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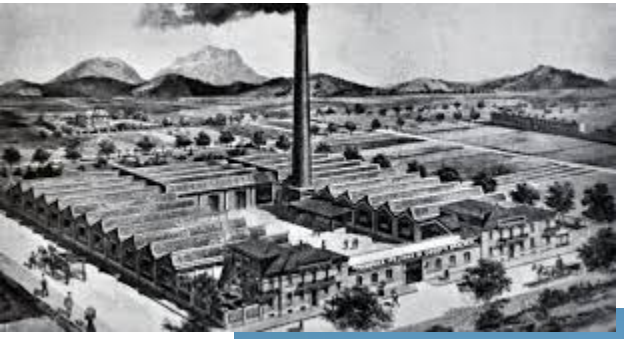
Economic Framework Analysis of Regional Commuting: a model



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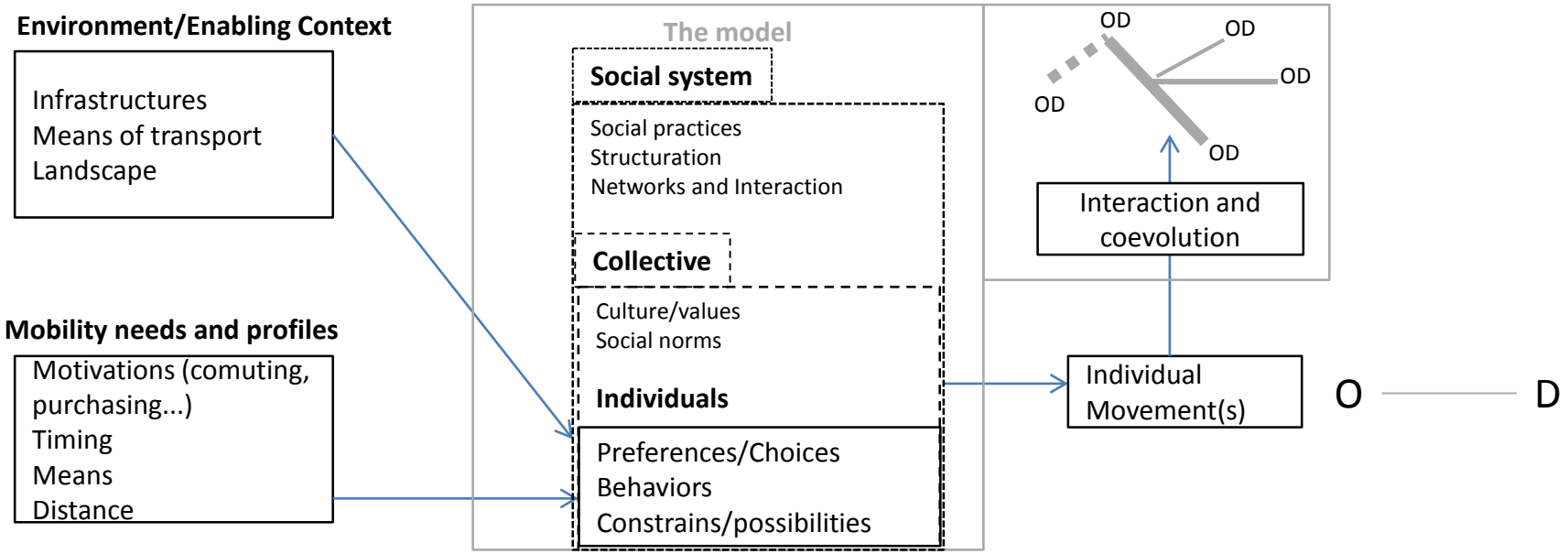
E. State-of-the-art and next steps

