Casares Labor Market Multiagent Interactive Simulation

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Introduction

The Casares multiagent simulation model is conceived to test and try dynamics of labor market dynamics.

The main concern introduced in this model is to explore the relevance of the decay on the reservation wage during unemployment to the overall market. During past research about unemployment effects in the area of Buenos Aires (Persia & De Grande, 2000), the variation on the reservation wage, along with the discouragement effect toward stay looking for a job under hostile conditions, appeared as major factors in jeopardizing the chances of reentrance to the labor market.

The literature on multiagent simulations for labor market has rapidly grown during last years (Ballot, 2002; Tesfatsion, 2001; Yang et al. 2004). However, the impact of these variables is not usually taken into account (De Grande et al., 2006).

This stylized model shows plausible relations among aggregated variables of labor market dynamics (participation rate, unemployment, income, salary). This version allows visualizing the flows and socioeconomic changes of the population, as well as interactively modifying the model parameters during the simulation.

In the following sections characteristics of the model are described.

About the model

There are two kinds of agents in the Casares model: persons and companies. The interaction between these agents if governed by the following constrains:

1) Persons can be at three different employment states: occupied, unemployed or inactive. At inactive state, they stay out of the labor market (i.e. they do not have work and do not look for a job either).

2) While being unemployed, they look for a job. They can perform a new interview every month in order to find a company to work at.

3) Both companies and persons have a fixed color tag, from 5 different possible values. Employees with color tag A cannot work at companies with color tags B, C, D or E.

4) The recruitment interviews follow two criterions:

- The company must match with the person's color tag in order to hire the employee. Every company and every person hold a color tag that acts as a metaphor for specific preferences of the company and/or employee.

- If the employee's color matches the company's color, the company will hire the employee setting her current salary equal to its reservation wage (the minimum amount of money she is able to accept). It will not try to lower such threshold, nor will pay any more money than that (i.e. in the model, the candidates are transparent regarding its reservation wage).

5) As an unemployed person keeps looking for a job (sometimes not having being lucky at finding one that fits is color), she can act in two different manners:

- Stay looking for jobs.

- Give up.

6) The act of 'giving up' because someone believes there won't be a place for her turns that person into an 'inactive by discouragement'. The time a person waits until she gives up looking for a job is one of the main parameters of the model. However, no all the people can chose not to work. At the default configuration of the model, the population is made of 4000 persons, where 1000 are single are 3000 are married (making 1500 couples). This is relevant when it comes to participation in the market, as only the persons having a partner who is occupied can chose no to look for job.

7) When the person keeps looking for jobs, the most direct way (from her perspective) to get a job as soon as possible is reducing her reservation wage. Even when the reservation wage can be seen as 'what a person needs to survive', under scenarios of downward social mobility reservation wage can lowered significantly. The rate at which the unemployed population lowers its reservation wage is also a parameter of the model.

8) For the simulated companies, the profit is a major concern. As the model is focus in modeling the behavior of unemployment, the measure for profit is implemented in a very simplistic way: every employee has a fixed productivity over time (20 credits). The cost for production for the companies is exclusively the salaries. Such salaries grow over time due to seniority regulations. The seniority at the model represents the bonus for being long time at the company, but it also represents other aspects of production that may lead a company to situations where productivity cannot keep the track of salaries: costs of obsolescence of core technologies, effects of new competitors, changes on preferences of the demand for its products, etc.

9) At the end of every year, companies consolidate their balances and they can decide to fire people before the salaries of old employees rise too high. The procedure for doing such thing makes use of the two parameters:

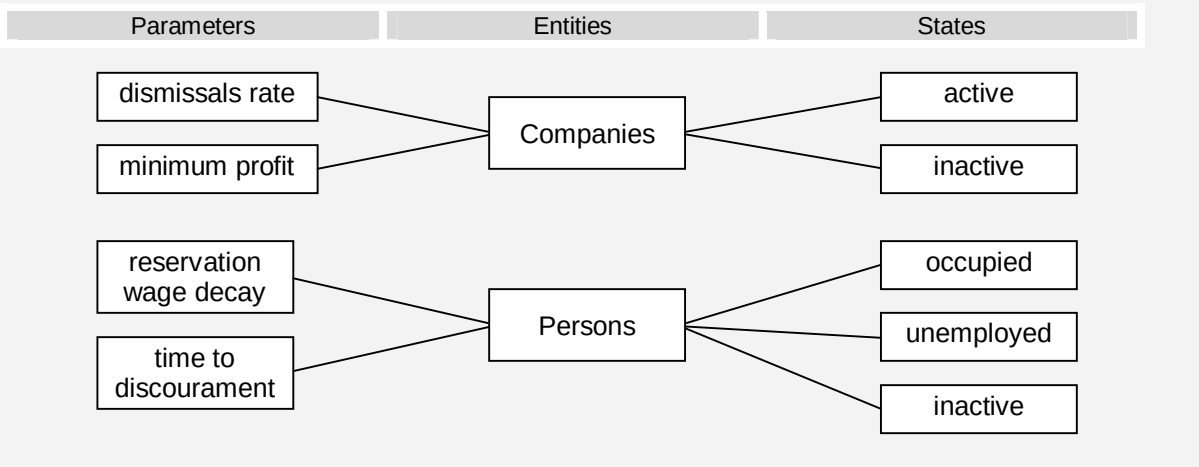
- Profit baseline (profit): the amount of profit (measured as the % of total product) under which the company will decide to fire people.

