Univrsità degli studi di Torino
Corso di laurea in Economics

Tesi di laurea:
Exploring labor market policies.
Insights from a simulation model.

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Introduction

Individual employability is supposed to depend mainly on two aspects; firstly on its endowment in terms of human capital/knowledge, technical and transversal skills; secondly the correspondence of the features of this human capital with the demand on the labor market. As we will explore with the paragraphs dedicated to labor market interventions and public employment services, experts of the problem connected to labor exclusion and practitioners of employment services know that the reality is not so straightforward. Skills, even when they are proved by certificates of attendance (of given training courses) or by previous labor experience do not guarantee labor insertion. Similarly, individuals sharing apparently comparable educational and training paths, may incur in very different outcomes. As it become more clear retracing the literature on the matching model, among the others, one explanation rely on the fact that labor insertion is not an instantaneous event from a status: “unemployment” to another one “employment”, but it is a process which takes its passages and time and that involve many inherent characteristic of the individual (the most important of them is probably his social status).

This is particularly true in the case of young people first entering in the labor market after their educational path or more in general in case of individuals having stayed outside the labor market for different reason (from natural driven reasons as pregnancy, child and elderly care, up to more labor market related reasons as training or the labor policy related status as the Italian “cassa integrazione guadagni” and “mobilità”). Labor insertion can then be represented by a series of experiences incurred by the individual searching for a permanent job. These
experiences include job search activities, job interview, short term labor experiences and various type of failures. All of them interact and accumulate, strongly affecting the individual attitudes towards jobs and at the same time the job giver appreciation. The probability of being hired become in this perspective the outcome of a complex model in which the different agents (jobseekers, job givers, trainers and employment services) interact and continuously change their attitude (so that agent base modeling become a more appropriate tool to describe the evolution of the processes as it is discussed in the section two). Starting from the same initial capital a different combination of events or even only their timing can then change a lot the outcome in terms of placement. In this view, shared by the major subjects involved in the management of labor market policy in Europe, producing knowledge on the field threw models and their results become essential in order to being able to understand and predict outcomes and events as well as intervene efficiently and effectively.

The dissertation is then organize as follow: in section one we present the general theoretical and practical framework of labor market, matching and labor market policies; in section two we present the modeling technique; in section three we present the model; in section four we discuss the result coming from the model; the final section concludes.
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1 From the general theory to the real context.

1.1 Labor market theory

Studying labor market theory means to study the demand, the supply of labor and those mechanism threw which these match one with the other. We will present here the basic literature about this field.

1.1.1 Neoclassical labor market theory

We give here a quick overview of the neoclassical model of labor demand and labor supply, but more details can be found in any Labor economics textbooks.

1.1.1.1 Labor supply

In the basic neoclassical model of labor supply agents are assumed to maximize a utility function over consumption and leisure under certain constraint (in particular the budget constraint). The optimum quantity of labor supplied is reached when the ratio of the marginal utilities equalize the ratio of their relative cost. Agents which do not works are those whose ratio between the marginal utility of leisure and the marginal utility of consumption is still lower (or equal in a really particular case) to their relative prices when they decide to use all the time for leisure.

Since as we now in reality: the leisure/labor decision does not take the continuum of points of time but usually only a finite subset of them; we can have non-labor incomes; we can supply a limited number of hours in a day; we have taxes and benefits...
of course, the model can be improved with a finer definition of the budget constraint and of the utility function. However in general the results are quite similar.

One of the most interesting consequence (even if as we will see the global result will be not a general rules as most think in economics that depends on parameters and other variables) of the model is that an increase in the wage (or the opportunity cost of leisure) will lead at the same time to an increase in the supply of labor threw the substitution effects (a time of leisure is now relatively more costly so it is convenient to use less time for leisure) and a decrease in the same threw the income effect (since the agent is relatively more rich he find convenient to have more time spent on leisure, which is assumed to be a normal good).

As we anticipated the final results is not predictable but it seem reasonable to assume that at a first step the dominating effect is the substitution effect while at a second one when the wages is higher the dominating effect is the income effect. The model then for the individual labor supply predict something close to the following graph.

"L" is the total number of labor supplied "w" is the wage level "w*" is the level at which the individual supply of labor reaches its maximum level.
1.1.2 Labor demand

In the basic neoclassical model of labor demand firms are assumed to maximize an objective function (usually profits to whom we will refer from now on) under certain constraints. The maximization is performed over the inputs in the production function. To get the labor demand the model focuses on the maximization over the labor input. While maximizing profits firms demand for more labor input until the marginal productivity of labor is higher with respect to its cost (the real wage). The optimum is reached when labor productivity is equal to its cost in term of real wage and the optimality condition is guaranteed by the decreasing marginal productivity of labor.

The most straight results of the model is that a positive shock (which in the naïf model we presented can be translated as an increase in the price or an increase in workers' productivity) will be translated directly into a higher demand for labor.

1.1.3 The market

Aggregate labor supply is given by the sum of the amount of labor which each worker is going to offer for each level of wage.

Aggregate labor demand instead is not given by the total amount of labor which each firms is going to ask for each wage level since it is not plausible to keep the price of good fixed (if we increase the wages to increase labor then the quantity produced increases, but then the price should fall). Indeed
aggregate labor demand is more rigid with respect to the line representing the sum of individual demand.

The equilibrium in the market is reached when labor demand equalize labor supply. Of course different final conditions apply with different market structures both on the labor and the good markets (competition, monopolies...).

1.1.2 The matching model

One of the main advance in the field of labor market theory was the introduction of the search mathematical framework to the labor market. We report here the simplified version (developed by Pissarides in 1985) presented in the work: “Market with search frictions” which granted a Nobel price to Diamond, Mortensen, and Pissarides. (2010)

1.1.2.1 Labor market flows

Consider a labor market in a steady state with a fixed number of labor force participants, “L”, who are either employed or unemployed. Time is continuous and agents have infinite time horizons. Jobs are destroyed at the exogenous rate “\(\phi\)”; all employed workers thus lose their jobs and enter unemployment at the same rate. Unemployed workers enter employment at the rate “\(p\)” which is endogenously determined. Frictions in the labor market are summarized by a matching function of the form \(H = h(uL, vL)\), where \(uL\) is the number of unemployed workers and \(vL\) the number of job vacancies. The matching function is taken as increasing in both arguments, concave and exhibiting constant returns to scale (or in other words homogenous of
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degree one \( f(ax)=af(x) \). Unemployed workers find jobs at the rate \( p = h(uL,vL)/uL = h(1,v/u) = p(\theta) \) where \( \theta = v/u \) is a measure of labor market tightness. Firms fill vacancies at the rate \( q = h(uL,vL)/vL = h(u/v,1) = q(\theta) \). Obviously, \( p(\theta) = \theta q(\theta) \) and \( p'(\theta) > 0, q'(\theta) < 0 \). The tighter the labor market, the easier it is for workers to find a job, and the more difficult for firms to fill a vacancy. (Thus, \( q \) falls with \( v \) and \( p \) falls with \( u \) as more agents searching on the same side cause a negative congestion externality, while \( q \) rises with \( u \) and \( p \) rises with \( v \) as more agents searching on the other side cause a positive trading externality). A steady state entails “equilibrium” in the labor market in the sense that the unemployment rate is unchanging over time. This occurs when the inflow from employment into unemployment, \( \varphi(1-u)L \), equals the outflow from unemployment to employment, \( p(\theta)uL \). The steady-state unemployment rate is thus given as:

\[
u = \varphi / (\varphi + p(\theta)) \quad (1)\]

Since \( \theta = v/u \), this equation also implies a negative relationship between unemployment and vacancies (known as the Beveridge curve, after the British economist William Beveridge).
A deterioration of matching efficiency, i.e., a decline in job finding given a certain level of tightness, involves an outward shift of the Beveridge curve in the \((u,v)\) space. An increase in the job destruction rate, possibly induced by faster sectoral reallocation of jobs, is also associated with an outward shift of the Beveridge curve. On the other hand, since other model parameters, such as the productivity of a match between worker and employer (due to technology or aggregate-demand factors), do not appear in this relation, movements in these parameters imply movements along the curve. These differences between model parameters allow us to gain insights into which fundamental factors are the likely determinants of \(u\) and \(v\).

### 1.1.2.2 Workers

The benchmark model features exogenous search effort and workers can only influence unemployment through their impact on wage setting. Workers care about their expected present values of incomes and recognize that these values depend on labor market transition rates as well as wages while employed and unemployment benefits while unemployed. Let \(U\) denote the expected present value of income of an unemployed worker and \(W\) the corresponding present value of an employed worker. With

---

1 Equation (1) is a steady-state relation, and thus it is not immediate that it can be used to analyze time-series data. However, if the adjustments to steady state are rather quick, the equation is a good approximation also over shorter time horizons.
an infinite time horizon and continuous time, these value functions can be written as:

\[ rU = b + p(\theta)(W - U) \] (2)
\[ rW = w + \varphi(U - W) \] (3)

For an easier reading it is possible to consider these functions as if these where return on assets, where \( r \) is the discount rate, \( b \) is unemployment compensation (or the value of leisure or home production during unemployment), and \( w \) is the wage. Since we consider a steady state here, \( U \) and \( W \) are constant. The flow value of unemployment, \( rU \), involves an instantaneous income \( b \) as well as the prospect of moving from unemployment to employment; this happens at the rate \( p(\theta) \) and involves a "capital gain" of \( W - U \). The flow value of employment, \( rW \), includes instantaneous wage income \( w \) and the risk \( \varphi \) of a job loss and the associated "capital loss" of \( U - W \). From (2) and (3) one can solve for \( rU \) and \( rW \) as functions of \( b \), \( w \), \( r \), \( p(\theta) \) and \( \varphi \).

1.1.2.3 Firms

Jobs are created by firms that decide to open new positions. Job creation involves some costs and firms care about the expected present value of profits, net of hiring costs. Assume for simplicity that firms are "small" in the sense that each firm has only one job that is either vacant or occupied by a worker.

---

\(^2\) (2) - (3) give us \( U - W = (b - w)/(r + p(\theta) \cdot \varphi) \)

Then we get \( rU = b + p(\theta) \cdot (b - w)/(r + p(\theta) \cdot \varphi) \) and \( rW = w \cdot \varphi \cdot (b - w)/(r + p(\theta) \cdot \varphi) \)
There is a flow cost, \( k \), associated with a vacancy. Let \( V \) denote that expected present value of having a vacancy and \( J \) the corresponding value of having a job occupied by a worker. A vacancy is filled at the rate \( q(\theta) \), whereas an occupied job is destroyed at the rate \( \phi \). As before then the value functions can thus be written as:

\[
\begin{align*}
\text{r}_V &= -k + q(\theta)(J - V) \quad (4) \\
\text{r}_J &= y - w + \phi(V - J) \quad (5)
\end{align*}
\]

where \( y \) is output per worker, which is taken as exogenous.

The flow value of a vacancy, \( rV \), involves an immediate cost \( k \) as well as the prospect of finding a worker and thereby turning the vacancy into an occupied job. The flow value of a filled job, \( rJ \), involves the instantaneous profit \( y - w \) but also a risk of job destruction. Free entry of vacancies implies \( V = 0 \) in equilibrium: firms open vacancies as long as it is profitable to do so. By imposing the free-entry condition on equations (4) and (5), one obtains the key demand-side relationship of the model:

\[
y - w = (r + \phi)k / q(\theta) \quad (6)
\]

This free-entry condition implies a negative relationship between the wage and labor market tightness. The tighter the labor market, the more costly it is to recruit new workers. This has to be offset by lower wages so as to maintain zero profits. Note that \( y > w \) must hold because of hiring costs, \( K > 0 \) (otherwise without frictions the competition bring again the wage to the marginal productivity of labor which in the model is \( y \)). In

\[
\begin{align*}
V = 0 \text{ imply that (4) leads to } J &= k / q(\theta) \\
\text{Then from (5) with } V = 0 \text{ and } J &= k / q(\theta) \text{ we get (6)}
\end{align*}
\]
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equilibrium, the excess of the marginal product of labor over the wage cost is equal to the expected capitalized value of the vacancy cost. The incentives to create vacancies are reduced by a higher real interest rate, a higher job destruction rate and a higher vacancy cost. Vacancy creation is encouraged by improved matching efficiency that exogenously increases the rate at which the firm meets job searchers.

1.1.2.4 Wage bargaining

Since the labor market is characterized by frictions and bilateral meetings, the standard wage determination mechanism does not come into play. So how are wages determined? The main approach that has been used in the literature assumes that there is bargaining between the employer and the worker. So suppose that wages are set through individual worker-firm bargains and that the Nash solution applies, i.e.

\[ w = \arg \max [W(w) - U]^{1-\beta} [J(w) - V] \]

where \( \beta \) is a measure of the worker's relative bargaining power, \( \beta \in (0,1) \). \( W(w) \) and \( J(w) \) represent present values associated with a particular wage \( w \) in this bilateral bargain (to be distinguished from the wage used in other matches), i.e.,

\[ rW(w) = w + \phi (U - W(w)) \quad (3w) \]
\[ rJ(w) = y - w + \phi (V - J(w)) \quad (5w) \]

The value of unemployment is independent of \( w \) and is obtained from equations (2) and (3). Note that the threat points in the Nash bargain are taken to be \( U \) and \( V \), i.e., what the worker and the firm would receive upon separation from each other. The outcome of this maximization is a surplus-sharing rule of the form:
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\[ W(w) - U = \beta[W(w) - U + J(w) - V] \quad (7) \]

The wage is set so as to give the worker a fraction \( \beta \) of the total surplus from a wage agreement. (7) can be rewritten in several ways so as to yield a wage equation, i.e., the bargained wage as a function of labor market tightness and the parameters of the problem. A useful partial-equilibrium wage equation expresses the wage as a weighted average of labor productivity and the flow value of unemployment\(^4\):

\[ w = \beta y + (1-\beta)rU \quad (8) \]

It is possible to go one step further to obtain the following\(^5\):

\[ w = \beta(y+k\theta) + (1-\beta)b \quad (9) \]

This expression has the intuitive property that the bargained wage is an increasing function of unemployment benefits, labor productivity and labor market tightness.

1.1.2.5 Equilibrium

\(^4\) From (3w) \( W(w) = (w + \varphi U)/(r + \varphi) \)

From (5w) \( J(w) = (y-w)/(r+\varphi) \)

Then using these equation in (7) and \( V = 0 \) we got (8)

\(^5\) Take (2w) \( rU = b + p(\theta)(W(w) - U) \)

From (7) \( W(w) - U = \beta (J(w) - V)/(1-\beta) \)

But from (4w) and \( V = 0 \) \( J(w) = k/q(\theta) \) and then \( W(w) - U = \beta k/(q(\theta)*(1-\beta)) \)

and then \( rU = b + p(\theta)\beta k/(q(\theta)(1-\beta)) \)

Recalling that \( p(\theta) = \theta q(\theta) \) and substituting \( rU \) in (8) we got (9)
The overall steady-state equilibrium is now characterized by (1), (6) and (9). (6) and (9) determine w and θ and the unemployment rate follows from (1). The vacancy rate is obtained by using the fact that v/u=θ. The equilibrium unemployment rate is determined by b,y,k, β,r, φ as well as by the parameters of the matching function. It is possible, by variable substitution, to reduce the set of equations to one equation in one unknown: labor-market tightness.

1.2 Labor market policy

By labor market policies, we refer to those policies addressed to the labor market. The aim of these policies is usually recognizes in restoring inefficiencies of this market. We can see this for example exploiting Eurostat (2012) definition of labor market intervention:

labor market interventions are public interventions in the labor market aimed at reaching its efficient functioning and correcting disequilibria.

We do not fully agree with these definitions that involuntary exclude from labor market policies all those policies whose aim is not restore inefficiencies. An example of such a policy can be employment/unemployment benefits pursuing equalization (which in our view is a possibly desirable but different aims with respect to efficiency) or, in general, all those policies rising from other principles that, targeting labor market, should be included anyway in labor market policies. Another possibility is to accept this definition enlarging the sense of disequilibria up to the point in which this world includes all those features we were referring at previously.
However, we agree upon the fact that the main pursued (or at least declared) aim of policy interventions is restore inefficiencies indeed, also in our case, we focus on inefficiency problems of labor market. Moreover, the main recognize inefficiency of the labor market consist of unemployed workers then (from Neugart 2006),

The objective of labor market policies is at least twofold: to provide benefits to those people who are unemployed in order to cushion their income loss, and to improve the allocation of workers\textsuperscript{6} to job openings in the labor market.

In particular, we can distinguish two major sets in which Labor market policies may fall: active labor market policies and passive labor market policies. Quoting again Neugart (2006) simply to complete the previous sentence:

The first set of policies goes under the name of passive labor market policies while the second set under the one of active labor market policy.

We report now the satisfactory classification of labor market policies given by OECD. To complete it we simply added the separation in active/passive labor market policies.

\textbf{OECD classification}\textsuperscript{7}

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\textsuperscript{6}In particular the reallocation again usually refers to unemployed but not uniquely, indeed sometimes we talk also about relocations of employed for a better match.

\textsuperscript{7}The classification is restricted to measures which are "targeted".
Active labor market policies

1. Public employment services and administration

1.1 Placement and related services include open information services, referral to opportunities for work, training and other forms of assistance, counselling and case management of jobseekers, financial assistance with the costs of job search or mobility to take up work, and job brokerage and related services for employers, if spending on these functions can be separately identified. Services provided by the main public employment service and by other publicly-financed bodies are included.