Premises ...and genealogy of the research questions

Premises

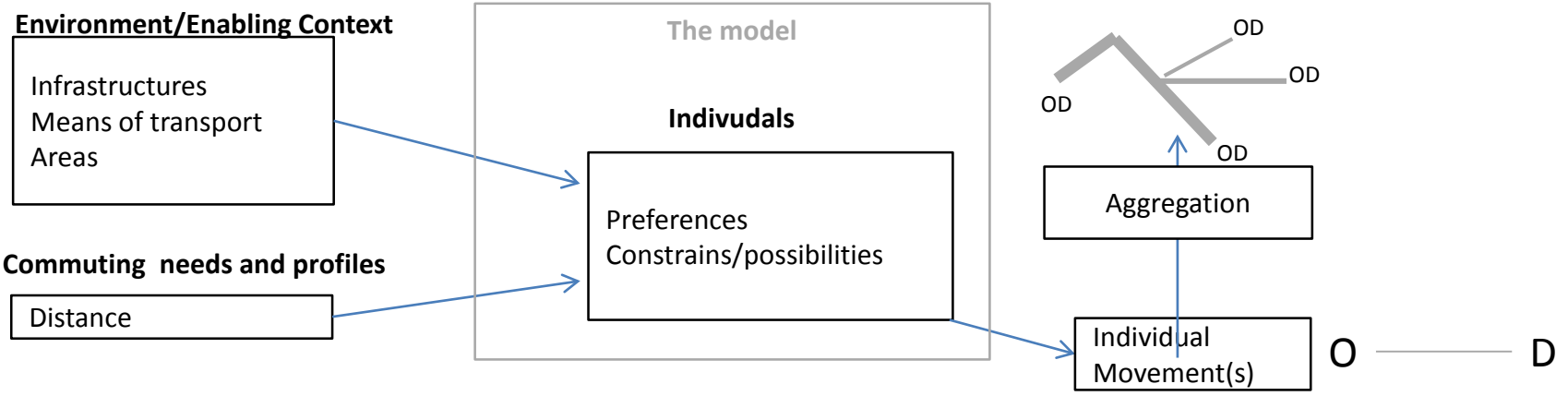
- Commuting, as a breed of the wider mobility phenomenon, results from the interplaying of individual (preferences, needs and constrains) and objective (infrastructure, means and distance) elements .
- People decide how to move by adapting their preferences and possibilities to the present conditions in order to satisfy their own needs.
- Studies on mobility mainly focus on preferences and choices, we decide to go a step behind...

1°) How social factors and people's preferences, opportunities and choices in a heterogeneous world may influence the shaping of mobility patterns at regional level ?

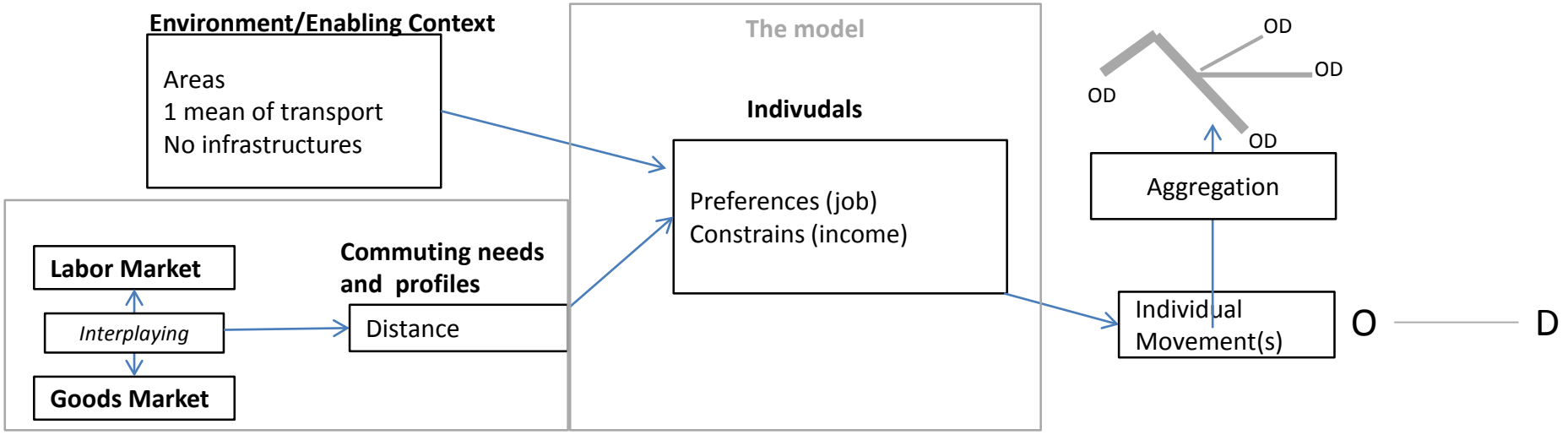


Premises ...and genealogy of the research questions

2°) How people's preferences, opportunities and choices may influence the community patterns in a limited geographical area (reducing complexity)?



3°) How individuals (people and neterpises) interaction in the labor and good markets may determined the commuting patterns in a limited geographical area (endogenizing commuting)?



Objectives and research questions

Objectives

- overcoming the limitations of considering mobility flows as an exogenous variable of the mobility system
- explaining generative mechanisms of commuting as a result of interactions among elementary agents in the labor, goods and credit market

Questions

Given a spatial area, that entirely contains both economic dynamics and mobility patterns

- how do mobility patterns evolve due to the evolution of the general economic dynamics through the ‘filter’ of individual preferences?
- how are economic dynamics influenced by individual mobility behaviors?

