# A model-based policy exercise to examine climate migration policy in Europe IASA

Michał Pajak<sup>1,2,4</sup>, Piotr Magnuszewski<sup>1,2</sup>, Sebastian Poledna<sup>1</sup>, Nikita Strelkovskii<sup>1</sup>, Elena Rovenskaya<sup>1</sup>, Anne Goujon<sup>1</sup>, Alessandra Conte<sup>3</sup>, JoAnne Linnerooth-Bayer<sup>1</sup>, Alberto Fresolone<sup>1</sup>, Michele Catalano<sup>1</sup>, Paolo Campo<sup>2</sup>

<sup>1</sup> International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria <sup>2</sup> Centre for Systems Solutions (CRS), Wroclaw, Poland <sup>3</sup> Knowledge Centre on Migration and Demography (KCMD), Joint Research Centre of the European Commission (JRC), Ispra, Italy <sup>4</sup> Wroclaw University of Economics and Business, Wroclaw, Poland

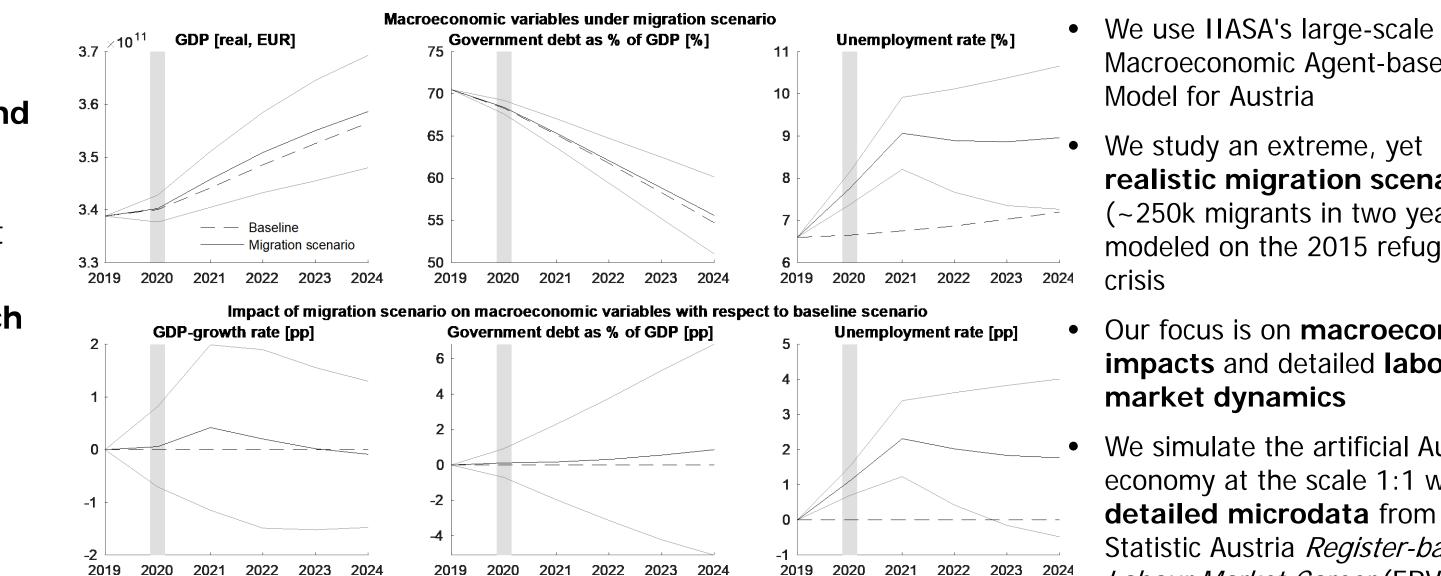
Presenter & correspondence: fresolone@iiasa.ac.at