1.2 Benefit administration expenditure includes the budget of institutions that manage the unemployment and early retirement benefits reported in Categories 8 and 9, if this spending can be separately identified.

1.3 Other expenditure includes the budget of institutions that provide placement and related services (if the relevant spending could not be separately reported in Category 1.1 above); institutions that manage labor market programs in

This excludes measures such as: training that is generally available to employed adults; apprenticeship programs that are generally available to young adults; in-work benefits that are available to all employees whose earnings fall below a threshold; and early retirement benefits that are conditional only on age or contribution record.

Examples of "targeted" programs that are included are: programs targeted on the registered unemployed; training for those known to be at risk of involuntary job loss; apprenticeship support for those who have been unable to find an apprenticeship through the usual channels; and special early retirement benefits created to promote the restructuring of a particular industrial sector or enterprise.
Categories 2 to 7 below (except for costs already included in these categories); and institutions that administer the benefits in Categories 8 and 9 below (if these costs could not be separately identified in Category 1.2 above). However if these institutions’ budgets cover functions that are outside the scope of this database (neither placement and related services, nor the management of active or passive labor market programs within the scope of Categories 2 to 9), estimated spending on those functions should be excluded.

2. Training

2.1 Institutional training refers to programs where most of the training time (75% or more) is spent in a training institution (school/college, training center or similar).

2.2 Workplace training refers to programs where most of the training time (75% or more) is spent in the workplace.

2.3 Alternate training (formerly called Integrated training) refers to programs where training time is evenly split between a training institution and the workplace.

2.4 Special support for apprenticeship refers to programs providing incentives to employers to recruit apprentices from labor market policy target groups, or training allowances for particular disadvantaged groups. Note again that apprenticeship schemes that are generally available are considered to be part of the general education and vocational training system and so should be excluded.

4. Employment incentives

8 In this updated version point 3 have been ignored. The subcategory of point 4, Job rotation and job sharing replace former category 3.
4.1 Recruitment incentives are programs making payments for a limited period only to facilitate the recruitment of unemployed persons and other target groups into jobs where the majority of the labor cost is covered by the employer. They include payments to individuals that are conditional upon the take-up of a new job (back-to-work bonus, mobility/relocation allowance or similar) only if they are targeted (e.g. restricted to the long-term unemployed).

4.2 Employment maintenance incentives are similar but facilitate continuing employment, in a situation of restructuring or similar. Generally-available in-work benefits for low-income groups should not be included.

4.3 Job rotation and job sharing. Job rotation refers to schemes promoting the full substitution of an employee by an unemployed person or a person from another target group for a fixed period. Job sharing refers to schemes promoting the partial substitution of an employee by an unemployed person or a person from another target group.

5. Sheltered and supported employment and rehabilitation

5.1 Sheltered and supported employment consists of subsidies for the productive employment of persons with a permanently (or long-term) reduced capacity to work. These measures typically provide ongoing support and have no planned duration. However, lifetime sheltered work provisions are normally considered as part of social policy and outside the scope of the database. Recruitment incentives payable for a fixed period to the employer or the disabled worker upon hiring in a regular job appear in Category 4.1.

5.2 Rehabilitation refers to vocational rehabilitation for persons with a reduced working capacity which prepares them
to move on to work or regular training. Social and medical rehabilitation are not included. Participation by disabled workers in regular training as distinct from rehabilitation appears in Category 2

6. Direct job creation

These programs create additional jobs - usually of community benefit or socially useful, and usually in the public or non-profit sector although similar projects in the private sector may also be eligible - for the long-term unemployed or persons otherwise difficult to place. The majority of the labor cost is normally covered by the public finance. Provisions for lifetime sheltered work in a non-productive environment should not be included. Note that the former subcategories 6.1 Permanent and 6.2 Temporary (which were largely redundant since few countries reported permanent direct job creation) are no longer implemented.

7. Start-up incentives

Programs that promote entrepreneurship by encouraging the unemployed and target groups to start their own business or to become self-employed.

**Passive Labor Market Policies**

8. Out-of-work income maintenance and support

8.1.1 Unemployment insurance refers to benefits payable to workers satisfying criteria for membership in an unemployment insurance scheme. These are often paid only for a limited period.

8.1.2 Unemployment assistance refers to benefits payable to workers either failing to satisfy criteria for membership in an unemployment insurance scheme or who have exceeded the
period for entitlement to unemployment insurance benefit. Unemployment assistance is normally means tested.

8.2 Partial unemployment benefits refer to benefits compensating for the loss of wage or salary due to short-time working arrangements, and/or intermittent work schedules, where the employer/employee relationship continues.

8.3 Part-time unemployment benefits refer to benefits paid to persons working part-time who have lost a full-time job or an additional part-time one and are seeking to work more hours.

8.4 Redundancy compensation refer to capital sums paid from public funds to employees who have been dismissed through no fault of their own by an enterprise that is ceasing or cutting down its activities.

8.5 Bankruptcy compensation refers to capital sums paid from public funds to employees to compensate for wages not paid by the employer due to bankruptcy/insolvency.

9. Early retirement

These programs facilitate the full or partial early retirement of older workers who are assumed to have little chance of finding a job or whose retirement facilitates or whose retirement facilitates the placement of an unemployed person or a person from another target group. Early retirement benefits normally cease when the beneficiary becomes entitled to an old age pension. Moreover, benefits paid to beneficiaries over the standard retirement age as established in the reference pension scheme should not be recorded here. Also programs that are conditional only on age or contribution record should not be included.

As we can see also from the classification, labor policy includes a big variety of actions and aims. For example we can
distinguish “fiscal” policies (as incentives) from more “normative” policy (as the rules governing placement), or employment policies from policies for maintain/improve the worker’s social status.

Our work focus on active labor market policies and in particular on public employment services and administration. So we will discuss these ones more deeply, laying a bit aside from the discussion the others which unfortunately will appear occasionally and surely not in a complete way.

1.3 Active labor market policies in Europe

1.3.1 Some data in Europe

As it was probably already deducible, labor economics is a hot topic in the wide field of economics. The relevance of the themes treated is probably also reflected in the unrestrained number of work on labor market and labor market policy emerging each year; however we report here as another evidence of the relevance of the topic some tables from Eurostat (2012), about the considerable (otherwise probably we would also not have noticed such an expansion in theoretical studies) expenditures of the different countries in labor market policies.

The following table and graph show the labor market expenditure as a percentage of GDP. In particular expenditure is

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9 To see more or more detailed and updated data surf on their site e.g. on http://ec.europa.eu/eurostat/web/labor-market/labor-market-policy/main-tables.
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divided by the previous described categories\textsuperscript{10}. To be known for
an easier reading, are the standard abbreviation of countries\textsuperscript{11}
and that the “e” in the table means simply estimated (and
statistically significant otherwise it would have been a “:n”) value, “p” means provisional data, “.:” are missing observations,
“-“ are zero or non-applicable values.

<table>
<thead>
<tr>
<th>Total LMP expenditure</th>
<th>Total LMP expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>(category 1)</td>
<td>(category 2: 9)</td>
</tr>
<tr>
<td>EU-27</td>
<td>EU-15</td>
</tr>
<tr>
<td>2.13 LMP expenditure</td>
<td>2012</td>
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<tr>
<td>(labor expenditure GDP)</td>
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<tr>
<th>Total LMP expenditure</th>
<th>Total LMP expenditure</th>
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<tr>
<td>(category 1)</td>
<td>(category 2: 9)</td>
</tr>
<tr>
<td>EU-27</td>
<td>EU-15</td>
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<tr>
<td>2.13 LMP expenditure</td>
<td>2012</td>
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<td>(labor expenditure GDP)</td>
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</table>

10 Note that the paper we are referring to was published in 2012 and the last OECD revision in classification, we referred to, is dated 2014 so the third category is still computed separately from the fourth (and not as a sub part of this last one). Also for this reason we were discussing continuously also to the previous update of OECD classification.

11 BE Belgium; BG Bulgaria; CZ Czech republic; DK Denmark; DE Germany; EE Estonia; IE Ireland; EL Greece; ES Spain; FR France; IT Italy; CY Cyprus; LV Latvia; LT Lithuania; LU Luxembourg; HU Hungary; MT Malta; NL Netherlands; AT Austria; PL Poland; PT Portugal; RO Romania; SI Slovenia; SK Slovakia; FI Finland; SE Sweden; UK United Kingdom; NO Norway.
From the graph is possible to quickly get the sum of the previous presented quantitative information and compare the OECD countries underlying which of them are committing a (relative) major amount of resources to labor market policies. The most active countries in the field are Ireland, Spain, Belgium and Denmark exceeding the 3% of the expenditure with respect to the GDP followed closely by Netherlands, Finland and France. A part for the United Kingdom (for which we have data only on category 8 and 9 and then we are not sure) we see that in all OECD countries the expenditure for labor market policies exceed the 0.5% of the GDP. In particular Italy is around 1.8%, but we have to notice an increasing trend from previous years (for more see tables on the web from 1985).

The following table instead shows the labor market expenditure divided in category as a percentage of the total labor market expenditure. The notation is the same as before.
Exploring labor market policies. Insights from a simulation model

As we can see from this table (or comparing the color of previous graph if preferred) quite in every considered OECD countries passive labor market policies (category eight and nine or the orange color of the graph) exceed active ones (category from one to seven), the exception are Denmark, Poland, Sweden. In some countries active policies are less than one quarter of total expenditure in labor market policies, these countries are Bulgaria, Estonia, Ireland, Greece, Spain, Italy and Romania. If we refer then uniquely to active labor market policies (referring again also to previous table and graph) the nations with the highest values (more than 1 percentage point of gross domestic product) are in order Denmark, Belgium, Sweden, Netherlands and France; followed closely by Finland, Germany, Ireland and Austria. These are the common Nordic countries following the tradition of the welfare state; to them we add some countries with higher level of unemployment (as Belgium) or that reacted quicker to recent welfare state and subprime crisis using
reforms on labor market (as in Germany with Harts reform; even if to be said is that Germany also belongs also to the tradition of the welfare state). The composition of active labor market policy is multi-colored. In Italy the 0.4% of the GDP used for active policies (around 19.1% of total expenditure in labor market policies) is mostly devoted to training and employment incentive (around 17.6% with respect the total expenditure).

1.3.2 From data to commitment

Also official documents and public declaration of many states reflects that labor market, labor market policies and labor market policies evaluation is sincerely felt as primary topics in Europe.

For example communitarian institutions are declaring from many years that to find the best response to European unemployment rate we have to focus on active labor market policies. These strategies written in the white paper on “growth competitiveness and employment” (1993) can be recovered also in the European employment strategy (which “started after” the assembly which took place in Luxemburg on November 1997) and in the Europe 2020 growth strategy. Without discussing the utility of passive labor market policies for their complementary aims, in these texts emerge the preferences of communitarian institutions for active labor market policies: the dominating role attributed to them is confirmed by targets which are focusing more and more on public employment services and administration.

We found a recent a study carried out by the European Commission which has analyzed the organization and funding
framework of Member States' public employment services, jointly with the type of services supplied to customers (jobseekers and employers). This study analyzes also how public employment services are adapting their model and themselves to the new challenges of labor market. The emerging models are very different from centralized models with more (e.g. U.K.) or less (e.g. Germany) organizational and instrumental independence threw decentralize models depending on local jurisdiction (e.g. Italy), to decentralized independent model (as in Estonia).

1.3.3 The framework

Public employment services (PES from now on) are one of the main means for the application of active labor market policies. In particular current challenges (first of all the economic crisis) and the related reactions of Member states enhance their role and their activities.

At a European general level we already quoted European employment strategy which gave a general big push to PES modernization. (Also thanks to the support of the European Commission which allocate a considerable amount of resources to the scope; the resources allocated threw the European Social Fund should be hypothetically expired in 2013 but them have been renewed for the current period going from 2014 up to 2020). However we have to quote also the document by the European commission (Contributo dei servizi pubblici per l'occupazione alla strategia Europa 2020. Documento finale sulla strategia SPO 2020) where we can find the description of the changes in the roles and in the purposes of PES required to apply Europe 2020 strategy (mainly trying to reach a set of services more oriented to labor demand). The Commission
indeed believe that it is necessary to combine an efficient activation of jobseekers with a good qualitative assistance to employers (of course this is subsequent to a deep understanding of labor demand) as well as with a good cooperation between the various PES (to manage the great interdependence of the various national labor markets). In particular even if it is possible to deal with challenges in many different ways (the convenient methods probably depend also on the structure of labor market and political socio economic context) PES are asked to transform themselves in customer-oriented agencies with coordinated and personalized services for transitions of every jobseekers (also the further as, reading the world further in a figurative and not literal way, the one close to get out the labor market).

On the other hand if at a general level we have these clear guideline in practice we have many different (and possibly valid contemporaneously) organizational model for PES (which has been adopted by the various member states). The understanding of the different models adopted gain then a huge relevance to fight the employment related problems which are emerging as a consequence of economic conjunctures (mainly unemployment but for example I recall also the problems related to productivity and sustainability...). The first thing we anticipate is that most of the European PES share as an emerging strategic choice the attempt of strengthen and rationalize the structure and this choice, driven of course also by the need of well managing the available resources, is translated usually threw the incorporation into technical agencies which depend directly on central governments agencies that in such a way can manage
j o i n t l y a c t i v e a n d p a s s i v e l a b o r m a r k e t p o l i c e s. T h i s i s t h e c a s e
o f U n i t e d k i n g d o m , S w e d e n , I r e l a n d a s w e l l a s I t a l y .

1.3.4 The problems targeted

A s w e c a n r e a d a l s o i n "B e n c h m a r k i n g s u i S e r v i z i p u b b l i c i
p e r l ' i m p i e g o i n E u r o p a " ( B e n c h m a r k i n g o n P E S i n E u r o p e ) b y
I t a l i a L a v o r o ( 2 0 1 4 ) t h e m a i n a s p e c t c o n n e c t e d t o t h e g o v e r n a c e
o f P E S i s " l a c a p a c i t à d i i n t e r c e t t a r e l a p l a t e a d e i s o g g e t t i a l l a
r i c e r c a d i l a v o r o " ( T h e a b i l i t y t o r e a c h t h e j o b s e e k e r s ) a n d i n
p a r t i c u l a r ( i f w e a s k e v e n m o r e ) " l a c a p a c i t à d i c o l l e g a r e
c o r r e t t a m e n t e i s o g g e t t i " ( t h e a b i l i t y t o r e a c h t h e c o r r e c t
j o b s e e k e r f o r a g i v e n v a c a n c y o r v i c e v e r s a t h e c o r r e c t v a c a n c y
f o r a g i v e n j o b s e e k e r ) . I n p r a c t i c e t h i s a b i l i t y a p p e a r s e x t r e m e l y
m u l t i - c o l o r e d ( f r o m a r o u n d 9 0 % o f S w e d e n t o s o m e t h i n g a r
o u n d 5 % o f I t a l y , t a b l e s i n a p p e n d i x ) b u t i t s e e m s s t r o n g l y c o r r e l a t e
t o t h e r e s o u r c e s a v a i l a b l e t o t h e g i v e n P E S . A t t h e s a m e t i m e a s
w e n o w t h e f i n a n c i a l c o n s t r a i n t b e c a m e m o r e b i n d i n g f o r q u i t e
a l l ( i f n o t a l l ) M e m b e r S t a t e s i n t h e a t t e m p t o s t a b i l i z e n a t i o n a l
b a l a n c e s h e e t d u r i n g t h e c r i s i s . N o t i c e a l s o t h a t t h e c r i s i s i t s e l f
( t h r e w h i g h u n e m p l o y m e n t l e v e l s ) c o m b i n e d w i t h t h e
d e m o g r a p h i c t r e n d s b r o u g h t a n i n c r e a s i n g i n t h e d e m a n d f o r
p u b l i c g o o d s a n d w e l f a r e ( p r o b a b l y w o r s e n n a t i o n a l b a l a n c e
s h e e t s e v e n m o r e ) .

1.3.5 The solutions adopted

I n g e n e r a l , m o s t o f t h e P E S b e l o n g i n g t o t h e M e m b e r S t a t e s
a r e e v o l v i n g ( b o t h i n t h e s e n s e o f t h e i n t e r n a l o r g a n i z a t i o n a n d
r e s o u r c e s m a n a g e m e n t ) r e f l e c t i n g t h e n e w o r g a n i z a t i o n a l
theories related to the new public management. As an example many PES have been modernized with innovative models for the relocation of workers, including outsourced services to specialized companies (which moreover do not lie on PES resources). At the same time the need to modernize in a time of austerity brought to the rationalization and reengineering of the infrastructure. Rationalize in the sense of reduction of costs and duplicated services, reengineering in the sense of the conversion of PES in specialized costumer oriented branch (with an higher return on investments) involved in partnerships and with enlarged roles.

In particular we can distinguish fore major categories of reforms: Rationalizations of institutional structures, new models of public private competition and partnership, change in the displacement of human resources, accessibility and user-friendliness of PES.

