PhD Project, GSBE Learning & Work, Maastricht University
Minciencias scholarship, Colombia

Project title:
The impact of technology and changing skills demands on the pension and labor market behavior of older workers

Supervision team:
- Prof.dr. Didier Fouarge, Research Center for Education and the Labour Market (ROA), Maastricht University (contact: d.fouarge@maastrichtuniversity.nl)
- Prof.dr. Mark Vancauteren, Research Group of Economic Policy, Hasselt University
- Dr. Montizaan Raymond, ROA, Maastricht University

Description of the research project:
Automation (such as robotization, digitalization, machine learning, Artificial Intelligence (AI)) promise great potential for growing productivity and boosting general welfare. However, automation will also fundamentally change the demand for skills: it decreases the demand for routine tasks (Autor, 2015), and increases the demand for analytical and problem-solving skills (Weinberger, 2014) as well as the demand for soft skills (Deming, 2017). These changes are expected to speed up the level of skills obsolescence of older works and affect their labor market and retirement behavior. The project focuses on three research questions:

1. To what extent does automation affect **retirement behavior and pension income**?
   a. Does automation lead to earlier or later retirement?
   b. To what extent does automation lead to more inequality in pension benefits between retirees with different skills?

2. To what extent do **employers discriminate against older workers in the allocation of formal training and job tasks from which workers learn in an informal way**?

3. How does occupational exposure to technological changes impact the **cognition and health of older workers/retirees**?
   a. How does exposure to automation during the career affect the development of cognitive and non-cognitive skills post retirement?
   b. How does exposure to automation during the career affect the mental and physical health after retirement?

These three research questions will be answered in three interrelated projects.

Project 1: To what extent does automation affect **retirement behavior and the pension income**?

This research question is inspired by the fact that automation may displace jobs, but that it also can also generate new employment since automation reduces the prices of the goods and services whose production process have been automated. Automation will typically raise the relative demand for analytical and soft skills, both within and across occupations (Autor 2015), since these skills are complementary to technology. How this affects older workers will depend on their personal skills set and their sorting in occupations.

Although current research has already shown that technical changes were skills biased (in particular routine tasks have disappeared), there is virtually no research on how this affected the labor position of older workers, and as a consequence their retirement behavior. The only study we are aware of is Friedberg (2003) who looked at the impact of the adaptation of computers in the US. Her conclusion was that impending retirement, rather than age alone, explains why older workers used computers less than prime-age workers did. A second conclusion is that computer users retired later than non-users. Although this pattern may arise because workers planning later retirement decided to acquire computer skills, her empirical analysis suggested that the causation also went in the other direction, with computer users choosing to delay retirement.

In order to assess the impact of automation on late career employability and retirement of older workers, we match the data on automation at the industry sector level to Dutch register data (SSB) on employment and retirement behavior. This allows us to explore the relationship between automation and late career employability of older workers in the past decades. The link with the Labor Force Surveys (LFS) allows us to investigate the

impact of automation at the occupational level, including income and wage as LFS respondents can be matched to SSB.

Our analyses will build on the latest micro-econometric literature on the impact of technological innovations. We will use state-of-the-art empirical methods which deal with issues such as the mechanical correlation between total factor productivity and labor share (computed from SSB), and the fact that contemporaneous productivity innovations are unlikely to induce their steady-state effects immediately. These methods will make optimally use of the longitudinal nature of the data, and control for other factors that affect sectoral employment and productivity such as internationalization (Van Cauwenberge et al. 2019). Following Goos et al. (2014) we will make use of a two-stage setup for modelling the production process in which output in different industries is produced from a set of tasks (computed from the Netherlands Skills Survey; NSS), and where each task is produced using a technology that combines labor from a specific occupation (computed from LFS) and other inputs (from Dutch National Accounts). This type of two-stage setup has also been used in recent work by, among others, Teulings (1995, 2005); Autor, Levy, and Murnane (2003); Autor, Katz, and Kearney (2006); Grossman and Rossi-Hansberg (2008); Costinot and Vogel (2010); Acemoglu and Autor (2011); and Autor and Dorn (2013).

