

Forced migration and long-term mental disorders in post-WWII Finland

Matti Sarvimäki,^{1,2*} Henri Salokangas,³ Jari Haukka,^{4,5} Pekka Martikainen,^{6,7,8} Jaana Suvisaari⁹

¹Department of Economics, Aalto University School of Business, FI-02150 Espoo, Finland

²VATT Institute for Economic Research, FI-00100 Helsinki, Finland

³Department of Economics, University of Turku, FI-20100 Turku, Finland

⁴Clinicum, Department of Public Health, University of Helsinki, FI-00290 Helsinki, Finland

⁵Faculty of Medicine and Health Technology, Tampere University, FI-33014 Tampere, Finland

⁶Population Research Unit, University of Helsinki, FI-00170 Helsinki, Finland

⁷Centre for Health Equity Studies, Stockholm University and Karolinska Institutet, SE-114 18 Stockholm, Sweden

⁸Max Planck Institute for Demographic Research, DE-18057 Rostock, Germany

⁹Mental Health Unit, National Institute for Health and Welfare, FI-00271 Helsinki, Finland

*To whom correspondence should be addressed; E-mail: matti.sarvimaki@aalto.fi.

A large literature has examined the association between migration and mental health, but establishing causality has proved elusive due to the lack of plausible control groups for migrant populations. We use the internal displacement of 430,000 Finns after World War II as a "natural experiment." Using linked census and psychiatric admission register data, we find that displaced persons had 7% lower risk of psychiatric admission for mental disorders than comparable non-displaced persons living in the neighboring regions before the war. In comparison, the self-selected group of non-displaced persons who migrated voluntarily during the same period had 6% higher admission risk for mental disorders than non-migrants. This difference between estimates for the

displaced and the voluntarily migrated highlights the importance of an appropriate research design when measuring the impacts of migration.

Introduction

Migration is often considered a risk factor for mental disorders, because it entails changes in the social environment and, in some cases, the migration experience itself may be traumatic (1–3). However, evidence on the impact of migration on mental health remains mixed. Previous work has documented both positive (4, 5) and negative (6–12) associations between migration and mental health. These conflicting findings may partly reflect the multitude of migration experiences. For example, moving voluntarily to take up a new job likely affects mental health differently than having to flee an armed conflict. However, the mixed results may also arise from differences between studies in the extent and direction of selection bias.

The key challenge in measuring the impact of migration is to evaluate what would have happened to the migrants had they not migrated. When people self-select into migration, non-migrants are unlikely to constitute an appropriate control group that could be used to construct this counterfactual. Indeed, earlier work has found that people who choose to migrate have lower risk-aversion (13), higher cognitive ability, adaptability (14), and sociability (15), and more self-reported mental health problems (16) than non-migrants already before they migrate. Furthermore, the association between adverse outcomes and migration seems to attenuate when genetic and shared environmental confounds are controlled for (17). As ethical and practical considerations rule out randomized trials in the study of migration, researchers have started increasingly to study historical events such as armed conflicts (18–20) or administrative decisions such as randomized visa ballots (16, 21, 22) that create situations where self-selection to migration does not occur. Under these "naturally" occurring conditions, exposure to migration resembles random allocation and may thus allow for causal inference.

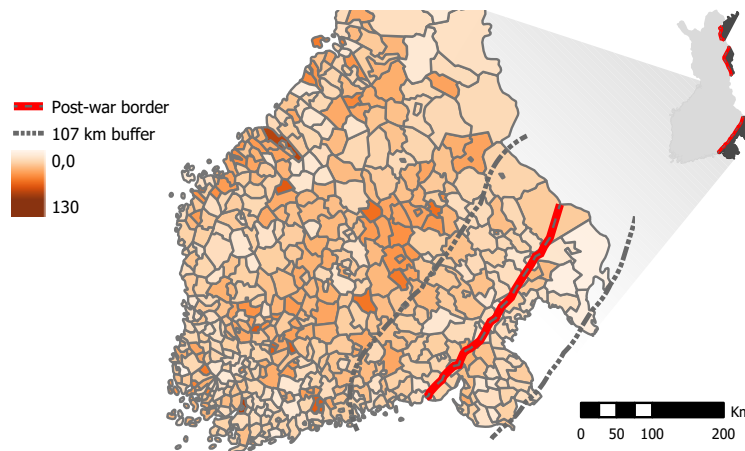


Fig. 1: Pre- and post-war borders of Finland and the pre-war prevalence of mental disorder. Areas east of the post-war border were ceded to the Soviet Union, and the entire population living in these areas was resettled to the remaining parts of Finland. The colors show the pre-war annual average of mental disorders per 10,000 inhabitants at the municipal level (measured for the years 1932-34). The prevalence is based on the psychiatric treatment statistics (Medical District Statistics of Finland) and population statistics (Statistical Yearbooks of Finland). Here we show the areas where most of the population lives and exclude the Northern parts of the country.

In this paper, we present natural experimental results on the impact of forced migration on the long-term mental health of Finns, who were displaced from the areas ceded to the Soviet Union after World War II. The entire population living in the ceded areas in the Eastern parts of the country – 430,000 persons or 11% of the Finnish population – was evacuated and resettled to the remaining parts of Finland (see Figure 1). Displaced farmers were given land in areas that resembled their place of origin and assistance to establish new farms (23). Rural communities were held together by resettling entire villages into the same resettlement areas. Urban residents received monetary compensation and were free to resettle wherever they could find accommodation; see Materials and Methods for details of the displacement and the resettlement policy.

Statistics Finland created our data by linking a 10 percent individual-level sample of the 1950 Census to 1970 Census data, register data on hospital discharges covering years 1971-2012, and outpatient visits covering years 1998-2012. The 1950 census included retrospective

Table 1: Average background characteristics

	Displaced	Control group	
		Non-displaced	≤107 km of the post-war border
Individual characteristics			
Female	50.8	51.1	51.1
Age in mid-October 1939			
unborn-0 years	20.3	18.9	19.1
0-10 years	28.1	29.3	30.8
10-20 years	29.5	28.6	28.5
20-29 years	22.1	23.2	21.6
Household characteristics			
Living in urban area	22.3	21.1	11.7
Migrated prior war (b/w provinces)	13.2	17.1	18.6
Employed	43.6	46.5	43.6
Employed in agriculture	36.3	41.6	45.7
Socio-economic status			
Entrepreneur	13.9	13.1	13.1
White-collar worker	8.6	7.0	6.3
Blue-collar worker	21.2	26.4	24.2
Family member	9.8	8.8	8.8
Out of labor force	46.5	44.8	47.6
Observations	18,830	145,787	25,126

Average pre-war observable characteristics (in percentages) by displacement status. All measures come from retrospective questions in the 1950 census and refer to the situation in September 1939. For those born after September 1939, we use the 1939 characteristics of the 1950 household head (predominantly father). Percentage employed in agriculture is calculated conditional on being employed.

questions on region of residence in September 1939, i.e., two months before the start of the war. As only 0.5 percent of all residents in the ceded areas did not migrate (24), the pre-war residence information gives us an accurate measure of forced migration. We focus on individuals born in 1910-1945 who were still alive and living in Finland in 1970 (N=164,617). Overall, displaced and non-displaced persons were quite similar in their background characteristics (Table 1). However, displaced persons were somewhat less likely to work in agriculture and blue-collar occupations than the rest of the population, reflecting well-known differences in economic structure between these areas.

A natural concern when comparing the post-war mental health of displaced and non-displaced populations is that possible differences could reflect unobserved differences between the two populations rather than the effect of forced migration. For example, while the genetic framework of the Finnish population is homogeneous compared other European populations (25, 26), genetic variation across Finnish regions exists (27, 28).

This concern may be partly supported by pre-war regional differences in mental disorder treatment shown in Figure 1. The treatment of mental illnesses was less common in the ceded areas than in the non-ceded areas before the war. However, it is not clear whether these pre-war reports correspond to differences in the underlying prevalence of mental disorder or whether they reflect differences in the availability of hospitals providing mental health care. Nevertheless, in order to examine the robustness of our results, we report estimates with and without conditioning for pre-war individual characteristics and prevalence of mental disorders in the pre-war resident municipality. Furthermore, we also use an alternative control group of individuals who lived in the non-ceded areas close to the post-war border before the war.

