Pensioners Without Borders: Agglomeration and the Migration Response to Taxation

Salla Kalin, Antoine Levy, Mathilde Muñoz*

Abstract

This paper investigates whether and why pensioners move across borders in response to tax rate differentials. In 2013, retirees relocating to Portugal became eligible to a full tax exemption of foreign-source pensions. Contrary to the broadly held belief that seniors "age in place", we find substantial international mobility responses to the reform, concentrated among wealthy and educated pensioners in higher-tax origin countries. The implied migration elasticity of the stock of foreign pensioners to the net-of-tax rate is large (between 1.5 and 2) and increases at longer horizons. Tax-induced retirement migration clusters in space, and exhibits peer effects, amplification, and hysteresis patterns consistent with agglomeration through endogenous amenities. We show such forces theoretically and empirically have significant implications for optimal tax rates, and for the limited efficacy of unilateral policy responses to tax competition, like the source-based taxation of pensions.

*Labour Institute for Economic Research (salla.kalin@helsinki.fi); UC Berkeley Haas (levya@berkeley.edu); UC Berkeley, CEPR and NBER (mathildemunoz@berkeley.edu). We thank Arnaud Costinot, Benjamin Faber, Joao Pereira dos Santos, Jim Poterba, Emmanuel Saez, Dimitry Taubinsky, Danny Yagan and seminar participants at UC Berkeley and MIT for valuable comments. Tai Nguyen provided excellent research assistance.

1 Introduction

In aging advanced economies, retirees represent a large share of income tax revenue.[1] While the senior population is often overlooked in studies of income taxation and its consequences, pensioners no longer attached to local labor markets retain the option to relocate to lower-tax jurisdictions. Amid declining costs of cross-country migration, this may lead to renewed tax competition for mobile retirees, as governments attempt to expand the tax base without incurring the perceived costs of working-age migration for local labor markets.

This crucially depends, however, on whether pensioners "age in place", the amenities they value, and their mobility response to tax burdens. We shed light on these questions by demonstrating that international retirement migration is peculiarly responsive to income tax differentials. In doing so, we provide evidence that agglomeration externalities operating across migrants are a key mechanism to explain the efficacy of targeted, group-specific tax breaks. We show that these forces theoretically and empirically amplify individual responses, lead to the spatial concentration of pensioner migration within destination countries, and raise novel implications for revenue-maximizing policy choices and international responses to tax competition.

Our laboratory is the European Union, the world's largest free movement area, and one of its most rapidly aging advanced economies. We exploit the implementation of – and foreign countries' response to – the most generous pensioner-specific tax break in the world: Portugal's Non-Habitual Resident (*NHR*) regime. We find quantitatively large, persistent, and dynamically increasing migration responses of foreign retirees to the full tax exemption of pensions drawn from abroad. Tax-induced pensioner migration is concentrated at the top of the income and pension distribution in high-tax origin countries. Importantly, the migration response exhibits dynamic accumulation, spatial clustering, peer effects, and asymmetric hysteresis patterns consistent with amplification through endogenous agglomeration.

[1] In Portugal – our main empirical setting – 20% of income taxpayers are retirees, and they represent close to 15% of overall reported taxable personal income.

We start by developing a framework to explain international migration patterns across different age groups, and derive the causal impact of targeted tax breaks in the presence of agglomeration effects. Our location choice model predicts that retirees are indifferent to local wages in the destination, but move to low-tax countries. Consistent with theory as well as within-country evidence (Badilla, Faber, Levy, and Munoz, 2024), internationally mobile pensioners go in the opposite direction of working-age movers. They migrate away from high-income countries, towards lower-wage and low-tax destinations. Using individual longitudinal data on the universe of residents from a specific origin country (Finland), we also show that international emigration exhibits a sharp uptick around the exact timing of retirement, especially for childless and unmarried pensioners; and that cross-border relocation is over-represented among educated, high-income retirees.

Our model also implies that endogenous, age-specific agglomeration in amenities amplifies mobility responses, and leads to asymmetric effects of the introduction and repeal of a tax break. Motivated by these predictions, we then turn to the causal effect of taxes on international retirement migration, by exploiting the natural experiment stemming from the Non-Habitual Resident regime (*"Residentes Não Habituales"*; henceforth, NHR).

The NHR was introduced in 2009 to attract "high value-added" migrants through a preferential 20% tax rate on earnings in specialized professions. It incorporated a full tax exemption (for a duration of ten years) of most foreign-source income; legislative language was clarified to exempt foreign pensions starting in 2013. A 2020 amendment established a 10 percent tax rate on foreign-sourced pensions for new immigrants, before the NHR was fully repealed (for newcomers) in 2024. These reforms resulted in quasi-experimental variation in the tax treatment of various cohorts of foreign pensioners arriving in Portugal.

Using a difference-in-differences strategy, we find that moves of retirement-age individuals to Portugal increased substantially – relative to comparable but unaffected destinations – following the implementation of the NHR tax regime. Our results are robust to alternative counterfactual estimates: comparing flows of older versus younger movers to

Portugal, or using synthetic controls combining destination countries with similar prior migration patterns. Overall, the stock of foreign EU pensioners to Portugal rose by a factor of more than 3 as a result of the NHR, with the largest effects arising for migrants from high-tax origin countries and those with longer expected retirement duration.

Our estimated international migration elasticities to the net-of-tax rate hover around 2 and are close to 3 in the long-run. They are quantitatively consistent with cross-sectional patterns of pensioner mobility in the EU, and significantly larger than those found in research studying working-age movers across countries, which cluster slightly below 1. Applying our reduced-form estimates, we cannot reject that all pensioners benefiting from the NHR scheme were "marginal" movers induced to relocate to Portugal by the regime.

We examine selection into tax-induced migration, and the heterogeneous response of international pensioner mobility depending on past income and demographics. To do so, we exploit individual migration registry and income tax panel data on the universe of Finnish residents. We find that pensioners with high career wages, high current capital incomes, and pensions belonging to the very top of the income distribution, are all substantially more likely to relocate to Portugal after the implementation of the tax break. Highly educated and unmarried residents exhibit stronger responsiveness to the implementation of the NHR regime, representing a more substantial share of movers to Portugal after the tax break was introduced.

We verify that the sharp migration response is indeed attributable to the tax break, rather than unrelated contemporaneous pull factors drawing retirees to Portugal. To do so, we exploit a novel source of origin-destination-time-specific variation stemming from policy responses to tax competition. The expiration of the Portugal-Finland double taxation agreement re-allocated taxing rights on Finnish pensions to the source country, thus denying the benefit of the NHR to Finnish retirees after 2018 – including those already residing in Portugal. Finnish pensioner *flows* to Portugal had been multiplied by a factor of 25 after the start of the NHR. However, relative to a similar origin country unaffected by the taxation of pensions at source at the time (Sweden), Portugal-bound flows of retirees originating from Finland substantially dried down and reverted to their pre-policy trend after the tax treaty was repealed in 2018.

In the final part of the paper, we demonstrate that our estimated causal responses are consistent with substantial agglomeration effects among migrating pensioners, a fact with important implications for optimal policies and international tax coordination.

First, return migration responds asymmetrically to the end of the tax break, consistent with a permanent change in retiree-specific amenities following the EU-wide inflow of pensioners to Portugal. In line with the predictions of our framework, we find only a partial reversal of the cumulative increase in the *stock* of Finnish pensioners in Portugal following the origin-specific repeal. The hysteresis of location choices is reminiscent of other permanent effects of temporary shocks arising due to endogenous agglomeration and feedback loops, for example in local labor markets following recessionary shocks (Yagan, 2019). This implies that unilateral policy responses to tax competition, like source-based taxation, are imperfect counter-measures when migration is subject to the presence of agglomeration effects. They curtail emigration outflows but fail to fully reverse the persistent cumulative effects of tax breaks on the stock of retirees abroad.

Second, matching migration decisions to individual data on lifetime work experiences allows us to show that destination-specific moves in retirement tend to be correlated with co-workers' past choices of international relocation. We provide suggestive evidence that tax-induced moves are partly the result of peer effects and a "social multiplier" in pensioner migration, through the influence of networks in the decision to retire abroad.

Third, using granular data across 3092 Portuguese parishes, we show that within destination countries, internationally mobile pensioners cluster spatially significantly more than working-age movers. Moreover, this spatial concentration of foreign pensioners within Portugal also rose dramatically as a result of the reform. While the population share of foreign pensioners doubled on average, it diverged locally: two thirds of the aggregate NHR-induced inflow was concentrated in the top quartile of locations by initial share of foreign pensioners. Rather than a uniform increase across space, but consistent with agglomeration forces playing a key role, international retiree migration to Portugal induced by the NHR focused in a small subset of locations.

We show that agglomeration has substantive implications for the optimal tax-setting policy of a revenue-maximizing government. Our results imply that targeting groups with strong endogenous agglomeration spillovers can justify aggressive tax policies designed to trigger a "big pull" of migrants from a certain demographic, and kick-start a persistent shift in the level of foreign inflows, and permanent changes in location patterns.

Contribution The fiscal consequences of population aging in advanced economies have been highlighted in the academic literature (Elmendorf and Sheiner, 2000) and policy reports (Dougherty, Biase, and Lorenzoni, 2022). While higher age dependency ratios impact debt and expenditure dynamics (e.g. Lee and Edwards (2002) or Cho and Lee (2022)), an older population can also generate novel challenges for collecting taxes. Retirees represent a large and growing share of income tax revenue, but studies of income taxation focus almost exclusively on working-age individuals, or how tax incentives matter for the late-career decision of workers to retire (Coile and Gruber, 2007; Manoli and Weber, 2016).[2] One explanation for this blind spot is the commonly held view that once retired, pensioners are essentially unresponsive to tax changes. We revisit this view by showing that international migration represents a substantial adjustment margin for pensioners, providing some of the first causal evidence of pensioners' response to income taxes.

Our results are consistent with systematic evidence in Europe (Muñoz, 2021) and the US (Rauh and Shyu, 2024) – as well as industry-specific studies on professional athletes (Kleven, Landais, and Saez, 2013) or innovators (Akcigit, Baslandze, and Stantcheva, 2016; Moretti and Wilson, 2017) – that income taxes influence the location choices of high earners. Limited attention has been devoted to the mobility of those *not* in the labor force. One exception is Agersnap, Jensen, and Kleven (2020), who show that immigrants to Nordic countries respond to in-cash welfare benefit variation. Recent work (Badilla et al., 2024; Komissarova, 2022) investigates within-country retiree migration, but focuses on its *consequences* for local economic development. Conway and Rork (2012) also studied the effects of State taxes on within-US elderly migration, using a panel regression in Census data.[3]

[2]Another related literature studies how tax incentives affect the accumulation of retirement savings (Poterba et al., 2007).

[3]A smaller literature has studied the response of housing mobility to age-dependent *real estate* taxation.

We focus on the international migration responses of pensioners to quasi-experimental changes in tax rates. While previous research has documented declining migration rates over the life cycle (Molloy, Smith, and Wozniak, 2011), our findings reveal that pensioners are, in fact, as responsive to tax rates as the most mobile segments of the labor market. The large effects we find at the very top tail of the pension income distribution imply that even small, granular migration flows can have large fiscal externalities in origin countries.

Methodologically, our setting allows us to address some of the empirical challenges faced by the previous literature. Existing work on taxation and migration, recently summarized in Kleven et al. (2020), focuses exclusively on labor force participants, whose location choices are jointly determined by tax *and* wage considerations. Empirically, even sharp tax policy shocks can be correlated with changes in pre-tax wages, due to general equilibrium pass-through or simultaneous labor market reforms, complicating identification. Pensioners are explicitly retired from the labor market and thus likely insensitive to wage differentials.

Conceptually, we emphasize how agglomeration effects, peers, and social multipliers, shape mobility responses to taxation. The persistent effects of tax breaks on migration stocks even after their origin-specific reversal are consistent with such agglomeration forces, and contrast with existing research finding a full reversal (Kleven et al., 2014). Our tests of endogenous age-specific agglomeration forces using the rising spatial concentration of migrant pensioners are reminiscent of those conducted by Leonardi and Moretti (2023) for urban amenities.

From a policy perspective, the role of social multipliers for both migration (Munshi, 2003) and retirement decisions (Duflo and Saez, 2002; Oral, Rabate, and Seibold, 2024) could potentially justify targeted, temporary tax breaks aimed at permanently changing the location choices of populations with a high propensity to agglomerate, such as retirees. These findings also have implications for the debate on source- versus destination-based taxation in public finance (Agrawal, Poterba, and Zidar, 2024). The arguments for and

Shan (2010) shows that State-level property tax relief for seniors discourages residential mobility among the elderly, while Cunningham and Engelhardt (2008) evidence a positive resale response of older homeowners to preferential capital gains tax on their primary residence prior to the Taxpayer Relief Act of 1997. Unlike these papers, we are concerned with income taxation (rather than real estate taxes) and we study international mobility decisions (rather than short-distance domestic residential moves).

against source-based taxation have heretofore focused on corporate taxes (Auerbach et al., 2017), sales taxes (Agrawal and Mardan, 2019), and capital or property taxation (Wilson and Wildasin, 2004). We quantify the implications of asymmetric international mobility responses characterized by hysteresis for the source-based taxation of pension income.

2 Conceptual Framework and Empirical Strategy

We develop a framework to explain location choices across different age groups. The model highlights the key determinants of international migration decisions for both pensioners and working-age individuals, and delivers cross-sectional empirical predictions for the geographic distribution of senior migration across countries. We use the model to derive our main estimating equation for the causal impact of age-specific tax breaks, guide the interpretation of our estimates in the presence of agglomeration effects, and identify potential sources of endogeneity to be addressed in our identification strategy.

2.1 Model setup

Pensioner location choice We adapt a standard location choice model to better describe the peculiarities of migration patterns for retired people. A pensioner h from origin i locating in country j at time t receives indirect utility from net income, local amenities, potential moving costs and idiosyncratic multiplicative preference shocks:

$$U^P_{ijt}(h) = P_{it}(1 - \tau^P_{ijt})A^P_{jt}\mu^P_{ij}\epsilon_{ijt}(h)$$

The net income is the product of the gross pension income received (P_{it}), according to pension determination rules in the origin country, and one minus the average tax rate (ATR) on pensions, τ^P_{ijt}, which can depend on both origin and destination countries in double taxation agreements. Utility is increasing in amenities A^P_{jt} in the destination country.[4]

[4] These amenities are age-specific, and can be made endogenous to local pensioner counts ($A^P_{jt} = A^P_{jt}(N^P_{jt})$) through agglomeration effects (see below). Our indirect utility function abstracts from international price differentials, assuming they are subsumed in age-specific price indices incorporated in the amenity index.

$\mu_{ij}^P \leq \mu_{ii}^P = 1$ denotes "iceberg" (psychological, monetary, or other) inverse moving costs between i and j, normalized to be zero for stayers. Finally, idiosyncratic shocks $\epsilon_{ijt}(h)$ have a Frechet distribution; the inverse dispersion parameter σ_P governs the migration elasticity, due to pensioners' preference heterogeneity across destinations. Aggregating over all pensioners from i yields a location choice probability at time t:

$$\pi_{ijt}^P = \frac{\left(P_{it}(1-\tau_{ijt}^P)A_{jt}^P\mu_{ij}^P\right)^{\sigma_P}}{\sum_k \left(P_{it}(1-\tau_{ikt}^P)A_{kt}^P\mu_{ik}\right)^{\sigma_P}} \tag{1}$$

Worker location choice It is useful to contrast the location patterns of pensioners to those made by working-age individuals. In particular, a worker h from country i locating in country j at time t receives utility:

$$U_{ijt}^W(h) = w_{jt}(1-\tau_{jt}^W)A_{jt}^W\mu_{ij}\epsilon_{ijt}(h)$$

Utility depends on the nominal gross wage income received (w_{jt}), affected by labor market conditions in the destination country. The net income also depends on the average tax rate (ATR) for wage income, τ_{jt}^W, which, due to *lex laboris* standards, is generally only a function of destination-level tax rates. Utility is increasing in local (age-specific) amenities in the destination country A_{jt}^W. Finally, idiosyncratic shocks $\epsilon_{ijt}(h)$ are distributed according to a Frechet law with dispersion governed by σ_W. Aggregating choices across workers from i yields the location choice probability:

$$\pi_{ijt}^W = \frac{\left(w_{jt}(1-\tau_{jt}^W)A_{jt}^W\mu_{ij}^W\right)^{\sigma_W}}{\sum_k \left(w_{kt}(1-\tau_{kt}^W)A_{kt}^W\mu_{ik}\right)^{\sigma_W}} \tag{2}$$

2.2 Cross-sectional predictions

Our model yields predictions for the relative stocks of old and young people from a specific origin locating in a given destination as a function of observable determinants. Normalizing choice probabilities by the home-country location in both cases yields an "odds-ratio" – the probability that a pensioner from i locates in j rather than at home, compared to the same quantity for a working-age individual:

$$\frac{\pi^P_{ijt}/\pi^P_{iit}}{\pi^W_{ijt}/\pi^W_{iit}} = \frac{\frac{\left((1-\tau^P_{ijt})A^P_{jt}\mu^P_{ij}\right)^{\sigma_P}}{\left((1-\tau^P_{iit})A^P_{it}\right)^{\sigma_P}}}{\frac{\left(w_{jt}(1-\tau^W_{jt})A^W_{jt}\mu^W_{ij}\right)^{\sigma_W}}{\left(w_{it}(1-\tau^W_{it})A^W_{it}\right)^{\sigma_W}}} = (\frac{1-\tau^P_{ijt}}{1-\tau^P_{iit}})^{\sigma_P} \times (\frac{w_{jt}}{w_{it}})^{-\sigma_W} \times (\frac{1-\tau^W_{jt}}{1-\tau^W_{it}})^{-\sigma_W} \times \alpha_{ijt} \quad (3)$$

The (log) old-young odds-ratio is linearly increasing (with slope σ_P) in the destination-origin (log) ratio of keep rates for pensioners ($\frac{(1-\tau^P_{ijt})}{(1-\tau^P_{iit})}$), and linearly decreasing in the destination-origin (log) ratio of working-age earnings ($\frac{w_{jt}}{w_{it}}$), and in the destination-origin (log) ratio of keep rates for workers ($\frac{(1-\tau^W_{jt})}{(1-\tau^W_{it})}$).

2.3 Estimating the effect of pensioner-specific tax breaks

Scaling equation 1 by the number of pensioners originating from i at the beginning of period t, $\bar{N}^P_{it}$, yields a prediction for the (log) number of pensioners from i in j at time t:

$$\begin{aligned}\log(N^P_{ijt}) &= \log(\bar{N}^P_{it}\pi^P_{ijt}) \\ &= \sigma_P \log(1-\tau^P_{ijt}) \\ &+ \log(\bar{N}^P_{it}) - \log(\sum_k [(1-\tau^P_{ikt})A^P_{kt}]^{\sigma_P}) + \sigma_P \log(\mu^P_{ij}) \\ &+ \sigma_P \log(A^P_{jt})\end{aligned}$$

Absorbing origin-time and origin-destination invariant terms in fixed effects yields:

$$\log(N^P_{ijt}) = \sigma_P \log(1-\tau^P_{ijt}) + \kappa_{it} + \alpha_{ij} + \epsilon_{ijt} \quad (4)$$

Equation 4 corresponds to a regression equation with origin-year and origin-destination pairwise fixed effects. Exogenous shocks to the tax rate for pensioners from i in j identify σ_P, the pensioner migration elasticity, under the condition that the structural error term ($\epsilon_{ijt} = \sigma_P \log(A^P_{jt})$) is orthogonal to the shocks. We leverage two sources of plausibly exogeneous variation in τ^P_{ijt} to identify σ_P from Equation 4.

2.3.1 Destination-Specific Variation Across Origins

First, the introduction of the NHR tax break in Portugal introduces variation in τ^P_{ijt} across destinations j in Europe. At the time of the introduction of the NHR in Portugal, all bilateral tax agreements in Europe allowed pensions received by immigrants to be taxed in the destination country, so $\tau^P_{ijt} = \tau^P_{jt}$ for all $i \neq j$. For a pensioner originating from $i \neq j$, τ^P_{ijt} drops to zero after 2013 if moving to $j =$ Portugal, but stays on a constant counterfactual trajectory elsewhere in Europe. Our baseline identification strategy is thus a difference-in-differences design comparing the migration of all EU foreign retirees to Portugal relative to similar, unaffected destination countries, before and after the NHR sharply reduced the tax rate on foreign pensions received in Portugal.

This strategy rests on the assumption that the sharp drop in τ^P_{jt} in Portugal in 2013 is orthogonal to ϵ_{ijt}. It would be violated if migration flows of pensioners to Portugal increase after 2013 because of unobserved but contemporaneous shocks. For instance, a change in amenities A^P_{jt} making Portugal more attractive to pensioners even in the absence of the NHR scheme would constitute a threat to our identification strategy. To address this concern, we use a control destination likely to be affected by similar time-varying shocks in A_{jt}, but which did not implement any specific tax benefit for foreign pensioners.

We focus on Spain as our main comparison destination. Spain is a neighboring country to Portugal, with comparable amenities (yearlong warm weather; a large availability of beaches and coastal towns; and comparable tourism-specific amenities) and is also attractive to foreign retirees (for example, 120,000 UK pensioners lived in Spain in 2016, representing close to half of all UK pensioners abroad). Spain was hit similarly by the great recession and euro area periphery crisis from 2009 to 2011. Time-varying but non-tax related economic pull factors are likely to follow similar trends in Portugal and Spain after 2013, given their high trade integration and similar industrial structure.

Our main identifying parallel trends assumption is that international migration flows of retirees to Portugal would have followed similar patterns to the flows of retirees directed to Spain, absent the introduction of the NHR tax break in 2013. The absence of differential pre-NHR trends in migration between Portugal and Spain, as well as the post-2020 reversal of migration trends that followed the curtailment of the NHR regime, both support this identifying assumption. In robustness exercises yielding qualitatively and quantitatively close estimates, we also replace Spain by either all EU destinations, or a composite "synthetic control" (Abadie, Diamond, and Hainmueller, 2010) of countries matching Portugal's past migration trends constructed from a pool of EU member States.[5]

2.3.2 Origin-specific Variation Within a Destination

In a second-step, we exploit the repeal of the tax break for some origin countries but not others, that arose from the renegotiation and expiration of bilateral tax treaties with Portugal and the implementation of a source-based taxation of pensions. Such policy responses to tax competition are not only of interest in themselves, but introduce dyadic variation in tax rates by origin ($\tau_{ijt} \neq \tau_{i'jt}$) within a destination-year. We can compare Portuguese-bound migration flows of pensioners from origin countries affected or not by the change in the bilateral tax treaty, without resorting to the assumption of unaffected destination countries serving as controls.

Equation 4 shows the benefit of origin-destination-year specific shocks to the tax rate τ_{ijt}. Econometrically, exploiting such shocks, as we do when examining policy responses to tax competition in origin countries, allows for the introduction of destination-year fixed effects, alleviating concerns that simultaneous shocks to local amenities in the destination A^P_{jt} (common to pensioners from all origins) drive the estimated causal effects.

In practice, we compare flows of pensioners to Portugal originating from Finland to those from comparable origin countries (in our case, Sweden), after the renegotiation (in 2016) and repeal (on June 14, 2018) of the Finland-Portugal tax treaty. The repeal denied the benefit of the NHR to Finnish retirees (including those already residing in Portugal at the time) who were subsequently taxed at source on their pension. The parallel trends assumption here is that the stock of Finnish retirees to Portugal would have followed similar patterns to foreign retirees from comparable origins (Swedish pensioners), absent the repeal of the Finland-Portugal tax treaty.

[5] This alternative approach also enables us to address the SUTVA violation concern that migration flows of foreigners to Spain could have been affected by the NHR scheme if Spain and Portugal are deemed particularly close substitutes (due to their similarity) by internationally mobile pensioners.

2.4 Allowing for agglomeration effects

The model-driven estimation strategy also helps to clarify under what conditions our difference-in-differences regression could recover transformations of the structural parameter σ_P. One case of particular interest is when local, age-specific amenities endogenously depend on the total number of pensioners in a destination.[6] This could arise due to age-based homophily (Ward, LaGory, and Sherman, 1985) or through the endogenous provision of age-specific amenities (Almagro and Domínguez-Iino, 2024). We model such a case as:

$$A_{jt}^P = \tilde{A}_{jt}^P \times (N_{jt}^P)^\eta$$

where amenities depend iso-elastically on $N_{jt}^P = \sum_k N_{kjt}^P$ – the number of pensioners choosing destination j. In this case, re-writing equation 4 yields:

$$\log(N_{ijt}^P) = \sigma_P \log(1 - \tau_{ijt}^P) + \kappa_{it} + \alpha_{ij} + \sigma_P \eta \log(\sum_k N_{kjt}^P) + \sigma_P \log(\tilde{A}_{jt}^P)$$

Since N_{jt}^P endogenously responds to the tax rate in j, the structural residual is not orthogonal to any tax shock, and we must make additional assumptions to recover σ_P.

