Home-Country Natural Disasters and Mental Health of Migrants*

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Abstract

While natural disasters cause loss of life and worsen health in the local areas they impact, the overall health impacts of these disasters can be more widespread. Using linked administrative and survey data (the 45 and Up Study) from Australia, a country where one in four residents was born overseas, we show that migrant mental health is significantly affected by home-country natural disasters. In the three months following a disaster, mental health related drug use and visits to mental health specialists increase by 7% and 34%, respectively. The effects persist for up to 12 months after the initial shock. To place these effects in context we provide suggestive comparisons to the impacts of home-country terrorist attacks and macroeconomic shocks on mental health, and also compare the effects on mental health to physical health conditions of migrants. *Keywords: migration; natural disasters; mental health*

1 Introduction

The forces of climate change, population growth, rising urban densities, and the spatial expansion of human settlements imply that natural disasters are increasingly impacting human health (Iglesias et al. 2021, Yang et al. 2018, Nathan 2009). While these natural disasters can have large local health impacts as measured by loss of life and increased morbidity, as people increasingly migrate to different parts of the world, the health impacts of natural disasters could be widespread through migrant communities. In this paper, we investigate whether shocks to migrants' home countries in the form of natural disasters affect their mental health, and whether this effect varies with characteristics associated with migration (distance to the home country, time since migration, strength of social networks in destination country, etc.). If migrants continue to be linked to their countries of origin (either through direct family ties, or through social or financial networks, or simply a sense of longing or care), we might expect their health, and especially their mental health, to deteriorate in the aftermath of a natural disaster in the home country. In our sample, we look at established migrants (the average migrant in our sample has been away from their home country for more than 40 years) and use administrative health records linked to a dataset on global natural disasters to show that *unexpected* natural disasters in their home countries lead migrants to seek mental health services in their country of residence.

In the three months following the disaster, mental health drug use and mental health specialist visits increase by 7% and 34%, respectively. The effects persist up to 12 months. Natural disasters in home countries do not lead migrants to seek care for non-mental health related illnesses. Furthermore, the magnitude of the reaction in the migrant's mental health varies with the severity of the disaster with more serious shocks eliciting larger responses. Finally, as a way to fit these magnitudes within a broader context, we estimate the mental health impacts of terrorist attacks and macroeconomic shocks in home countries. We find that the impacts of major terrorist attacks in the home country on migrant mental health are quite a bit larger than those caused by natural disasters, while the impacts of macroeconomic shocks are smaller and/or insignificant. While we are unable to fully flesh out the mechanisms behind these differences, we think this provides an interesting point of departure for future studies in this space.

We use a unique and large Australian survey dataset (the 45 and Up Study), which is linked to the respondents' administrative medical records. Australia is an ideal setting to study the behavior of migrants as one in four Australian residents is born overseas. Mental health is measured by prescription drug use and mental health specialist visits, which is available at a monthly level for every individual. The frequency of the medical records allows for precise identification of the timing of the effects of natural disasters

on mental health. These data allow us to know the exact timing of when visits are made, to whom, and also when prescription drugs are picked up by individuals. The information on natural disasters comes from a comprehensive worldwide disaster database (EM-DAT). After controlling for individual fixed effects, which also capture time-invariant home-country characteristics, and time effects, natural disasters are plausibly exogenous and unexpected. Accounting for home-country heterogeneity is important, since some countries are prone to more natural disasters than others, and the frequency of such events could pick up correlated and unobserved home-country characteristics.

Much has been written about the mental health of migrants in psychiatry and psychology (Bhugra (2004) provides a thorough review of this literature). The broad conclusions reached therein support the intuitive idea that migration itself can be extremely traumatic and stressful for the migrant and those around them, and that there is heterogeneity in experiences and stress related outcomes. However, there appears to be a lacuna in terms of understanding whether events in home countries can still impact the mental health of migrants. The literature, perhaps understandably, has focussed on certain aspects of the destination that might help mitigate the stress that migrants go through. For example, we know that migration due to conflict can be particularly stressful as is evidenced in recent refugee studies (Bogic et al. 2015), but social capital in destination countries can play a mediating role (Lecerof et al. 2015). These papers relate to our finding that home-country events might be important mental health triggers for a migrant population.

Our paper relates to and builds on some recent work trying to understand the links between migration and mental health. Barrett & Mosca (2013) use a sample of migrants and non-migrants from Ireland (the migrants in the sample are return migrants), and correlate migration history with alcohol use as an indicator for the mental health toll that someone may have incurred during their migratory episode. They account for selection into migration by using a propensity score matching technique. Examining a similar question about whether migration itself impacts mental health, Stillman et al. (2009) use a lottery to account for selection effects into migration more directly. They compare lottery winners to losers for an opportunity to migrate and find that lottery winners (those who end up migrating) have better mental health outcomes than those who are unable to. While these papers have made excellent progress on question of whether migration itself impacts mental health of migrants, the question we seek to answer is somewhat distinct as it pertains to shocks in the home country and the impact that has on migrant mental health. Within this area, a couple of closely related papers (at least in terms of methodology) examine subjective well being and mental health of migrants in response to home-country macroeconomic shocks (Akay et al. 2017, Nguyen & Connelly 2018). Akay et al. (2017) find that migrants in Germany whose home countries have positive economic shocks report having *worse* subjective well being. They interpret their

results within the context of reference dependent behavior; hence, they provide evidence that for migrants, the home country is the relevant and natural comparator for economic outcomes. Nguyen & Connelly (2018) find the opposite result: good macroeconomic conditions in the home country have positive impacts on mental health among migrants in Australia. Our paper adds to this space by considering a different stressor, natural disasters, and the effect these have on migrant mental health. We build on the existent literature methodologically by being able to observe *direct* mental health outcomes as opposed to self-reported outcomes which could be under-reported (Bharadwaj et al. 2017), and the high frequency of observed medical outcomes allows for a more precise matching of timing of natural disasters and mental health outcomes. While our results on the impacts of other stressors like macroeconomic shocks and terrorist attacks are suggestive, we believe they extend this literature in important directions and provide directions for future research.

2 Data and methods

For the empirical analysis, we use a unique data set from Australia constructed by linking the Sax Institute's 45 and Up Study data to individual medical records. The 45 and Up Study is a survey of more than 250,000 individuals 45 years of age or older residing in New South Wales (NSW), the most populous state of Australia (45 and Up Study Collaborators 2008). The sample was drawn from the Department of Human Services (formerly Medicare) enrolment database, which covers all citizens and permanent residents of Australia. People 80 years of age or older and residents of rural and remote areas were oversampled to increase their numbers. Information from the 45 and Up Study participants was collected via mail questionnaires in stages from 2006 to 2009. Most of the questionnaires (78%) were completed in 2008. Close to 18% of the sent-out questionnaires were returned, resulting in a sample of 267,153 individuals (about 11% of the NSW population aged 45 years and over). The 45 and Up Study sample is broadly representative of the populations of NSW and Australia in terms of most demographic and socioeconomic characteristics (age, gender, marital status, and employment), but there is positive selection on household income (Johar et al. 2012).

After excluding a small number (1,701) of invalid observations (volunteers and individuals younger than 45) and observations with missing information on the country-of-birth (3,197), the sample contains 262,355 individuals. Almost a quarter of them (63,474) are first generation migrants, that is, born outside Australia.[1] The migrants in the sample arrived to Australia on average 37 years ago (in 1970) at the average age of 26 years.

[1] In the survey, respondents are asked "In which country you were born?" with a list of the main source countries provided and "Other" to be specified option, which is later coded.

Only a small proportion (5%) migrated to Australia in the past 10 years. There are migrants from 153 different countries in the 45 and Up Study sample. Most migrants (38.6%) came from the United Kingdom, followed by New Zealand (7.92%), Germany (4.37%), the Netherlands (4.13%), and Italy (3.34%).

The 45 and Up Study, with the consent of all the participants, is linked to the individuals' administrative health records, including the Pharmaceutical Benefits Scheme (PBS) and the Medicare Benefits Schedule (MBS) databases. The PBS and MBS data are supplied by the Commonwealth Department of Human Services (DHS) and linked to the 45 and Up Study by the Sax Institute using a unique identifier provided by the DHS. More than nine years of administrative records are available for all individuals in the sample, starting September 2005 and ending October 2014 for PBS and December 2014 for MBS.

The PBS database includes all filled prescriptions for the drugs covered by PBS except for those that cost less than the co-payment. For the general public, the co-payment varies from A$28.60 in 2005 to A$36.90 in 2014. For the individuals who hold a health care concession card (HCCC)[2], the co-payment is substantially lower (A$4.60 and A$6.00 in 2005 and 2014, respectively). Once the total amount spent on prescription drugs reaches a set amount, the Safety Net threshold[3], individuals without a concession card are also eligible for the lower co-payment for the rest of the calendar year. Most of the drug purchases recorded in the PBS data are made using a HCCC (87% of all drugs and 86% of depression and anxiety drugs).

We restrict the sample to the individuals who hold a HCCC because, as described in the previous paragraph, we can observe their complete history of prescription drug use. To identify concessional individuals we use information from both the survey and the administrative records. Concessional individuals are defined as (1) those who self-report that they have a HCCC in the survey or (2) those who fill in a prescription using a HCCC as per the administrative records. The analysis sample consists of monthly observations of filled prescriptions by these concessional individuals in the year they complete the survey or fill a script using a HCCC and all the following years.[4] There are 15,707,408 individual-month-year observations of concessional individuals (54% of the full sample). The eligibility for a health care concession card is linked to welfare benefit receipt, veteran status, low income, and/or pension age. This is reflected in the differences in the characteristics between concessional and non-concessional individuals as shown in Table 1. Concessional individuals are older, less likely to have a university degree, more likely to be at the bottom of the distribution of household income and live in lower socioeconomic

[2]We are referring to these individuals as 'concessional'.

[3]The Safety Net threshold was A$874 and A$1,421 in 2005 and 2014, respectively.

[4]We do not include the years prior to the survey/first HCCC use, because some individuals become eligible to a HCCC once they reach pension age; thus doing so may over-estimate their concessional status.

status areas, as measured by the SEIFA Index of Relative Socioeconomic Advantage and Disadvantage. Thus, if there is heterogeneity in the effects of home-country shocks, our results are more informative of these effects in the sub-population that is older and less socioeconomically advantaged. There are no differences, however, in migrant status and gender between the two sub-samples.

Our main measure of mental health is a binary variable that takes the value one if an individual fills a prescription for depression and/or anxiety drugs in a given month, and the value zero otherwise.[5] Drugs for these mental conditions (as well as other health conditions that we use in the analysis) are identified in the administrative data using the Anatomical Therapeutic Chemical (ATC) Classification System codes,[6] provided in Appendix Table A.1.