Results

Figure 2 presents our main results. In comparison to the entire non-displaced population, displaced persons had 5% lower risk (incidence rate ratio (IRR) 0.953, 95% confidence interval (CI) 0.912–0.996) of any psychiatric admissions during the follow-up period. This difference is largely driven by the lower risk of mood disorders (IRR 0.911, CI 0.847–0.980), while we find similar but slightly weaker and statistically insignificant differences for schizophrenia (IRR 0.935, CI 0.852–1.026) and other disorders (IRR 0.965, CI 0.913–1.021). The results conditioning on pre-war sociodemographic characteristics are very similar to the unconditional ones. Furthermore, controlling for municipal-level pre-war regional treatment prevalence has little impact on the estimates.

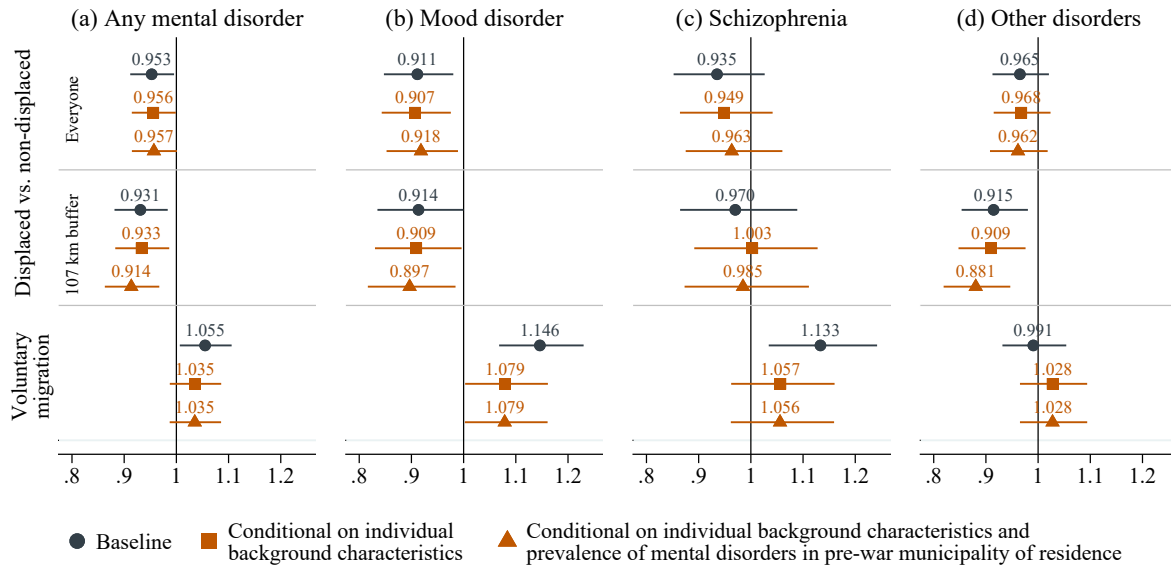


Fig. 2: Poisson regression estimates (incidence rate ratios) and 95% confidence intervals for the impact of forced migration on psychiatric admissions due to mental disorder. Each panel reports estimates for displacement status without conditioning on any other covariates (top), conditional on individual pre-war characteristics (middle), and conditional on individual pre-war characteristics and pre-war mental disorder prevalence at the 1939 residence municipality (bottom). The top panels report the estimates for displacement status using the full sample. The middle panels present similar estimates using a sample of individuals living within 107 km of the post-war border before the war. The bottom panels show corresponding estimates for voluntary migration between provinces between 1939 and 1950 using data on the non-displaced population.

To further reduce the possible confounding due to geographical differences in unobservable factors, we repeat our analysis using only persons living within the 107 km buffer area near the post-war border. As shown in the (vertically) middle panels of Figure 2, the point estimates now suggest a somewhat larger protective effect for any mental disorders (IRR 0.931, CI 0.881–0.983) and the estimates for other disorders become statistically significant (IRR 0.915, CI 0.853–0.980). Again, the inclusion of socio-demographic and pre-war psychiatric treatment control variables have little impact on the estimates. In the Supplementary Materials, we also report regression discontinuity estimates (29), which are similar, although less precise, as the estimates reported here (Table S1).

We examine heterogeneity in the displacement effect by urban status, sex, and age (Supple-

mentary Materials Fig. S3-S5). The results suggest that displacement was protective for the rural population, while we do not find an effect for the urban population. This finding is similar to earlier work showing that forced migration substantially increased income and the likelihood of moving to urban areas and non-agricultural jobs among the rural population, while having a small negative effect on the long-term income of the urban population (19). The pattern of results is thus consistent with the hypothesis that increased income or transition away from agriculture contributed to the decrease of mental disorders among the displaced rural population. We find no significant differences by age or between men and women.

To put these results into context, we report the association between voluntary migration and mental health outcomes at the bottom panel of Figure 2. We construct these estimates using the same methods as for our natural experimental estimates, but now use only the non-displaced population and define migration status as moving between Finland's ten provinces between 1939 and 1950. Thus these results are based on a similar research design as used in much of the earlier literature examining the association between self-selected migration and mental health.

The voluntary migrants are more likely to have psychiatric admissions than non-migrants (IRR 1.055, CI 1.007–1.106). This difference is driven by a higher incidence of mood disorders (IRR 1.146, CI 1.068–1.230) and schizophrenia (IRR 1.133, CI 1.034–1.242), while the association for other disorders is small (IRR 0.991, CI 0.932–1.054). Conditioning on the observed pre-war characteristics reduces the point estimates, and only the point estimate for mood disorders remains statistically significantly different from zero at conventional levels. Importantly, however, the estimates for any mental disorder and mood disorder are statistically significantly different from the natural experimental estimates in all specifications (Supplementary material Table S4).

Discussion

We found that displaced persons had a lower risk of mental disorders than comparable non-displaced population more than 26 years after being forced to migrate. This is a perhaps surprising finding because earlier work has documented a high prevalence of mental health disorders among current refugees (30). We stress that it may not be appropriate to extrapolate these results into other contexts and that our results do not necessarily imply that forced migration in itself would have been protective against mental health disorders even in the Finnish case. The Finnish resettlement policy was extraordinarily generous and other factors affected by the resettlement—such as the impact on moving away from agriculture and increased income (19)—may explain our findings. Nevertheless, our results suggest that population displacements do not inevitably lead to long-term mental health disorders.

The main limitation of our study is that we observe mental health disorders only from 1971 onwards. Thus, we cannot examine the short- or medium-term effects of displacement. Furthermore, the displaced persons are slightly more likely to leave the sample between 1950 and 1970 than the non-displaced persons (Supplementary Materials Table S2), which raises the possibility that our results could arise from selective attrition. However, as we discuss in detail in the Supplementary Materials, this is unlikely to drive our results. Specifically, we show that even in an extreme scenario of selective attrition, the data would suggest that displaced persons had fewer mental health disorders than non-displaced persons.

Our results can also be interpreted as a cautionary case study suggesting that observational associations between migration status and mental health may lead to misleading conclusions. In the context of post-WWII Finland, voluntary migrants have worse mental health than non-migrants. However, our natural experimental results suggest that this association is likely to be due to a higher propensity to migrate among those with a higher risk of mental health prob-

lems. This comparison of the natural experimental and non-experimental results highlights the importance of an appropriate control group when evaluating the impacts of migration.

Materials and methods

Historical background¹

The Soviet Union attacked Finland in November 1939. The Finnish authorities anticipated the attack, and had started evacuations of the civilian population in the border areas in October 1939. The civilians were transported to designated evacuation areas in the middle and western parts of the country, where the local population was obliged to shelter them. In the peace treaty ending the hostilities in March 1940, Finland ceded roughly a tenth of its territory to the Soviet Union and evacuated the remaining population from the ceded areas that had stayed under Finnish control during the war. Altogether, 430 000 persons (11 % of the Finnish population) living in the Eastern parts of the country were evacuated in the winter of 1939–40. In 1941, Finland allied with Germany and joined its attack on the Soviet Union in June. Finland reoccupied the ceded areas, and held them until the summer of 1944. The armistice of September 1944 restored the 1940 borders and ceded some additional areas to the Soviet Union. The entire population living in the ceded area was again evacuated and resettled. The border has stayed undisputed ever since.