Amplification of aggregate tax rate shocks In our baseline empirical setting, the shock to the tax rate is a destination-year level shock in j at time t (the introduction of the NHR repeal), applicable to pensioners from all origins i. In that case, re-arranging terms shows that – under the proper orthogonality assumption – our difference in differences specification recovers an "amplified" elasticity that takes into account the endogenous effect on population adjustments:

$$\log(N_{ijt}^P) = \frac{\sigma_P}{1 - \sigma_P \eta} \log(1 - \tau_{jt}^P) + \kappa_{it} + \alpha_{ij} + \epsilon_{ijt}$$

The economic interpretation is that an exogenous tax cut in destination j attracts pensioners from all origins (with elasticity σ_P), yielding an increase in local amenities for

[6] Section 5 documents empirically the spatial clustering of pensioner migration, and provides direct evidence of the role of agglomeration effects in retiree mobility.

pensioners through agglomeration (at rate η), themselves attracting more pensioners, and so on. This circular process of a "social multiplier" (Glaeser, Sacerdote, and Scheinkman, 2003) amplifies the baseline effect of the tax cut by a factor $\frac{1}{1-\sigma_P\eta}$. Empirically, such an amplification effect implies larger tax elasticities of migration in the long-run than in the short-run.

Asymmetric response to bilateral tax rate shocks Endogenous agglomeration effects can also account for asymmetries between the effects of the broad-based introduction of the scheme, and the origin-specific repeal of the preferential tax rate for pensioners from Finland. The introduction of the NHR in Portugal, for pensioners from all origins, triggers Finnish migration to Portugal through both the direct effect on net pensions, and the indirect "agglomeration multiplier" effect: an overall increase in pensioner-specific amenities in Portugal as a result of rising pensioner inflows from all over the EU. The origin-specific repeal of the tax rate, however, reduces Finnish pensioner flows to Portugal through the direct effect, but endogenous amenities in Portugal remain higher than in the pre-policy period, since foreign inflows from other countries remain at a permanently higher level. Therefore, the introduction of the Portuguese tax break has larger effects than its origin-specific repeal on pensioner stocks coming from Finland and living in Portugal. As shown in simulations of the model in appendix F, such asymmetry and hysteresis in the effects of a temporary drop in the tax rate are predicted to be larger for "small" origin countries representing a lesser share of overall stocks of foreign pensioners in the destination.

3 Institutional context and data

3.1 International Migration of Retirees in Europe

The European Union (EU) provides an ideal laboratory to study elderly migration decisions. First, there are no formal barriers to international migration between EU countries. The legal principle of free movement of people applies to all EU citizens, whatever their age, employment status, or country of residence. Second, the EU population is aging rapidly, making the behavioral responses of pensioners a primary concern for tax revenue collection. More than 20% of the population was more than 65 in 2023, a share expected to increase to one third by 2100. Third, health insurance transfer considerations are mostly irrelevant. EU pensioners living in different member State are entitled to free, publicly provided healthcare through reciprocal agreements between EU countries, making healthcare costs recoverable from the origin government through aggregate compensating transfers each year.[7] Finally, the majority of European countries share a currency (the euro) – so that pensions are effectively fixed in nominal terms upon migration.

However, there remains substantial variation in taxes, amenities, and consumer prices across EU economies. In a context of free migration, such dispersion in characteristics helps identify the drivers of international location choices for pensioners, the intensity of their local ties, and their overall migration elasticity. More than 2.2 million EU citizens aged 55 or more live in a European country different from their citizenship. While this figure may under-estimate the total number of EU citizens relocating internationally during retirement,[8] it demonstrates that it constitutes a substantial and fast-growing share of overall within-EU migration.

As a result, the international migration of retirees is a central coordination problem in the EU – illustrated by the thorny debates surrounding the cross-border transferability of pension rights during the Brexit negotiation (McCarthy, 2018). There is no federal tax system to fund either pensions or healthcare in the Union. EU regulations guarantee the portability of recipients' rights, allowing pensioners to receive their pensions if they live abroad, and to consume publicly provided healthcare in any EU country in which they decide to establish residence.[9]

[7]Foreign pensioners still retain the option to consume health care back in their country of origin, should they wish to.

[8]Return migration towards one's own country of citizenship is not counted by construction, some EU pensioners fail to register as residents in their new destination, and country-specific sources imply that a substantial number of European workers, notably in France and the UK, retire outside the EU.

[9]When retirees move abroad, the country of origin is obligated to compensate the country of destination for any healthcare expenses incurred while living there, with costs evaluated at local prices in the destination country, through the issuance of individual *PD S1* forms.

3.2 The Portuguese Non-Habitual Resident Regime

The NHR regime in Portugal was introduced in 2009 to convince foreigners, including retirees and high-net-worth individuals, to establish tax residence in the country.[10] To be eligible, individuals must not have been tax residents in Portugal in the five years preceding their application. The process involves registering as a tax resident in Portugal, typically requiring that one spends more than 183 days in the country each year. Applicants are not required to purchase property in Portugal, but must have a domicile in Portugal that demonstrates their intention to occupy a permanent place of abode there.[11]

Those qualifying for the NHR regime enjoy a 10-year tax exemption on foreign-source income, covering dividends, interest, and capital gains. Under the NHR regime, Portuguese-source income, such as employment and self-employment income, can be subject to a reduced flat tax rate of 20% if the employment falls under a list of pre-specified highly-skilled occupations. Individuals covered by the NHR regime still pay regular VAT rates on their consumption in Portugal. There is no wealth taxation nor inheritance taxation in Portugal, for either foreign and domestic tax residents.

In August 2012 and in the following 2013 State budget law, clarification of legislative language affirmed that pensioners were eligible to the full ten year exemption of their pension income since it was deemed "foreign-sourced", as long as a bilateral tax treaty between Portugal and the origin country adjudicated taxing rights over the income. Foreign pensioners migrating to Portugal starting from fiscal year 2013 were thus granted a 0% income tax rate on their foreign pensions for a duration of 10 years. The unprecedented generosity of the full pension exemption led accounting firm PricewaterhouseCoopers to label it "*Europe's best-kept secret*" in 2016.[12]

By 2021, the NHR regime had become the largest personal income tax loophole in the budget. The "mechanical" or static fiscal cost (comparing the tax liability of taxpayers

[10] The NHR was launched during the euro area periphery financial crisis. Its explicit goal was to trigger high-income foreign migration to Portugal in order to boost the economy during the slump.

[11] In parallel to the NHR, Portugal introduced a "golden visa" program in 2012 providing a path to residency (with no tax incentives) to those purchasing real estate in excess of EUR 500,000 (Santos and Strohmaier, 2024). In our empirical application, we focus on the response of EU pensioner migration to the NHR, since EU citizens do not need a visa to establish residence in Portugal and are thus left unaffected by the golden visa policy.

[12] See PwC, *Europe's best kept secret*, accessed August 2024.

with the NHR to their counterfactual liability with the same reported income, had they not claimed it) represents more than half of all tax expenditures in the country, for a yearly value of 0.6% of GDP (EUR 1.5 billion) in 2021.[13] In 2021, the full exemption was replaced by a 10% flat income tax rate, partly as a result of the mounting fiscal cost and partly due to backlash from Portugal's EU partners, who deemed the NHR regime uncooperative.

The tax provisions of the NHR apply only to retirees receiving a pension from a country with which Portugal has established a Double Taxation Agreement (DTA). DTAs often allow some non-resident income to be taxed in the source country. However, most DTAs choose not to tax the pension income earned by non-residents, as long as it is or could be subject to taxation abroad.[14] Finland and Sweden both engaged in a renegotiation of their DTAs with Portugal, eventually ending them unilaterally, to protest the zero tax rate granted to foreign pensioners. Finland repealed its bilateral tax treaty with Portugal in 2018, while Sweden ceased its own agreement in 2022.

3.3 Data on International Retirement Migration

We measure the *stock* of European residents by age, country of citizenship, and current country of residence in each EU country from 2009 to 2022, using data from Eurostat as well as national population registers and Censuses from several European countries.[15] We use this source to track the evolution of the number of foreign citizens residing in each European country for each age group. We also collect information from countries' statistical offices on migration *flows* by age, to focus more directly on the high-frequency international movement of individuals towards or away from Portugal in response to tax shocks. Throughout the paper, we define pensioners as individuals aged 55 and above.[16]

[13] Appendix Figure C.17 shows the evolution of the fiscal cost until 2022, using data from *Autoridade Tributaria e Aduaneira, Estatisticas do IRS, Declaracoes Modelo 3.*

[14] Some exceptions pertain to pensions arising from past public employment in the origin country. For instance, the pensions of French or UK citizens paid by the French or UK public system as a consequence of their career as civil servants are – almost always – taxable in France or the UK, even if recipients live abroad.

[15] Appendix G provides detailed information on the data construction.

[16] We vary this age threshold to 65 in some robustness checks. Alternatively, we also use a definition based on whether individuals already draw a pension, when using data from specific high-income origin countries where this information is available. We focus on pensioners from the European Union (and include the UK and Switzerland in some specifications), who are unaffected by changes in the golden visa program since they can reside visa-free in Portugal.

We merge our dataset on the international migration of retirees in Europe with measures of income tax rates applicable to pensioners and workers in each destination and origin country, drawn from the OECD *Central government personal income tax rates and thresholds* and *Pensions at a glance* databases. Since migration decisions are driven by the total average (rather than marginal) tax liabilities, we estimate elasticities with respect to (one minus) the average tax rate (ATR) calculated at different levels of retirees' overall income to account for tax progressivity.

Finally, we collect data from one high-income origin country, Finland, on the migration behavior of the entire population of residents, which we combine with administrative income tax longitudinal information to obtain individual data on migrating pensioners, including education, lifetime earnings, capital income, and past firm and establishment IDs. This information allows us to study selection into international retirement migration, heterogeneity in the responsiveness to foreign tax breaks, and potential peer effects among movers in the country of origin. The availability of population-wide micro-data on the entire Finnish population also enables us to study the response of emigration and return migration to a particular quasi-experiment, the origin-destination-year specific response to the expiration of the bilateral tax treaty between Finland and Portugal, which muted the benefit of the NHR only for Finnish pensioners after 2018 (see section 2).

Appendix A.1 uses the Finnish registry data to document patterns of self-selection of retirees into international migration. In particular, we find that older individuals tend to relocate immediately after exiting the labor force, as documented by Badilla et al. (2024) for within-country migration, with a stronger effect for unmarried and childless individuals. Compared to pensioners who stay in their home country, internationally mobile pensioners are also significantly positively selected in terms of education and career labor income, and exhibit higher variance and higher mean in capital and business income.

3.4 Stylized facts on cross-country retirement migration

We test the cross-sectional predictions of equation 3, using age-specific migration stocks across all EU countries. We focus on the year 2022 and the full set of available origin-destination pairs in our dataset. In Figure 1, we show cross-country evidence on the relationship between the bilateral old-young odds-ratio and pensioners' net-of-tax rates ratio (panel A), the workers' net-of-tax rates ratio (panel B) and the average wages ratio (panel C). In each panel, we show the best linear fit using an unweighted univariate regression. We also compute the corresponding elasticities and standard errors, by regressing the log y-axis outcome on the log x-axis variable. We report these estimates in each graphs.

The cross-sectional predictions from the model are indeed verified in the data by three tight, approximately linear, and statistically significant negative or positive relationships. Consistent with equation 3, relative stocks of pensioners compared to working-age migrants are increasing in the net-of-tax rate for pensioners (Panel A), with a large implied elasticity (point estimate above 2). On the other hand, the old-young odds-ratio is decreasing in the workers' net-of-tax rate ratio (Panel B) and worker earnings (Panel C), consistent with the predicted indifference of pensioners to working-age net earnings.[17]

These cross-sectional patterns also hold true within destination countries. We use granular spatial data from the Portuguese Census describing the location choices of recently arrived immigrants to Portugal by age group, across 3092 small parishes.[18] While there is no within-country variation in tax rates, appendix Figure C.21 shows that there is a tight, linear, negative relationship between the share of seniors among immigrants, and average local earnings in a parish, consistent with retiree mobility being targeted relatively more towards low-income towns than working-age migration, since retirees' location choices do not factor in the strength of local labor markets.

4 Migration Effects of Taxes on Pensioners

4.1 Reduced-form Graphical Evidence

Aggregate time series Panel (A) of Figure 2 describes the evolution of the raw flow of foreign retirees originating from the entire EU and arriving in Portugal between 2008 and

[17] Panel (D) also shows that the old-young odds ratio is decreasing in bilateral distance. This finding is consistent with moving costs increasing in distance at the same rate for both workers and pensioners, and pensioners' migration elasticity being larger than working-age movers.

[18] Parishes, or *freguesias*, are the smallest administrative division in Portugal, with an average population of less than 3,500 and a median close to 1,000.

2022. Immigration flows of foreign pensioners were fairly stable in the pre-reform period from 2008 to 2012. Following the introduction of the NHR scheme, indicated by the first solid vertical line, there is a sharp, noticeable increase in the number of foreign retirees newly arriving in Portugal each year. By 2019, immigration flows of foreign EU retirees to Portugal had been multiplied by a factor of 30 compared to their pre-reform level. The flow exhibits a sharp decrease (without fully reverting back to its pre-reform level) after the implementation of a 10% tax rate on foreign pensions was enforced starting in 2020.

Second, we show that such international arrivals of old-age migrants in Portugal originating from EU countries rose by an order of magnitude more than flows of younger, working-age European migrants. Panel (B) of Figure 2 demonstrates that both series followed precisely parallel trends prior to the introduction of the NHR regime, but diverged immediately after the NHR provided foreign pensioners with a larger tax benefit, before starting to converge once again after the scale-down of the tax break.[19]

As an additional piece of descriptive evidence, figure C.14 plots search interest for retiring in various countries, from 2004 to 2022, among users of Google in France, a proxy for the stated intent to move abroad among (prospective) retirees. After the implementation of the NHR exemption for pensioners in 2012, "retire in Portugal" Google searches exhibit a sharp and persistent break from trends observed for both Spain and Italy. Again, the Portugal series reverts back to the observed pattern in alternative destinations after the implementation of a 10% tax rate on foreign pensions in 2020.

Portugal versus control destinations Going beyond descriptive statistics on migration flows, we formally estimate the causal effect of the NHR scheme on the overall stock of retirees to Portugal. Sharp changes in immigration inflows do not necessarily translate into corresponding increases in stocks: they could simply reflect higher turnover and be accompanied by corresponding outflows. Moreover, while the dramatic break in the trend

[19] As explained in section 2, the NHR also provided younger workers with a partial tax benefit of a flat 20% rate if they belonged to high-value added specialty occupations, making this group potentially partly treated. Therefore, while the stark divergence in the flows of EU retirees and EU working-age migrants to Portugal after 2012 displayed in Figure 2 strongly supports our overall causal claims, the age-group comparison is not our baseline estimation strategy for σ_P, the structural elasticity of the stock of pensioners to the net-of-tax rate, since the control group could be partly treated by the NHR starting in 2009. Instead, we rely on the comparison of senior flows to Portugal and Spain, a fully unaffected destination.

of old-age flows to Portugal observed in Figure 2 is suggestive of tax-induced retiree migration, it could have occurred even in the absence of the NHR if, for example, overall barriers to pensioner mobility decreased after 2013 everywhere in the EU, or due to coinciding demographic waves of newly retired pensioners in typical origin countries. To transparently control for such aggregate trends, we plot in Figure 3 the number of foreign retirees in Portugal and in Spain, a comparable destination country where tax rates for foreign pensioners did not change during the period. Before addressing potential confounders in this difference-in-differences, three lessons emerge from the raw data.

First, the (normalized) stock of foreign retirees in Spain (our control) follows the treatment series (in Portugal) extremely closely in the 2009-2012 period, before the scheme is introduced. These common pre-policy trends support our (untestable) parallel trends assumption that Spain provides a credible counterfactual for the migration flows of retirees towards Portugal, absent the tax exemption scheme. Second, after the scheme was implemented, the stock of foreign pensioners in Portugal rises dramatically, whereas the number of migrant retirees in Spain exhibits no discontinuous break in trend. By 2017, while the number of foreign pensioners in Spain was almost identical to 2013 levels, the treatment series had almost doubled. Third, the effects on the stock of foreign retirees take time to materialize, with the number of foreign retirees in Portugal reaching a threefold increase in 2021 (relative to the control group's trend) before plateauing after the introduction of the 10% minimum tax rate.

The sharp increase in the age-specific mobility of retired European citizens to Portugal, and the subsequent stagnation that followed the implementation of the 10% flat tax, provide strong evidence of tax-driven migration. To formally quantify this effect, we estimate the difference-in-differences equation arising from our model:

$$\log(N_{jt}^{P}) = a + \beta \times \mathbb{1} \cdot (t \geq 2013) \times \mathbb{1} \cdot (j = \text{Portugal}) + \gamma_t + \gamma_j + u_{jt} \tag{5}$$

The coefficient β, reported in Figure 3, captures the proportional increase in the number of foreign pensioners in Portugal after the reform, compared to Spain, and relative to the pre-reform period. Our estimate indicates a 60% increase in the number of foreign retirees living in Portugal caused by the introduction of the NHR scheme. This average treatment effect in the post-policy period masks substantial dynamics, with long-run estimates yielding a more than doubling caused by the regime.

While Spain's close geographic and economic proximity makes it a natural counterfactual, we also probe the robustness of our findings to the use of a distinct estimation strategy. We show in Appendix D that our results are quantitatively similar when using a synthetic control approach.

4.2 Estimates of the International Migration Elasticity for Pensioners

We estimate the migration elasticity with respect to the net-of-tax rate implied by the graphical evidence presented in Figure 3. Since location choices are driven by average tax rates, we compute predicted average tax rates in all countries for pensioners at various levels of total income, to take into account progressivity.[20] To leverage exogenous changes in tax rates from the NHR, we instrument the log net-of-tax rate by the reform interaction $\mathbb{1} \cdot (t \geq 2013) \times \mathbb{1}(j = \text{Portugal})$, and estimate the model-based equation:

$$\log(N_{jt}^{P}) = \alpha + \sigma_P \log(1 - \tau_{jt}^{P}) + \gamma_t + \gamma_j + u_{jt} \tag{6}$$

Our baseline estimates are summarized in Table 1. The top panel uses Spain as a control group; while the bottom panel uses all EU countries as controls. In the first two columns, we report the 2SLS estimates of σ_P from Equation (6). In the third column, we report the reduced-form effect of the reform, β, estimated from Equation (5).

Migration elasticities are large and precisely estimated, between 1.5 and 2 in our preferred specifications and up to 4 in some control groups and subsample definitions. As predicted by our model, the elasticity σ estimated from quasi-experimental changes in the net-of-tax rate is of similar magnitude than the cross-sectional correlation showed in Figure 1.

We find large elasticities for all pensioners; but older pensioners appear more respon-

[20]We use the OECD Taxes on Personal Income database to compute destination-year specific tax rates on earnings at two profiles of earnings in the destination country.

sive to tax rates than younger pensioners. We explore the short and medium-run of migration elasticities for pensioners by estimating the 2SLS coefficients for different time horizons to the reform. The results show migration elasticities close to 3 in the medium-run (e.g., 5 to 9 years after the reform). In comparison, Kleven et al. (2014) find migration elasticities of 1.5 for a tax break targeted at top executives in Denmark. Simulating the counterfactual stock of foreign retirees in Portugal under our estimated elasticities implies an overall causal increase of 20,000-25,000 European retirees moving due to the scheme during the period. Since this interval contains estimates (from government reports) of the number of pensioners benefiting from the NHR in 2021, we cannot reject that close to all pensioners using the NHR regime were marginal, and would not have relocated in Portugal absent the tax break.

4.3 Heterogeneous migration responses

Country-level heterogeneity We first explore heterogeneity in the migration responses to the tax break by origin country. First, we split the average effect in Figure 3 across several large origin countries in Figure C.16. While we observe positive migration responses for all origins, the effects are noticeably larger for some countries (France, Belgium) than others (Netherlands, Germany). We also note that the dynamics vary across origins: while migration responses are immediately large in the year that follows the introduction for French retirees, they take more time to materialize for German pensioners.

To formally test which origin countries were most likely to see pensioners emigrate to Portugal in response to the non-habitual resident regime, we re-estimate Equation (5) by disaggregating stocks at the origin-destination-year level:

$$\begin{aligned}\log(N^P_{i,j,t}) = \alpha_{it} + \gamma_{ij} + \beta \cdot \mathbb{1}\{j = Portugal\} \times \mathbb{1}\{t \geq 2013\} \\ + \zeta \cdot \mathbb{1}\{j = Portugal\} \times \mathbb{1}\{t \geq 2013\} \times Z_{i,2022} + u_{ijt} \quad (7)\end{aligned}$$

In this specification, α_{it} are origin-year-fixed effects; γ_{ij} are origin-destination-fixed effects; and $Z_{i,2022}$ is one of the potential drivers of migration at origin (average tax rates of pensioners, net pension replacement rate, and life expectancy after exiting the labor force). Other terms are absorbed by the fixed effects. The coefficient of interest is ζ, which summarizes the role of conditions at origin as drivers for the heterogeneous response of tax-induced migration to Portugal relative to Spain. Standard errors of the regression are heteroskedasticity-robust and two-way clustered at the at the destination-year (30) and origin (12) levels.

We report our estimates of η from the estimation of Equation (7) using weighted (Table 2) and unweighted (Table C.5) fixed effects OLS regressions. We find that the introduction of the NHR regime for pensioners had stronger effects on migration flows originating from high-tax origin countries. We also find that tax-induced migration responses are larger for pensioners from countries with longer expected retirement duration, consistent with the benefits of mobility to low-tax destinations accruing for a longer time period. Those results outline that different origin countries are more or less vulnerable to aggressive tax incentives implemented to attract pensioners, and may thus have different incentives to implement policy responses to tax competition. We study such responses in the next section.

Individual-level heterogeneity Exploiting our detailed data on Finnish pensioners, we can then characterize heterogeneous senior migration responses to tax cuts depending on individual-level characteristics. In particular, matching the migration registry to longitudinal tax information allows us to capture heterogeneity by past career earnings, capital income, and other demographics.

To align with our difference-in-differences design, we compare the evolution of average demographic characteristic for the stock of Finnish pensioners living in Portugal and in Spain, before and after the introduction of the NHR. Figure 4 shows that on average, Finnish retirees in Portugal and in Spain exhibited similar evolution in characteristics in the few years leading to the implementation of the scheme: a similar trend in the probability of belonging to the top decile of incomes during their work career, to receive capital income, to be highly educated, or to be married. After the implementation of the NHR in 2013, however, the stock of Finnish pensioners in Portugal exhibited a dramatic shift in composition, with a sharp rise in the share of top earners, the proportion of capital income recipients, and the share of highly educated individuals, and a drop in the share of married individuals. Portuguese-bound movers induced by the NHR scheme tend to be substantially richer than their unaffected counterparts in Spain.

The shift in the demographic composition of Finnish citizens retiring in Portugal after the introduction of the NHR regime suggests that pensioners moving to Portugal after 2013 receive higher pensions. Using data on pension recipients, we show the evolution of the average pension for Finnish citizens living in Spain and in Portugal in panel (A) of Figure 5. Pensions received by Finnish retirees in Portugal and Spain were very similar prior 2013, around EUR 1,600 per month. After the implementation of the NHR, the average pension paid to pensioners who migrated to Portugal increased to EUR 3,500 per month, while it remained stable and close to its pre-policy level in Spain. Panel (B) of Figure 5 focuses on the upper end of the pension distribution by plotting the evolution of the average annual pensions in the top 10% of the distribution for these two countries. Prior to the NHR reform, the top decile of pensions in Spain and Portugal followed a similar pattern. However, immediately around the implementation of the NHR reform, there is a significant and sharp increase for the top decile of pensioners in Portugal, suggesting that the reform specifically attracted retirees from the very top of the pension distribution.[21]

Overall, the compositional shift in Finnish retirees in Portugal after the implementation of the tax break implies that the fiscal externality exerted on origin countries is larger than a naive prediction based on the pre-reform characteristics of the average migrating pensioner. Marginal tax-motivated movers belong to the top tail of the pension distribution, and thus disproportionately contribute to fiscal revenue lost in origin countries.

This also suggests that a substantial share of the aggregate effect of the NHR policy on Finnish emigration to Portugal is driven by the stronger response of top income earners. We verify this fact formally by examining heterogeneous responses across groups more systematically, running our main specification Equation 5 (but with only one origin, Finland) in various sub-samples. The results, summarized in Figure C.18, suggest that individuals with high working-age income, capital income, and higher education are more

[21]The sharp rise to such high levels is possible because, unlike in many other countries, the Finnish pension system does not have a pension ceiling, meaning there is no upper limit on the pensionable wage or the pension amount itself.

likely to respond to the introduction of the NHR by migrating to Portugal, while seniors without capital income show a more muted response.

