Research statement

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1 Introduction

My research covers three areas: causal machine learning, the socioeconomic integration of refugees, and algorithmic job recommendations. In my work, I aim to provide methodological insights of practical relevance to empirical researchers and novel evidence for policy-makers, as reflected in various collaborations with governmental and non-governmental institutions. This statement outlines my three main research strands, explains how they are interconnected, and provides an outlook for future projects.

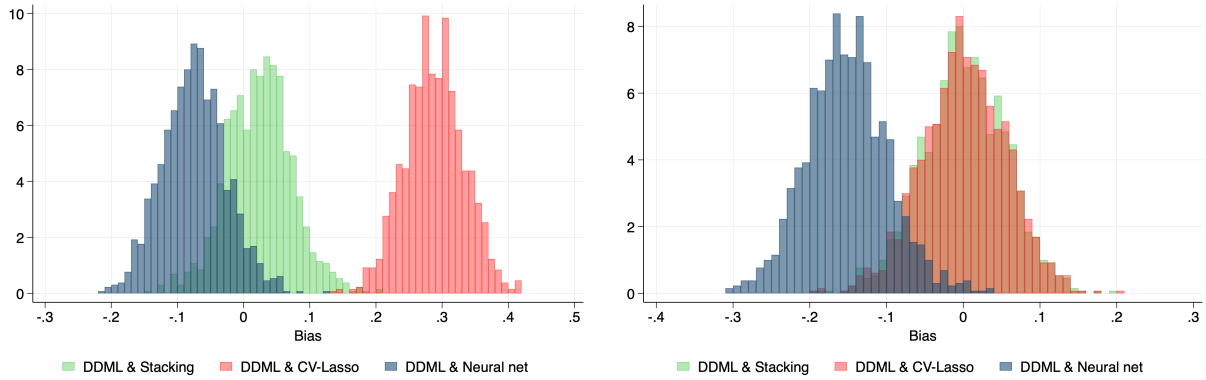
2 Causal machine learning

2.1 Double/debiased machine learning

Supervised machine learning is increasingly leveraged for causal inference. For example, post-double-selection lasso (Belloni, Chernozhukov, and Hansen, 2014) and double/debiased machine learning (DDML; Chernozhukov et al., 2018) have become popular estimators of causal effects in applied economics (e.g. Gilchrist and Sands, 2016; Dhar, Jain, and Jayachandran, 2022). Yet, a recent literature also raises practical concerns about the use of machine learning for causal inference. Wüthrich and Zhu (2021) find that the lasso, a widely used supervised machine learner, often fails to select relevant confounders in small samples, while conventional inference based on linear regression performs relatively well. Angrist and Frandsen (2022) argue that machine learning is "ill-suited to IV applications in labor economics." A key characteristic shared by many of these studies using machine learning for causal inference is, however, the focus on a single pre-selected machine learner, usually the lasso estimator or random forests.

"Model Averaging and Double Machine Learning" (Under review, J. of Applied Econometrics). In this paper, co-authored with Christian Hansen, Mark Schaffer, and Thomas Wiemann, we revisit applications of machine learning for causal inference in light of this recent critique. We highlight the benefits of pairing DDML with stacking, a form of model averaging (Wolpert, 1996; Breiman, 1996), and introduce two novel approaches aimed at improving practical feasibility and stability in finite samples: Short-stacking reduces the computational burden and pooled stacking decreases the variance of stacking-based learners. Based on calibrated simulation studies, we illustrate the finite sample performance of stacking-based DDML estimators. Furthermore, we use two applications estimating gender gaps in citations and gender wage gaps to illustrate how the pairing of DDML and stacking can increase the robustness of structural parameter estimates. The results suggest that stacking with a rich set of candidate estimators can address some of the shortcomings highlighted in the recent literature on causal inference relying on a single pre-selected machine learner (see Figure 1). Finally, we complement the paper with software packages for Stata and R implementing our proposed approaches (Ahrens et al., 2023a; Wiemann et al., 2023).