The Finnish Parliament approved a series of laws in 1940 and 1945 that permitted compensation for lost property and agricultural land for the displaced farmers. The compensation rate varied from full reimbursement for small losses to compensations of only ten percent for the largest losses. Those who had lost property filed a claim reporting their losses and, on average, roughly forty percent of the claimed property were compensated (31). The urban population received their compensations mostly in the form of inflation-indexed government bonds for which a liquid secondary market quickly emerged. Those who had owned or rented land in the ceded areas were given agricultural and forest land. In order to preserve social connec-

¹This section draws heavily from (19) and (31).

tions, each farmer from a ceded village was settled to a designated target area together with the other farmers from the same origin village. No farmers were placed in Northern Finland, where conditions for agriculture are unfavorable. Furthermore, the Swedish-speaking municipalities on the western and southern coasts were mostly exempt from receiving displaced farmers. The non-agrarian population was free to settle wherever they could find accommodation. The resettlement was financed by Property Expatriation Tax—a massive and progressive tax on capital. For those owning agricultural land, the tax typically took the form of part of their land being expropriated. The resettlement process was completed in 1948, after which no further policies were targeted specifically for the displaced population.

Statistical methods

We estimated the risk of mental disorders using Poisson regression models with the first incidence of a psychiatric disorder as an outcome variable. Our follow-up started on 1 January 1971 and continued until the date of the first psychiatric hospital admission or outpatient visit, death, or the end of the follow-up period (31 December 2012). We used the logarithm of person-years as the offset term and excluded individuals admitted to a hospital with a primary diagnosis for any mental disorder before 1 January 1971. We used Stata 15 and presented the results as incidence rate ratios (IRR) (i.e., risk ratios) with 95% confidence intervals. Standard errors were clustered at the household level.

Data

Our individual-level data consists of a 10% sample of 1950 census microdata linked with the 1970 census microdata and the hospital discharge and outpatient visit data from The National Institute for Health and Welfare. Statistics Finland pseudonymized the data and provided it to us through a secure remote access service. See the Supplementary Material for details.

Mental health measures

Our measures of mental health disorders come from the Finnish hospital discharge register, which has information on the date of admission and discharge for all inpatient stays since 1971. This information was supplemented with all psychiatric outpatient visits since 1998. We studied psychiatric admissions (both inpatient and outpatient visits) with primary diagnoses for mental disorders in general (ICD-10 F04*–F69*), schizophrenia and other non-affective psychoses (shortly schizophrenia) (ICD-10 F20*, F22*–F29*) and mood disorders (F30*–F33*, F340, F348, F349, F38*, F39, F4320–F4322). Other disorders include any mental disorders except mood disorder and schizophrenia diagnoses. Diagnoses related to dementia or intellectual disabilities are not included in these diagnoses. We used comparable ICD-9 (years 1987–1995) and ICD-8 codes (years 1971–1986).

We also obtained information on the eligibility of special reimbursement of drugs. The eligibility for special reimbursement in psychiatric drugs implies severe mental disorders, and this information works as a proxy for psychotic disorders. In the Supplementary Materials, we show that this measure yields similar results as our main estimates (Table S3). Furthermore, our results are similar when we exclude outpatient visits from outcome measures based on the hospital discharge register (Table S4).

Migrant status

Our measure for being displaced was based on the municipality of residence on 1 September 1939. This information came from a retrospective question included in the 1950 census. We defined a person to be displaced if she lived in a municipality that was later entirely ceded to the Soviet Union. For those born after 1939, we assigned the pre-war residential information of the parent closest to the pre-war Finnish-Soviet border. We defined a person as having voluntarily migrated if she moved between non-ceded provinces between September 1939 and December

1950.

Control variables

As control variables, we used the birth year, household head's socioeconomic status (entrepreneur, white-collar worker, blue-collar worker, family member, not in labor force), sector of employment (agriculture, manufacturing, construction, services, unknown), and rural/urban status. All control variables refer to the year 1939. For those born after 1926, we used the pre-war background information of the 1950 household head. Regional pre-war mental disease prevalence was measured as annual average mental disorders per 10,000 inhabitants at the municipal level for the years 1932–34 and linked to the individual-level data based on individuals' 1939 municipality of residence.

Supplementary materials

Supplementary material for article includes:

Section S1. Additional Information and Results

Fig. S1. Pre-war location and short-term migration (1939-50) of the non-displaced

Fig. S2. Pre-war location and post-war mental health

Fig. S3. The impact of forced migration by urban status

Fig. S4. The impact of forced migration by sex

Fig. S5. The impact of forced migration by age

Table S1. Regression discontinuity estimates on the impact of forced migration on long-term mental health disorders

Table S2. Attrition

Table S3. Descriptive statistics on mental health follow-up

Table S4. The effect of displacement on mental health

Table S5. The effect of displacement on mental health: inpatient admissions only

References

1. D. Bhugra, Migration and mental health. *Acta Psychiatr. Scand.* **109**, 243-258 (2004).
2. D. Bhugra, Migration, distress and cultural identity. *Br. Med. Bull.* **69**, 129-141 (2004).
3. D. Bhugra, M. A. Becker, Migration, cultural bereavement and cultural identity. *World Psychiatry* **4**, 18-24 (2005).
4. N. Goldman, A. R. Pebley, M. J. Creighton, G. M. Teruel, L. N. Rubalcava, C. Chung, The consequences of migration to the United states for short-term changes in the health of Mexican immigrants. *Demography* **51**, 1159-1173 (2014).
5. B. F. Grant, F. S. Stinson, D. S. Hasin, D. A. Dawson, S. Chou, K. Anderson, Immigration and lifetime prevalence of DSM-IV psychiatric disorders among mexican Americans and non-Hispanic whites in the United States: Results from the national epidemiologic survey on alcohol and related conditions. *Arch. Gen. Psychiatry* **61**, 1226-1233 (2004).
6. E. Cantor-Graae, C. B. Pedersen, Full spectrum of psychiatric disorders related to foreign migration: A Danish population-based cohort study. *JAMA Psychiatry* **70**, 427-435 (2013).
7. E. Cantor-Graae, J.-P. Selten, Schizophrenia and migration: A meta-analysis and review. *Am. J. Psychiatry* **162**, 12-24 (2005).
8. E. Montgomery, A. Foldspang, Discrimination, mental problems and social adaptation in young refugees. *Eur. J. Public Health* **18**, 156-161 (2008).

9. S. Swinnen, J.-P. Selten, Mood disorders and migration: Meta-analysis. *Br. J. Psychiatry* **190**, 6 (2007).
10. E. M. Getanda, C. Papadopoulos, H. Evans, The mental health, quality of life and life satisfaction of internally displaced persons living in Nakuru County, Kenya. *BMC Public Health* **15**, 755 (2015).
11. N. Tsuchiya, N. Nakaya, T. Nakamura, A. Narita, M. Kogure, J. Aida, I. Tsuji, A. Hozawa, H. Tomita, Impact of social capital on psychological distress and interaction with house destruction and displacement after the Great East Japan earthquake of 2011. *Psychiatry Clin. Neurosci.* **71**, 52-60 (2017).
12. C. Siriwardhana, R. Stewart, Forced migration and mental health: Prolonged internal displacement, return migration and resilience. *Int. Health* **5**, 19-23 (2013).
13. D. A. Jaeger, T. Dohmen, A. Falk, D. Huffman, U. Sunde, H. Bonin, Direct evidence on risk attitudes and migration. *Rev. Econ. Stat.* **92**, 684–689 (2010).
14. A. Bütikofer, G. Peri, How cognitive ability and personality traits affect geographic mobility. *J. Labor Econ* (forthcoming).
15. M. Jokela, Personality predicts migration within and between US states. *J. Res. Pers* **43**, 79–83 (2009).
16. S. Stillman, D. McKenzie, J. Gibson, Migration and mental health: Evidence from a natural experiment. *J. Health Econ.* **28**, 677-687 (2009).
17. L. M. Bramson, M. E. Rickert, Q. A. Class, A. Sariaslan, C. Almqvist, H. Larsson, P. Lichtenstein, B. M. D’Onofrio, The association between childhood relocations and subsequent