- Maximum dismissal rate (dismissal rate): the quota of the personnel that companies fire when they have no profit at all. The actual quota of people a company will decide to fire after it's end-of-the-year balance will be cero if the profits are higher than the profit baseline and in a linear relation between zero (for profits = profit baseline) and the dismissal rate (for profit = 0).

10) When companies cannot prevent themselves to have 'negative profits', they go into bankruptcy (they become 'inactive'). After a period of latency, new companies can be created where old companies have gone into bankruptcy.

In figure 1, a summary of the model entities, possible states and parameters is shown.

Fig. 1. Summary for parameters, entities and entity-states of the model.



Motivations

Eguia and I performed in previous research an exhaustive exploration of the space of parameters of the Casares model (De Grande & Eguía, 2006). The nature of such analysis required an implementation where the parameters during each run had to be fixed. As the parameters formed a space where the outcomes of the model could be examined, the restriction over parameter variability was mandatory.

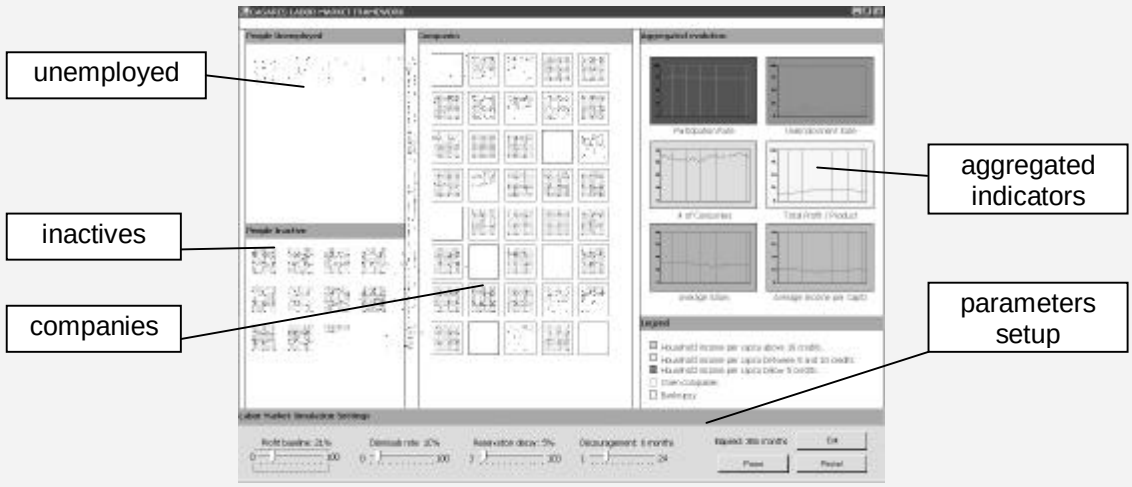
That exploration laid to meaningful insights: the capacity of the employees to limit the companies' performance (by holding their salary demand through time) showed to be effective no matter which strategy the companies could adopt. However, even when companies could not escape from bankruptcy under such strategy, the damage for the majority of the employees was also remarkable, as only a few among them remain occupied. Large inequalities were observed under this scenario, with high salaries and elevated unemployment rate.

The current implementation of the model targets a different type of analysis. The driving question is focused on what paths can appear after changes in strategy. The underlying assumption is that strategy changes can overcome unexpectedly in labor market, induced by external factors (i.e. they could not be modeled as an endogenous evolutionary factor). Qualitative exploration of how the model reacts to such external changes (e.g. in terms hysteresis and resilience) was the key motivation for the construction of an interactive simulator.

User interface layout

The interactive simulator for the Casares model provides a visual representation for each agent (companies and persons), as well as aggregated level indicators. The parameters can be controlled through slider controls before or during the execution of the simulation.

Fig. 2. Simulator layout.



In Fig. 2 the main areas of the simulator are shown:

- Companies: in the center of the screen, the companies and their employees are displayed. The color of each employee identifies the current salary level for the employee.

- Persons: those who are not employees are displayed in the left. Two areas are reserved for inactive and unemployed.

- Statistics: at the right, dynamic charts for key indicators are shown (participation rate, unemployment rate, number of companies, profit, average salary and average income)

- Parameters: at the bottom of the screen the parameters profit baseline, dismissal rate, reservation wage decay and time for discourament can be modified during the evolution of the model.