As an alternative definition of mental health, we use an indicator for whether or not an individual visited a mental health specialist (psychiatrist or psychologist) in a given month. In Australia treatment of patients with less severe mental health issues is managed by general practitioners, who prescribe most of mental health drugs (85%), and only more serious cases are referred to mental health specialists (Australian Institute of Health and Welfare 2023). Thus, mental health specialist visits are more likely to capture severe mental health problems. The information on the visits to a mental health specialist comes from the MBS data. All medical services covered by Medicare are recorded in the MBS data, including general practitioner (GP) and specialist visits and diagnostic tests. Medicare covers all visits to psychiatrists; patients with depression and/or anxiety symptoms (as determined by their GP) are also eligible to receive compensation for a limited number of psychologist visits (starting 1 November 2006).

Table 2 presents the means of the demographic and socioeconomic characteristics and mental health measures for native Australians (column 1), all migrants (column 2), 47 largest migrant groups[7] (column 3), and the 30 largest migrant groups[8] (column 4) in the concessional sample. Table 2 shows that the largest migrant groups (irrespective of the definition) are comparable to all migrants in terms of demographic and socioeconomic characteristics and mental health measures. There are, however, differences between Australian natives and migrants. Migrants are more likely to be male, are more educated, but have substantially lower (self-reported) household income than natives. On the other hand, there are no large differences in age and socioeconomic status of the local area by migrant status.

[5]Depression and anxiety drugs constitute the vast majority of all prescription mental health drugs (97% for both natives and migrants).

[6]ATC classfication system is controlled by the World Health Organization Collaborating Centre for Drug Statistics Methodology (WHOCC): http://www.whocc.no/atc_ddd_index/.

[7]With at least 100 individuals in the concessional sample.

[8]With at least 200 individuals in the concessional sample.

Table 2 shows that mental health drug use is lower among migrants: 11.4% of migrants take depression or anxiety drugs in a given month compared to 13.6% of natives. This difference is driven by antidepressant use. The lower mental health drug incidence among migrants does not necessarily mean that migrants are less prone to mental disorders. As suggested by Bharadwaj et al. (2017), migrants are more affected by mental health stigma and in turn are less likely to seek mental health care. Note that due to migrant unwillingness to seek care, we may be underestimating the impact of home-country natural disasters on migrant mental health in our analysis. On the other hand, the incidence of mental health specialist (both psychiatrist and psychologist) visits is comparable among natives and migrants and lower than the incidence of mental health drug use, as expected. Close to a 1% of individuals visit a mental health specialist in a given month.

To avoid the influence of outliers in small migrant groups, our main analysis sample consists of the concessional individuals from the 30 largest migrant groups and includes 3,464,152 individual-month-year observations on 36,940 individuals. Migrants in this sample come from various European, Asian, African, and North and South American countries, listed in Appendix Table B.1. The average time since arrival is 44 years, and the average age at arrival is 28 years.

Information on natural disasters comes from EM-DAT, The International Disaster Database, maintained by the Centre for Research on the Epidemiology of Disasters (CRED) at the School of Public Health of the Universit Catholique de Louvain, Brussels, Belgium (CRED 2015). Information for the database is collected from various sources, including United Nation agencies, governments, non-governmental organizations (the International Federation of Red Cross and Red Crescent Societies), insurance companies, research institutes, and press agencies with the priority given to the first three sources. CRED constantly reviews entries for inconsistencies, redundancy, and incompleteness, and revises them. EM-DAT contains information on natural and technological disasters in the world from 1900 to present. We have been granted access to the 'raw' EM-DAT data.

In order for a disaster to be included in EM-DAT, at least one of the following criteria must be met:

1. At least 10 people are reported dead,
2. At least 100 people are reported affected (dead, injured, homeless, and in need of assistance),
3. A state of emergency is declared, or
4. International assistance is called for.

The following information is available about each disaster: date; country; type of disaster; the numbers of dead, injured, homeless, and in need of immediate assistance; and estimated value of damage (not always available).

We use EM-DAT data to create an indicator for whether or not one of the following disasters occurred in a migrant's home country in a given month-year:

- Geophysical: earthquake (ground movement or tsunami), mass movement (avalanche, landslide, or rockfall), or volcanic activity;
- Climatological: wildfire;
- Hydrological: flood or landslide; or
- Meteorological: storm (convective or extra-tropical storm or tropical cyclone) or extreme temperature (heatwave or coldwave).

Our main focus is on severe natural disasters. Migrants may only be aware of severe natural disasters in their countries, and less severe disasters may be local to specific areas. Our main measure of severity is death and injury rate per 100,000 population. We define a binary variable that takes the value one if at least 10 people per 100,000 population died or got injured in the home country in a natural disaster in a given month-year, and the value zero otherwise. We also test the sensitivity of results to alternative thresholds. Another measure of severity is the percentage of population 'affected' by the disaster (dead, injured, homeless, and in need of assistance). It is our less preferred definition, because of the likelihood of measurement errors in the numbers of homeless and in need of assistance.

Table 3 presents summary statistics on the incidence of natural disasters in the home countries of Australian migrants. One in five migrants have a disaster occurring in their home country in a given month. Most of these disasters are quite minor (as per our definition). In a given month, only 0.14% of the migrants have a severe disaster that resulted in at least 10 deaths or injuries per 100,000 occurring in their home country. Over the analysis period (2004-2014), there were seven such disasters, which affected migrants from six countries (in the sample of the 30 largest migrant groups). Appendix Table B.2 lists these disasters and provides information on their locations, dates, and extent. In the last three columns of Appendix Table B.1, we also present the incidence of natural disasters of various degrees of severity in the largest 30 migrant groups in the analysis period. The incidence of alternatively defined severe natural disasters is higher as expected. Close to 1% of Australian migrants had a natural disaster occurring in their home country that affected at least 1% of their home country population. The incidence of natural disasters is comparable among all migrants and the largest migrant groups.

2.1 Estimating equations

To determine whether or not migrants are affected by severe natural disasters in their home countries, we estimate the following equations:

$$MH_{ijt} = \beta_0 + \sum_{l=1}^{k} \beta_{t-l} ND_{j,t-l} + \alpha_i + \mu_t + u_{ijt}, \tag{1}$$

where i indexes individuals, j indexes country-of-birth, and t indexes month-year; MH_{ijt} is a binary variable denoting health care for mental health problems as measured by mental health drug use or mental health specialist visit in a given month; $ND_{j,t-l}$ is an indicator for an occurrence of a natural disaster in a migrant's home country in period $t-l$; α_i is individual fixed effect (FE), which captures any time-invariant individual-specific characteristics, μ_t is month-year effect, and u_{ijt} is a random error term. We allow for long-term mental health effects of natural disasters (up to 18 months initially). Because of the low monthly incidence of severe disasters, we aggregate monthly disaster data into quarters; that is, we estimate how migrant mental health in the current month is affected by a severe natural disaster in the past 1 to 3 months, the past 4 to 6 months, and so on up to the past 16-18 months.

Natural disasters are plausibly exogenous to migrant mental health conditional on individual and time effects. Individual fixed effects capture any time-invariant differences in mental health between migrants from different countries including cultural differences in reporting mental health issues or seeking medical care as well as differential disaster risk across countries. Individual fixed effects also help to address the potential issue of endogenous sample selection. Recall that individuals enter the sample when they either report possession of a HCCC or are observed using a HCCC in the administrative data.[9] If some migrants are more likely to obtain a HCCC each year, and HCCC eligibility is related to mental health, then the composition of each migrant group may change differentially across migrant groups. Individual fixed effects allow for the selection on time-invariant personal characteristics. Month-year effects account for any events common to all migrants that may affect their mental wellbeing, including any Australia-wide and worldwide shocks. Equation (1) is estimated as a fixed-effects regression (that is, individual fixed effects are eliminated), and standard errors are clustered at the country-of-birth level. As the number of clusters is relatively small (30 in main analysis)[10] and our sample size is large, we also employ alternative inference methods: wild bootstrap, randomization inference, and Leamer's rule of thumb.

[9] In total there are 110 month-year periods from September 2005 to October 2014, and individuals are in the sample for 93.8 periods on average.

[10] The clusters vary in size, which is determined by the number of migrants from a given country, presented in Column (1) of Appendix Table B.1.

As part of sensitivity analysis, we estimate alternative specifications of Equation (1). First, to check how important sample selection may be, we re-estimate Equation (1) using a balanced sample, which includes individuals who possess a HCCC throughout the analysis period. We also compare our baseline individual fixed effects estimates to the estimates of a regression that controls for country-of-birth effects only. To allow for country-specific monthly and annual mental health shocks, we estimate a model with country-month and country-year effects added. In another specification, we include country-specific linear trends (in addition to country and month-year effects) to account for the possibility of differential changes in mental health over time across countries of birth.

Finally, we take into account the fact that some respondents are likely to have died or returned home during our analysis period. We can precisely identify only a small fraction of deaths (deaths in hospitals in 2006-09, a period during which the survey data is linked to hospital administrative records). We exclude the respondents who died in hospital during this period. Additionally, we exclude individuals who stop showing up in MBS data. A vast majority of our sample individuals attend a doctor or get a diagnostic test at least once a year. This is not surprising given that our sample is older and health care is heavily subsidized in Australia. Therefore, attrition from the MBS data may indicate that a person passed away or returned to their home country. Alternatively, there may be some healthy individuals who never use health care services. However, the estimates based on this restricted sample are useful, as together with the main estimates they can provide bounds for the true estimates of home-country disaster effects on migrant mental health. If the most vulnerable people die (or return home), the main estimates can be thought of as the lower bounds since they would have otherwise been most affected by shocks in their home countries. If in the exercise described above, we exclude the most mentally stable people and they are least affected by shocks in their home countries, these estimates can be thought of as upper bounds.

3 Results

3.1 Effects of natural disasters on migrant mental health

We start by estimating how migrant mental health is affected by a major (most severe) natural disaster in the home country (controlling for individual and month-year effects). Table 4 shows that severe disasters, as measured by the rate of deaths or injuries caused by the disaster, have significant negative effects on mental health and that more severe disasters elicit larger effects. In the sample of the largest 30 migrant groups (panel A), a disaster in the home country that caused 1 or more deaths or injuries per 100,000

population increases mental health drug use by 0.25 percentage points, whereas a disaster that caused 5 (10) or more deaths or injuries per 100,000 population increases mental health drug use by 0.59 (0.81) percentage points. Although these figures may seem small, they correspond respectively to a 2.2%, 5.1%, and 7.0% increase relative to the average incidence of mental health drug use, which is not negligible. The effect of a major home-country disaster on migrant mental health is strongest immediately after the disaster, but it persists for several months. For example, migrant mental health drug use remains 0.56, 0.63, and 0.40 percentage points higher 4-6, 7-9, and 10-12 months after the occurrence of the disaster, respectively, following a natural disaster in the home country that caused at least 10 deaths or injuries per 100,000. Panel B of Table 4 shows that the coefficient estimates are comparable in the sample of all migrants, but less precisely identified.[11] In the following analyses, we will present the results for the sample consisting of the 30 largest migrant groups.[12]

To check the validity of our research design, we next conduct an event-study type analysis. We include in equation 1 indicators for not only past but also future disasters, which should not affect migrants' current mental health.[13] We also include an indicator for there being a disaster in the current month. Appendix Table B.4 shows that the effects of future disasters are largely statistically insignificant and smaller than the effects of past disasters, as expected. One exception is a negative coefficient on the indicator for a disaster in the next 10-12 months, which is difficult to explain. We have also constructed Figure 1 based on this table, which presents the differences between the coefficients on the disasters in the next/last X-Y months and the coefficient on the disaster in the next 1-3 months (t-1) to resemble a standard 'event study graph'. This figure visually shows the absence of a pre-trend in the months leading to a major disaster.