The first category is translated in more coordinated service, sharing of expertise, realising economies of scale and

12 New public management refers mainly to the transfer of pseudo private sector models to the public sector. In the paper Managing Decentralisation: A New Role for Labor Market Policy we find described the characteristics of the new public management as decentralization, management by objectives, contracting out, competition within government and consumer orientation. Only to give a general idea before going on with our specific case it refers to the competition between different public agencies, and between public agencies and private firms or incentives related mechanism on more economic lines Managing Decentralisation: A New Role for Labor Market Policy, Organisation for Economic Co-operation and Development, Local Economic and Employment Development (Program), OECD Publishing, 2003, p 135,
avoiding duplication. Examples include reforms undertaken by the German PES, which now has an integrated delivery system for customers receiving unemployment insurance and social assistance. Denmark has also combined these services while focusing the delivery of PES in municipalities. In France and in the UK, organisations administering benefit systems and providing employment services were merged as part of efforts to, among other goals, encourage the use of active measures. In Finland too, the PES has addressed the efficiency challenge by rationalising its organisational structure. The number of local PES offices has been significantly reduced, and from 2012 a single PES administrative centre has been established in each of the country's 15 regions. Each office operates a service model based on three separate but complementary service lines.

The second category is translated in the outsourcing of specialized services combined with a more intensive support and training given to complementary profit or no-profit providers, in a more flexible system, indeed service quality can be improved through the subsequent more intensive use of external providers and expertise (notice that this is the point that can lead also to part of the cost savings included in the previous category). The forerunner in this field is probably the United Kingdom, in contrast to other Member States which tend to pre-define services to be provided by contractors, he has developed a model combining a substantial use of public private

15 These are: placement and services for employers; services for those who need improvement of their skills or advice to change their career; and services for those who need strong individual support.
partnerships with a specific form of procurement which gives the providers significant autonomy in determining the services to be provided.

The third category is translated mostly in the segmentation and profiling of customers. Individual plans allowed to give more effective services also to more vulnerable agents.

The forth category is translated firstly in the attempt to reach also furthest jobseekers reducing barriers, extending market coverage, increasing mobility and usability of services, with improved or new management of contacts. Secondly it is translated in the attempt to reach a higher cooperation with the other intermediaries of labor market in the diffusion of the information on vacancies (and jobs in general) and in the transparency of the market itself. These actions are of course assisted by the development of the information and computer technology. As an example also in Italy (mostly in Piedmont and Lombardy) PES are developing a structure for the electronic exchange of information on vacancies between public and private bodies. Also others nations as Belgium, Germany, UK are improving their services with on-line instruments which in this case are used mainly to stabilize the relations with employers (which can be translated in an automatic matching).

In order to give a more detailed overview of the heterogeneity of the models (in terms of organizational schemes, processes, funding managements, target specification) we decided report below some examples on model adopted by some Member States. The information have been collected mainly from the “EEPO 2014 Small Scale Study on PES Business Models”.

33
We selected the sample in particular trying to cover the wide spectrum of possible governance models (from the most centralize to the more diffused), but at the same time we believe that it covers also an interesting overview of the various funding managements and type of provided services.

Sources of financing, expenditures and staffs are compared in appendix

1.3.6 Some specific examples

1.3.6.1 Germany

The main actor is the Federal Employment Agency (Bundesagentur für Arbeit). It has two different types of objectives: strategic business policy goals and staff-orientated goals. The former determine the operative orientation and the success of the Federal Employment Agency in the respective policy fields while the latter refer to secure and improve the productive efficiency and the employability of Federal Employment Agency staff. The following tools are used to monitor objectives: monthly reports on target achievements; management information systems; controlling indicators within the field of minimum income benefit system for jobseekers; cost accounting to check cost effectiveness and comparisons of results of Employment Agencies and job centers within local agencies and between job centers with comparable labor market conditions.

The main tasks of the Federal Employment Agency include placement in training and work using the full range of Active Labor Market Policies e.g. qualifications; vocational guidance; employer counselling; promotion of vocational training and
further training; promotion of professional integration of people with disabilities; and issuing benefits (e.g. unemployment benefit). In addition, the Federal Employment Agency conducts labor market monitoring, analysis and research and produces reports and labor market statistics. Moreover, it distributes child benefit through the Family Benefits Office. It also has the regulatory responsibility for monitoring benefit fraud.

The main targets for 2014 include: the prevention of unemployment and reducing the duration of unemployment; promoting integration into the labor market; and improving access to the labor market for all clients. For the first time, in 2014 the Federal Employment Agency implemented qualitative targets in addition to the existing quantitative targets in the field of unemployment insurance. These include: the share of sustainable integrations; the share of integrations of which the contact with customers lasted over six months beforehand; share of successfully filled vacancies in SMEs; and the share of integrations with and without certificate of secondary education. There are also three main targets for the minimum income benefit scheme: reduction of persons in need; improvement of the integration into employment; and avoiding long-term benefit dependency.

The Federal Employment Agency is composed of the head office in Nuremberg, 10 Regional Directorates (Regionaldirektionen), 176 Employment Agencies and approximately 610 branch offices. Moreover the Federal Employment Agency is an active player in 303 out of 408 job centres which have been jointly established by local employment agencies and individual states and urban and rural
districts. The head office is responsible for the strategic, conceptual and contextual framework for the Agency and controls the Regional Directorates. The Regional Directorates are responsible for the success of regional labor market policies and they work closely with local governments to coordinate labor market and structural and economic policies. Employment Agencies are responsible for the implementation of the duties of the Federal Employment Agency at a local level. The two providers of the minimum income benefit scheme (Employment Agencies and individual states and urban and rural districts) deliver services through job centres.

The Federal Employment Agency is a self-governing public-law corporation endowed with its own legal status; it reports directly to the federal government and the Ministry for Labor and Social Affairs.

The Federal Employment Agency is headed by the Executive Board that consists of the Chairman and two members. The Executive Board manages the Federal Employment Agency and the conduct of business. All members of the Executive Board serve full-time and are appointed for a term of five years. The Regional Directorates and local Employment Agencies are also managed by three-member managing boards, each of whose members has a particular area of responsibility.

The central institution of self-governance of the Federal Employment Agency is the Board of Governors. Furthermore, each employment agency has an Administration Council that acts as local institution of self-governance. These self-governing bodies supervise the work of the Executive Board, respectively the management of the local Employment Agencies and advise them on questions concerning the labor market. The institutions
of self-governance, the Executive Board of the Federal Employment Agency, and the management boards of the employment agencies cooperate on a basis of trust in fulfilling the statutory objectives and tasks of the Federal Employment Agency.

The Board of Governors consists of seven voluntary representatives for each of the three groups of employees, employers and public bodies; each group has equal rights. This ensures the premium payers of unemployment insurance are involved in the formation of the business policies of the Federal Employment Agency.

About the network and information management there are partnerships which are based on contracts in job centres as well as the involvement in international networks. Within Germany, further partnerships are limited to networks e.g. cooperation with ministries at a national or regional level. There are also networks for migration and for local business promotion initiatives. There are no common rules for the quality of cooperation. The following tools are used to share information internally: email, the intranet, and databases for customer care (topic dependent). For external communication, the main tool is the labor market monitor (Arbeitsmarktmonitor) in which structural labor market indicators, sectoral developments and labor market information for professions is available; in addition, the Federal Employment Agency uses newsletters and meetings for network partners.

While collecting information on job vacancies the Federal Employment Agency receives a large number of placement vacancies from employers. Federal Employment Agency provides active – candidate-oriented – job placement acquisition, e.g.
Federal Employment Agency directly addresses companies that offer employment opportunities for unemployed i.e. jobseekers or applicants for apprenticeships who are registered within the Federal Employment Agency. The statistic shows the reported vacancies (reported by employers to employment agencies and Job centers) monthly. For these vacancies employers wish to receive support regarding the job placement-process.

The penetration rate in 2013 was 26.7 % (data up to June 2013). According to the current calculations of the Institute for Employment Research in 2013, 48 % of successfully filled vacancies in companies were in touch with the employer's service or its online services. The outflow rate in 2013 (outflow of unemployed in the reference month related to the stock of unemployment of the previous month) was 21.9 %. The PES market share is defined as filled vacancies (i.e. PES placements as a percentage of all hires across the economy).

In the end the Federal Employment Agency routinely monitors (at an overall level) the characteristics of current vacancies (e.g. required skills, levels of education needed, sectors, occupations, regional distribution etc.) compared to the qualifications and capacity of current jobseekers.

The employment agencies take part systematically in working groups and workshops providing regional information on skills shortages.

1.3.6.2 Denmark

The objectives of the Danish Agency for Labor Market and Recruitment are to: increase labor supply; move people from public income support into employment or education; support and ensure that Denmark has a flexible, dynamic and efficient
labor market; retain people in the Danish labor market and support the efforts to attract and recruit highly qualified professionals from outside Denmark.

The targets for 2013 and 2014 are as follows: decrease the number of young people without an education; improve and enhance the support for unemployed people; reduce the numbers granted disability pension; reduce the number of long-term unemployed; and strengthen cooperation between Job Centres and employers.

The tasks of the Danish Agency for Labor Market and Recruitment include: analysing future skills needs; assisting the Ministry with policy development, legislative work, and developing reform proposals; delivering employment measures and initiatives nationally and locally with IT systems; developing evidence-based labor market information; collecting data in order to follow-up on implemented reforms; and providing services to foreign citizens (e.g. issuing residence permits).

The Danish Agency for Labor Market and Recruitment was established 1 January 2014. The agency is a result of the merger of The National Labor Market Authority and The Danish Agency for Labor Retention and International Recruitment; it forms part of the Ministry of Employment.

There are 94 job centres run by municipalities at the local level. Job centres perform the task of supporting the unemployed to access employment or education. At the regional level, there are four employment regions, which monitor the performance of job centres and the implementation of reforms and initiatives. At the national level, The Danish Agency for
Labor Market and Recruitment develops strategic policy and employment initiatives to be implemented at the local level.

As part of the Danish Ministry of Employment, the Danish Agency for Labor Market and Recruitment is subject to the control of Government.

About the network and information management the Danish Agency for Labor Market and Recruitment sets the national framework for coordination and management of the Employment Policies and initiatives including the framework for involving other stakeholders. Partnerships with other public and private stakeholders are managed through national, regional and local employment councils/boards and through partnership agreements.

Internally and externally, the website www.jobindsats.dk, provides information for all stakeholders at all levels. Internally, there are regular performance meetings between the Employment Regions and the local job centres.

Collecting information on job vacancies

While collecting information on job vacancies the Danish Agency for Labor Market and Recruitment receives information on job vacancies from the public website for all jobseekers and employers in Denmark (can be found at internet: www.jobnet.dk). On the website, employers can post their vacancies or ask for help for filling a vacancy from the local job centre. The website also searches all online job websites on a daily basis and publishes them.

The public job centres are municipal and their methods of gathering job vacancies vary. They rely on the employers volunteering information on vacancies. But on a smaller scale, they also contact employers directly, by phone and make
campaigns and job fairs to gather vacancies. This takes place on a daily basis. Some job centres have agreements with the companies concerning recruitment of staff.

The Danish Agency for Labor Market and Recruitment routinely monitors (at an overall level) how the characteristics of current vacancies (e.g. required skills, levels of education needed, sectors, occupations, etc.) compare to the qualifications and capacity of current jobseekers. They use an online tool, the Labor Market Balance, which continually monitors the job opportunities on the labor market and presents them at a regional level. The job opportunities are categorised as 'excellent job opportunities', 'job opportunities' and 'less good job opportunities'. The Danish Agency for Labor Market and Recruitment also uses labor market intelligence to guide the direction of future training needs, using Labor Market Balance.

1.3.6.3 Estonia

The main actor is Estonian Unemployment Insurance Fund, (EUIF form now on). Its mission is to help jobseekers to find a job and employers to find a suitable employee. EUIF implements active labor market policies and administers unemployment insurance with the overall objective to achieve high levels of employment, minimise the duration of unemployment, provide unemployed income replacement for the period of job-search, compensate employees for loss of employment due to redundancy and secure employees outstanding claims in the event of employer's insolvency. These overall objectives translate into strategic objectives to increase effectiveness and
improve the quality and access to services and to develop a competent and efficient organisation.

The EUIF has quantitative national and regional performance targets. The annual action plan sets out main development activities and targets at organisational level while regional targets are defined in performance plans agreed with each EUIF Regional Office.

14 For 2014-2015 national targets are set out in the Employment Programme and EUIF Development Plan 2014-2016. These are available at:

http://www.tootukassa.ee/sites/tootukassa.ee/files/ARENGUKAVA%202014_2016_0.pdf

Nationally, the quantitative performance targets for 2014 and 2015 include:

The rate of entering employment for the new registered unemployed (excluding new recipients of unemployment insurance benefit) within 12 months: 2014: ≥ 54.9 %, 2015: ≥ 56.4 %

The rate of entering employment for the new recipients of unemployment insurance benefit within 12 months: 2014: ≥ 68.5 %, 2015: ≥ 70.5 %

The average share of participants in labor market services in a month: 2014: ≥ 30 %, 2015: ≥ 30 %

The participation of the long-term unemployed (registered as unemployed for 12 months and longer) in labor market services within 12 months: 2014: ≥ 85 %, 2015: ≥ 90 %

The jobseeker and employer satisfaction index should all be ≥ 80 for both groups in 2014 and 2015

The staff satisfaction index should be ≥ 85 in 2014 and 2015.
Regionally, performance targets are divided into three groups (impact, output and quality targets). Impact targets include the rate of entering employment within 12, 6 and 4 months for new recipients of unemployment insurance benefit; rate of entering employment within 12, 6 and 4 months for newly registered unemployed (excl. recipients of unemployment insurance benefit); rate of entering employment within six months after work practice and the rate of entering employment within six months after labor market training. Output targets include participation rates in active measures; participation rates in active measures of long-term unemployed; inflow to active measures and inflow of vacancies. Lastly, quality targets include the quality of decisions on registering the unemployed; relevant and comprehensive Individual Action Plans and satisfaction indexes of jobseekers, employers and EIF employees.

The main key tasks of the EIF include the payment of unemployment insurance benefits (benefits in the event of unemployment, redundancy and employer's insolvency), the provision of labor market services and the management of unemployment insurance funds.

The management of EIF is the responsibility of the Management Board composed of three members (Head of the Board, Member of the Board in charge of benefits and Member of the Board in charge of employment services). EIF has a Head Office and 15 Regional Offices with 26 client service points. Regional Offices have a status of department of the EIF and are managed by Regional Managers, who are subordinate to the Head of the Management Board. The Head Office has two core departments: the Benefits Department and the Services
Department. The Benefit Department processes applications for unemployment insurance benefits and unemployment allowance claims and the Services Department is responsible for designing client services, ALMPs provision and coordinating and supporting service delivery in regional offices. The Regional Offices are composed of staff directly servicing jobseekers as well as employers' advisers and staff responsible for administering training and other service contracts. They are also responsible for servicing job-seekers and employers, identifying their needs, providing employment services and delivering ALMPs.

The EUIF is a quasi-governmental organisation, and a legal person in public law. It performs its activities independently from government, in the framework of its mission and of operational rules defined by law.

About the network and information management the EUIF has a lead co-ordinating role in stimulating labor market actors to cooperate and innovate. Public and private stakeholders are usually EUIF contracted service providers. In addition, EUIF has cooperation agreements with relevant employers and the EUIF is represented in the boards of the vocational training institutions and other education/employment related networks. The quality of the cooperation is ensured by setting out qualification criteria for service providers and on-the-spot monitoring the service delivery. The EUIF organises regular information and training events for current and potential partners and meets with employers at national, as well as regional level, to exchange information and receive feedback.

To communicate internally, the EUIF uses an internal website for employees and EUIF information systems (i.e.
records on clients, contracted out services etc are included in the employment services information system 'EMPIS'). Furthermore, regular information days are held for the staff, including monthly meetings with regional managers. External communication tools include a webpage, Facebook, Skype, a self-service portal (ITP), the organisation of job and career fairs, EUIF's own broadcast on national TV and regular round tables and meetings with external service providers and employers.

Job vacancy information is gathered by employers volunteering information on vacancies (via the EUIF website and from January 2011 via the self-service portal), by contacting individual employers (for example, making calls to employers on a daily basis) as well as through organising meetings with employers at a regional and local level. These take place every month. In addition, the EUIF shares information with Enterprise Estonia. The EUIF provides information on the available labor workforce and helps to fill vacancies through active labor market policies (e.g. training, wage subsidy, apprentices) while Estonia Enterprise provides information on potential investors and jobs to be created. In addition, the EUIF organises job fairs that bring together employers and jobseekers. Ten job fairs will take place across Estonia in 2014.

The PES market share accounts for 50 % in 2013 and it is defined as the share of vacancies advertised by the PES as a percentage of all vacancies. At the same time, the number of people leaving the PES unemployment record was 17 % in 2013.

In the end the EUIF does not regularly monitor supply and demand characteristics in the labor market. However it identifies, in collaboration with experts, priority areas for training in order to prepare the workforce for economic sectors
which show or have potential for growth. Training programmes in those priority areas are developed together with employers, training providers and professional associations, and are tendered for on a regular basis.

1.3.6.4 Italy

The objectives include designing employment service policies to improve labor market matching and social inclusion, enhance the Italian PES efficiency and effectiveness and monitor activities to identify areas of improvement.