Methods: panel estimation for large administrative data, advanced econometric techniques.

Project 2: To what extent do **employers discriminate against older workers in the allocation of formal training and job tasks** from which workers can learn (informal learning)?

The research question deepens previous research by Montizaan and Fouarge (2016) which investigated age discrimination in hiring and employers' training provision, and older workers' decision whether or not to train. This research project will add to the existing research by focusing on the impact of employers' tasks allocations and learning processes (during training and learning from job tasks) by introducing a randomized stated preferences experiment on tasks allocation and human capital investments among managers in the well-established LISS panel survey as well as in the ROA/APG employer survey. By doing so, we tackle an important gap in the training literature that predominantly focused on younger workers and on formal training courses only, while it is evident that informal learning is crucial to acquisition of skills (De Grip and Sauermann, 2012). We introduce randomized stated preferences experiments in the LISS panel and ROA/APG employer survey to investigate 1) in what way employers allocate routine and analytical tasks to workers who differ a.o. in their age, and 2) what triggers employers to invest in the human capital (formal training and informal learning) of their older employees in a situation in which they are confronted with technological innovations. In particular, we focus on what they consider to be the optimal design of human capital investments.

Methods: mixed logit models for stated choices experiments.

Project 3: How does occupational exposure to technological changes impact the **cognition and health of older workers/retirees**?

For this question, we use SHARE data to identify the causal effect of exposure to new technologies while at work on older workers' memory scores, stress and depression after retirement. Using retrospective data on occupational careers from SHARE, which has been underused so far in research, we can measure workers' exposure to automation which is likely, depending on the institutional context, to induce early retirement and stress. We instrument the timing of retirement using country variations in institutional arrangements and pension reforms (Bonsang et al., 2012). The introduction of the exposure to automation during the career on cognitive and health decline after retirement is novel and allows us to be the first to identify occupation-specific variations within countries. The question is relevant as in earlier work, we showed that pension reforms affect mental health (De Grip et al. 2012). Exposure to automation could be expected to have similar effects through forced exit from paid labour when made redundant.

Methods: IV estimation and panel data techniques.

Proposed time schedule:

	2020		2021				2022				2023				2024	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Project 1																
Project 2																
Project 3																

Data:

The research project builds on the following data sources:

1. Novel automation risk databases to which we have exclusive access through an ongoing Horizon2020 project. This includes measures of the impact of technological innovations from Oxford scholar Carl Frey who is a partner in the Horizon2020 project, and currently being gathered data on automation at the job tasks level within occupations.
2. Statistics Netherlands' register data on labor participation, retirement and pension benefits, National Survey on Work Circumstances for Employees (in conjunction with TNO) and LFS data, with which the researchers are familiar.
3. NSS and the LISS panel. ROA contributed to the set-up of the NSS, the first Dutch dataset that contains detailed information on job tasks, skills as well as retirement transitions and labor supply among the elderly. In combination with stated preferences experiments on human capital investments and task allocation, we develop a better understanding of the importance of tasks and technological innovations for the optimization of human capital investments.
4. The ROA/APG employer survey, is a panel survey annually conducted since 2011 among a representative group of employees in the public and privatized sector. We will exploit further waves (data are gathered by the researchers of this project) to design new stated-choice experiments to test the impact of employers' preferences and attitudes on the way they organize tasks and invest in the human capital of workers who differ in age.
5. The Survey of Health, Ageing and Retirement in Europe (SHARE) is a multidisciplinary and cross-national panel database on health, socio-economic status and social and family networks. It contains validated measures of cognition and health such as health and depression.

Expected impact:

Expected societal impact: Pension funds, policy makers, insurance companies, and scientist will greatly profit from new detailed insights into the impact of technology on employability, retirement behavior, pension benefits and health. This topic fills this gap in the Netspar research program. The project will help social partners and policy makers to develop policies aimed at vulnerable groups of older workers with respect to employment and/or health risks, and to identify the effectiveness of different type of human capital developments to alleviate the potential negative effects of automation.