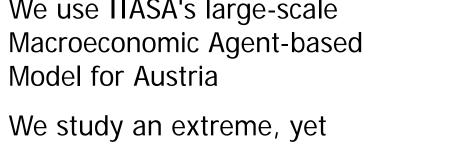
12.04.2023

### Motivation and aim

- In Europe, large migratory shocks have led to a heated political debate on their management
- Uncertainty about the **migratory impact on the economy and society** has in many instances polarized the debate
- The task of modelers and social scientists is to use their tools to inform stakeholders and policy makers of the most likely economic and social consequences

### Agent-based model to unravel the economic effects of migration





We study an extreme, yet realistic migration scenario (~250k migrants in two years) modeled on the 2015 refugee





23. Österreichischer KLIMATAG Ressourcen im Wandel

11. bis 13. April 2023 Montanuniversität Leoben



- Our aim is to combine the Agent-based modeling approach (ABM) and a social science approach to support policymaking process ( $\rightarrow$  science to policy)
- Our case is a large migration flow into Austria: **pilot test** efficacy of game



- Our focus is on **macroeconomic** impacts and detailed labour market dynamics
- We simulate the artificial Austrian economy at the scale 1:1 with detailed microdata from Statistic Austria *Register-based* Labour Market Career (ERV) data

**Register-based Labour Market Career (ERV)** Data on the employment history of each person in Austria from 2009 onwards (~4.1 mln. employees; ~20 mln. employment relationships)

Images sources: Tindoarchitect/Dreamstime, (Izquierdo et al., 2019)

## The Policy Exercise (gamified policy simulation)

- Is a virtual tool for stakeholder engagement & deliberation
- Enables an experiential process where participants with diverse backgrounds interact collectively to *explore a complex reality*
- Its scenario being Migration from the MENA-region to Austria due to impacts of climate extremes, which is

### informed by the ABM

- *Social* because it requires the participation of people who represent different groups and organizations (political parties)
- *Simulation* because it represents carefully selected real-world structures and processes (parliamentary assembly)

### **PROCESS STEPS**

to a specific topic, that would include

members of other parties. As a work-

group you will decide on recommen-

dations on policy directions for Austria.



## Player roles and policy questions

Each **player** takes the What should be Austria's role of a political party representative as part of the Austrian

