Risk on the Run: Public Pensions, Migration Risk and Pivot to Alternatives

Rahul Singh Chauhan*

July 14, 2026

Abstract

How does local debt sustain with a mobile tax-base? This paper provides new evidence on how pension underfunding shapes inter-state migration. Exploiting plausibly exogenous variation in funding gaps driven by relative portfolio performance, I find that widening pension deficits significantly increase net out-migration of households and income flows from underfunded to better-funded states. This mobility erodes the tax base, raising the effective cost of funding pensions and constraining governments' ability to close shortfalls through higher contributions. I further show that states facing higher "migration risk" - those that face larger out-migration when local taxes rise - systematically under-contribute relative to actuarially required levels and shift pension assets toward opaque, higher-yielding alternatives such as private equity and hedge funds. This pattern reveals a novel mechanism by which household mobility exacerbates both fiscal fragility and risk-taking incentives. To interpret these findings, I develop a spatial model of tax-setting and pension investment under endogenous migration. The model highlights a migration–funding–risk feedback loop: governments that fail to internalize out-migration overestimate tax capacity, under-contribute, and induce fiduciaries to pursue riskier portfolios.

*University of Chicago Booth School of Business (e-mail: rahulchauhan@chicagobooth.edu). I thank Rodrigo Adao, Aleksandar Andonov (discussant), Juanma Castro-Vincenzi, Leonardo D'Amico, Aditya Dhar, Eugene Fama, Daniel Garett, Gianluca Yong Gonzalez, Laura Gu, Lars P Hansen, Joanna Harris, Jacob Hartwig, Kilian Huber, Tanvi Jindal, Anil Kashyap, Ralph Koijen, Joe Kupeferberg, Raymond Lin, Saptarshi Majumdar, Lucy Msall, Stefan Nagel, Raghuram Rajan, Esteban Rossi-Hansberg and Erick Zwick for helpful comments and feedback. All errors are my own.

1 Introduction

Defined-benefit (DB) public pension plans across the United States face persistent underfunding. Unfunded pension liabilities are now among the largest off-balance-sheet obligations of state and local governments (Giesecke and Rauh, 2023), and funding ratios remain depressed well after the Great Recession. These liabilities raise concerns not only about fiscal sustainability, but also about the political economy of financing public promises when the tax base is mobile. Existing work studies the fiscal, economic, and financial consequences of pension underfunding (Novy-Marx and Rauh, 2012; Andonov et al., 2017; Anzia, 2022; Aiello et al., 2024). Much less is known about how pension deficits interact with household mobility, and how the threat of mobility feeds back into states' contribution policies and pension funds' investment decisions.

This paper studies this feedback loop. I ask two related questions. First, does persistent pension underfunding predict taxpayer out-migration? Second, conditional on funding needs, do states facing greater migration risk under-contribute to their pensions and shift their pension portfolios toward riskier assets?

The starting point is that pension underfunding represents a claim on future public resources. When DB pension deficits deepen, state and local governments must eventually close these gaps through some combination of higher borrowing, lower expenditures, higher employee contributions, benefit reforms, or higher taxes.[1] Because many state and local governments operate under balanced-budget rules, pension shortfalls affect the broader fiscal environment. They can signal future tax increases, cuts to public services, or both. In this sense, pension funding status is not merely an accounting measure; it is a leading indicator of future fiscal burdens and local amenities.

This matters because households and firms can respond to fiscal stress by relocating (Tiebout (1956), Inman (1982)). If pension underfunding widens tax and amenity differences across jurisdictions, residents may move toward states with lower expected tax burdens or better public services. Consistent with this mechanism, I document that higher pension underfunding is associated with higher corporate tax rates, higher state income tax rates, lower public school expenditures, and greater net out-migration.

Migration then creates a feedback loop. If underfunding induces out-migration, and out-migration erodes the tax base, then pension deficits can become harder to finance precisely when financing needs are greatest. This creates the possibility of a vicious cycle: underfunding raises expected fiscal burdens, fiscal burdens induce migration, and migration further weakens the government's capacity to fund pension promises. The first part of the paper therefore asks whether pension funding gaps, in absolute and relative terms, predict household migration.

To study the migration response, I begin with a location-choice framework for migrant households. The empirical design parallels the canonical specification in Moretti and Wilson (2017), who study how state-tax differentials affect the location choices of star scientists. My contribution is to treat pension funding gaps as a source of expected fiscal differences across states. Because balanced-budget constraints tie pension underfunding to taxes, spending cuts, or both, funding gaps should affect migration through differences in fiscal burdens and public amenities.