4.4 Consequences of the Source-Based Taxation of Pensions

In the baseline strategy, the main confounding threat is that contemporaneous amenity "pull" factors occurring in Portugal could have made the country more attractive to foreign retirees exactly when the NHR went into force. For example, targeted advertising campaigns vaunting the appeal of retiring in Portugal around that time period might have played a role in the rise of pensioner flows after 2013.

To verify that our results are indeed driven by tax-motivated migration, rather than contemporaneous unrelated shocks, we exploit bilateral *origin-destination-year* specific variation over time in the net-of-tax pension available to retirees from certain countries moving to Portugal. After the introduction of the NHR scheme, Finland's government issued complaints to Portugal as it became concerned that many wealthy retired business executives had moved to Portugal in pursuit of more favorable tax treatment. In 2016, Portugal and Finland signed a new agreement (replacing the one signed in 1970) allowing Finland to tax its retired citizens living in Portugal. However, the document was not ratified by the Portuguese Parliament. The Finnish government thus decided to unilaterally enforce the source-based taxation of pensioners starting in 2018-19.

We study the migration effects of this switch to a source-based taxation of pensions, a specific form of policy response to tax competition for retirees. This variation allows us to estimate migration responses to tax rates while fully controlling for changes in destination-year level amenities A_{jt} that enter our structural error term. Panel A of Figure 6 graphically displays the effects of this policy change. Three main lessons emerge. First, consistent with our findings in Figure 3, the number of Finnish pensioners in Portugal was multiplied by 3 after the introduction of the NHR tax break, relative to the number of Finnish pensioners in Spain. Second, the rate of growth in the *stock* of Finnish seniors in Portugal started to slow down in 2016, after Finland negotiated a new bilateral tax agreement with Portugal that was not ratified. Third, when the Finnish government unilaterally enforced the source-based taxation of its pensioners in 2019, the number of Finnish pensioners in Portugal immediately started to decrease. At the same time, Finnish pensioners in Spain remained stable and close to their pre-2013 level.

Alternatively, we can compare the migration patterns of retirees of various origins within a destination. We exploit the moves of Finnish and Swedish pensioners to Portugal over the period. Sweden is a neighboring country to Finland, characterized by comparable tax rates and a generous pension system, with similar climate and amenities.[22] Our identification assumption is that Finnish and Swedish retirees are similarly affected by any changes in time-varying amenities in Portugal, while only Finnish retirees in Portugal lose eligibility to the NHR regime in 2018. Panel B of Figure 6 evidences that the number of Swedish and Finnish retirees in Portugal were following the exact same trends before 2016, including during the period 2013-2016 when the NHR was available for both origins. As expected, the migration response to the NHR introduction thus had comparable magnitude and dynamics for pensioners from Finland and Sweden. As soon as Finland suspended its tax treaty with Portugal, the two series diverged, and the gap increased after Finnish citizens lost eligibility to the NHR regime in 2019.[23]

Using two alternative designs, Figure 6 thus demonstrates large migration responses of pensioners to source-based taxation, a policy lever peculiarly suited to respond to tax competition for pensioners, given the origin of their income. This finding is robust to contemporaneous changes in age-specific amenities in Portugal and confirms that the NHR's 0% tax break, not other shocks, drives our estimated international migration response.

5 The Role and Consequences of Agglomeration Effects

In this section, we test for the presence of agglomeration effects in the spatial relocation choices of retirees, and study their implications for the migration responses to tax breaks. We present three separate pieces of evidence for agglomeration effects in pensioner mi-

[22]Furthermore, Sweden also decided to terminate its tax treaty with Portugal in 2022, confirming that the two countries also share similar policy environments. We study the short-run migration responses to the delayed introduction of source-based taxation for Swedish retirees in Portugal in Appendix E, and find similar qualitative and quantitative results.

[23]The number of Swedish and Finnish retirees to Spain, on the other hand, evolved similarly over the same period, as shown in appendix Figure C.19.

gration consistent with the theoretical framework of Section 2.4: an asymmetric response to the introduction and repeal of the tax break; suggestive evidence of peer effects in migration; and a strong spatial clustering of old-age migrants within Portugal that sharply rose following the NHR-induced aggregate inflow of foreign pensioners.

5.1 Asymmetric Responses and Hysteresis

While the stock of Finnish pensioners in Portugal was substantially reduced by the introduction of source-based pension taxation in Finland in 2018, Figure 6 shows that it does not fully revert back to its pre-2013 level and remains permanently higher. Rather, the stock of Finnish pensioners in Portugal having peaked at 5 times its pre-NHR level in end-2018, remains around 3 times the pre-reform level even long after the introduction of source-based taxes. This asymmetric response is consistent with the model prediction of Section 2.4 that while the unilateral policy response of one (small) origin country mutes the direct effect of tax breaks on pensioner emigration, it does not counteract the EU-wide increase in pensioner flows to Portugal, and thus the endogenous improvement in age-specific amenities attracting Finnish pensioners to Portugal. Consistent with this interpretation, panel (B) of figure 6 also shows that when *Sweden* later suspended its own tax treaty with Portugal (starting 2021, see appendix E), the stock of Swedish pensioners in Portugal started plateauing too, but at a substantially higher level (about 8.5 times its pre-2012 value) than Finland. While Swedish and Finnish retirees initially flew to Portugal at similar rates form 2013 to 2016, the significantly longer time period of tax-induced accumulation of the stock of Swedish pensioners in Portugal led to a larger cumulative level of inflows, and thus to a permanently higher level of stocks, even after Sweden's policy response. This hysteresis phenomenon is similar to other contexts where temporary shocks exert permanent effects on population stocks, for instance in local labor markets hit by recessions (Yagan, 2019).

We decompose the asymmetric rise and fall in the number of Finnish pensioners in Portugal into the cumulative effects on *outflows* (from Finland to Portugal) and on return migration or *inflows* (from Portugal to Finland) in the left panel of appendix Figure C.20. After the tax treaty repeal, the rate of pensioner emigration from Finland to Portugal dries down and reverts almost fully back to its pre-policy trend. On the other hand, while return migration of Finnish pensioners from Portugal to Finland does increase substantially after the repeal, cumulative return flows after 2018 are significantly smaller than cumulative emigration during the policy period, representing slightly more than half of the initial outflow. This is indeed the expected pattern if Finnish retirees initially drawn to Portugal by the tax cut remain there even after the repeal, due to their perceived improvement in local, pensioner-specific amenities endogenously triggered by the EU-wide inflow of retirees. The asymmetric respective effects of the introduction and repeal of the NHR are also visible when examining patterns of selection among Finnish retirees in Portugal. For instance, as demonstrated in Figure 5, the average pension of Finnish retirees in Portugal (relative to Spain) goes down but remains much larger after the repeal than its pre-reform level, consistent with wealthier Finnish migrant pensioners remaining in Portugal even after the end of the NHR.

5.2 Peer Effects in Origin Countries

We next use the Finnish administrative data to study peer effects in migration upon retirement in origin countries. We aim to determine whether individuals' decisions to retire abroad are influenced by their social networks. Such peer effects could be interpreted as giving rise to agglomeration externalities in the migration decisions of retirees, if the presence of peers abroad improves the perceived amenity value of retiring in a specific destination.

We exploit individual data on lifetime work experiences in Finland to document this mechanism. We use the exhaustive migration records to identify all individuals who relocated abroad between 1991–2012 ("the movers").[24] We then combine this information with comprehensive work history data, which includes encrypted identifiers for firms and establishments. We identify individuals who were employed at the same firm or establishment than any of the movers in a given year during the period 1991-2012. If an

[24]We include not only individuals over 55 from our estimation sample, but also younger individuals to broaden our definition of peers and increase power, recognizing that peers of all ages can influence the decision to move. We focus on the ten most popular destination countries for senior Finns: Sweden, Denmark, Spain, Portugal, Estonia, France, Germany, Norway, the United Kingdom and the United States.

individual was at some point in their career exposed to an individual who moved abroad before 2012, they are considered exposed to peer migration.

We then restrict the sample to the individuals who are over 55 and remained in Finland up to the year 2012. For them, we measure their exposure in two ways: we know (i) if they ever worked during the period 1991-2012 with individuals who moved abroad during the period 1991-2012 (ii) which country $j \in S$ their co-workers moved to. We then estimate the following specification, either for the full sample or conditional on retiring abroad:

$$Y_{ijt} = \alpha + \beta_j \cdot \mathbb{1} \cdot (E_{-i,j} = 1) + \sum_{j' \neq j} \beta_{j'} \cdot \mathbb{1} \cdot (E_{-i,j'} = 1) + u_{it} \tag{8}$$

Where Y_{ijt} is the probability that individual i moves to $j \in S$ in year t after 2012. The variable $E_{-i,j}$ is equal to one if any of individual i's peers, denoted $-i$, have moved to country j before 2012. We estimate Equation (8) separately for each of the ten destinations j.

The coefficient β_j captures the effects of having ever worked in an establishment where some co-workers moved to country j before 2012, on the probability that a senior individual retires in country j after 2012. The coefficients $\beta_{j'}$ capture the effects of having worked with individuals who moved to other destination countries j' before 2012, on the probability to retire in country j after 2012. If peer effects are destination-specific (e.g. the probability to move to Portugal is increased by having people in one's social network who moved to Portugal before), β_j should be larger than $\beta_{j'}$. On the other hand, if an individual probability to retire in a given destination is only affected by knowing other people who retired abroad, but not to that specific destination, β_j and all the $\beta_{j' \neq j}$ should be of similar magnitude. Moreover, detecting any large effect of exposure to peers who moved to j' on an individual's propensity to move to j could also be the sign that our design simply captures self-selection in migration rather than true peer effects. For instance, highly educated individuals are more likely to retire abroad but also more likely to work in similar establishments.

In Figure 7, we plot the estimated coefficients of interest, β_j, along with the series of $\beta_{j'}$, estimated separately for Denmark (Panel A), Estonia (Panel B), Norway (Panel C), and

France (Panel D) as destination countries. A consistent pattern emerges across all panels: individuals who were previously exposed to peers who migrated to a specific destination are significantly more likely to retire in that same country. In contrast, the impact of exposure to peers who retired in other destination countries is smaller, with effects centered around and generally not statistically distinct from zero.[25] This helps alleviate concerns that our measure of exposure to peers moving to a particular destination could be highly correlated with other factors also affecting the overall probability to move; for instance if past co-workers exhibit similar education or skill level than the focal individual on average. While self-selection may still partly explain the patterns observed in Figure 7 –given that individuals are not randomly assigned to past establishments– we consider the likelihood of selection based on destination-specific factors to be less likely.

After documenting that social networks influence not only the decision to retire abroad but also the choice of *where* to retire, we proceed to study peer effects in tax-driven migration. We begin with the estimation sample used in Equation (8), focusing on individuals aged 55 and older who remained in Finland until 2012. We split this sample between those who ever had co-workers, during the period 1991-2012, who moved to Portugal *before* 2012; and those who were never exposed to co-workers moving to Portugal before 2012. We then plot, for each of those groups, their likelihood to move to Portugal *after* 2012. The series in Figure 8 show evidence that migration responses to the Portuguese tax scheme were larger for individuals with any past exposure to peers who moved to Portugal before 2012. When considered together, Figure 7 and Figure 8 provide suggestive evidence that peer effects in origin countries govern the decision to retire in a given country, and therefore also contribute to heterogeneity in tax-induced migration decisions.

5.3 Agglomeration Effects and Local Concentration

Finally, we provide additional evidence of the presence of agglomeration effects in pensioner migration, using the location patterns of foreign retirees *within* destination countries. To do so, we exploit granular data on migration by age and citizenship across 3092

[25] Appendix Tables C.6 and C.7 show the country-by-country estimates of Equation (8) for, respectively, the full sample of seniors in Finland in 2012, and only those who moved abroad (anywhere) after 2012.

Portuguese parishes (*freguesias*).

First, in the cross-section, we find that pensioner location choices empirically exhibit substantial spatial concentration across local townships, compared to working-age movers. Using 2021 data on recent migrants to Portugal reported at the parish-level fine spatial scale, we find significant excess concentration of old-age international movers. Panels (A) and (B) of Figure 9 display the unweighted distribution of pensioner immigrant shares and prime-age immigrant shares across parishes. The right skew (relative to the mean share, depicted by a vertical dashed line) indicates substantial spatial concentration of retiree migration, potentially owing to the endogenous provision of age-specific amenities acting as an agglomeration force. The dissimilarity index measuring the relative concentration of immigrants aged 55 or more (relative to all immigrants) across parishes in Portugal is 0.29, while the corresponding measure for prime-age movers (25-40) is 0.16.

Second, instead of being uniform across space, the bulk of the *increase* in the total number of EU pensioners living in Portugal during the NHR period occurred in locations with a high initial share of foreign EU pensioners in their population. Standard regression to the mean would predict that parishes with a high 2011 initial exposure to EU pensioners would face a *smaller* increase in the foreign pensioner share over time. In contrast, during the period 2011-2021,[26] the exact reverse occurs. Parishes with a high initial share of foreign pensioners witness a *larger* increase in their foreign pensioners population share, in a non-linear pattern evidenced in panel (A) of Figure 10. Such a "great divergence" is suggestive of age-specific agglomeration effects (Diamond, 2016). Consistent with these forces operating through age-targeted amenities, we observe no correlation between the 2011-2021 change in the *young* (20-40) EU migrant share and the initial EU foreign pensioner share. Therefore, locations that attract and concentrate the large inflows of tax-motivated retirees through endogenous agglomeration are exclusively attracting migrants in a specific age class, not all EU immigrants to Portugal. Quantitatively, panel (B) of Figure 10 shows that of the nationwide increase in the number of foreign pensioners (EU, plus Switzerland and UK) living in Portugal, 88% (pop weighted: 83%) occurred in parishes in

[26] We use 2011 and 2021 since these correspond to two decennial census waves for which we have detailed local level information.

the top half of initial EU pensioner population share, and 67.5% (pop. weighted: 71.5%) in parishes in the top quartile of initial exposure.

Additionally, we examine the evolving distribution of the share of old-age migrants among all migrants in a parish, after the NHR reform triggered a large exogenous inflow of foreign pensioners to Portugal. As shown in appendix Figure C.22, before the NHR reform, the shares of pensioners among migrants were relatively homogeneous (and small) across *freguesias*. After the reform, however, the senior migration share not only increases on average, but exhibits substantially more dispersion, indicating a large rise in the spatial concentration of pensioner migrants. By 2021, nine years after the introduction of the NHR, the spatial concentration of pensioner migration across Portuguese parishes had dramatically risen, consistent with the presence of self-sustaining and age-specific agglomeration forces. From 2011 to 2021, the standard deviation of the share of pensioners among all migrants rose by 19%; and the difference in this share between the 90th and 10th percentile of parishes rose by 67%. Our tests for agglomeration effects in pensioner migration are reminiscent of those conducted by Leonardi and Moretti (2023), who study the rise in the spatial concentration of establishments following a large inflow of new restaurants in Milan after a reform liberalized entry in 2005.[27]

A model without endogenous agglomeration would imply that the tax break generates a uniform increase in the share of foreign pensioners across Portuguese localities. Instead, the departure from this prediction provides *prima facie* evidence that, even within country, internationally mobile pensioners target locations with suitable age-specific amenities and an already established community of foreign pensioners, triggering a self-reinforcing cycle of age-based agglomeration and concentration. This is consistent with our model in which large estimated migration elasticities are the product of age-specific social amenity multipliers that compound the effect of tax cuts on foreign pensioner inflows.

[27]As in the case of Milanese restaurants, the rise in the spatial concentration of internationally mobile pensioners after the "big push" of the NHR is consistent with self-reinforcing agglomeration forces.

5.4 Tax Policy Implications of Agglomeration in Migration

Finally, we explore the implications of agglomeration effects for the revenue-maximizing tax policy and the design of policy responses to tax competition. The optimal tax policy rule is affected by the presence of agglomeration externalities, due to amplification and cross-base effects. We assume that a government in a specific destination country implements a tax policy to maximize overall revenue, and, consistent with the case of pensioners, migration is the only response to taxation. Each potential migrant group k (with fixed taxable income Y_k) can be targeted with a special income tax rate τ_k. A revenue-maximizing government seeks to maximize:

$$\max TR = \max \sum_k L_k(1-\tau_k, A_k)\tau_k Y_k$$

The problem yields a set of first-order conditions:

$$Y_k L_k(1-\tau_k) = \sum_i \tau_i L_i Y_i(\epsilon_{L_i,(1-\tau_k)} + \epsilon_{L_i,A_i} \sum_j \eta_{A_i,L_j} \epsilon_{L_j,(1-\tau_k)}) \tag{9}$$

where $\epsilon_{L_i,(1-\tau_k)}$ is the elasticity of the number of i people to the net-of-tax rate on k, by ϵ_{L_i,A_i} the elasticity of the number of i people to their group-specific amenity, and by η_{A_i,L_j} the agglomeration elasticity in amenities for i stemming from the size of group j. Making the natural assumption that group i's migration is only directly sensitive to the tax rate on its own group i, we can specialize to $\epsilon_{L_i,(1-\tau_k)} = 0$ if $i \neq k$. We then have a set of optimal tax formulas for all k:

$$\frac{1-\tau_k}{\tau_k} = \epsilon_{L_k,(1-\tau_k)}(1 + \sum_i \frac{\tau_i L_i Y_i}{\tau_k L_k Y_k} \epsilon_{L_i,A_i} \eta_{A_i,L_k}) \tag{10}$$

The standard optimal tax rule with a migration option ($\frac{1-\tau_k}{\tau_k} = \epsilon_{L_k,(1-\tau_k)}$), corresponds to a special case with no agglomeration ($\eta_{A_i,L_k} = 0 \; \forall(i,k)$) in our setting. Our formula for the Laffer rate differs from this inverse elasticity formula in several ways. First, the "own-migration" elasticity is amplified by endogenous agglomeration. Indeed, in the special case where endogenous amenities for a given group only depend on the number of people from the same group ($\eta_{A_i,L_k} = 0$ if $i \neq k$), we can rewrite 10 as:

$$\tau_k = \frac{1}{1 + \epsilon_{L_k,(1-\tau_k)}(1 + \epsilon_{L_k,A_k}\eta_{A_k,L_k})} \tag{11}$$

Second, the revenue-maximizing tax rule in 10 takes into account fiscal externalities arising from the (tax-revenue weighted) cross-base change in amenities triggered by the tax-induced migration of each group. The tax rate on group k will be set lower, the more other (larger, higher income, higher tax rate, and more mobile) groups value the presence of group k members in their location choice.

Third, our formula shares features of the optimal coordinated place-based transfer found in Fajgelbaum and Gaubert (2020). While we consider the case of uncoordinated revenue-maximizing tax policy from the perspective of a single location, cross-group amenity agglomerations must be taken into account when setting tax and transfer rates on each constituency. This also implies that even uncoordinated tax policies may not be exclusively "beggar-thy-neighbor", due to the presence of agglomeration benefits.

Our evidence of agglomeration effects and a self-reinforcing pattern of retiree location choices implies that beyond migration elasticities, cross-group agglomeration effects are important parameters in defining policy trade-offs when setting targeted tax breaks. In destination countries, such group-specific agglomeration forces can rationalize aggressive but temporary tax breaks designed to permanently reshape the location patterns of those groups most prone to agglomerate. Analogous to "big push" industrial policies, a "big pull" tax policy durably improves endogenous group-specific amenities by permanently shifting up the stock of immigrants, making it difficult to reverse. Beyond the example of pensioners, many groups targeted by migrant tax schemes have been shown to display evidence of agglomeration and peer effects (Gruber, Johnson, and Moretti, 2023), potentially justifying such "big pull" policies.

6 Discussion of findings

This paper demonstrates and explains the quantitatively large mobility response of retirement-age individuals to tax differentials across countries. Pensioners offer attractive features to empirically study tax-induced migration. Because their pre-tax income is determined in their country of origin, in most cases it is unaffected by their location decision, since it consists of a nominally fixed pension. As a consequence, while prices, amenities, and personal ties to a location could affect the spatial mobility of retirees, they are mostly indifferent to labor market considerations in the destination region, muting a key endogeneity concern when examining the relationship between taxation and relocation. In spite of this, pensioners have been mostly absent from the literature on income taxation and its consequences, since they can no longer adjust labor supply. By contrast, the migration decision represents their main adjustment margin when facing high tax burdens.

The mobility response of pensioners to taxation also has distinct policy implications, compared to working-age movers. First, to attract or retain *workers* through the tax code, tax rates are the sole resource available to governments. By contrast, in publicly controlled pension systems, governments have the ability to modulate the level of pensions at source. They can condition their payment or their tax treatment to pensioners' residence choices. As a consequence, the portability of pension rights – one of the major stumbling points during the Brexit negotiations between the UK and the EU – is a crucial aspect of cross-country coordination. Conditioning the benefits of pensioners to residence choices can therefore represent an essential policy lever for origin countries when responding to tax competition for retirees, although coordination among origin countries determines the effectiveness of such a policy response.[28]

Second, our findings that agglomeration effects can explain the amplified and persistent response of some groups to targeted tax policies has broader implications for international tax competition. Similar forces could operate, for example, in the global competition

[28]One extreme example of retaining such control in the source country is the practice of "frozen" State pensions paid by the United Kingdom to pensioners living abroad in most of the Commonwealth. Only UK pensioners living in the European Economic Area and a few countries with a reciprocity agreement benefit from the same inflation-indexed yearly pension increases as pensioners residing in the UK.

for firms. If low corporate tax rates or loose regulatory scrutiny initially attract a sufficient mass of firms, business services (like law practices and banks) can endogenously agglomerate in that destination, making it an attractive place to establish firm headquarters – even after the end of the initial pull factor, be it bank secrecy or tax haven status.

Finally, foreign pensioners do not participate in the labor market, but consume non-tradables locally with incomes drawn from abroad. If pensioners at the top of the income distribution are particularly responsive to international tax differentials, targeted tax exemption schemes constitute a form of industrial policy, and a potent instrument to foster local economic development in the destination localities where migrating pensioners cluster. Such concentrated local economic effects, explored in Badilla et al. (2024), are a fruitful area for future research.

References

Abadie, Alberto, Alexis Diamond, and Jens Hainmueller (2010). "Synthetic control methods for comparative case studies: Estimating the effect of California's tobacco control program". *Journal of the American statistical Association* 105.490, pp. 493–505.

Agersnap, Ole, Amalie Jensen, and Henrik Kleven (2020). "The welfare magnet hypothesis: Evidence from an immigrant welfare scheme in Denmark". *American Economic Review: Insights* 2.4, pp. 527–542.

Agrawal, David R and Mohammed Mardan (2019). "Will destination-based taxes be fully exploited when available? An application to the US commodity tax system". *Journal of Public Economics* 169, pp. 128–143.

Agrawal, David R, James M Poterba, and Owen M Zidar (2024). *Policy Responses to Tax Competition*. Tech. rep. National Bureau of Economic Research.

Akcigit, Ufuk, Salomé Baslandze, and Stefanie Stantcheva (2016). "Taxation and the international mobility of inventors". *American Economic Review* 106.10, pp. 2930–2981.

Almagro, Milena and Tomás Domínguez-Iino (2024). *Location sorting and endogenous amenities: Evidence from amsterdam*. Tech. rep. National Bureau of Economic Research.

Auerbach, Alan J et al. (2017). “Destination-based cash flow taxation”. *Oxford University Centre for Business Taxation* WP 17/01.

Badilla, Marco et al. (2024). *Senior Migration, Local Economic Development and Spatial Inequality*. Tech. rep.

Cho, Dooyeon and Kyung-woo Lee (2022). “Population aging and fiscal sustainability: Nonlinear evidence from Europe”. *Journal of International Money and Finance* 126.

Coile, Courtney and Jonathan Gruber (2007). “Future social security entitlements and the retirement decision”. *The Review of Economics and Statistics* 89.2, pp. 234–246.

Conway, Karen Smith and Jonathan C Rork (2012). “No country for old men (or women) – Do state tax policies drive away the elderly?” *National Tax Journal* 65.2, pp. 313–356.

Cunningham, Christopher R and Gary V Engelhardt (2008). “Housing capital-gains taxation and homeowner mobility: evidence from the Taxpayer Relief Act of 1997”. *Journal of urban Economics* 63.3, pp. 803–815.

Diamond, Rebecca (2016). “The determinants and welfare implications of US workers’ diverging location choices by skill: 1980–2000”. *American Economic Review* 106.3, pp. 479–524.

Dougherty, Sean, Pietrangelo de Biase, and Luca Lorenzoni (2022). *Funding the future: The impact of population ageing on revenues across levels of government*. OECD Working Papers on Fiscal Federalism 39. Organisation for Economic Co-operation and Development (OECD).

Duflo, Esther and Emmanuel Saez (2002). “Participation and investment decisions in a retirement plan: The influence of colleaguesâ choices”. *Journal of public Economics* 85.1, pp. 121–148.

Elmendorf, Douglas W and Louise M Sheiner (2000). “Should America save for its old age? Fiscal policy, population aging, and national saving”. *Journal of Economic Perspectives* 14.3, pp. 57–74.