Main assumptions (1)

1. **Environment** : a bounded area where zones are settled. Zones do not have geomorphological properties but are identified only on the basis of their location. They host interacting enterprises and workforces and that represent the Origin/Destination of the commuting

2. **Individual Agents**

Enterprises (Ent):

- price-takers,
- homogeneous production technology; labor only input
- heterogeneous endowment (assets, employees) and strategic planning

Laborforces (emplyed/unemployed) ($Lf_{e/u}$)

Homogeneous: skills (deteriorate along unemployment)

Heterogeneous: scheme of preferences (fragility, wage and distance) in selecting employer, income (wages and subsidy)

Main assumptions (2)

3. Markets

Credit : regulated by a reserve mechanism; companies and labor forces can deposit /withdraw without limit; due to interest, borrowers are at risk of bankruptcy or insolvency

Labor: demand driven; under the assumption of limited rationality, in selecting enterprise LF have access only to some public information related to the situation at the zone-level

LF perspective -> for Lf_u Ents are identical , for Lf_e Ents are slected based on preference schemes

Ents perspective -> for Ents Lf_e are identical but distinguishable and preferred to Lf_u

Goods: 1 good, production is entirely purchased by laborforces (no stokcs, no export)

4. Mobility system

systematic journey-to-work mobility flows are considered

a unique mean of transport with a unique cost per unit of distance covered; t

he infrastructures have not been considered.

5. Multi-level system

Micro level -> active elementary agents (Ents and LFs)

Meso level -> zones, inactive agents that influence agency of hosted micro agents, connect each other (are OD nodes of commuting flows)

Macrolevel -> system

Complexity in continous interaction among different agents at different levels

Overview - Purpose

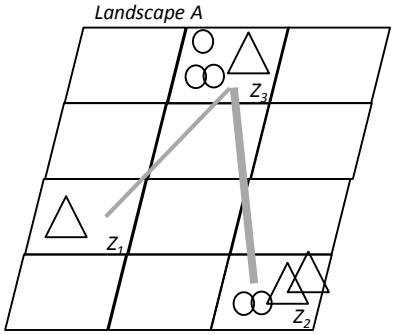
- Explore the mechanisms of generation of commuting flows in a delimieted area as they derived from the balancing of the local economic system that emerge from the interactions among elementary agents (laborforces and enterprises) within the labor, goods and credit markets.
- Commuting is at the same time determined by and determinants of wider socio-economic dynamics as the cost for commuting play a crucial role in determining the scheme of preferences and the final choices of laborforces
- In practice, through the simulation of economic dynamincs along T periods, the objective of the model is to produce a OD matrix at the ned of each period and to study how it is related with processes involved :

- how do commuting patterns evolve due to the evolution of the general economic dynamics?
- what are the relationships among different combination of planning and production strategy diffused in the local systems and the commuting flows?
- what are the relationships among different scheme of preferences and priorities diffused among citizens and the commuting flows?
- how are economic dynamics influenced by individual commuting behaviors?

Overview - Variables and scales (1)

Scales

Space: the simulated enevironment is an indefferentiated landscape *A* where a *Z* number of zones (not overlapping portions of the space) host laborforces and enterprises and represent the Origin-Destination of the commuting flows (including self-containment)



Time:

The t_i period *T* doesn't have an actual meaning but is connected to the completion of the periodical functions and procedures typical of a micro-economic cycle (production, sell, budgeting, planning).

Variables

The total amount of variables managed by Nlogo code is 118 : 18 macro; 20 meso referred to zones; 62 micro referred to enterprises (33) and laborforces (29). 12 globals and 6 parameters are located in the interface for setting up the experiments (...)

Overview - Variables and scales (2)

Macro scale

Variable name	Description
Areas	List of areas that host laborforces/eneterprises
totEnterprises /_dead/_Born	Total amount of enterprises / dead/ new
totLaborForces /totUnemplyed/totEmployed	Total amount of labor forces
theta_1_0_list / theta_2_0_list	parameters for programming/production functions [-1, 0, 1]
laborforcePreferenceSchemes	List of the scheme of preferences of labr forces
totY_t / _t-1	Value of production at time t / t-1
qEstimatedTotal /_t-1	Total amount of production at time t/t-1
P_t / _t+1	Average price of the good at period t /t-1