Figure 1: Estimation bias of DDML with cross-validated lasso, feed-forward neural net and stacking



(a) Non-linear DGP **(b)** Approximately sparse linear DGP

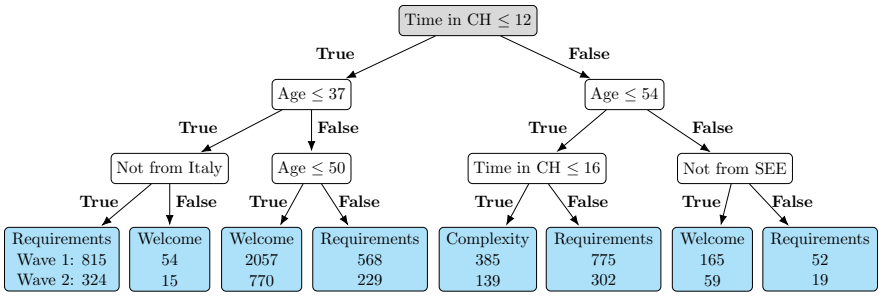
Notes: Figure (a) and (b) show the bias of DDML with different supervised machine learners (i.e., cross-validated lasso, neural net) under a non-linear and approximately sparse data-generating process, respectively. The results show that strategies exclusively relying on a single pre-selected machine learner can yield misleading causal effect estimates. DDML using stacking, on the other hand, is associated with a low bias under both data-generating processed provided a rich set of candidate learners is considered. The example is taken from Ahrens et al. (2024).

Other projects. In an ongoing research project with the same authors, we explore the use of DDML for IV estimations. Our preliminary results suggest that DDML with stacking demonstrates promising performance for IV estimations, thereby putting the aforementioned findings of Angrist and Frandsen (2022) into perspective. However, we also find that conventional under-identification tests can fail if the first stage is high-dimensional and explore alternative testing strategies. Finally, we are, together with Damien Kozbur and Victor Chernozhukov, in the process of preparing a proposal for a review paper on double machine learning for the *Journal of Economic Literature*.

2.2 Policy learning

Policymakers frequently need to select among alternative treatment options. While one of the stated aims of empirical research is to provide new insights to inform decision-making, the primary focus is usually on estimating averages of treatment effects rather than giving direct guidance on how to choose between alternative treatment options. Policy learning provides a framework for directly estimating statistical decision rules, so-called policy rules, which prescribe treatments to individuals based on their observed characteristics (also known as profiling or targeting). While its origins date back to statistical decision theory (Wald, 1950; Savage, 1951), recent theoretical advances and the advent of machine learning have reignited interest in the topic (e.g. Manski, 2004; Manski, 2007; Kitagawa and Tetenov, 2018; Athey and Wager, 2021). However, applied research using policy learning is still relatively scarce (exceptions are Kitagawa and Wang, 2023; Assunção et al., 2022; Bhattacharya and Dupas, 2012).

In the paper *"Optimal multi-action treatment allocation: A two-phase field experiment to boost immigrant naturalization" (R&R, J. of Applied Econometrics),* co-authored with Alessandra Stampi-Bombelli, Selina Kurer, and Dominik Hangartner, we evaluate the practical feasibility of targeted assignment rules and assess their benefits using a tailored, two-phase randomized controlled trial. We design and field an individualized treatment allocation program with the goal of encouraging



Notes: The figure shows the fitted policy tree, which assigns one out of three treatments to eligible immigrants in the city of Zurich, based on their age, country of origin and time spent in Switzerland (CH). The treatments are different information letters that are designed to address the perceived complexity of the application process ("Complexity"), knowledge gaps ("Requirements"), and the feeling of not being welcome ("Welcome").

Figure 2: Fitted policy tree

eligible immigrants to apply for naturalization in the City of Zurich, Switzerland. The application is motivated by an expanding body of literature highlighting the benefits of naturalization on employment, earnings and other integration dimensions (e.g. Gathmann and Keller, 2018; Hainmueller, Hangartner, and Ward, 2019; Felfe et al., 2021). Yet, despite these benefits, naturalization rates remain low in many countries.