Fajgelbaum, Pablo D and Cecile Gaubert (2020). “Optimal spatial policies, geography, and sorting”. *The Quarterly Journal of Economics* 135.2, pp. 959–1036.

Glaeser, Edward L, Bruce I Sacerdote, and Jose A Scheinkman (2003). “The social multiplier”. *Journal of the European Economic Association* 1.2-3, pp. 345–353.

Gruber, Jonathan, Simon Johnson, and Enrico Moretti (2023). "Place-Based Productivity and Costs in Science". *Entrepreneurship and Innovation Policy and the Economy* 2.1, pp. 167–184.

Kauppinen, Ilpo and Panu Poutvaara (2023). "Decomposing Migrant Self-Selection: Education, Occupation, and Unobserved Abilities".

Kleven, Henrik et al. (2020). "Taxation and migration: Evidence and policy implications". *Journal of Economic Perspectives* 34.2, pp. 119–142.

Kleven, Henrik Jacobsen, Camille Landais, and Emmanuel Saez (2013). "Taxation and international migration of superstars: Evidence from the European football market". *American Economic Review* 103.5, pp. 1892–1924.

Kleven, Henrik Jacobsen et al. (2014). "Migration and wage effects of taxing top earners: Evidence from the foreigners' tax scheme in Denmark". *The Quarterly Journal of Economics* 129.1, pp. 333–378.

Komissarova, Kristina (2022). *Location choices over the life cycle: The role of relocation for retirement*. Tech. rep. mimeo.

Lee, Ronald and Ryan Edwards (2002). "The fiscal effects of population aging in the US: Assessing the uncertainties". *Tax Policy and the Economy* 16, pp. 141–180.

Leonardi, Marco and Enrico Moretti (2023). "The agglomeration of urban amenities: Evidence from Milan restaurants". *American Economic Review: Insights* 5.2, pp. 141–157.

Manoli, Day and Andrea Weber (2016). "Nonparametric evidence on the effects of financial incentives on retirement decisions". *American Economic Journal: Economic Policy* 8.4, pp. 160–182.

McCarthy, Helen (2018). "The End of the Retirement Dream? British Pensioners in the European Union after Brexit". *Migration Policy Institute Europe Brief* 10.

Molloy, Raven, Christopher L Smith, and Abigail Wozniak (2011). "Internal migration in the United States". *Journal of Economic perspectives* 25.3, pp. 173–196.

Moretti, Enrico and Daniel J Wilson (2017). "The effect of state taxes on the geographical location of top earners: Evidence from star scientists". *American Economic Review* 107.7, pp. 1858–1903.

Muñoz, Mathilde (2021). "Do European top earners react to labour taxation through migration?"

Munshi, Kaivan (2003). "Networks in the modern economy: Mexican migrants in the US labor market". *The Quarterly Journal of Economics* 118.2, pp. 549–599.

Oral, Emre, Simon Rabate, and Arthur Seibold (2024). *The Social Multiplier of Pension Reform*. Tech. rep.

Poterba, James et al. (2007). "Defined contribution plans, defined benefit plans, and the accumulation of retirement wealth". *Journal of public economics* 91.10, pp. 2062–2086.

Rauh, Joshua and Ryan Shyu (2024). "Behavioral responses to state income taxation of high earners: evidence from California". *American Economic Journal: Economic Policy* 16.1, pp. 34–86.

Santos, João Pereira dos and Kristina Strohmaier (2024). *All That Glitters? Golden Visas and Real Estate*. Tech. rep. IZA Discussion Paper.

Shan, Hui (2010). "Property taxes and elderly mobility". *Journal of Urban Economics* 67.2, pp. 194–205.

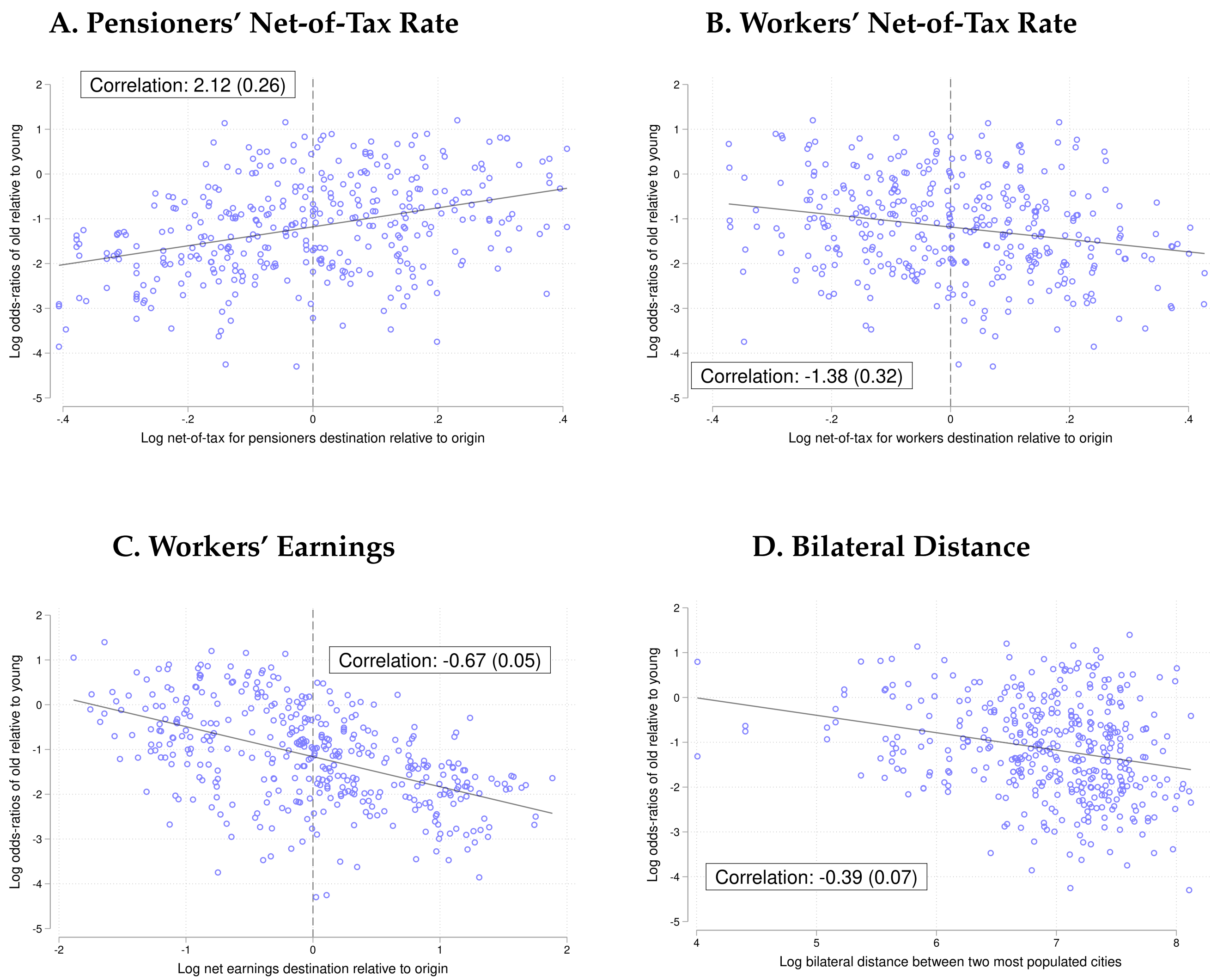
Ward, Russell A, Mark LaGory, and Susan R Sherman (1985). "Neighborhood and network age concentration: Does age homogeneity matter for older people?" *Social Psychology Quarterly*, pp. 138–149.

Wilson, John Douglas and David E Wildasin (2004). "Capital tax competition: bane or boon". *Journal of Public Economics* 88.6, pp. 1065–1091.

Yagan, Danny (2019). "Employment hysteresis from the great recession". *Journal of Political Economy* 127.5, pp. 2505–2558.

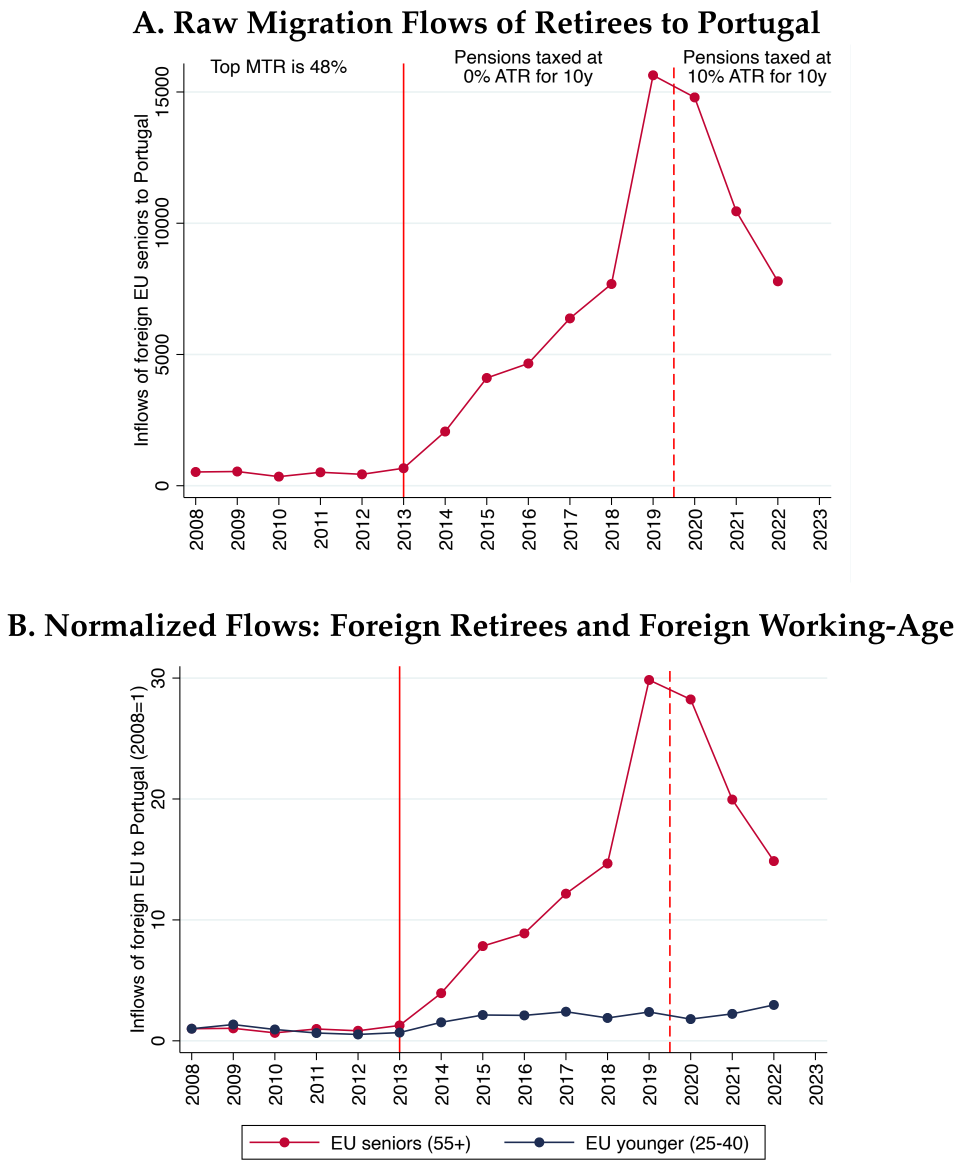
Main figures

Figure 1: **Correlates of Migration Flows of Pensioners vs Workers in the EU**



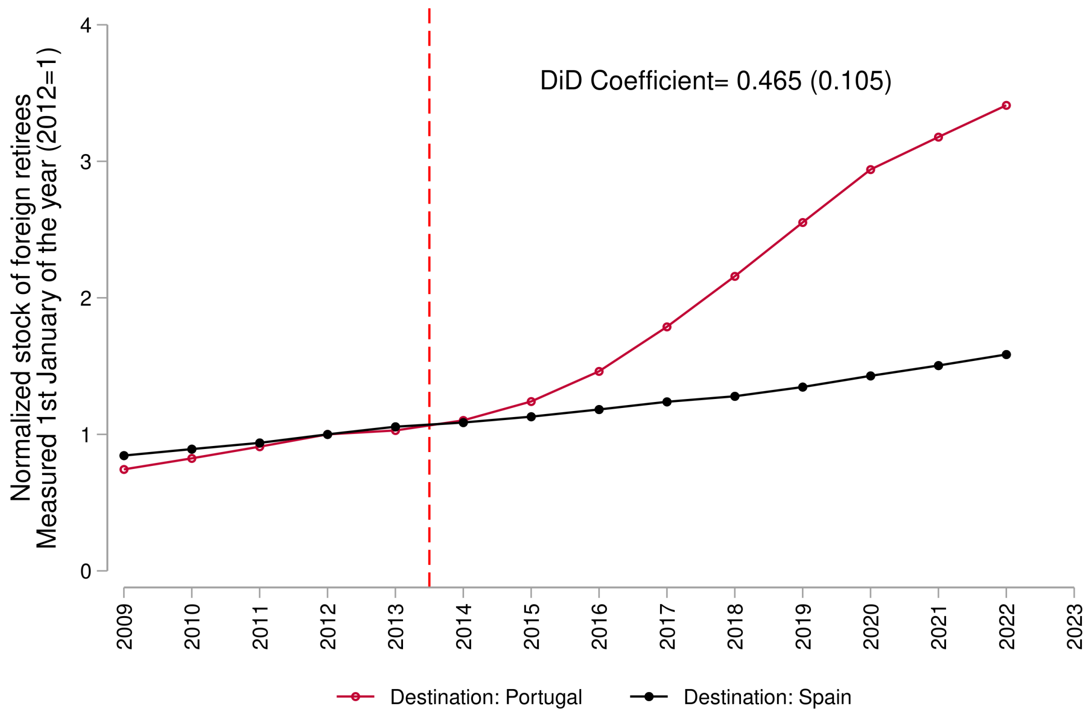
Notes: This figure shows the cross-country relationship between (log) old-young odds-ratio (defined in Equation 3) and log) pensioners' net-of-tax rates ratio (panel A), the (log) workers' net-of-tax rates ratio (panel B), the (log) average wages ratio (panel C), and the log bilateral distance (panel D). We focus on all destination-origin pairs in our EU-wide dataset for year 2022. In each figure, we show the best linear fit using an unweighted, univariate regression. The coefficients and standard errors reported in the figures are obtained by regressing the y-axis outcome on the x-axis outcome. Data are obtained from Eurostat, national censuses, the OECD Taxing Wages and Pensions at a Glance databases, and the CEPII international trade database.

Figure 2: **Migration Flow Responses to the Portuguese Tax Break for Retirees**



Notes: Panel A displays aggregate trends in raw international migration flows to Portugal from all EU origin seniors (aged 55 or more) from 2008 to 2023. Panel B compares the normalized flows to Portugal of foreign EU seniors (treated, red series) to EU working-age movers (control, blue series), before and after the NHR reduced the income tax rate to 0% for foreign retirees moving to Portugal while providing younger workers with a partial tax benefit of a flat 20% rate if they belonged to high-value added specialty occupations. Both series are normalized to one in the pre-reform year (2012). The first vertical solid line marks the introduction of the NHR scheme in 2013, and the second dashed line indicates the curtailement of the regime after 2020. Data are obtained from SEFStat, the annual statistical reports of SEF (*Servico de Estrangeiros e Fronteiras*).

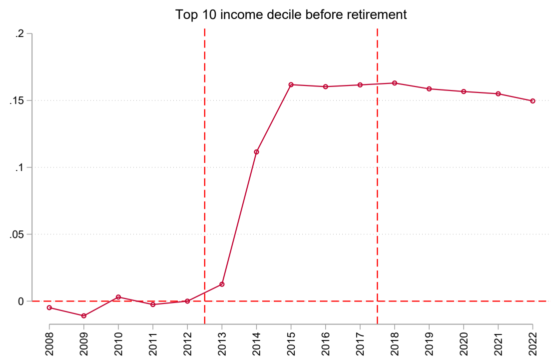
Figure 3: **Effect of the Tax Cut on Stock of Foreign Retirees in Portugal**



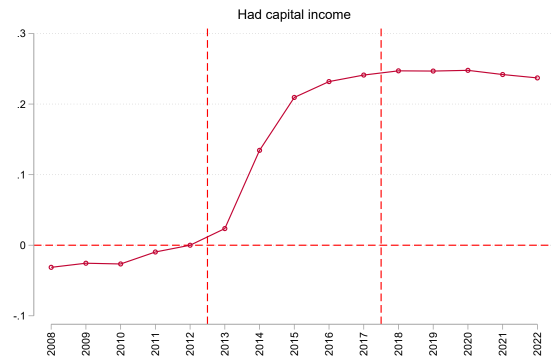
Notes: This figure shows the stock of foreign EU retirees in Portugal (treated, red series) and Spain (control, blue series), before and after a reform (vertical red dotted line) reduced the income tax rate to 0% for foreign retirees moving to Portugal. All series are normalized to one in the pre reform year (2012). The difference-in-difference coefficients from equation 5 is displayed, along with the estimate of the standard error. Data are obtained from Eurostat, the European statistical office (population by age group and citizenship as of January 1 of each year), complemented when missing with data from national Censuses.

Figure 4: **Selection of Retirees into Tax-Induced Migration: Characteristics**

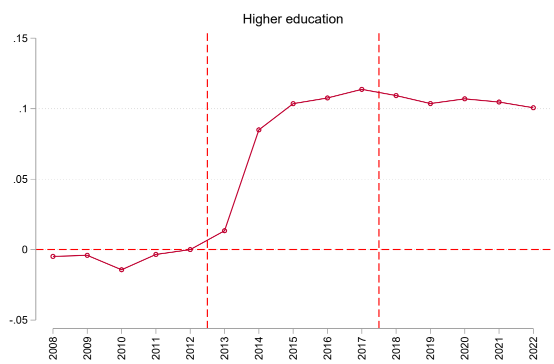
(a) **Share with earnings in top decile**



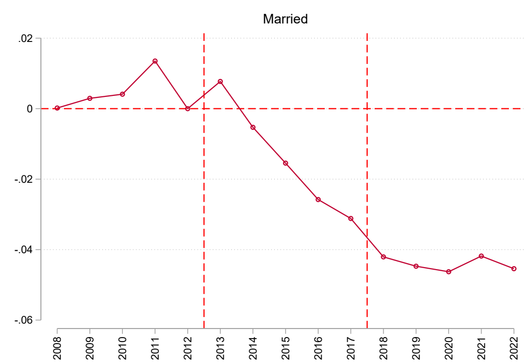
(b) **Share with any capital income**



(c) **Share with higher education**



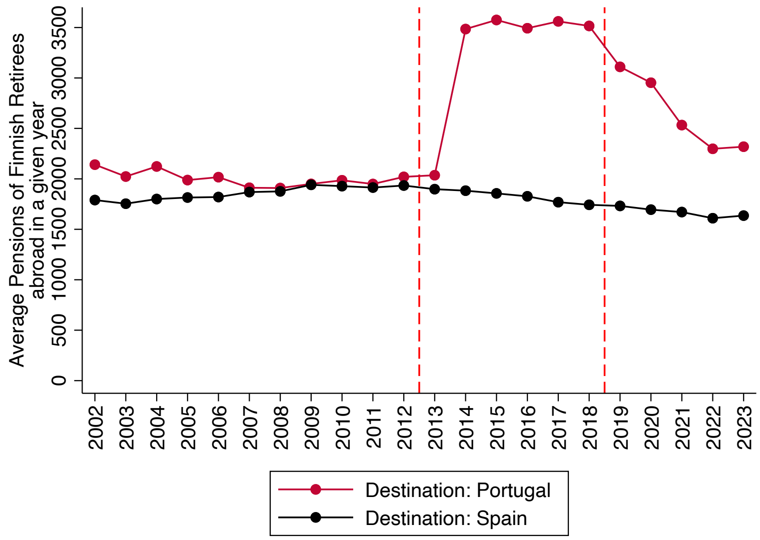
(d) **Share married**



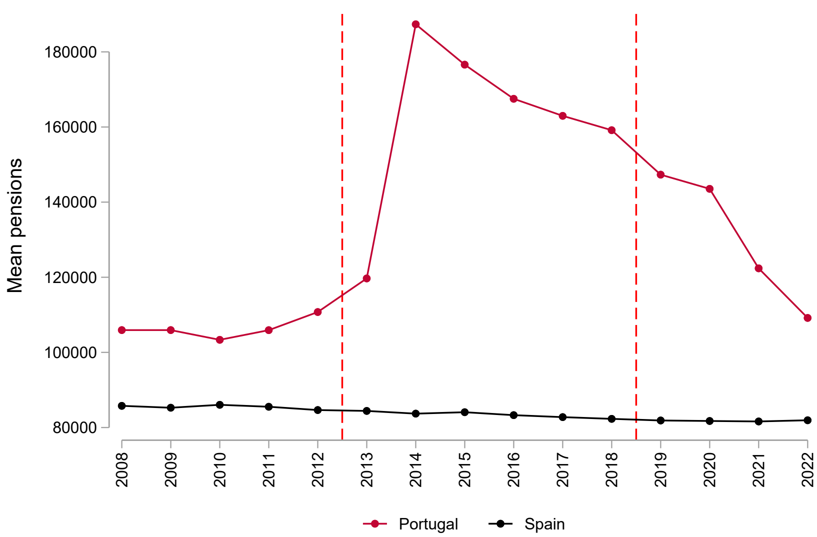
Notes: This figure displays the difference in average characteristics in the stock of Finnish pensioners living in Portugal (treatment group) and Spain (control group), focusing on different demographic features. It highlights changes before and after the NHR reform reduced the income tax rate to 0% for foreign retirees (first vertical red dotted line), and after the repeal of the Finland-Portugal tax treaty (second vertical line). The average characteristics are computed by matching the Finnish population-wide migration register data (starting in 1991) to administrative income tax data, adjusting the sample in each country annually for new incoming migrants and return migration to Finland. The calculation of stocks is explained in detail in Appendix G.1. The difference is normalized to zero in the immediate pre-reform year (2012).

Figure 5: **Selection of Retirees into Tax-Induced Migration: Pensions and Earnings**

A. Average Pensions

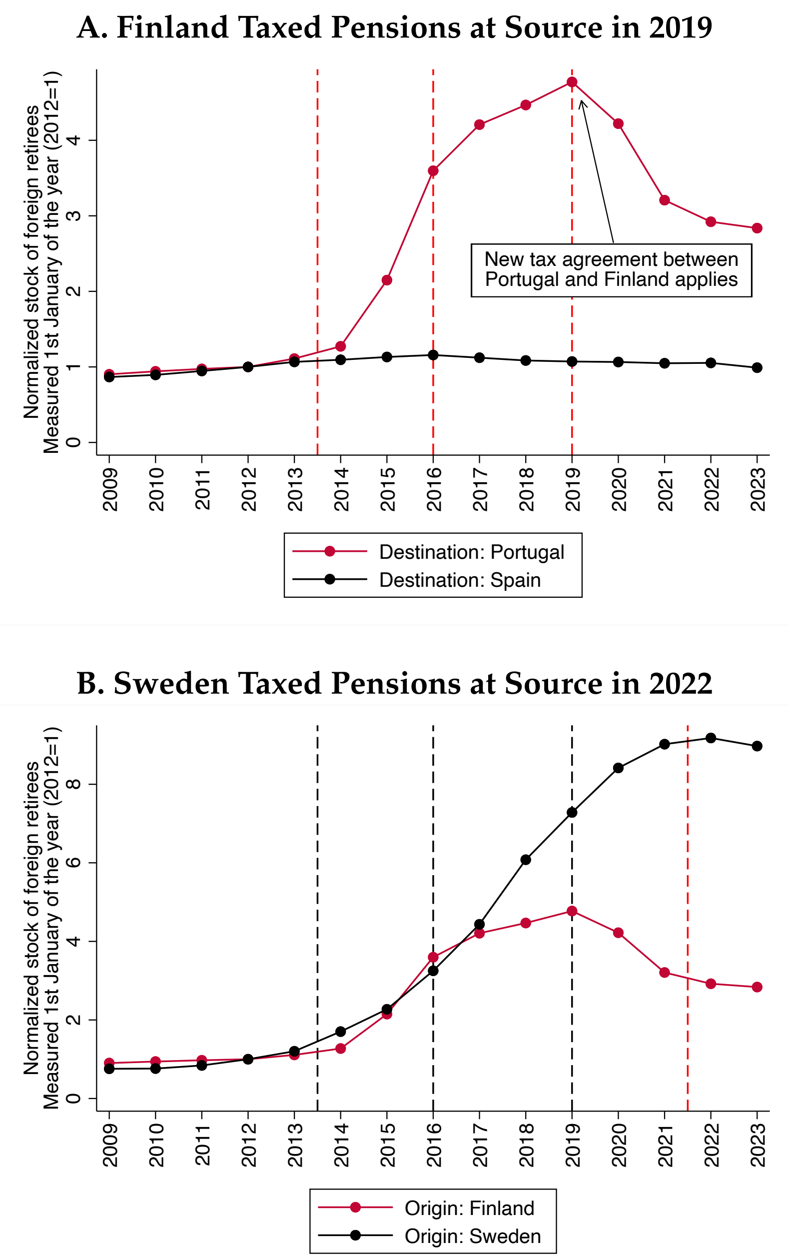


B. Top 10% of Pensions Received by Finns Retired in Portugal



Notes: Panel A shows the average pension received by Finnish retirees located in Portugal (treated, red series) and in Spain (control, blue series), before and after a reform (first vertical red dotted line) reduced the income tax rate to 0% for foreign retirees moving to Portugal; and after the repeal of the Finland-Portugal tax treaty (second vertical line). Panel B displays the average pensions for the top 10% of pensioners who move to Portugal or Spain each year. In the pre-period, pensioners are ranked based on their pensions in two-year intervals, while in the post-period, this ranking occurs annually. For each period, the top 10% of pensioners are identified and added to the existing stock of top 10% pensioners, after which the average pension for this group is calculated.