- risk of suicide attempt, psychiatric problems, and low academic achievement. *Psychol. Med.* **46**, 969–979 (2016).
18. T. K. Bauer, S. Braun, M. Kvasnicka, The economic integration of forced migrants: Evidence for post-war Germany. *Econ. J.* **123**, 998-1024 (2013).
 19. M. Sarvimäki, R. Uusitalo, M. Jäntti, Habit formation and misallocation of labor: Evidence from forced migrations (2020). Available at <https://ssrn.com/abstract=3361356>.
 20. J. Haukka, J. Suvisaari, M. Sarvimäki, P. Martikainen, The impact of forced migration on mortality: A cohort study of 242,075 Finns from 1939–2010. *Epidemiology* **28** (2017).
 21. D. McKenzie, S. Stillman, J. Gibson, How important is selection? Experimental vs. non-experimental measures of the income gains from migration. *J. Eur. Econ. Assoc.* **8**, 913–945 (2010).
 22. S. Stillman, J. Gibson, D. McKenzie, H. Rohorua, Miserable migrants? Natural experiment evidence on international migration and objective and subjective well-being. *World Dev.* **65**, 79–93 (2015).
 23. K. U. Pihkala, The land settlement program of Finland. *Land Economics* **28**, 147-159 (1952).
 24. A. Haasio, E. Hujanen, *Tasavallan panttivangit* (Suo-säätiö, 1990).
 25. L. Peltonen, A. Palotie, K. Lange, Use of population isolates for mapping complex traits. *Nat. Rev. Genet.* **1**, 182 (2000).
 26. M. Nelis, T. Esko, R. Mägi, F. Zimprich, A. Zimprich, D. Toncheva, S. Karachanak, T. Piskackova, I. Balascak, L. Peltonen, E. Jakkula, K. Rehnström, M. Lathrop, S. Heath,

- P. Galan, S. Schreiber, T. Meitinger, A. Pfeufer, H.-E. Wichmann, B. Melegh, N. Polgar, D. Toniolo, P. Gasparini, P. D’Adamo, J. Klovins, L. Nikitina-Zake, V. Kucinskas, J. Kasnauskiene, J. Lubinski, T. Debniak, S. Limborska, A. Khrunin, X. Estivill, R. Racionet, S. Marsal, A. Julia, S. E. Antonarakis, S. Deutsch, C. Borel, H. Attar, M. Gagnebin, M. Macek, M. Krawczak, M. Remm, A. Metspalu, Genetic structure of Europeans: A view from the north–east. *PLOS ONE* **4**, 1-10 (2009).
27. E. Jakkula, K. Rehnström, T. Varilo, O. P. H. Pietiläinen, T. Paunio, N. L. Pedersen, U. DeFaire, M.-R. Järvelin, J. Saharinen, N. Freimer, S. Ripatti, S. Purcell, A. Collins, M. J. Daly, A. Palotie, L. Peltonen, The genome-wide patterns of variation expose significant substructure in a founder population. *Am. J. Hum. Genet.* **83**, 787–794 (2008).
28. U. Hannelius, E. Salmela, T. Lappalainen, G. Guillot, C. M. Lindgren, U. von Döbeln, P. Lahermo, J. Kere, Population substructure in Finland and Sweden revealed by the use of spatial coordinates and a small number of unlinked autosomal SNPs. *BMC Gen.* **9**, 54 (2008).
29. M. D. Cattaneo, N. Idrobo, R. Titiunik, *A Practical Introduction to Regression Discontinuity Designs: Foundations* (Cambridge University Press, 2019).
30. A.-C. Hollander, H. Dal, G. Lewis, C. Magnusson, J. B. Kirkbride, C. Dalman, Refugee migration and risk of schizophrenia and other non-affective psychoses: cohort study of 1.3 million people in sweden. *BMJ* **352** (2016).
31. H. Waris, V. Jyrkilä, K. Raitasuo, J. Siipi, *Siirtoväen sopeutuminen* (Otava, Helsinki, 1952).

Funding This research was supported by Yrjö Jahnsson Foundation (grant number 5919). H.S. acknowledges support by Yrjö Jahnsson Foundation (grant numbers 6797 and 20187108).
Author contributions HS, MS, JH, JS and PM designed the research. HS analyzed data with

inputs from JH and MS. MS and HS wrote the paper with inputs from JH, JS and PM.

Competing interests The authors declare no competing interests.

Data availability The analysis is based on data that require a license from Statistics Finland, The National Institute for Health and Welfare (THL), and Social Insurance Institution of Finland (Kela). Access to these data is not restricted to any particular institution or research group. The data can be analyzed at Statistics Finland's remote server from universities and research institutes in the EU, subject to Statistics Finland's data security approval. Details of the application process are available at http://www.stat.fi/tup/mikroaineistot/index_en.html

Supplementary Materials for ”Forced migration and long-term mental disorders in post-WWII Finland”

Matti Sarvimäki,^{1,2*} Henri Salokangas,³ Jari Haukka,^{4,5} Pekka Martikainen,^{6,7,8}
Jaana Suvisaari⁹

¹*Department of Economics, Aalto University School of Business, FI-02150 Espoo, Finland* ²*VATT Institute for Economic Research, FI-00100 Helsinki, Finland* ³*Department of Economics, University of Turku, FI-20100 Turku, Finland* ⁴*Clinicum, Department of Public Health, University of Helsinki, FI-00290 Helsinki, Finland* ⁵*Faculty of Medicine and Health Technology, Tampere University, FI-33014 Tampere, Finland* ⁶*Population Research Unit, University of Helsinki, FI-00170 Helsinki, Finland* ⁷*Centre for Health Equity Studies, Stockholm University and Karolinska Institutet, SE-114 18 Stockholm, Sweden* ⁸*Max Planck Institute for Demographic Research, DE-18057 Rostock, Germany* ⁹*Mental Health Unit, National Institute for Health and Welfare, FI-00271 Helsinki, Finland*

**To whom correspondence should be addressed; E-mail: matti.sarvimaki@aalto.fi.*

June 15, 2020

This PDF includes:

Section S1	Additional Information and Results	2
 Figures		
Fig. S1	Pre-war location and short-term migration (1939-50) of the non-displaced	5
Fig. S2	Pre-war location and post-war mental health	6
Fig. S3	The impact of forced migration by urban status	7
Fig. S4	The impact of forced migration by sex	8
Fig. S5	The impact of forced migration by age	9
 Tables		
Table S1	Regression discontinuity estimates on the impact of forced migration on long-term mental health disorders	10
Table S2	Attrition	11
Table S3	Descriptive statistics on mental health follow-up	12
Table S4	The effect of displacement on mental health	13
Table S5	The effect of displacement on mental health: inpatient admissions only	14

S1 Additional Information and Results

Regression Discontinuity Estimates

In the main paper, we presented estimates using only individuals who lived within 107 km from the postwar border as a robustness check. The idea of these comparisons was to mitigate potential confounding due to geographical differences. A natural alternative would have been to use the regression discontinuity approach (RD), where one aims to compare displaced and non-displaced individuals living precisely at the border. The strength of such comparisons is that they plausibly eliminate confounding due to geographical differences. However, a limitation in our context is that non-displaced persons living right next to the post-war border may be affected by the fact that they end up living very close to a border of a hostile country. Furthermore, the shift of the border may have affected economic conditions in these areas by cutting them off from locally important markets in the ceded areas (1). Indeed, those living in the non-ceded areas close to the post-war border, were substantially more likely to migrate than those living further away from the border (Figure S1). Hence, we chose to report estimates comparing a broader group of individuals living in the same region in the main paper and report the RD estimates here.

Figure S2 presents regional variation in mental health disorders by plotting the prevalence of our outcome variables over distance to the post-war border of individuals' pre-war residence municipality. Among people living in the non-ceded areas, those living in the Western part of the country tended to have a lower prevalence of mental health disorders than those living further to the East. However, this association reverses around roughly 75 km West of the postwar border. The incidence of mental health disorders appears to drop discontinuously at the post-war border, after which the association between living further to the East and a higher prevalence of mental health disorders returns. These patterns are consistent with the presence of a general East-West gradient in mental health disorders, a spillover effect to non-ceded areas close to the new border, and a positive impact of forced migration on mental health.

Table S1 reports the RD estimates. We follow the standard regression discontinuity literature (2, 3) and use linear regression framework for these estimates (see table notes for details). The RD estimate suggests a 7.3% decrease for cumulative incidence in any mental disorder. In comparison, the corresponding Poisson estimate using data only on individuals living within 107 km of the postwar border implies a 6.9% decrease (Fig 2 of the main paper). For mood disorders, the RD estimate is substantially larger than the Poisson estimate (32.2% vs. 8.7%), while estimates for other disorders are quite similar (7.5% vs. 8.5%). Finally, both approaches yield point estimates that are close to zero for schizophrenia. However, the RD estimates are less precise, and thus only the estimate for mood disorders is statistically significant at conventional levels.