Meso scale

Variable name	Description
pEnterprises /_dead/_Born	N of enterprises (/dead/new) in the area
pLaborForces /totUnemplyed/totEmployed	N of labor forces (unemployed/employed) settled in the area
pWorkers	N of employees in the area (settled or not)
p_Y/_T-1	Value of production at time t / t-1 in the area
Trends	Track of the last *n* periods in the area
S1	Financial Salubrity (health) of the area (pEntDead/pEnterprises)
S2	Fragility odd-ratio (pEntDead and notSelfFinancing/ pEntDead & SelfFinancing) /(pEnterprises & notSelfFinancing /pEnterprises & SelfFinancing)
R	Average of wages in the area
D	Distances among the area and all the other areas of the landscape
zonesByPreference	List of 6 elements corresponding to the 6 schemes of preferences of laborforces. Each element is a list composed of : 1 scheme of preference and 2 areas selected on the basis of that scheme
inFlows / outFlows	Laborforces that move in/move out the area

Overview - Variables and scales (3)

Micro scale - enterprises

Variable name	Description
Equity/settlment	Equity/ area
theta_1_0/theta_2_0	Parameter for programming/production function
theta_2_0	parametro di forma della funzione di produzione
operating /selffinancing /hiring	Operating / self financing
qEstimated/q_t-1	Estimated production/production at t-1
qToBeSelled / qSelled	Total (decreasing)amount of quantity to be sold/total (increasing) amount of sold production
salary/salaryDelta	Wage offered by the enterprise/ coefficient to avoid bankrupt
productionCost	Total amount of salary payed
price	Price decided on the basis of the average expected price and an idiosyncratic shock *u*
y/_t-1	Value of production q_estaimted*price
profit	Profit
financialPosition/finacilaFlowEnt	Equity – productionCost / debit
workers/_Needed /demand	Current employees / employees needed on the basis of programming function/ open positions
workersMovingAway/applicants	Emplyees candidates to other enterprise/ candidates to the enterprise

Micro scale - laborforces

Variable name	Description
residence/weath/employed?	Residence area (Origin)/ patrimony / employment
workplace	Enterprise work for
destination	workplaceArea (Destination)
mypreferencescheme	Scheme of preferences chosen among 6 available at global level
mytargetareas	2 areas selected on the basis of preferences scheme
target1/2	Enteprise to which apply
income/subsidy	salario o sussidio percepito nel periodo corrente
qPurchased/ myqToBePurchased	(increasing) amount of purchased good/(decreasing) amount
cF/cCom	Expenditure for purchasing goods / commuting services
financialFlowLf	debit
myDistance	distanza percorsa per recarsi al lavoro

Overview – Process overview and scheduling

0. INITIALIZATION
Selection of *Z zones* and settlement of
- Enterprises
- Laborforces

2. Credit market and budgeting
- Enterprises compute profit and current equity (including cash flows) , if equity < 0, bankrupto and workers unemployed
- Laborforces compute total expenditure (for goods and commuting services) and if patrimony < 0 and unemplyed kicked off of labr forces

t_ start

1. Goods market
- Enterprises produce *qEstimated* = *qToBeSelled*, compute *price* and sell
- Laborforces compute *myqToBePurchased* and start a recursive process of looking for different enterprises for purchasing. If patrimony <0 activate cash flow at central bank
- Laborforces and enterprises satisfy their needs

t = cycle (monthly, yearly?)

3. Labor market
- Enterprises programme production *qEstimated* on the basis of their own strategies and equity. They compute workers needed and, in case, open positions or fire
- A share of employed Laborforces look for new workplaces and change/don't change. Unemplyed wait for being hired
- The Origin and Destination of commuting flows are updated

t_ end

2. Credit market and budgeting
- Enterprises pay salaries and compute cost of production.If financial possition if </> o withdraw/deposit at central bank
- Emplyed(Unemployed laborforces receive salary/subsidy

5. Global system updating and commuting flows
- Updates of all the meso and macro scle varibles
- Computation of commuting flows among *Z* zones

Design concepts (1)

1. BASIC PRINCIPLES

Heterogeneity : different interactions among different agents at different levels

- Enterprises are different for settlement, size, equity, programming and prduction strategies, prices and salaries
- Laborforces are different for settlement, employment, wealth, preferences' schemes in looking for job
- Zones are different for total amount of enterprises, workers and emplyed(unemplyed population
- Interactions among laborforces and enterprises are direct (labro and goods market) and indirect (mediated by zone as basin of information)

Bounded rationality : agents define expectations and take decision on the basis of uncertainity and limited information

- Labor market

Laborforces select targets for submission on the basis of information at meso(zone) level (for S1,S2, R and D). When got in contact with enetprises they access infos about wages

Enterprises offerr a salry on the basis of past period with no certain information about prices and possible profit of the current period

- Goods Market,

Laborforces access infos about the price at the moment of purchasing

Enterprise define the price on the basis of past period (with idiosincratic correction). They take risk

2 EMERGENCE

Phenomena at meso and macro level result from the simple aggregation of values computed at the micro level.