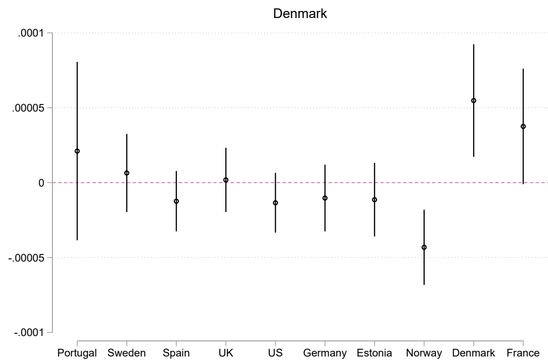
Figure 6: **Asymmetric Effects of Cutting the Tax Advantage for Retirees from Finland**



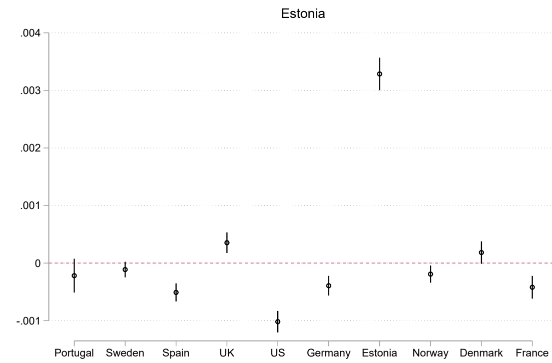
Notes: Panel A shows the stock of foreign Finnish retirees in Portugal (treated, red series) and in Spain (control, blue series). Panel B shows the stocks of retirees in Portugal originating from Finland (treated, red series) and from Sweden (control, blue series). The first three vertical lines in both panels indicate the NHR reform (first vertical red dotted line) which reduced the income tax rate to 0% for foreign retirees moving to Portugal; the renegotiation of the Finland-Portugal tax treaty (second vertical line); and its full repeal (third vertical line). The fourth vertical line in the bottom panel indicates the repeal of the Sweden-Portugal tax treaty. All series are normalized to one in 2012. Data are obtained from Eurostat, the European statistical office (population by age group and citizenship as of January 1 of each year)

Figure 7: **Establishment-Level Peers' Past Location Choices and Own Migration**

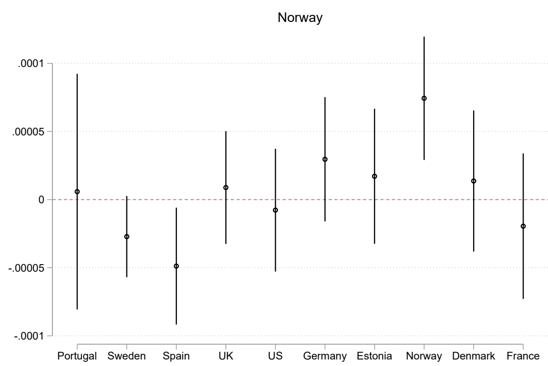
A. Retiring in Denmark



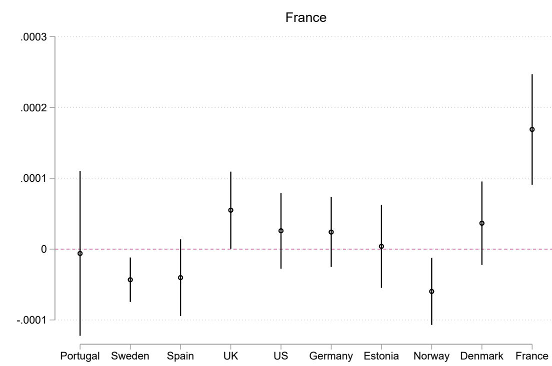
B. Retiring in Estonia



C. Retiring in Norway

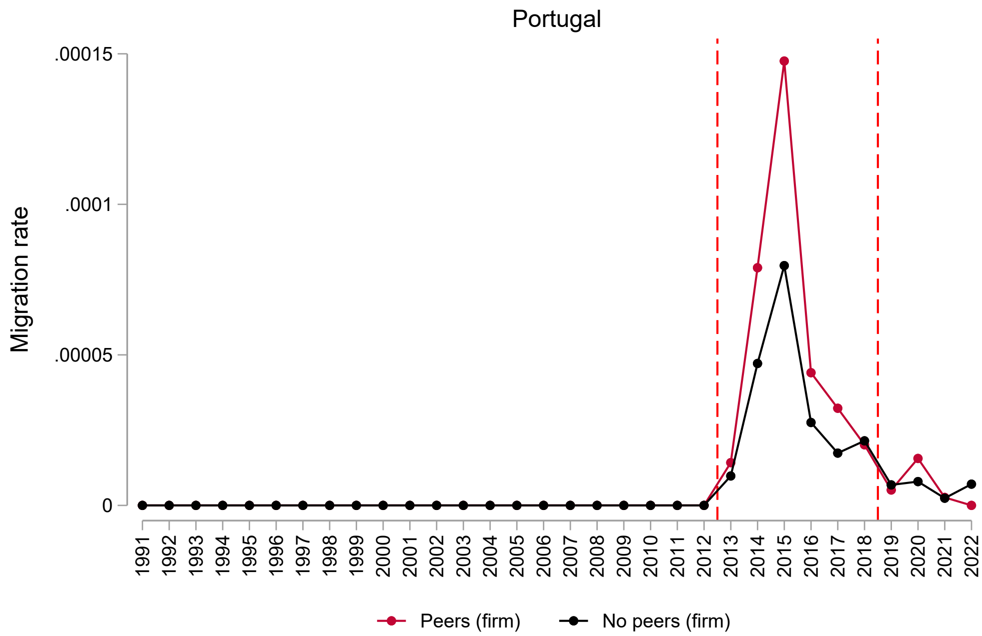


D. Retiring in France



Notes: This figure shows estimates of β_j and $\beta_{j'}$ from Equation (8), estimated separately for Portugal (panel A), Spain (panel B), Sweden (panel C) and France (panel D) as destination countries. In each panel, the outcome variable is the probability that individuals aged 55 or older retire in that specific destination after 2012. The coefficients capture how the probability to retire in Portugal (panel A), Spain (panel B), Sweden (panel C) and France (panel D) is affected by having worked with peers who moved (before 2012) to each country on the y-axis. Data come from matching the exhaustive migration registry for the post-2013 period to 1991-2012 work history FOLK dataset and peers are defined by co-workers in the same establishment-year pair (see appendix G.1).

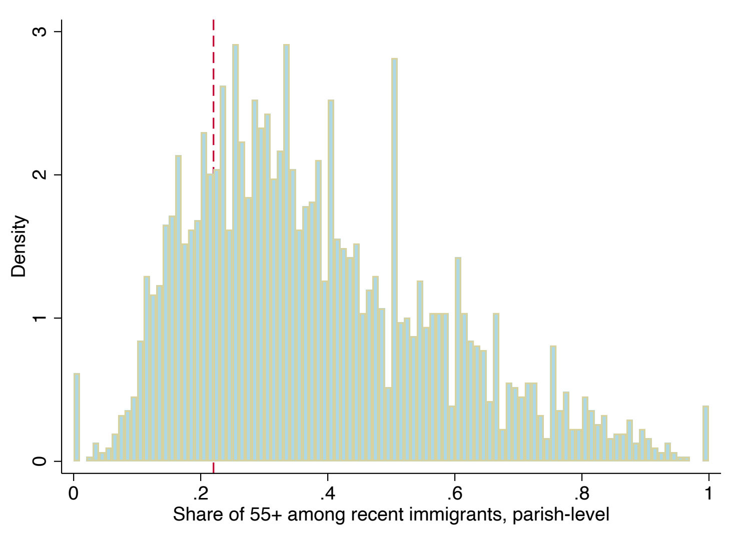
Figure 8: **Peer-Effects at Origin in Migration Responses to Taxes**



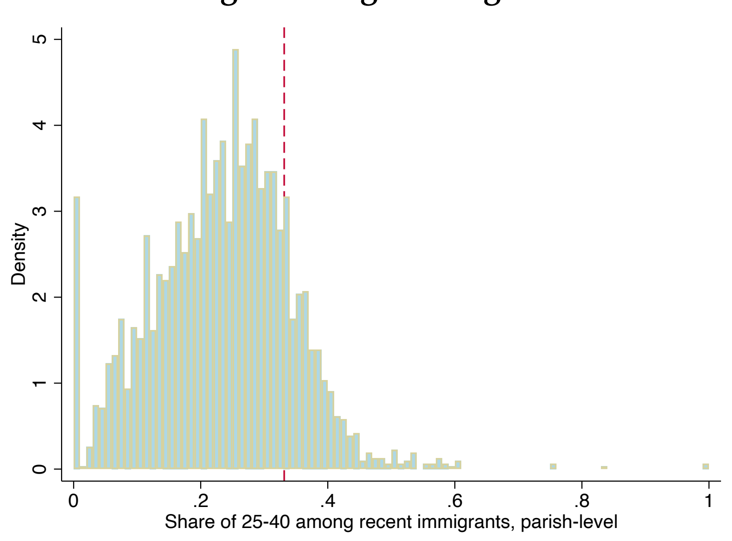
Notes: This figure shows senior migration from Finland to Portugal between 2013 and 2022, for those exposed (red series) and not exposed (dark series) to co-workers who moved to Portugal between 1991 and 2012. We consider all individuals who remained in Finland up to 2012 and are aged 55 years or older in 2012. For those individuals, we measure if they worked during the period 1991-2012 at the same firm as those who moved to Portugal between 1991-2012. We then construct the two groups of exposed and not exposed individuals, and plot their migration rate to Portugal between 2013 and 2022. The migration probabilities between 1991 and 2012 are zero by design, as all individuals who moved before 2012 have been excluded. The first vertical red line indicates the introduction of the 0% tax rate for foreign pensioners in Portugal. The second vertical red line indicates the repeal of the tax regime for Finns in Portugal.

Figure 9: **Spatial Concentration of Foreign Migrants by Age within Portugal**

A. Foreign EU Migrants Aged 55 or more



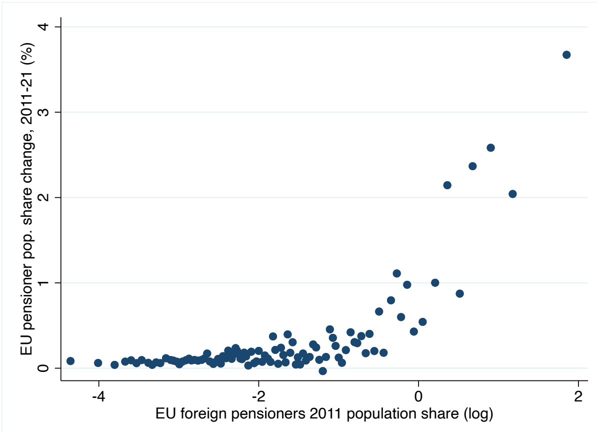
B. Foreign EU Migrants Aged 25-40



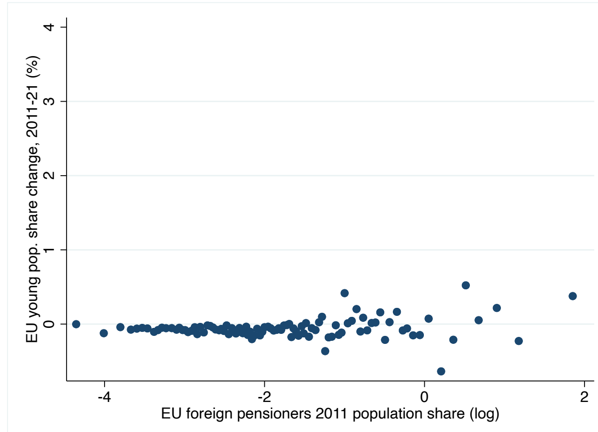
Note: This figure plots the distribution of the shares of movers of a given age group among all migrants arrived within the last ten years in a Portuguese parish (*freguesia*), across 3091 parishes as of January 2021. The vertical dashed lines denote the respective national average shares of each age group in total recently arrived migrants. Data are taken from the 2021 decennial census of Portugal.

Figure 10: **Evidence of Age-Specific Agglomeration in Migration Responses to Taxes**

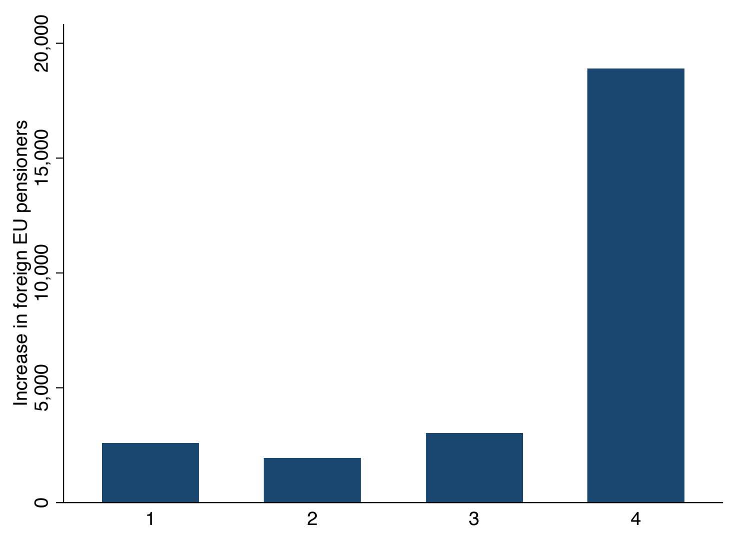
A. Diverging Share of Foreign Pensioners After the Reform



B. No Correlation with Change in Younger Migrants



C. Spatial Concentration of Pensioners Inflows



Note: This figure shows evidence of age-specific agglomeration forces in migration responses to the tax break. Panel (A) shows that parishes with a high initial population share of European seniors (55+) also experience a larger increase in the share of senior European migrants from 2011 to 2021. Panel (B) shows that these same parishes do not experience a differential rise in the population share of *young* (20-40) European migrants. Panel (C) decomposes the overall increase in the total number of European pensioners in Portugal across four equally-populated quartiles of parishes, ranked by their initial share of EU pensioners in the population. Data are taken from the 2021 and 2011 decennial censuses of Portugal.

Main tables

Table 1: **Migration Elasticity Estimates**

	IV		TWFE
	Pension=EUR 24,000 Log(1-ATR)	Pension=EUR 35,000 Log(1-ATR)	Treat × Post
A. Only Spain as the control			
Average (N=28)			
A1. Retirees 55+	2.046***	1.662***	0.465***
	(0.521)	(0.415)	(0.105)
A3. Retirees 65+	2.593***	2.107***	0.589***
	(0.625)	(0.497)	(0.125)
Long-term (N=18)			
A3. Retirees 55+	3.331***	2.692***	0.739***
	(0.372)	(0.285)	(0.053)
A4. Retirees 65+	4.127***	3.336***	0.915***
	(0.430)	(0.328)	(0.058)
Short-term (N=18)			
A5. Retirees 55+	0.822*	0.671*	0.191**
	(0.367)	(0.295)	(0.077)
A6. Retirees 65+	1.133**	0.925**	0.264**
	(0.464)	(0.372)	(0.097)
B. Other EU countries as the control			
Average (N=252)			
B1. Retirees 55+	1.363***	1.146***	0.348***
	(0.444)	(0.374)	(0.111)
B2. Retirees 65+	1.985***	1.669***	0.506***
	(0.513)	(0.433)	(0.127)
Long-term (N=161)			
B3. Retirees 55+	2.399***	2.031***	0.603***
	(0.330)	(0.278)	(0.078)
B4. Retirees 65+	3.229***	2.733***	0.812***
	(0.348)	(0.293)	(0.080)
Short-term (N=150)			
B5. Retirees 55+	0.388	0.324	0.100
	(0.301)	(0.252)	(0.077)
B6. Retirees 65+	0.819**	0.684**	0.211**
	(0.386)	(0.323)	(0.098)

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table displays elasticity estimates based on Equation (6). The outcome variable is $\log(N^P_{jt})$, the log number of foreign EU pensioners residing in a destination j in year t. We define pensioners as people aged 55 and more in a given year. The long-term (short-term) elasticity refers to a specification that includes years 2018-2022 (2013-2017) as the post-reform period. Panel A displays estimates where the control group is only Spain; while Panel B uses all other EU countries as controls. A.1 is the baseline estimate. We compute average tax rates (ATR) for pensioners using information on country-specific tax schedules from the OECD. We simulate ATRs for pensioners earning EUR 24,000 pensioners per year (columns 1-2) and EUR 35,000 per year (column 3-4).

Table 2: **Heterogeneous migration responses (Weighted)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portugal × Post	0.559***	0.487***	0.481***	0.513***	0.471***	0.570***	0.457***	0.325***
	(0.121)	(0.099)	(0.097)	(0.107)	(0.099)	(0.119)	(0.096)	(0.096)
Portugal × Post × Tax rate workers		-2.508***						-1.784
		(0.141)						(1.645)
Portugal × Post × Tax rate pensioners			1.564***					1.129
			(0.283)					(1.547)
Portugal × Post × Tax rate pensioners (pension=average earnings)				0.747				
				(0.776)				
Portugal × Post × Δ tax rates pensioners-workers					1.127***			
					(0.094)			
Portugal × Post × Net pension replacement rate						0.479		-0.821**
						(0.449)		(0.278)
Portugal × Post × Years after exit							0.080***	0.084*
							(0.023)	(0.039)
R-Square	0.990	0.990	0.990	0.990	0.990	0.990	0.990	0.991
Observations	336	336	336	336	336	336	336	336
Clusters	12	12	12	12	12	12	12	12

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table summarizes the estimated heterogeneous responses due to potential drivers of migration to Portugal *relative to Spain*. Standard errors are robust, two-way clustered at the destination-year level and origin level. The period of interest is 2008-2022, inclusive. $Post = 1$ implies the treated period starting in 2013. Each driver of migration is normalized $Z'_{o,2022} = Z_{o,2022} - \bar{Z}_{2022}$, where $\bar{Z}_{2022}$ is the average across all origins. All regressions are weighted by the total number of pensioners from origin o in 2012. In all regressions, the comparison of migrants stocks is between two destinations Portugal and Spain, involving 12 origin countries (Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Lithuania, Netherlands, Poland, Sweden, United Kingdom).

Appendices

A Additional facts

A.1 Self-selection into international migration for retirees

We use exhaustive, detailed administrative data on Finnish residents to describe the population of retirees who move abroad. Table A.3 compares the characteristics of Finnish pensioners who migrate internationally upon retirement (migrants) with those who remain in Finland (stayers). It reveals significant disparities in demographic and economic attributes.

Table A.3 first shows that migrants and stayers differ in their demographics. Mobile seniors are more likely to be male and less likely to have children, suggesting that the weakness of local ties may play a role in the decision to emigrate upon retirement. The second insight is that internationally mobile pensioners have higher income levels, with greater capital and business income compared to pensioners who remain in Finland. For example, their average labor income in the years leading up to retirement is 20% higher than that of stayers. In addition, it is more likely that they belonged to the top 10 income earners before retirement. Migrants are also more likely to be highly educated.

Overall, Table A.3 shows that international migration decisions at retirement are more prevalent among high-income earners. This kind of positive self-selection pattern is in line with the literature that focuses on the migration decisions of the working-age population (see Kauppinen and Poutvaara (2023) for results on Finland). This pattern may be due to the significant fixed costs of relocating abroad or because high-income earners have different preferences.

Table A.3: **Descriptive Statistics: Internationally Mobile Pensioners**

	(1) All pensioners	(2) Staying pensioners	(3) Migrating pensioners
Age	68.89	68.89	63.85
	(9.800)	(9.800)	(7.310)
Male	0.46	0.46	0.54
	(0.498)	(0.498)	(0.499)
Married	0.55	0.55	0.47
	(0.497)	(0.497)	(0.499)
Has children	0.83	0.83	0.56
	(0.374)	(0.374)	(0.496)
Higher education	0.27	0.27	0.32
	(0.445)	(0.445)	(0.465)
Pension	22991.70	22992.21	21518.66
	(15086.1)	(15079.3)	(28739.0)
Above median pension	0.51	0.51	0.37
	(0.500)	(0.500)	(0.482)
Had capital income 5 years before retirement	0.43	0.43	0.37
	(0.495)	(0.495)	(0.482)
Had business income 5 years before retirement	0.11	0.11	0.07
	(0.316)	(0.316)	(0.253)
Top 10 income decile before retirement	0.10	0.10	0.11
	(0.294)	(0.294)	(0.315)
Earnings (5 year mean before retirement)	35349.98	35345.67	42382.67
	(24421.2)	(24409.8)	(38265.7)
Capital income (5 year mean before retirement)	6988.88	6981.11	21059.94
	(67128.3)	(66890.6)	(248891.9)
Business income (5 year mean before retirement)	17116.65	17114.66	22155.34
	(31675.1)	(31658.7)	(60075.2)
Observations	28566511	28548062	18449
Unique observations	2772299	2770155	17723

mean coefficients; sd in parentheses

Notes: This table provides descriptive statistics on pensioners in Finland for the whole data period 2008–2022. Column (1) includes all pensioners, while Columns (2) and (3) distinguish between those who stayed and those who migrated, respectively. The data is taken from comprehensive administrative records provided by Statistics Finland. The number of observations reflects the total count of individuals in the dataset, with each person counted for every year they appear. Unique observations represent the number of distinct individuals.

B International migration around retirement

We also study the link between retirement and international migration events in Figure B.12. In Panel A, we start by plotting for a given cohort of all the residents we observe in Finland in a given year, the age at which they retire (left figure) and their probability to move abroad (right figure). A very large fraction of Finnish residents retire when they reach the age of 63.[29]

At the same time, we observe much larger international migration rates for individuals aged 63–65, compared to individuals just before their retirement age and after the most common retirement ages. To show this, we estimate Equation (12) for the cohort of individuals born in 1951:

$$Y_{it} = \sum_{t \neq 61} \beta_t Age_{it} + \epsilon_{it}, \tag{12}$$

where Y_{it} is one for people who migrated at age t and zero for people who decide to stay in Finland, Age_{it} is a dummy variable for the age of the individual and ϵ_{it} is the error term. Subfigure B (right) presents the estimated mean probabilities, β_t, of this cohort moving abroad, relative to age 61 (calendar year 2012).

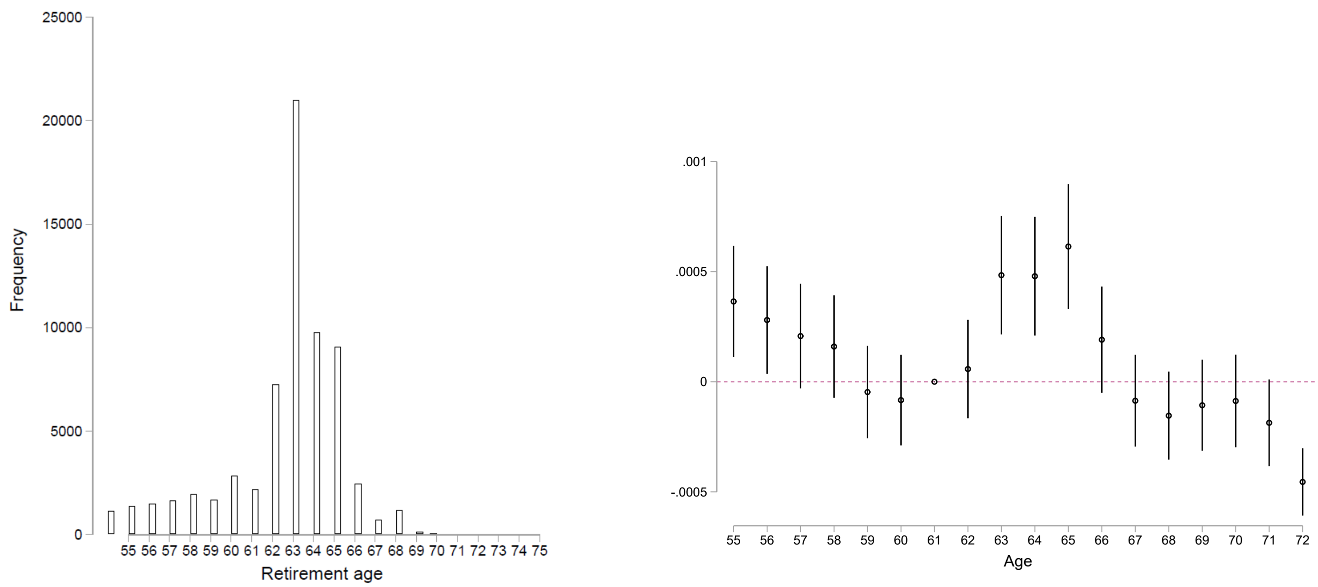
This suggests a tight connection between leaving the domestic labor force and moving abroad, already noticed by Badilla et al. (2024) in the context of within-country migration.