Attrition

A limitation of our study is that the follow-up for mental health disorders started in 1971. Furthermore, we have no data on other characteristics for the period between the censuses of 1950 and 1970. Roughly 9% (N=15,831) of the population born in 1910-1945 included in the 1950 census sample does not appear in the 1970 census, i.e., they have either died or emigrated between 1950 and 1970. The majority of this attrition is likely due to large-scale migration from Finland to Sweden in the late-1960s (4). Hence, one may be concerned that attrition could bias our estimates. Specifically, if being displaced would have increased the likelihood of individuals with mental health disorders to leave the sample before 1971 (compared to non-displaced persons with mental health disorders), our estimates would be biased downward.

We start examining the extent of potential bias by asking whether the attrition rate differs between displaced and non-displaced persons. We use data from the full sample of the 1950 census, i.e., including individuals who were not present in 1970 and are thus omitted from our analysis. We define the outcome variable as an indicator taking the value of one if the person was *not* present in the 1970 census and zero otherwise and regress it on an indicator for being displaced. The estimate from a bivariate regression (Table S2, specification 1) suggests that displaced persons were 0.44 percentage points (95% confidence interval 0.02–0.85 percentage points) more likely to leave the sample between 1950 and 1970. Conditioning on other background characteristics (specification 2) slightly reduces the point estimate to 0.36 percentage points (95% CI -0.07–0.78 percentage points).

In order to put these estimates into context, we compare them with the associations between other background characteristics and attrition. For example, men are 1.9 percentage points more likely to leave the sample than women, urban residents are 1.6 percentage points more likely to leave than those living in rural areas, and blue-collar workers are 2.1 percentage points more likely to leave than entrepreneurs and white-collar workers. We also find that those born

after 1939 are more likely to leave the sample than older cohorts, probably because they are more likely to emigrate. In comparison to these benchmarks, the association between displacement status and attrition thus appears relatively small.

How much bias could the difference in the attrition rates between displaced and non-displaced populations create? To answer this question, we note that in the full 1950 census sample, we observe 20,729 displaced and 159,719 non-displaced persons born in 1910-1945. In the 1970 census, we still observe 18,830 displaced and 145,787 non-displaced persons from these birth cohorts. This gives us the attrition rates of 9.16% for the displaced and 8.72% for the non-displaced persons, i.e., the unadjusted difference in the attrition rate is 0.44 percentage points as discussed above. Putting these numbers together implies that there are $20,729 \times 0.0044 = 91$ "missing" displaced persons in our follow-up sample compared to the non-displaced population.

Next, we ask how the unadjusted relative risk¹ of psychiatric admissions for any mental disorders between the non-displaced and displaced population—reported in Figure 2 of the main paper and Table S4 of this appendix—would change under the following scenarios:

Scenario 1 Let's assume that among the population that leaves the sample before 1970, the average cumulative incidence of any mental disorders in period 1951–1970 was 25% (corresponding to roughly twice the average cumulative incidence rate in 1971–2012 for the population we observe). The cumulative risk among the population leaving the sample is the same for displaced and non-displaced persons. In this scenario, the relative risk is

$$\frac{(2310 + 1899 \times 0.25)/20729}{(18748 + 13932 \times 0.25)/159719} = 0.965$$

Scenario 2 Let's now assume that *all* of the 91 extra "missing" displaced persons (see above) had a mental disorder prior to 1970. This scenario produces a "corrected" relative risk of

$$\frac{(2310 + 1808 \times 0.25 + 91)/20729}{(18748 + 13932 \times 0.25)/159719} = 0.989$$

These scenarios aim to present reasonable bounds to the possible influence of attrition bias. The first scenario corresponds to a mild case wherein we only need to take into account the slightly larger attrition rate among the displaced population. The second one is the "worst-case-scenario" that would create the maximum amount of bias to our estimates. The logic of this exercise is that if our broad findings survive even such extreme scenarios, attrition bias is unlikely to drive our conclusions. As it turns out, even the extreme scenario yields a point estimate suggesting that forced migration had a protective effect.

Data

The starting point of our data was a 10% sample of 1950 Census microdata. The original census forms of each dwelling unit were sorted by a municipality, within municipalities in alphabetical order and then filed in boxes. In 1997, Statistics Finland drew a sample from the full 1950 census by picking every tenth box. Nearly all of the information on the census forms was manually inserted into a database. The resulting sample contained roughly 114,000 dwelling units with 411,629 persons from 392 of municipalities (out of a total of 547 municipalities).

Statistics Finland matched the Census data to the Population Register using information on names, the dates of birth, and birth locations. This procedure allowed for assigning social security number (introduced in 1964) to each person and thus linking the 1950 census data with information from the 1970 census, the hospital discharge and outpatient visit data from The National Institute for Health and Welfare (THL), and data on special reimbursement for psychiatric drugs from The Social Insurance Institution of Finland (Kela). Statistics Finland then pseudonymized the data and provided it for us through their secure remote access service.

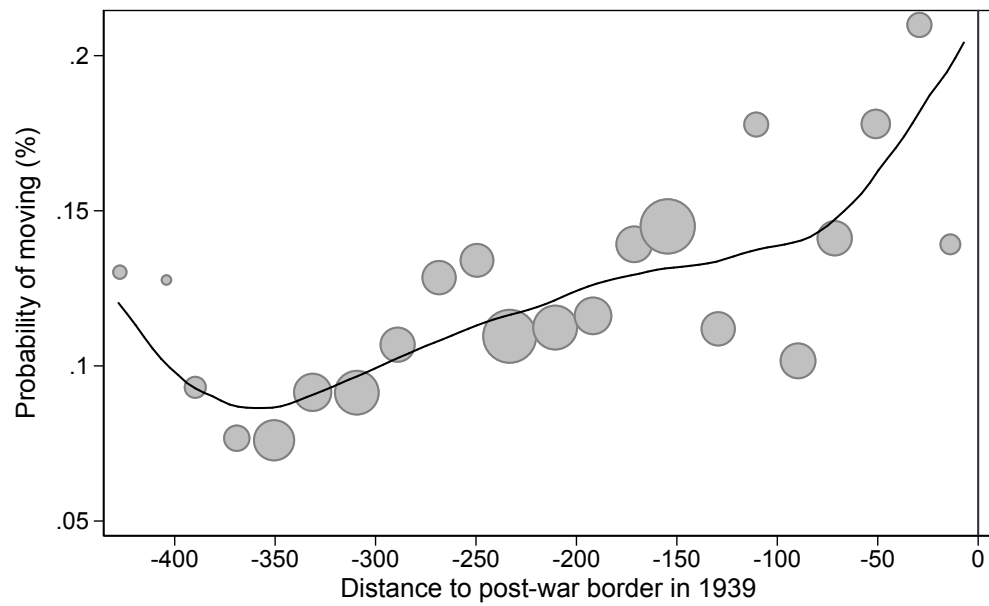
We focused on individuals born in 1910–1945, who were included in the 1970 Census. The cut-off for the earliest birth cohort included in the sample was based on the maximum observed mortality rate (90,6%). This discretionary exclusion removes birth cohorts 1860-1909, who were aged 30-79 at the start of the war. Birth cohort-based exclusion

¹We simplify our thought experiment by focusing on risk ratios rather than incidence ratios. The unadjusted risk ratio (0.954) of forced migration on any mental health disorder is very close to unadjusted incidence rate ratio (0.953).

ensures a natural data structure in which the observed mortality rate is inversely related to birth year, thus mitigating the problem related to attrition. The cut-off for the last birth cohort is due to focusing on individuals who could personally experience the displacement.

