



How to design policies for physical and human
capital improvements:
A spatial agent-based analysis.

Herbert Dawid, Simon Gemkow, Philipp Harting,
Bielefeld University

Michael Neugart
Free University of Bozen-Bolzano

Overview

- Introduction
- The model
- A policy experiment
- Conclusions

Motivation

Generation and diffusion of innovations is one of the main factors influencing (local) economic growth (e.g. Maddison (1991), Freeman (1994)).

In many cases the diffusion of innovations requires adequate skills of the workforce at the firms adopting the innovation (e.g. Basanini and Scarpetta (2002), Griffith et al. (2004)).

Skill distributions vary significantly across European countries and across regions within countries (OECD, Eurostat).

Motivation

Changes in the local skill distribution may be caused by different mechanisms:

- ▶ Public policy measures
- ▶ On the job training in local firms
- ▶ Flow of workers between regions

Interplay of these different mechanisms has been hardly studied and is not well understood.

Research Questions

How is local growth, employment and labor income affected by changes in the (local) distribution of general skills?

How is the effect of skill improving policy measures affected by the spatial distribution of measures across regions?

How is the optimal spatial distribution of skill improving policy measures affected by characteristics of the labor and goods market?

The Model: Market overview

Consumption goods market

- ▶ Households, firms (consumption goods producer, CGP).

Labor market

- ▶ Households, CGP.

Investment goods market*

- ▶ Investment goods producer, CGP.

Credit market*

- ▶ Bank, CGP.

Public sector*

- ▶ Government, Households, CGP, IGP, bank.

*(Dummy markets)

Key feature: Regional structure

Key markets are semi regional:

- ▶ Consumption goods market:

- Firms can sell their goods in different regions at local outlet malls.
 - Households can only visit the closest mall.

- ▶ Labor market:

- Households can work for firms in different regions.
 - They have to bear commuting costs.

Key feature: Differentiated skill structure

General skills:

- ▶ Proxy for individual education.
- ▶ Heterogeneous within and across regions.

Specific skills:

- ▶ Capabilities and experiences attained on the job.
- ▶ Associated with technology used by the employer.

Workers increase specific skills over time

Speed depends on general skill level b_w^{gen} and quality of technology used by employer $A_{i,t}$.

$$b_{w,t+1} = b_{w,t} + \lambda (b_w^{gen})(A_{it} - b_{w,t})$$

Production of consumption goods

The consumption good (homogeneous) is produced by using labor and capital as inputs.

- ▶ Input factors are vertically differentiated.

Impact of skills on the production process:

- ▶ Complementarity between quality of investment goods and level of specific skills of workers.

$$Q_{it} = \min[A_{it}, B_{it}] L_{it}^{\alpha} K_{it}^{\beta}, \quad 0 < \alpha, \beta, \alpha + \beta = 1$$

- ▶ A_{it} : average quality of the investment goods employed by firm i . It is updated as old capital is replaced by new investments
- ▶ B_{it} : average level of specific skills of employees of firm i .

The labor market

Firms post job vacancies based on planned output with specific skill depending wage offers.

Searching workers send applications based on posted salaries.

Firms rank applications **based on skills** and make offers.

Workers rank offers (wage - **commuting costs**), compare best offer to their reservation wage and accept/reject.

Consumption Goods Market

Consumption goods producers offer (and store) goods at local market outlets (*,malls'*).

CGPs post a unique price for their good in all served malls.

Households spend most of their (labour and capital) income for consumption.

Purchasing decision is based on the posted prices (Logit model).

Set up of the model

Regions	2
Households	400
Consumption goods producer	10
Capital goods producer	1
Malls	2

The general skills of workers within a region are distributed according to 3 skill distributions:

Skill group	1 (lowest)	2	3	4	5 (highest)
Skill distribution					
Low skill distribution	80 %	5%	5%	5%	5%
Medium Skill distribution	5%	5%	80%	5%	5%
High skill distribution	5%	5%	5%	5%	80%

Skill Improvement: A simple policy experiment

Starting point: Both regions with low skill distribution (**low-low** scenario).