Conclusions

Multiagent models can work as an 'in silico' laboratory for social science phenomena. Based on a set of simple rules, complex dynamics can be modeled.

However, the analysis of the outcome of such models is not trivial. When an exhaustive exploration of space parameters can provide a complete map for fixed strategy runs, an interactive simulator is crucial for testing the effects of exogenous strategy changes.

The basic elements for an interactive simulator have been set, while a lot of work on analysis of the behavior of the model still has to be done.

System Requirements

- Pentium IV Recommended.

- Microsoft Windows 98, 2000, XP or 2003.

- 1024 x 768 display configuration.

- Microsoft .NET Framework 1.1 runtimes (www.microsoft.com/downloads)

Note: Configuration files (run.ini and town.ini) are ready to use, and do not need modifications in order to run; however, you can change their settings to try different scenarios.

Glossary to use the application and configuration files

- Unemployed: a person who doesn't have a job, but would prefer to have one (usually measures by the question 'did you look for a job in the last n days?'.

- Inactive: a person who doesn't have a have a job and that is not looking for one.

- Participation Rate: the total number of employed and unemployed people, over the total population.

- Average Income (total population): the sum of all incomes over the number of total population.

- Average Salary (occupied population): the sum of all incomes over the number of employed persons.

- Profit / Product: In the model, the part of the product (calculated from the fixed productivity of the employees) that is does not make part of the salaries.

- Dismissal rate: quota of people the companies will fire if the run into zero profit.

- Reservation decay: the percentage of expected salary an unemployed can diminish on each of month of the search.

- Discouragement: stop looking for a job because of the lack of jobs available.

- Minimum expectations: the minimum money a reservation wage can run into.

Technical Details

The application submitted is a Win32 application developed using C#. Previous prototypes of the model had been built using Python 2.4. A 'not so revised' version of this Casares.NET version source code is submitted with the compiled version of the framework, and the Python prototype is available at Sourceforge.

The current .NET version has been tested using Microsoft Framework 1.1. A platform independent runtime named 'Mono .NET Framework' is available for compiling .NET code, and theses sources has also been successfully compiled using Mono .NET implementation.

Bibliography on Labor market and Multiagent Simulations

A. Calvo-Armengol and M.O. Jackson The Effects of Social Networks on Employment and Inequality, 2003 American Economic Review 94 (2004) 426.

A. Chaturvedi, S. Mehta, D. Dolk, R. Ayer, Agent-based simulation for computational experimentation: Developing an artificial labor market, European Journal of Operational Research 166 (2005) 694.

A.L. Espindola, T.J.P. Penna, J.J. Silveira, Rural-urban migration in d-dimensional lattices, International journal of modern physics C 16, issue 12 (2005)

C. Detang-Dessendre, C. Drapier, H. Jayet, The impact of migration on wages: empirical evidence from French youth, Journal of regional science, vol. 44 (2004) 661.

G. Ballot, Modeling the labor market as an evolving institution: model ARTEMIS, Journal of Economic Behavior & Organization, Vol. 49 (2002) 51.

P. De Grande and M. Eguía. Strategy Space Exploration Of A Multi-Agent Model For The Labor Market, International Journal of Modern Physics C [Computational Physics and Physical Computation], Vol. 17, No. 3 (2006) 357-371

J. M. Epstein and R. Axtell, Growing artificial societies: social science from the bottom up, Chap. V, MIT Press, Camdridge, 1996

J. Nun, "El futuro del empleo y la tesis de la masa marginal", in Desarrollo Econ\'omico, (vol. 38, no 152), 1999. English translation: Latin American Perspectives (California), 7 (2000)6 ; Novos Estudos CEBRAP (Sao Paulo), no56, March 2000, 43-62.

J. Persia, J. & P. De Grande, “La construcción de sujeto en los procesos de despidos”, in IV Jornadas de Sociología, FCS. Buenos Aires, 2000.

L. Tesfatsion, Structure, behavior, and market power in an evolutionary labor market with adaptive search, Journal of Economic Dynamics & Control 25 (2001) 419.

M. E. Gordon and W. A. Johnson. Seniority: A review of its legal and scientific standing, Personnel Psychology; 35 (1982) 55.

M. Neugart, Labor market policy evaluation with ACE, 'Agent-Based Models for Economic Policy Design' (ACEPOL05)

M.J. Piore, "8. Notas para una teoría de la estratificación del mercado de trabajo", in "El mercado de trabajo: Teorías y aplicaciones", Luis Toharia eds., Alianza Editorial. English version: Notes for a Theory of Labor Market Stratification, in Richard C. Edwards, Michael Reiche y David M. Gordon, eds., Labor market Segmentation, Lexington, Lexington Books, 1975

S.-R. Yang, J.-K. Min and S.-B. Cho, "Agent-based evolutionary labor market model with strategic coalition", Australian Conference on Artificial Intelligence 2004.