simulated Spatial Overlapping Generations Model with heterogenous skill.
[Accepted in *Journal of Transport and Land Use*]

KTH VETENSKAP OCH KONST
ROYAL INSTITUTE OF TECHNOLOGY

Öresund: one region, two countries

- Almost independent before the bridge.
- Commuting time approximately 40 minutes.
- Both countries in EU and out of eurozone.
- Different nations, governments, central banks.



Approach

Why General Equilibrium?

- Multiple markets, can capture indirect effects through behavioral equations.
- Simulate scenarios of various transport policies.

Why Overlapping Generations Model (OLG)?

- Policies affect different age cohorts differently (*young* vs *old* at time **t**).
- Policies affect a given age cohort differently in various real time points (*old* at time **t** vs *old* at time **t+1**).
- Have been used in other fields of economics before (pension system reforms, environmental economics). But not in a spatial context.

ROYAL INSTITUTE OF TECHNOLOGY

Alternative: Panel data econometrics

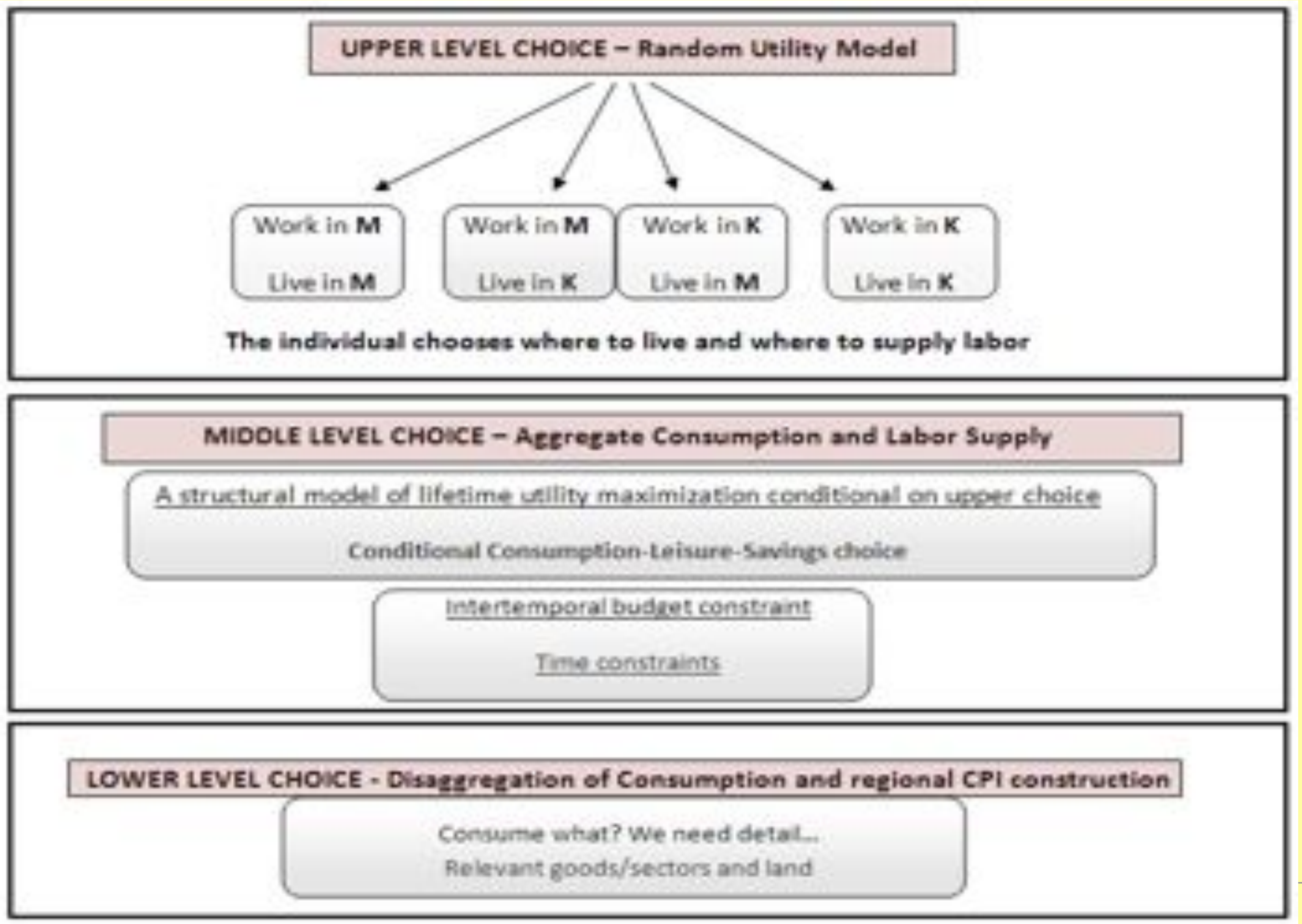
- FE, RE, GMM are widely used.
- More convenient.
- No software development (STATA suffices)
- Easy interpretation.
- Easier to publish!