The Directorate General for Employment Services Policies is in charge of coordinating employment services as established by law. It deals with the implementation of relevant provisions of the European Union, with initiatives to combat undeclared work, inclusion in work of disabled and disadvantaged people, prevention activities and studies on social emergencies and employment. It heads the development and management of the labor information system (SIL), in collaboration with the Regions.

The national performance targets for 2014 include implementing a monitoring system of private and public employment services to evaluate services and analyses their effect on the labor market; implementing the triennial programme to enhance the transparency and integrity of the Ministry of Labor and Social Policy; implementing an IT system to manage and monitor the LMP, specifically, those targeting youth and disseminating information to jobseekers, employers and other stakeholders.

The Italian PES is organised on three levels:
National level – Ministry of Labor and Social Policies (which designs labor market policies and is in charge of the coordination of PES actions)

Regional level – 19 Regions and two Autonomous Provinces (which design the labor market policies in cooperation with the MLPS, but they are also responsible for designing the regional policies and for the implementation of the measures)

Local Level – Provinces which are delegated by the Regions to deliver services, through the PES Offices.

The PES is located in the Ministry. The General Director of the DG for Employment Services Policies is the Head of the PES.

About network and information management the Italian PES has a lead co-ordinating role in stimulating labor market actors to cooperate and innovate. Regular meetings take place with different labor market actors to share ideas and identify how to work together to achieve national goals. Decision-making stakeholders with the right skills and experience are involved. This enhances the quality of the cooperation.

Internally, information is shared using the Cliclavoro portal (www.cliclavoro.gov.it), the intranet of the Ministry of Labor (www.lavoro.gov.it), thematic meetings with the Regions and other stakeholders and mailing lists. Cliclavoro is about to become the main database at the national level (comprising information from Ministry, Regions, Provinces, and other public bodies). The Cliclavoro portal is also used to share information externally, along with social media, newsletters and events (such as job fairs, conferences etc.).

The estimated market share of the PES is between 8 % and 13 %. The PES market share is defined as PES placements as a percentage of all hires across the economy.
In the end supply and demand is monitored using the 'Oracle Business Intelligence Enterprise Edition' software. This looks at the vacancies on the "Cliclavoro" portal. An analysis is undertaken looking at different parameters (such as an analysis of vacancies according to professional qualifications). At a regional level, labor market intelligence is used to guide the direction of future training needs.

1.3.6.5 United Kingdom

The main actor is Jobcentre Plus (JCP from now on). It sits within the Department for Work and Pensions (DWP). It performs the operational delivery of employment policy designed and held by the Department including requiring claimants actively to seek, or prepare for, work as a condition for receiving benefits where they can reasonably be expected to work; offering support to claimants' needs; delivering the Youth Contract to help young people into work; supporting disabled people to take up work through disability employment programmes; and referring the hardest to help claimants to the Work Programme. JCP also processes new benefits claims and makes benefit payments for those on Job Seekers' Allowance, disability benefits and Universal Credit.

In line with a new performance management framework implemented with effect from April 2011, JCP will publish information on two outcome measures, for which it will be accountable to DWP. These are the benefit off-flow rates into employment and the monetary value of fraud and error. To support the achievement of outcome measures there will be a range of supporting data, including information on customer and
employer experience, benefit administration, labor market, fraud and error, productivity, and value for money.

JCP undertakes tasks to get unemployed people back into employment, education or training and provides support according to the individual's needs. In addition, JCP is moving major transactional services online and providing help and support to people to use digital services.

Officials from DWP oversee the running of JCP from a national perspective and are responsible for the longer-term vision of DWP operations. The goals and funding for JCP are decided annually by the DWP and the Treasury, and set forth in the JCP business plan.

JCP has three core delivery arms: Jobcentres help people to find work and check peoples' entitlement and job search; contact centres take customer calls and claims to benefit; and benefit delivery processing claims and responding to customers' enquiries, and investigating fraud.

The delivery network is managed in Groups, which encompass broad geographical areas (e.g. Central England) and coordinate the activity of the associated District Offices. District Offices, often based on county boundaries, coordinate the activities of the Local Offices in their area; and Local Offices conduct the entire front facing activity of JCP. In addition, JCP also delivers services from over 1 200 other outreach locations and operates a mobile service.

JCP is part of DWP, and comes under the oversight of the DWP Permanent Secretary.

About network and information management

JCP has a lead coordinating role in stimulating labor market actors to cooperate and innovate. This takes place
through active labor market policies (ALMPs) such as compulsory fortnightly job search reviews. Partnerships with other public and private stakeholders are managed through formal commercial contracts. It is standard practice for DWP to evaluate ALMPs. The majority of DWP’s research is contracted out to a mix of research organisations, including academic institutions, commercial and not-for-profit organisations. All such research is published via the DWP website. Results of evaluations are taken into account, along with a range of other factors, in developing future policy.

JCP uses the following methods to communicate internally and externally: email circulation lists; intranet; regular meetings and databases. There is a dedicated staff intranet.

While collecting information on job vacancies, JCP liaises with trade bodies to actively encourage them to post vacancies. They also analyse growth sectors in the economy and target sectors with potential for recruitment. This engagement activity with employers is constantly on-going. In addition, advertising campaigns and seminars take place on an on-going basis.

Previously, JCP used the term ‘positions’ to count the number of vacancies and referrals. However, the system changed in 2012 when 570,000 job vacancies were advertised that year. In 2013, circa five million jobs were advertised but no further information available.

No data is available on the number of people leaving the PES unemployment records as a share of the registered unemployed as it is only those receiving unemployment benefits that specifically register with the PES. Others are directed towards and are able to use online services. The estimated market share of the PES is 30%. The PES market share is defined
as filled vacancies (i.e. PES placements as a percentage of all hires across the economy).

In the end JCP does not routinely monitor how the characteristics of current vacancies compare to the qualifications and capacity of current jobseekers. However, there is a periodic overview of the skills requirements for vacancies held on the PES database. In most cases the jobs require Level one or two skills. JCP uses labor market intelligence to guide the direction of future training needs. In almost all cases UK training is funded via general taxation, and jobseekers receiving benefits are normally restricted to short-term basic employability training (typically for a maximum of four weeks) or modules to supplement existing skills (maximum of 12 weeks duration). PES at national level feeds in information on jobseeker skills and employment aspirations to Sector Skills Councils. These bodies include representatives from both government and industry; they must assess courses as being fit for purpose to train people to enter specific sectors prior to funding being authorised. Local PES managers' liaise with training providers to inform decisions on vocational training modules provided by local institutions.
2 The technical approach.

2.1 Agent base modeling

Because of the innovative aspect, the relative novelty and the difficulties of the techniques used, we think that it is useful, if not necessary to discuss Agent Base Modelling (ABM from now on), explaining both its technicalities, both the pertinence for our work and even its general terms.

2.1.1 The general setting

Agent base modeling is a (relatively) new tool. In facts several decades have been passed from when this technical tool started to be explored by the forerunners, but, probably because of its technical requirements and/or its discussed role, it started to spread more widely as a possible instrument only in more recent days.

Anyway, historically speaking, we feel free to date the birth at the latest around 1988 when, at the Santa Fe Institute, started an economic program, recognizing (as was usually done also before) the economic activity as a social complex system and recognizing again that “some economic problems where simply too complicate to yield only on the old nineteen centuries techniques” (Weaver, 1948) at least how them where used till then.

Since then the ABM technique started to spread more quickly. This was probably due to the fact that the program and Santa Fe institute in general become also a reference point for the discussion about the already mentioned themes.
We can recover these points also in a letter of the first director Arthur (2003) sent to Martin Shubin commenting the program: “Our objective was not so much to reform economics as to catalyze certain changes that we saw as inevitable…” (here we see the sake of finding new techniques to be combined to already used instruments) “and Santa Fe institute was not the first to introduce… agent-based modelling, inductive reasoning and increasing returns approach, them were all pioneered elsewhere.” (here we see the fact that ABM birth should probably be dated even earlier) “but the program did much of the early work and the early development of these, and indeed got the credit for introducing them.” (here we see that Sante Fe Institute was instead recognize as the reference point of the new techniques since it was the place where them where improved but more importantly contextualized and clearly organized).

Later on we reach another turning point when, at the Santa Fe Institute, started another project called swarm (first release: 1994). Swarm is a multi-agent software platform for the simulation of complex adaptive systems. In the Swarm system the basic unit of simulation is the swarm, a collection of agents executing a schedule of actions. Swarm supports hierarchical modeling approaches whereby agents can be composed of swarms of other agents in nested structures. Swarm provides object oriented libraries of reusable components for building models and analyzing, displaying, and controlling experiments on those models (Minar et al., 1996).

We said that ABM technique started to spread around in the world, but it should be noted that in economics it is a technique largely discussed that have never been able to explicitly merge itself in the list of the ones commonly used by
the mainstream. This is probably due to its disadvantages or maybe to the limit that PCs memories have/had up to some years ago to run programs, which to be interesting enough, are/where a bit too heavy, or maybe more simply to the sociologic fact that people find hard to accept novelties. It can be seen indeed that usually the greatest difficulties to incorporate novelties are faced exactly by the experts of the field: the ones who knows better the benefits of previous tools and are more prepared, find hard to change their habits and mindset since them are more suspicious (probably fortunately indeed they own more instruments to evaluate possible risks and limits). Easy example should probably be recover in medicine, one is the introduction of penicillin (whose discovery is attributed to the Scottish scientist and Nobel laureate Alexander Fleming in 1928) and related medicines. First of all the penicillin and its possible benefits were probably guessed many years earlier (for example by the same Pasteur around 1890) but remain unexplored for many years; moreover, as Wikipedia states even when scientifically proved it took many years to be incorporated in medicine by doctors:

Fleming was a famously poor communicator and orator, which meant his findings were not initially given much attention. He was unable to convince a true chemist to help him extract and stabilize the antibacterial compound found in the broth filtrate. Despite the lack of a true chemist, he remained interested in the potential use of penicillin and presented a paper entitled "A Medium for the Isolation of Pfeiffer's Bacillus" to the medical research club of London, which was met with little interest and even less enthusiasm by his peers. Had
Fleming been more successful at making other scientists interested in his work, penicillin for medicinal use would possibly have been developed years earlier.

Whichever the reason, we now explain what people refer to when speaking about agent based simulations and agent based models. We will recover then purposes, critiques advantages and disadvantages of it.

2.1.2 Tool description:

When we talk about agent based simulations we talk about a replication, whose outcomes are numerically computed, usually regarding some aspect of reality (even if hypothetically it is not strictly required), in which there are multiple objects interacting one with the other and/or with the environment as autonomous agents following the rules (Bonabeau, E. 2002). In agent based models these objects are supposed to take some actions, pursue some objectives or have some kind of strategic behavior, otherwise, usually, people prefer to talk about multi agents models, which are models to find solutions (or the existence of them) when we deal with many agents and some restrictions. In multi agents system for example decisions can be not decentralized to agents themselves while doing so in an agent based model is considered somehow unacceptable since by definition “there is not top down control over their behavior”. (Leitner et al., 2013).

In theory nothing prevent ABMs form being performed by real agents (as humans) in a real space: for example if we ask my friends to enter a room and follow a set of instruction I give
to them and interact, we have in theory build an (probably useless) ABM. There is indeed a particular expanding field close to ABM but which focus on real agents which are asked to take decisions on virtual events. To be distinguished it is called serious gaming approach (Ghorbani et al., 2014).

But in practice and also in our case (indeed ABMs are optimal substitutes for experiments when them are too costly in term of money, ethics or whatever) ABMs are usually computer based and the data structure (representing agents) is exploit threw computers programs.

A useful way of programming when performing ABMs on PCs, is called object oriented programming: whit this program structure the code is not build to give a set of order to be read and completed by the machine, but to build a set of recipes (the so called methods and functions) accessible to agents when them are asked to perform some actions or take some decisions (and which, up to some limit, can be even rewritten by the agents themselves.

The relevancy of ABMs is wide in many fields and probably also in some practical activity but now we will discuss about ABM as a formal tool for scientific inquiry in economics.

2.1.3 Purpose

ABMs are used firstly as an instrument to produce knowledge (Boero et al., 2015). When used for this aim people create these close models to discover both the micro foundation of economic analysis and macroeconomics effects emergence of these micro foundation. Indeed the scientist creating a close agent based model with good prediction (we will discuss the goodness point later) can easily (since connected to the
assumptions, made to create the model itself) discover the basis of the set of rules on which the system lay on, and investigates which mechanisms, with their relatives weights (discovered threw a calibration of the model with real data), are responsible for a given phenomenon; on the other hand with the same good agent based closed model the scientist can looks at the time dynamics and at the emergences rising from it during the various steps. Once that the scientist discovered all these findings with its perfect model he can moreover pass to produce even more knowledge giving the predictions of the model and more interesting (since we already accumulated our findings) the predictions of particular conjunctures threw the so called "what if experiments". These last ones can be used both in an ex-ante way and in an ex-post one: ex ante are used to answer (scientist problems related?) research questions and to correctly address policies, finding weakness and missing points; ex post are used to evaluate the policies. Till now we assumed the scientist to have created a perfect model, but even in cases in which this does not happens (quite always as usually happen with every tool I think) many of the finding are usually reliable nevertheless the model can be improved and used ex-post (if we are able to recognize its weaknesses) and to discovering some further mechanism we do not think was playing a role.

To explain the whole paragraph better we will now make a stupid and not perfectly coherent with the definition of agent-based (otherwise we would have been geniuses finding a perfect models in a few time) examples:

Imagine that we created a model composed by agents with the ability to light/extinguish a fire, to combine objects and with a free disposal of eggs, some little pot full of water;
furthermore the model is equipped with the notion of cooking as a function of temperature and time and the notion of temperature as a function of fire and other factors. Then from this model we can discover the micro basic mechanisms driving the boiled eggs cooking. For example we could have discovered which are the correct sequence of actions which lead to the result as in reality (only assuming something like: light the fire, put the eggs in the pot, put the pot over the fire, wait some time, extinguish the fire) and then fell free to assume that agent while cooking eggs behave in that way; or we can have discovered calibrating the model with real data the time we need to wait with eggs on fire to reach desired cooking for each "given" set of factors (temperature...). Assuming that the scientist have known that temperature effects change with height/pressure but not that this reflects on the cooking results he would also have discovered the macro emergence that height influences eggs cooking. As we told the model can be used also to give policy suggestion, for example ex ante with this model the scientist can suggest what happen if people never extinguish the fire (so that temperature is always higher than before) or ex post how effective was a policy which command to light the fire in random periods (e.g. can give the benefit effects of the policies and also its whole as the fact that the policy maybe would have been more effective if it had commanded to light the fire not in random periods but before specific times/events). Suppose then that the model was imperfect e.g. was unable to incorporate effect of close fire and that after a change in real world we saw the model got wrong since when people lighting fire together our prediction on time are always longer with
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respect to real data, then recognizing it we have discovered the role of distances between fires.

The second point we now talk about is the fact that ABMs can be used also as a possible substitutive tools to face those problems which are not solvable with the usual tools because of our computational inability; for example ABMs can "easily" discover and incorporate those solutions where iteration is required; or because of the existence of transitions and complexity in general (we will discuss the complexity point later) to be incorporated.

Finally since them are models, as every modelling tools, ABMs may assist the scientist in replacing a phenomenon in an unfamiliar field by one in a field in which he is more confident (for example since models help to define properly a problem) and in a place in which he may enables the carrying out of experiments under more favorable conditions than would be available in the original system (Rosenblueth et al., 1945).

As we can imagine and as implicitly emerge from our previous discussions ABMs own both some advantages and some disadvantages and we will now generally discuss them.

2.1.4 Advantages and disadvantages:

The first advantage we recall briefly, is given by the fact that with ABMs we can cover some of the scientific space which can not be covered before: complex environments. In other words ABMs can help when we have to face with a considerable amount of variables which present strong nonlinear interaction among them. We are including in these problems also all those non deterministic problems where combining the summands we
do not got the sum, or in other words quoting Anderson (1972) when “the behavior of large and complex aggregates of elementary particles, it turns out, is not to be understood in terms of a simple extrapolation of the properties of a few particles but of always new appearing properties at each level of complexity”. Most of the common tools used in economics (as neo-classical equilibrium modeling, game theory...) are not viable for this purpose; try to manage these problems for example with averages simply will not work, it maybe will result impossible to fully understand these problems, but certainly to explain complex situations we can not use a tool which do not incorporate complexity. For example ABM differently from differential equations do not smooth out fluctuations and can describe those situations in which the system is linearly stable to small perturbation but unstable to larger ones. In practice ABM is usually a better tool when there is potential for emergent phenomena: when individual behavior is nonlinear and can be characterized by thresholds, if-then rules, or nonlinear coupling; and this discontinuity is difficult to be captured by differential equations; when Individual behavior exhibits memory, path-dependence, and hysteresis, non-markovian behavior, or temporal correlations, when we including learning and adaptation; when some of the assumptions between linearity, homogeneity, normality and stationarity are too strong to be taken (Bonabeau, 2002 and Bankes, 2002).

A disadvantage connected to this point is the fact that even if ABM algorithms are robust to complexity (Boero et al., 2015) sometimes results they lead are opaque and difficult to be read in particular without a long series of experiment.