parliamentary commission charged with making recommendations on the three

policy questions



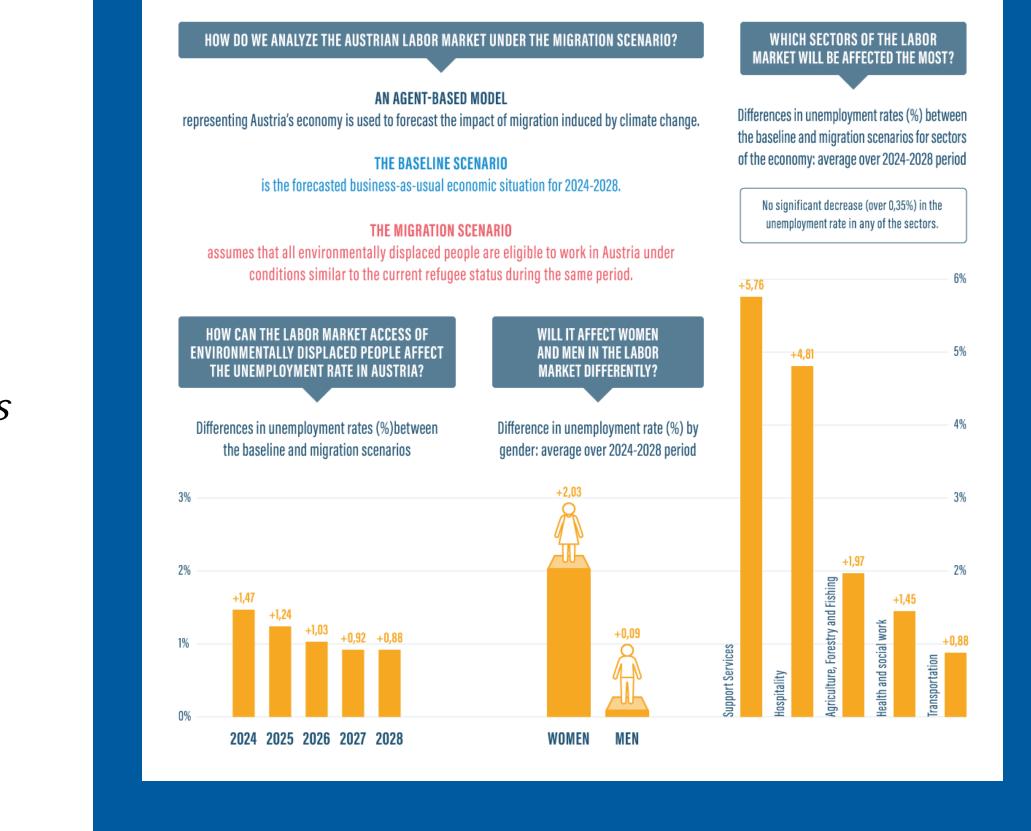
financial assistance to

MENA region governments?

negotiating position in the EU deliberations on creating a new classification for "environmental migrants", giving them the same labor rights as political refugees?

#### Example: fact sheet with migration scenario and model results

#### **MIGRATION AND AUSTRIAN UNEMPLOYMENT**







As a member of your party you wer sent to the commission that will

topics within your party. address current immigration issues.

First you will discuss polic You will work in a workgroup assigne ommendations will be se

will shape the future inte

olicies in Austria and guide

international strategie

o the parliament which ma

decide to adopt them.



support for Mediterranean sea rescue efforts and for relaxing its own border controls?

### Briefings

**Before playing** the Policy Exercise and simulating the policy negotiations, Once briefed, players the players are briefed on:

- The attribution of climate to extremes in the MENA region
- The economic impacts of a climate migration scenario (ABM) 250.000 individuals expected to arrive in Austria in 2023/24
- Their party platform and position
- The legal context

### Playing the Policy Exercise

- 1. choose their political party and receive their party position
- 2. negotiate their position with
  - members of their own party
- 3. discuss the 3 policy questions in three mixed party working groups and propose options
- 4. vote (in 2 rounds) on the options in the WGs (right image below)
- 5. Present and discuss their arguments in plenary
- 6. Go through a debriefing process

### Selected research questions

- What **new policy options** emerge?
- To what extent do the **participants** reach consensus on the policy questions?
- How do participants **rationalize** and argue their positions? e.g.
  - What **role** does the economy/model play?
  - To what extent does 'climate justice' (responsibility of

### First results

- First trials show promise in combining ABM and policy **simulation** to support the migration policy process
- The **ABM results informed** the (role-played) **stakeholder** deliberations, and in some instances a consensus emerged on complex policy questions.
- Participants experienced the complex and controversial negotiation process through the policy simulation.

#### > Next steps

- Detailed evaluation of game plays through discourse analysis (journal article forthcoming)
- Play the game with Austrian stakeholders to inform real policy processes (e.g., political party members & public officials)

Selection from post-simulation questionnaire\*:

...through films, fact sheets, legal briefs, breaking news, etc...



7. Fill in a post-simulation questionnaire (open and likert scale questions)

Austrians for extreme weather in MENA region) enter the debates?

- VOTING VOTING ASSISTANCE TO MENA COUNTRIES → ASSISTANCE TO MENA CO WHAT SHOULD BE AUSTRIA'S FINANCIAL ASSISTANCE TO THE MENA REGION IN LIGHT OF THE CLIMATE-RELATED FOOD CRISES? → WHAT SHOULD BE AUSTRIA'S Option A: No significant assistance B 5 Spo PPO ness States Se Option B: US\$ 250M C 0 Option C: US\$ 600M **O PROPOSITIONS** REMOVE O HIDDEN
- **65%** of participants stated they could give their view on problems and available solutions
- **74%** of participants achieved a common understanding of the challenge connected with the migration crisis
- 87% of participants came to an agreement re. (pre)established solutions
- **52%** of participants used migration data when making decisions
- 56% of participants used economic data generated by model/info about rescue effort when making decisions
- 83% of participants stated that the party program played a role when making decisions