- But still reduced form
- Not microfounded: The Krugman critique
- Important interactions might be omitted
- Pitfalls: Endogeneity, self-selection, measurement errors
- Pitfalls II: The Lucas Critique

F.R.O.G: model incredients

- Two regions (Future empirical reference: Öresund region)
- Overlapping Generations (two period living heterogeneous agents: commuting and relocation possible)
- Heterogeneity in skills.
- Myopic expectations.
- Competitive wage/rent setting mechanisms with frictions.
- Government invests in public capital (transport infrastructure).
- Transport infrastructure affects commuting times and trade costs, but not the production technology directly.

Model: Young Consumers (without maths)



Young consumers

Conditional utility functions:

- Consumption
- Leisure
- Psychic effects of living in the region of origin.

Intertemporal budget constraint:

- Consumption(old) = (1+r)Savings(young)+income(old)-frictions(old)

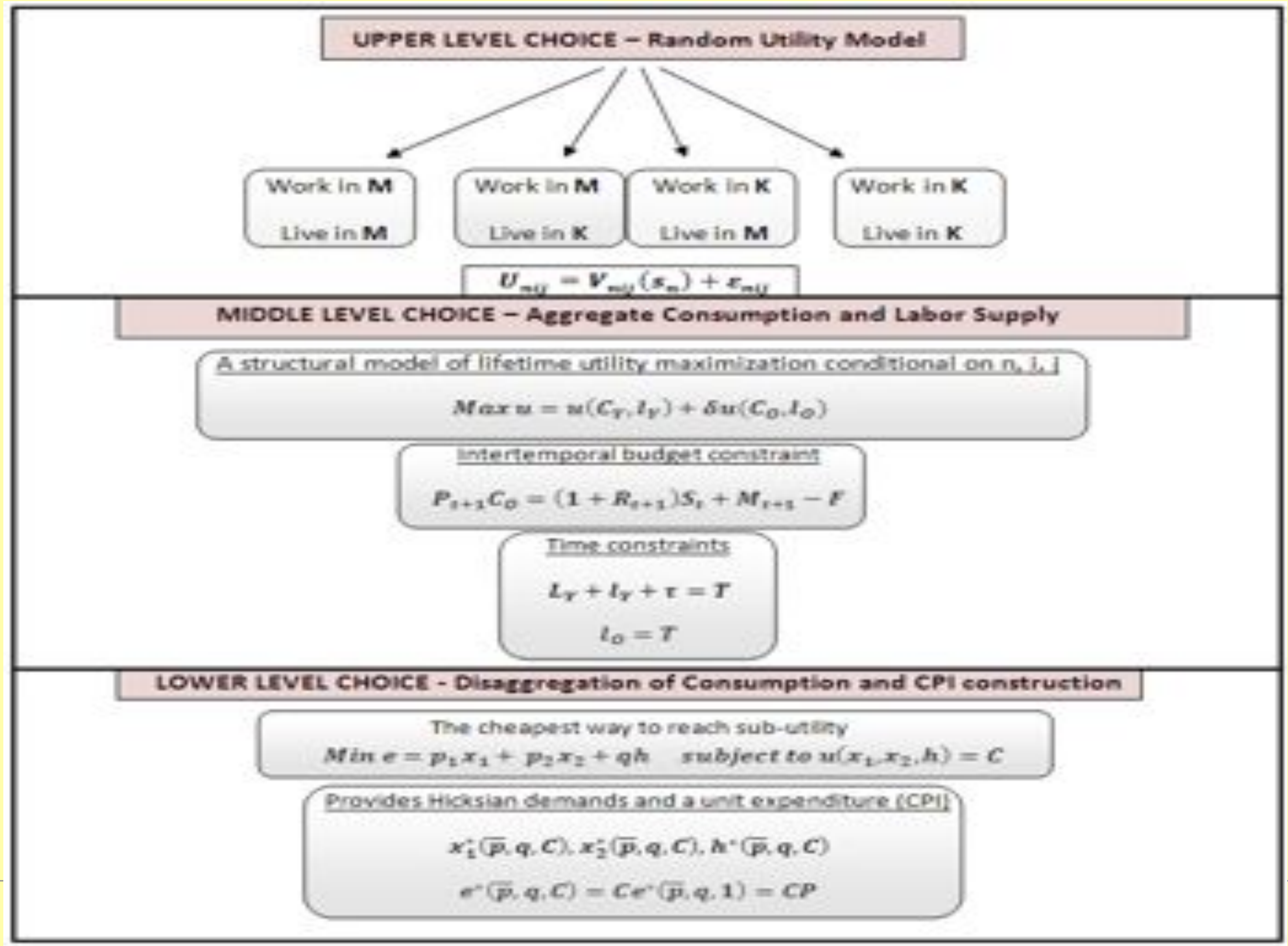
Time constraint:

- Total time = Labor supply + commuting + leisure

Consumption disaggregation:

- One good produced in each region.
- Both goods sold in each region.
- Neither substitutes, nor complements

Model: Consumers (with maths)



Model – Firms, matching, and transport costs

- One representative firm in each region.
- Produces with CRS, Cobb-Douglas technology.

$$Y = K^{\alpha} L^{\beta}$$

- Inputs: Capital, and **Labor in effective time units**.
- Effective labor supply: $\hat{L}_{nj} = (1 + d_{nj})L$
- Stochastic term **d** is specific to the match (individual, firm, region).
- Samuelson-type transport costs which are modeled explicitly, with respect to public capital, K(G), and congestion effects, X.

$$\frac{1}{Q_{01}} = f(K_G, \hat{X}_{01} | \bar{\xi})$$

Methodology- simulation experiments

- Simulate an initial steady state with homogenous labor (A).

	Initial steady state (without infrastructure)		
Experiment 1: Homogenous labor (no incentive to commute or migrate)	A		

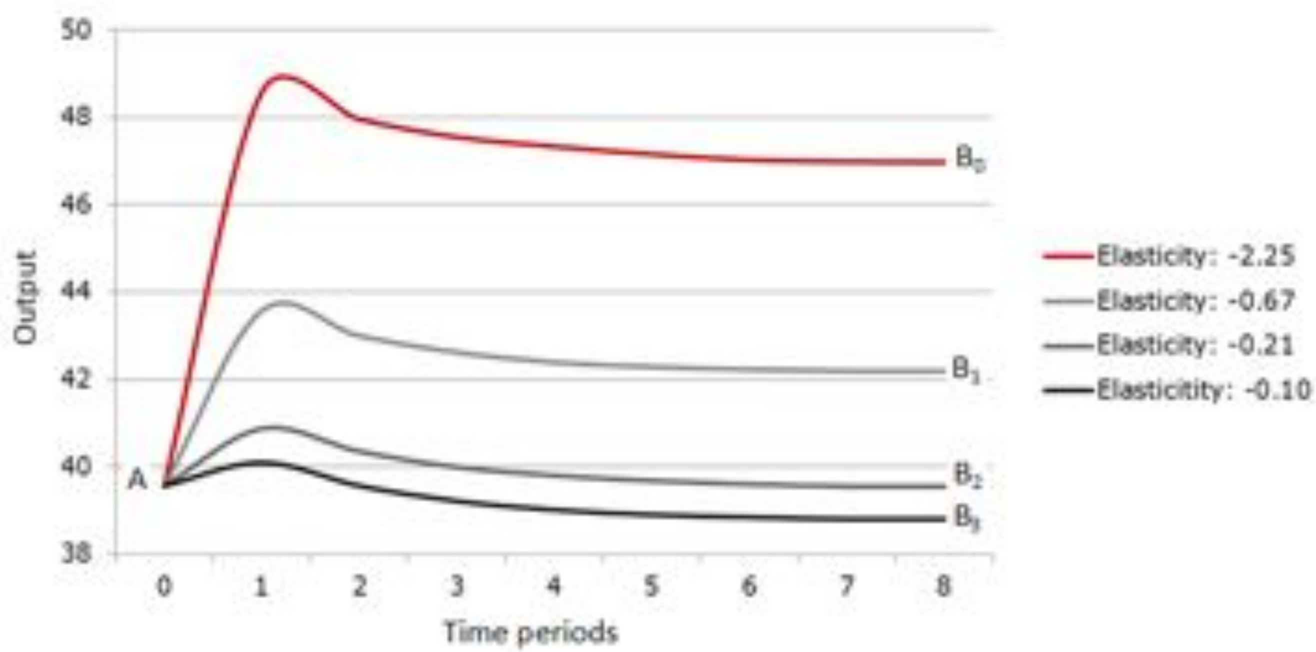
Methodology- simulation experiments

- Simulate an initial steady state with homogenous labor (A).
- Simulate the deterministic transition to a final steady state (B) after the infrastructure shock
- Compute the total gains in GDP: B-A

