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Daisuke Adachi

Address: Department of Economics
Yale University
New Haven, CT 06520-8268

Telephone: (+1) 475-243-8266

E-mail: daisuke.adachi@yale.edu

Web page: https://daisukeadachi.github.io/

Citizenship: Japan, J-1 Visa (no residence requirement)

Fields of Concentration:
International Trade
Labor Economics

Desired Teaching:
International Trade
Labor Economics

Comprehensive Examinations Completed:
2017 (Oral): International Trade, Labor Economics
2016 (Written): Microeconomics, Macroeconomics

Dissertation Title: *Essays in Automation and Globalization*

Committee:
Professor Costas Arkolakis (Chair)
Professor Lorenzo Caliendo
Professor Peter Schott

Expected Completion Date: May 2021

Degrees:
Ph.D., Economics, Yale University, 2021 (expected)
M.Phil., Economics, Yale University, 2018
M.A., Economics, Yale University, 2017
M.A., Economics, University of Tokyo, 2015
B.A., Economics, University of Tokyo, 2013

Fellowships, Honors and Awards:
Invited Participant, 7th Lindau Nobel Laureate Meetings on Economic Sciences, 2021
University Dissertation Fellowship, Yale University, 2020-

University Fellowship, Yale University, 2015-2020
Richard J. Bernhard Fellowship Fund, Yale University, 2016-2019
Cowles Foundation Fellowship, 2015-2019
Repayment exemption for graduate students with excellent achievements, Japan Student Services Organization Scholarship (JASSO), June 2014

Teaching Experience:

Yale University
Spring 2019, Teaching Assistant to Prof. Peter Schott, International Trade, Yale College
Fall 2018, Teaching Assistant to Prof. William Nordhaus, Intermediate Macroeconomics, Yale College
Spring 2018, Teaching Assistant to Prof. Peter Schott, International Trade, Yale College
Fall 2017, Teaching Assistant to Prof. Donald Andrews, Introductory Econometrics, Yale College

University of Tokyo
Winter 2014, Teaching Assistant to Prof. Andrew Griffen, Topics in Labor Economics (Grad.)
Winter 2013, Teaching Assistant to Prof. Michihiro Kandori, Microeconomics (Undergrad.)
Summer 2013, Teaching Assistant to Prof. Daisuke Oyama, Mathematics for Economics (Undergrad.)

Research and Work Experience:

Research Assistant to Prof. Costas Arkolakis, Yale University, 2018-2019
Research Assistant to Prof. Danial Lashkari, Yale University, 2018
Research Assistant to Prof. Bryan Kelly, Yale University, 2018
Research Assistant to Prof. Yukiko Saito, Research Institute of Economy, Trade, and Industry (Japan), 2017-2019
Research Assistant to Prof. Yasuyuki Sawada and Hiroyuki Nakata, Research Institute of Economy, Trade, and Industry (Japan), 2013-2014
Research Assistant to Prof. Yasutora Watanabe, Kosuke Uetake, and Kohei Kawaguchi, JR East Water Business Co Ltd, 2013

Working Papers:

"Robots and Wage Polarization: The Effects of Robot Capital across Occupations" (November 2020), *Job Market Paper*

"Robots and Employment: Evidence from Japan, 1978-2017" with Daiji Kawaguchi and Yukiko U. Saito (June 2020), *Revision requested at Journal of Labor Economics*

*"*Multinational Production and Labor Share" with Yukiko U. Saito (February 2020)

*"*Commuting Zones in Japan" with Taiyo Fukai, Daiji Kawaguchi, Yukiko U. Saito (February 2020) *, Under review*

Invited Presentations:

2020: Kobe University; Happy Hour Seminar

November 2020

Seminar and Conference Presentations:

2020: Econometric Society World Congress
2019: Asian and Australian Society of Labor Economics, National University of Singapore; University of Tokyo, Microeconomics Workshop; Investigations in International Trade; Young Economist Symposium; Cryptocurrency Research Conference; Midwest International Trade Conference; Hitotsubashi Winter International Trade Seminar
2018: Asian and Australian Society of Labor Economics, Seoul National University
2015: International Comparison Workshop, RAND Corporation; Japanese Economic Association Spring Meeting, Niigata University

Referee Service:

Economic Theory; Journal of Economic Behavior and Organization

Languages:

Japanese (native), English (fluent), Chinese (basic)

References:

Prof. Costas Arkolakis
Yale University
Department of Economics
New Haven, CT 06520
Phone: (+1) 203-432-3527
costas.arkolakis@yale.edu

Prof. Lorenzo Caliendo
Yale University
School of Management
New Haven, CT 06511
Phone: (+1) 203-432-4069
lorenzo.caliendo@yale.edu

Prof. Peter Schott
Yale University
School of Management
New Haven, CT 06511
Phone: (+1) 203-436-4260
peter.schott@yale.edu

Dissertation Abstract

Robots and Wage Polarization: The Effects of Robot Capital across Occupations [Job Market Paper]

In the last three decades, the global market size of industrial robots, measured by the number of robot arms, has grown by 12% annually. International trade of robots is also sizable, with 41% of all robots traded. Robots have gradually substituted for workers in some occupations, raising concerns about the distributional effects of such trends. In this paper, I study the distributional and aggregate impacts of industrial robots by combining new data on robots with a model with substitution between robots and labor within an occupation, international trade of robots, and dynamic robot accumulation. I find that robots contributed to US wage polarization across occupations from 1990-2007. A commonly advertised robot tax could increase the US real income in the short run, but leads to a decline in income in the long run due to robot de-accumulation.