\*Data from 4 plays of the game with 43 participants (IIASA YSSP; migration students & researchers from University of Vienna; researchers from IIASA & Danube University Krems)

#### (Voting results after 1<sup>st</sup> round (left) & 2<sup>nd</sup> round (right; after discussions informed by ABM))

Adam, D. (2020). "Design fiction" skirts reality to provoke discussion and debate. Proceedings of the National Academy of Sciences, 117(24), 13179–13181. https://doi.org/10.1073/pnas.2008206117	Gardner, M. (1970). Mathematical Games. Scientific American. https://doi.org/10.1038/scientificamerican1070-120
Barreteau, O., & Abrami, G. (2007). Variable time scales, agent-based models, and role-playing games: The PIEPLUE river basin management game. Simulation & Gaming, 38(3), 364–381. https://doi.org/10.1177/1046878107300668	Geurts, J. L. A., Duke, R. D., & Vermeulen, P. A. M. (2007). Policy Gaming for Strategy and Change. Long Range Planning, 40(6), 535–558. https://doi.org/10.1016/j.lrp.2007.07.004
Barreteau, O., Abrami, G., Chennit, S., & Garin, P. (2006). Support to Stakeholder Involvement in Water Management Circumventing Some Participation Pitfalls. In Water Governance for Sustainable Development. Routledge.	Gibon, A., Sheeren, D., Monteil, C., Ladet, S., & Balent, G. (2010). Modelling and simulating change in reforesting mountain landscapes using a social-ecological framework. Landscape Ecology, 25(2), 267–285.
Barreteau, O., Antona, M., d'Aquino, P., Aubert, S., Boissau, S., Bousquet, F., Daré, W., Etienne, M., Le Page, C., Mathevet, R., Trébuil, G., & Weber, J. (2003). Our Companion Modelling Approach. Journal of Artificial Societies and Social	/ https://doi.org/10.1007/s10980-009-9438-5
Simulation, 6(1). https://jasss.soc.surrey.ac.uk/6/2/1.html	Grazzini, J., & Richiardi, M. (2015). Estimation of ergodic agent-based models by simulated minimum distance. Journal of Economic Dynamics and Control, 51, 148–165. https://doi.org/10.1016/j.jedc.2014.10.006
Basco-Carrera, L., Meijers, E., Sarısoy, H. D., Şanli, N. O., Coşkun, S., Oliemans, W., van Beek, E., Karaaslan, Y., & Jonoski, A. (2018). An adapted companion modelling approach for enhancing multi-stakeholder cooperation in complex	Gurung, T. R., Bousquet, F., & Trébuil, G. (2006). Companion Modeling, Conflict Resolution, and Institution Building: Sharing Irrigation Water in the Lingmuteychu Watershed, Bhutan. Ecology and Society, 11(2).
river basins. International Journal of Sustainable Development & World Ecology, 25(8), 747–764. https://doi.org/10.1080/13504509.2018.1445668	https://www.jstor.org/stable/26266021
Becu, N., Neef, A., Schreinemachers, P., & Sangkapitux, C. (2008). Participatory computer simulation to support collective decision-making: Potential and limits of stakeholder involvement. Land Use Policy, 25(4), 498–509.	Harvey, S., Liddell, A., & McMahon, L. (2009). Windmill 2009: NHS response to the financial storm. King's Fund.
https://doi.org/10.1016/j.landusepol.2007.11.002	Joffre, O. M., Bosma, R. H., Ligtenberg, A., Tri, V. P. D., Ha, T. T. P., & Bregt, A. K. (2015). Combining participatory approaches and an agent-based model for better planning shrimp aquaculture. Agricultural Systems, 141, 149–15
Borton, T. (1970). Reach, Touch and Teach. McGraw-Hill.	https://doi.org/10.1016/j.agsy.2015.10.006