The expected scientific impacts are:

1. Improve systematic knowledge accumulation in the field of technological change.
2. Improvement of the quality of forecasting models, by technology scenario's in an econometric model that encapsulates the full width of the labor market and all its interactions between fields of study and occupation, as well as skills requirements.
3. The use of brand new measures of automation and build forth on combined panel datasets.
4. Revisiting the role of lifelong learning in an environment of continuous technological change and changing skill demands, employing a holistic view of human capital formation through formal, non-formal and informal as well as workplace learning.
5. Providing new experimental evidence on the optimization of human capital investments to retain employability to an older age.

Embedment of the project:

The project is embedded in ROA and the GSBE research theme Learning & Work where Fouarge and Montizaan have been conducting research on the position of older workers in the labour market, the transition from paid

labour to retirement and the importance of skills and technological change on employability. Fouarge is programme director of the Labour Market Dynamics research programme at the Research Centre for Education and the Labour Market (ROA), Maastricht University. He holds a Chair of "Dynamics of skills allocation" at the School of Business and Economics at Maastricht University. Montizaan is part of the Netspar network and is leading a project on Work, Health and Retirement which is financed by Netspar. Both researchers are leading a Horizon2020 (together with Prof. dr. Mark Levels) project on the impact of technological change on the labor market (Technequality: https://technequality-project.eu/). Fouarge and Montizaan are research fellows of IZA and Netspar. Mark Vancauteren will complement the supervision team. He has ample experience in applied econometric research on innovation, firm performance and labor market effects. Moreover, he has an affiliation with Statistics Netherlands (which facilitates access to data), and strong expertise in the use of employee-employer data and innovation data. The members of our project team can build on a rich experience in the research field of this proposal:

1. The researchers of Maastricht University (Raymond Montizaan and Didier Fouarge) have worked on earlier Netspar projects (*Retirement, HR and Worker behavior and Work, Health and Retirement*) financed by a Netspar Large Vision grant which ended in September 2016 and will end in December 2019. These highly successful projects have led to scientific publications in Economic Journal, Management Science, PLOS ONE, Journal of Economic Behavior and Organization, Journal of Vocational Behavior, Ageing & Society, Labour Economics, Economics and Human Biology, Journal International Archives of Occupational and Environmental Health and Scandinavian Journal of Work, Environment and Health. Within the project they focused on how labor supply at older ages responds to changes in pension schemes, and how individuals form their retirement decisions in such a dynamic environment, and whether and how HR-policies can affect employees' pension awareness, retirement intentions as well as their cognitive development, performance and employability. The previous research is therefore closely related to the topic in this proposal.

2. ROA also is the Principal Investigator for a major European Horirzon2020 project on technological change (Technequality: www.technequality-project.eu). Within this research project, we cooperate with leading scientific institutes such as Oxford University, Cambridge Econometrics, WZB Berlin, Tilburg University, SOFI Sweden, Tallinn University, and the European University Institute. This unique cooperation will also have positive externalities on this research project. The Horizon2020 Technequality project, is focused on labor market outcomes of the youth and on how formal education systems should change in order to educate today's children and workers for tomorrow's labor market. This PhD project focusses on the labor market of older workers and retirement behavior, and is thereby a substantial extension to Technequality that would allow us to develop a life cycle perspective. The student will not only benefit from this extended international network. An additional benefit is that we can introduce the research team of UHasselt into this international network.

3. Mark Vancauteren of UHasselt has published in journals such as the International Econometric Review, Journal of Small Business Management, Journal of Technology Transfer, Journal of business Research, and De Economist. His affinity with the research topic of this proposal follows from several publications on innovation, competition and productivity. Moreover, in a current research project he is looking at the effects of mergers & acquisitions on employee mobility and workers' stress. This project is also a research collaboration with ROA and Statistics Netherlands.