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A second advantage of ABMs should be recovered exactly on those fields well covered by others common tools. In these case the tool should be combined with the classical formalism but with ABMs computational ability we can often relax some assumptions (Bankes, 2002). These models while working on the just mentioned field can at least expand, if we are not interested in improving the existing ones, evaluation criteria (Ghorbani et al., 2014). For example in analyzing the policy effects why should we limit ourselves to classical models evaluation criteria without including the social consequences of the policy between them? We think that the benefit of such an improvement are quite evident both since as human we care about many different aspects and since anyway these criteria affect also the common studied policy effects. For example evaluate the perception, the diffusion and the social reaction of the policy is relevant as much, if not more, as knowing the direct effect of the norm. Taking Italy to illustrate, there people often criticize the fact that policy making is too often disconnected from the study of the practical life mechanism so that people are able (and consciously or unconsciously decide) to offset the effects. ABMs are particularly pertinent in this example also because while monitoring the effects of policy is one of the rare tool able in tracking reactions and not only comparing before and after situations.

ABMs become focal also when time dynamics are relevant: these models can easily shows the emergences in the various steps and are also able to localize the various aspects (giving a case to explain better, others tool are usually unable to capture when in the model a given problem born while ABMs do so) (Borshchev, et al., 2004). Because of this ABM is an optimal tool
when scientist pursue, more than explaining the general sense, is reproducing the various steps (Epstein et al., 1996).

Next advantage we talk about is related to a feature common to the inherent feature of social sciences and of ABM. Ideally in social science agents, not aggregations, are the ontological subjects (Bankes, 2002.) and, so, the one on which assumption should be taken (for the same reason economics studies also the one related to macro environment are now focusing a lot on their micro foundation). The focus on agents is, of course, even more required when we deal with decentralized problems. Not surprisingly then, our tool which is focused on agents and built upon local behavioral rules (if we model well how the system works) is the one which incorporate and display in a better way the bottom up effects. The second gain of this structure is somehow more practical, indeed when we need to deviate or leave the perfect maximizer agent we face many facilitation: with equations we have to formalize also these imperfections (with further assumptions) while with ABM we do not need it; in an ABM is quite natural to include individual differences and different behavior while in standard tools we face quite always the tradeoff between the need of heterogeneity and the need of clear/small assumptions. For this reason a think that can be performed with ABMs and not with standard theorizing (unless we talk about small populations and game theory tool) are study ad hoc for a given specific population. Of course in this case results are not reliable if generalized but these models can be anyway useful in particular in the short run.

As it was quickly mentioned before, ABM include (again since it focus on agents and agents relations) naturally also the
social structure/dimension and is one of the most recommended tools to study networks, networks effect and the deviations from predicted aggregate behavior due to the given social structure.

Another advantage (Boero et al., 2015), which is not often given by others tool, is the possibility to have theoretical and empirical connection. Most of the critiques to standard economic theory are related to the fact that theoretical works and empirical works are disconnected so that theoretical work are either per se consistent but useless in real world, or since not consistent not utilisable; empirical works instead either suffer the same critics when inconsistent with a theory (so seen as not utilisable or when seen as too specific and not utilisable in the future (in the sense of any different case). ABMs instead does not suffer (a part a bit for the last point) about these critiques (even if it suffer for others) since by construction it combine a clear theoretical model (given by the assumptions on agents behavior) and the empirical structure given by the data structure used to create and calibrate agents and agents variables. ABMs in fact are flexible and can be used for conducting abstract theoretical investigations that do not require empirical grounding (and generate as we discussed before quantitative and qualitative data), as well as performing very specific applied analysis that use large amounts of data, along a continuum of options. Furthermore, with ABMs it is possible to use empirical knowledge in theoretical analysis, allowing researchers both to not break the loop of scientific discovery, which goes back and forth between theory and data, and to properly address the different kinds of applied research questions posed by the contemporary world. Differently from empirical works ABM own clear causal relations, are usually free
of endogeneity and spurious correlation and can easily access more than one by one causal mechanism (as socio-economic phenomena usually have).

Another nice advantage of ABM a part of including our agonized social dimensions is the general possibility of easily mix also with other discipline which even if till know seemed useless may bring to interesting future results.

I finally want to recall, even if already mentioned, the cost advantage with respect to making expensive experiments/pre-experiments. In particular, as said, is easier to replicate phenomena and giving them the levels of simplicity/closeness to reality we want.

As we had a great inherent advantage also the main disadvantages are inherent in the usual techniques used for ABM: since it is a computer based tool models are subject to bug and restriction (given by the specific program we use or more generally by computer formalism) and results or lack of results can be often traced back of an involuntary error or a given pc constraint (for example we can find a results coming from bad approximations or we can miss to insert a desired point since PCs find hard to make abstract calculus…). Further errors can rise while doing an ABM because of human inability to use the instrument (and not because of the instrument itself), since programming activity is still a complicated activity requiring specific skills and knowledge (which when you are a scientist and not a programmer usually do not already have). This point is a problem also for communicative reasons, it is hard to communicate results to people which are not expects of computer modelling (we talked about computer modelling and
not ABM since probably agent based approach would not be difficult to be explained for it focus on agent).

Quoting the forthcoming book: agent base model of the economy (Boero et al., 2015) another problem is. “The difficulty of systematically exploring the entire set of possible hypotheses in order to infer the best explanation. This is mainly due to the inclusion of the behavioral rules for the agents within the hypotheses, generating a space of possibilities that is difficult, if not impossible, to explore completely.

2.1.5 Further notes:

The first point is about the goodness of the model, ABM is not good per se since it has been created; an ABM can be a good models or a bad models exactly as a classical model can be a good one or a bad one. Whether it is a good model depends from its ability to explain, predict and produce knowledge: a model explaining that eggs boils in the (cold) sea water is not a good model; quoting the book artificial economics and self-organization (Leitner et al., 2013) “The models reviewed in the previous section are more general and more complex than their overlooked ancestors, but they will ultimately be judged under the same metric: the ability to track real data, simulate policy options and provide policy guidance.”

The second point is about the possibility of using a combination of tool. While discussing sometimes this possibility indirectly appears. For example the need to combine empirical and theoretical studies, as we said, is so strongly felt that empirical studies, which usually use econometrics (or anyway data managing), are criticize if in fact do not use also a
reference model and others tools to study those models (as it can be a classical equilibrium model). In the same way we can (and is often used) base our theorizing both using ABM and system of equations (for example to justify some objective of the agent or to summarize some outline actions we are not focusing our attention on). The important thing is to be conscious of all the assumption needed, the limits and benefit each technique brings with it.

To sum up while presenting the tool, its advantage and limit we would not convince anybody that for modelling, doing policy analysis, sensitivity studies, statistics and so on... the best performing tool is ABM, our intention was to frame and clarify the instrument showing that it is powerful. Whether it is a good idea to use it is given by the object of interest, because the object imposes the methodology and necessary instruments to study it (e.g. sound and ears for the music and taste and mouth for the food); we have “simply” to choose the one which match in the best way the nature of the problem.

For this reason we will think is now relevant to discuss why we think that ABM can be useful for our studies

2.1.6 Why and how we used agent base modeling

The choice of the model is of course connected to the benefit we think it can give us in studying labor market structure and labor market policies.

The first reason why we decide to use an ABM is related to the fact that we think that complexity is playing a major role and we can exploit all those already mentioned advantages in using ABM to study complex environments. Indeed labor market is complex: in the sense of complexity and heterogeneity of
agents involved (McCall, 2001), in sense of complexity of agent choices while looking for jobs/workers and investing on human capital/assets which shows interactions and accumulating and nonlinear effects (Babcock et al., 1999 and Neal, 1999) and in sense of a set of complex of institutions (Bass et al., 2010).

At a fist stage with ABM it is possible to build a close model of the labor market assuming some reliable actions that agents perform while looking for jobs/workers. With this model firstly we look at the time dynamics and emergence of each step, then, comparing results with other theoretical works, we try to give further complementary insight. For example comparing results with theories which use the matching model we try to discover if it makes sense to use an exogenous matching function or if it makes more sense to consider the matching process as endogenous (so influenced by the changing context and by policy interventions: see also Neugart, 2004) on the other hand we try also to discover if the tendency to have some kind of equilibrium and a natural level of employment is reflected by the model.

Furthermore we try to exploit deeply the ABM, looking for insight on others possible outcomes. To give an example we try to discover the policy effects predicted by the model and how these policy effects are influenced by some simple behavioral assumption. To be more specific, first of all, we try to discover if them coincide by usually predicted policy effects and, secondly, we try to understand which are the situations (as agent assumable behavior and reactions) in which these effects are reliable or not (/more or less powerful).

Moreover we decided to rely on agent based modeling since it gives the possibility to focus on the existence of some ex-ante
or conjuncture driven disadvantaged category\textsuperscript{15} and, as already said, this kind of modeling, is one of the best tool in dealing with heterogeneous agents. In both case indeed using ABM ensure us that we can face also those variables which usually shows accumulating effects.

Then, at a second stage, we try to use the powerful tool of ABM threw its ability to have theoretical and empirical connection. In particular at the beginning when calibration with data is not given yet, we can use ABM to evaluate the intensity of the effect as a function of time and time dispersion/concentration (e.g. a policy can be effective at time $t$ and ineffective at $t + j$ since you are by decision or by force in facts out of the labor market) and to study if a policy harms the non-beneficiary. Later on after calibration ABM can be used to give more accurate evaluations up to (for example) some suggested order of preference over policy for labor market structure compatible with our model.

(In particular we intended to exploit the possibility of combining ABM with data on training involved agent in Piedmont using our dynamic microsimulation to discover the effects of training policy (for the second placement since the training program was targeted to people which needed to be reinserted

\textsuperscript{15} By ex-ante we mean those disadvantaged for all those characteristics related to the agents' nature (we may refer to age, sex but also to preferences...) while by conjuncture driven we refer to all those characteristics related to the artificial "manageable" endowment (we may refer to strictly manageable variables as education but also to more passive e.g. being unemployed).
in the labor market). Data are use firstly to give characteristics to agents, then to calibrate predictions, so that then we can compare policies) (da togliere se non ci arriviamo)

In the end, even if it could be roughly contained in the complexity argument, the choice of ABM is a good choice because it can include the social context, so that we can have the emerging affecting results and we can gain information also of effects over it performing a network analysis which is not always viable with the common tools. This kind of study is interesting since, as Durkheim (1951) says, the reasons for social regularities must be found not only in the intentions of individuals but also in the structure of the social environments in which they are embedded.

Again since we will use this methodology in our tool we again believe that is everything but useless to recall the major passage of network analysis.

2.2 Connecting individuals: Network analysis

2.2.1 The general setting

By Freeman (2004) we can get a synthetic definition of social network analysis and an even more synthetic division of its history. He declare that the study of networks should own four main characteristics: it should be:

("motivated by a structural intuition" and) focused on ties between actors rather than on attributes of actors; it should be based on systematic collection of data about those ties; it should rely on graphics; and mathematical/computational tools to make sense of the welter of information about all those ties.
In his vision the history of social network analysis can be divided then in four major period the first till the end of the twenties so till when network analysis was performed roughly (or at least not completely with respect to the characteristics we mentioned); the second during all the thirties, when social network analysis flourished; the third instead was a dark period for network analysis: this period going from nineteen-forty to the nineteen-sixty-nine saw the social scientists' return to traditional focus on individual characteristics; the last period (modern era) holding till now which is the one which shows a new renewal for social network analysis. We will now recover the main steps of the evolution of social network analysis.

Even if the field was explored previously and many attempts were done before the thirties, we agree with Freeman vision when he said that in these years social network analysis flourished. The most important step can be represented by Moreno’s “sociometry” (1934): here we find the first way of making the abstract social structure tangible (in some of its representation we find something really close to the computer base representation of networks between agents of a model: we found agents represented as circle/node, collection of agents and connections representing feelings between these agents represented as directed and undirected lines/links).

Another step in the evolution of social network analysis is given by the application of matrix algebra and graph theory in the analysis. Introduced in the “dark period” these techniques helped in formalize fundamental social-psychological concepts such as groups and social circles in network terms, making it possible to objectively discover emergent groups in network data (Luce et al., 1949). We
disagree with Freeman definition of this period also because we found some interesting studies (performed not on individual characteristics but on ties). An example is given by Bavelas's (1950) work on the effects of different communication network structure on the ability of a group to solve problems. Studies on the field continued and kept on in expanding; to quote some famous work we refer to the theoretical model (Pool et al. 1978) and the empirical work (Milgram, 1967) which have been able to show that U.S. are a really "small world" considering networks: more than 50% of the population (or the sample in the empirical work) could be linked by chains with no more than two intermediaries.

Next passage is given by the introduction of reduced model for the complex algebra (Lorrain, 1971): it is based on the idea to allow the collapse of those nodes with equal/similar incoming and outcoming connections... since we assume to get a similar (if not the same) response from similar agents.

Last necessary step, probably done during these same years, to enter the Freeman's idea of modern era was a change in the focus from nodes to links. For completeness we quote Granovetter article (1973) which for us ensure the passage was made (the study show how strong link tend to form self-referential groups).

### 2.2.2 Some notes

Before going on, a thing to be noticed is that social network analysis probably should be consider something more than a simple tool. When scientist try to discover network antecedents and/or effects or the general network theory probably it should
be seen more as a science rather than a tool\textsuperscript{16} (we will discuss the critiques related to this statement later).

Firstly, to disambiguate what a social network is, we report here its definition from Wasserman and Faust (1994, pp 17-21):

"A social network consists of a finite set or sets of actors and the relation or relations defined on them. The presence of relational information is a critical and defining feature of a social network."

And the one from the Wiki Book: "Social network analysis: Theory and applications" (2011)

"In its simplest form, a social network is a map of specified ties, such as friendship, between the nodes being studied. The nodes to which an individual is thus connected are the social contacts of that individual. The network can also be used to measure social capital – the value that an individual gets from the social network."

Secondly, to facilitate future reading, we report here some definitions:

In social network analysis actors (which are also called agents, individual, nodes...) are linked one to another by

\textsuperscript{16} For example I recall Pool and Kochen (1978), who tried to discover which is the probability that two agents are connected by a k chain of intermediaries in a population with N individual having an average of n (< N) connections, and Milgram (1967) small world problem. To give another example I quote the work by Nadel, (1957) in which we have a study on pattern of relationship to be used then to study societies and their evolutions.
connection. The connections representing social relations are usually also called (social) ties, hedges or links.

At the most basic level a relation establish a link between two actors. This structure is called dyad. Subset of three connected actors are then a triad and so on... More generally we can have a subgroup which is a subset of actors (whose number can be also undefined); the subgroup containing all the population is the network.

The collection of a specific kind of link among members of a group is called a relation.

Since, as we saw, we can refer to different size of groups, we have of course different names also for each measure characterizing network structures at a different level of analysis: the dyadic level refers to measures focusing on two actors and their situation with respect to the population; the network level refers to measures which focus on the population in general; the node (from the name of a single agent) level refers to measures which focus on single agents and its role in the network.

When people talk about social capital in network analysis they usually refers to the advantage created by a person's location.

Last point to be noticed, before starting the pure description, is that we can deal with multiple network: firstly in the sense that different kinds of dyadic links can be (analytically and theoretically) distinguished. Note that each network potentially own a unique structure and different implications for the nodes involved. Secondly in the sense that these different kinds of networks can coexist in a unique graph/model; if this is the case we can perform also useful
studies on their interactions, e.g. the formal network of economic transactions among actors can be influenced by the informal social relations among the same set of actors (the idea of the example has been inspired from Granovetter work, 1985).

2.2.3 Tool description:

As we already said mentioning the fundamental steps for network analysis, it is performed threw “a graphical representation” of the concepts of network (which sometimes can be only assumed/imagined and not drawn) of dyadic phenomena/networks between nodes/objects; in this usage indeed a network and a mathematical graph are synonymous and we can use graph theory (which, using Wikipedia definition, is the theory focusing on the study of those mathematical structures used to model pairwise relations between objects) to make calculus on nodes and hedge of given contexts.

Probably there is an infinite number of possible concept, proprieties and measures to be exploit, but now we will discuss about the (main) families of graph-theoretic properties scientist quite always use to characterize networks, positions of actors and link in each of its level of analysis.

At the network level of analysis scientist usually focus on cohesion and shape properties. Cohesion properties refer to the connectedness of the global structure and includes properties such as density, characteristic path length, and fragmentation. Cohesions properties are often also used to define and detect subgroups that have some of the already mentioned specific cohesive properties, such as high density, short distances or multiple independent paths among members. On the other hand shape properties refer to the overall distribution of links
including properties as core-peripheriness, clumpiness and scale-freeness of the degree distribution.

At the node level of analysis, the most widely studied family of properties is centrality, a set of properties related to the importance or prominence of a node in the network. An example is Freeman’s betweenness, which captures the property of frequently lying along the shortest paths between pairs of nodes. This is often interpreted in terms of the potential power that an actor might wield due to the ability to slow down flows or to distort what is passed along in such a way as to serve the actor’s interests.

At the dyad level of analysis the most important family of properties regard dyadic cohesion and dyadic equivalence. By dyadic cohesion we refer to the social closeness of a pair of nodes for example threw geodesic distance (the length of the shortest path from one to the other) or multiplexity (the number of different kinds of relations that bind a pair of nodes), by dyadic equivalence we refers to the similarity of structural roles played by the nodes, to illustrate, a possibility is to see if two nodes are isomorphic (own the same structure of links / structure variation; note that same structure does not only means the same links).