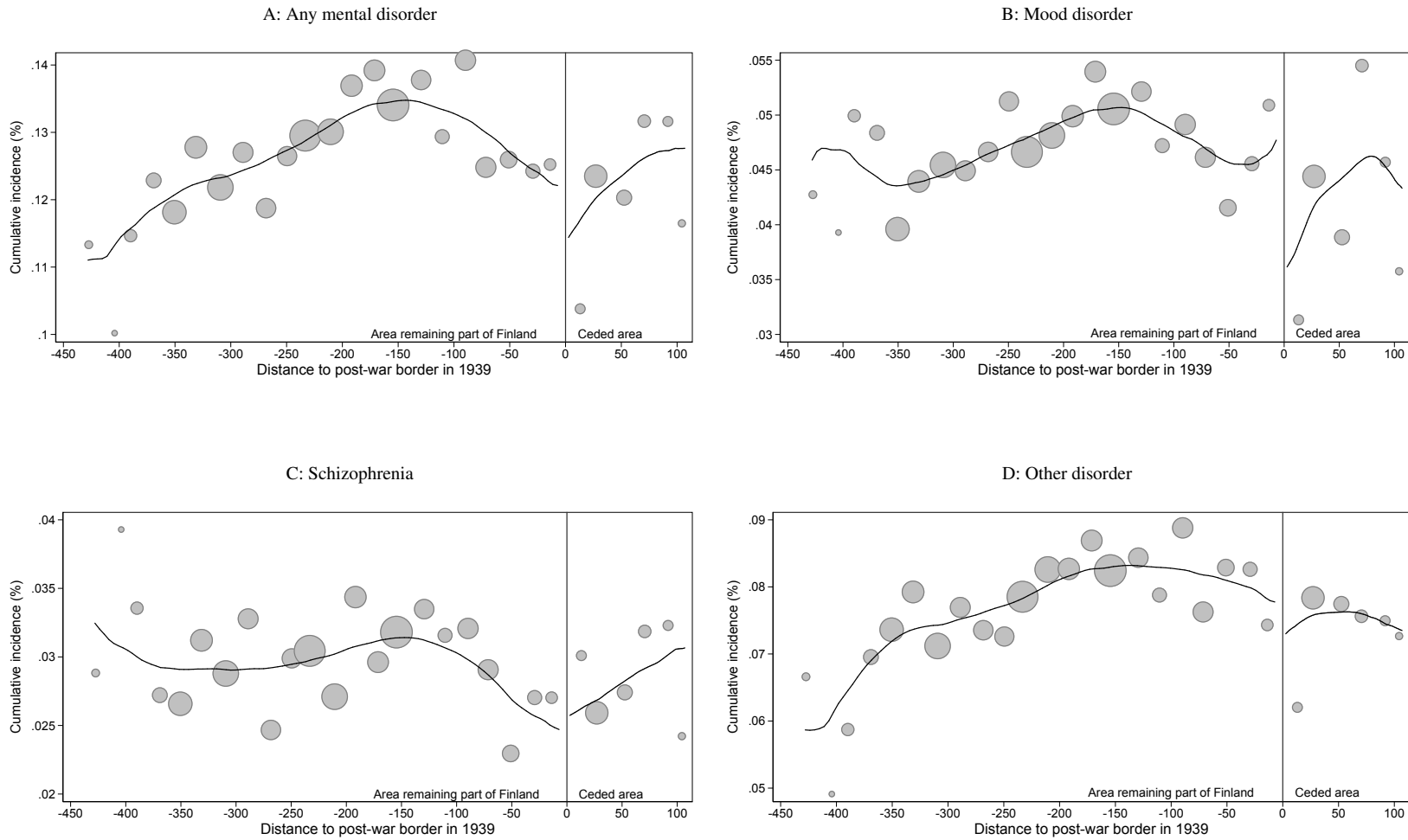
Furthermore, we excluded persons who i) lived in municipalities partly ceded to the Soviet Union (N=12 539), ii) who spoke Swedish as their native language (N=13 061) or lived in predominantly Swedish-speaking population prior to the war (N= 163), iii) were in institutional care (N=241), iv) entered hospital prior to 1971 and were given psychiatric diagnosis upon discharge (N=1,435), or v) for whom some of the data was missing (N=132). These data were linked to the mental health measures discussed in detail below using personal identification numbers. Our final study sample included 164,617 individuals.

Fig. S1: Pre-war location and short-term migration (1939-50) of the non-displaced



Note: Non-displaced pre-war location and probability of moving between provinces 1939-50.

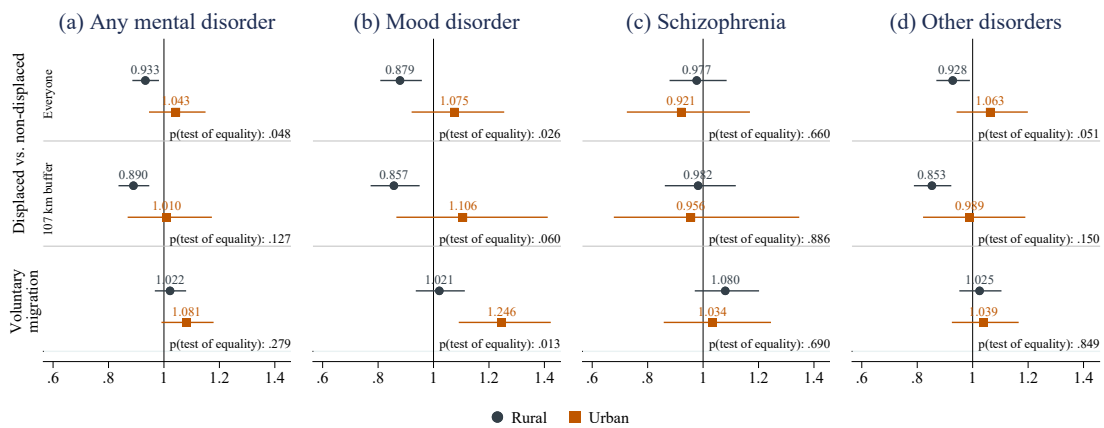
Fig. S2: Pre-war location and post-war mental health



9

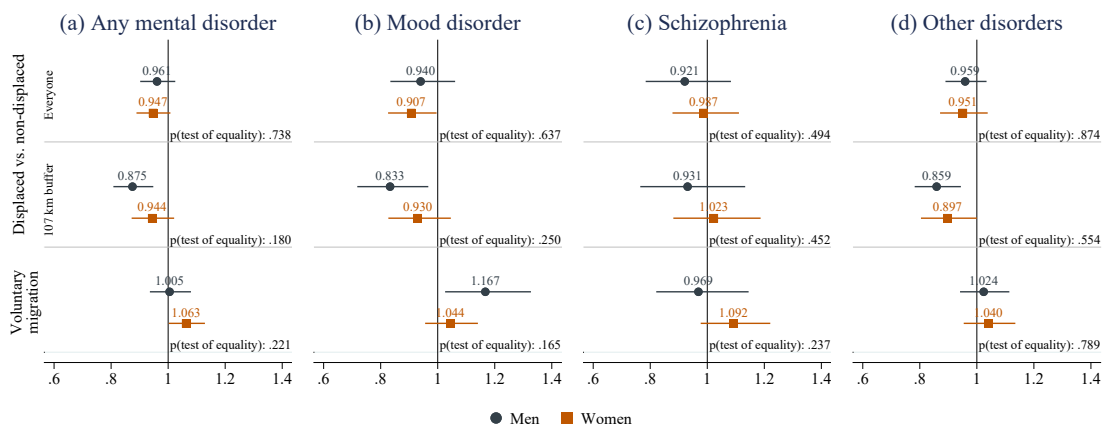
Note: Cumulative outcome incidences on any mental disorder, mood disorder, schizophrenia and other disorders. The negative number in the x-axis refer to non-displaced and their distance to post-war border are calculated according to pre-war municipality of residence.