For comparison, we present the estimates of the effects of any natural disaster in the home country on migrant mental health. As shown in column (1) of Appendix Table B.5, these effects are smaller and less statistically insignificant. This is not surprising, because many of the disasters recorded in EM-DAT data base are minor; most migrants may not even be aware of them. The estimated effects are even smaller, if we use the number of natural disasters instead (column 2). We also do not find any significant changes in

[11] To show that the results in Table 4 are not driven by the largest disasters only, we also estimate a specification in which we include indicators for 'small' (less than 1 deaths/injuries per 100,000 population), 'large' (1 to less than 10 deaths/injuries per 100,000 population) and 'very large' (10 or more deaths/injuries per 100,000 population) natural disasters simultaneously. These estimates, presented in Appendix Table B.3, demonstrate that the effects of 'small' home-country disasters on migrant mental health are small and not always statistically significant effects, but both 'large' and 'very large' disasters affect migrant mental health significantly.

[12] The results for the sample of all migrants are comparable in size and usually less precisely estimated in all regressions. These estimates are available upon request.

[13] It is possible that there may be some warning signs of a disaster, for example, a severe disaster may be preceded by less severe disasters, but we do not expect such large effects as for major disasters.

migrant mental health if we define major disasters by the percentage of affected (dead, injured, homeless, or in need of assistance) population, as shown in Appendix Table B.6. In the following analyses, we define a major natural disaster as the disaster that caused at least 10 deaths or injuries per 100,000 population.

Since most individuals with prescriptions for depression or anxiety drugs (75%) have only one prescription in a given month, we focus on the extensive margin analysis. We have also estimated the effects of major disasters on the number of prescriptions in a given month and compared the two sets of results in Appendix Table B.7. The estimated effects on the number of prescriptions are somewhat larger (1.22 ppt versus 0.81 ppt one to three months after the disaster) suggesting that being exposed to a major disaster in the home country may also increase the number of mental health drugs an individual takes (for example, in addition to anti-depression medication, anti-anxiety medication may be prescribed).

Results presented in columns (1) and (2) of Appendix Table B.8 show that the main findings are not driven solely by one type of mental illness. We find significant increases in both depression and anxiety drug use following a major natural disaster in the home country. The effect on depression drug use is, however, more persistent. In columns (3) and (4) of Appendix Table B.8, we investigate whether the effects of home-country natural disasters are larger for the individuals who were previously treated for mental health conditions.[14] We expect these individuals to be especially vulnerable to shocks such as home-country natural disasters. Among the previously treated individuals, the effects are indeed substantially larger, although the average rate of mental health drug use is also higher.

Columns (5) and (6) of Appendix Table B.8 present the results by the history of home-country natural disasters, more precisely, by whether an individual's home country experienced a disaster that resulted in 1 or more deaths/injuries per 100,000 13-36 months ago.[15] We find that the baseline results are driven by those who did not experience such disaster in the past, but cannot separate the heterogeneity by the history of disasters from the heterogeneity by the country of birth, because only Indonesia and Philippines experienced such disaster in the past. Additionally, the sample size of migrants with a history of home-country natural disasters is small.

[14]For this analysis, we divide this sample by whether or not they were treated with either depression or anxiety drugs 13-24 months ago.

[15]We do not separate the sample by the history of a disaster that resulted in 10 or more deaths/injuries per 100,000, because only Indonesia experienced such disaster twice during the analysis period.

3.1.1 Heterogeneity

We further explore the heterogeneity in the effects of home-country natural disasters on migrant mental health by first checking whether these effects vary by the distance between Australia and the home country.[16] The expected direction of the differential effects is ambiguous. The farther migrants are, the harder it is for them to travel to their home countries to help out in the event of a disaster, which in turn may increase distress. On the other hand, greater distance may reduce the strength of social and familial networks and the exposure to information about the extent of a disaster. The results presented in column (1) of Table 5 provide some support for the first conjecture as a net effect. All interactions are positive, although only two of them are statistically significant.

We construct other proxies for connectedness to the home country and the strength of migrant networks. We do not find any evidence that mental health effects of home-country disasters vary by the time since arrival to Australia (as shown in column 2 of Table 5). However, these results may be explained by the limited variation in the time since arrival to Australia in our sample: most of the migrants arrived in Australia a long time ago and only a small proportion (5%) migrated to Australia in the past 10 years. Migrants with higher levels of social capital[17] are found to be more likely to fill a prescription for mental health drugs after a major disaster in their home country (as shown in column 3 of Table 5). A potential explanation for this result is that people in one's social network may encourage an individual to seek mental health care. As mentioned above, there is general reluctance to seek mental health treatment due to mental illness stigma, which is especially pronounced among migrants (Bharadwaj et al. 2017). In column (4) we investigate whether local networks of migrants from the same country affect how migrants react to a major disaster in the home country. There two potential reasons to expect heterogeneity along this dimension. First, a migrant is likely to have more information about the disaster and its consequences if there are more migrants from the home country in his/her social environment. Second, migrants from the same country can support each other, which may reduce the need to rely on mental health medication. Consequently, the interactions between natural disaster dummies and the size of the local migrant network (as measured by the percentage of home-country population in the local area according to 2006 census) can be positive or negative (or nil). We find that these interactions are negative suggesting that the second effect dominates.[18]

[16] Since Australia is located far away from most countries of the world, the distance to the home country is skewed to the left. Nonetheless, there is sufficient variation in the distance to the countries with major natural disasters in our analysis period: 3,457km to Indonesia, 4,158km New Zealand, 4,437km to Philippines, 7,474km to China, and 6,814km to Sri Lanka, and 12,734km to Chile.

[17] Social capital is measured by an index made up of four measures of social support. More information on the construction of this index is provided in Appendix A.2.

[18] Following Bertrand et al. (2000), we also create an alternative network measure that takes into account not only the size of the network, but also "quality" of the network, the latter measured by the

We also estimate regressions that allow the effects of major disasters on mental health to vary by gender, age, marital status, and education, because these characteristics may affect how migrants react to disasters in their home countries. The results are presented in Appendix Table B.9. We find generally smaller effects for men than women, consistent with men being more prone to mental health stigma and thus less likely to seek treatment (Bharadwaj et al. 2017), but alternative explanations are also possible; for example, men might have a higher threshold for seeking care compared to women. Estimated effects of major disasters are also lower for older individuals (above 70, which is approximately the average in our sample). Older individuals may be less connected to their countries, more likely to feel mental health stigma, or be more resilient. We may expect single individuals to be more affected by disasters in their home countries, because married or partnered individuals can be supported by their partners. Our results are not in line with this conjecture: married or partnered and single migrants are equally affected. The effects of major disasters are found to be lower for migrants with university education, but the interactions are mainly statistically insignificant.

Finally, we have separately estimated the effects of the three types of major disasters to which migrants were exposed: ground movement, tsunami, and tropical cyclones (as detailed in Appendix Table B.2). The results presented in Figure 2 show that all three types of disasters contribute to the baseline results.

3.1.2 Sensitivity analysis

Table 6 shows that our results are not affected by the choice of several alternative model specifications in that the coefficients on home-country disaster indicators remain of similar sizes and statistical significance. For comparison, column (1) presents the results for the base specification that controls for the individual and month-year effects. The estimated effects of home-country disasters are comparable in the balanced panel, presented in column (2)[19]. In contrast, the coefficients are somewhat smaller in magnitude in the specification that includes the country-of-birth instead of individual effects (column 3). Adding country-of-birth linear trends and country-year and country-month effects (in addition to or instead of country-of-birth effects) produces similar results to those in column (3). This suggests a moderate sample selection and supports individual fixed effects model as the preferred specification.

proportion of home-country population in the local area using mental health drugs. We do not find that the effect of home county disasters on migrant mental health would vary by this network measure. Additionally, we find that there is no heterogeneity by home-country GDP. As mentioned earlier, previous findings regarding the effects of home-country GDP on migrant wellbeing are mixed. We do not find evidence of mitigating effects of GDP that would be motivated by GDP acting as a proxy for the speed of recovery. There results are not reported but available upon request.

[19]The balanced panel consists of individuals who purchased prescription drugs with a HCCC in 2005, which implies that they are in the sample in all 110 month-year periods.

Appendix Table B.10 presents additional robustness checks. The results are not affected by (1) excluding potentially deceased people from the sample, (2) including only the migrants from countries that experienced a major disaster, or (3) controlling for the history of mental health drug use. Additionally, Appendix Table B.11 demonstrates that results are robust to excluding each country exposed to a major disaster at a time. Thus, no one country is driving our baseline results.

We next regress other health conditions (psychosis[20], diabetes, cardiovascular disease, and asthma) on the set of home-country disaster indicators. The incidence of these conditions is measured using the data on filled prescriptions, as in the case of mental health. Given that many health conditions, including those listed above, are related to stress, we do not necessarily expect to see nil effects.[21] We do expect, however, home-country disasters to affect these conditions to a smaller extent than mental health conditions. The estimates presented in Figure 3 support this hypothesis. We do not find any statistically significant effects on psychosis, diabetes, or cardiovascular disease up to 12 months after the occurrence of a major disaster in the home country. There are positive, but small and only marginally significant effects on asthma drug use.

We conclude this subsection by applying alternative inference methods. We first address the issue of a relatively small number of clusters in our analyses by applying wild cluster bootstrap method to obtain p-values. In particular we use the wild cluster bootstrap-t procedure, as recommended by Cameron et al. (2008).[22] To implement the procedure we use *boottest* command in Stata 17 (Roodman et al. 2019). These p-values, presented in column (2) of Table 7, are larger than baseline p-values in column (1), but the effects of major disasters are still considered to be statistically significant at the conventional levels up to 7-9 months after the exposure.

Another potential concern is that the usual critical values may be too small in large samples as ours, and Leamer's rule of thumb is proposed as a solution. According to this rule, a coefficient is deemed to be statistically significant if the t-statistic (in absolute value) is greater than $\sqrt{ln(N)}$, where N is the sample size. This value is equal to 3.88 in our case, and the t-statistics on disaster indicators in the last 1-3, 4-6, 7-9, and 10-12 months are equal to 4.419, 3.570, 4.609, and 1.760, respectively. Thus, the indicators for a disaster in the last 1-3 and 7-9 months would be considered statistically significant.

[20]Psychosis is a serious mental health condition, which causes are complex and not completely understood. It is unlikely that exposure to the information about a natural disaster in the home country would cause psychosis, although it could potentially aggravate it.

[21]Stress can be especially harmful to people who are already vulnerable to these conditions.