But values at micro level result form the complex and unpredictable interaction among agents and among level, e.g.:

total value of production (sum of individual production) depends on the idiosincratic correction to the prices applied by enterprises

OD flows (sum of individual flows) depend on the unpredictable matching between enterprises' demand and laborforces preferences scheme

Design concepts (2)

3. Adaptation

Both the system and the agents keep memory of the past events and agents continously reformulate expectations and decisions by adapting to the modifications of the wider environemnt, e.g. :
Laborforces look for alternative workplaces on the basis of statistics computed taking into account previous periods.
Eneterprises foreseen future equity and correct salary to avoid bankrupt on the basis of salaries and price expectations computed on previous periods

4. Objectives

Just to survive, both for enterprises (no maximisation) and laborforces (no enrichment)

5. Learning

Not appliable

6 Prediction

Enterprises decide salary on the basis of budget expectations . They consider the value of aggregaate production (at t-1 prices) , cost production (salaries) e and through a reiterative process adjust salary to avoid bankrupt

7 Sensing(*Cognition*)

Agents get knowledge about the world thorugh accessing public information at meso (SRD, macroeconomic variables) and macro level (macroeconomic variables).
All information at micro level are in general private (preferences, eqity, wealth..) and not accessible (except for price and salary when interacting)that's why micro agents behave with bounded rationality

8 Interaction

Among agents: direct on Labor market (matching labor demand/supply) and goods market (matching good demand / supply); iIndirect in laborforces research for alternatives (mediated by the zones)
Among levels, reciprocal influence in constraining (meso->micro) and define (micro->meso)

Design concepts

9 STOCHASTICITY

Inizialization: enterprises and population per zone, Unemployment rate per zone, Equity and wealth, Programming and production functions
Searching for job : assigment of preferences scheme, selection of enterprises once decides the area
Price of good : idiosincratic shock applied to average price
All selecting processes (hiring, firing, seller) are random choices

10 COLLECTIVES

Not appliable

11 OBSERVATION

Phenomena are observed at macro and meso levels. In details

Type of variable	Level	
	Macro	*meso*
Macroeconomics variables	Production (quantity and value) Price and salary (inflation) Emplyment/unemplyment rate Enterprises turnover rate Work mobility cashflows Safety of economy structure (nakrupted/not selfFinancing eneterprises)	Production (quantity and value) Price and salary (inflation) Emplyment/unemplyment rate Enterprises turnover rate Work mobility cashflows Safety of economy structure (nakrupted/not selfFinancing eneterprises)
Commuting variables	Matrix OD Distances covered Overall cost of commuting services	In/out commuting flows

Details - INIZIALIZATION AND INPUTS DATA* (1)

No inputs data but random assignment of the values to the variables that describe the environment and the agents properties and initial models of behaviors (strategies for enterpirses and preferences for laborforces)

```
to setup
  clear-all
  setup-globals
  ifelse RealWorld
  [setup-RW]
  [setup-random]
  setup-unemployed
  assess-financial-position
update-macro-meso ; first update, in the run
substituted by end-update-variables
 set qEstimatedTotal_t sum [qEstimated] of enterprises
 reset-ticks
end
```

```
to setup-random
  ;zones
ask n-of nAreas patches[
set areas lput self areas ; append to the global areas
set pid position self areas ; name itself
; initailize list to store distances and keep track of past periods
set D []
  set trends [] ;
  sprout-admins 1 [set hidden? false] ;instrumeental to create link
  set inFlows []
  set outFlows []
  set inoutFlows []

foreach areas
  [  ask ?[ foreach areas [set D lput (list ? distance ?) D]

    ; enterpsies and employed
  sprout-enterprises (MinEntArea + random (maxEntArea - MinEntArea))
[   born-enterprises-rand  ]

end
```

*A RealWorld version has been considered (and partially developed) aimed at feeding the model with data that describe a styized landscape of Piemonte region (33 AIT or SLL)

Details - INIZIALIZATION AND INPUTS DATA (2)

```
to born-enterprises-rand
…
  ; shape parameter for programming and producing
set theta_1_0 one-of theta_1_0_list
set theta_2_0 one-of theta_2_0_list ; shape parameter for producing

   ;equity randomly assigned in min-max range (interface) normalized per size (AIDA2011)
    let i 0
    ifelse i < 0.85
   [set equity precision (4 + random-float 3) 2]
   [set equity precision (7 + random-float 2.2) 2 ]

; prgramming and estimating workers need
set qEstimated scalingProg * (equity ^ (elasticityProg ^ theta_1_0)) ;
set nWorkers ceiling((qEstimated / scalingProd) ^ ((1 / elasticityProd )^ theta_2_0));

; salary assigned on the basis of dimensions (AIDA 2011)
      ifelse nWorkers < 50 [set salary equity * 0.031647646]
   [ifelse nWorkers < 100  [ set salary equity * 0.007070202]
     [ifelse nWOrkers < 250  [ set salary equity * 0.003426548 ]
       [ set salary equity * 0.001358794 ]

   hatch-laborforces nWorkers
   [     ; set all laborforces properties ]
set workers laborforces with [workplace = myself]
  set productionCost salary * count workers
….
end
```