Fig. S3: The impact of forced migration by urban status



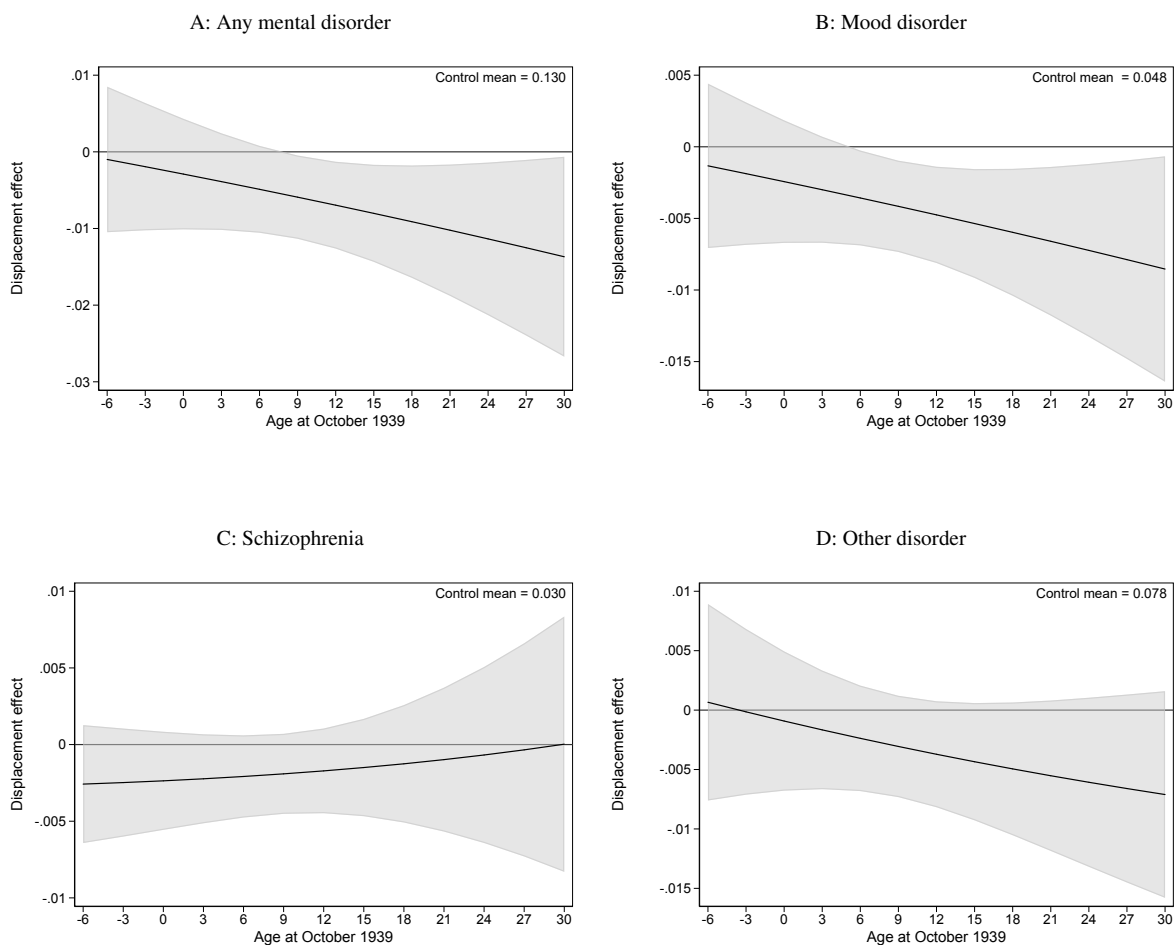
Note: Poisson regression estimates (incidence rate ratios) and 95% confidence intervals for the impact of forced migration on psychiatric admissions due to mental disorder for rural and urban population. Rural/urban status is defined by the 1939 residence municipality of the 1950 household head. The p-values reported in each panel refer to testing the null that the impact of displacement was the same for rural and urban population. All estimates come from a specification conditioning on individual-level pre-war characteristics and pre-war mental disorder prevalence at her 1939 residence municipality. The top panels report the estimates for displacement status using the full sample. The middle panels present similar estimates using a sample of individuals living within 107 km of the post-war border before the war. The bottom panels show corresponding estimates for voluntary migration between provinces between 1939 and 1950 using data on non-displaced population.

Fig. S4: The impact of forced migration by sex



Note: Poisson regression estimates (incidence rate ratios) and 95% confidence intervals for the impact of forced migration on psychiatric admissions due to mental disorder for men and women. The p-values reported in each panel refer to testing the null that the impact of displacement was the same for both sexes. All estimates come from a specification conditioning on individual-level pre-war characteristics and pre-war mental disorder prevalence at her 1939 residence municipality. The top panels report the estimates for displacement status using the full sample. The middle panels present similar estimates using a sample of individuals living within 107 km of the post-war border before the war. The bottom panels show corresponding estimates for voluntary migration between provinces between 1939 and 1950 using data on non-displaced population.

Fig. S5: The impact of forced migration by age



Note: Estimated effects of being displaced by age. The estimates are reported as contrast of marginal effects of displacement status at different ages (percentage points). Panel A reports estimates for any mental disorders, panel B for mood disorders, panel C for schizophrenia spectrum disorders, and panel D for other disorders. The shaded areas represent 95% confidence intervals. All estimates from Poisson regressions with psychiatric disorder of interest as dependent variable and full set of controls variables interacted with age at October 1939 (mean (10.9) centered) as explanatory variables.

Table S1: Regression discontinuity estimates on the impact of forced migration on long-term mental health disorders

Outcome	N(BW)	Control mean	Displaced	Effect, %
Any mental disorder	42,801 (105.3 km)	0.130	-0.010 [-0.029,0.010]	-7.3
Mood disorder	33,503 (83.4 km)	0.045	-0.015 [-0.029,-0.000]	-32.3
Schizophrenia	43,956 (107 km)	0.029	0.001 [-0.009,0.011]	4.2
Other disorders	42,471 (101.8 km)	0.082	-0.006 [-0.020,0.007]	-7.5
Special reimbursement for psychiatric drugs	43,956 (107 km)	0.034	-0.001 [-0.011,0.009]	-2.1

Note: Regression discontinuity estimates of the effect of displacement on cumulative incidence of mental disorders. We use pre-war distance to the post-war border and its interaction with the displacement status, and weight the observations close to the border more than those further away using a triangle-shaped kernel. We restrict the sample to include individuals who lived close to the border, and use (5) algorithm for choosing the optimal bandwidth and restrict maximum bandwidth to 107 km, i.e. maximum distance of the displaced from the post-war border. The first column reports sample sizes and bandwidths. The second column reports average outcomes for the non-displaced population. The third column present point estimates and 95% confidence intervals. The last column presents the ratio of the point estimates to the control means.

Table S2: Attrition

	(1)	(2)
Displaced	0.0044 [0.0002,0.0085]	0.0036 [-0.0007,0.0078]
Female		-0.0190 [-0.0214,-0.0161]
Urban		0.0162 [0.0125,0.0200]
Pre-war migration		0.0069 [0.0030,0.0107]
Pre-war regional mental disorder incidence		-0.0002 [-0.0003,-0.0001]
Sector of occupation (ref. Agriculture)		
Manufacture		-0.061 [-0.0123,0.0000]
Construction		0.0032 [-0.0054,0.0118]
Services		-0.0123 [-0.0184,-0.0062]
Unknown		0.0101 [-0.0008,0.0210]
Socio-economic status (ref. Entrepreneur)		
White-collar		0.0015 [-0.0060,0.0090]
Blue-collar		0.0213 [0.0159,0.0266]
Family member		-0.0108 [-0.0163,-0.0053]
Out of labor force		-0.0056 [-0.0170,0.0057]
Age at Oct.1939 (ref. Unborn)		
0-4		-0.0108 [-0.0156,-0.0059]
5-9		-0.0207 [-0.0257,-0.0157]
10-14		-0.0272 [-0.0322,-0.0222]
15-19		-0.0343 [-0.0390,-0.0295]
20-24		-0.0319 [-0.0369,-0.0270]
25-29		-0.0094 [-0.0146,-0.0043]
Constant	0.0872 [0.0858,0.0886]	0.1124 [0.1068,0.1181]
N	180,448	180,448

Note: Linear probability regression estimates (with 95% confidence intervals) of being lost in follow-up regressed on displacement status. First specification includes no pre-war covariates and second includes full set of pre-war covariates.

Table S3: Descriptive statistics on mental health follow-up

Variable	Displaced	Control group	
		Non-displaced	≤107 km of the post-war border
Number of people with any mental disorder	2,310	18,748	3,281
Mean length of follow-up (years)	30.8	30.7	30.5
<i>If has any psychiatric admissions</i>	19.7	19.7	19.2
<i>If no psychiatric admissions</i>	32.2	32.3	32.3
Average age at entering health follow-up (1.1.1971) (years)	41.9	42.1	41.9
Cumulative psychiatric event incidence (per 1000 people)			
<i>Any mental disorder</i>	122.7	128.6	130.6
<i>Mood disorders</i>	43.1	47.4	47.1
<i>Schizophrenia</i>	27.9	29.8	28.6
<i>Special reimbursements for psychiatric drugs</i>	31.0	33.4	34.3
<i>Other disorders (than mood disorder or schizophrenia)</i>	75.8	78.6	82.3
Observations	18,830	145,787	25,126

Note: Other disorders refer to any mental disorders with the exclusions of mood disorders and schizophrenia. The sums of the cumulative incidences of mood disorders, schizophrenia and other disorders exceed that of any mental disorder because in our analysis of the first incidence of a psychiatric diagnosis subcategory may be preceded by a psychiatric admission in some other psychiatric diagnosis subcategory.