Identifying this effect is difficult. Underfunded states may differ systematically from better-funded states in ways that also affect migration. For example, fiscally profligate states may provide better public services that attract households, while fiscally conservative states may experience outflows because of unrelated local economic shocks. Measurement error is also a concern because more underfunded states may use different

[1] An additional channel is through reforms that reduce pension benefits or increase employee contributions. Drawing on National Association of State Retirement Administrators (NASRA) reports between 2005 and 2022, I classify reforms into four categories: (i) higher employee contribution rates, (ii) reduced benefits, (iii) plan design changes, and (iv) other adjustments. Details are provided in the appendix.

discount-rate assumptions to understate liabilities. An identification strategy must therefore isolate plausibly exogenous variation in pension funding status.

I motivate my instrument using a variance decomposition of long differences in pension funding ratios. I decompose changes in funding status into components due to investment performance, contribution policy, and actuarial projections. Investment performance explains a large share of the explained variation over time, followed by changes in contribution rates. This motivates my primary instrument: cumulative excess returns created from synthetic portfolios, keeping the pension allocations to public equity and fixed income as of 2001 interacted with returns earned on the S&P 500 and Bloomberg Global Treasuries Index respectively [2]. The exclusion restriction is that the instrument affects migration only through pension funding status, after controlling for origin-destination pair fixed effects and time-varying origin and destination characteristics.

Using IRS county-to-county taxpayer migration data, I estimate how relative pension funding gaps affect bilateral migration flows. Restricting attention to interstate migration, I find that within an origin-destination pair, a one-standard-deviation increase in the destination-origin pension funding gap - equivalent to the destination's funding ratio being 10 percentage point higher than the origin's - increases the odds of migration by 4.88 percentage points. This corresponds to an annual county-to-county migration probability of 4.2 basis points. For a county the size of Cook County, with roughly 2 million non-migrant tax returns in 2022, this implies an additional annual adjusted gross adjusted income flow of approximately $14 million in response to a percentage point difference in funding status. I also estimate county-level two-stage least squares regressions of net out-migration on pension funding ratios. A one-standard-deviation decline in the funding ratio implies an annual net adjusted gross income outflow of approximately $540 million for a county the size of Cook County.

I confirm the intermediate channels through which these funding gaps pass-through to household migration. I find that the relative gap between capital expenditure and it's share in state expenditures of destination vs. origin responds positively to their instrumented relative funding gap i.e. destination counties tend to have higher capital outlays which associate positively with pubic infrastructure and services. Destination state income taxes and corporate taxes are also move negatively relative to origin when the relative funding gap increases. This underlines the chain of causality - relative investment performance moves funding status which passes through to relative fiscal policy. Relative fiscal policy shapes households location choice.

In a dynamic OLS specifications, when the destination-origin funding gap widens, the odds of out-migrant returns relative to non-migrant returns increase by about 2% over ten years. After instrumenting funding-gap changes with relative return surprises, the odds of out-migration rise by 8% within six years of the gap widening, before tapering to roughly 5% after ten years. The pattern remains when migrants are weighted by adjusted gross income. The response is especially stronger among older tax filers, those aged 55 and above, and among high-income filers with adjusted gross income above $200,000. Overall, the evidence suggests that as pension funding deteriorates in origin states relative to destinations, residents increasingly relocate to better-funded jurisdictions.

The second part of the paper studies how this mobility constraint affects pension finance. Since the early 2000s, public pension portfolios have shifted substantially toward alternative assets such as private equity, hedge funds, real estate, and other private investments. By 2023, alternatives accounted for a value-weighted average allocation of 35% of total invested assets. Prior work attributes this rise to political boards (Andonov

[2] I also validate the results using public unionization density, as in Mittal (2024), which plausibly affects pension contribution policy

et al., 2017), evolving discount-rate assumptions (Giesecke and Rauh, 2023), beliefs about asset performance (Begenau et al., 2024), and gambling for resurrection (Mittal, 2024). Related theoretical work studies public pension portfolio choice as a joint problem of minimizing fiscal costs while investing in risky securities (Lucas and Zeldes, 2009; Pennacchi and Rastad, 2011; Lu et al., 2019).

The migration response implies that a mobile tax base constrains the financing of pension debt. Novy-Marx and Rauh (2014) emphasize the revenue demands created by public pension debt and note the possibility of out-migration if states raise contributions to repair underfunding. Gao and Gao (2025) show theoretically that the migration elasticity of taxes can shape local governments' choice between taxation and debt issuance. Building on this logic, I measure states' migration risk: the extent to which their tax base shrinks when fiscal burdens rise.