Government intends to improve workers' general skills.

2 Options:

1. Uniform support of both regions → medium improvement in both regions (**medium-medium** scenario).
2. Concentration of resources in one region → strong improvement in supported region, the other remains unchanged (**low-high** scenario)

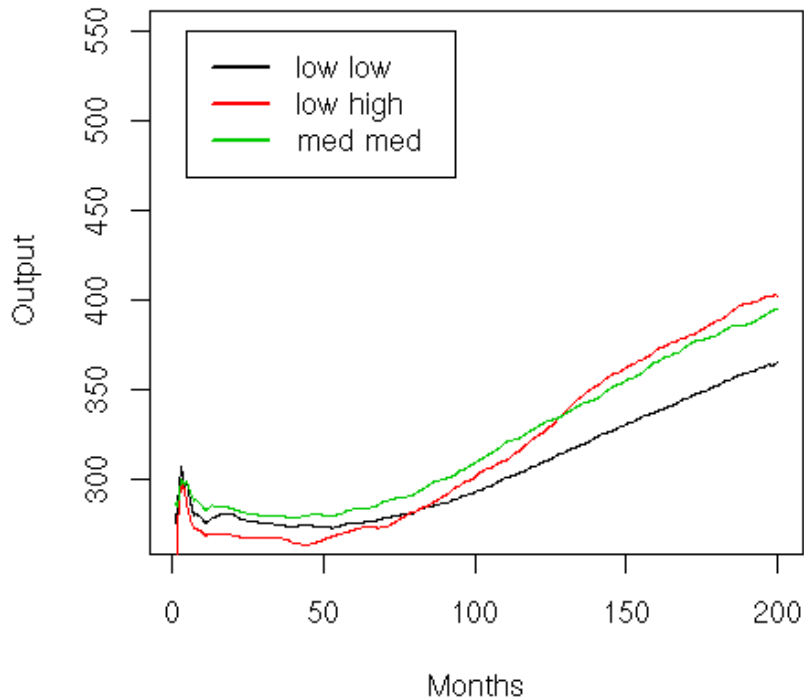
How do the policy effects differ between the med/med and the low/high scenario?

How are the effects of the different policies affected by the size of the workers commuting costs?

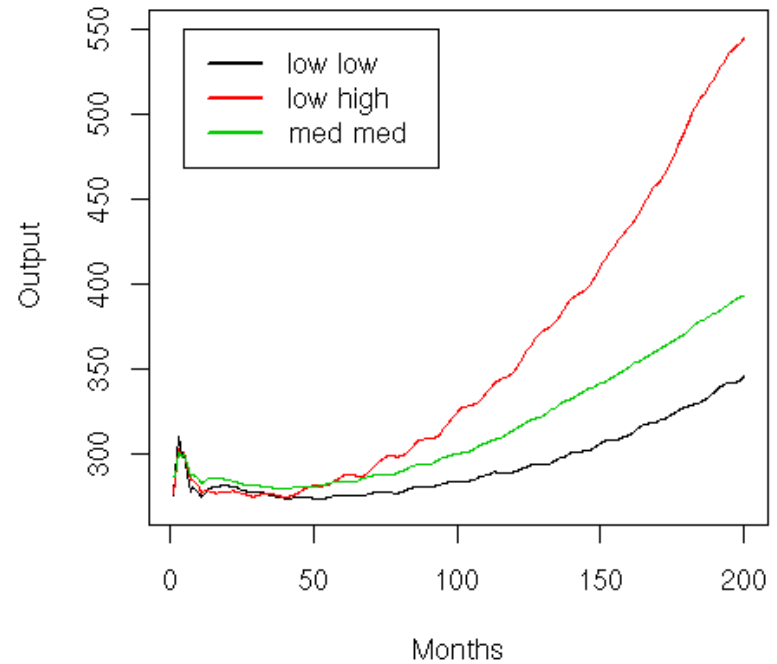
Case 1:	comm = 0	No commuting costs
Case 2:	comm = 0.05	Non-prohibitive level