[29]There was a pension reform in Finland in 2005 which set the legal retirement age between 63–68. If an individual retires before age 63, their pension is reduced, while retiring after age 68 results in an increased pension.

Figure B.11: International Migration by Cohort

Cohort 1951

A. Legal Retirement Age **B. Probability to Move Abroad**



Notes: This figure describes retirement and international migration behavior for individuals born in 1951 and residing in Finland in 2005. Panel A (left) displays the distribution of their age of effective retirement. In Panel B, we plot the estimated β's from Equation (12) in the main text. The confidence intervals are presented at the 95% confidence level, and are based on robust standard errors.

We can use the longitudinal nature of our dataset to better explore this connection, now by linking individual-specific retirement events to individual-specific migration events. We run a simple event-study model to see if individuals are more likely to leave Finland when they approach their own retirement event. Specifically, we estimate:

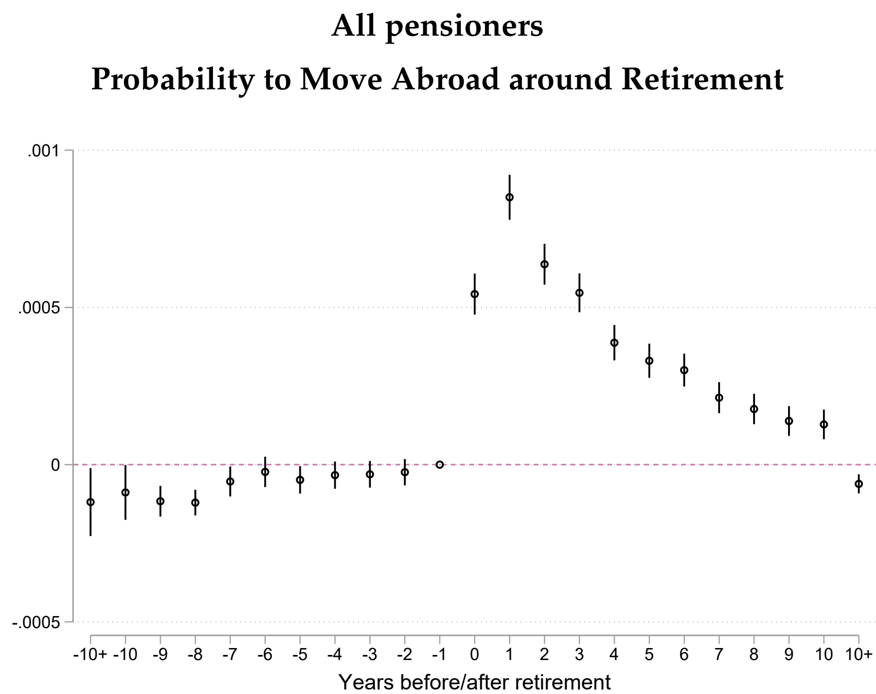
$$Y_{it} = \sum_{j \neq -1} \beta_j X_j + \epsilon_{it}, \tag{13}$$

where Y_{it} is one for people who migrate in calendar year t and zero for people who decide to stay in Finland. X_j are relative time-to-retirement indicators which are set to 1 if period t is j periods from the start of retirement, i.e. $X_j = \mathbb{1}\{j = t - t_i^*\}$ where t_i^* denotes the year of retirement of individual i. ϵ_{it} is the error term.

We plot the series of coefficients β_j in Panel B, that capture individuals' propensity to move abroad in j relative to one year prior to the year of retirement. The figure supports the descriptive finding in Panel A. Older citizens exhibit a large uptick in international migration rates immediately around their retirement, which fades down as time relative to retirement age increases. This confirms that retirement and international migration are closely coordinated decisions.

We also estimate Equation (13) for various subgroups. Specifically, we run this regression separately for married individuals, single individuals, those with and without children, and individuals in the top 10% of earners prior to retirement versus those in the bottom 90%. Figure B.13 illustrates that the probability of migration around retirement is higher for individuals with fewer ties to their home country, such as single individuals and those without children. Additionally, wealthier individuals appear more likely to migrate around retirement.

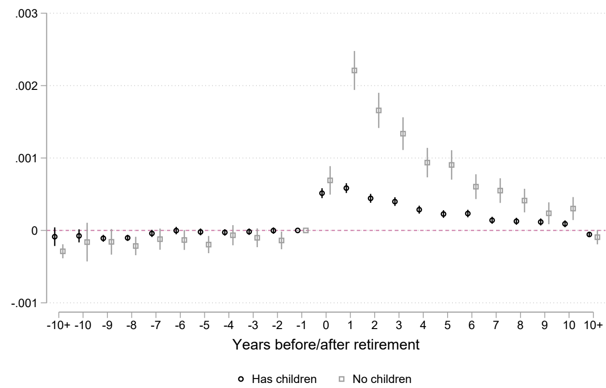
Figure B.12: **International Migration Around Retirement**



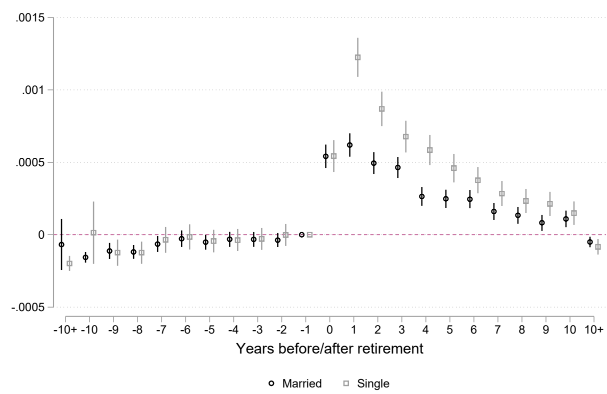
Notes: This figure shows the estimated probability of moving abroad around retirement age (Equation 13). The data includes individuals aged 55 and over with known retirement ages who resided in Finland at some point between 2008 and 2022. The confidence intervals are presented at the 95% confidence level, and are based on robust standard errors. The data is taken from comprehensive administrative records provided by Statistics Finland.

Figure B.13: **International Migration Around Retirement: Heterogeneity**

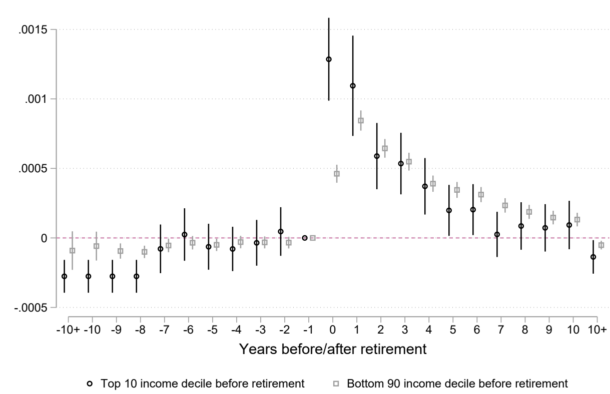
A. With and Without Children



B. Married and Single



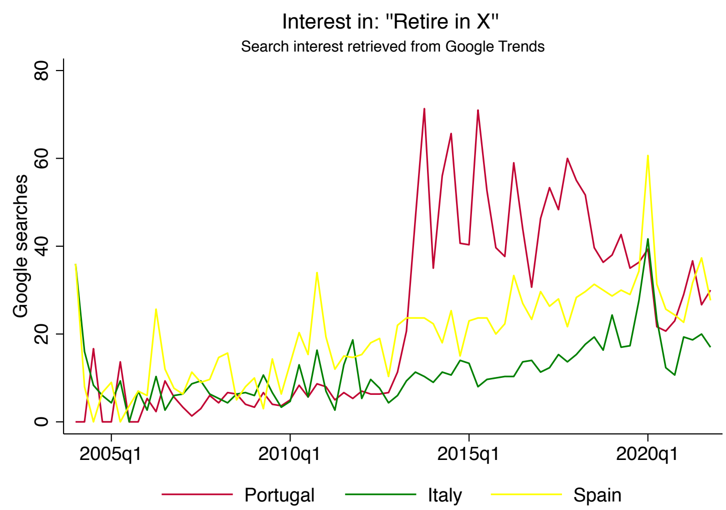
C. Top Earners and Bottom Earners



Notes: This figure shows the estimated probability of moving abroad around retirement age (Equation 13) across different demographic groups. Panel A compares the probability of moving for individuals with and without children, Panel B contrasts this probability for married versus single individuals, and Panel C focuses on pensioners who were in the top 10% of income earners compared to those in the bottom 90%. The data includes individuals aged 55 and over with known retirement ages who resided in Finland at some point between 2008 and 2022. The confidence intervals are presented at the 95% confidence level, and are based on robust standard errors. The data is taken from comprehensive administrative records provided by Statistics Finland.

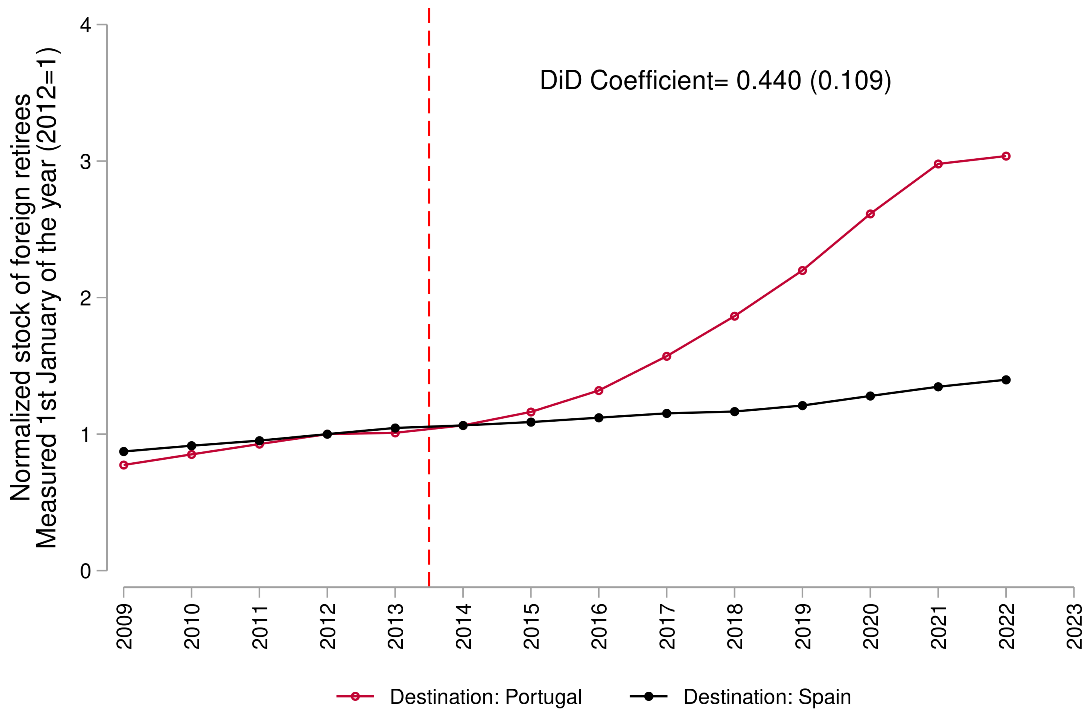
C Additional Figures and Tables

Figure C.14: **Intent to move to Portugal: proxy**



Notes: This figure shows our proxy for intended migration to Portugal and control destinations (Google search interest from Google Trends) from one specific high-income origin country (France). All series are normalized so that 100 corresponds to the maximum value of any of the series in the time window.

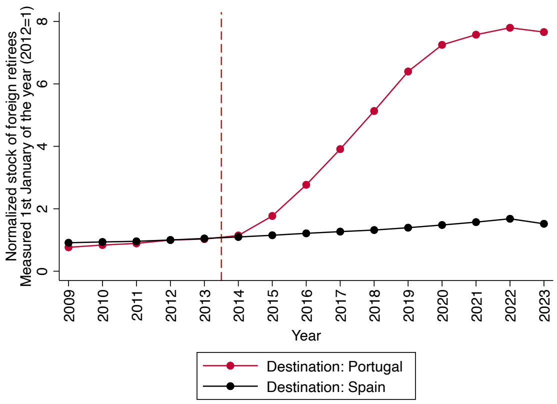
Figure C.15: **Effect of the Tax Cut on Stock of Foreign Retirees in Portugal: Including British Retirees**



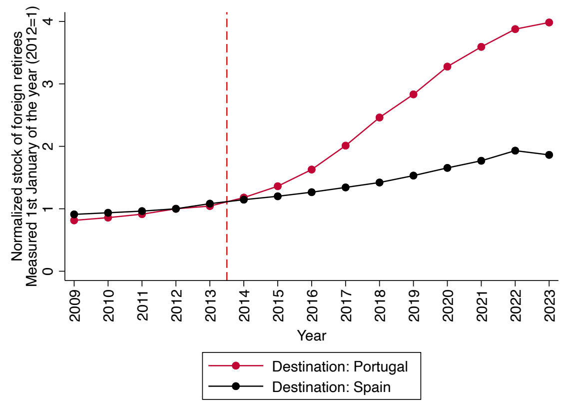
Notes: This figure repeats our baseline results including British retirees in the measure of the stock of EU foreigners. The UK left the EU in 2016. British citizens retired in EU countries faced some uncertainties regarding the portability of their pensions and healthcare rights during the period 2016-2020.

Figure C.16: **International Migration Responses for Main Origin Countries**

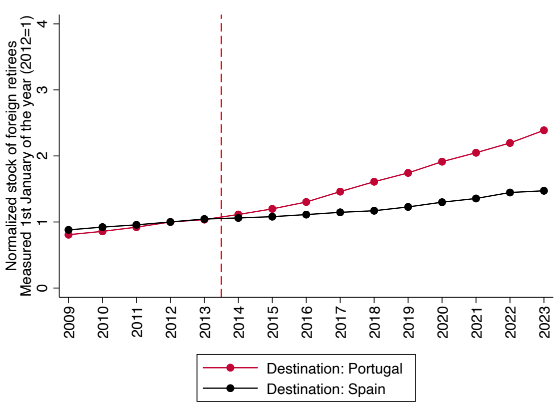
A. From France



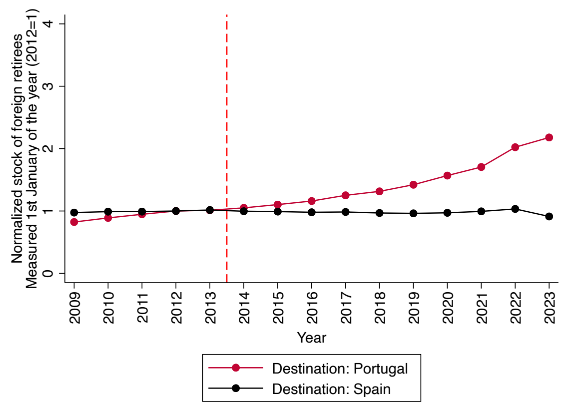
B. From Belgium



C. From Netherlands



D. From Germany



Notes: This figure shows the stock of foreign retirees in Portugal (treated, red series) and Spain (control, blue series), before and after a reform (vertical red dotted line) reduced the income tax rate to 0% for foreign retirees moving to Portugal, for four of the main origin countries. All series are normalized to one in the pre reform year (2012). Data are obtained from Eurostat, the European statistical office (population by age group and citizenship as of January 1 of each year)

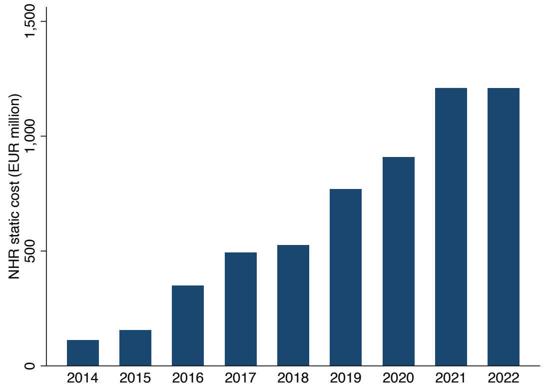
Table C.4: **Descriptive Statistics: Finnish Pensioners in Spain vs Portugal**

	(1) Portugal Pre	(2) Portugal Post	(3) Spain Pre	(4) Spain Post
Age	64.47	65.07	63.57	64.71
	(5.575)	(5.516)	(5.644)	(6.166)
Male	0.55	0.62	0.55	0.53
	(0.504)	(0.486)	(0.497)	(0.500)
Married	0.68	0.66	0.56	0.51
	(0.474)	(0.475)	(0.496)	(0.500)
Has children	0.90	0.91	0.84	0.82
	(0.304)	(0.282)	(0.369)	(0.384)
Higher education	0.55	0.69	0.36	0.38
	(0.504)	(0.464)	(0.480)	(0.486)
Pension	36458.34	62719.57	28808.54	25270.39
	(40551.7)	(68449.9)	(31745.3)	(20193.7)
Above median pension	0.66	0.78	0.63	0.52
	(0.483)	(0.415)	(0.483)	(0.500)
Had capital income 5 years before retirement	0.65	0.77	0.55	0.51
	(0.483)	(0.422)	(0.498)	(0.500)
Had business income 5 years before retirement	0.10	0.13	0.11	0.14
	(0.304)	(0.331)	(0.308)	(0.348)
Top 10 income decile before retirement	0.17	0.35	0.15	0.13
	(0.385)	(0.476)	(0.353)	(0.338)
Earnings (5 year mean before retirement)	54010.28	69600.47	41813.33	37832.17
	(46361.1)	(50174.9)	(32601.4)	(30063.6)
Capital income (5 year mean before retirement)	13972.78	25997.11	11720.18	9741.06
	(23762.1)	(145279.5)	(26598.8)	(39500.8)
Business income (5 year mean before retirement)	8838.68	18307.14	24276.35	22121.87
	(8377.1)	(29993.1)	(31525.3)	(29349.7)
Observations	40	472	764	987
Unique observations	39	471	754	973

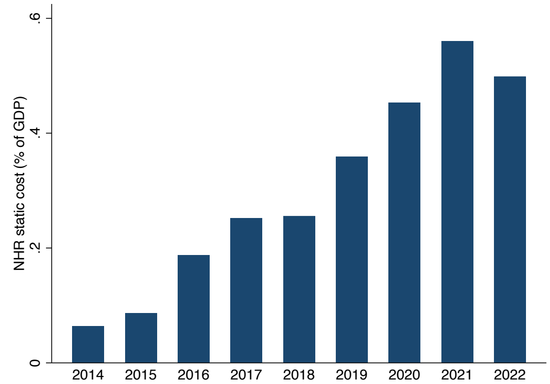
mean coefficients; sd in parentheses

Notes: This table presents descriptive statistics on pensioners in Finland for the period 2008–2019. Columns (1) and (3) cover the years before the NHS reform (2008–2012), while Columns (2) and (4) cover the period during the NHS reform (2013–2018). The data is taken from comprehensive administrative records provided by Statistics Finland. The number of observations indicates the total count of individuals in the dataset, including those who have moved multiple times. Unique observations refer to the number of distinct individuals who have moved to Spain or Portugal.

Figure C.17: **Static Cost of the NHR Regime: Tax Authority Estimates**



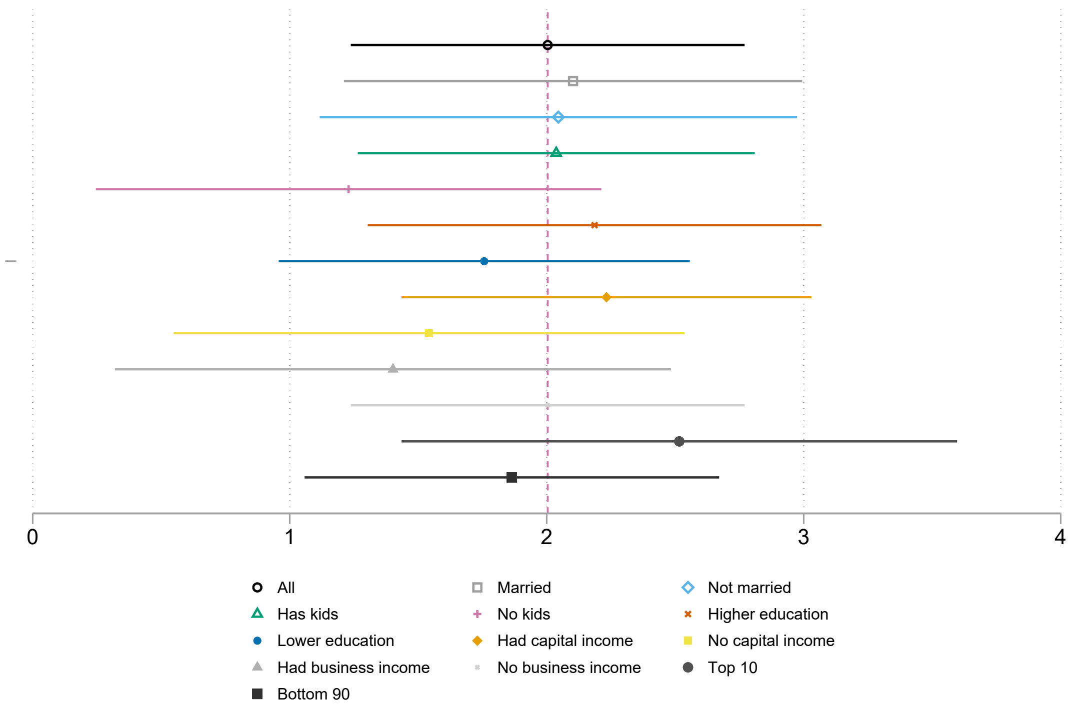
(a) EUR million



(b) % of GDP

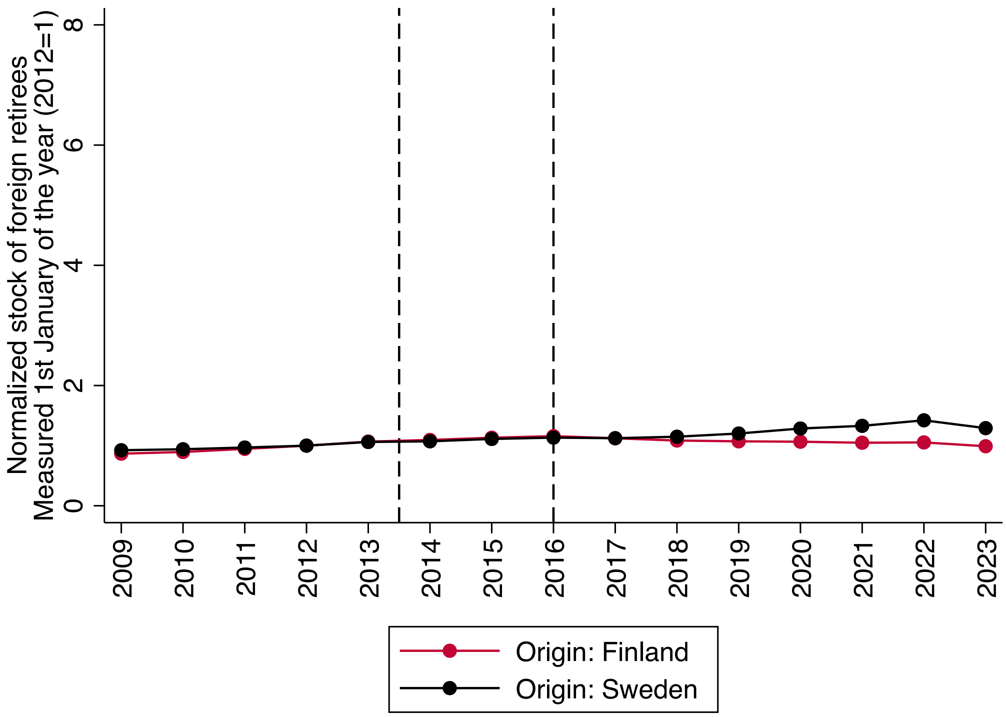
Note: This figure plots estimates of the static costs of the NHR regime (including both the zero rate on pensioners and foreign capital income, and the reduced rate on high-value added domestic labor earnings for impatriates. The estimate is a "mechanical" measure, based on computing a counterfactual tax liability for NHR-claiming taxpayers, if they had stated the same amount of income but had not claimed the special tax regime.