I argue that migration risk is an overlooked state variable in this phenomenon. If raising contributions through taxes causes residents to leave, then states with a more mobile tax base have less fiscal capacity to repair pension deficits through contributions. In such states, pension underfunding is harder to close through conventional fiscal policy. This may induce under-contribution and place greater pressure on pension fiduciaries to seek higher returns through riskier portfolios or smooth volatility through opaque assets.

I construct three complementary measures of migration risk [3]. The main measure exploits plausibly exogenous increases in tax liabilities created by the State and Local Tax deduction cap introduced under the Tax Cuts and Jobs Act of 2017, which disproportionately affected taxpayers in high-tax states. Across these measures, high-migration-risk states are those where fiscal burdens are more likely to erode the tax base.

I find that states with higher migration risk systematically under-contribute relative to actuarially required contribution levels. Their pension funds also have worse funding status. I then examine whether migration risk shapes pension portfolio choice. Across all three measures, pension plans in high-migration-risk states respond differently to underfunding. For each one-percentage-point increase in pension deficits, they reallocate an additional 68 to 141 basis points into alternative assets such as private equity, real estate, and hedge funds. This difference persists over time, amounting to 2 to 7 percentage points higher alternative allocations on average relative to plans in low-migration-risk states. Allocations to fixed income and public equities remain flat or decline, consistent with a portfolio shift toward riskier higher-yield or opaque assets.

To rationalize these patterns, I develop a two-period spatial model of pension funding, household mobility, and portfolio choice. Households choose locations based on local amenities and taxes, both of which depend on pension funding status. State governments are represented by a political executive that sets taxes and contributions to minimize political costs subject to pension obligations and exogenous spending needs. Pension fiduciaries choose the share of assets invested in risky securities. The fiduciary is risk-averse and maximizes payoffs proportional to end-of-period funding status. The optimal risky share is decreasing in ex-ante funding, state contributions, the sensitivity of funding to investment performance, and managerial risk aversion.

Politicians face re-election constraints which makes them under-contribute and shift risk to the future, relative to a planner that doesn't face re-election uncertainty. As a result, underfunded states lose residents as well as under-contribute to pensions and implicitly induce fiduciaries to take more investment risk. I contrast this decentralized equilibrium with a social-planner allocation in which the state government internalizes both investment risk and the migration response. In the planner's problem, the optimal risky share is inversely

[3] The other measures are: (i) coefficients on state-level regressions of net out-migration on changes in income tax rates, controlling for time-varying state characteristics. This provides a transparent, though potentially endogenous, ranking of states by migration sensitivity. (ii) elasticities recovered from bilateral location-choice framework of Moretti and Wilson (2017), using changes in tax gaps between states to estimate relative migration propensities.

related to the efficiency of public service provision and declines with out-migration. Calibrating the planner's allocation to current tax and expenditure data, I find allocations to alternative asset classes explain the excess risk observed in data relative to the model-implied optimum risky allocation.

This paper makes two contributions. First, I show that pension underfunding affects household mobility: funding gaps between jurisdictions predict migration flows and shrink the local tax base. Second, I show that migration risk shapes pension finance: states with more mobile tax bases under-contribute to their pensions and reallocate toward riskier, higher-yielding alternative assets. The model links these findings through a migration-funding-risk feedback loop, showing how pension underfunding can simultaneously weaken fiscal capacity and encourage risk-taking in public pension portfolios. I also used the model to quantify the wedge between the optimum allocation to risky assets and the allocations observed in data.

Related Literature. A large literature examines public pension underfunding. Novy-Marx and Rauh (2009) document the post-recession surge in unfunded liabilities; Novy-Marx and Rauh (2012, 2014) study the fiscal imbalance and revenue demands created by pension shortfalls, with Novy-Marx and Rauh (2014) linking fully funding pension obligations to Tiebout-style mobility (Tiebout, 1956). Anzia (2022) show that rising pension expenditures reduce public employment, and Aiello et al. (2024) show that investment windfalls capitalize into local property prices. Relative to this work, I focus on long-horizon local effects of unfunded pension liabilities on *observed* interstate net migration, using a bilateral location-choice design estimated via two-stage least squares.

