Racing With or Against the Machine?
The Employment Effects of Technological Progress

New Approaches to Economic Challenges

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The labor market impacts of new technologies

- Long-standing debate on labor market impacts of technological progress (Autor 2015; Mokyr et al 2015; Nordhaus 2015)

- In recent years, revival of public concerns about labor racing against the machine: concerns for jobless future
  - 73% of European citizens agree with the statement “Robots steal people's jobs” (Eurobarometer 2013)
  - Frey & Osborne (2013, 2016): 47% of all U.S. work can be automated within 15 years

- Is labor racing against the machine?
Is technology destroying jobs?

- Economic literature argues that technological change can have labor-replacing effects.
  - Routine tasks follow a strict protocol, making them codifiable in software.

- However, these replacement effects are **not the only factor**:
  - **Substitution effects**: technology replaces labor in performing tasks, reducing labor demand.
  - **Product demand effects**: increased productivity reduces prices, increasing demand for goods and services, and thereby also increasing labor demand.
Aim: study economy-wide labor demand effects of routine-replacing technological progress both theoretically & empirically

1. Develop **task-based framework** capturing main channels through which **routine-replacing technologies impact labor demand**
2. Estimate key parameters from framework using data over 1999-2010 for 238 regions across 27 European countries, to **construct empirical estimate of labor demand effect**
3. **Decompose total effect** into contributions from different labor and product demand channels
The labor demand effects of technological progress

Figure 1: Predicted European labor demand change, 1999-2010

Source: Gregory, Salomons, & Zierahn (2016)
A jobless future?

- **Substitution effects** are already sizable now

- **Product demand effects** likely to continue being important (both for existing goods and services; and for new goods and services)

- Many technologies complement rather than substitute human labor
The distributional effects of technological progress

- However, technological progress is a biased shock: it does not affect all work in the same way.

- **Middling jobs** are most likely to be automated since they are intense in routine tasks.

- Technological progress leads to **job polarization**: increasing employment shares of both high- and low-paying jobs at the expense of middling jobs (Autor & Dorn 2013; Goos, Manning, & Salomons 2014).
Figure 2: Job polarization in Europe, 1993-2010

Source: Goos, Manning, & Salomons (2014)
Conclusion

- Positive absolute labor demand effect from technological progress: product demand effects overcompensate substitution effects.

- However, not all work is affected in the same way, leading to shifts in relative labor demand: currently, middling jobs are most vulnerable to automation, resulting in job polarization.

- Debate should focus less on fears of mass unemployment and more on distributional concerns and institutions (e.g. education system, minimum wages, safety nets), to optimally reap and share the gains offered by advancing technologies.
Technology, Globalization and Inequality

New Approaches to Economic Challenges

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Introduction

- In the debate about technology and globalization, public perception is that economists think that the gains are ubiquitous.

- But this does not come out of textbook models showing that there are strong distributional effects from technology and globalization.

- These textbook models are becoming outdated with recent progress in theory, data and empirical methodology, welfare and policy instruments, and interdisciplinary.
Technology

- Skill-Biased Technological Change (SBTC) is a model of (overall) wage inequality.

- But the recent nature of technological progress (e.g. automation of routine-codifiable tasks) and empirical events (e.g. falling absolute wages for unskilled workers, job polarization) necessitate a richer framework.

- The recent “Ricardian Model of the Labor Market” assumes that workers reallocate across jobs based on comparative advantage following the automation of routine-codifiable tasks.
Comparative advantage and supply-demand

robots/AI is not about joblessness but about the types of jobs that they do relatively better/cheaper than workers

- The market assigns Brian May (Queen) to play the guitar and you to do scientific research.

- This is true even if Brian May, who holds a degree in astrophysics, would be a better scientist than you are because his hits make the world a better place (compared to the counterfactual where he does fantastic science but you write bad music).

- Comparative advantage says there is always something for someone even if they are dominated in all activities.
- So will specialised AI-robots have a comparative advantage at doing low, medium or high skilled activities?
Figure 11  Source: Data on EU employment are from Goos et al. (2009). US data are from the May/ORG CPS files for years 1993-2006. The data include all persons aged 16-64 who reported employment in the sample reference week, excluding those employed by the military and in agricultural occupations. Occupations are first assigned to 326 occupation groups that are consistent over the given time period. These occupations are then grouped into three broad categories by wage level.
Globalization

- Stolper-Samuelson predicts the recent rise in wage dispersion in advanced economies due to increased trade in final goods with developing countries entering world markets.

- But advances in transportation (e.g. containerization, ICT, business travel) and empirical events (e.g. the rising trade in intermediate inputs) necessitate a richer framework.

- Models of Global Value Chains (GVCs) assume international fragmentation of production where workers reallocate across jobs based on comparative advantage following advances in transportation.
Figure 2
Foreign Value-Added Shares in 560 Global Value Chains, 1995 and 2008

Source: Timmer et al. (14)
Technology, globalization and inequality

- The recent nature of technological progress and globalization has resulted in empirical puzzles for textbook models.
- This is leading to richer frameworks assuming individual workers differ in their productivity of performing various tasks.
- There is reallocation of workers across jobs based on comparative advantage, leading to winners and losers from technological progress and globalization and to consequent changes in inequalities.
Challenges

- Comparative-advantage models are underidentified ("there are more unknowns than knowns") unless we:
  - Observe more outcomes for inputs and/or outputs, i.e. have access to "multimarket" data.
  - In contrast to textbook CEF estimators, use different empirical methodologies that account for non-random sorting.