[22]This procedure involves (1) generating a large number (for example, 999 as we do) pseudo-samples from the original sample; (2) calculating the t-statistic with errors clustered at the country-of-birth for each pseudo-sample; and (3) using the distribution of this t-statistic across all pseudo-samples to make inference about the coefficients on disaster indicators.

Finally, we perform a permutation test (also referred to as randomization inference), in which we assign each individual the natural disaster history of another randomly selected individual in the sample.[23] We then re-estimate the baseline model and save the coefficient estimates. This process is repeated 999 times. We calculate the p-value for each coefficient by calculating the fraction of replications such that $|\hat{\beta}_i| > |\hat{\beta}_{true}|$, $i = 1, \ldots, 999$. Two of these p-values, presented in column (4) of Table 7, are under 0.1 and one is just above 0.1 suggesting (marginally) statistically significant effects up to nine months after a major disaster.[24] We also graph the distributions of the coefficients on home-country disaster indicators after 999 replications in Appendix Figure B.1. The vertical lines correspond to the true coefficients based on the balanced sample presented in column (2) of Table 6. We expect the significant true coefficients to be in the right tails of the corresponding simulated distributions, which is what we find. Hence, this permutation test allows us to cleanly show that the results of randomly assigning someone else's shock does not produce the same results.

Overall, all three alternative inference methods strongly suggest that the effect of a major disaster in the home country has a statistically significant short-term effect on mental health and that this effect may last up to nine months after the disaster.

3.1.3 Mental health specialist visits and medical expenditure

Consistent with the results on mental health drug use, we find an increase in mental health specialist visits following a major natural disaster in the home country. These results are presented in Figure 4. Importantly, we find the effects of major home-country disasters on both concessional and non-concessional individuals.[25] There are some differences in the dynamics of the effects between the two groups. Among concessional individuals, the probability of visiting a mental health specialist increases by 0.31 percentage points (34% relative to the mean) in the first three months following a major home-country disaster, and this effect persists for up to twelve months. Among non-concessional individuals, there is no change in mental health specialist visits immediately after the disaster, but after four to six months the probability of a visit increases by 0.18 percentage points (21% relative to the mean), and this increase also persists up to 12 months. We find comparable effects on both psychiatrist and psychologist visits (results not reported, but available upon request).

[23] For this test, we use the balanced panel.

[24] Baseline p-values in the balanced panel are presented in column (3).

[25] As explained above, for the analysis of mental health drug use we can only use individuals who have a HCCC and thus face a lower co-payment, but we have information on mental health specialist visits for all individuals.

Additionally, we use individuals' monthly expenditure on drugs and primary care (doctor visits and diagnostic tests) as an outcome after adjusting it for inflation and present the results in Appendix Table B.12.[26] We find no statistically significant effects of home country natural disasters on the real expenditure on drugs and primary care. This is not that surprising, because the estimated effects of disasters on mental health drug use are small (ranging from 0.004 to 0.008, as shown in column 3 of panel A in Table 4), and being prescribed mental health drugs increases monthly real expenditure by a moderate amount (A$177). We also create an indicator for the expenditure being greater than median and find consistent results: the coefficients are small but more precisely estimated. The small effects of home-country disasters on the medical expenditure do not imply that we should not care about the negative effects on mental health. To evaluate the full economic cost, the effects of mental health on employment, income and other important outcomes should be considered.

3.2 Comparison to the effects of other home-country events

In this subsection, we compare mental health effects of home-country natural disasters to the effects of other home-country events. First, we estimate the effects of terrorist attacks in home countries using the data from the Global Terrorism Database (National Consortium for the Study of Terrorism and Responses to Terrorism 2022). Major terrorist attacks are similar in nature to major natural disasters in that they are salient, shocking, and largely unpredictable. But terrorist attacks may be more distressing as they are caused by humans. We create indicators for whether attacks of different severity, measured by the number of deaths and injuries, occurred in the home country in the past twelve months. To define the most severe attacks we normalize the number of deaths and injuries by population, but there are few such disasters.[27] Consistent with the results on natural disasters, in Table 8 we find that terrorist attacks increase the use of mental health drugs, but only the effects of major attacks (in which at least 5 persons per 100,000 population are injured or killed) are statistically significant.

We also estimate the effects of macroeconomic conditions, which are expected to have smaller effects on migrant mental health, as measured by prescription drug use. Following the literature (Akay et al. 2017, Nguyen & Connelly 2018), in Table 9 we present the

[26]It is also possible to compute individuals' total medical expenditure including hospital and emergency department (ED) visits, but costing hospitalizations and ED visits would be an involved and imperfect exercise, as explained by Ellis et al. (2012). Since we do not expect to find any meaningful impacts of home country disasters on serious health events requiring hospitalizations or ED visits, we limit our analysis to the expenditure on drugs and primary care.

[27]In our analysis period, there were 15 attacks in which at least 1 person per 100,000 was killed/injured in the 30 home countries we are focusing on (in Lebanon, Sri Lanka, and the UK). Only the attack in Lebanon in August 2013 resulted in more than 5 deaths/injuries per 100,000.

estimated effects of nominal and real gross domestic product (GDP) and inflation (as measured by the consumer price index) on migrant mental health.[28] We do not find any statistically significant effects of home-country GDP and only a small effect of inflation: 1 percentage point increase in inflation is estimated to increase the probability of being prescribed mental health drugs (in a given month) by 0.06 percentage points. Insignificant and smaller effects than in the literature may be explained by the differences in mental health measures. As opposed to self-reported mental health status used in the cited studies, we measure mental health by filled prescriptions of anxiety/depression drugs.

4 Conclusion

This paper explores the spillover health impacts of natural disasters. While natural disasters can cause large losses of life and health in local communities, they can also have widespread impacts by impacting the mental health of migrants from these localities. This paper empirically explores this relationship with detailed, administrative data on mental health doctor visits and prescription drug use from Australia (a country where a large fraction of the population are migrants). We find that natural disasters in the home country increase mental health drug use by 7% and mental health specialist visits by 34%. These impacts suggest that migrants suffer mental health declines when their home country faces losses of life and health through disasters.

Our findings suggest several areas for future research. Our results are reduced form and as such do not identify the mechanism(s) behind these impacts. For example, the mental health response could be the result of additional financial stress on migrants who feel compelled to send more money to their home country in the wake of a natural disaster. A translation of these mental health impacts into economic costs that would say measure work days lost or productivity losses would be a valuable exercise. Having data on remittances sent and hours worked by migrants would be a valuable next step for researchers in this space. We provide suggestive evidence that the effect size of these natural disasters on mental health are somewhere in between the effects of terrorist attacks and macroeconomic shocks. However, terrorist attacks in our sample are relatively rare and we think these comparisons should form the basis for a broader study, involving more countries to fully understand the global mental health toll of such events.

References

45 and Up Study Collaborators (2008), 'Cohort Profile: The 45 and Up Study', *Interna-*

[28] We obtain these data from the World Bank Databank (https://databank.worldbank.org/).

tional Journal of Epidemiology **37**(5), 941–947.

Akay, A., Bargain, O. & Zimmermann, K. F. (2017), 'Home sweet home? macroeconomic conditions in home countries and the well-being of migrants', *Journal of Human Resources* **52**(2), 351–373.

Australian Institute of Health and Welfare (2023), 'Mental health-related prescriptions'. https://www.aihw.gov.au/mental-health/topic-areas/mental-health-prescriptions, accessed on 26 April 2024.

Barrett, A. & Mosca, I. (2013), 'The psychic costs of migration: evidence from irish return migrants', *Journal of Population Economics* **26**(2), 483–506.

Bertrand, M., Luttmer, E. F. P. & Mullainathan, S. (2000), 'Network Effects and Welfare Cultures', *Quarterly Journal of Economics* **115**(3), 1019–1055.

Bharadwaj, P., Pai, M. M. & Suziedelyte, A. (2017), 'Mental health stigma', *Economics Letters* **159**, 57–60.

Bhugra, D. (2004), 'Migration and mental health', *Acta psychiatrica scandinavica* **109**(4), 243–258.

Bogic, M., Njoku, A. & Priebe, S. (2015), 'Long-term mental health of war-refugees: a systematic literature review', *BMC international health and human rights* **15**(1), 29.

Cameron, A. C., Gelbach, J. B. & Miller, D. L. (2008), 'Bootstrap-based improvements for inference with clustered errors', *The review of economics and statistics* **90**(3), 414–427.

CRED (2015), 'EM-DAT, The International Disaster Database'. Centre for Research on the Epidemiology of Disasters (CRED) at the School of Public Health of the Universite Catholique de Louvain, Brussels, Belgium.

Ellis, R., Fiebig, D., Johar, M., Jones, G. & Savage, E. (2012), 'Explaining health care expenditure variation: Large-sample evidence using linked survey and health administrative data'. Economics Discipline Group Working paper No. 1, UTS Business School, University of Technology Sydney.

Iglesias, V., Braswell, A. E., Rossi, M. W., Joseph, M. B., McShane, C., Cattau, M., Koontz, M. J., McGlinchy, J., Nagy, R. C., Balch, J. et al. (2021), 'Risky development: Increasing exposure to natural hazards in the united states', *Earth's future* **9**(7), e2020EF001795.

Johar, M., Jones, G. & Savage, E. (2012), 'Healthcare expenditure profile of older australians: evidence from linked survey and health administrative data', *Economic Papers: A journal of applied economics and policy* **31**(4), 451–463.

Lecerof, S. S., Stafström, M., Westerling, R. & Östergren, P.-O. (2015), 'Does social capital protect mental health among migrants in sweden?', *Health promotion international* **31**(3), 644–652.

Nathan, F. (2009), Natural disasters, vulnerability and human security, *in* 'Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts', Springer, pp. 1121–1129.

National Consortium for the Study of Terrorism and Responses to Terrorism (2022), 'Global terrorism database, 1970 - 2020 [data file]'. https://www.start.umd.edu/gtd.