On investment policy, Lucas and Zeldes (2009) analyze the trade-off between tax smoothing and risky asset exposure; Andonov et al. (2017) show that higher liability discount rates—chosen by politically influenced boards—spur risk-taking; and Giesecke and Rauh (2023) argue that discount-rate practices understate underfunding. Lu et al. (2019) formalize reach-for-yield behavior in state and local funds; Myers (2023) document excessive risk-taking by cities post-crisis; Begenau et al. (2024) attribute the rise in alternatives to return expectations and experience; and Mittal (2024) find that the most underfunded plans match with smaller private equity funds and earn lower total returns. A complementary literature studies how taxes and local policies shape the geography of economic activity (Suárez Serrato and Zidar, 2016; Giroud and Rauh, 2019; Fajgelbaum et al., 2019; Rauh, 2022; Rauh and Shyu, 2024). Gao and Gao (2025) connect municipal finance to labor mobility. This paper links these strands by showing that pension underfunding shifts migration patterns and that the resulting *migration risk* is a first-order determinant of contribution policy and portfolio tilts toward alternative asset classes.

Road Map. Section 2 describes the data. Section 3 presents stylized facts on state pension plans, lays down the conceptual framework connecting relative funding statuses with migration decisions, and the the association of pension funding status to local economic outcomes. Section 4 presents the instrument, and the baseline results of the relationship between pension funding and migration. Section 4 develops the state-wise migration risk measure and explores the relationship between migration risk and pension portfolio allocations. Section 6 contains the model. Section 7 concludes.

2 Data

The analysis draws on several complementary data sources. The core dataset is the Center for Retirement Research's Public Plans Database (PPD), which reports annual balance-sheet details, asset allocations, and performance metrics for 228 state and local pension systems for the time period of 2001-2023. I use the reported Actuarial Funding Ratio which is the ratio of the pension funds assets and liabilities in the dataset and underfunding is one minus the funding ratio. I get variables on plan-wise employer and employee contribution rates and amounts, investment return assumption, inflation assumption, methods of valuation, amortization and smoothing period, and required contribution rates from this dataset. I also use the plan-wise portfolio allocation data which gives the break up of the pension assets by equity, fixed income, and alternative investments such as private equity, hedge funds, real estate and others.

For migration data, I use Internal Revenue Service's Migration Files which helps track both aggregate as well as county-to-county and state-to-state migration of tax returns and adjusted gross income for the time period 2001-2022. I use the county-to-county outflows to for the baseline regression and get the number of out migrant returns and adjusted gross income (AGI to a different state, and do not use data on migration within a state or to or from abroad. I aggregate to county-level to measure annual net migration by county by subtracting inflows from outflows.

I obtain information on state finances from the Census Bureau's Annual Survey of State and Local Government Finances. I obtain state marginal income-tax rates from NBER's TAXSIM, and state corporate tax rates from the Tax Foundation. Public-school spending data are sourced from the National Center for Education Statistics. Finally, household-level variables—including wages, rents, employment growth, and property-tax liabilities and other miscellaneous variables—are drawn from the American Community Survey and the Current Population Survey. Summary statistics for all variables used in the analysis are reported in Appendix Table 5.

3 Facts and Motivation

Aggregate funding ratios have trended downwards since the early 2000s. Figure 1 documents a steady decline in the value-weighted funding ratio for state and local pension plans—from full funding in 2001 to below 75 percent by 2023. However, there is substantial heterogeneity - while the 95th percentile in 2023 corresponds to full funding, the 5th percentile hovers below 50%. Panel (b) dis-aggregates the series by administering authority, revealing that city- and school-district plans became markedly more underfunded than their state and county counterparts during the 2010s, although the gap has narrowed in recent years. Simultaneously public pension allocations have pivoted towards alternative pension classes such as private equity, hedge funds, real estate and other asset classes from equities and fixed income securities. Figure 2 shows the simultaneous, growing allocation towards alternative asset classes since the great recession, with alternative asset classes now accounting for over a quarter of total allocation.

3.1 Tracking Drivers of Cross-sectional Differences in Pension Funding Status

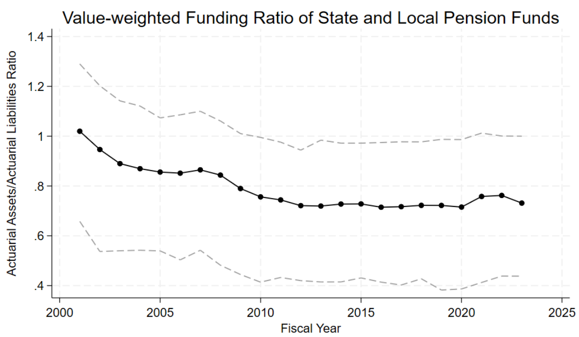
What explains variation in pension underfunding? Past literature [4] has identified three main determinants of pension underfunding, which are: (i) investment performance (ii) changes in contribution rates and benefits policy (iii) changes in actuarial assumptions such as changes in discount rates, expected rate of return and payroll growth assumptions. To understand what explains the cross-sectional variation in deteriorating pension funding status arising from the three main determinants, we can utilize the following formulation:

$$\begin{aligned} dU_{it,t-h} = g\big(&\Delta \text{ Investment Performance (IP)}_{it}, \Delta\text{Contribution Policy (CP)}_{it}, \\ &\Delta\text{Actuarial Projections (AP)}_{it}, \nu_{it}\big) \end{aligned}$$