4. Important is further that a close ongoing collaboration exists between the two teams of UHasselt and ROA. Wendy Smits who is a fellow at ROA works closely together with both teams and is involved as a member of a PhD commission of a PhD student at UHasselt, Ngoc Han Nguyen. In addition, both teams also hosted Maastricht University internship (see Smits et al., 2018) that looks at the link between globalization and the demand for non-routine versus routine based tasks. Both teams have a large experience with the valorization of the results of their research. The team is experienced with publishing several articles in various professional journals and at the Me Judice website and gave various interviews in the media. Moreover, the ongoing cooperation of ROA with APG (pension fund based in Heerlen), allows us to develop with a local business partner products aimed at relevant stakeholders. Furthermore, we have a large experience with presenting research findings at conferences for a broader audience organized by various Ministries, pension funds, GAK Foundation, Wijzer in Geldzaken and other organizations. We have presented our results on events in which also Queen Maxima of the Netherlands participated.

5. Both teams have extensive experience in developing and working with large scale survey questionnaires such as ROA-Levenslang Leren Enquête; the survey questionnaire of OECD's worldwide Programme for the International Assessment of Adult Competencies (PIAAC) study, the Netherlands Skills Survey, and the ROA/APG/Statistics Netherlands'/National Bank Belgium employee-employers surveys. The PhD student can benefit from this experience when writing her / his thesis and data access opportunities can be put easily into place.

References:

Autor, D. (2015). Why are there still so many jobs? The history and future of workplace automation. *Journal of Economic Perspectives*, 29(3), 3-30.

Acemoglu, D. and D. Autor. (2011). Skills, Tasks and Technologies: implications for Employment and Earnings. In: O. Ashenfelter and D. Card (Eds.), Handbook of Labour Economics (volume 4). Amsterdam: Elsevier.

Autor, D.H. and D. Dorn (2013). The growth of low skill service jobs and the polarization of the US labour market. *American Economic Review*. 103(5): 1553–97.

Autor, .H., Katz, L., & Kearney. M. (2006). "The Polarization of the U.S. Labor Market." *American Economic Review* 96 (2): 189–94.

Autor, D., F. Levy, and R. Murnane. (2003). The Skill Content of Recent Technical Change: An Empirical Exploration*. Quarterly Journal of Economics* 118, 1279-1334.

Bonsang, E., Adam, S., & Perelman, S. (2012). Does retirement affect cognitive functioning? *Journal of Health Economics*, 31(3), 490-501.

Costinot, A., & Vogel., J.E. (2010). "Matching and Inequality in the World Economy." *Journal of Political Economy* 118 (4): 747–86

Grip, A. D., Lindeboom, M., & Montizaan, R. (2011). Shattered dreams: the effects of changing the pension system late in the game. *The Economic Journal*, *122*(559), 1-25.

De Grip, A., & Sauermann, J. (2012). The effects of training on own and co-worker productivity: Evidence from a field experiment. *The Economic Journal*, 122(560), 376-399.

Deming, D. J. (2017). The growing importance of social skills in the labor market. *The Quarterly Journal of Economics*, *132*(4), 1593-1640.

Goos, M., Manning, A., and Salomons, A. (2014). Explaining job polarization: Routine-biased technological change and offshoring. *American Economic Review*, 104(8), 2509-2526.

Grossman, G.M., & Rossi-Hansberg., E. (2008). "Trading Tasks: A Simple Theory of Offshoring." *American Economic Review* 98 (5): 1978–97.

Smits, W, Vancauteren, M & Weyns, I 2018, Importconcurrentie en de vraag naar niet-routinematige arbeid. In *Internationaliseringsmonitor 2018-II: Werkgelegenheid.* CBS, Den Haag, pp. 93-109.

Montizaan, R.M., & D. Fouarge (2016). The impact of employer's characteristics on the willingness to hire older workers: Evidence from a stated preferences experiment Netspar DP 01/2016-054,

Teulings, Coen. (1995). "The Wage Distribution in a Model of the Assignment of Skills to Jobs*." Journal of Political Economy* 103 (2): 280–315.

Van Cauwenberge, A., Vancauteren, M., Braekers, R., & Vandemaele, S. (2019). International trade, foreign direct investments, and firms' systemic risk: Evidence from the Netherlands. *Economic Modelling*, *81*, 361-386. Weinberger, C. J. (2014). The increasing complementarity between cognitive and social skills. *Review of Economics and Statistics*, *96*(4), 849-861.