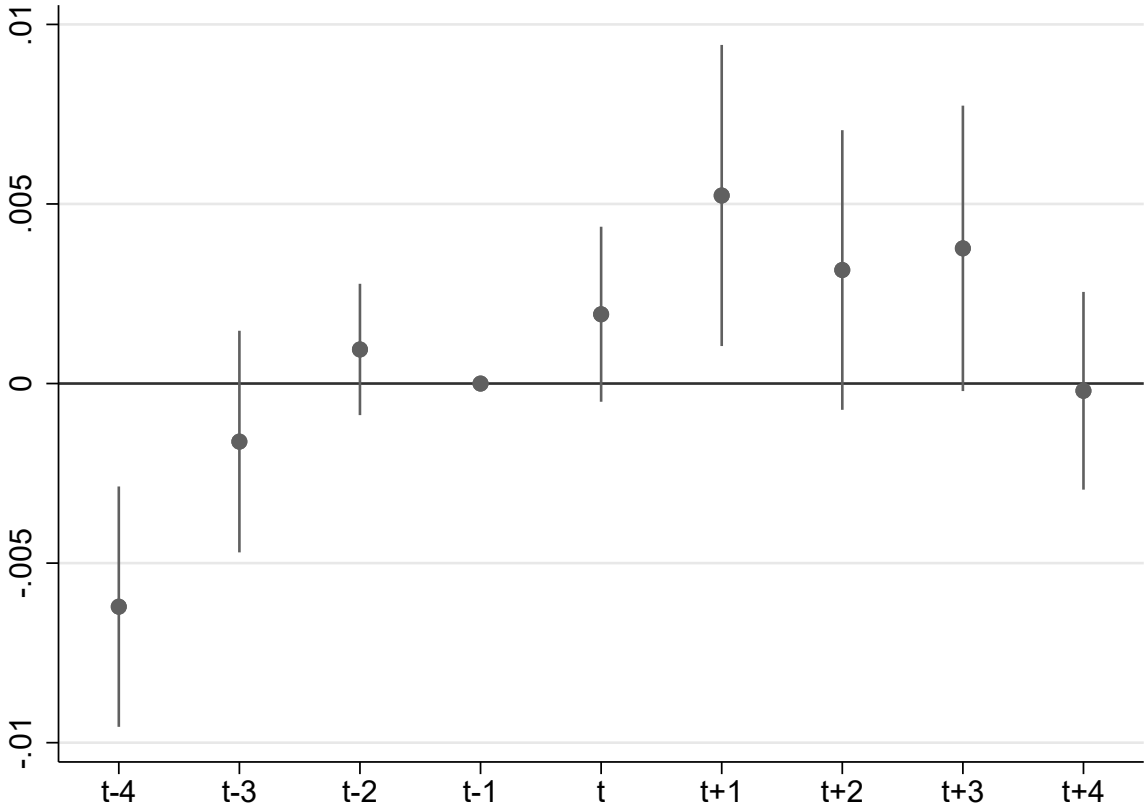
Nguyen, H. T. & Connelly, L. B. (2018), 'Out of sight but not out of mind: Home countries' macroeconomic volatilities and immigrants' mental health', *Health Economics* **27**(1), 189–208.

Roodman, D., Nielsen, M. Ø., MacKinnon, J. G. & Webb, M. D. (2019), 'Fast and wild: Bootstrap inference in stata using boottest', *The Stata Journal* **19**(1), 4–60.

Stillman, S., McKenzie, D. & Gibson, J. (2009), 'Migration and mental health: Evidence from a natural experiment', *Journal of health economics* **28**(3), 677–687.

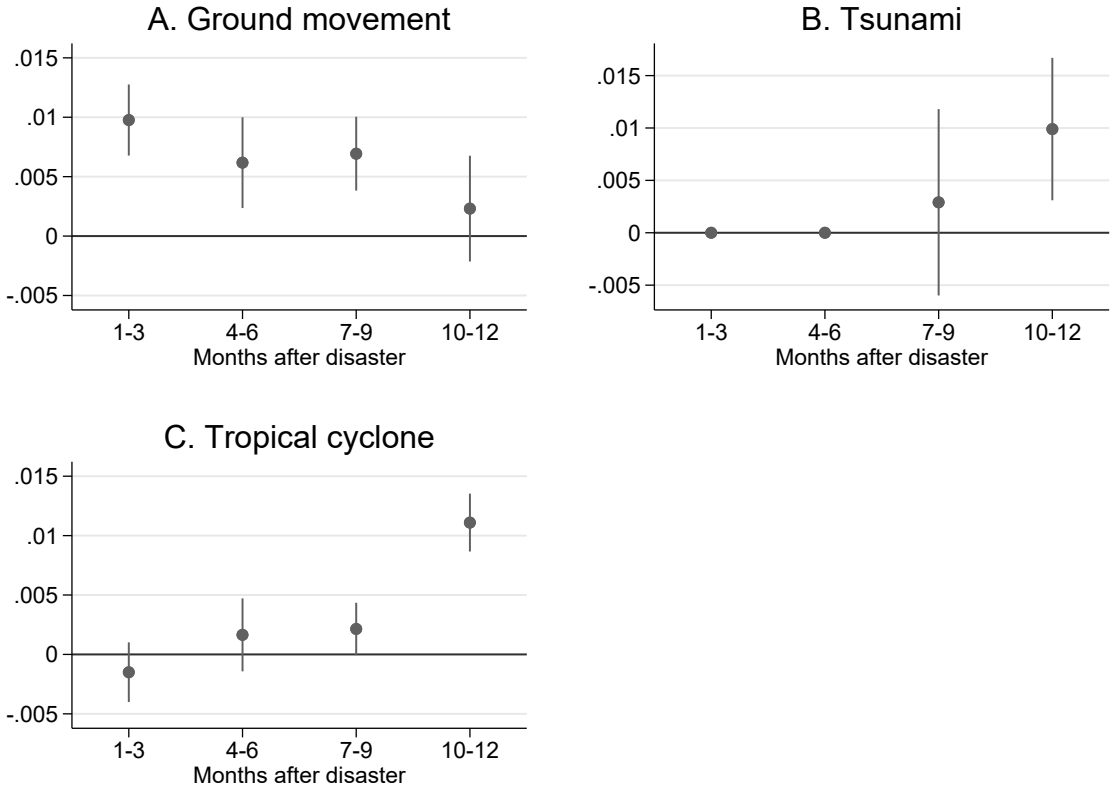
Yang, H., Dietz, T., Yang, W., Zhang, J. & Liu, J. (2018), 'Changes in human well-being and rural livelihoods under natural disasters', *Ecological Economics* **151**, 184–194.

FIGURE 1: Timing of major home-country disasters and migrant mental health drug use



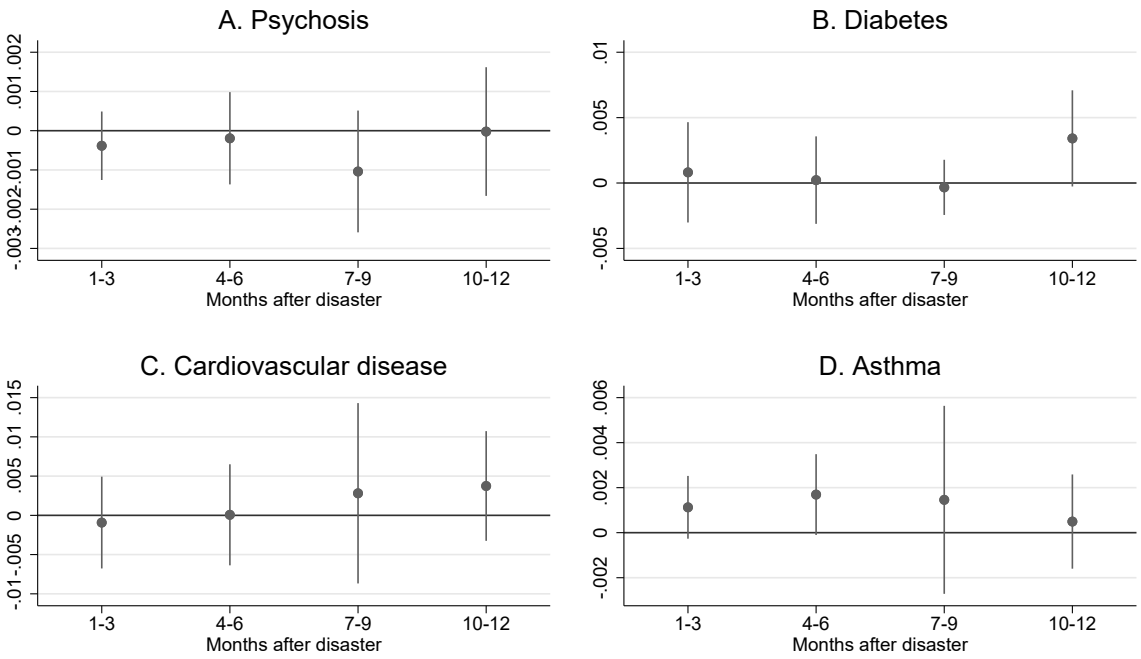
Notes: The figure is based on column (3) of Appendix Table B.4. The circles represent the differences between the coefficients on the indicators for a disaster in next/last X-Y months and the coefficient on the indicator for a disaster in next 1-3 months, and the vertical lines represent the associated 95% confidence intervals. The sample consists of concessional individuals from 30 largest migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. The regression is estimated by fixed effects and controls for month-year effects. Standard errors are clustered at the country-of-birth.

FIGURE 2: Major home-country disasters and migrant mental health drug use: heterogeneity by type of disaster



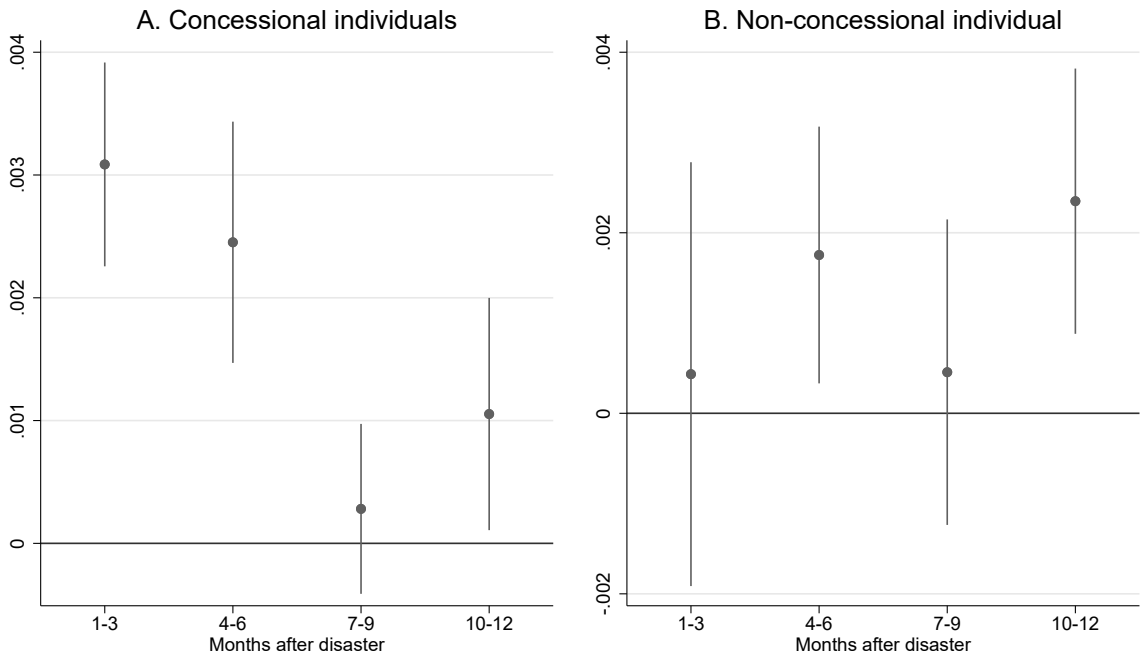
Notes: The circles represent the coefficient estimates, and the vertical lines represent the associated 95% confidence intervals. The sample consists of concessional individuals from the 30 largest Australian migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth.