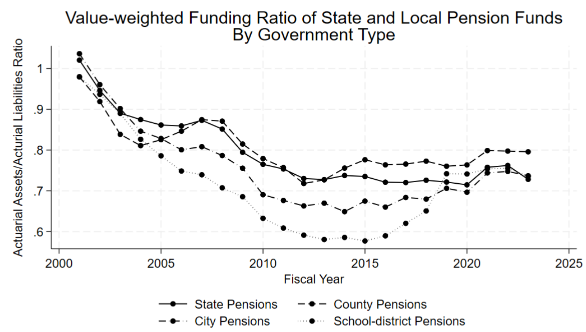
[4] Refer to Giesecke and Rauh (2023) for review

Figure 1: Aggregate Trends and Dispersion of Public Pensions' Funding Status

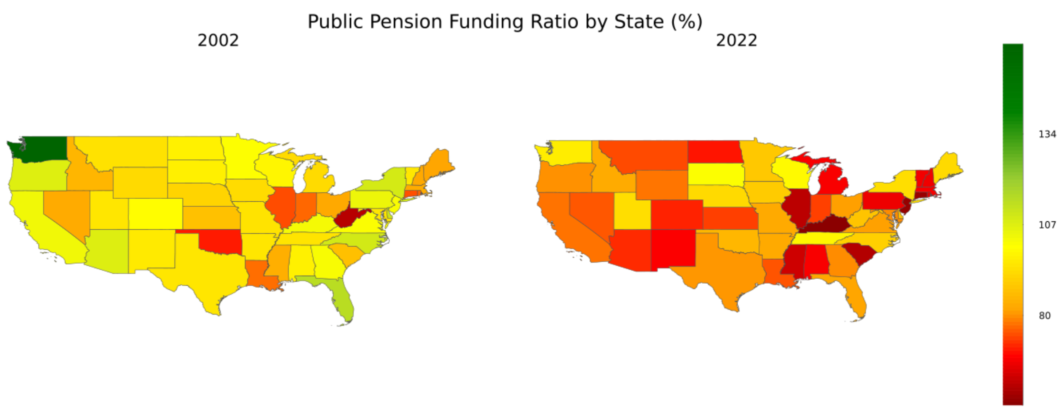
These figures plot the value-weighted ratio of pension fund actuarial assets to liabilities. Data comes form Public Pensions Database from the Center for Retirement Research. Panel (a) shows the value-weighted funding ratio, along with the 5th and 95th percentile funding status in the sample as dashed lines. Panel (b) shows the ratios by government type. Panel (c) shows the spatial dispersion in funding ratios. Data ranges from 2001-2023.



(a) Aggregate



(b) By Government Type



(c) Spatial Dispersion

Figure 2: Allocation Trends

This figure plots the aggregate portfolio allocations by asset class for public pension funds. Data comes from Center for Retirement Research's Public Pensions Database and ranges 2001-2023.