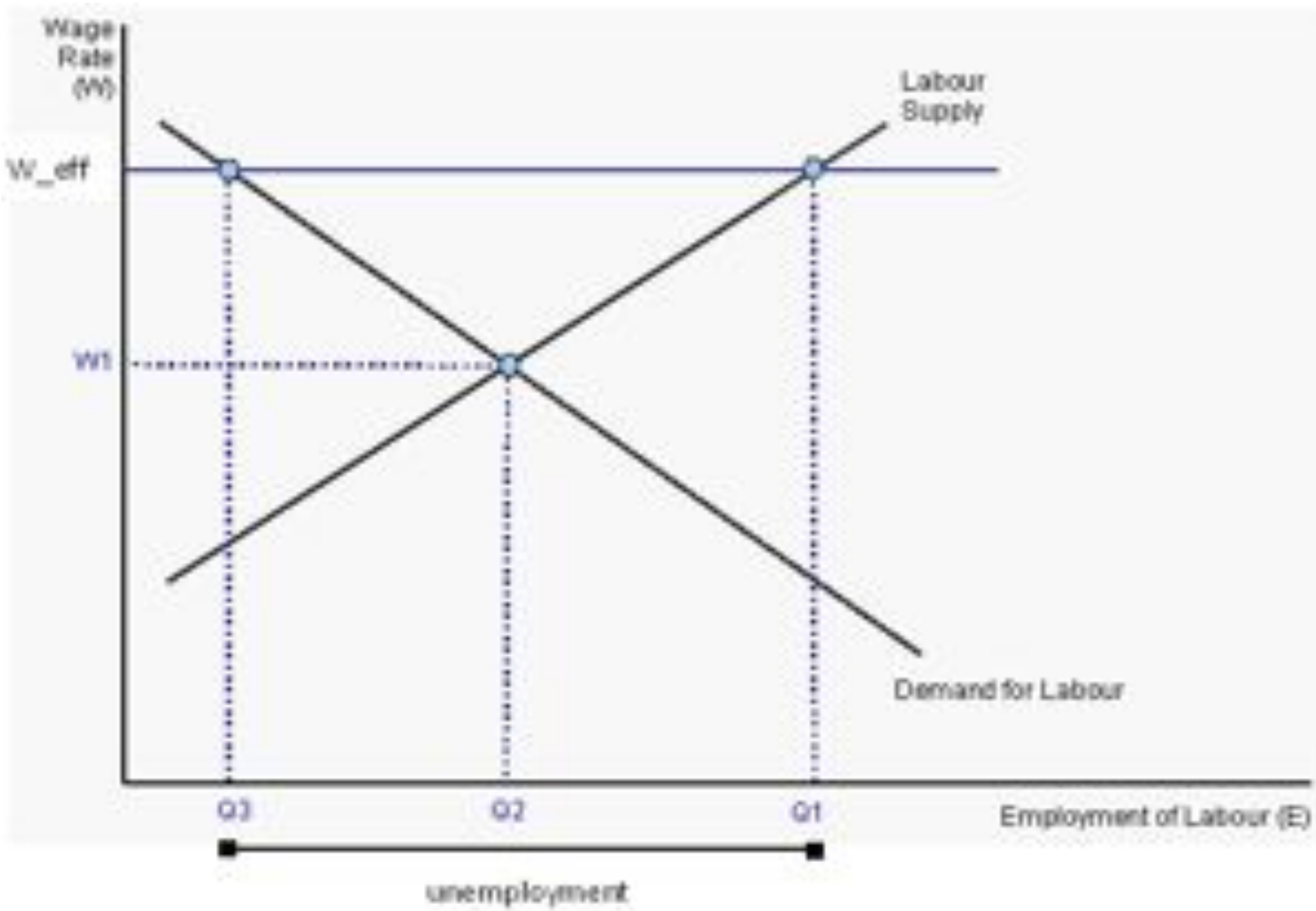
	Initial steady state (without infrastructure)	Final steady state (with infrastructure)	Difference: Total gains in GDP attributed to better trade and labor matching
Experiment 1: Homogenous labor (no incentive to commute or migrate)	A	B	B-A = Total gains in GDP under homogenous labor force.