Comparison of production levels

(Average over 50 batch runs)



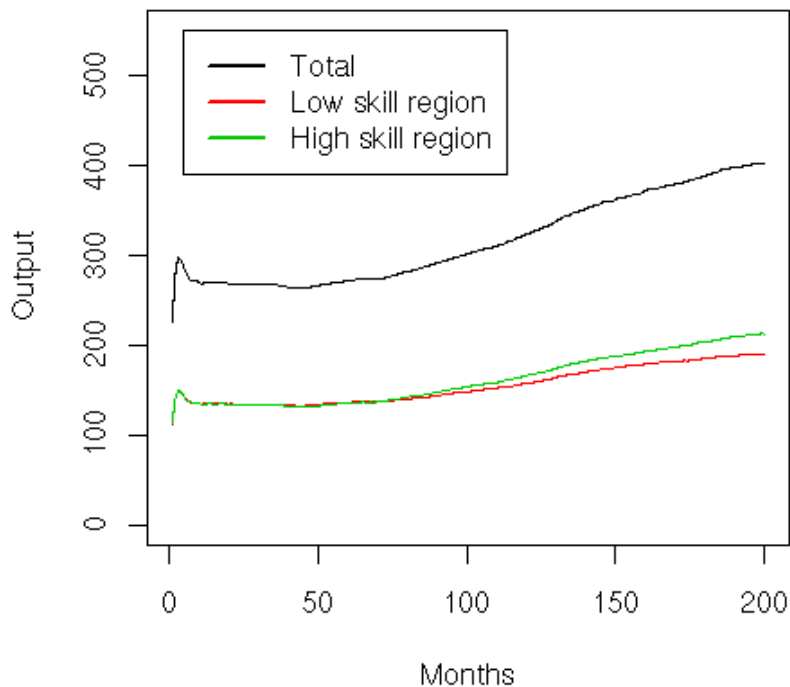
comm = 0 (case 1)
No spatial frictions



comm = 0.05 (case 2)
With spatial frictions

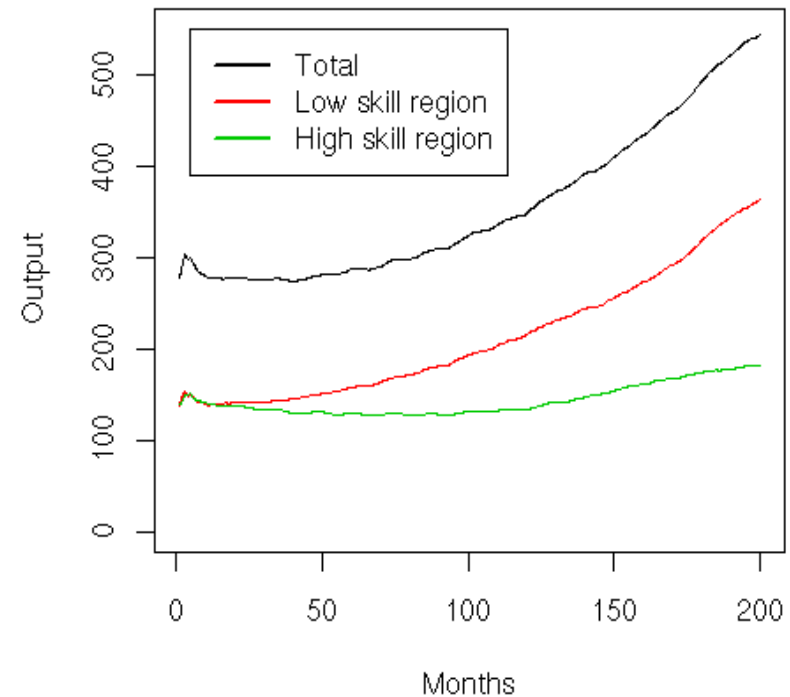
Output in low/high scenario

(Average over 50 batch runs)



comm = 0 (case 1)