Table S4: The effect of displacement on mental health

	Displaced vs. rest of Finland			Displaced vs. 107 km buffer area controls			Voluntary migration among the non-displaced vs. non-migration		
	BL	FM1	FM2	BL	FM1	FM2	BL	FM1	FM2
Any mental disorder									
Displacement effect	0.953	0.956	0.957	0.931	0.933	0.914	1.055	1.035	1.035
95% CI	[0.912,0.996]	[0.915,0.999]	[0.915,1.001]	[0.881,0.983]	[0.883,0.986]	[0.863,0.967]	[1.007,1.106]	[0.987,1.086]	[0.987,1.086]
P(N0: point estimate = 0)	0.031	0.045	0.056	0.011	0.014	0.002	0.026	0.151	0.153
P(N0: exp. estimate = non-exp. estimate)	0.001	0.02	0.002	0.182	0.275	0.059			
Mood disorder									
Displacement effect	0.911	0.907	0.918	0.914	0.909	0.897	1.146	1.079	1.079
95% CI	[0.847,0.980]	[0.843,0.976]	[0.852,0.989]	[0.835,1.000]	[0.830,0.996]	[0.817,0.985]	[1.068,1.230]	[1.003,1.161]	[1.002,1.161]
P(N0: point estimate = 0)	0.013	0.009	0.025	0.049	0.041	0.022	0.001	0.042	0.043
P(N0: exp. estimate = non-exp. estimate)	<0.001	0.009	0.021	0.005	0.066	0.064			
Schizophrenia									
Displacement effect	0.935	0.949	0.963	0.970	1.003	0.985	1.133	1.057	1.056
95% CI	[0.852,1.026]	[0.864,1.042]	[0.875,1.060]	[0.864,1.089]	[0.892,1.128]	[0.873,1.111]	[1.034,1.242]	[0.962,1.160]	[0.962,1.159]
P(N0: point estimate = 0)	0.159	0.270	0.446	0.607	0.963	0.805	0.007	0.248	0.254
P(N0: exp. estimate = non-exp. estimate)	0.003	0.076	0.043	0.938	0.461	0.776			
Other disorder									
Displacement effect	0.965	0.968	0.962	0.915	0.909	0.881	0.991	1.028	1.028
95% CI	[0.913,1.021]	[0.915,1.024]	[0.908,1.018]	[0.853,0.980]	[0.847,0.976]	[0.819,0.947]	[0.932,1.054]	[0.965,1.094]	[0.965,1.094]
P(N0: point estimate = 0)	0.214	0.254	0.180	0.012	0.008	0.001	0.772	0.394	0.393
P(N0: exp. estimate = non-exp. estimate)	0.465	0.231	0.019	0.808	0.405	0.103			
Special reimbursement for psychiatric drugs									
Displacement effect	0.927	0.930	0.935	0.897	0.922	0.918	1.051	1.036	1.036
95% CI	[0.850,1.012]	[0.852,1.015]	[0.855,1.022]	[0.806,0.999]	[0.826,1.030]	[0.820,1.028]	[0.963,1.146]	[0.948,1.133]	[0.947,1.133]
P(N0: point estimate = 0)	0.089	0.105	0.139	0.048	0.150	0.138	0.264	0.436	0.439
P(N0: exp. estimate = non-exp. estimate)	0.046	0.194	0.216	0.718	0.821	0.973			
N	164,617	164,617	164,617	43,956	43,956	43,956	145,787	145,787	145,787

Note: Poisson regression estimates (Incidence rate ratios, IRR's) of displacement effect on psychiatric admissions with 95% confidence intervals, p-value of point estimate and p-value under the null hypothesis of experimental (forced migration) and non-experimental (voluntary migration) incidence risk being equal. Control group has the reference value of 1. Value below 1 indicates lower risk of psychiatric incidence among the target group (displaced or non-displaced voluntary migrants) vs. control group and value above 1 indicates higher risk of psychiatric incidence among the target group vs. the control group. BL refers to a regression specification with no covariates and FM1 to model with the full set of socioeconomic pre-war covariates (sex, urban status, socioeconomic status, employment status, an indicator of living in the province of birth in 1939, being employed in agriculture and birth year). Additional regression adjustments for the regional pre-war mental disorder (treatment) prevalences are made in municipal (FM2) level. Displacement effects are first computed for the whole study sample with (all), and second with a geographical restriction of within 107 km buffer from the post-war border. The last four columns report association between non-displaced persons who voluntarily migrated between 1939-1950 and non-displaced non-migrants.

Table S5: The effect of displacement on mental health: inpatient admissions only

	Displaced vs. rest of Finland			Displaced vs. 107 km buffer area controls			Voluntary migration among the non-displaced vs. non-migration		
	BL	FM1	FM2	BL	FM1	FM2	BL	FM1	FM2
Any mental disorder									
Displacement effect	0.953	0.957	0.954	0.926	0.932	0.904	1.062	1.031	1.031
95% CI	[0.907,1.000]	[0.912,1.005]	[0.908,1.002]	[0.872,0.984]	[0.877,0.990]	[0.849,0.962]	[1.009,1.118]	[0.979,1.085]	[0.979,1.085]
P(N0: point estimate = 0)	0.050	0.078	0.062	0.012	0.022	0.002	0.020	0.244	0.244
P(N0: exp. estimate = non-exp. estimate)	0.002	<0.001	<0.001	0.141	0.285	0.070			
Mood disorder									
Displacement effect	0.896	0.895	0.896	0.880	0.880	0.857	1.159	1.058	1.058
95% CI	[0.825,0.973]	[0.824,0.973]	[0.824,0.975]	[0.795,0.973]	[0.794,0.974]	[0.771,0.951]	[1.072,1.254]	[0.975,1.148]	[0.975,1.148]
P(N0: point estimate = 0)	0.009	0.009	0.011	0.013	0.014	0.004	<0.001	0.176	0.177
P(N0: exp. estimate = non-exp. estimate)	<0.001	<0.001	<0.001	0.003	0.081	0.077			
Schizophrenia									
Displacement effect	0.946	0.956	0.968	0.966	0.992	0.973	1.147	1.072	1.072
95% CI	[0.860,1.040]	[0.869,1.052]	[0.878,1.068]	[0.859,1.087]	[0.880,1.118]	[0.860,1.100]	[1.044,1.261]	[0.974,1.181]	[0.973,1.180]
P(N0: point estimate = 0)	0.252	0.358	0.517	0.567	0.897	0.662	0.004	0.156	0.159
P(N0: exp. estimate = non-exp. estimate)	0.005	<0.001	<0.001	0.903	0.520	0.823			
Other disorder									
Displacement effect	0.967	0.972	0.961	0.915	0.914	0.875	1.002	1.039	1.039
95% CI	[0.909,1.029]	[0.913,1.034]	[0.901,1.024]	[0.847,0.988]	[0.845,0.988]	[0.807,0.948]	[0.938,1.070]	[0.972,1.111]	[0.972,1.111]
P(N0: point estimate = 0)	0.289	0.370	0.216	0.023	0.024	0.001	0.950	0.262	0.259
P(N0: exp. estimate = non-exp. estimate)	0.415	0.300	0.026	0.917	0.590	0.158			

Note: Poisson regression estimates (Incidence rate ratios, IRR's) of displacement effect on psychiatric hospital admissions with 95% confidence intervals, p-value of point estimate and p-value under the null hypothesis of experimental (forced migration) and non-experimental (voluntary migration) incidence risk being equal. Control group has the reference value of 1. Value below 1 indicates lower risk of psychiatric incidence among the target group (displaced or non-displaced voluntary migrants) vs. control group and value above 1 indicates higher risk of psychiatric incidence among the target group vs. the control group. BL refers to a regression specification with no covariates and FM1 to model with the full set of socioeconomic pre-war covariates (sex, urban status, socioeconomic status, employment status, an indicator of living in province of birth in 1939, being employed in agriculture and birth year). Additional regression adjustments for the regional pre-war mental disorder (treatment) prevalences are made in municipal (FM2) level. Displacement effects are first computed for the whole study sample with (all), and second with a geographical restriction of within 107 km buffer from the post-war border. The last four columns report association between non-displaced persons who voluntarily migrated between 1939-1950 and non-displaced non-migrants.

References

1. S. J. Redding, D. M. Sturm, The costs of remoteness: Evidence from german division and reunification. *American Economic Review* **98**, 1766-97 (2008).
2. D. S. Lee, T. Lemieux, Regression discontinuity designs in economics. *Journal of Economic Literature* **48**, 281-355 (2010).
3. M. D. Cattaneo, N. Idrobo, R. Titiunik, *A Practical Introduction to Regression Discontinuity Designs: Foundations* (Cambridge University Press, 2019).
4. J. Korkiasaari, I. Söderling, Finnish Emigration and Immigration after World War II (2012).
5. G. Imbens, K. Kalyanamaran, Optimal bandwidth choice for the regression discontinuity estimator. *The Review of Economic Studies* **79**, 933-959 (2012).