In the first phase of our field experiment, we randomly allocate 60% of our sample of 5,145 citizenship-eligible immigrants to receive one of three information letters addressing specific naturalization hurdles. The three treatment letter options are designed to address the perceived complexity of the application process, knowledge gaps, and the feeling of not being welcome. Based on first-wave application outcomes and leveraging observed treatment effect heterogeneity, we estimate the optimal multi-action policy tree using the estimation framework of Zhou, Athey, and Wager (2022). The fitted policy rule, shown in Figure 2, takes the form of a decision tree and optimally assigns one of three treatment letters to each individual based on observed characteristics. In the second phase, we field the fitted policy rule on one-half of the remaining sample while sending random treatment letters to the other half. This allows us to evaluate the performance of the derived policy rule against random treatment allocation, one-size-fits-all policy rules assigning the same treatment to everyone, and a model-free plug-in rule assigning the treatment with the largest estimated treatment effect. Despite only moderate levels of heterogeneity, the policy tree yields a larger increase in take-up than each individual treatment.

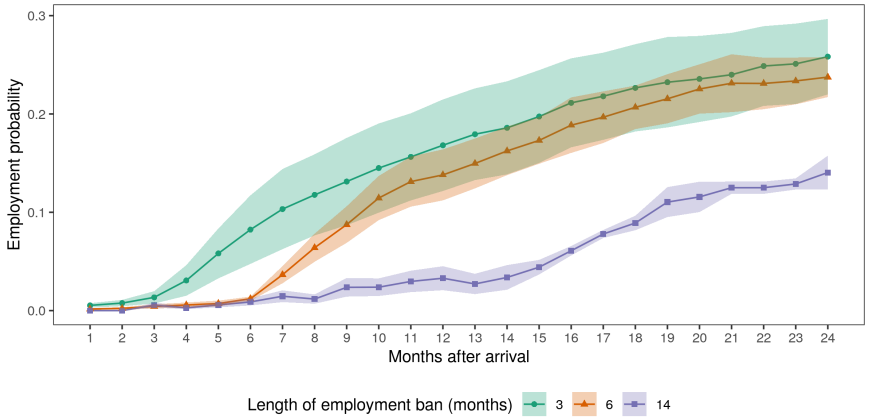
3 The socioeconomic integration of refugees

The economic and cultural integration of refugees is a long process, often spanning multiple decades (Abramitzky, Boustan, and Eriksson, 2020; Brell, Dustmann, and Preston, 2020). Typical for many European countries, only around one-third of refugees in Switzerland are in employment four years after their arrival. In the following three research projects, I investigate how welfare and labor market policies shape refugees' short and long-term employment opportunities, criminal behavior, and educational attainment while leveraging the rich sub-national policy variation in Switzerland.

A fourth project focuses on Venezuelan refugees who have migrated to Peru in the aftermath of the Venezuelan economic crisis.

"The Labor Market Effects of Restricting Refugees' Employment Opportunities" (Under review, AER). In many countries, refugees do not have access to all jobs in the labor market due to a variety of restrictive policies. In this paper with Andreas Beerli, Dominik Hangartner, Selina Kurer, and Michael Siegenthaler, we argue that such restrictions help explain why refugees have lower employment rates and wages than comparable native citizens, even years after these restrictions cease applying. We exploit the substantial temporal variation in labor market restrictions in Swiss cantons 1999-2016, and linked asylum and employer-employee data. We document large negative employment and earnings effects of initial employment bans (see Figure 3), prioritizing residents over refugees, and restricting refugees' labor markets by region and sector. Moving from the least to the most restrictive policy mix reduces refugees' average employment rate in the first five years after arrival from 19.1% to 11.5%. We link the policies' impact to the recent literature on outside options (see Caldwell and Harmon, 2019). Consistent with the role of outside options, removing 10% of refugees' potential jobs also lowers their wages by 3.0%. Finally, we find no evidence that restrictive policies spur refugee emigration or improve the labor market outcomes of competing EU immigrants, suggesting that these policies fail to achieve their intended goals.

Figure 3: Employment probability of refugees in Switzerland since arrival by initial employment ban



Notes: The figure shows the employment rates of refugees in Switzerland by the length of the initial employment ban (for more information, see Ahrens et al., 2023b).

"Social Assistance and Refugee Crime" (To be submitted shortly, AEJ: Applied). One of the most controversial debates in migration policy revolves around the generosity of welfare benefits for recently arrived immigrants and refugees. In this study, we examine how changes in social assistance rates for refugees affect their propensity to commit crimes. The identification strategy relies on the exogenous assignment of refugees to cantons combined with mobility restrictions, which rules out the sorting of refugees to cantons with more generous welfare regimes. The unique Swiss setting thus allows us to credibly estimate the causal effects of welfare benefits using person-fixed effects panel regressions and two difference-in-differences event studies zooming in on the cantons of Zurich and

Lucerne, which experienced sudden policy changes in 2012 and 2015. We find that higher cantonal welfare benefits reduce the propensity of refugees to be charged with a criminal offense, especially for petty crimes and drug offenses. Adding to the high policy relevance of our topic, we provide a simple back-of-the-envelope calculation, suggesting that increases in benefit rates could reduce public spending through savings in policing, judiciary, and incarceration costs.