No spatial frictions

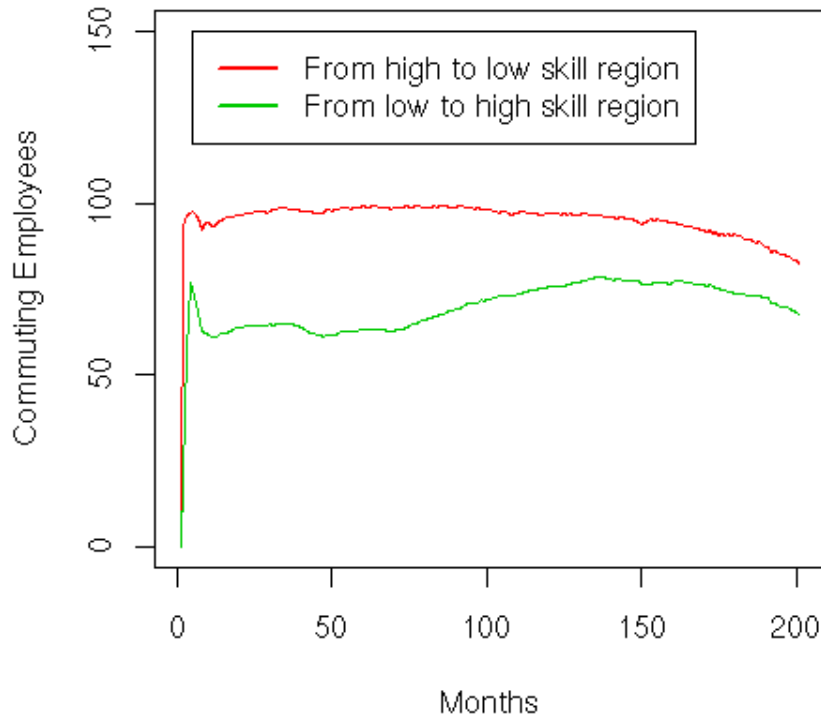


comm = 0.05 (case 2)

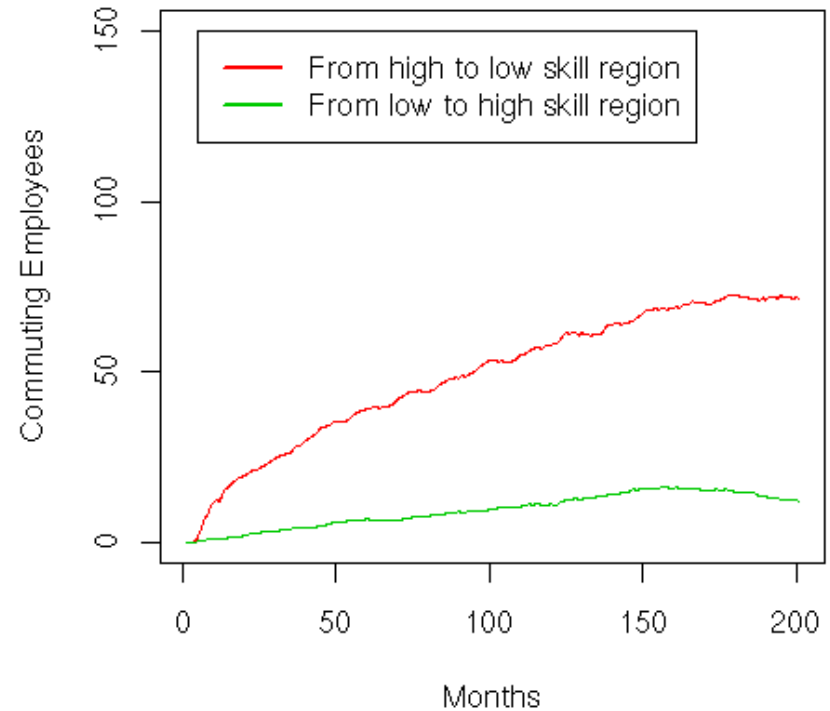
With spatial frictions

Commuters in low/high scenario

(Average over 50 batch runs)