The choice of different measure/properties to be analyze probably emerge also as a consequences of the conceptual metaphors the network represent. Before we gave some definitions of “network” which we thought were possibly including the major two. A network can represent a flow model or an architecture model (Borgatti, 2009): in the first one the network is seen as the ideal space where things flow (as a
system of “roads”); in the second the network is seen as the ideal structure upon which socio-cultural-system are built.

The last point we will recover to describe network analysis is related to the link generation process. In the literature again two main category can be distinguished: networks as result of opportunity based antecedents or networks as result of benefit based antecedent. Opportunity based approach focus on the probability to come in contact, for example we can talk about opportunities created from geographic proximity (Festinger et al., 1950) or social proximity (Blau, 1977) benefit based approach instead, assume some kind of optimization problem (in sense of conscious or unconscious research/escape of a gain/lost) an example can be McPherson. works (2001) where authors express the relation generation for example using the tendency to create links with similar individual since it is more effective and easier to exchange information.

2.2.4 Advantages and disadvantages:

There are many reason to perform a network analysis, but in general we can say that, since the inherent axiom to justify the use of network is that structure matters, then it is used when people do believe that different structures can lead to different outcomes or can explain part of the actual state of world.

In particular, firstly, network analysis can give an advantage when one or more of the following mechanism is playing a relevant role: transmission, adaptation, binding and exclusion.

An example of a work based on transmission mechanism is the one by Davis (1991), which illustrate the speed and
adaptation of "poison pills\textsuperscript{17}" as an infection transmitted from corporate board to board through shared directors or all also those based on the diffusions of ideas or on the influence of a node to another. We can say that work based on transmission mechanism invoke the existence of relevant transfer from node to node (either of physical or immaterial things).

An example of a work based on transmission mechanism can be the one by Rowson (2010) where agents are shaped in society by connectivity, contagion and reflexivity. Adaptation mechanism can maybe be also the mechanism better summed up by Christakis and Fowler sentence while referring to social network analysis (2009):

"The science of social networks provides a distinct way of seeing the world because it is about individuals and groups, and about how the former actually become the latter".

We can say that work based on adaptation mechanism invoke the existence of relational roles which affect outcomes either threw experiences or threw adaptation to the environment. The difference with transmission mechanism is based on the fact that are not necessary talking about a flow from node to node, rather we are talking about a context (for each node) which shape the node itself possibly without any flow.

An example of work based on binding mechanism is the one by Burt (2005) which shows as in some competitive setting the personal network of each node can be more performing if own

\textsuperscript{17} A corporate governance practice that came to be widely adopted in the 1980s as a defense against hostile takeovers.
lots of structural hole (missing links between nodes belonging to its personal networks). We can say that work based on binding mechanism invoke the existence of properties emerging from the bounded. Differently from adaptation mechanisms binding it is not based on an evolution of the node, instead the new bounded nodes are somehow seen as new entities with their own properties.

An example of an experiment based on exclusion mechanism is the one by Yamagishi (1988) or its extension by Markovskiy (1988), where it is discussed the bargaining power of a set of nodes in a chain. For example in its work Yamagishi shows that in a five node chain the three intermediate nodes own (of course) more bargaining power with respect to the two extremes one, but also that the one in the middle is the one with less bargaining power between the three intermediate nodes since the other two can freely exclude him relying on the low powerful extreme nodes. We can say that, in general, work based on the exclusion mechanism invoke the existence of new properties emerging from relations. It is similar to binding mechanisms but it differs since connected groups of nodes are not seen as new entities with their own properties; rather the node's position in the network determines the opportunities and constraints that it encounters. In the example before the one to own some proprieties are not subsets of the chain which grouped themselves to gain bargaining powers or avoid some loss about it, but single nodes which belonging to a given position gain or lose the power.

The second set of advantages of the use of network analysis are related to the inclusion of the measurement of the social sphere variables and theirs effects in the study performed.
As we saw describing the tool, we can indeed examine the interactions between nodes (actors, groups or institutions); we can measure the resource/information flows between nodes or we can try to understand political, economic and social aspect of individuals and organizations (see for example the case study on Multistakeholder Water Governance in Ghana in the book by The World Bank 2007); in particular, since each social interaction can be viewed in network terms, a formal network analysis can assists in examining individuals within their institutional/relational context and in examining the relational perspective of collective action (viewed as dependent on the social context and/or the transitivity of ties). For example from the previous quoted work we know we can gain insights on the distribution of power and the effective influence of social and political action.

The third type of advantages is related to the fact that, as already said, social network analysis provides a powerful tool for the graphic representation of relations. This can lead to have a more intuitive (and at the same time statistically strong) analysis. Moreover in its graphical representation it pertains to both actor and systemic factors. Then it allows for the examination of events in tandem with actors.

A further advantage of network analysis is given by the possibility of combining it with quantitative and qualitative approaches (for a complete dissertation of this point see Edwards 2010).

Talking about disadvantages instead, a possible disadvantage, since actors and their actions are viewed as interdependent rather than independent autonomous units, is related to the fact that networks violate independent
observations principles, so we have to use either different tools or more complex statistical ones (as ABM or Monte Carlo Markov Chains) to have a more rigorous hypothesis testing of network proprieties.

Another possible disadvantage (or better a usual critique) about network analysis is that it is often view either lacking intentionality and subjectivity of agents (Emirbayer et al., 1994) or that intentionality is distorted by our focus on networks (Giddens, 1984).
3 The model

3.1 Agents

In the model we have three type (or breed) of agents workers, firms and agencies.

3.1.1 Workers

Workers are created in the setup procedure. In our model, since we are not focusing on a growth problem and we prefer to keep the model relatively simple in its complexity, there is not a population growth process. However if we are interested in studying different population effects we can use different trial. Their number is given by a slider and remain constant for the entire duration of the simulation. We allowed to the possibility to set a time of death (decided by fixing a number for the input variable mortality), but in those cases in which the mortality is not fixed at zero (which for us it means no death) we use an overlapping generation (OLG) model where, when an agent die, it is substituted by a new (young) born. Note that for this reason when we uses the OLG model instead of destroying the old agent and, at the same time, creating the new one, we decided to simply (and carefully) restore it modifying its variables (so that the program runs faster).

Both at the beginning and when a new worker needs to born, we assign randomly (uniformly over a reasonable range) the following variables: the location on the space, ability, degree of activity, the set of preferences (over works in general, over dimension and technology of firms, over manual or intellectual attitude), the interiorized human capital (from compulsory schooling, note that since it is quite coherent with
our purpose we focus only on people which passed the period of compulsory schooling ignoring all the problems and literature related to child labor and school dispersion. Other variables, as the bliss point, the schooling/training certificates and the activity level are fixed at a positive initial level while the remaining start from zero.

On the other hand the age (in addition to the less relevant variables as the shape, the size and the color of the agent which are fixed once and for all at the beginning) is the unique variable which is managed differently in the setup with respect to subsequent periods: in the setup procedure it takes a uniformly random distributed integer between the minimum and the maximum age while new born of course start with the age fixed at its minimum level.

The age distribution is hypothetically uniform, but actually can vary a lot at each trial (with a different seed) so that we can also try to see the different effect of different competition related to different age distribution.

3.1.2 Firms

Firms are created in the setup procedure. They own as internal variable some of the usual variable we can imagine in any model including firms: wage, price, demand and profits, some of the characteristic related variables we anticipate describing workers: type of work offered, technology level and dimension and (more particularly even if it is probably predictable) some variables related to the matching procedure: one vacancy to be filled, the set of applicants and of recommended workers. When a new firm is created we randomly assign its demand and the characteristic related variables. Profits, the vacancy, applicants and recommended instead of
course starts from zero (or as an empty set if we are talking about a set of agents). Price instead is fixed at one for all firms: we are not focusing on the good market so we decide to assume that there is a unique good (which can represent consumption in general) and that one (a convenient number) is the added value corresponding to the firm production of one unit of this good.

The evolution of firms instead is more controversial and we imagine many different hypothesis. A part of our work focuses also on this problem and we kept the possibility of different choices also in the final model with a chooser bar. Below we find some of the possible idea we explored.

We divide for simplicity cases in two set: the first set involves cases with exogenous number of firms the second with endogenous number of firms.

The first possibility, with exogenous number of firms, is to keep firms constant (in all sense). Since, for our purpose, we would like to have firms which changes over time we preferred to have an evolving situation and we do not cover this trace.—Given that we are not using constant firms, we have still the possibility to have a fix number of firms. Variation of the market are then given by internal changes. This can be used to study effects and events on the “short run”. By short run we are not referring to the usual idea, (where firms can not enter or exit the market) since changes somehow can reflects some symmetric entry and exit events, but we are bounding ourselves on period of times in which the population and its economy are quite constant (around the initialization parameters).

The other possibility with exogenous number of firms of course is to use a variable number of them. Of course we can
imagine infinite number of variation from the easiest to more complex ones. I propose here and discuss three major category: variation of firm number with trends (e.g. add a new firm each period), with cycles (e.g. adding a firm for n periods then removing a firm for the next n periods), with casual realizations.

Trend categories of variation are usually used when we want to study the effect on the world of a boom/imploding situation. In our case assuming trends it a bit useless (at least as long as we do not introduce ourselves in a more macro environment with population grow...): to study different situation with different firm population we can use different initialization parameters. Using any trend without population growth all other micro effect would be probably obfuscate bringing to an obvious final result of complete employment/unemployment.

Cycle categories of variation are usually used when we want to add some decisions/frictions related to the number of firms but we want to keep this one relatively fix. In our case this kind of variations can generate some conjuncture events (and so generate cases to be studied) on individual which in a fixed world wouldn’t have happened (e.g. the possibility for a great worker to lose a job and enter in a negative loop in spite of its ability).

Causal realization categories of variation are usually used when we do not want to fix a precise variation but we still want that a variation exist. Casual events can generate a probability related way of thinking and even more frictions with respect to cycles. Of course we can think of more or less ruled casual realization from the “easy” random walk to realization with well-defined distribution. In our case assuming evolution with casual realization can be interesting again to add some conjuncture events (and so generate cases to be studied) on individual which in a fixed world wouldn’t have happened (e.g. the possibility for a great
worker to lose a job and enter in a negative loop in spite of its ability) and to add the role of expectation to the problem.

In fact usually these variation are combined (e.g. trend with drift) and used differently for different need, for example in our model we decided to propose the evolution of firms number also with cycles made by casual realization. This should be used in our vision to have a relatively constant fraction between workers and firms populations without giving up the friction we need. At the same time this method can clean the ex post (after the initialization) random generated advantages/disadvantages. Results should then depends really and clearly on decisions, situations and policies regarding working activity and human capital.

To reach this process we first made two steps, the first using a simple random walk process and the second a more complex probability structure. We understood quite early that a random walk process was insufficient (since even if the expectation correspond to the value the initial number of firms, its actual realizations are very different). Then, to solve the last given problem, we decided to try (and we kept as a possible choice) a random structure generating/destrocting firms which have a constant mean (given in the initialization) but in which the probability of creation (destruction) decrease (increase) as the number of firms increase and it increase (decrease) as the number of firms decrease. In the end with this mechanism we expect that at every time the proportion between worker and firms (and it expected value) in a given trial is quite constant but on the other hand we can look for cycle driven results.

The possible choices with endogenous number of firms instead are obviously not related to the evolution of firms number itself (which is one of the realizations) but on the way we make
endogenous that number. The way to make endogenous the number of firms in the literature have usually been connected to profit (or expected profits), directly or, sometimes, threw demand and imitation, indirectly. Anyway the first think to be chosen (as we could see also in the matching model we presented where job destruction is exogenous) is if we want both the entry and the exits events endogenous or one of them is sufficient. We decide to have both the entry and the exits events endogenous and related to profits: when the aggregate profit (weighted by the number of firms) is increasing new firms born when the aggregate profit is decreasing some of the worst firms (in the sense of profit accumulated) close down.

3.1.3 Agencies

Agencies in our model are randomly generated over the space and are the main mean threw which the policies are performed. Agencies' number is again fixed threw a slider to be set at the beginning of each trial and them own an internal variable to manage their contacts (the costumers)

3.1.4 Links

Links are not properly an agent, indeed links have no meaning without the existence of (both of) the nodes involved, however we think it is necessary to describe also their internal variables even if them are only an ideal construction of our mind to manage relations. In the model links basically own two variables (keeping aside the ones defining shape, agents connected...) strength and period of inactivity. Both are useful for the network evolution: the first one refers to the importance which has the link for the starting node (the agent from which the directed link depart from), the second one to the time in
which the link has not been exploited (the time in which agent do not shared an action or renewed one of their meetings).

3.2 The space

The space in the model is not irrelevant indeed some of the frictions are distance related. Note that, even if it is possible to give a simple geographical interpretation of the space (where agents are reluctant to explore further place since it is “more expensive”), it is also possible to interpret it metaphorically with distances representing closeness to personal usual activity (where interaction with further agents are less plausible since those last one usually are not in the list of possible choice) or personal social relation (where relations are easier with closer agents since them are close to the personal mindset).

The space in practice is divided in cells (two hundred by two hundred of cells which we will call patches). In theory we do not have any role for the space since we manage agents with different breeds but in practice we gave to one of the cells (patch zero zero zero) the role to store some of the general information. In particular we decided to have our hypothetical web in a variable of our special patch.

3.3 The matching process

The matching between workers and firms is computed through the direct actions of agents. Both the workers and the firms look for their counterpart so we divided the actions in two groups the one performed by workers and the one performed by firms.

3.3.1 Workers looking for firms
Each worker can perform a finite number of action depending on his internal value of the natural level of activity and of the mean number of actions we decide to be done by a worker in the given trial (fixed in the setup threw a slider). The possible actions that can be performed by workers are: looking for a job sending the application, looking for a job using the personal network, looking for a job using web (newspapers or public offers in general), doing nothing and investing in human capital. We recognize that the decision of vocational training and schooling is not a decision related to the matching process, but since we think that in facts it is computed at the same time and in "competition" with the working decision we find necessary to keep it as a contemporaneous choice.

When performing an action to look for a job sending applications, workers make a list of the near firms and then select the desired one to which sending their application. Firstly we recall that by near we do not necessarily mean in a geographical sense but that it depends on the interpretation of the space; secondly (a thing which with the geographic interpretation have no sense) we want to underline that we rescale the distance as a function of the dimension of the firms, so that bigger (/most famous) firms are more easily achieved.

When performing an action to look for a job using the personal network workers exploit their contacts. When workers ask to firms they ask to be recommended for its personal vacancy when instead they ask to a worker, they asks to be recommended for a vacancy owned by one of the firms in the network of the activated friend. In particular the probability to ask to another individual is given by the relative strength of the link connecting the worker to the other agent. Relative in the
sense that it is weighted by the total sum of the strength of links departing from the worker so that for each single time the worker decide to use this procedure he knows that in expectations one action is performed as when he look for a job sending

When performing an action using the web the workers uses or put information in the container variable included in our special patch. As we know the problem with the web (or this way of proceeding in general) is the excess of information which usually do not lead to the desired result. To reflect this idea we decided to include a probability which drive the success to become applicants in one of the firms posting offers in the web. At the same time agents while run this procedure are also allowed to include their curriculum directly on the web (even if it was already done, so that they increases their probability to be selected).

We think that the procedure doing nothing is self-explanatory: it is a wasted action.

3.3.2 Firms looking for workers

Differently from workers firms do not own the possibility to exploit curriculums and applications so they use the remaining possibilities: recommendations and the web (public offers). Another difference is related to the fact that we assumed that all workers (also employed) perform actions of research, differently firms research for a new worker only if they own a vacancy or if their current worker is not very productive.

While looking for workers using recommendations firms do exactly the same actions of workers but with the reversed subjects: when firms ask to workers they recommended the
worker itself for their personal vacancy when instead they ask to a firm, they asks to receive a recommended worker for their vacancy between the workers in the network of the activated friend.

While looking for workers using the web firms again face the same problem of workers: the excess of information bring the risk to fail in adding an applicants to their list. The best they can do is to try and at the same time to put also their public offer on the web so that also them own some probability to be chosen.

3.4 The hiring process

Once we computed the matching of workers and firms we need of course also to include their decisions about the opportunities they get.

As we know, in real world, it is not so easy to satisfy at the same time both vocational, leisure needs of workers and productivity and preferences needs of employers; not surprisingly, we have many works discussing these themes. An example of work discussing about workers preferences on job choice is the one by Judge and Bretz (1992) where the authors extend the usual studies on the effects of work values\(^{18}\) (on job satisfaction, commitment, individual decision making...) by explicitly adding it linkage to job choice decisions. Since as they argue:

\[^{18}\text{More rigorously value is often define either as consistency with many (religious) beliefs that people hold so that values are enduring perspectives of what is fundamentally right or wrong (Rokeach, 1973) or as preference and need for particular outcomes or states (England, 1967).}\]
the selection process [...] is the primary means through which person-organization value congruence may be achieved.

They use a sample of professional degree students and a policy capturing design, to study the influence of work values on job choice (in the context of job attributes that have previously been shown to affect this decision process). Not surprisingly their results show that work values were found to exhibit significant effects on job choice decisions. Further, individuals were more likely to choose jobs whose value content was similar to their own value orientation.

On the other hand, an example of work discussing about firm recruitment is the one by Rynes. (1991). In some chapters of the book the author explores the major recruitment practices and activities that have dominated previous speculation and research and their principal outcomes. (E.g. the impact of various recruiter characteristics and employer preferences for various sources, on applicant impressions and decisions...).