"Incentive or Impediment? The Short- and Long-Term Impact of Low Welfare Support on Refugee Integration." While there is evidence that reductions in welfare benefits can incentivize refugees to participate in the labor market in the short run (Dustmann, Landersø, and Andersen, 2023), the limited financial support may have adverse effects on refugees' long-run labor market outcomes and their educational attainment, as well as on the prospects of refugees' children. I explore these issues in this ongoing project together with Dominik Hangartner, Selina Kurer, and Michael Siegenthaler, where we combine multiple administrative data sources, allowing us to track refugees and their children over more than 20 years.

"Cash-Based Interventions Improve Multidimensional Integration Outcomes of Venezuelan Immigrants" (R&R, World Development). The final paper in this research strand is co-authored with Dominik Hangartner, Marine Casalis, and Rodrigo Sánchez, and developed in cooperation with the *International Organization of Migration (IOM)*. Since 2015, over 7 million Venezuelans have been forced to leave their homes, seeking refuge predominantly in neighboring countries across Latin America and the Caribbean. This study evaluates the impact of a one-time cash-based intervention (CBI) on the social, economic, and political integration of highly vulnerable Venezuelan immigrants in Peru. We find that the CBI increased our multi-dimensional measure of integration, boosted self-employment by 2 percentage points but also raised the intention to emigrate from Peru by 1.2 percentage points.

4 Algorithmic job matching

Job search is generally a challenging process. Previous research suggests that job seekers search too little (Spinnewijn, 2015) and too narrowly, usually focusing on their past occupations (Belot, Kircher, and Muller, 2019). A burgeoning literature explores the potential of online tools (Kircher, 2022; Altmann et al., 2022; Ben Dhia et al., 2022; Benghalem et al., 2023; Bächli et al., 2023) and recommender systems (Naya et al., 2021; Barbanchon, Hensvik, and Rathelot, 2023; Behaghel et al., 2024) for facilitating job matching. Below I describe two of my current projects related to this field. The first project designs and fields an online job platform for refugees. The second project develops a recommender system designed to support caseworkers in Swiss employment centers.

4.1 Path2Work: An Online Platform for Refugee Job Matching

When searching for jobs, refugees must navigate through an unfamiliar labor market, often equipped with no or only limited host country language skills. While there is a large literature on active labor market programs for the general population (see overview in Card, Kluve, and Weber, 2018), less is known about the efficacy of job search assistance for refugees. A few studies use experimental designs to evaluate the impact of in-person counseling and mentoring for refugee job seekers (Dahlberg et

al., 2022; Battisti, Giesing, and Laurentsyeva, 2019; Fondazione Rodolfo Debenedetti, 2021). They find substantial benefits in terms of wages and employment. However, a drawback of these solutions is that, by relying on in-person counseling and intensive coaching, they are relatively costly, require the support of governmental stakeholders, and are not easily scalable. Another additional burden for refugee job seekers, which is not addressed by intensive counseling, is that employers might hesitate to hire refugees — possibly due to the higher expected onboarding costs, asymmetric information regarding refugees' skills and qualifications, discriminatory attitudes and unfamiliarity with the asylum system.

In this project, Mirjam Bächli, Dominik Hangartner, Rafael Lalive and I develop the online job platform *Path2Work*.[1] The project is supported by the *Swiss State Secretariat for Migration* and the *Swiss State Secretariat for Economic Affairs*, and financially supported through a J-PAL grant, for which I act as the Co-Principal Investigator. The platform offers access to a large database of vacancies provided by our industry partner *X28*, skill-based algorithmic vacancy recommendations, and application guidance. We use the platform to answer two central research questions:

RQ1: Can an online platform with algorithmic vacancy recommendations improve refugees' labor market integration?

RQ2: Can targeted candidate suggestions and information about the asylum system increase employers' willingness to employ refugees?

