

The Costly Bargain: Economic Impacts of Price-Seeking Behavior in Aging Populations

Extended Abstract

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ABSTRACT

This paper examines the effects of an aging population on key macroeconomic factors, including unemployment, labor market tightness, firm revenue, and product prices. Using a combination of agent-based and statistical models, we find that a rising old-age dependency ratio is associated with higher unemployment rates and lower firm revenue.

KEYWORDS

Agent-based Modeling, Labor Markets, Goods Market, Unemployment, Aging, Search Intensity

ACM Reference Format:

Fuguang Chen and Alan Tsang. 2025. The Costly Bargain: Economic Impacts of Price-Seeking Behavior in Aging Populations: Extended Abstract. In *Proc. of the 24th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2025)*, Detroit, Michigan, USA, May 19 – 23, 2025, IFAAMAS, 2 pages.

1 INTRODUCTION

The 21st century saw aging become a serious issue in many countries across the world. In this paper, we examine how demographic changes impact macroeconomic variables, particularly the labor market. We introduce an agent-based model of the economics of an aging population and compare the model's results to real-world data. Our main innovation is the introduction of search intensity into the analysis of unemployment — shoppers may devote variable amounts of time while shopping for the same goods. For example, a retiree with a search intensity value of 0.9 indicates that there is a 90% probability that she will engage in a second search for goods after meeting with a seller in hopes of finding a lower price. Given the significant economic and social implications of unemployment, particularly in countries with aging populations, understanding its relationship to demographic factors is a critical area of research.

2 RELATED WORK

Literature on the aging of the labor market is limited, and primarily focus on how the aging labor force affects the unemployment rate or labor force participation rate of the young or old [1–3, 7].

Instead, we focus on the effect that an aging workforce has on unemployment within the working age population.

Our approach is motivated by Burdett and Judd [4]. They recognize that searching the market for lower prices is costly in time — a limited resource for a worker, but one that is more available for the unemployed or retired. As a result, these segments of the population exhibit increased price sensitivity and are able to purchase goods at lower prices. This is evident when examining data from the Survey of Time Use of Americans (ATUS) data from 2003 to 2016: Krueger and Mueller [8] show that unemployed people spend more time shopping and pay less for their goods than their employed counterparts.

3 METHODOLOGY

Our model simulates the interaction between the working labor force and the retirees, both acting as consumers, and goods providers. The simulation proceeds in 1-year steps. Agents in the labor force may transition between employment and unemployment within each step, and age by 1 year after each step. The model was created in Python v3.11. The model has three components: agents representing individuals (aged 0 to 100) including **Children** (Aged 0 to 14), **Working Population** (Aged 15 to 64), and **Retirees** (Aged 65+), firms, and the goods market. We opted not to represent the labor market explicitly because the core attributes of the labor market are effectively represented by firms and the goods market in a lump-sum way based on the assumption of constant wage.

4 EMPIRICAL RESULTS

Figure 1 depicts the effects of the old-aged dependency ratio (on the x-axis) on several socioeconomic factors (on the y-axes of each subplot): the unemployment rate, labor market tightness (i.e., the ratio of number of unfilled job vacancy to unemployed workers), firms' revenue, and price respectively. There is a clear upward trend between the old-aged dependency ratio and unemployment rate (top-left in Figure 1), which is mirrored by the downward curve of labor market tightness (top-right in Figure 1). That is, lower market tightness means it is less likely for a job seeker to find a job, and therefore increases the unemployment rate. The bottom-left curve shows why the unemployment rate goes up as the firms' net revenue goes down. As the net revenue declines, the firms remove existing job position, fire the employed workers, and cut the existing job vacancies in response to a drop in goods prices. The bottom-right curve illustrate why the firms' revenues drop: the selling prices of goods decrease.



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Proc. of the 24th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2025), Y. Vorobeychik, S. Das, A. Nowé (eds.), May 19 – 23, 2025, Detroit, Michigan, USA. © 2025 International Foundation for Autonomous Agents and Multiagent Systems (www.ifaamas.org).



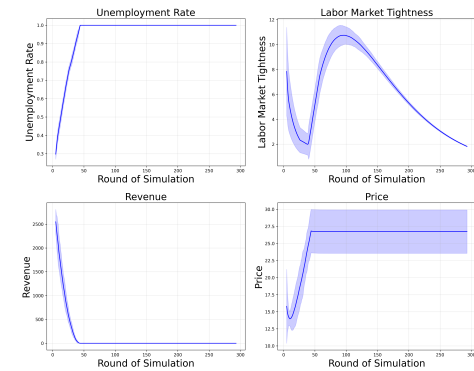
Figure 1: Effects of old-aged dependency ratio (stars indicate positions every 10 iterations, and advance from left to right)

The model shows a strong correlation between firms' net revenue and the unemployment rate. We next examine the effects of expanding the number of firms in the market from 10 in the initial simulation to values of 50, 100, 200, and 1000. Figure 2 shows the results of 10 replications under the 100 firms and 1000 firms conditions. As in Figure 1, we plot the four macroeconomic variables (unemployment rate, labor market tightness, firms' average revenue, and average product posting price) with their mean values and 95% confidence intervals.

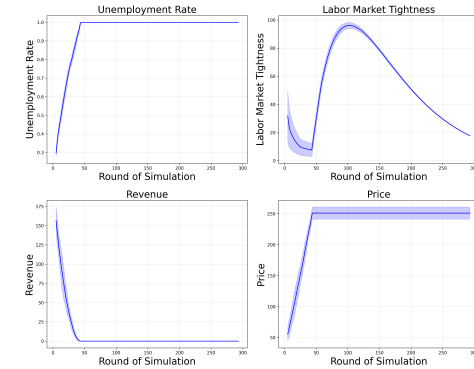
Our results show that the general relationship between the old-aged dependency ratio, and unemployment rate as well as firm revenue from Figure 1 are robust. As firm size increases from 10 to 1000, holding the same population structure, it reveals that the unemployment rate rises with old-aged dependency ratio.

5 REAL WORLD STATISTICAL ANALYSIS

Several quantitative studies have explored the complex relationship between aging and unemployment, revealing multiple factors can influence this dynamic. The findings from these studies are often conflicting on the impact of aging on unemployment rates. Some conclude that aging reduces the unemployment rate [5, 6, 9]; other reach the opposite conclusion [10]. We perform a regression analysis on cross-national data from the World Bank to examine connections between aging and unemployment. We conduct a statistical regression analysis using 3 different models to examine the impact of old-age dependency ratios on unemployment rates across different regions. After adjusting for the influence of time and other key macroeconomic variables traditionally considered to influence the unemployment rate, our models show that the relationship between the unemployment rate and the old-age dependency ratio appears to be the ascending segment to the left of the axis of symmetry in a quadratic form. These results confirm a positive impact of the old-age dependency ratio on the unemployment rate in real-world data, which aligns with the findings from our agent-based model. Details are not included in this short paper version.



(a) 100 Firms



(b) 1000 Firms

Figure 2: Effects of old-aged dependency ratio under varying firm sizes on macroeconomic variables. Mean values (from 10 runs) are plotted with 95% confidence intervals.

ACKNOWLEDGMENTS

We acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC), [RGPIN-2021-04196].

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