Our model then could not ignore these points and we decided to include some functions to manage these aspects.

To reach the final decision on the way firms evaluate workers, workers evaluate firms, firms decide how and which offers to made, to include the recommendation system we made many steps. We will now discuss the evolution of these steps starting with the way in which firms evaluate workers.

3.4.1 The selection of workers by firms

In the first prototype, we gave simply some variables to workers that were freely accessible to firms, using this set of information each firm decided then to which of its candidates
make an offer. In particular, the workers owned the variable ability (which should reflect workers inner talent); the variable formation (which should reflect the skills acquired through education, training, practice and schooling); a general variable called type of workers (which should be considered as the sum of all those characteristics specifically required by each different firm e.g. some firms may prefer physically stronger man while others look for extroverted guys). The decision then was to sort application threw a formula summing the already mentioned preferences. To do so we assumed that all firms sake workers with an higher ability level, more skilled ones and workers more close to their ideal type (also firms owned indeed a variable called type of firm). In facts, the pseudo formula was something like this:

\[ \text{ability} + \text{formation} - |\text{type of firms} - \text{type of workers}| \]

Note that, of course, the three values were weighted opportunelely but we think that this simple formula is clearer without confusing parameters as number alphas etc., and that it is surely enough to understand the general idea. A further note is that of course type of firms and type of workers owned the same range (them were two uniformly randomly assigned number from zero to one).

Another think to notice is that we wouldn't like to accept any ex-ante discrimination on the ideal type even if we know that probably discrimination sometimes do exists (e.g. see all the literatures on gender gap). But, as at this point it could be imagined, the focus of our dissertation lay on labor market frictions related to failures and not on labor frictions related to discriminations (otherwise we would not have made a sum of the huge set of characteristics of people in a unique variable). To
avoid the ex-ante discrimination then, instead of imaging the "ideal type" matching on a segment, we imagined it on a circle (where point zero coincide with point one) so that, since type were both randomly distributed, ex ante each extraction own the same possibilities of the other one. If we would not made such change an agent in the middle would own a higher probability to be in advantage with respect to the ones laying on the extreme positions. Practically we did a specific report procedure, which does not change up to the final model and is the one we discussed before (true type distance).

We soon noticed that, as it was, the function was unsatisfactory, lacking many important notions of economics that we could not forget discussing labor market and labor market policies so we changed it reaching the second step. The first problem we had with the previous mentioned function was that it does not include the notion of asymmetric information and measurement errors. As we know, for example from our courses of econometrics, ability is not a measurable variable. The second problem was related to a more practical evidence: older people were strongly in advantage against young since formation is a monotone (increasing) function. This in part is reflected in reality but in real world, we notice also that often firms do prefer to offer jobs to younger people all other variables are fixed.

The function then evolved in an expectation function, which includes as known some values and use the expected value of the other ones. Regarding the second point instead, we added in the cycle some shocks related to age affecting productivity that then where internalized by firms. The pseudo formula then evolve to:
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\[ E[\text{ability} + \text{formation} - |\Delta \text{tipe}| - \text{age related decadence of ability}] \]

The attempt of keeping the model closer to reality brought us to change many times the way in which firms evaluate workers. However, the major notions driving the latter changes were connected to a more rigorous vision of human capital and formation (/training).

We now discuss the fundamental views of human capital:

The Becker view: human capital is directly useful in the production process. More explicitly, human capital increases a worker's productivity in all tasks, though possibly differentially in different tasks, organizations, and situations. In this view, although the role of human capital in the production process may be quite complex, there is a sense in which we can think of it as represented (representable) by a unidimensional object, such as the stock of knowledge or skills, \( h \), and this stock is directly part of the production function.

The Gardener view: according to this view, we should not think of human capital as unidimensional, since there are many dimensions or types of skills. A simple version of this approach would emphasize mental vs. physical abilities as different skills. Let us dub this the Gardener view after the work by the social psychologist Howard Gardener, who contributed to the development of multiple-intelligences theory, in particular emphasizing how many geniuses/famous personalities were very "unskilled" in some other dimensions.

The Schultz/Nelson-Phelps view: human capital is viewed mostly as the capacity to adapt. According to this approach, human capital is especially useful in dealing with "disequilibrium" situations, or more generally, with situations
in which there is a changing environment, and workers have to adapt to this.

The Bowles-Gintis view: "human capital" is the capacity to work in organizations, obey orders, in short, adapt to life in a hierarchical/capitalist society. According to this view, the main role of schools is to instill in individuals the "correct" ideology and approach towards life.

The Spence view: observable measures of human capital are more a signal of ability than characteristics independently useful in the production process.

To continue the discussion we will refers to the set containing the first four view as a unique vision (which we will attribute for simplicity to Becker) against Spence's view. Indeed in the first set, even if in very different way, human capital affect (directly or indirectly) productivity while in Spence's view human capital is only a simple signal of ability.

In our model, we basically align to Becker's view, tacking human capital as a factor directly affecting productivity. On the hand we do also allows for some reasoning on signaling effect, since we include expectations and we study and distinguished the signals (certificates) from the true improvements coming from them (human capital accumulation). Notice that this mechanism is only closer to Spence's view but it is not the same: we do not include the idea that the firms use the signals to understand the employee ability (but only that firms use signals to discover the human capital acquired itself). To be said about this in the end, is that our model also in its last version probably is still lacking of a distinction between general training (affecting productivity in all sectors) against specific training (affecting productivity in a specific sectors or in subgroups of
firms) or with other worlds talking about skills, soft skills against specific skills.

After deciding to align to Becker’s view, as anticipate we decide that certificates does not directly means an improvement in the human capital accumulated. We reach then the third step where basically we distinguished certificates from expected human capital so that, since as we will see we have a specific mechanism for the human capital accumulation the certificates and practice are weighted by the (mean agent) probability of interiorizing them. As it can be seen in this step, we do also distinguished the visible set of characteristics from the ones in which agents should use expectation.

\[ E[\text{ability}] \times (1 - |\Delta \text{visible type}|) \times E[1 - |\Delta \text{invisible type}|] + \]
\[ + \text{certificates for human capital} \times E[\text{probability to interiorize a course}] + \]
\[ -E[\text{age related decadence}] \]

The final step we report here is the one made to distinguish the more practical related human capital (professional skills) and the more intellectual related one (basic knowledge). Since we assumed that more technologic firms are looking for workers owning a lot of basic knowledge while less technologic firms are looking for ones owning a lot of professional skills we uses the level of technology to weight them. Last point is about practice: after some periods the worker own the same job it become more productive in the given firms and, on the other hand sometimes (with a given probability in our model), the worker human capital (/professional skills) is increased. We report here then the pseudo formula used by firms to evaluate the boost in productivity related to formation, training and practice.
Exploring labor market policies. Insights from a simulation model

\[ \alpha(tech)^{19} \ast \]
\[ \ast (certificates \text{ for basic knowledge} \ast E[probability \text{ to interiorize a course}]) + \]
\[ + \alpha \left(\frac{1}{tech}\right) \ast \text{signaling effect} \ast \]
\[ \ast (certificate \text{ for professional skills} + E[practice]) \ast \]
\[ \ast E[probability \text{ to interiorize a course}] \]

Completed the evaluation of candidates firms then use the recommendations to switch the order of their candidate (in proportion to the strength of the recommender) and then make ordered wage offers to workers. The wage offer is related to the evaluation of workers, firms indeed threw the formula interiorize expected productivity, and then expected profit for each level of wage. Threw a reservation level of profits (which can evolve over time: increases when the firms has increasing profits, decreases when profits decrease or the firm have the vacancy empty) firms fix the wage for each candidate. Firms which already own the vacancy filled of course ask for more profits with respect to their current level of profits.

Workers then have to decide whether to accept or not the offer, but we will explore this point in next paragraph.

3.4.2 The selection of firm by workers

When workers receive a wage offer, they have to decide whether it is suitable or not. This decision in our case is made by a reservation "utility level". The utility level of a work is computed threw the following pseudo formula.

\[^{19}\alpha(tech) \text{ means a parameter increasing in technology while } \alpha(1/tech) \text{ means a parameter decreasing in technology.} \]
wage + (1 - Δ visible type) + E[1 - Δ invisible type]) +
- (technology desired - technology of firm) +
- (dimension desired - dimension of firms)

(Again of course the four value of the sum are weighted
opportune but we omitted the parameters). As it can be seen the
utility is increasing in wage, in the closeness to desired work
and closeness to desired level of technology and dimensions.
Computed the expected utility given by the offer the unemployed
worker compare it with his reservation utility, the employed one
with his current position (note that in this case the evaluation
of the current position is computed using the true value of all
the variables).

The reservation point is not stable during time, employed
workers which are happy with their position increases their
request for subsequent periods, while unemployed which seeks
strongly for a job decrease their reservation utility. Note that
we leave to workers the possibility to get out of the labor
market, when their reservation utility has been low for a long
time, then (with some probability) the reservation utility make
a jump to an high levels which is really hard to satisfy and which
takes a large number of unit of times to get back to medium
levels.

If the worker accept the offer then he takes the vacancy; if
the vacancy was filled then the previous worker is fired.

3.5 The network evolution process

The first way we use to update the network is based on the
impression that networks can be summed up by a set of
apparently casual meeting happening during life (so if we use
randomness it is quite as good as): sometimes indeed people create a connection with others while are doing their activities in their usual life (as it could be shopping, working...); these connection are not exactly casual but for an outsider it looks as if they were. For this reason the possibilities of link creation (or link strengthening / degeneration) listed below, are managed with this idea as events that happens with a given probability.

In facts in our model we assume that: people always create a link while doing their working activity (so that we create two links connecting the worker and the firm); that Sometimes some links are created between applicants (people who met while searching for a job and become friends); sometimes links are created between people involved in formation/education; sometimes links are created between two agent belonging to the same network of another individual (people who meet each other threw a common friend), sometimes, if we have a directional link, the corresponding reverse link is created.

The second way we use to update the network is related to the concept of similarities: even if sharing socially significant attributes does not imply to have a connection, we think it is correct to use similarities as a condition (or state) that increase the probability of forming some of our ties.

For this reason we use the possibility (again using also a probability structure) to have links generated between close agents (which in our case means those with a close value of the variable summing the various characteristics: visible type of agent).

The third way we use to update the network is based on the evaluation of the “requests and gifts” given to or received by the
other agents. Since we involved the previous described recommendation system we thought it would have been interesting to include also the effects of recommendation on networks. In the model then when an agent agrees upon some requests, recommends the agent..., then agent's connection with him become stronger, at the same time the one to whom the recommendations were performed evaluate the recommended and if they are fitting well for the purpose the strength of their link to the recommenders increases vice versa if they do not fit well the strength decreases.

Differently as before, the final way we use to update the network is used only to strengthen or weaken the already existing network (before if the link did not exist, a new one were created). This way of updating the network indeed is related to the weaken of unused connections over time: when we have a lot of object (which, as already said, can be also immaterial as idea, recommendations...) flowing in the connection, it is more plausible that the link strengthen, on the other hand if a link is not exploited it is really probable that the connection may fall down.

This mechanism is managed threw the previous presented variable referring to the period of inactivity: after each unit of time (tick) the variable increases, when an event involve the connection the period of inactivity is restored to zero but when this period overcome a given amount of time the link starts to become less and less strong (decreasing the absolute value of the other link's variable referring to strength).
3.6 Workers investment in human capital

In the end we describe the procedure which bring to the evolution of the human capital and the formation related certificates.

When a worker decided to invest in human capital (and do not get a job) firstly he has to decide in which type of human capital to invest: general knowledge or professional skills. Each worker of course own his personal preference but the decision should be also driven by his past decision (as we now in reality as in the model specialist are preferred$^{20}$ and the education/formation path is strongly correlated to the past). In the model the decision then is driven by a probability which reflect the percentage of the specific human capital (with respect to the total) owned, but the preferred human capital is worth double. Once also this decision is taken the worker attend the course and automatically get the correlated certificate, on the other hand it is not given that he actually increased his real value of human capital: this happen threw a shock which is positive correlated with ability and is also a function of the

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$^{20}$ If it is not clear note that in the model threw the parameter increasing in technology and the one decreasing in technology firms for a fix amount of total human capital prefers either higher general knowledge or higher specific skills. If an agent own half and half he is probably preferred to the set including the not desired (by the given firm) specialists but in facts he will often find the desired (by the given firm) specialist which gain the vacancy in its place.
preferred human capital (the probability increases if the agent is exploiting his preferred type).
4 Results

We report here some of the results of the model, of course we explored only a subset of all the possible experiments exploiting only partially the power of the model.

Note that it is possible to replicate experiments indeed we report the full code in appendix and we fixed the pseudo random sequence of number (called seed in the Netlogo language)

4.1 The basic experiment

The first results are used to give the benchmark point to which we will refer at. In this trial we fixed the global variables manageable by the interface of the program (inputs slider and chooser) as written below; in the subsequent experiments if a variable is not quoted it takes the value reported here.

The initial number of workers is fixed at one hundred as well as the initial number of firms (so that full employment can be hypothetically reached). The total number of agencies is ten. The seed as said is fixed and it is the number one. Mortality is fixed after one thousand ticks and the starting point for possible negative shocks at one third of mortality (round to the integer 333). The chooser about firm creation is set on “constant-firms”. The switcher (a bar for Boolean variable) workers from dataset is switched off while the switcher about the random distribution of agencies is switched on. We use all possible type of link generation mechanism we listed before so the slider “link mechanism” is set at thirty one (which means method zero + method one... since it is created as $\sum_{i=index \ of \ desired \ mechanism} 2^i$) the link diffusion speed is set at ten as well as the link diffusion
between similar agents. The visibility radius of workers is set on one as the reservation utility adjustment speed, the recommendation power and the vacancy cost (the cost of having an open vacancy). The switcher about agent's selection process is switched on (so that workers evaluate firms and vice versa). The mean number of workers action per cycle is four and the probability to perform one of the five actions listed in the matching process for workers (send curriculum, use friends, use the web, invest in human capital, do nothing) is zero point two. The probability of attend courses after inscription is fixed at it maximum (one) while the probability of successfully using the web at zero point one. The slider about agency activity is set on twenty five even if for now it is irrelevant since agency action is set on zero (which since we use the same mechanism we used for links means no action: \( \sum_{i=\text{index of desired mechanism}} 2^i = 0 \iff i = \emptyset \)).

The chooser about agency targets is on “fixed threw distance” while the switcher about the decision to restrict the policy only to disadvantaged is off. In the end the switcher deciding if agencies recommends their contacts is on (otherwise agencies when contacts firms for workers simply send the application for them) as well as the switcher used to decide whether agencies can exploit the full set of information of agents (otherwise agencies do not care about a good match but only of a match).

Generated the world (procedure called by the button setup) and leaving the program run for eight hundreds ticks (procedure called by the button go) we obtain the following results:

Describing the general economy, we note that after the first predictable boom of the new born economy, employment rate stabilize around forty percent of the population, flows
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(agents entering in unemployment or in employment) instead fluctuate around ten people (ten percentage point of the total population) per period of time and since the two flows compensate each other we can deduce that we reached the steady state of the economy. The mean productivity in the end is around one point two and we see that it is still slightly increasing, the results is probably driven by the increase in the general levels of human capital (see subsequent set of graphs) and for the slightly improvement of the network which is still going on (reflected by the slowly decreasing of mean betweenness; that index is still over four hundreds but as already said is slowly going down)

[Graphs showing unemployment rate, flows, betweenness, and good-match-for-firms]

Workers in the model seem able to exploit quite the total share of surplus, indeed by competition of firms the mean profit (a loss in the case, but note that we are talking about means some firms make substantial profits others make even greater loss, moreover profits are computed also for firms owning only an unfilled vacancy) stabilize around (in facts a little bit over)
the cost of the vacancy (which is one) \(^{21}\). Wages instead are around sixteen and are still increasing exploiting also the new coming surplus of increased productivity.

We can recover also the premiums on the probability to be hired for workers investing more in human capital (as we can see gets the certificate is enough, so we are giving an extra proof of the relevance of signaling effects of education\(^{22}\) and for workers which have more practice (firms internalize it by predicting the practice level from the number of jobs made by the candidate) the graphs indeed reports the mean number of jobs made of workers over the mean (in grey for certificates and in red for practice) against the ones below it (in black for certificates and in green for practice). The mean duration of a job is around four periods and a half, and most of the match (\(\approx 60\%\)) hold for less than four periods so we expect a distribution with a long right tale.

\(^{21}\) The fact that are a little bit over is probably due related to the unit of times necessary to workers for exploiting the new possibilities of gain coming from increased productivity.

\(^{22}\) Note again that in our case this hold since certificates are correlate to the expected human capital. Agents are not trying to signals their ability (we do not have here pooling/separating strategy of agents) since the ability is reflected in the internalization of these certificates but firms have no means to infer it (since true human capital owned is an unobservable variable).
At a first touch it seems that the model has not good predictions with such a small employment rate, but we want to recall that usual unemployment measures are computed as the people which are actively looking for a job (after having lost at least one job otherwise the person fall in the category of people looking for their first job) over the labor force. It is true that in
our model the entire population looks for job, but we can say that not the entire population looks actively for a job: agents with a too high reservation utility level or which have too strict preferences (think for a possible real example about an agent which work only if he receive an well paid part time offer without any searching activity, otherwise he only take care of the family) could in our vision be classified as inactive, at the same time older agents (with highest age related decadence of ability) and young (which continue their studies instead of getting a job) may be even considered outside the labor force.