Figure C.18: **Heterogeneity in Pensioners Migration Responses to Taxes**



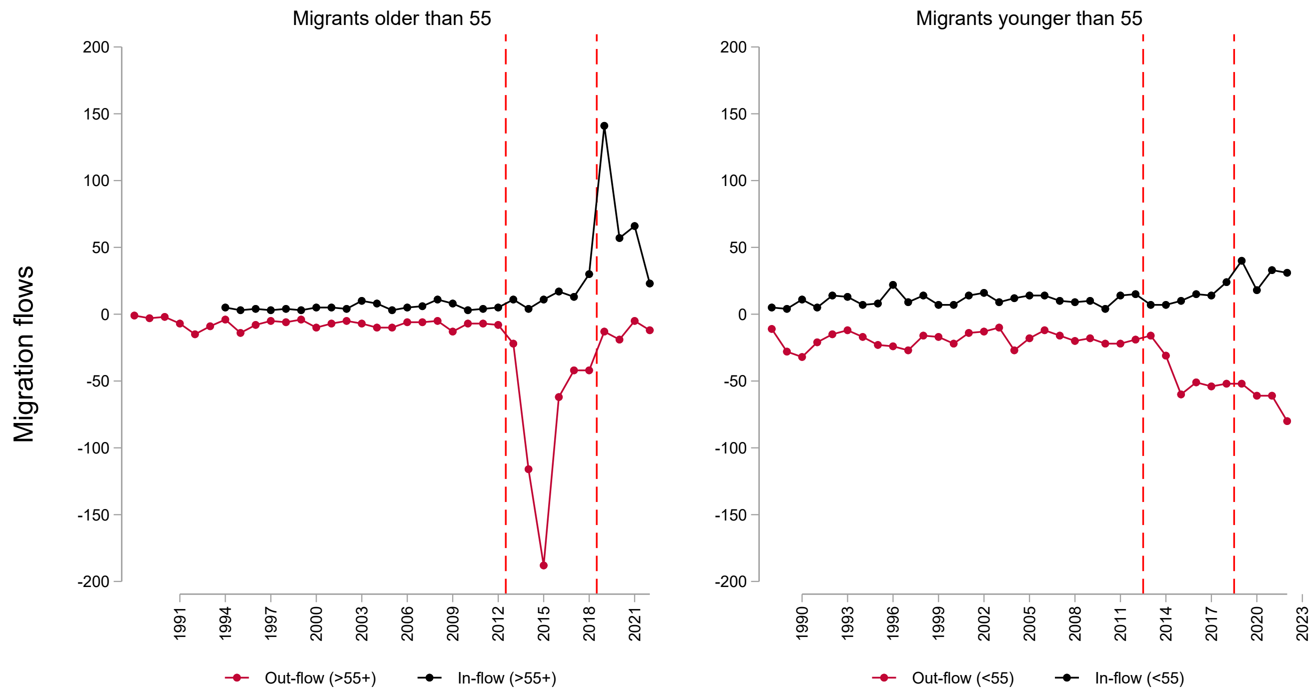
Notes: This figure displays heterogeneous migration responses by Finnish pensioners to the Portuguese tax break. We compare Finnish pensioners moving to Portugal (treated) versus Spain (control), before and after the introduction of the NHR regime in Portugal. We perform this comparison focusing on different subgroups of the population. Each coefficient corresponds to a separate regression estimated on a separate subsample. For each subsample, we run Equation (5), using flows instead of stocks, and report the estimated coefficient on the reform interaction β and the 95% level confidence interval. Data are obtained from the Statistics Finland. The data includes all 55 and above who migrated to Portugal or Spain between the years 2008–2022. The data are aggregated using micro flows.

Figure C.19: **Finnish and Swedish Retirees in Spain**



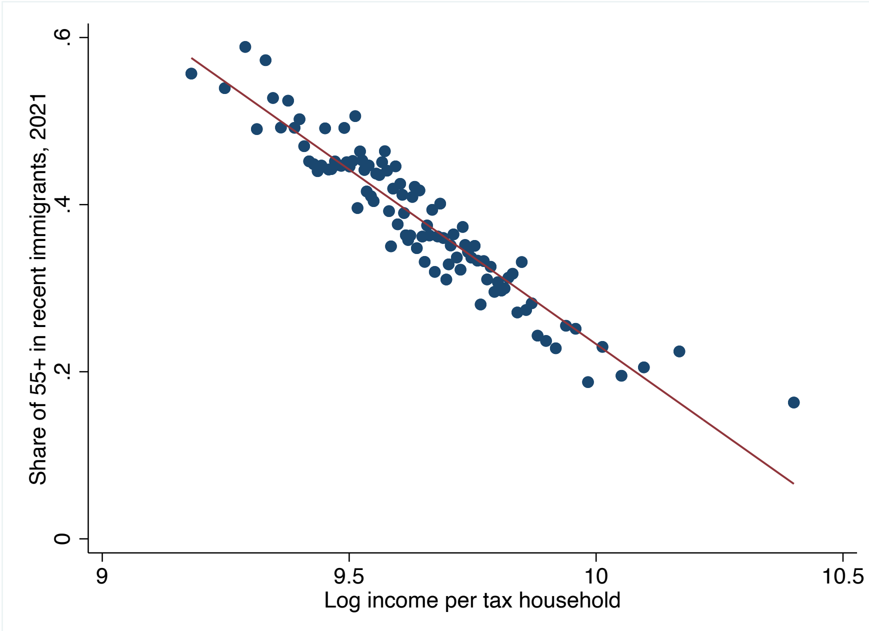
Notes: This figure displays a placebo test for Swedish and Finnish pensioners in Spain. We compare Finnish pensioners moving to Spain (placebo treated) versus Spain (placebo control), before and after the introduction of the NHR regime in Portugal. The vertical lines indicate the NHR reform (first vertical red dotted line) which reduced the income tax rate to 0% for foreign retirees moving to Portugal; and the renegotiation of the Finland-Portugal tax treaty (second vertical line). All series are normalized to one in 2012. Data are obtained from Eurostat, the European statistical office (population by age group and citizenship as of January 1 of each year).

Figure C.20: **Asymmetric Migration Flows Response to Introduction and Repeal of the Tax Break**



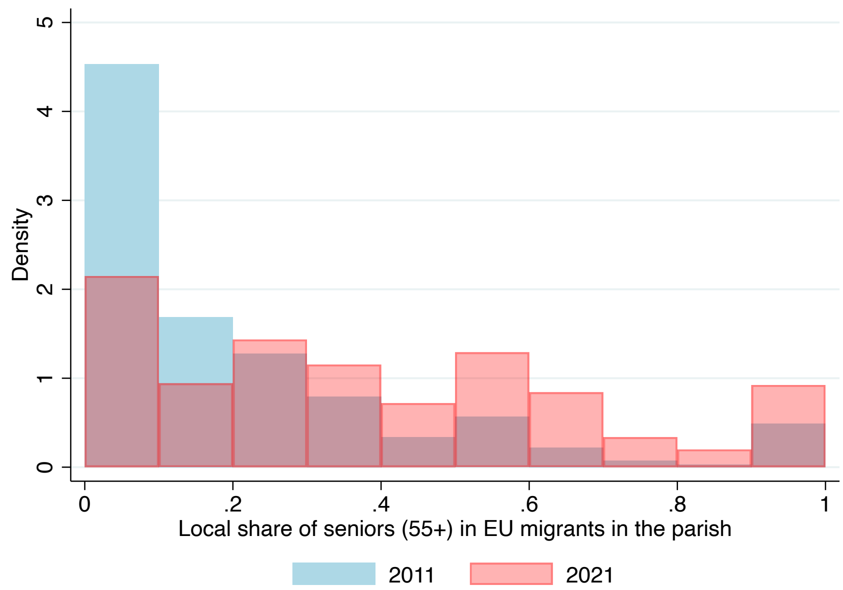
Notes: This figure shows the flows of migrants from Finland to Portugal (red series) and from Portugal to Finland (blue series) by age group (pensioners in the left panel, and working-age in the right panel). The vertical lines indicate the introduction of the NHR (first vertical red dotted line) which reduced the income tax rate to 0% for foreign retirees moving to Portugal; and its eventual repeal after the renegotiation of the tax treaty between Finland and Portugal (third vertical line). Data are obtained from the Finnish population-wide migration register.

Figure C.21: **Within-country directed migration**



Note: This figure plots the share of movers aged 55 or more among all migrants arrived within the last ten years in a Portuguese parish (*freguesia*), on the y axis, against the average income per taxable household in the locality, across 3092 parishes as of January 2021, using Portuguese Census data. The figure is a binned scatter plot of unweighted percentiles.

Figure C.22: **Local share of seniors among all EU migrants, 2011 and 2021**



Note: This figure plots the distribution (across 3092 Portuguese parish parishes or *freguesias*) of the proportion aged 55 or more among all EU migrants in the parish, in 2011 and 2021, using Portuguese decennial Census data.

Table C.5: **Heterogeneous migration responses (Unweighted)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Portugal × Post	0.588***	0.560***	0.528***	0.527***	0.534***	0.601***	0.557***	0.590***
	(0.132)	(0.107)	(0.111)	(0.114)	(0.105)	(0.133)	(0.115)	(0.106)
Portugal × Post × Tax rate workers		-2.302**						-4.426**
		(0.835)						(1.490)
Portugal × Post × Tax rate pensioners			1.458					-2.744*
			(0.817)					(1.445)
Portugal × Post × Tax rate pensioners (pension=average earnings)				1.200*				
				(0.645)				
Portugal × Post × Δ tax rates pensioners-workers					1.021**			
					(0.459)			
Portugal × Post × Net pension replacement rate						0.375		-0.954
						(0.567)		(0.557)
Portugal × Post × Years after exit							0.073***	0.057
							(0.018)	(0.038)
R-Square	0.991	0.992	0.991	0.991	0.991	0.991	0.991	0.992
Observations	336	336	336	336	336	336	336	336
Clusters	12	12	12	12	12	12	12	12

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table summarizes the estimated heterogeneous responses due to potential drivers of migration to Portugal *relative to Spain*. Standard errors are robust, two-way clustered at the destination-year level and origin level. The period of interest is 2008-2022, inclusive. $Post = 1$ implies the treated period starting in 2013. Each driver of migration is normalized $Z'_{o,2022} = Z_{o,2022} - \bar{Z}_{2022}$, where $\bar{Z}_{2022}$ is the average across all origins. In all regressions, the comparison of migrants stocks is between two destinations Portugal and Spain, involving 12 origin countries (Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Lithuania, Netherlands, Poland, Sweden, United Kingdom).

Table C.6: Peer effects in migration: full sample, all destinations

	(1) Portugal	(2) Spain	(3) Sweden	(4) UK	(5) US	(6) Germany	(7) Estonia	(8) Norway	(9) Denmark	(10) France
Estab exposure Portugal=1	0.000187*	0.000187	0.000107	0.000131**	0.000157**	0.0000948	-0.000218	0.00000582	0.0000211	-0.00000613
	(0.000104)	(0.000138)	(0.000104)	(0.0000637)	(0.0000670)	(0.0000723)	(0.000150)	(0.0000441)	(0.0000304)	(0.0000593)
Estab exposure Spain=1	-0.00000554	0.000276***	-0.000247***	-0.0000280	-0.0000695***	-0.0000182	-0.000510***	-0.0000488**	-0.0000124	-0.0000403
	(0.0000448)	(0.0000673)	(0.0000522)	(0.0000241)	(0.0000257)	(0.0000290)	(0.0000801)	(0.0000219)	(0.0000103)	(0.0000276)
Estab exposure Sweden=1	0.0000779**	0.0000972**	0.000108**	-0.000108***	-0.000140***	-0.0000899***	-0.000112	-0.0000272*	0.00000644	-0.0000432***
	(0.0000309)	(0.0000481)	(0.0000527)	(0.0000177)	(0.0000178)	(0.0000214)	(0.0000690)	(0.0000152)	(0.0000133)	(0.0000160)
Estab exposure UK=1	0.0000799*	0.000168**	-0.0000568	0.0000900***	0.0000575**	-0.00000586	0.000354***	0.00000883	0.00000181	0.0000550**
	(0.0000443)	(0.0000712)	(0.0000561)	(0.0000285)	(0.0000289)	(0.0000313)	(0.0000914)	(0.0000211)	(0.0000109)	(0.0000277)
Estab exposure US=1	0.0000737	-0.0000446	-0.0000791	-0.00000174	0.000108***	0.0000453	-0.00102***	-0.00000775	-0.0000135	0.0000259
	(0.0000483)	(0.0000691)	(0.0000587)	(0.0000250)	(0.0000297)	(0.0000336)	(0.0000954)	(0.0000230)	(0.0000102)	(0.0000273)
Estab exposure Germany=1	0.0000469	-0.0000713	-0.000200***	-0.0000110	-0.0000469*	0.0000735**	-0.000393***	0.0000296	-0.0000103	0.0000241
	(0.0000456)	(0.0000661)	(0.0000555)	(0.0000231)	(0.0000241)	(0.0000326)	(0.0000874)	(0.0000233)	(0.0000114)	(0.0000252)
Estab exposure Estonia=1	0.000175***	0.000238***	-0.000228***	-0.000000933	-0.0000438	0.0000192	0.00329***	0.0000171	-0.0000114	0.00000395
	(0.0000520)	(0.0000776)	(0.0000561)	(0.0000270)	(0.0000289)	(0.0000340)	(0.000144)	(0.0000253)	(0.0000125)	(0.0000299)
Estab exposure Norway=1	-0.0000985***	-0.000108*	0.0000417	-0.0000669***	-0.0000571**	-0.0000958***	-0.000192**	0.0000744***	-0.0000432***	-0.0000597**
	(0.0000382)	(0.0000584)	(0.0000544)	(0.0000220)	(0.0000230)	(0.0000277)	(0.0000762)	(0.0000231)	(0.0000128)	(0.0000241)
Estab exposure Denmark=1	0.0000799	0.000160**	0.000358***	0.0000225	0.0000212	0.0000404	0.000183*	0.0000137	0.0000548***	0.0000365
	(0.0000523)	(0.0000789)	(0.0000655)	(0.0000280)	(0.0000276)	(0.0000329)	(0.0000994)	(0.0000264)	(0.0000192)	(0.0000301)
Estab exposure France=1	0.000212***	0.000177**	0.0000564	0.0000803**	0.0000677**	0.0000983**	-0.000420***	-0.0000195	0.0000375*	0.000169***
	(0.0000614)	(0.0000864)	(0.0000682)	(0.0000323)	(0.0000332)	(0.0000412)	(0.000101)	(0.0000272)	(0.0000197)	(0.0000398)
mean	0.00019	0.00052	0.00072	0.00016	0.00021	0.00020	0.00122	0.00009	0.00004	0.00011
r2	0.00018	0.00013	0.00003	0.00002	0.00003	0.00002	0.00058	0.00001	0.00001	0.00003
N	2605535	2605535	2605535	2605535	2605535	2605535	2605535	2605535	2605535	2605535

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Note: This table shows estimates of β_j and $\beta_{j'}$ from Equation (8), estimated separately for the top 10 destination countries of senior Finns. In each panel, the outcome variable is the probability that individuals aged 55 or older retire in that specific destination after 2012. The coefficients capture how the probability is affected by having worked in the same establishment as peers who moved (before 2012) to each country on the y-axis. The sample includes all Finns still living in Finland in 2012 and aged more than 55.

Table C.7: Peer effects in migration: mover sample, all destinations

	(1) Portugal	(2) Spain	(3) Sweden	(4) UK	(5) US	(6) Germany	(7) Estonia	(8) Norway	(9) Denmark	(10) France
Estab exposure Portugal=1	0.00909	-0.00340	0.00517	0.0135	0.0161*	0.00490	-0.0639***	-0.00278	0.00225	-0.00863
	(0.0148)	(0.0189)	(0.0150)	(0.00946)	(0.00979)	(0.0107)	(0.0194)	(0.00668)	(0.00453)	(0.00907)
Estab exposure Spain=1	0.00855	0.0879***	-0.0324***	-0.00121	-0.00949	0.00329	-0.0393***	-0.00839*	-0.00122	-0.00613
	(0.0100)	(0.0143)	(0.0113)	(0.00555)	(0.00589)	(0.00667)	(0.0152)	(0.00509)	(0.00238)	(0.00629)
Estab exposure Sweden=1	0.0304***	0.0586***	0.0790***	-0.0174***	-0.0212***	-0.00906*	0.0201	-0.000777	0.00405	-0.00511
	(0.00770)	(0.0116)	(0.0121)	(0.00435)	(0.00443)	(0.00540)	(0.0138)	(0.00393)	(0.00344)	(0.00401)
Estab exposure UK=1	0.00158	0.000854	-0.0426***	0.0162***	0.00853	-0.00871	0.00712	-0.00226	-0.000968	0.00813
	(0.00958)	(0.0147)	(0.0118)	(0.00623)	(0.00639)	(0.00703)	(0.0161)	(0.00472)	(0.00247)	(0.00607)
Estab exposure US=1	0.0306***	0.0190	-0.00157	0.00277	0.0268***	0.0147**	-0.128***	0.00106	-0.00192	0.00952
	(0.0103)	(0.0141)	(0.0121)	(0.00552)	(0.00649)	(0.00736)	(0.0166)	(0.00504)	(0.00222)	(0.00591)
Estab exposure Germany=1	0.0169	-0.00187	-0.0297**	0.00169	-0.00669	0.0224***	-0.0359**	0.0101*	-0.00149	0.00843
	(0.0105)	(0.0145)	(0.0122)	(0.00542)	(0.00568)	(0.00765)	(0.0167)	(0.00550)	(0.00271)	(0.00596)
Estab exposure Estonia=1	-0.00677	-0.0415***	-0.116***	-0.0163***	-0.0246***	-0.0182***	0.337***	-0.00854**	-0.00666***	-0.0124***
	(0.00745)	(0.0108)	(0.00846)	(0.00414)	(0.00443)	(0.00511)	(0.0135)	(0.00380)	(0.00206)	(0.00442)
Estab exposure Norway=1	-0.00975	0.00611	0.0485***	-0.00794	-0.00323	-0.0117*	0.0274*	0.0235***	-0.00843***	-0.00826
	(0.00888)	(0.0130)	(0.0120)	(0.00515)	(0.00552)	(0.00652)	(0.0146)	(0.00565)	(0.00303)	(0.00566)
Estab exposure Denmark=1	-0.00224	-0.0101	0.0272**	-0.000268	-0.00232	-0.00147	-0.0208	-0.00416	0.00923**	0.00181
	(0.0101)	(0.0145)	(0.0119)	(0.00560)	(0.00561)	(0.00655)	(0.0158)	(0.00532)	(0.00376)	(0.00586)
Estab exposure France=1	0.0215*	-0.00637	-0.0126	0.0103*	0.00746	0.0101	-0.109***	-0.00847	0.00609	0.0269***
	(0.0113)	(0.0153)	(0.0125)	(0.00611)	(0.00634)	(0.00778)	(0.0163)	(0.00539)	(0.00382)	(0.00745)
mean	0.03662	0.10102	0.13882	0.03120	0.03996	0.03966	0.23650	0.01686	0.00832	0.02043
r2	0.02812	0.02511	0.01617	0.00257	0.00470	0.00247	0.05917	0.00310	0.00160	0.00474
N	13463	13463	13463	13463	13463	13463	13463	13463	13463	13463

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Note: This table shows estimates of β_j and $\beta_{j'}$ from Equation (8), estimated separately for the top 10 destination countries of senior Finns. In each panel, the outcome variable is the probability that individuals aged 55 or older retire in that specific destination after 2012. The coefficients capture how the probability is affected by having worked in the same establishment as peers who moved (before 2012) to each country on the y-axis. The sample includes all Finns still living in Finland in 2012 and aged more than 55 who moved abroad (to any destination) after 2012.

D Synthetic Control

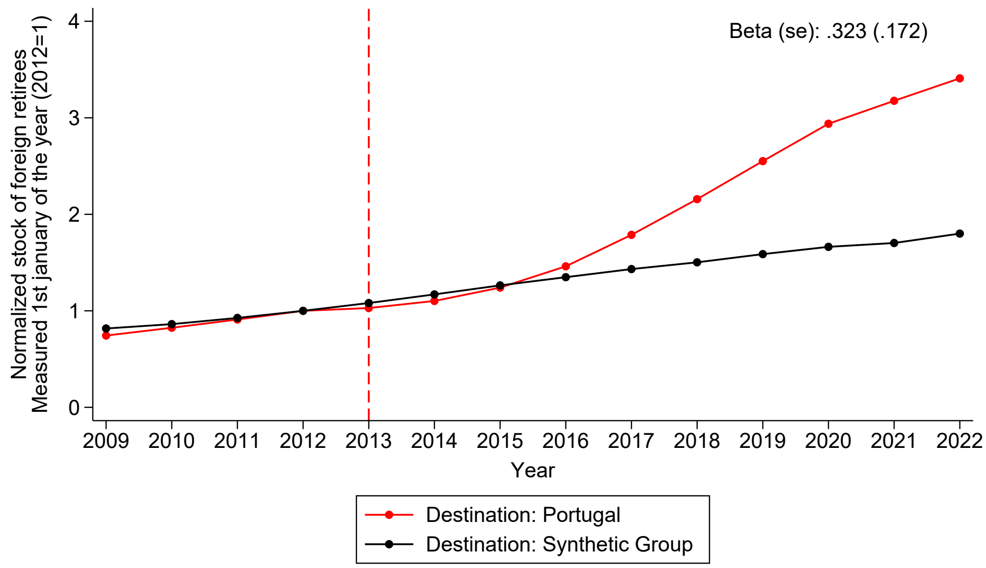
While Spain's close geographic and economic proximity makes it a natural counter-factual, we also probe the robustness of our findings to the use of a distinct estimation strategy.

We employ an alternative, data-driven pick for the counter-factual, through a synthetic control approach. We compare the focus destination to a synthetic Portugal constructed from a weighted pool of donor EU member States. The weights are chosen to minimize the distance between past migration flows to Portugal and to the synthetic control in the pre-reform period 2009-2012.

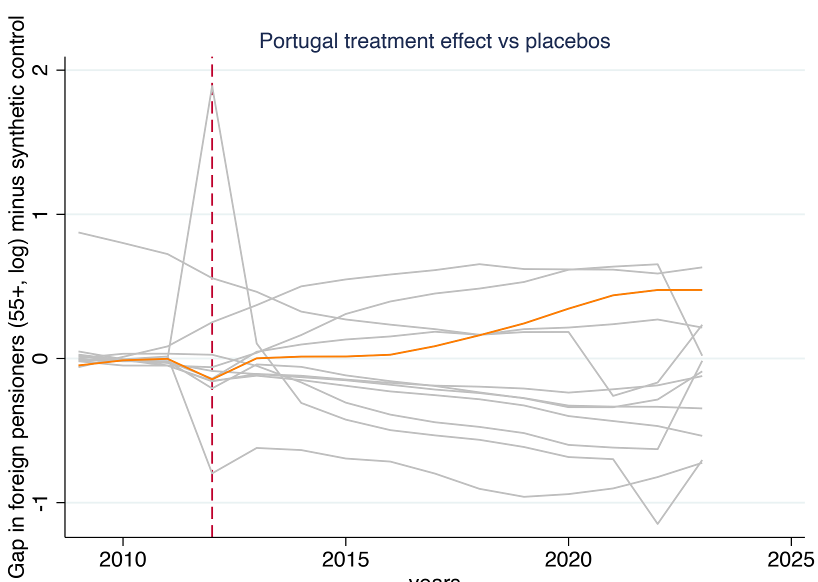
Figure D.23 supports the baseline quantitative and qualitative result of a large, significant, and persistent increase in the stock of foreign pensioners in Portugal caused by the introduction of the NHR. The figure also presents a robustness exercise comparing the estimated effect on the foreign retiree stock in Portugal to a full set of placebo estimates applying the SCM method to other, untreated destination countries. The effect on pensioner mobility to Portugal (the actual treated destination) is verified to be an outlier relative to all other untreated EU member states.