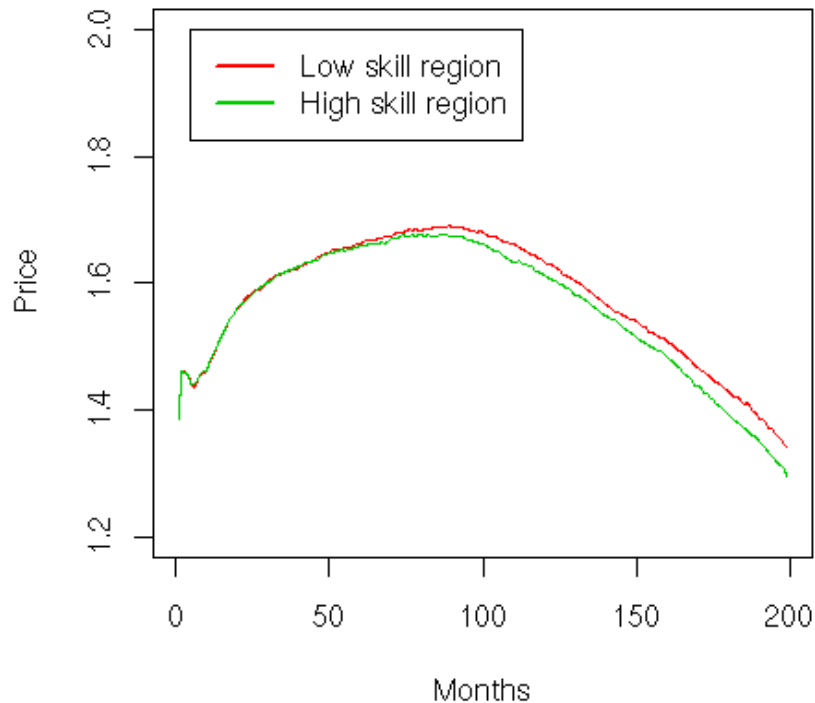
comm = 0 (case 1)
No spatial frictions



comm = 0.05 (case 2)
With spatial frictions

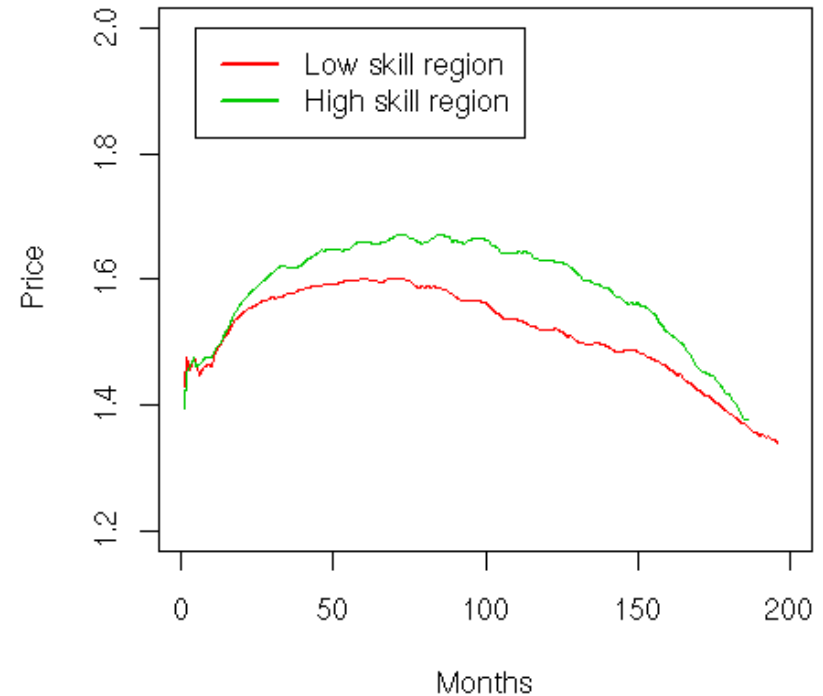
Prices in low/high scenario

(Average over 50 batch runs)



comm = 0 (case 1)