- Microfoundations of comparative advantage allow for welfare analyses and the development of new policy instruments given market imperfections related to technology and globalization.

- Use interdisciplinarity (e.g. to quantify the nature of technological progress or to include psychological or ethical aspects of inequalities in welfare analyses).
Organizing research in a multidisciplinary way

New Approaches to Economic Challenges

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Multidisciplinary approaches

“Links of research on technological change to other disciplines”

• Relates to work and income (sociology, labour economics, labour law, social security law, ....)
• Relates to inequality and its causes and effects (history, sociology, fiscal law, political science, .....)
• Relates to education and training of labour force (pedagogy, educational sciences, organisational science, ....)
• Relates to values and norms (political philosophy, human rights studies, law, ...)

Multidisciplinary approaches

“Links of research on technological change to other disciplines”
Institutions for Open Societies
Strategic theme of Utrecht University

• We try to make these links in a systematic way, by breaking obstacles between disciplines
• Multidisciplinary approaches to societal issues

Main instruments:

- Designated chairs
- Top researchers
- Support for workshops, conferences, valorization
- Talent policy
- Fellows / visiting fellows
- Seed money
Five interdisciplinary pillars

- Interdisciplinary working communities
- Thematically focused, oriented on societal issues
- Linked to top-quality research

1. Institutions for Cooperation, Self-regulation and Collective Action
2. Institutions for Sustainability and Resilience
3. Institutions for Innovation and Prosperity
4. Institutions for Equality, Inclusion and Social Mobility
5. Institutions for Democratic Governance, Citizenship and Trust

Each pillar is composed of:
- a core team of c. 12 scholars (coordinators / members of programme team, designated chairs, top researchers, talents, seed money teams, visiting fellows)
- a wider group of c. 50 scholars involved from all relevant disciplines
Top researchers

- Engaging high-quality scholars in this multi/interdisciplinary research network
- Enabling them to develop new, interdisciplinary research teams
- Enabling them to develop joint models, theories, concepts
- Developing research consortiums, organizing workshops, stimulating seed money applications, identifying social partners, building interdisciplinary education
Other initiatives

- Workshops: c. 25 internal workshops (enhancing interdisciplinarity) and c. 25 workshops with external partners (enhancing societal impact) per year
- Building, research infrastructure, facilities, support
- Dataset infrastructure: i-Lab
- Interdisciplinary education, new courses, Young Innovators League
- Collaboration with societal partners: forming consortiums
- Making impact (social enterprise policy, technological change and labour markets, innovation policy, .....
Examples: Institutions for Economic and Social Sustainability and Resilience

• **Sustainable Finance Lab:**
  - Aims for robust financial sector that contributes to an economy that serves humanity without depleting its environment
  - Develops ideas and provides a platform to discuss these
  - Bridges science and practice (actors from within financial sector)

• **Development of well-being:**
  - OECD-report “How was Life: Global Well-being since 1820”, Jan Luiten van Zanden et al. (2014)
  - Launch *Comprehensive Index of Wellbeing* for the Netherlands (December 2016)
The study shows strong progress in reducing gender inequality over the past 60 years in many countries. But differences between regions remain large. The Western countries of Europe and North America, for instance, performed best, although gender equality is still inexistent there. The Middle East and North Africa; and South and Southeast Asia performed worst.

How Was life? Global Well-Being since 1820, a collaboration between the OECD, the OECD Development Centre and the CLIO-INFRA project of academic researchers, has compiled data for 25 countries, eight global regions and for the world.

To obtain a copy of the study, journalists are invited to contact the OECD Media Division (news.contact@oecd.org; tel: +33 1 45 24 97 00). Further information is available online about the OECD's work on measuring well-being.

For additional information about the CLIO-INFRA project, please contact Jan Luiten van Zanden (jlvz@iasg.nl).

**Compare well-being indicators over time in the interactive graph**

How Was Life? in 1820

How was life in 1820, and how has it improved since then? What are the long-term trends in global well-being? Views on social progress since the Industrial Revolution are largely based on historical national accounting in the tradition of Kuznets and Maddison. But trends in real GDP per capita may not fully reflect changes in other dimensions of well-being such as life expectancy, education, personal security or gender inequality. Looking at these indicators usually reveals a more equal world than the picture given by incomes alone. But has this always been the case? The report *How Was Life?* aims to fill this gap.

Click on a year or press play to see the evolution of the quality of life. See if and when data are available for a given country:

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**Select a Country**

**GDP per capita**

People's incomes are a fundamental measure of their material standard of living, and hence of their well-being. The best available measure of historical incomes is GDP per capita. GDP measures the value of goods and services produced in an economy in dollars of 1990, making use of Purchasing Power Parities. They are reported per person.

Move over a country to have information on data quality from 1: good, to 4: estimate.

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5,000 10,000 15,000 20,000 25,000 30,000 35,000 40,000
Examples:
Institutions for Innovation and Prosperity

• “Financial and Institutional Reform for the Entrepreneurial Society“ (FIRES), Mark Sanders, EU Horizon 2020, history, economics, geography and law

• “Intrapreneurship: Enabling Talent for Innovation“, Erik Stam, Dutch Research Council, consortium with large companies

• “Innovation Systems“, Marko Hekkert, collaboration with ministry of Economic Affairs

• “The sharing economy“, Koen Frenken, high public visibility, The Guardian, etc.