Experiments with homogenous labor: Gains from trade without commuting

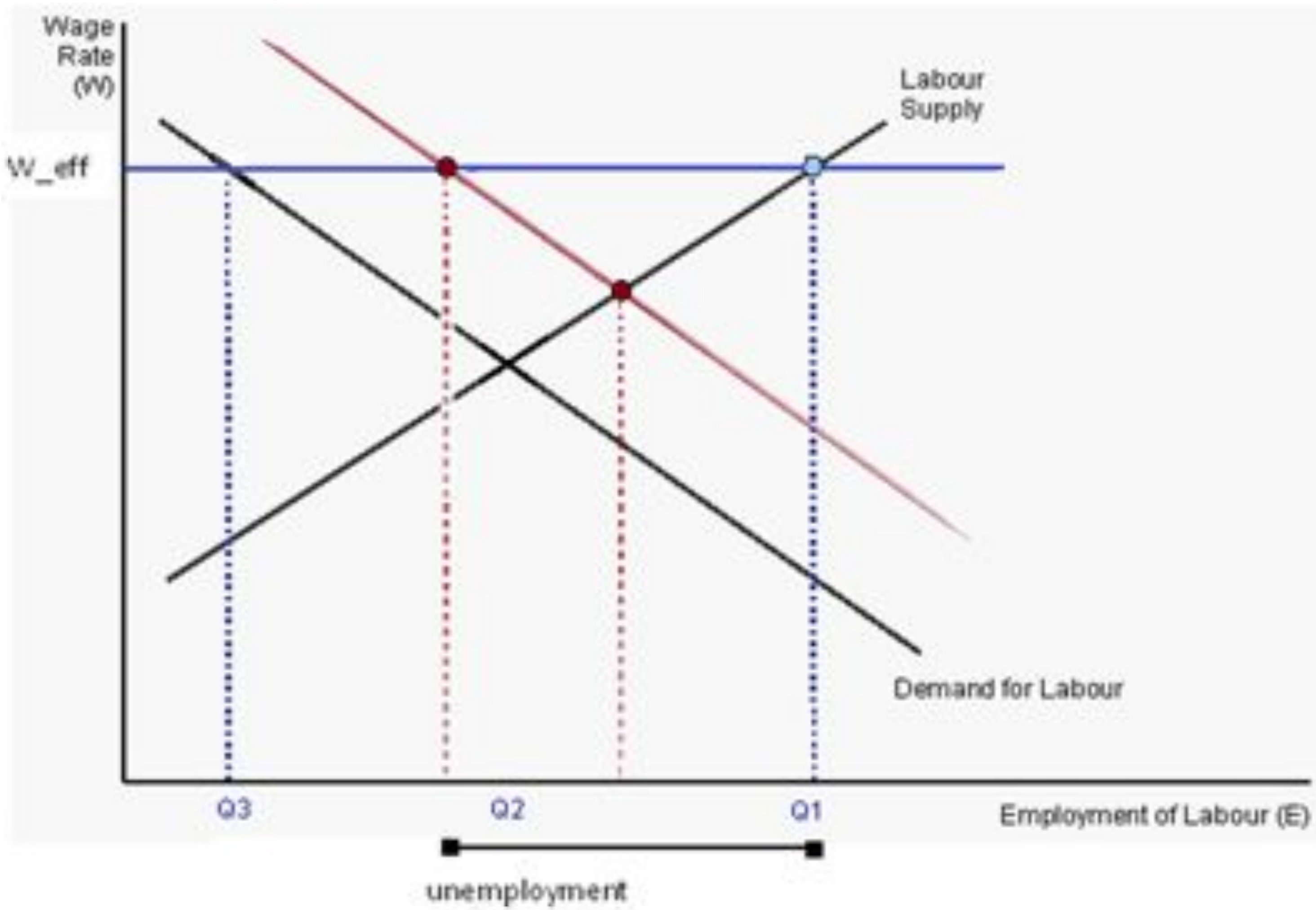
- Two steady states: without the bridge (initial) and with the bridge (final).
- Homogenous labor does not commute.
- The only gains come from demand boom.
- Gains from trade similar to: Zhu, Van Ommeren, Rietveld (2009).
- Elasticity of transport costs w.r.t. public capital (decisive factor)
- Retain the A-B0 as the benchmark model.



The Zhu-Van Ommeren-Rietveld story. Efficiency wage unemployment



The Zhu-Van Ommeren-Rietveld story. Efficiency wage unemployment



Methodology- simulation experiments

- Repeat the experiment of the simulated transition for some degree of heterogeneity in the labor force (C,D).
- Simplifying assumption: No incentive to commute or migrate initially, as in the homogenous labor experiments.

	Initial steady state (without infrastructure)	Final steady state (with infrastructure)	Difference: Total gains in GDP attributed to better trade and labor matching
Experiment 1: Homogenous labor (no incentive to commute or migrate)	A	B	B-A = Total gains in GDP under homogenous labor force.
Experiment 2: Heterogeneous labor (no incentive to migrate, might have an incentive to commute after the shock)	C		
	C-A = 0		

Methodology- simulation experiments

- The adjustment process and the new steady state (D) are stochastic, because the populations born at each time period are endowed with different skill levels.

	Initial steady state (without infrastructure)	Final steady state (with infrastructure)	Difference: Total gains in GDP attributed to better trade and labor matching
Experiment 1: Homogenous labor (no incentive to commute or migrate)	A	B	B-A = Total gains in GDP under homogenous labor force.
Experiment 2: Heterogeneous labor (no incentive to migrate, might have an incentive to commute after the shock)	C	D	D-C = Stochastic total gains in GDP under some degree of heterogeneity in the labor force.
	C-A = 0	D-B = Difference in final steady state GDP across	Differences in differences [D-C]-[B-A]=D-B