Parameters to feed programming and production function…

… and derive Quantity to be produced Workers needed

On the basis of employed LFs, by applying proportion based on current statistics, the total amount of laborforce is computed for each area

Details – submodels (1)

to go

if ticks = simDuration [stop]
tick
sell-purchase
budgeting
init-update-variables
planning-production-workers_demand
hire-fire
assess-financial-position
end-update-variables
compute-flows
export-OD-vector

end

Goods market

Labor market

Details – submodels (2)...model equations for enteprises behavior

Eq. 1 $\tilde{q}_{fj,t} = \tilde{Q}(e_{fj,t}; \boldsymbol{\theta}_1) > 0$ *Programming function (equity based)*

Eq. 2 $\tilde{q}_{fj,t} = Q(a^*_{fj,t}; \boldsymbol{\theta}_2) > 0$ *Production function (labor based)*

Eq. 3 $a^*_{fj,t} = A(e_{fj,t}; \boldsymbol{\theta}_3) \equiv Q^{-1}(\tilde{q}_{fj,t}; \boldsymbol{\theta}_3) > 0$ *Estimating labor demand*

Where $\Theta_{0,1,2}$
Respectively parameters of
- shape
- scale
- elasticity

Fabbisogno atteso $a^*_{fj,t} =$		**Produzione** Tecnologia con Rendimenti decrescenti $\theta_2^{(0)} = -1$	costanti $\theta_2^{(0)} = 0$	crescenti $\theta_2^{(0)} = +1$
Programmazione	$\theta_1^{(0)} = -1$ meno che prop.	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)^{\theta_2^{(2)}}$	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)$	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)^{\frac{1}{\theta_2^{(2)}}}$
con	$\theta_1^{(0)} = 0$ proporzionale	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)^{\theta_2^{(2)}}$	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)$	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)^{\frac{1}{\theta_2^{(2)}}}$
Strategia	$\theta_1^{(0)} = +1$ più che prop.	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)^{\theta_2^{(2)}}$	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)$	$\left(\frac{\tilde{q}_{fj,t}}{\theta_2^{(1)}}\right)^{\frac{1}{\theta_2^{(2)}}}$

Heterogeneity : 9 different typologies of enterprises

Submodels (3) : goods market

```
to planning-production-workers_demand
   ask enterprises[
;programming prooduction and computing workers need
 set qEstimated ceiling(scalingProg * ((equity) ^ (elasticityProg ^ theta_1_0))); Eq 1
 set workersNeeded ceiling(((qEstimated / scalingProd) ^ ((1 / elasticityProd )^
theta_2_0))); Eq. 3
...
set workersDemand workersNeeded - (count workers - count
workersMovingAway)
...
end
```

```
to sell-purchase
ask enterprises[
...
 ;compute production to be sold and price
set qToBeSelled qEstimated
let u1  0
set u1 2 - u0
set u u0 + random-float (u1 - u0)
set price u * P_t+1
]
```

Enterprises perspective

Consumers/laborforces perspective

```
ask laborforces ; loop for consumers satisfaction
 while [qPurchased < realqToBePurchased]
 set myqToBePurchased realqToBePurchased - qPurchased
let ent_sellers enterprises with [qToBeSelled > 0]
ifelse any? ent_sellers
[   let ent_seller one-of ent_sellers ;seleziona un'impresa
  ifelse myqToBePurchased <= [qToBeSelled] of ent_seller
  [  set qPurchased qPurchased + myqToBePurchased ;update own variable
    let ent_price [price] of ent_seller
    set cF cF + (ent_price * myqToBePurchased);
```

```
ask ent_seller ; update seller variables
    [ set qToBeSelled qToBeSelled - [myqToBePurchased] of myself
      set qSelled qSelled + [myqToBePurchased] of myself
      set y y + ([myqToBePurchased] of myself * price)
```

```
...
end
```

Submodels (3) : labor-market – laborforces preferences

```
to planning-production-workers_demand
   ask enterprises[
....
;select  a share of workers that will search for alternative workplaces
set workersMovingAway n-of round(random-float movingWorkersRatio * count workers)
workers
ask workersMovingAway [
  set moving? true
  selectTarget1-2
...
end
```

```
to selectTarget1-2
;ask laborforces
;[
set myPreferenceScheme one-of laborforcePreferenceSchemes

foreach zonesByPreference
[
 if myPreferenceScheme = item 0 ?
 [set myTargetAreas (list item 1 ? item 2 ? )
   set target1 one-of enterprises with[settlement = item 1 ?]
   set target2 one-of enterprises with[settlement = item 2 ?]

end
```