I construct a unique dataset that tracks the number of robot arms and their average prices disaggregated by the occupations that robots replace. To do so, I match the information about task-level Japanese robot shipment with O*NET match scores on occupation similarity and the US

Census/ACS. The resulting dataset links robots in the US shipped from Japan, which comprise one-third of all robots in the US, to the US wages at the occupation level. I show that over 1990-2007, robot average prices fall heterogeneously across occupations. I also find that there is a positive correlation between the growth of prices and that of US wages.

Guided by these facts, I develop a general equilibrium (GE) model that features the trade of robots in a large-open economy and endogenous robot accumulation. I consider the impact of an automation shock that extends the set of tasks robots can perform. To estimate the elasticities of substitution (EoS) between robots and labor within each occupation—key parameters for the distributional effect of the automation shock—I face the identification challenge that the robot cost shock and the automation shock are correlated. To overcome this challenge, I use the GE structure and obtain the structural residual of labor market outcomes, which is free from the effect of the automation shock. I then assume that the structural residual is orthogonal to the robot cost shock measured from the price changes in my dataset. From this moment condition, I construct the optimal model-implied IV, which increases the estimation precision.

I find that the within-occupation EoS between robots and labor in the US is heterogeneous across occupation groups. For routine occupations that perform production and material moving, the estimates are as high as 4. These estimates are significantly higher than the range of literature's estimates of the EoS between general capital and labor, a maximum of about 1.5, revealing the susceptibility of workers to robots in these occupations. The estimated model and backed-out shocks predict US occupational wage changes during 1990-2007, indicating that the automation shock compressed the wage growth in the middle deciles of the wage distribution in 1990. This explains 11.7% of the wage polarization measured by the 90th-50th percentile wage ratio.

Finally, I examine the counterfactual effect of introducing a tax on robot purchases. From a normative viewpoint, a robot tax could potentially increase the aggregate income of a country. A government can exert monopsony power in the global robot market by taxing robot purchases, leading to a decrease in the before-tax price of imported robots in each period. In contrast, the robot tax also disincentivizes the accumulation of robots in the long run, potentially reducing aggregate income. Quantitatively, the latter effect dominates the former in the long-run, and robot tax decreases the aggregate real income.

Robots and Employment, Evidence from Japan, 1978-2017, with Daiji Kawaguchi and Yukiko U. Saito*, Revision requested at Journal of Labor Economics*

We study the impact of industrial robots on employment in Japan, the country with the longest tradition of robot adoption. We obtain a novel data set of robot shipments by destination industry and robot application (specified task) in quantity and unit values. The data show a decreasing trend in robot unit values. Narrative evidence suggests that technological progress drove the decreasing trend. Guided by these findings, we employ an identification strategy leveraging the heterogeneous application of robots across industries and heterogeneous price changes across applications. For example, the automobile industry relies heavily on welding processes while the electric machine

industry predominantly requires assembling tasks. Thus, the price drop of welding robots relative to that of assembling robots induces faster adoption of robots in the automobile industry than in the electric machine industry. Our industry-level analysis indicates that a one-percent decline in robot prices increased the number of robot arms by 1.54 percent and total employment by 0.44 percent. These estimates suggest that robots and labor are gross complements at the industry level that aggregates the occupations in each industry. We also show that the result is robust to the robot quality adjustment, where the quality is backed out from the robot demand function. Finally, we compare our estimates with the existing studies and propose a mechanism that explains apparent differences between the results.

Multinational Production and Labor Share, with Yukiko U. Saito

We investigate the impact of multinational enterprises (MNEs) on the labor share in the source country. We propose an equilibrium model that features a production function with factor inputs in foreign countries. Each firm receives a shock that shifts the productivity of foreign factor inputs. We conduct comparative statics regarding the foreign factor productivity shock and show that the difference in factor demand elasticities with respect to foreign factor prices affects aggregate labor share. To identify these elasticities, we develop a method-of-moments estimator that leverages a foreign factor productivity shock. We then apply the estimator to a unique natural experiment: the 2011 Thailand Floods. The floods had a strong impact on manufacturing clusters in areas north of Bangkok city and affected Japanese MNEs by forcing them to halt operations of plants located in the cluster. We employ a unique combined Japanese firm- and plant-level dataset that tracks wages, employment, fixed assets in Japan, and employment in foreign subsidiary plants. The estimated factor demand elasticities indicate that foreign factor augmentation increased capital demand in Japan more than labor demand, suggesting that the foreign factor augmentation contributes to reducing the labor share in Japan.