Figure D.23: Synthetic Control Method

A. Portugal vs Synthetic Portugal



B. Placebo Tests



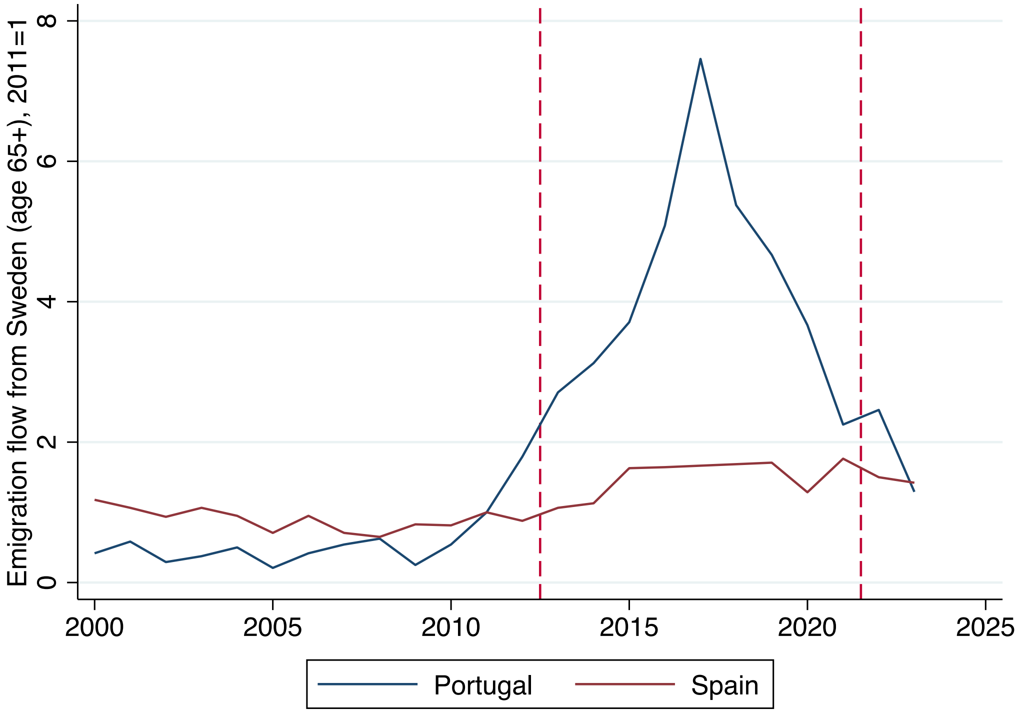
This figure repeats our baseline estimates using the synthetic control method. The weights are chosen to minimize the distance between past migration flows to Portugal and to the synthetic control in the pre-reform period 2009-2012.

E Sweden-Portugal bilateral evidence

We provide additional evidence on tax-induced migration by exploiting the Sweden-Portugal bilateral row which ended in Sweden repealing its tax treaty with Portugal starting in 2022. Like Finland in 2016, but with a two-year lag, Sweden started expressing concerns about the NHR and complained about non-cooperative and beggar-thy-neighbor tax policy on Portugal's end in EU institutions. Portugal and Sweden engaged in the renegotiation of their Double Taxation Agreement in 2018, and a protocol was ratified by Sweden in May 2019. However, Portugal failed to ratify the new treaty on its end. After several years of uncertainty, Sweden unilaterally repealed its tax treaty with Portugal starting January 1, 2022.

Similar to the case of Finland (but starting two years later for the renegotiation and three years later for the actual repeal), this event generated bilateral variation in the net-of-tax rate applicable to pensions originating from Sweden and received in Portugal, but not in other destination countries or for other origin countries. We collect data from the Swedish Statistical Bureau (*Statistiska centralbyran*) on emigration flows by broad age group and destination country from 2002 to 2023. We exploit the same identification strategy (comparing emigration flows of senior Swedish residents towards Portugal and comparable destinations, such as Spain) around the 2018-2022 window. Our results demonstrate that uncertainty on the future treatment of foreign-sourced pensions reduced emigration flows to Portugal starting in 2018. Portugal-bound flows of retired citizens from Sweden then fully reverted back to the (normalized) level of alternative destinations after the full repeal of the DTA was enacted in 2022.

Figure E.24: **Migration from Sweden to Portugal**



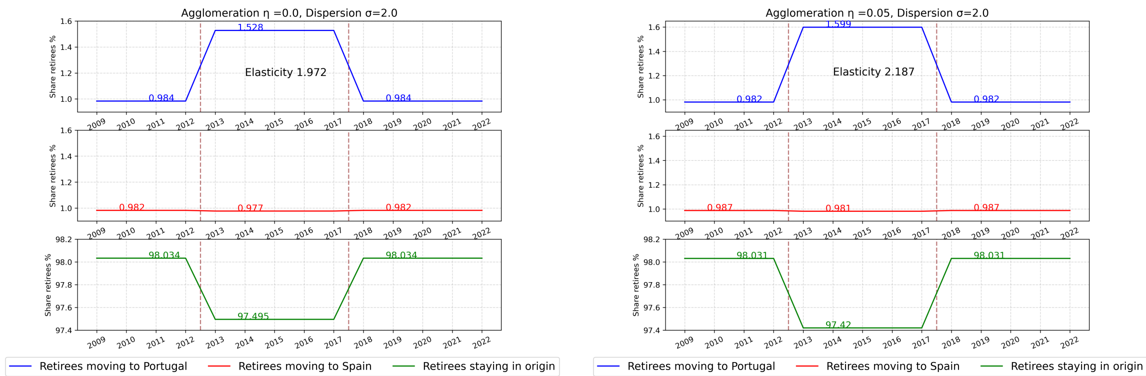
Notes: This figure shows the international migration flows of retirees to Portugal (treated, red series) and Spain (control, blue series), around the introduction of the NHR (2012), renegotiation of the Sweden-Portugal tax treaty (2018) and eventual repeal (2022). All series are normalized to one in the pre reform year. Data are obtained from SCB (Sweden's statistical office), series "*Immigrations and emigrations by country of emi-/immigration, region of birth, age and sex. Year 2000 - 2023*".

F Model simulations

To gain quantitative insights into the role of agglomeration for amplification and hysteresis, we simulate our location choice model with two origin countries (one large, "France", with 5,000,000 retirees, and one small, "Finland", with 500,000). Pensioners from each origin maximize utility by picking a location between three options: staying home, moving to Spain, and moving to Portugal. Consistent with large moving costs, we calibrate initial amenities in Spain and Portugal relative to the home country so that only a small share ($\pi_P \simeq 0.01$) of pensioners elect to retire in Portugal at baseline, and pick initial tax rates of 20% in all destinations. Pensioners are subject to idiosyncratic preference shocks distributed Frechet, with an inverse dispersion equal to σ, and a country-specific location parameter that is allowed to depend on the endogenous number of pensioners locating there.

We display simulations of counter-factual experiments in the model in figure F.25. We average the estimated elasticities and responses across 50 simulations for robustness. A temporary drop in the tax rate applicable to pensions in Portugal for pensioners from all origin countries yields an increase in the share of pensioners relocating there, with an average numerical estimated elasticity with respect to the net-of-tax rate $\frac{\Delta \log(N)}{\Delta \log(1-\tau_P)}$ very close to $\sigma(1-\pi_P) \simeq 2 \times (1-0.01) = 1.98$. We next introduce agglomeration forces in the simulated model, making destination-specific amenities depend on the number of foreign pensioners from all origins locating in Portugal, with elasticity $\eta = 0.05$. As in the analytical formulas in section 2, this increases the estimated numerical elasticity by a factor of $\frac{1}{1-\eta\sigma} \simeq 110\%$.

Figure F.25: **Amplification through agglomeration**

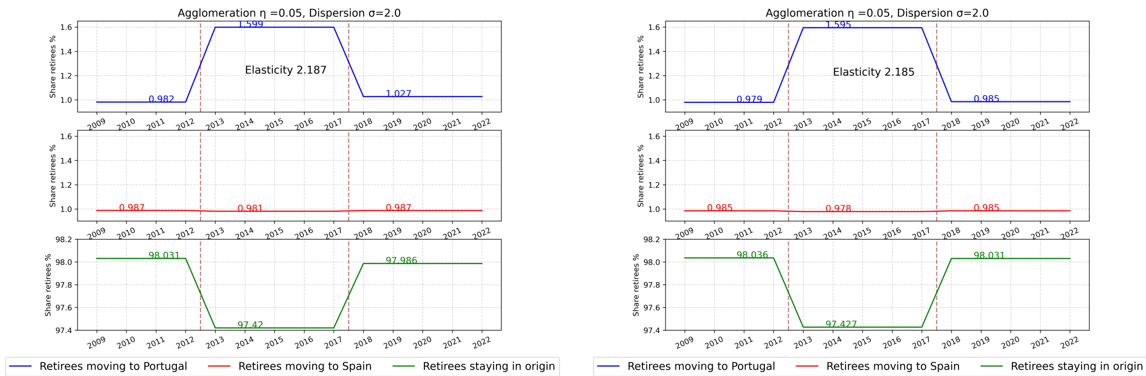


(a) Response with exogenous amenities (b) Response with endogenous amenities

Notes: The figure displays simulated responses of location choices in a calibrated version of our model with $\sigma = 2$. We simulate a reduction in the tax rate applicable to foreign pensions for all origin countries in Portugal after 2012, and a repeal of the preferential tax rate in 2018 for all origin countries. Panel A (resp. panel B) displays the impact of both reforms when amenities are exogenous (endogenous with $\eta = 0.05$).

We then show that responses to origin-specific repeals display heterogeneous hysteresis, depending on the size of the origin country. In figure F.26, we simulate the repeal of the preferential tax rate after 2018, for either only the small origin country or only the large one – for example due to the application of source-based taxation for pensions received by Finland (or French) pensioners moving to Portugal. When applied only to the small country ("Finland"), this removal results in an incomplete reversal of the migration response – the level of migration remains more than five percent higher than at baseline even after the repeal. Permanently higher pensioner inflows from the other, larger origin country keep endogenous amenities in Portugal at a higher level from the point of view of Finnish pensioners, even after the end of the regime, leading to hysteresis. On the other hand, removing the favorable tax regime for only the large country ("France") yields an almost exact full reversal of the migration response of French pensioners: the level of post-reversal migration to Portugal is only 0.6% larger than at baseline. Finnish pensioners in Portugal are few enough to have a limited impact on the endogenous amenity there through agglomeration. Thus, the observed hysteresis effects documented in the paper is more likely to appear for small than for large destinations.

Figure F.26: **Heterogeneous hysteresis**



(a) Repeal in small origin country

(b) Repeal in large origin country

Notes: The figure displays simulated responses of location choices in a calibrated version of our model with $\sigma = 2, \eta = 0.05$. We simulate a reduction in the tax rate applicable to foreign pensions for all origin countries in Portugal after 2012, and an origin-specific repeal of the preferential tax rate in 2018. Panel A (resp. panel B) displays the impact of both reforms when the origin-specific repeal applies in only the small (resp. only the large) country after 2018.

G Data appendix

G.1 Description of Finnish administrative data

The Finnish administrative data are provided by Statistics Finland and contain information on all individuals permanently residing in Finland. Our analysis uses these individual-level, full-population administrative records for the years 1990 to 2022. The main data source is the longitudinal modules on personal data (FOLK), which provide extensive socio-economic information, including age, sex, educational level, firm and establishment IDs, main activity, all taxable income (such as pensions, business income, and capital income), and the start date of pension benefits. All information is recorded at the end of the year.

The data is then merged with the migration register using encrypted individual social security numbers. Since we do not observe individuals in the data after they emigrate, we must link the data to the year before their emigration. This means all demographic information is recorded one year prior to the move. To accurately reflect the age at the time of migration, the age variable is adjusted by adding one year. The migration data provide details on the date of migration (including both emigration and immigration) and the countries of destination or return. The migration records capture only registered migration events. However, the incentive to register is substantial; spending more than six months abroad exempts you from Finnish taxes, which are typically higher than those in the destination country, and recording your return is necessary to qualify for transfers. As before, we define pensioners as individuals older than 55 years. Although we can identify actual pensioners, it is possible that some wealthy individuals near retirement age may choose to retire early by relocating from Finland to Portugal, where their capital income is not taxable. Therefore, focusing only on pensioners may not capture all tax-related migration events. Our results are similar when focusing only on individuals drawing a pension.

Tables G.8 and G.9 provide descriptions of the main variables used in the analysis carried out using Finnish administrative data. Variables such as earnings, capital income, business income, and income decile are calculated based on values before retirement. Since these variables often decline as the official retirement date approaches, we use a

5-year average before retirement. For individuals older than 55 years but not officially retired, we calculate a 5-year average before moving.

Constructing flow of migrants. The flow of migrants is derived from the Finnish administrative micro-data described above. We aggregate the micro-data by destination country and migration year. In addition to calculating the overall flow of migrants to each country, we also compute the flows for various demographic groups, including married and single individuals, those with and without children, those with capital or business income, and those who were in the top 10% or bottom 90% of earners before retirement.

Constructing stocks of migrants. The stocks are calculated based on migration records from 1991 to 2022 merged with FOLK personal data. Although aggregate data sources could provide the total number of Finns residing in Portugal before this period, we would lack detailed information about their characteristics. Therefore, we construct the stock using the available micro-data. The starting point is the flow of migrants described above. Using the aggregated flow data, we first calculate a base stock for years 1991–1995 which is adjusted for individuals returning to Finland during this time period. Next, this base stock is updated annually to account for outflows to each country and inflows back to Finland. Using FOLK personal data, we track the demographics of individuals who move away. This allows us to calculate the cumulative numbers of, for example, married and single individuals. The shares of different groups are then determined by dividing the number of each group by the total stock. We also track how income variables like earnings, pensions, capital income, and business income change within the stock by adding the income of newcomers, subtracting the income of return migrants, and relating these numbers to the total stock. In addition, in this analysis, we limit the movers to those who have the same destination and return country (or a missing return country if they did not return). This ensures the accurate calculation of shares as individuals who initially migrated to Spain but later migrated to Portugal would otherwise inappropriately reduce the Portuguese stock, despite not being part of it initially.

Table G.8: Data Appendix: Variable Descriptions (Part 1)

Variable Name	*Description*
Age	Age when the individual moved to another country.
Male	Reported sex of the individual (1 = Male, 0 = Female).
Married	An individual is classified as married if they are married (including same-sex marriages, which were previously referred to as "registered partnerships" before 2017). They are classified as not married if they are divorced, widowed, or single. (1 = Married, 0 = Not Married). For movers, this classification is based on the information available one year before their move, at the end of that year.
Has children	Calculated based on a variable that records the number of children. (1 = Has >=1 Child, 0 = No Children or information missing). For movers, this classification is based on information available one year before their move, at the end of that year.
Higher education	An individual is classified as highly educated if they hold a higher education degree, either from a university of applied sciences or a university. A higher education degree is defined as a bachelor's degree or higher, based on the individual's highest obtained degree. If information is missing, it is classified as no higher education (1 = Higher Education, 0 = No Higher Education). For movers, this classification is based on information available one year before their move, at the end of that year.
Migrant	An individual is classified as a migrant if they relocate from Finland (1 = Migrant, 0 = Non-Migrant). A person may experience multiple migration events.
Pension	Information on pension income is sourced from tax records. This information is only available for individuals who have officially retired, meaning that it is missing for those who move close to retirement age but have not yet officially retired. If these individuals retire officially while abroad, we do not have information on their current pension as the FOLK data only has individuals residing in Finland. For movers, this information is based on information available one year before their move, at the end of that year. Pensions are adjusted to 2023 values. The reported mean values do not include zeros or missing values.

Table G.9: Data Appendix: Variable Descriptions (Part 2)

Variable Name	*Description*
Above median pension	This variable is constructed by calculating the pension decile each individual falls into annually (excluding zeros and missing values). It is coded as 1 for those in the 5th decile or above (Above Median) and 0 for those in deciles below the 5th (Below Median). For movers, this classification is based on information available one year before their move, at the end of that year.
Earnings	Average taxable earnings 5 years before retirement. For individuals older than 55 years but not officially retired, this variable is a 5-year average before moving. Earnings are adjusted to 2023 values. The reported mean values do not include zeros or missing values.
Capital income	Average capital income 5 years before retirement. For individuals older than 55 years but not officially retired, this variable is a 5-year average before moving. Capital income is adjusted to 2023 values. The reported mean values do not include zeros or missing values.
Business income	Average business income 5 years before retirement. For individuals older than 55 years but not officially retired, this variable is a 5-year average before moving. Business income is adjusted to 2023 values. The reported mean values do not include zeros or missing values.
Had capital income	If the 5-year average for capital income is greater than zero and nonmissing, this value is 1 and zero otherwise.
Had business income	If the 5-year average for business income is greater than zero and nonmissing, this value is 1 and zero otherwise.
Top 10 income decile	If an individual belonged to the top 10 income decile at some point 5 years before retirement, this value is 1 and zero otherwise.

G.2 Eurostat

We measure the *stock* of European residents by age, country of citizenship, and current country of residence in each EU country from 2009 to 2022, using data from Eurostat as well as national population registers and Censuses from several European countries. In this data appendix, we describe in detail the data sources as well as the adjustments we made to the raw data for our analyses.

EU aggregate migration data by destination-year This data set combines three series in the Eurostat database that count the number of EU citizens in each country of destination, excluding citizens of the destination country: (1) EU27 countries (2007-2013) except reporting country, (2) EU28 countries (2013-2020) except reporting country, and (3) EU27 countries (from 2020) except reporting country.

Within each group of tables, we procure data for 5-year age bins ranging from 20-24 years to 80-84 years and 85+ years. We define the retirees to be migrants aged 55 years or more (65 years or more in several robustness checks). We define working age migrants to be between 20 and 39 years of age. We then combine the three groups of tables together to obtain a time series spanning 2009-2022 for the retired and working-age migrants. This combined data set contains data for the following 22 EU countries: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, and United Kingdom.

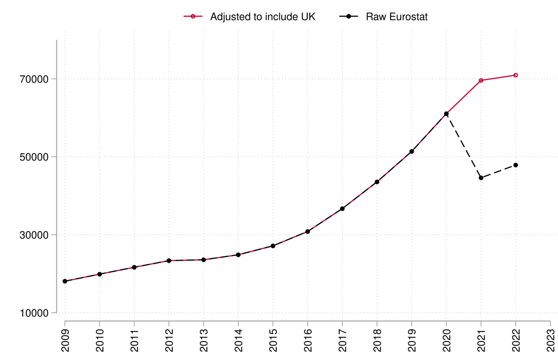
Destination-origin migration data. For certain analyses, we use destination-origin-level data instead of the EU aggregate. This data is also obtained from the Eurostat database for 5-year age bins. We similarly define retirees to be migrants aged 55 years or more (or 65 years or more), and working age migrants to be between 20 and 39 years of age. This data set contains the following EU 22 countries as destinations: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. Migrants to these destinations come from 28 EU countries:

Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. Data for France as a destination is largely missing from this data. Therefore, we supplement this data with the French census data, which provides with us the numbers of retired and working-age migrants from Belgium, Germany, Italy, Netherlands, Poland, Portugal, Romania, Spain, and United Kingdom. Since data for the UK as a destination is missing, to normalize odds-ratios for the UK we obtain the number of UK citizens living in the UK by age group from Eurostat.

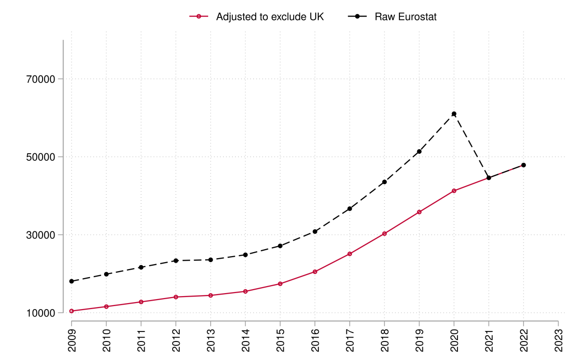
Data interpolation. In the EU aggregate migration and destination-origin migration data from Eurostat, there are years when data on the number of retirees or working age migrants are missing. We impute these missing data using interpolation. However, we limit this imputation to cases where both data for the previous and succeeding years are available, in which cases the imputed value is the arithmetic mean of the previous and succeeding years' values. For the EU aggregate migration data, we impute data for the following destination-year combinations: France-2014, Luxembourg-2011, Norway-2015, Norway-2020, Poland-2009, and Romania-2022. For the destination-origin migration data, we impute data for the following destination-year combinations: Austria-2011, Estonia-2021, Netherlands-2011, Germany-2011, and Romania-2012. For each destination-year combination, imputation is carried out for all origins.

Adjustments to include or exclude the UK. The EU aggregate migration data from the Eurostat database includes the United Kingdom up until 2020 and excludes the United Kingdom beginning 2021. To obtain two time series that consistently include or exclude the United Kingdom, we combine the EU aggregate migration data and the destination-origin-level migration between the UK and other destination countries. Specifically, for the series with the United Kingdom, we take the sum of the EU aggregate migration count and the count of migrants from the UK for two years 2021 and 2022. For the series without the United Kingdom, we subtract the count for migrants from the UK from the total EU-wide count for years on or before 2020. In our baseline analyses, we use the time series that excludes the United Kingdom. Figure G.27 demonstrates these adjustments to the EU aggregate migration counts for Portugal and Spain.

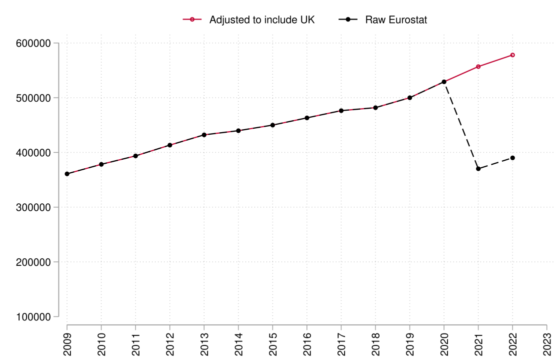
Figure G.27: Illustration of adjustments to raw *eurostat* EU aggregate stocks data



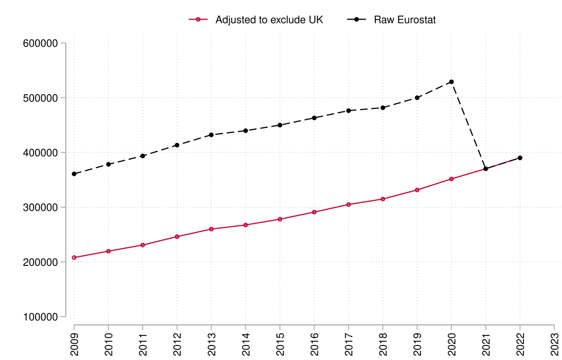
(a) EU retirees in Portugal (incl. the UK)



(b) EU retirees in Portugal (excl. the UK)



(c) EU retirees in Spain (incl. the UK)



(d) EU retirees in Spain (excl. the UK)

Note: This figure plots the illustrations of the adjustments to the raw Eurostat migration data for two destinations Portugal and Spain.

G.3 Additional sources

OECD Central government personal income tax rates and thresholds data The Eurostat international migration of retirees data are then merged with measures of income tax rates applicable to pensioners and workers in each destination and origin country, drawn from the Central government personal income tax rates and thresholds database. Since migration decisions are driven by the total average (rather than marginal) tax liabilities, we estimate elasticities with respect to (one minus) the average tax rate (ATR) at different levels of overall income of retirees to account for tax progressivity, which will be discussed in detail below.

Estimation of average tax rates. We estimate the average income tax rates for each country from 2009 through 2022 for an income profile I. In the OECD data, every country has a certain number of income brackets k with associated upper thresholds t_k and marginal tax rates r_k. Within every income bracket k, the tax liability L_k is computed as follows

$$L_k = \begin{cases} (I - t_{k-1})r_k & \text{if } t_{k-1} < I < t_k \\ (t_k - t_{k-1})r_k & \text{if } I \geq t_k \\ 0 & \text{otherwise} \end{cases}$$

where $k \geq 1$ and $t_0 = 0$. The total tax liability of income profile I is the sum of tax liabilities across income brackets k, and the average income tax rate applicable for income profile I is the ratio of the total tax liability in a year and income I. We perform this estimation on two income profiles EUR 24,000 and EUR 35,000 in our baseline analyses. The estimated average personal income taxes range from 0% to 34.8% for the first income profile and from 0% to 38.1% for the second.

Adjustments to Germany's non-linear marginal tax schedule. Unlike other countries in the OECD income tax rates and thresholds data set during the 2009-2022 period, Germany has *progressive* marginal tax rates[30] within a bracket (as opposed to *fixed* marginal tax rates in other countries) for the second and third brackets. Within these income brackets, the marginal tax rates vary linearly with income. Using this linear relationship and known lower and upper marginal tax rates of these brackets (14 and 24% for the second level and 24 and 42% for the third), we can estimate marginal tax rates within these brackets for an income profile I.

OECD Pensions at a glance data We rely on the OECD *Pensions at a glance* average tax rates applicable to retirees and workers in 2022. This database covers OECD countries

[30] For details, see https://www.lohn-info.de/einkommensteuertarif_2021.html and https://www.lohn-info.de/einkommensteuertarif_2017.html for years 2021 and 2017.

and hence most of the EU countries (and the United Kingdom) in our analysis, except for Bulgaria, Croatia, Cyprus, Malta, and Romania. Average tax rates for workers and pensioners are use to compute (log) ratio of keep rates (1-ATR) between the destination and the origin for pensioners and workers.

Eurostat average income data Another data source used in the validation of the cross-sectional predictions is the Eurostat net earnings series. It provides information on gross and net earnings as well as taxes and social security contributions by year and EU country.

CEPII Bilateral distance data We use the distance between capital cities from the CEPII bilateral distance dataset.