Laboforce level

By matching its own scheme of preference with the avaialble rankings at zone level, a preferred zone is selected and 2 enterprises are randolmly chosen

```
to orderAreasByPreferenceSchemes
foreach areas
  [
 ask ?
  [
  let preference "SRD"
  let tl []
  let zonesOfinterest patch-set areas
  set zonesByPreference []

  set tl sort-on [S1] zonesOfInterest
  set zonesOfInterest patch-set filter [ position ? tl < round(0.90 *
(length tl - 1))] tl

  set tl sort-on [S2] zonesOfInterest
  set zonesOfInterest patch-set filter [ position ? tl < round(0.90 *
(length tl - 1))] tl

  set tl sort-on [R] zonesOfInterest
  set zonesOfInterest patch-set filter [ position ? tl < round(0.90 *
(length tl - 1))] tl

  set tl sort-on [distance myself] zonesOfInterest
  set zonesOfInterest patch-set filter [ position ? tl < round(0.90 *
(length tl - 1))] tl

  set zonesByPreference lput (list preference item 0 tl item 1 tl)
zonesByPreference
```

Zones level

An array with rankings of zones based on different combination of prioirities (S x R x D)is computed and stored

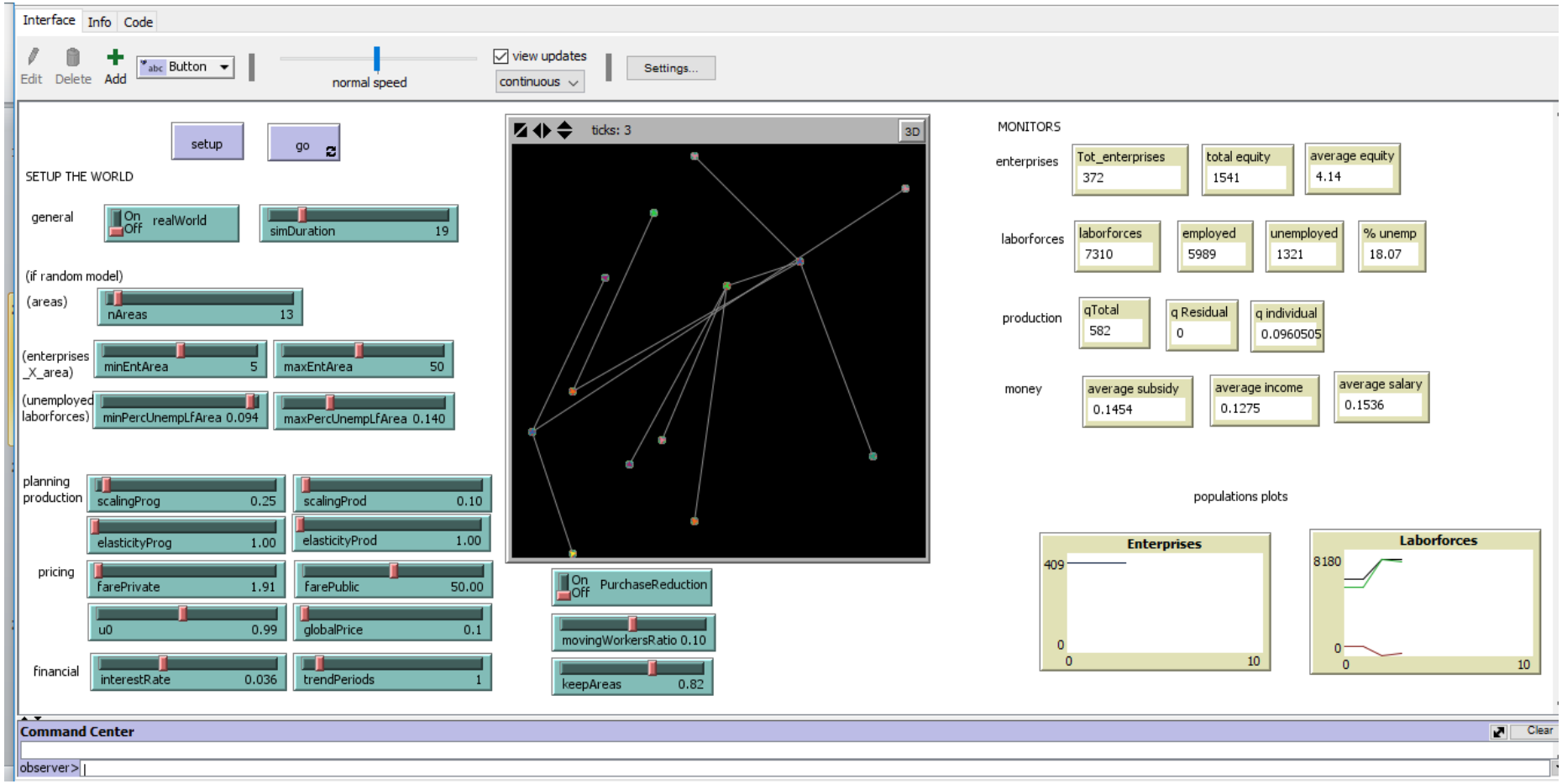
Laborforces settled in the zone access the same rankings