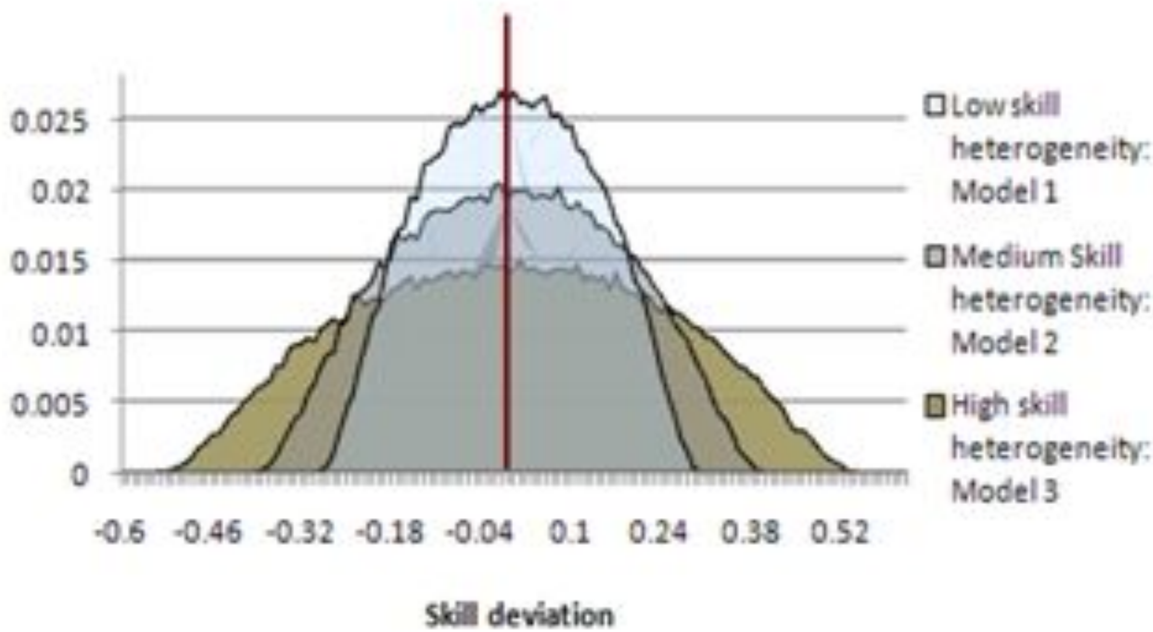
Experiments with heterogenous labor: Distribution of the matching term

- Heterogenous labor. Effective labor supply depends on the region of labor supply (*j*) and the origin of individual (*n*).

- Universal innate ability: X_n

- Johnson SB transformation: $d_{nj} = \xi_{nj} + \theta_{nj}\{\frac{\exp(X_n)}{1+\exp(X_n)}\}$

- Assume that for the domestic labor market: $d_{nj} = 0$
- How many will supply labor to the opposite side?



ROYAL INSTITUTE OF TECHNOLOGY

Decisive factors for interregional commuting and migration

Migration

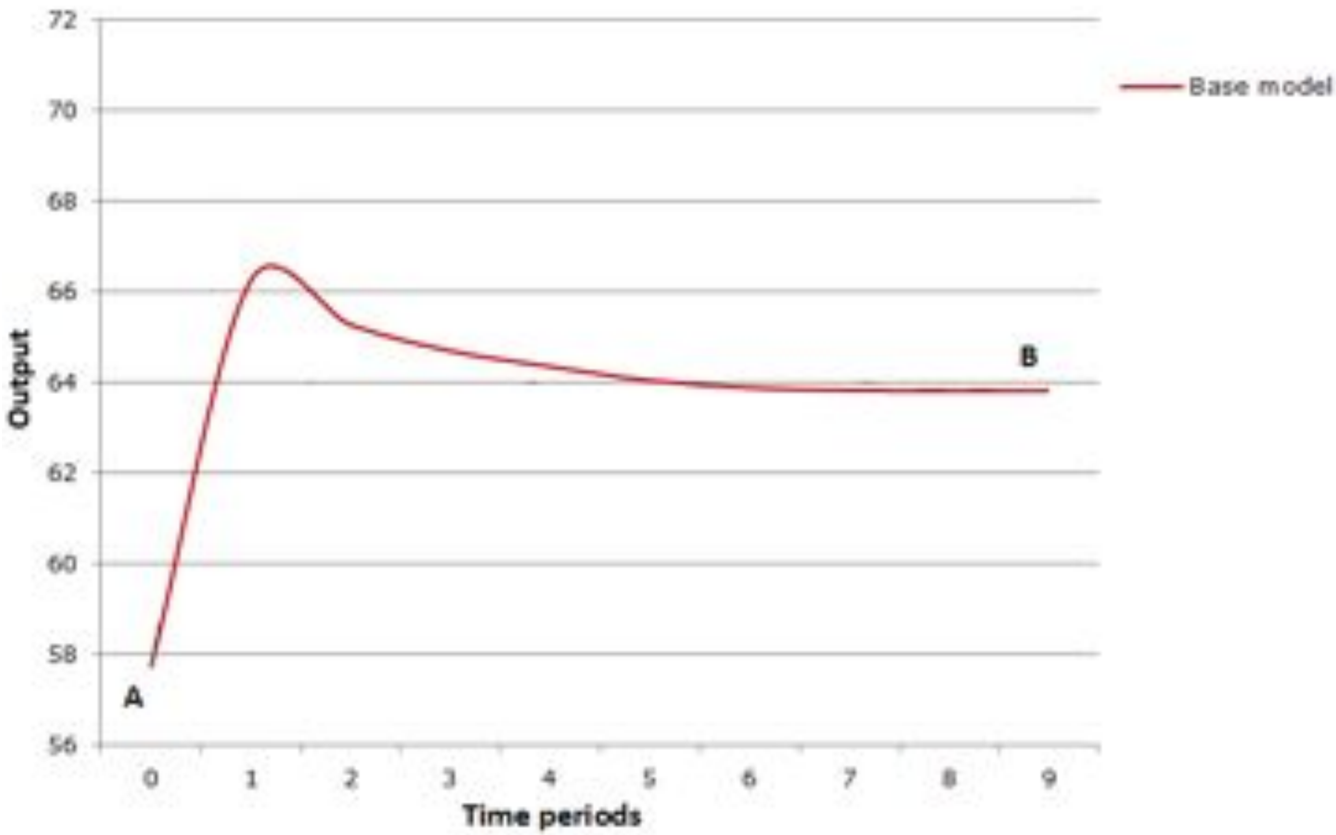
- Preference for living in region of origin
- Household relocation costs