Caballero, R. J. (2010). Macroeconomics after the Crisis: Time to Deal with the Pretense-of-Knowledge Syndrome. Journal of Economic Perspectives, 24(4), 85–102. https://doi.org/10.1257/jep.24.4.85	Malyuchenko, I. (2015). Labour migration from Central Asia to Russia: Economic and social impact on the societies of Kyrgyzstan, Tajikistan, and Uzbekistan (No. 21; Central Asia Security Policy Briefs).
Campo, P. C., Mendoza, G. A., Guizol, P., Villanueva, T. R., & Bousquet, F. (2009). Exploring management strategies for community-based forests using multi-agent systems: A case study in Palawan, Philippines. Journal of Environmental	a/ Manthrithilake, H., & Liyanagama, B. S. (2012). Simulation model for participatory decision making: Water allocation policy implementation in Sri Lanka. Water International, 37(4), 478–491.
Management, 90(11), 3607–3615. https://doi.org/10.1016/j.jenvman.2009.06.016	https://doi.org/10.1080/02508060.2012.708602
Castella, JC., Trung, T. N., & Boissau, S. (2005). Participatory Simulation of Land-Use Changes in the Northern Mountains of Vietnam: The Combined Use of an Agent-Based Model, a Role-Playing Game, and a Geographic Information	Mcmahon, S., Tintori, G., Perez, F. M., Alessandrini, A., Goujon, A., Ghio, D., Petroliagkis, T., Conte, A., Minora, U., & Kalantaryan, S. (2021). Population exposure and migrations linked to climate change in Africa (EUR 30881).
System. Ecology and Society, 10(1). https://doi.org/10.5751/ES-01328-100127	https://doi.org/10.2760/77546
Crooks, A., Castle, C., & Batty, M. (2008). Key challenges in agent-based modelling for geo-spatial simulation. Computers, Environment and Urban Systems, 32(6), 417–430. https://doi.org/10.1016/j.compenvurbsys.2008.09.004	Naivinit, W., Le Page, C., Trébuil, G., & Gajaseni, N. (2010). Participatory agent-based modeling and simulation of rice production and labor migrations in Northeast Thailand. Environmental Modelling & Software, 25(11), 1345–1
Dawid, H., Gemkow, S., Harting, P., van der Hoog, S., & Neugart, M. (2018). Agent-Based Macroeconomic Modeling and Policy Analysis: The Eurace@ Unibi Model. In SH. Chen, M. Kaboudan, & YR. Du (Eds.), The Oxford Handbook of	f https://doi.org/10.1016/j.envsoft.2010.01.012
Computational Economics and Finance (p. 0). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199844371.013.19	Neugart, M., & Richiardi, M. (2012). Agent-based models of the labor market. In SH. Chen, M. Kaboudan, & YR. Du (Eds.), Handbook on Computational Economics and Finance (Vol. 1). Oxford University Press.
Duke, R. D., & Geurts, J. L. A. (2004). Policy Games for Strategic Management. Rozenberg Quarterly. https://rozenbergquarterly.com/policy-games-for-strategic-management/	https://doi.org/10.1093/oxfordhb/9780199844371.013.44
Dupont, H., Gourmelon, F., Rouan, M., Le Viol, I., & Kerbiriou, C. (2016). The contribution of agent-based simulations to conservation management on a Natura 2000 site. Journal of Environmental Management, 168, 27–35.	Notten, P. van. (2006). Scenario Development: A Typology of Approaches (pp. 69–92). OECD. https://doi.org/10.1787/9789264023642-6-en
https://doi.org/10.1016/j.jenvman.2015.11.056	Nyaki, A., Gray, S. A., Lepczyk, C. A., Skibins, J. C., & Rentsch, D. (2014). Local-Scale Dynamics and Local Drivers of Bushmeat Trade. Conservation Biology, 28(5), 1403–1414. https://doi.org/10.1111/cobi.12316