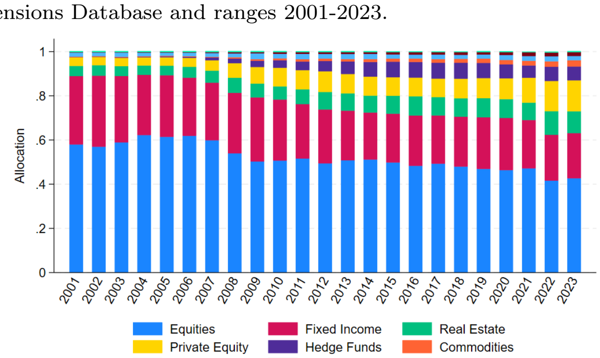
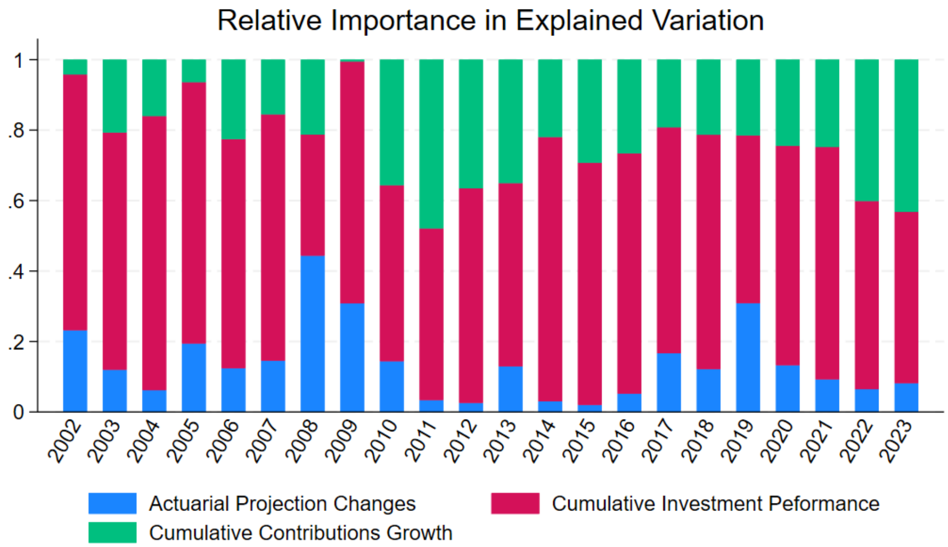


Figure 3: Variance Decomposition

This plot represents the Shapley-value decomposition of the explained variation in the long-differences in pension funding status of 228 state and local defined benefit pension run on three drivers of pension characteristics: (i) Changes in Actuarial Projections (ii) Cumulative Investment Performance (3) Cumulative Contributions Growth.



I run year-by-year regressions of cumulative changes in funding status relative to 2001, on cumulative investment return performance, contribution growth and change in normal costs predicted by changes in actuarial assumptions. I then carry out a Shapley decomposition of the explained variation.

Figure 3 documents the variance decomposition. Investment performance remains the biggest drivers of pension funding variation across states initially explain anywhere between 50-75% of variation. Contribution growth has recently become an important explanation, with around one-third of the explained variation rising to about 43% in 2023, which is consistent with the findings in Giesecke and Rauh (2023). Variation in actuarial projections are relatively less influential, even though discount rate assumptions being linked to investment returns can be absorbed by the portion explained by investment performance. Overall, investment performance and contribution policies explain cross-sectional variation in pension funding trends in the data. Thus dispersion in pension investment performance could explain the relative funding gaps across state and local government pensions. I next lay down the conceptual framework of how these relative funding gaps could potentially drive migration across states.

3.2 Conceptual Framework: Funding Gaps and Migration Flows

How does relative public pension funding gaps pass-through to household migration? An individual's migration decision is motivated by the utility difference between the origin and destination. Assuming a Cobb-Douglas utility function with preferences over consumption and housing, households maximize utility within a location subject to local labor income net of taxes, with labor being inelastically supplied. The indirect optimized utility of a resident in a location j would thus be: $V_j = B_j(1-\tau_j)w_j r_j^{\alpha-1}$, where B_j represents amenities, τ_j is local income tax, w_j is wage, and r_j is rent. Thus, with a time dimension, the indirect utility of an individual who lived in county o in the previous year and moved to county d (in a different state) at time t is as follows:

$$V_{iodt} = \alpha \ln(1-\tau_{dt}) + \alpha \ln w_{dt} + \gamma \ln r_{dt} + B_d + B_{dt} + e_{iodt} - C_{od} \quad (1)$$

Here I divide amenities into two parts: B_d captures location specific fixed amenities and B_{dt} captures time-varying amenities at the location. e_{iodt} represents location specific idiosyncratic preferences and C_{od} is the utility cost of moving. Therefore, the utility gain or loss experienced by individual if she moves from state o to state d in year t is a function of the difference in taxes, wages, housing costs, and location-specific amenities between the origin and destination. This simple framework allows us to consider all possible pairs of origin and destination to model the relative bilateral utility gain from moving:

$$\begin{aligned} V_{iodt} - V_{ioot} =& \alpha[\ln(1-\tau_{dt}) - \ln(1-\tau_{ot})] + \alpha \ln(w_{dt}/w_{ot}) + \\ & \gamma \ln(r_{dt}/r_{ot}) + B_{dt} - B_{ot} + B_d - B_o - C_{od} + e_{iodt} - e_{ioot} \end{aligned}$$

Between all possible county pairs, I test the odds of out-migration from an origin county o to a destination county d in another state as a function of tax, wage, and rent gaps, conditioning on destination–origin fixed effects along with either origin–time or destination–time fixed effects. This location choice design is similar to Moretti and Wilson (2017), who study the effect of state income taxes on the migration of star scientists. The innovation of this paper is to extend this framework by identifying migration responses to relative pension funding gaps which drive changes in local fiscal conditions.