Commuting

- Commuting time
- Commuting costs

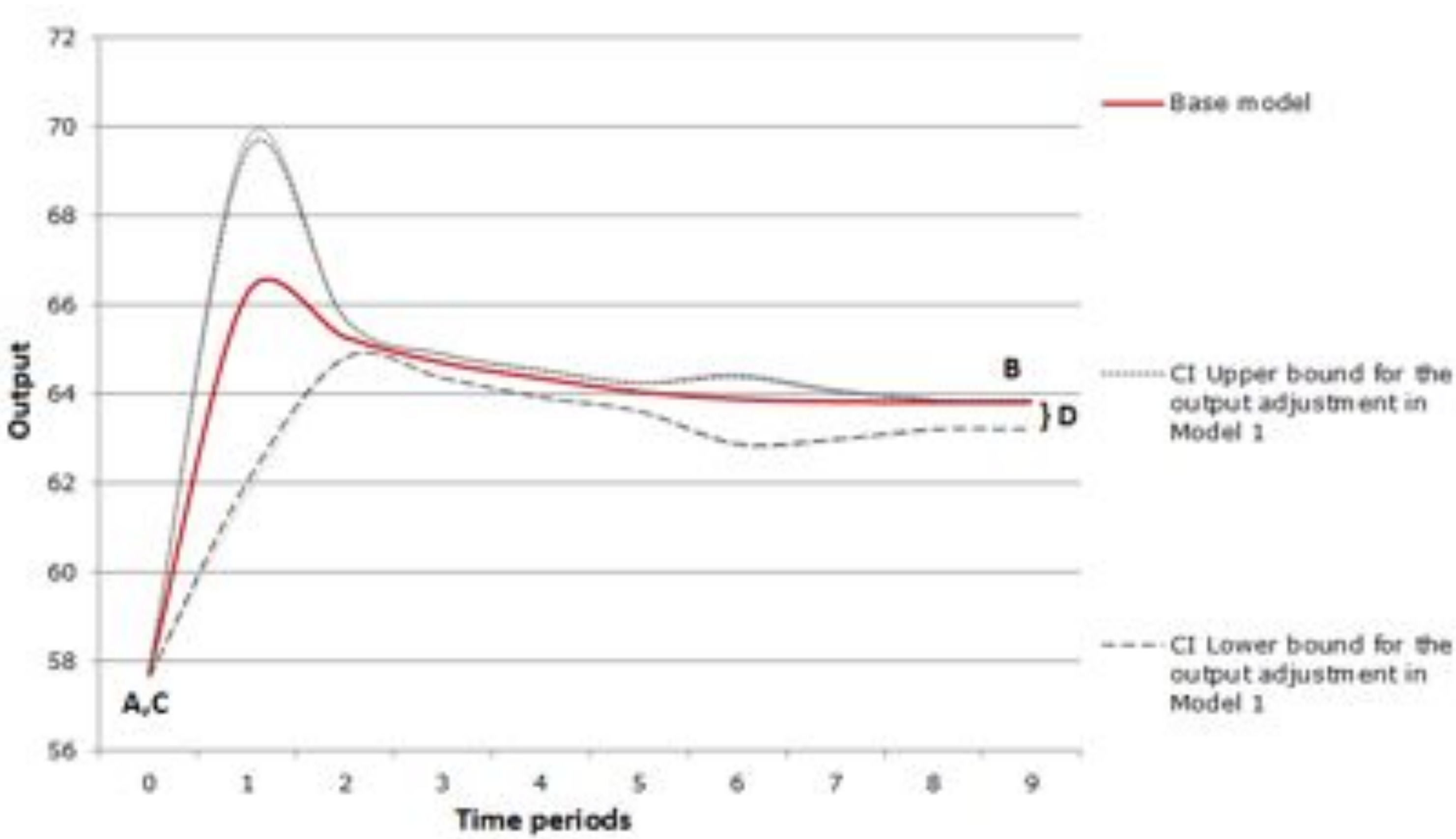
Gains from trade + Gains from matching in the labor market (low degree of skill heterogeneity)