No spatial frictions

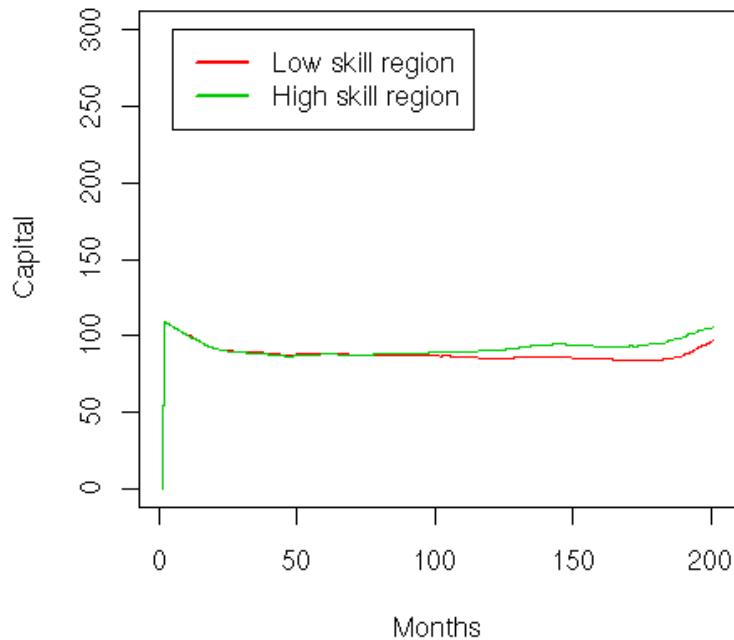


comm = 0.05 (case 2)

With spatial frictions

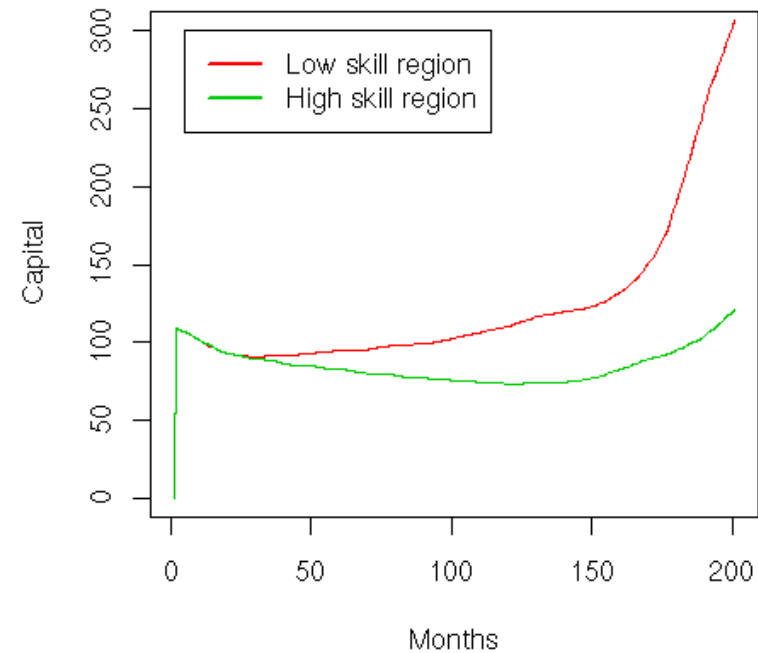
Capital stock in low/high scenario

(Average over 50 batch runs)



comm = 0 (case 1)