Eisinger, D., Thulke, HH., Selhorst, T., & Müller, T. (2005). Emergency vaccination of rabies under limited resources – combating or containing? BMC Infectious Diseases, 5(1), 10. https://doi.org/10.1186/1471-2334-5-10	Palmer, R. N., Cardwell, H. E., Lorie, M. A., & Werick, W. (2013). Disciplined Planning, Structured Participation, and Collaborative Modeling—Applying Shared Vision Planning to Water Resources. JAWRA Journal of the American
Epstein, J. M. (2008). Why Model? Journal of Artificial Societies and Social Simulation, 11(4)(12). https://jasss.soc.surrey.ac.uk/11/4/12.html	Resources Association, 49(3), 614–628. https://doi.org/10.1111/jawr.12067
Epstein, J. M., & Axtell, R. L. (1996). Growing Artificial Societies: Social Science from the Bottom Up. https://doi.org/10.7551/mitpress/3374.001.0001	Poledna, S., Miess, M. G., Hommes, C., & Rabitsch, K. (2023). Economic forecasting with an agent-based model. European Economic Review, 151, 104306. https://doi.org/10.1016/j.euroecorev.2022.104306
Etienne, M., Du Toit, D., & Pollard, S. (2011). ARDI: A Co-construction Method for Participatory Modeling in Natural Resources Management. Ecology and Society, 16(1). https://doi.org/10.5751/ES-03748-160144	Pruyt, E., Islam, T., & Arzt, T. (2018). On the Spot and Map: Interactive Model-Based Policy Support Under Deep Uncertainty. In J. R. Gil-Garcia, T. A. Pardo, & L. F. Luna-Reyes (Eds.), Policy Analytics, Modelling, and Informatics:
Fagiolo, G., & Roventini, A. (2017). Macroeconomic Policy in DSGE and Agent-Based Models Redux: New Developments and Challenges Ahead. Journal of Artificial Societies and Social Simulation, 20(1), 1.	Innovative Tools for Solving Complex Social Problems (pp. 315–342). Springer International Publishing. https://doi.org/10.1007/978-3-319-61762-6_14
Farmer, J. D., & Foley, D. (2009). The economy needs agent-based modelling. Nature, 460(7256), Article 7256. https://doi.org/10.1038/460685a	Richiardi, M. G. (2017). The Future of Agent-Based Modeling. Eastern Economic Journal, 43(2), 271–287. https://doi.org/10.1057/s41302-016-0075-9
Farolfi, S., Müller, JP., & Bonté, B. (2010). An iterative construction of multi-agent models to represent water supply and demand dynamics at the catchment level. Environmental Modelling & Software, 25(10), 1130–1148.	Rouan, M., Kerbiriou, C., Levrel, H., & Etienne, M. (2010). A co-modelling process of social and natural dynamics on the isle of Ouessant: Sheep, turf and bikes. Environmental Modelling & Software, 25(11), 1399–1412.
https://doi.org/10.1016/j.envsoft.2010.03.018	https://doi.org/10.1016/j.envsoft.2009.10.010
Freebairn, L., Atkinson, J., Kelly, P., McDonnell, G., & Rychetnik, L. (2016). Simulation modelling as a tool for knowledge mobilisation in health policy settings: A case study protocol. Health Research Policy and Systems, 14(1), 71.	Ruankaew, N., Le Page, C., Dumrongrojwattana, P., Barnaud, C., Gajaseni, N., van Paassen, A., & Trébuil, G. (2010). Companion modelling for integrated renewable resource management: A new collaborative approach to create
https://doi.org/10.1186/s12961-016-0143-y	common values for sustainable development. International Journal of Sustainable Development & World Ecology, 17(1), 15–23. https://doi.org/10.1080/13504500903481474