- Deterministic adjustment of the benchmark model



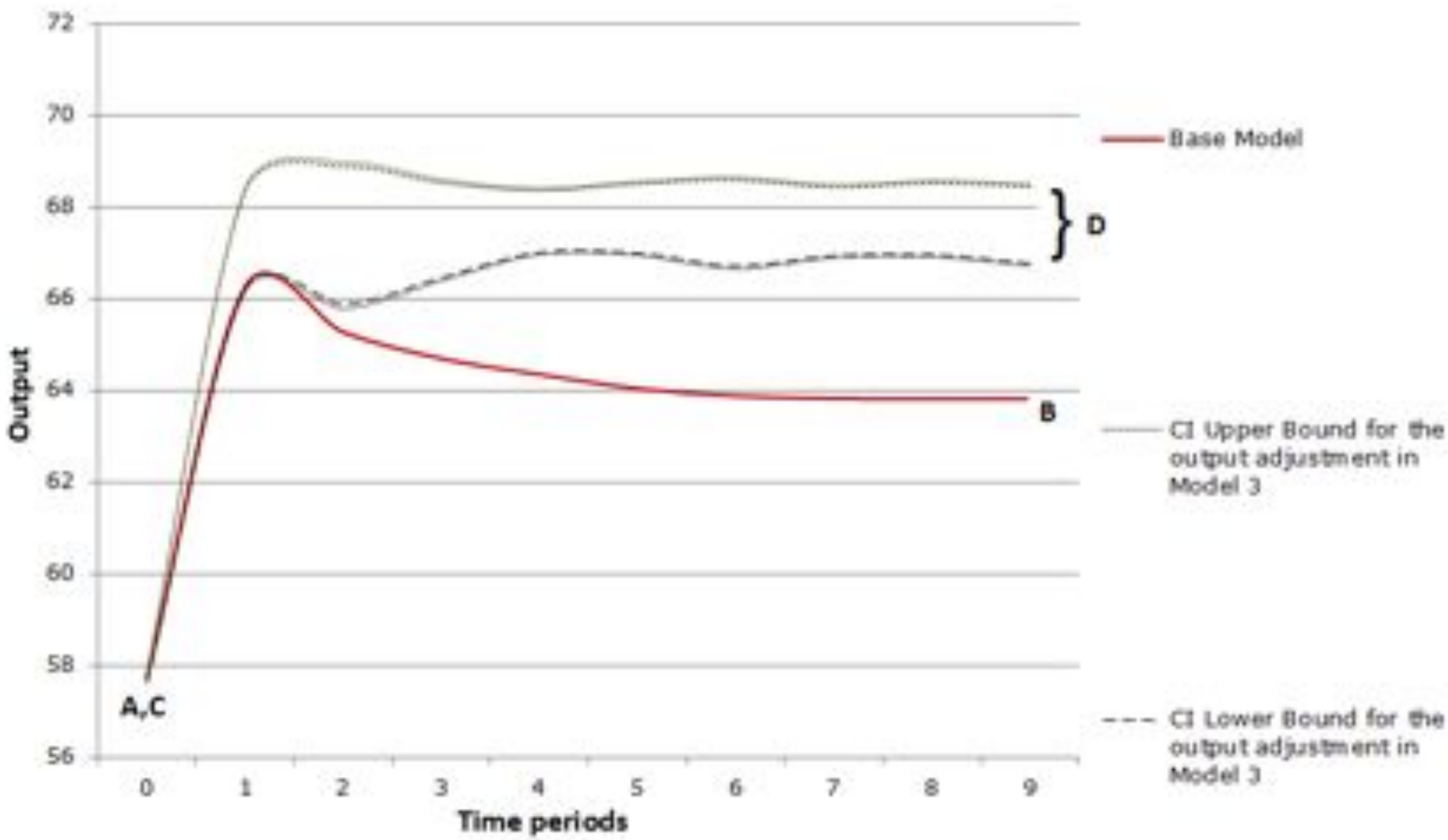
Gains from trade + Gains from matching in the labor market (low degree of skill heterogeneity)

- Deterministic adjustment of the benchmark model
- Stochastic adjustment of the low heterogeneity model



Gains from trade + Gains from matching in the labor market (high degree of skill heterogeneity)

- Deterministic adjustment of the benchmark model
- Stochastic adjustment of the high heterogeneity model



Synopsis-highlights

- **Growth with overlapping generations**
- **Captures full effects of diminished transport and commuting costs.**
- **Decomposes these effects into i)trade effects and ii)labor matching effects.**
- **Policy implications: Matching effects can be realized with alternative policies (transport irrelevant).**
- **Future platform to compare policies and simulate scenarios**

Warnings, future improvements and possibilities

- **Rational expectations**
- **More regions. Expand on a network economy.**
- **More generations/age cohorts.**
- **Small open economy characteristics: Exogenous interest rate.**
- **Calibration: The adjustment paths shown earlier are produced under plausible values of the parameters, i.e. by guess or adopted from separate studies. For policy making, we need data to calibrate them.**

End

Contact: ioannis.tikoudis@abe.kth.se