Pension benefits are part of state and local governments' operating budgets, and higher promised liabilities translate into greater expenditures due to balanced budget requirements.[5] When pension assets fall short of covering recurring liabilities, states must finance the gap through either raising taxes or cutting expenditures. Consistent with Novy-Marx and Rauh (2014), greater revenue demands accompany higher levels of underfunding. Through the budget constraint, tax rates can therefore be expressed as a decreasing function of the pension funding ratio. Similarly, better funding status lowers funding pressures on state pensions, leaving more room for expenditure on amenities. We can re-write time-varying amenities as an affine function of funding ratio. [6] I later illustrate the mechanisms through which relative funding gap translate to a changes in intermediate fiscal outcomes. Since $g(\cdot)$ is an increasing function, the qualitative impact of migration from o to d can be recovered by regressing on differences in funding ratios. This provides a reduced-form quantification of the odds of migration driven by pension underfunding.

As $g(.)$ is an increasing function of its argument, we can recover the qualitative impact on movement from o to d by regressing the gap on the gap in funding ratios. This can be useful in quantifying the reduced-form odds of migration due to higher levels of funding gap.

$$V_{iodt} - V_{ioot} = \beta[\ln f_{dt} - \ln f_{ot}] + \alpha \ln(w_{dt}/w_{ot}) + \gamma \ln(r_{dt}/r_{ot}) + B_d - B_o - C_{od} + e_{iodt} - e_{ioot}$$

If e_{iodt} follows a Type-1 Extreme Value distribution, then the population shares sorting into migrant versus non-migrant groups would be equivalent to the log odds of migrant relative non-migrant individuals within the origin county at a given point of time. This gives us an econometric specification akin to a gravity equation in spatial economics, with the logit shares of the ratio of migrant and non-migrant returns being

[5] https://taxpolicycenter.org/briefing-book/state-and-local-tax/fiscal-federalism-and/what-are-state-balanced

[6] I later assume a parametric form for amenities $B_{st} = 1 - \exp(-\gamma_s x(f_{st}))$, where x_{st} are state expenditures-to-GDP, which are linear in funding status. The regressor could be then expressed as the first-order approximation of the logged amenities.

the dependent variable:

$$\ln(P_{odt}/P_{oot}) = \beta[\ln f_{dt} - \ln f_{ot}] + \alpha \ln(w_{dt}/w_{ot}) + \gamma \ln(r_{dt}/r_{ot}) + B_d - B_o - C_{od} + e_{iodt} - e_{ioot} \tag{2}$$

Let P_{odt} denote the number of individuals migrating from state o to state d, and P_{oot} the number of non-migrants. Before moving to testing this design, I look at the state pensions' funding level association with current and future state-level fiscal outcomes, to motivate the $g(.)$ function in the framework.

3.3 Pension Underfunding's Association with State Outcomes

Figure 1 shows that aggregate funding status of public pensions have deteriorated over time since 2001. Since persistent pension underfunding may have a lagged but protracted effect on real outcomes, akin to local projections, I estimate the response of a variable to an independent variable at each horizon. This is tantamount to running separate regressions run of different leads of the dependent variable on present underfunding. For horizon $h = 0, \ldots, H$:

$$Y_{s,t+h} = \beta_h U_{s,t} + \gamma' X_{s,t} + \delta_s + \tau_{t+h} + \varepsilon_{i,t+h}, \tag{3}$$

where $U_{s,t}$ is underfunding in state s in time period $t-1$, $Y_{s,t+h}$ being the outcome of interest. Each specification also contains the first and second lags of the dependent variable to control for serial correlation over time. $X_{s,t}$ includes state-time varying controls and state and time fixed effects. I include state-wise aggregate pension controls which includes the lagged contribution growth rate and dummy for whether any of the state's constituent pensions changed investment return assumption, inflation assumptions, amortization methods or other actuarial assumptions that could affect total pension liability, in the past year. Residualizing underfunding variable would remove their confounding effect and isolate the impact of underfunding-levels net of growth in contributions or changes in assumptions. Other state level controls include the lagged outstanding debt to GDP ratio which reflects a confounding element in the state's capital budget residualizing the effect of the state being a more heavy borrower in general, state-level employment growth and GDP growth to account for time-varying factors that may effect revenue levels and state's tax base. I also control for the share of republican representatives the state elected to the US house representatives in the lagged election year to control for state's political leaning. I use this empirical design to track the impact on state's corporate tax rates, state's marginal top marginal income tax rate and states' logged total public school capital expenditure. I omit using state employment growth as a control when I use net adjusted gross income (AGI) outflow per non-migrant tax-payer as the dependent variable might be a driver. I additionally use lagged log wage and log state-level average rent variable to control for local economic factors that could impact migration outcomes. I use Driscoll-Kraay standard errors to correct for heteroskedasticity and serial correlation in standard errors.