FIGURE 3: Major home-country disasters and other drug use by migrants



Notes: The circles represent the coefficient estimates, and the vertical lines represent the associated 95% confidence intervals. The sample consists of concessional individuals from the 30 largest Australian migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth.

FIGURE 4: Major home-country disasters and mental health specialist visits by migrants



Notes: The circles represent the coefficient estimates, and the vertical lines represent the associated 95% confidence intervals. The sample consists of individuals from the 30 largest Australian migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population.

TABLE 1: Summary statistics: Concessional vs non-concessional individuals

	Non-concessional	Concessional
	(1)	(2)
First-generation migrant	0.236	0.247
Male	0.469	0.460
Age	57.506	70.915
University degree	0.351	0.135
Bottom quartile of annual HH income (< $20k)	0.044	0.441
Bottom SEIFA quintile	0.073	0.121
Individual-month-year observations	13,149,552	15,707,408
Individuals	164,774	167,394

Notes: The table is based on the records with non-missing information on HCCC status either in the survey or administrative data. HH stands for household. SEIFA stands for the SEIFA Index of Relative Socioeconomic Advantage and Disadvantage, which is a measure of the socioeconomic status of the local areas in Australia. The sum of individuals in columns (1) and (2) is greater than the number of individuals in the 45 & Up survey, because many individuals switch from non-concessional to concessional status when they age.

TABLE 2: Summary statistics: natives vs migrants

	Australia-born	All migrants	47 largest migrant groups	30 largest migrant groups
	(1)	(2)	(3)	(4)
Male	0.447	0.501	0.500	0.501
Age	70.708	71.544	71.720	71.831
University degree	0.121	0.176	0.173	0.172
Bottom HH income quartile	0.428	0.482	0.477	0.471
Bottom SEIFA quintile	0.129	0.098	0.096	0.095
Any MH drugs>0	0.140	0.118	0.119	0.119
Depression/Anxiety drugs>0	0.136	0.114	0.115	0.115
Depression drugs>0	0.108	0.085	0.085	0.086
Anxiety drugs>0	0.040	0.040	0.040	0.040
MH professional visits>0	0.009	0.010	0.009	0.009
Psychiatrist visits>0	0.004	0.005	0.005	0.004
Psychologist visits>0	0.005	0.005	0.005	0.005
Individual-month-year observations	11,826,138	3,881,270	3,675,630	3,464,152
Individuals	126,085	41,309	39,165	36,940

Notes: The sample consists of concessional individuals (HCCC holders). MH stands for mental health; HH stands for household. SEIFA stands for the SEIFA Index of Relative Socioeconomic Advantage and Disadvantage and is a measure of the socioeconomic status of the local areas in Australia. In columns (3) and (4), 47 and 30 largest migrant groups include migrants from countries with at least 100 and 200 individuals in the sample, respectively.

TABLE 3: Monthly incidence of natural disasters, percent

	All migrants	47 largest migrant groups	30 largest migrant groups
	(1)	(2)	(3)
Natural disaster	20.03	21.14	20.48
Dead/injured per 100,000 $\geq$ 1	1.10	1.12	1.11
Dead/injured per 100,000 $\geq$ 5	0.22	0.20	0.21
Dead/injured per 100,000 $\geq$ 10	0.14	0.13	0.14
Geophysical	0.10	0.11	0.11
Climatological	0.00	0.00	0.00
Hydrological	0.00	0.00	0.00
Meteorological	0.03	0.02	0.03
Affected pop $\geq$1%	1.04	1.08	1.02
Affected pop $\geq$5%	0.33	0.34	0.32
Affected pop $\geq$10%	0.07	0.06	0.06
Individual-month-year observations	3,881,270	3,675,630	3,464,152
Individuals	41,309	39,165	36,940

Notes: The sample consists of concessional individuals (HCCC holders). In columns (2) and (3), 47 and 30 largest migrant groups include migrants from countries with at least 100 and 200 individuals in the sample, respectively. Geophysical disasters are earthquakes, mass movements, and volcanic activities. Climatological disasters are wildfires. Hydrological disasters are floods and landslides. Meteorological disasters are storms and extreme temperatures. Affected individuals include dead, injured, left homeless, or requiring assistance.

TABLE 4: Major home-country disasters (as measured by deaths/injuries per 100,000) and migrant mental health drug use

	≥1/100,000 deaths/injuries		≥5/100,000 deaths/injuries		≥10/100,000 deaths/injuries	
	(1)		(2)		(3)	
A. 30 largest migrant groups						
Disaster in last...						
1-3 months	0.0025**	(0.0011)	0.0059**	(0.0026)	0.0081***	(0.0019)
4-6 months	0.0036***	(0.0010)	0.0039*	(0.0019)	0.0056***	(0.0017)
7-9 months	0.0035***	(0.0009)	0.0046***	(0.0016)	0.0063***	(0.0015)
10-12 months	0.0024***	(0.0008)	0.0023	(0.0019)	0.0040*	(0.0023)
13-15 months	0.0017*	(0.0009)	0.0006	(0.0023)	0.0015	(0.0034)
16-18 months	0.0018**	(0.0008)	0.0018	(0.0026)	0.0043	(0.0034)
Mean (dep var)	0.1152		0.1152		0.1152	
Sample size	3,464,152		3,464,152		3,464,152	
B. All migrant groups						
Disaster in last...						
1-3 months	0.0019*	(0.0010)	0.0046**	(0.0022)	0.0056**	(0.0021)
4-6 months	0.0026***	(0.0010)	0.0028*	(0.0016)	0.0037**	(0.0017)
7-9 months	0.0029***	(0.0009)	0.0036**	(0.0015)	0.0049***	(0.0015)
10-12 months	0.0018**	(0.0008)	0.0010	(0.0018)	0.0016	(0.0025)
13-15 months	0.0019**	(0.0009)	0.0002	(0.0022)	−0.0001	(0.0035)
16-18 months	0.0013	(0.0008)	0.0011	(0.0023)	0.0026	(0.0031)
Mean (dep var)	0.1140		0.1140		0.1140	
Sample size	3,881,270		3,881,270		3,881,270	

Notes: The sample consists of concessional individuals. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE 5: Major home-country disasters and migrant mental health drug use: heterogeneity by connectedness and strength of social networks

	Distance to HC, 1000km	Years since arrival	Social capital index	HC population in postcode, %
Disaster in last...	(1)	(2)	(3)	(4)
1-3 months	0.0097***	0.0072***	0.0086***	0.0095***
	(0.0018)	(0.0016)	(0.0019)	(0.0024)
4-6 months	0.0062**	0.0058***	0.0058***	0.0075***
	(0.0025)	(0.0016)	(0.0014)	(0.0019)
7-9 months	0.0079***	0.0054***	0.0067***	0.0071***
	(0.0021)	(0.0017)	(0.0014)	(0.0016)
10-12 months	0.0043	0.0020	0.0039*	0.0057***
	(0.0036)	(0.0019)	(0.0021)	(0.0020)
1-3 months × X	0.0014*	0.0001	0.0096**	−0.0005*
	(0.0007)	(0.0001)	(0.0041)	(0.0003)
4-6 months × X	0.0007	0.0001	0.0032***	−0.0008*
	(0.0011)	(0.0001)	(0.0010)	(0.0004)
7-9 months × X	0.0015*	−0.0000	0.0015	−0.0005
	(0.0008)	(0.0001)	(0.0033)	(0.0003)
10-12 months × X	0.0005	−0.0001	0.0010	−0.0009***
	(0.0015)	(0.0001)	(0.0016)	(0.0002)
Mean (dep var)	0.1152	0.1147	0.1153	0.1153
Sample size	3,264,338	3,464,152	3,234,454	3,448,538

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. HC stands for home country; X stands for the migrant characteristic that is interacted with disaster dummies, as indicated by column headings. Distance to HC and Years since arrival are demeaned. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE 6: Major home-country disasters and migrant mental health drug use: alternative model specifications

	Individual FE	Balanced panel	CoB FE	CoB trends	CoB-yr & CoB-mo FE
Disaster in last...	(1)	(2)	(3)	(4)	(5)
1-3 months	0.0080***	0.0091***	0.0061***	0.0072***	0.0047**
	(0.0018)	(0.0019)	(0.0016)	(0.0013)	(0.0022)
4-6 months	0.0055***	0.0055**	0.0036**	0.0048***	0.0035***
	(0.0015)	(0.0023)	(0.0015)	(0.0015)	(0.0010)
7-9 months	0.0061***	0.0067**	0.0041***	0.0049***	0.0052**
	(0.0013)	(0.0030)	(0.0014)	(0.0016)	(0.0020)
10-12 months	0.0038*	0.0032	0.0011	0.0016	0.0019*
	(0.0021)	(0.0038)	(0.0021)	(0.0027)	(0.0011)
Mean (dep var)	0.1152	0.1397	0.1152	0.1152	0.1152
Sample size	3,464,152	2,345,970	3,464,152	3,464,152	3,464,152

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. A major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. Regressions in columns (1) and (2) are estimated by fixed effects. Regressions in columns (3) to (5) control for country-of-birth effects. Additionally, regressions in columns (1) to (3) control for month-year effects, regression in column (4) controls for the country-of-birth and year interaction and month-year effects, and regression in column (5) controls for country-year and country-month effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE 7: P-values under alternative inference methods

	Analysis sample (unbalanced panel)		Balanced panel	
	Baseline	Wild bootstrap	Baseline	Permutation test
Disaster in last...	(1)	(2)	(3)	(4)
1-3 months	0.0001	0.0661	0.0000	0.0170
4-6 months	0.0013	0.0300	0.0211	0.1301
7-9 months	0.0001	0.0300	0.0337	0.0981
10-12 months	0.0889	0.2012	0.4142	0.3934
Sample size	3,464,152	3,464,152	2,345,970	2,345,970

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. The table presents the p-values associated with the coefficients on major disaster indicators. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed effects and control for month-year effects.

TABLE 8: Terrorist attacks in home countries and mental health drug use by migrants

	Deaths/injuries			Deaths/injuries per 100,000	
	≥1	≥10	≥100	≥1	≥5
Terrorist attack in last...	(1)	(2)	(3)	(4)	(5)
1-3 months	−0.0007*	0.0014	0.0028	0.0045	0.0225***
	(0.0004)	(0.0018)	(0.0021)	(0.0042)	(0.0010)
4-6 months	−0.0009**	−0.0001	0.0012	0.0016	0.0079***
	(0.0003)	(0.0013)	(0.0014)	(0.0013)	(0.0013)
7-9 months	−0.0004	−0.0003	0.0017	0.0017	0.0141***
	(0.0005)	(0.0012)	(0.0010)	(0.0011)	(0.0016)
10-12 months	−0.0008*	−0.0002	−0.0000	−0.0016	0.0023*
	(0.0004)	(0.0011)	(0.0013)	(0.0015)	(0.0011)
13-15 months	−0.0005	−0.0016	0.0002	−0.0025	−0.0065***
	(0.0004)	(0.0012)	(0.0016)	(0.0016)	(0.0012)
16-18 months	0.0000	−0.0007	0.0026**	−0.0003	
	(0.0006)	(0.0017)	(0.0012)	(0.0016)	
Mean (dep var)	0.1152	0.1152	0.1152	0.1152	0.1152
Sample size	3,464,152	3,464,152	3,464,152	3,464,152	3,464,152

Notes: The sample consists of individuals from the 30 largest Australian migrant groups. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE 9: Macroeconomic conditions in home countries and mental health drug use by migrants

	(1)		(2)		(3)	
Log(real GDP) t	−0.0115	(0.0173)				
Log(real GDP) t-1	0.0021	(0.0148)				
Log(nominal GDP) t			0.0025	(0.0060)		
Log(nominal GDP) t-1			−0.0074	(0.0046)		
Inflation t					0.0006**	(0.0003)
Inflation t-1					0.0005**	(0.0002)
Mean (dep var)	0.1152		0.1152		0.1152	
Sample size	3,464,152		3,464,152		3,440,188	

Notes: The sample consists of individuals from the 30 largest Australian migrant groups. Real GDP is measured in constant (2010) US dollars. Nominal GDP is measured in current US dollars. Inflation is measured by the consumer price index (in percentages). All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. ** denotes statistical significance at the 5% level.