Submodels (3) : labor-market - matching

```
to planning-production-workers_demand
    ask enterprises[
....
;select  a share of workers that will search for alternative workplaces
set workersMovingAway n-of round(random-float movingWorkersRatio *
count workers) workers
ask workersMovingAway [
  set moving? true
  selectTarget1-2
...

end

to hire-fire

ask enterprises[
; check if workers are needed and hire/fire
 set workersApplicants laborforces with [target1 = myself or target2 =
myself]
   ifelse workersDemand > 0 [set hiring 1  hiring_workers
abs(workersDemand)]
[set hiring -1  fireing-workers abs(workersDemand)]
... update list of workers...

salary-adjustment

set productionCost ((salary * count workers with[origin = 1 or origin = 0]) + (
(1 - dEntryLevel) * salary * count workers with[origin = 2 or origin = 3]))  ;eq.
32
...
End
```

```
to salary-adjustment
; expectations about future default
;computing expected production cost and cash flow
set clup (productionCost / q_t-1) ;eq. 13
let salary_e clup * (qEstimated / workersNeeded) ;eq.15
let production_cost_e salary_e * count workers ;eq.16
let financial_position_e equity - production_cost_e ;eq. 17
   ifelse financial_position_e > 0 ; eq.18
   [set selfFinancing_e 1]
   [set selfFinancing_e -1]
   let financial_flow_ent_e (0.5 * (1 + selfFinancing_e) + interestRate) *
financial_position_e  ;eq. 19

;computing price and Y
let price_e P_t ;eq.20
let y_e price_e * qEstimated ;EQ.21

;computing expected , equity and probability of default
let profit_e (y_e - production_cost_e);eq.22
let equity_e ( equity + profit_e + financial_flow_ent_e ); eq.23
   ifelse equity_e > 0 ; eq.24
   [set operating_e 1]
   [set operating_e -1]

;loop for adjusting salary until bankrupt is avoided
set salaryExpected salary_e
ifelse operating_e = 1
[set salary salary_e]
[set salaryDelta 0.01
  while [ equity_e <= 0 ]
  [   set salary_e salary_e * ( 1 - salaryDelta)
   set equity_e ( equity + (y_e - (salary_e * count workers)) + financial_flow_ent_e

  set salary salary_e
end
```

Interface


Interface
Info
Code
Edit
Delete
Add
Button
normal speed
view updates
continuous
Settings...
setup
go
SETUP THE WORLD
general
On Off realWorld
simDuration 19
(if random model)
(areas)
nAreas 13
(enterprises _X_area)
minEntArea 5
maxEntArea 50
(unemployed laborforces)
minPercUnemplfArea 0.094
maxPercUnemplfArea 0.140
planning production
scalingProg 0.25
scalingProd 0.10
elasticityProg 1.00
elasticityProd 1.00
pricing
farePrivate 1.91
farePublic 50.00
u0 0.99
globalPrice 0.1
financial
interestRate 0.036
trendPeriods 1
ticks: 3
3D
On Off PurchaseReduction
movingWorkersRatio 0.10
keepAreas 0.82
MONITORS
enterprises
Tot_enterprises 372
total equity 1541
average equity 4.14
laborforces
laborforces 7310
employed 5989
unemployed 1321
% unemp 18.07
production
qTotal 582
q Residual 0
q individual 0.0960505
money
average subsidy 0.1454
average income 0.1275
average salary 0.1536
populations plots
Enterprises
409
0
0
10
Laborforces
8180
0
0
10
Command Center
Clear
observer>

Work in progress and next steps

What we have done

- Partial formalization (enterprises' behaviors)
- Complete implementation in Nlogo
- Verification

What to do

- Calibrate and validate the current release
- Integrate formalization of laborforces' behavior
- Time scale: is it reasonable to align the enterprises' cycle with the laborforces' cycle or It would be better to have a longer lasting cycle for the laborforces?

Thank you for your attention!

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