On the platform, we field two randomized controlled experiments — one targeting refugee job seekers and one targeting potential employers. The first experiment invites, randomized over four waves, more than 65'000 refugees residing in Switzerland to register on the platform, allowing us to evaluate the overall efficacy of the platform. The second experiment contacts employers with relevant vacancies by email and tests whether targeted candidate suggestions and information about the asylum system can improve employers' willingness to hire refugees. We will run a pilot from mid-March to May 2024 and plan to start the full-scale field experiment in July 2024.

4.2 Algorithmic job recommendations

In this project, commissioned by the *Swiss State Secretariat for Economic Affairs (SECO)*, we develop a recommender system that is designed to support caseworkers in Swiss local employment centers by suggesting open vacancies and suitable candidates. The project's four work streams are led by Elliot Ash (explainability), Dominik Hangartner/Michael Siegenthaler (discrimination), Uwe Schmitt (GUI development), and myself, whereby I lead the design and development of the recommender system. Caseworkers will begin to test the recommender system in May, and based on their feedback, the SECO will decide whether the recommender system will be integrated into the employment centers' software system.

Beyond its impact on shaping the quality of job recommendations in Switzerland, the project is a unique opportunity to explore several issues of academic interest that will, in turn, inform researchers and policymakers in other countries. First, since the algorithm is trained on past caseworker recommendations, we consider several approaches (Kamiran and Calders, 2012; Hardt et al., 2016; Calmon et al., 2017) to account for biases inherent in the data, e.g., caseworkers' potential biases against female or non-Swiss job seekers. Second, we explore alternative techniques to enhance the transparency and interpretability of the algorithm (e.g., Ribeiro, Singh, and Guestrin,

[1]The pilot version of the platform is available at `https://www.path2work.ethz.ch/`.

2016; Lundberg and Lee, 2017). The ability to easily understand the reasoning behind the recommendations is likely crucial for the caseworkers' willingness to incorporate the algorithm in their decision-making. Explainability is also fundamental in light of recent important proposals for regulating the use of AI (European Commission, 2021). Third, there is the risk that the algorithm exacerbates inequality if, for example, it strictly prefers the same highly skilled candidates across all occupations (an issue that Naya et al. 2021 identified in a similar context). We are planning to explore these issues in academic articles and thus contribute to an emerging literature exploring the use of AI and recommender systems for job matching (Naya et al., 2021; Barbanchon, Hensvik, and Rathelot, 2023; Behaghel et al., 2024).

5 Summary and outlook

The three strands of research are linked through their focus on novel econometric approaches that draw from machine learning (e.g., DDML, policy learning, recommender systems), their high policy relevance fostered by close collaborations with non-academic institutions, and their concern for vulnerable groups at risk of discrimination (i.e., refugees and internationally displaced persons, female and migrant job seekers).

Each of the three strands offers avenues for future research. In particular, I plan to focus on the following projects in the near future:

1. In the research on double machine learning (outlined in Section 2.1), I will continue to investigate if the attractive robustness properties of DDML paired with model averaging generalize to IV estimations. Subsequent research could also explore the use of DDML and model averaging for panel models. The research agenda is driven by the aim to enhance empirical practices and improve the quality of evidence in economics.
2. The project *"Incentive or Impediment?"* (Section 3) will conclude a series of three papers on refugee integration in Switzerland by focusing on the long-term impacts of welfare benefits on refugees and their children. The insights from this research will allow for a better assessment of the current policy framework shaping the lives of refugees in Switzerland, and elsewhere. Following a data update due to arrive in June, I am planning to have a first draft available by autumn 2024.
3. The *Path2Work* platform (Section 4.1) is designed as a long-term project. The unique access to refugee job seekers and the ability to field customized experiments on the platform will allow me to explore issues pertaining to the discrimination of refugees in the labor market, their job search behavior, and optimal approaches to support refugee integration.
4. Although started as a commissioned policy project, the research on algorithmic job recommendations (outlined in Section 4.2) provides a unique opportunity to promote the development of practically relevant and trustworthy recommender systems while accounting for aspects of discrimination, explainability, and equality.

Beyond these projects, I am committed to combining methods from econometrics, data science, and machine learning to advance the use of empirical methods in economics and to gather insights relevant to policy-making.

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