No spatial frictions

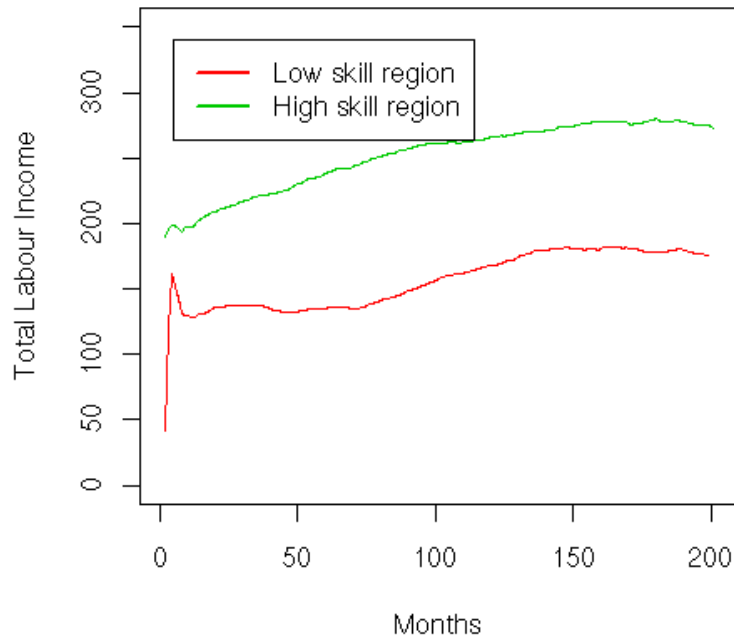


comm = 0.05 (case 2)

With spatial frictions

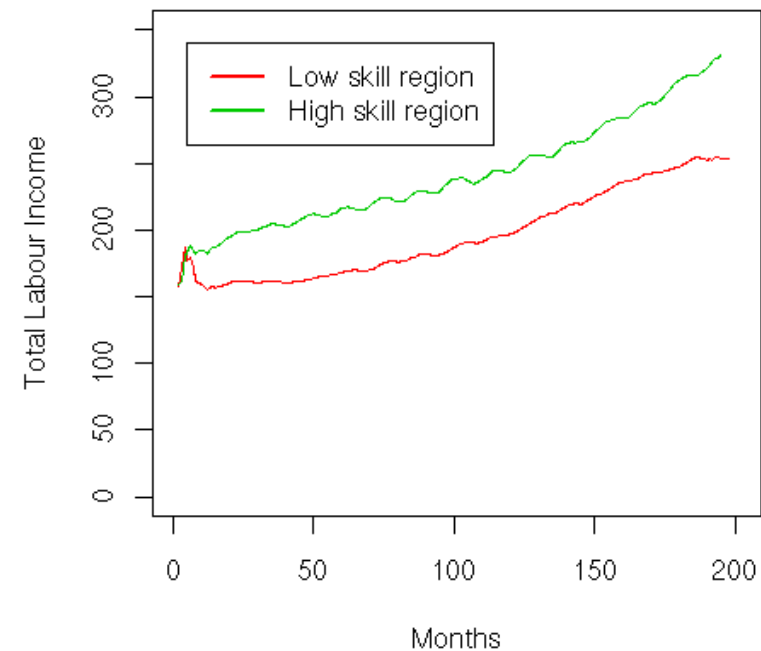
Labor income in low/high scenario

(Average over 50 batch runs)



comm = 0 (case 1)

No spatial frictions



comm = 0.05 (case 2)

With spatial frictions

Summary

The model provides first steps to capture interplay of technological change and spatial skill dynamics.

Growth and employment in a region is influenced by the own skill distribution and that of neighboring regions.

Effects of regional skills differences are strongly influenced by the interaction of the mobility of consumption goods and the mobility of labor (commuting costs).

Reduction of spatial frictions does not necessarily increase total output!

Spatial distribution of policy measures is important!