Online Appendix for "Home-Country Natural Disasters and Mental Health of Migrants"

A Data Appendix

A.1 Identifying drugs for particular conditions

Table A.1: ATC codes used to identify drugs for different health conditions

Disease/Health Condition	ATC codes
Depression	N06AXXX, N06CXXX
Anxiety	N05BXXX, N05CXXX
Psychosis	N05AXXX
Cardiovascular diseases	CXXXXXX
Diabetes	A10XXXX
Asthma	R03XXXX

A.2 Constructing the social capital index

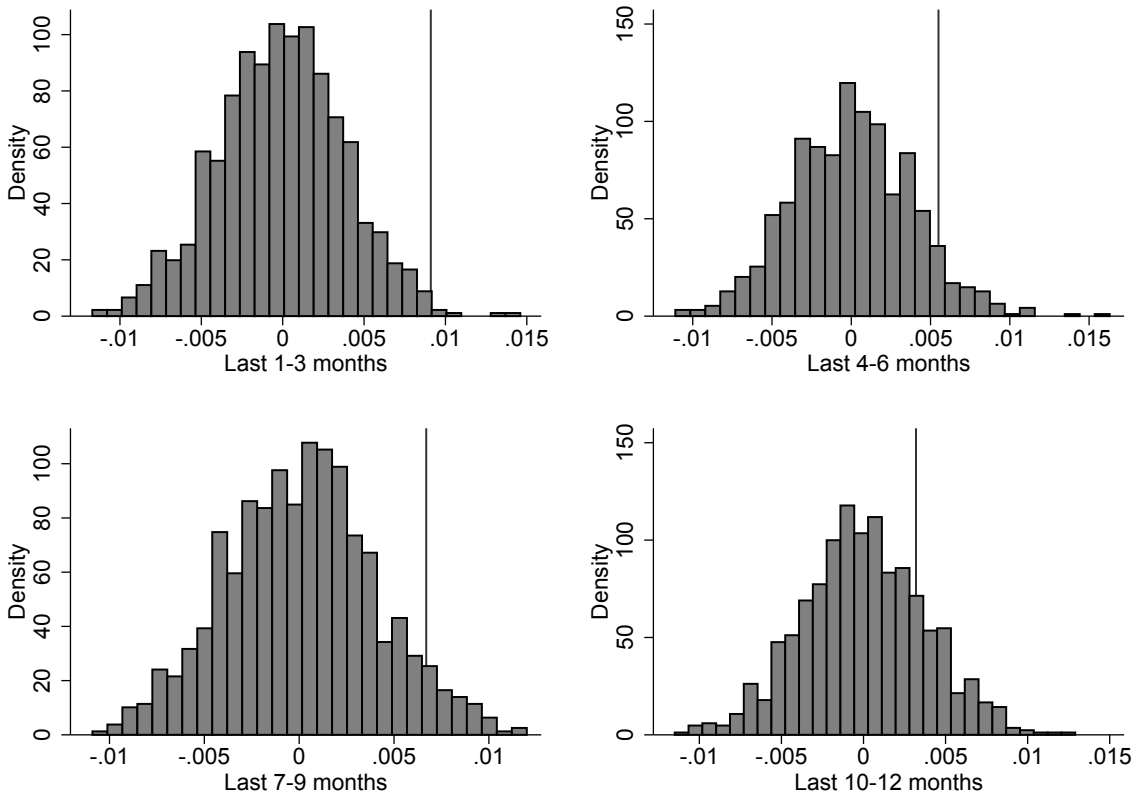
The social capital index is based on four survey questions:

1. How many times in the last week did you:
   (a) spend time with friends or family who do not live with you?
   (b) talk to someone (friends, relatives or others) on the telephone?
   (c) go to meetings of social clubs, religious groups or other groups you belong to?
2. How many people outside your home, but within one hour of travel, do you feel you can depend on or feel very close to?

All questions are open-ended, that is, respondents can provide any numbers. We aggregate the information contained in these questions using principal component factor analysis. One factor with eigenvalue greater than one is produced. By definition the social capital factor (index) has mean zero and a standard deviation equal to one.

B Additional figures and tables

Figure B.1: Major home-country disasters and migrant mental health drug use: permutation test



Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups observed throughout the analysis period (balanced sample). The sample size is 2,345,970. The permutation test is based on 999 replications. In each replication, individuals are randomly assigned to the natural disaster history of another individual in the sample. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed-effects and control for month-year effects. The vertical lines represent the "true" coefficients, presented in column (2) of Table **??**.

TABLE B.1: 30 largest Australian migrant groups

				Disasters w/ deaths/injuries		
	Persons	%	Cum %	$\geq$ 1/100k	$\geq$ 5/100k	$\geq$ 10/100k
United Kingdom	17001	41.14	41.14	1	0	0
New Zealand	2764	6.69	47.83	2	1	1
Germany	2042	4.94	52.77	0	0	0
Netherlands	2015	4.88	57.65	1	1	0
Italy	1549	3.75	61.39	1	0	0
China	1136	2.75	64.14	4	1	1
Ireland	750	1.81	65.96	0	0	0
Philippines	707	1.71	67.67	9	2	1
Malta	670	1.62	69.29	0	0	0
Greece	635	1.54	70.83	2	0	0
India	635	1.54	72.36	1	0	0
South Africa	625	1.51	73.88	0	0	0
Vietnam	599	1.45	75.32	2	0	0
Lebanon	545	1.32	76.64	0	0	0
United States of America	523	1.27	77.91	0	0	0
Poland	476	1.15	79.06	0	0	0
Egypt	469	1.13	80.20	0	0	0
Hungary	432	1.05	81.24	3	1	0
Austria	413	1.00	82.24	0	0	0
Croatia	336	0.81	83.05	0	0	0
Indonesia	294	0.71	83.77	5	2	2
Canada	282	0.68	84.45	0	0	0
Fiji	281	0.68	85.13	2	0	0
Malaysia	281	0.68	85.81	1	0	0
Sri Lanka	276	0.67	86.48	1	1	1
Hong Kong	269	0.65	87.13	1	0	0
Chile	266	0.64	87.77	3	1	1
Czech Republic	245	0.59	88.36	0	0	0
France	214	0.52	88.88	1	0	0
Korea, Republic of (South)	210	0.51	89.39	0	0	0

Notes: A "large" migrant group is defined by the presence of at least 200 concessional individuals from the country in the sample. The last three columns report the incidence of major disasters as defined by deaths/injuries per 100,000 population during the analysis period September 2004 to September 2014.

TABLE B.2: Major home-country disasters in analysis period affecting Australian migrants from 30 largest migrant groups

Disaster type	Country	Locations	Date	Deaths	Injuries	In need of assistance	Homeless	Deaths/ injuries per 100,000	Percent population affected
Tsunami	Indonesia	Aceh province (Nangroe Aceh Darussalam) (Sumatra), Sumatera Utara	26-Dec-04	165,708	0	0	532,898	74	0.31
Tsunami	Sri Lanka	Jaffna, Kilinochchi, Mullaitivu, Trincomalee, Batticaloa, Ampara, Hambanthota, Matara, Galle, Kalutara, Colombo, Gampaha, Puttalam,Vavuniya districts	26-Dec-04	35,399	23,176	516,130	480,000	305	5.49
Ground movement	Indonesia	Yogyakarta, Central Java	27-May-06	5,778	137,883	2,340,745	699,295	63	1.39
Ground movement	China	Wenchuan country, Wenchuan, Beichuan, Deyang, Mianyang, Yingxiu (Wenchuan), Mianzhu, Chengdu, Aba (Ava prefecture, Sichuan province), Gansu, Shaanxi, Chongqing, Yunnan, Shanxi, Guizhou, Hubei, Hunan, Henan provinces	12-May-08	87,476	366,596	45,610,000	0	34	3.48
Ground movement	Chile	Concepcion (Biobio province); O'Higgins; Valparaiso; La Araucania; Metropolitana Santiago; Maule	27-Feb-10	562	10,334	1,861,222	800,000	64	15.70
Ground movement	New Zealand	Christchurch	22-Feb-11	181	1,500	300,000	0	38	6.88
Tropical cyclone	Philippines	Samar, Leyte, Cebu, Iloilo, Capiz, Aklan and Palawan provinces	8-Nov-13	7,354	28,689	16,078,181	0	37	16.52

Source: EM-DAT.