For this reason and to get also insights related to a more or less ideal world, we report here also the results from the experiments performed reducing the (nice) frictions we add to the model and reducing the actions performed by agents.

4.2 Experiments over simplified models

4.2.1 Experiment with “stupid” agents and minimum friction

In this experiment we omit all the processes related to the selection and the evaluation of the counterpart made by agents\(^{23}\) (we kept only the reordering of offers by firms which should not affect a lot employment). The decision is recognize by the code threw the change in the switccher about agent’s selection process\(^{24}\), in this experiment indeed it is off. The reduction of

\(^{23}\) (the corresponding code is not run or it is slightly modified with some “if” statements).

\(^{24}\) (which if necessary to replicate the experiment is exactly called preference-over-jobs/profits)
frictions is made instead threw the stressing of all variables which gives limits: the slider about visibility radius of workers is set on fifty (some agent do not see the total world but we are close to), the one about the mean number of actions made by workers is on thirty. This things are combined with a zero probability of doing nothing and with the slider about the probability of successfully using the web on one. In the end we fixed the vacancy cost at zero.

As we can see form the graphs if workers accept any offer, firms do not take care of the productivity of workers and we can reach any position we get a completely different situation. The first think we notice is that unemployment oscillate around ten percentage points (instead of the previous sixty). This level is probably showing the true level of weakness of the model. We believe indeed that this level of unemployment is related to the fact that in this trial when last (in the sense of the last ones computing the action in the cycle) firms with filled vacancy find a new worker, the worker previously occupying the vacancy in facts lose the possibility to find a job in the current cycle. This problem is combined with the fact that unemployment is calculated after each unit of time (without distinguish agents which could not find a job from the ones which simply still do not owned the possibility to look for it yet) and we do not clean this effect\textsuperscript{25}. Of course it is cleanable but we believe that it

\textsuperscript{25} To show that we got the point it is possible to study the combination of workers with no jobs and with at least alphas period of searching activity without job;
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would be more difficult to read results if we omitted in unemployment those part of the population which do not find a job in a short period of time\textsuperscript{26} and that (mostly in the other experiments) it would be not so bad to consider in the unemployment rate the part generated by the time friction. In the end we expect this bias reduced in other experiments since it is of course a function of flows which in this trial are at their maximum level (oscillate around nighty position per turn, and all position hold less than four periods with a mean of two point three).

The second think to be notices is that final betweenness is halved and it decreased faster with respect the previous experiment indeed the lowered level of friction helped also for the diffusion of the network.

\textsuperscript{26} Moreover also the definition of small is something which otherwise should have been largely discussed
On the other hand as we could expect we have an unstable random path for wages and profits. Agents simply match one with the other but are not able to tacking decisions trying to improve their positions.

4.2.2 Reintroducing frictions

In this experiment we reintroduce the standard values we used in the basic experiment for the variables we changed in the previous experiment to relax frictions (visibility radius of workers, mean number of workers’ actions, probability of doing nothing and probability of successfully using the web). On the other hand we kept switched off switcher about agent’s selection process.
As we can see (and we could expect) unemployment rate increased up to values around twenty five percentage points. So the first think we can deduce is that unemployment should count for this amount while the remaining thirty percentage points to reach the basic experiment, have to be probably count as people outside the labor force. Flows instead decreased indeed them oscillate around thirty five, the result reflect the fact that frictions made the matching process more difficult. For the same reason the betweenness come back to value around four hundred (recovering in this case all the gap between the previous and the basic experiments) indeed the network evolution (as it should be) is strongly affected not only by the sliders we used to manage it but also by the general level of friction itself. We skip the graphs to be concise, but if we would have reported the experiment with "clever agents" and minimum friction we would have noticed the same betweenness of the ones with "stupid agents and the minimum level of frictions. Differences would have been on the unemployment rate (reintroducing those agents with too strict preferences) and on the general market structure: lower mean level of flows (with a bit higher variance) associated with a higher mean duration of jobs; higher ability of worker to exploit the surplus....

27 Note that if we accept this point related to the common ways measures are calculated then to have the common calculated unemployment we have to compare unemployed with the labor force. For example in this case if we have a 25% unemployment rate with respect to the total population and the labor force is 70% of the population, then usually computed unemployment rate is then around 35% = 25% / (1 - 30%).
4.3 Experiments with agencies interventions

4.3.1 Agencies finding jobs

The first experiment involving our intermediators is the experiment related to the study of the effects generated by customized matching activities of employment services. With the related procedure agencies are supposed to help their customers by exploiting their market share of contacts and their baggage of information on them and on workers and firms in general in order to match the correct workers with the correct firms.

Agencies actions is then set on two (which means only procedure one: the just mentioned targeted matching). We recall since results may vary sincerely that the slider about agency activity is at twenty five (which means twenty five possible activities per cycle) and that the switcher used to decide whether agencies can exploit the full set of information of agents is active, indeed we are discussing about customized interventions.

The first think we need to comment is of course the primary objective: unemployment rate

As we can see from the graph when agencies intervene it stabilize around zero point two, which is a really lower value compared to the classical experiment. We note also a good
increase in the flexibility of the market (evaluate using the flows graph) and we deduce that the two results are probably correlated: agents which do not own strict preferences are less reluctant to leave their current position in front of higher employment rates (and probable future good positions) and at the same time agents (even the one with strict preferences) own an higher probability to accept the offer since this last one is more targeted to their needs.

Networks effect of the policy instead are low, with respect to the general model we get a value of betweenness around three hundred fifty. Furthermore the extra benefit is probably simply related to the new position which may connect agents which were not connected before, this can be see noticing the soft decreasing path for betweenness.

More interesting is the evolution of profit and wages. As we can see the general surplus and in particular the surplus of the increasing productivity is not fully exploited by workers as before. Wages indeed increase up to a value around ten (instead of sixteen) while profits increased around a value of four (instead of minus one: the cost of vacancy).
These results are probably related both to the agency activity itself. Even if the true beneficiary looks to be the worker, if workers are more satisfied by the suggested position then firms can more easily offer an acceptable lower wage. On the other hand, the effect of the higher employment (which usually push up wages threw the competition for the few disposable workers) is not here since as we saw the flexibility of the market is increased in front of the increased employment so in facts disposable workers are not decreased.

4.3.2 Agencies boosting training

4.3.2.1 Agencies only boosting training

In this trial agency action is fixed at sixteen (the value corresponding to action four or, in words, to training program). Results from the model seem dramatically poor: not only the unemployment rate as well as flows are at the same level of the one in the classical experiment, but the effects of the certificates on the probability to be employed decreased dramatically, reaching sometimes also the unbelievable situation in which owning more certificates for specific skills is a disadvantage since it decreases the probability to get a job (see the graph about formation differential going below zero or the back line of practical certificate graph over the corresponding grey line).
We are not so able to focalize the specific mechanism driving the result. Our hypothesis is that it either can be a selection driven result or a result on the effectiveness of policy. Agencies boost the human capital of some workers, but if usually
the selected workers are the lower performing or the ones with so strict preferences that tend to remain anyway (quite always) outside the labor market then, even increasing their human capital, the selected workers for jobs are the others (so the one which in the end own relatively less human capital\textsuperscript{28}). On the other hand to be fair, finding these results in a real situation, would not have astonished us, indeed we do believe that usually training policies become ineffective (in order to increase the probability of being hired) if not matched with any policy related to work insertion or other general policies of public employment services. Of course this suggested us the following experiment with a non-null degree of hope. Finally to conclude the comment of this experiment note that the model confirm the prediction following from Becker's view: if we use policy to invest in human capital we increases the productivity (and the surplus) of agents; indeed the mean productivity is quite doubled with value around two point four.

\textsuperscript{28} We recall that the graph report the mean number of jobs made by agents with human capital higher or lower with respect to the mean.
4.3.2.2 Agencies boosting training and finding jobs

We immediately report the various graphs.
Note that in this case agency action slider is at eighteen since we are using both method four and method one\textsuperscript{29}. We comment firstly training results (which we now care more). As it can be seen now the effects of certificates on the probability of getting a job are almost doubled in each field\textsuperscript{30}, this seem to confirm our hypothesis that training policies are valuable but that in reality them become ineffective (in order to increase the probability of being hired) unless them are matched with other policies related to public employment services. Again in the model we recognize also the benefit of the various agency activities: flows are at a higher level (around thirty) and unemployment rate is around twenty five percentage points.

4.4 A dynamic microsimulation with interacting agents

4.4.1 About microsimulations

To complete our works we decided also to include in our model a microsimulation model exploiting the Italian survey:

\textsuperscript{29} As already mentioned the number is equal to the sum of two raised to the power of the selected method so that we can have all possible combinations.

\textsuperscript{30} Note that the lines about the education differential the formation differential and practice seems to own the same slope of the classical graph but this result is only related to the fact that graphs are rescaled
"Questionario per la rilevazione degli esiti occupazionali degli interventi formativi finalizzati all'accusabilità.\textsuperscript{31}"

Broadly defined, form Leitner et al (2013) microsimulation is

"a methodology used in a large variety of scientific fields to simulate the states and behaviors of different units—individuals, households, firms, etc.—as they evolve in a given environment—a market, a state, an institution."

Since as in our case it is often it is motivated by a policy interest, narrower definitions are still pertinent in our case as the one from Martini and Trivellato (1997) as

"Computer programs that simulate aggregate and distributional effects of a policy, by implementing the provisions of the policy on a representative sample of individuals and families, and then summing up the results across individual units"

Combining the data and the agent base model then we can both have the advantage of a microsimulation (with his policy focus and where if a non-linear relationship exists between an output $Y$ and inputs $X$, we can use the whole distribution of $X$ for predicting the average value of $Y$, and not the average value of $X$ only) and of agent based model (with his theoretical focus and where we can include interactions and cumulating factors).

\textbf{4.4.2 The experiment}

\textsuperscript{31} Valutazione del POR FSE della regione Piemonte OB. 2 "competitività regionale e occupazione" per il periodo 2007-2013.
The survey focuses on a sample of agents which was enrolled into a regional training activity, to be noticed is that we own a particular sample since the main aims of the regional training activity were to reintegrate into the labor market disadvantaged categories. The survey firstly explores the previous status of agents (such as the main activity carried out by himself and his parents, the maximum educational qualification got...); secondly it explores reasons and evaluations of the course (such as reason to get enrolled and, if done, to leave it, appreciation of the service...); thirdly it explores subsequent actions and activity (such as reasons and methods for job search activities or re-integration in the schooling activity; details on the jobs performed...).

We use the two thousand twenty-three observation by generating (the same number of) workers with the corresponding characteristics. In particular we used a stata program to manage the dataset. From the survey we can get then from the easiest information such as can be age or years of education to more complex ones such as propensity to general knowledge vs. specific skills or activity level.

In particular (skipping the values for the number of workers, for age and for the time passed from last working activity which are straightforward) we got the activity level of workers by adding one for each type of search action performed by the agent itself and then rescaling it\textsuperscript{32}. The preferences over

\textsuperscript{32} Notice that "type of actions" is not exactly the correct variable but, since the number of actions was not feasible, given the high correlation of them it is a good proxy.
general knowledge and specific skills instead are revealed by induction by the course followed by the agents: to get the information it is "simply" necessary to divide courses in categories for their contents. Talking about previous experiences we divide the previous years of schooling (information built by exploiting educational qualifications) in our two category of human capital; unfortunately since we do not own any way to divide correctly among them we use a random process); we induced previous jobs activity and practice experience combining the information coming from pre and post programme activity (in particular by using the questions on number of contracts). The agents which own a job are simply those which found it after the programme. In the end we calibrate probabilities of the various mechanisms (using applications, using contacts and using instrument for public offer as internet) workers use to find a job with their distribution in the sample.

Interesting on the side of firms is probably the way in which we decide the number of firm: we starts with our population of workers, then from the percentage of employed we get the number of (hypothetically) filled vacancies; from the percentage of unfilled vacancies we can then calculate the (hypothetically) unfilled vacancy and get our number of firms. In the model the number is then 1836 (round from 1835,9....).

33 The percentage of unfilled vacancies (with respect to the total number of vacancies) is estimated around 0.5%

34 Calculated as: percentage of unfilled vacancies/(1- percentage of unfilled vacancies)*filled vacancies
Talking about agencies instead, agency action slider is fixed at eighteen as in the previous experiment.

The results coming from the sample are in this case poor performing, not in the sense that the model seems to bring to strange predictions but that selected policies (training and assistance in labor insertion) seem not to have a relevant impact on the probability of disadvantaged workers to get the job: the difference in the mean number of jobs made between agents with certificates, referring to the part of human capital connected with specific skills, over the mean and ones with a level below the mean, is negative, the difference in the mean number of jobs made between agents with level of certificates, referring to the general knowledge part of human capital, over the mean and ones with a level over it, instead is positive but differently as previous experiments it is stabilizing at a low level or anyway it increases with a lower slope.

Firms indeed seem to select between these disadvantaged workers mainly using previous experiences as we can see from the practice related graphs. Note that we are not sure that this is a good news indeed we do not have the competition with
standard agents which usually also own more previous experiences).

Of course unemployment rate anyway benefit from the agencies actions as well as flows\(^{35}\). However unemployment is still over the mean of the previous example\(^{36}\). Because of this we are suspicious that the benefits for disadvantaged workers are lower with respect to the mean effects.

Given these reflections, an interesting experiment to get a higher external validity would be to use a larger sample including not only agents enrolled into a training programme (where the control group is given by ones which then do not attend the courses) but also with simple agents not enrolled in any programme (where the control group is then given by these ones) to compare results coming for the two groups.

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\(^{35}\) Flows are, as in the previous example, around 30% of the population indeed I recall that now we have 2023 workers instead of 100.

\(^{36}\) Mean around 30% with respect to the previous 25%
Conclusions

With this work we tried to address the role of labor market policies in the activity of job search.

In particular we firstly review the literature discussing the labor market models from which get the theoretical benchmark. At the same to complete the framework we had to discuss the role and the ways in which labor market policies are actually implemented. Not to lose the contact with reality for the scope we referred to the European context selecting a wide (if not in terms of number since we selected six nations, at least probably in term of policies performed) pool of Member States which are actively involved in labor market policies implementation and which are updating their strategy to face current challenges.

Secondly we tried to expand the knowledge exploiting an agent based model created on purpose and equipped with the possibility to take into account the social context and empirical data. Of course we used both the tools, the first one by letting agent interact into a network (which then has been analyzed and which shape their decisions) and by performing a dynamic microsimulation with interacting agents using the data coming from an Italian experience (and survey).

Results from the model gives various insight on the effect of labor market policies (as matching activity, training, labor insertion policies) on the labor market itself (as the effects on unemployment, on flexibility of the market and probability to find a job) and on the network structure.

In particular the model seems to confirm that targeted actions are a lot better performing, and more interestingly that training policies effects are vanishing if not combined with the
other policy related to public employment services. So we can deduce that the model is suggesting (to have more effective policies) that European reforms are (at least in theory) in the right direction, but that efforts should be dedicated even more on the management of the various policies as a combined set of actions. From the microsimulation over the special subgroup of agents (composed by conjecturally disadvantaged agents) the model seems to predict that we need further stronger corrective measures to have a good impact over the sample.

Many further research and scientific insights can still be explored, from different timing, composition and magnitude of policy interventions to finer models including more good market structures and differentiated behavior and contract types. However with this model we hope to give a boost in the research on the field.
Appendix: Netlogo Code

```netlogo
; Code (Netlogo)
;...
```

127
Exploring labor market policies. Insights from a simulation model
Exploring labor market policies. Insights from a simulation model
131
Exploring labor market policies. Insights from a simulation model
Exploring labor market policies. Insights from a simulation model.

```plaintext
report int(36*active-capital) / (mortality + 1)

report ability-basic (expected)
  "Reto expected" = 0.1
  if report 0.5
  report 0.5

report labor-intensity

report (occupation-probability
  "Occupation probability"

report aging-effect

set y = y + (time-dependent) of workers
report 0.11 / (introduced) + introduced

report age-negative-hope (expected)
  "Hope negative" = 0.3
  "Reto negative" = 0.3
  "Deter deter" = triangular (decadence-starting-point) / (mortality + 1 + report 0.5)

report 0
report age-decline / (rescale + 1)
report 0

report result
  report 0 + triangular (mortality) - triangular (decadence-starting-point) / 100

report triangular [x]
report x * (m - age) / -
```

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References

Anderson P. W., (1972), “more is different”, science vol 177.


Borshchev A., Filippov A.. (2004), “From System Dynamics and Discrete Event to Practical Agent Based Modeling: Reasons,
Exploring labor market policies. Insights from a simulation model

Techniques, Tools.”, in the 22nd International Conference of the System Dynamics Society.


Granovetter M.S., (1985) American Journal of Sociology, 91, 481


OECD (2014) “Coverage and classification of OECD data for public expenditure and participants in labour market programmes.”.
Rynes, S. L. (1991) , “Recruitment, job choice, and post-hire consequences: A call for new research directions.”, in M. D. Dunnette & L. M. Hough (Eds.), Handbook of industrial and