TABLE B.3: Magnitude of home-country disasters and migrant mental health drug use

Disaster that caused:	30 largest migrant groups		All migrants	
<1/100,000 deaths/injuries				
1-3 months ago	0.0008*	(0.0004)	0.0007	(0.0004)
4-6 months ago	0.0005	(0.0004)	0.0004	(0.0004)
7-9 months ago	0.0003	(0.0005)	0.0003	(0.0005)
1 - <10/100,000 deaths/injuries				
10-12 months ago	0.0008**	(0.0003)	0.0006*	(0.0003)
1-3 months ago	0.0014	(0.0014)	0.0012	(0.0012)
4-6 months ago	0.0032**	(0.0013)	0.0024*	(0.0013)
7-9 months ago	0.0031**	(0.0013)	0.0027**	(0.0012)
10-12 months ago	0.0025**	(0.0011)	0.0021*	(0.0011)
≥10/100,000 deaths/injuries				
1-3 months ago	0.0086***	(0.0017)	0.0061***	(0.0019)
4-6 months ago	0.0054***	(0.0016)	0.0036***	(0.0013)
7-9 months ago	0.0054***	(0.0017)	0.0044***	(0.0014)
10-12 months ago	0.0027	(0.0025)	0.0008	(0.0023)
Mean (dep var)	0.1152		0.1140	
Sample size	3,464,152		3,881,270	

Notes: The sample consists of concessional individuals. Omitted categories are no disaster in last 1-3, 4-6, 7-9, and 10-12 months, respectively. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.4: Future home-country disasters and migrant mental health drug use

	≥1/100,000 deaths/injuries		≥5/100,000 deaths/injuries		≥10/100,000 deaths/injuries	
	(1)		(2)		(3)	
Disaster in ...						
next 10-12 months	0.0005	(0.0009)	−0.0032**	(0.0013)	−0.0032**	(0.0013)
next 7-9 months	0.0013	(0.0010)	0.0002	(0.0021)	0.0014	(0.0012)
next 4-6 months	0.0016	(0.0014)	−0.0003	(0.0036)	0.0039	(0.0023)
next 1-3 months	0.0031**	(0.0013)	0.0018	(0.0025)	0.0030	(0.0019)
current month	0.0028**	(0.0013)	0.0033	(0.0035)	0.0049*	(0.0024)
last 1-3 months	0.0025**	(0.0011)	0.0055*	(0.0030)	0.0082***	(0.0020)
last 4-6 months	0.0036***	(0.0010)	0.0036	(0.0022)	0.0061***	(0.0019)
last 7-9 months	0.0029***	(0.0010)	0.0043**	(0.0017)	0.0067***	(0.0015)
last 10-12 months	0.0013	(0.0010)	0.0014	(0.0021)	0.0028	(0.0021)
Mean (dep var)	0.1159		0.1159		0.1159	
Sample size	3,094,752		3,094,752		3,094,752	

Notes: The sample consists of concessional individuals from 30 largest migrant groups. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.5: Any home-country disaster and migrant mental health drug use

	(1)		(2)	
Any disaster in last...				
1-3 months	0.0011**	(0.0005)		
4-6 months	0.0009*	(0.0005)		
7-9 months	0.0007	(0.0005)		
10-12 months	0.0010***	(0.0003)		
13-15 months	0.0004	(0.0004)		
16-18 months	0.0001	(0.0004)		
Number of disasters in last...				
1-3 months			0.0004	(0.0002)
4-6 months			0.0002	(0.0002)
7-9 months			0.0002	(0.0003)
10-12 months			−0.0000	(0.0002)
13-15 months			−0.0002	(0.0001)
16-18 months			−0.0002	(0.0002)
Mean (dep var)	0.1152		0.1152	
Sample size	3,464,152		3,464,152	

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.6: Major home-country disasters (as measured by percentage of population affected) and migrant mental health drug use

	Affected ≥1%		Affected ≥5%		Affected ≥10%	
Disaster in last...	(1)		(2)		(3)	
1-3 months	0.0007	(0.0014)	0.0016	(0.0017)	0.0027	(0.0035)
4-6 months	0.0001	(0.0015)	0.0018	(0.0023)	0.0029	(0.0035)
7-9 months	0.0019	(0.0012)	0.0045***	(0.0010)	0.0049	(0.0042)
10-12 months	0.0003	(0.0013)	0.0001	(0.0010)	0.0041	(0.0048)
13-15 months	0.0013**	(0.0006)	0.0014	(0.0010)	0.0016	(0.0049)
16-18 months	0.0006	(0.0011)	0.0003	(0.0025)	0.0059	(0.0069)
Mean (dep var)	0.1152		0.1152		0.1152	
Sample size	3,464,152		3,464,152		3,464,152	

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Affected individuals include dead, injured, left homeless, or requiring assistance. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.7: Major home-country disasters and migrant mental health drug use: extensive versus intensive margin

	MH drug prescriptions > 0		# of MH drug prescriptions	
Disaster in last...	(1)		(2)	
1-3 months	0.0081***	(0.0019)	0.0122***	(0.0030)
4-6 months	0.0056***	(0.0017)	0.0101***	(0.0034)
7-9 months	0.0063***	(0.0015)	0.0098***	(0.0025)
10-12 months	0.0040*	(0.0023)	0.0077**	(0.0035)
13-15 months	0.0015	(0.0034)	0.0024	(0.0054)
16-18 months	0.0043	(0.0034)	0.0075	(0.0051)
Mean (dep var)	0.1152		0.1556	
Sample size	3,464,152		3,464,152	

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.8: Major home-country disasters and migrant mental health drug use: heterogeneity by type of illness, history of illness and history of disaster

			History of illness		History of disaster	
	Depression	Anxiety	Yes	No	Yes	No
Disaster in last...	(1)	(2)	(3)	(4)	(5)	(6)
1-3 months	0.0058**	0.0043***	0.0300***	0.0021	0.0010	0.0083***
	(0.0024)	(0.0011)	(0.0046)	(0.0029)	(0.0046)	(0.0018)
4-6 months	0.0057***	0.0004	0.0136***	0.0032***	0.0062	0.0048*
	(0.0015)	(0.0011)	(0.0043)	(0.0008)	(0.0042)	(0.0024)
7-9 months	0.0056***	0.0019**	0.0121**	0.0047**	0.0033	0.0064***
	(0.0010)	(0.0009)	(0.0050)	(0.0022)	(0.0022)	(0.0023)
10-12 months	0.0036***	0.0017	0.0026	0.0030**	0.0052*	0.0029
	(0.0007)	(0.0023)	(0.0107)	(0.0013)	(0.0026)	(0.0035)
Mean (dep var)	0.0856	0.0401	0.4142	0.0218	0.0958	0.1183
Sample size	3,464,152	3,464,152	116,887	2,172,904	468,650	2,995,502

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. Individuals with a history of mental illness are defined as those with a prescription for depression/anxiety drugs 13-24 months ago. Individuals with history of a natural disaster are defined as those whose home country experienced a disaster that resulted in at least 1 death/injury per 100,000 13-36 months ago. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.9: Major home-country disasters and migrant mental health drug use: heterogeneity by demographic characteristics

	Male	Age > 70	Single	University education
Disaster in last...	(1)	(2)	(3)	(4)
1-3 months	0.0072***	0.0087***	0.0069***	0.0084***
	(0.0023)	(0.0023)	(0.0020)	(0.0019)
4-6 months	0.0076***	0.0096***	0.0060***	0.0061***
	(0.0022)	(0.0019)	(0.0013)	(0.0010)
7-9 months	0.0100***	0.0075***	0.0062***	0.0077***
	(0.0029)	(0.0014)	(0.0010)	(0.0018)
10-12 months	0.0062**	0.0067**	0.0045	0.0036**
	(0.0023)	(0.0030)	(0.0028)	(0.0014)
1-3 months × X	0.0017	−0.0017	0.0039	−0.0034
	(0.0020)	(0.0021)	(0.0060)	(0.0026)
4-6 months × X	−0.0048*	−0.0090***	−0.0016	−0.0030
	(0.0028)	(0.0016)	(0.0033)	(0.0036)
7-9 months × X	−0.0089	−0.0031**	0.0004	−0.0071*
	(0.0053)	(0.0013)	(0.0018)	(0.0040)
10-12 months × X	−0.0054**	−0.0061	−0.0018	−0.0005
	(0.0025)	(0.0055)	(0.0049)	(0.0039)
Mean (dep var)	0.1152	0.1152	0.1150	0.1146
Sample size	3,464,152	3,464,152	3,394,398	3,368,834

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. X stands for the migrant characteristic that is interacted with the disaster indicators, as indicated by column headings. Single includes never married, widowed, separated, and divorced individuals. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.10: Major home-country disasters and migrant mental health drug use: additional robustness checks

Disaster in last...	(1)	(2)	(3)	(4)
1-3 months	0.0080***	0.0073**	0.0082***	0.0082***
	(0.0018)	(0.0035)	(0.0013)	(0.0015)
4-6 months	0.0055***	0.0052*	0.0072**	0.0054***
	(0.0015)	(0.0026)	(0.0018)	(0.0009)
7-9 months	0.0061***	0.0061**	0.0072**	0.0070***
	(0.0013)	(0.0027)	(0.0018)	(0.0010)
10-12 months	0.0038*	0.0032*	0.0051**	0.0042*
	(0.0021)	(0.0016)	(0.0019)	(0.0022)
Potentially dead excluded	No	Yes	No	No
Only countries with major disaster	No	No	Yes	No
Controls for past MH drug use	No	No	No	Yes
Mean (dep var)	0.1152	0.1212	0.0925	0.1151
Sample size	3,464,152	3,145,536	473,028	2,857,132

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Column (1) presents baseline results. In column (2) potentially dead are excluded from the sample (see the text for the definition). In column (3), only the migrants from the countries that experienced a major disaster between September 2004 and September 2014 are included. In column (4), the regression controls for the use of depression/anxiety drugs 13-24 months ago. A major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.11: Major home-country disasters and migrant mental health drug use: sensitivity to exclusion of countries

	Excluded country					
	IDN	LKA	CHN	CHL	NZL	PHL
Disaster in last...	(1)	(2)	(3)	(4)	(5)	(6)
1-3 months	0.0075***	0.0080***	0.0079***	0.0071***	0.0076*	0.0097***
	(0.0018)	(0.0018)	(0.0022)	(0.0018)	(0.0039)	(0.0015)
4-6 months	0.0046***	0.0054***	0.0066***	0.0048***	0.0054	0.0061***
	(0.0013)	(0.0015)	(0.0018)	(0.0014)	(0.0036)	(0.0019)
7-9 months	0.0062***	0.0061***	0.0066***	0.0050***	0.0060**	0.0068***
	(0.0014)	(0.0013)	(0.0016)	(0.0010)	(0.0028)	(0.0015)
10-12 months	0.0034	0.0037	0.0060***	0.0028	0.0042	0.0030
	(0.0023)	(0.0022)	(0.0022)	(0.0019)	(0.0047)	(0.0021)
Mean (dep var)	0.1155	0.1155	0.1173	0.1152	0.1151	0.1164
Sample size	3,436,308	3,438,408	3,357,024	3,439,612	3,218,224	3,399,834

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Migrants from each of six countries that experienced major disasters are excluded from the sample in a respective column. IDN stands for Indonesia, LKA for Sri Lanka, CHN for China, CHL for Chile, NZL for New Zealand, and PHL for Philippines. A major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. All regressions are estimated by fixed effects and control for month-year effects. Standard errors are clustered at the country-of-birth and presented in parentheses. * denotes statistical significance at the 10% level, ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.

TABLE B.12: Major home-country disasters and migrants' monthly expenditure on drugs and primary care

	Expenditure, 2011-12 A$		Expenditure > median	
Disaster in last...	(1)		(2)	
1-3 months	4.136	(11.320)	0.002	(0.004)
4-6 months	0.344	(11.355)	0.010**	(0.004)
7-9 months	5.581	(7.372)	0.006***	(0.002)
10-12 months	−0.597	(4.831)	0.002	(0.005)
Mean (dep var)	295.28		0.49	
Sample size	3,464,152	3,464,152		

Notes: The sample consists of concessional individuals from the 30 largest Australian migrant groups. Standard errors are clustered at the country-of-birth and presented in parentheses. Major disaster is defined as a disaster that caused 10 or more deaths or injuries per 100,000 population. Expenditure includes expenditures on drugs and primary care in a given month. It is adjusted for inflation using quarterly CPI; CPI in 2011-12 = 100. All regressions are estimated by fixed-effects and control for month-year effects. ** denotes statistical significance at the 5% level, and *** denotes statistical significance at the 1% level.