The first panel shows the positive association of state corporate tax rates with underfunding. We can see that state corporate tax rates are about 5-10 basis points higher over the time horizon of 1-6 years for a given 10 percent point higher underfunding. The second panel shows that marginal state income tax rates on the top-tax bracket is also higher by about 50 basis points in the four years after a 10 percent point higher underfunding. The third panel shows the impact on public amenities as public school capital expenditures decline by about 5-10 percentage points annually following a 10 percent point decline in funding ratio for over 6 years. Finally the fourth panel shows that the net migration rate measured by the aggregate adjusted

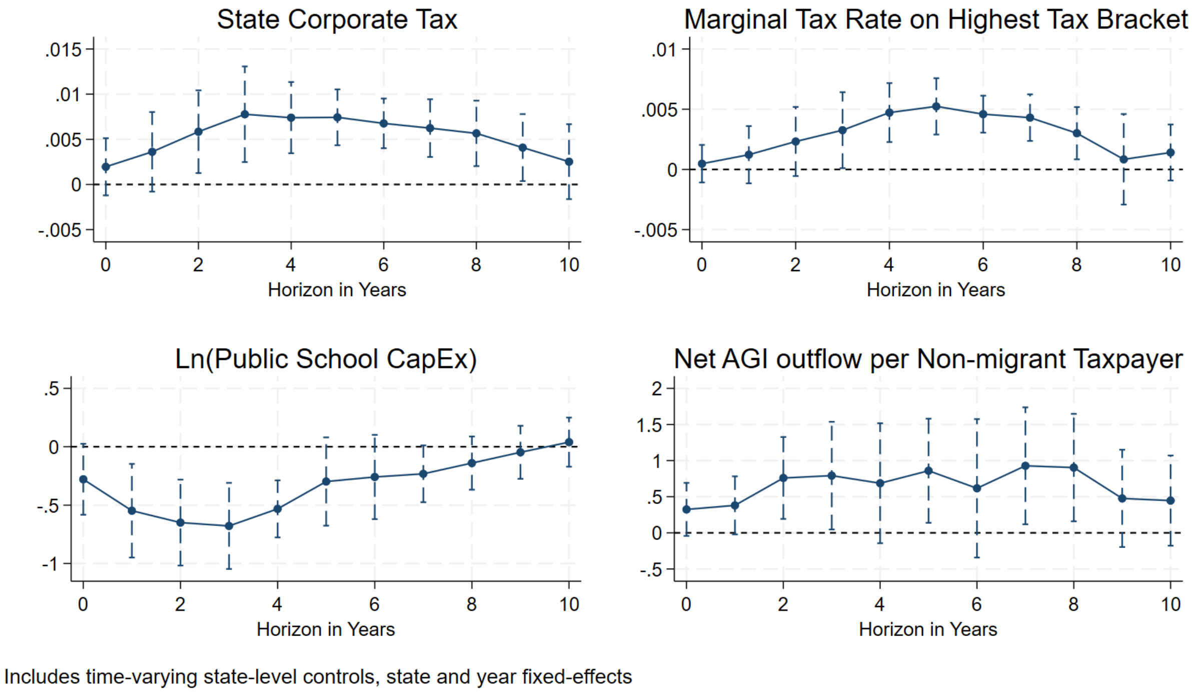


Figure 4: Tracing the impact of state pension underfunding over long horizons

gross income (AGI) reported by out-migrants net of in-migrants in the state divided by the total number of tax-payers in the states. The benefit of using this variable is that size-weights out-migrant returns of households and firms. The net migration rises by \$50-100 per-non-migrant taxpayer or equivalent to \$1-2 billion for the state of California, following a 10% point negative shock to the state's pension funding ratio. These correlations, in sum, paint the picture that pension underfunding is a marker of state's fiscal health: persistent underfunding predicts higher taxes and worsening public services in the future, which might also be related to the net outflow of the state's tax-base. This poses a cyclical issue - whether states with worse funding status lose their respective tax base due to the issue itself or whether out-migration itself reduces the state's fiscal capacity, and hence its ability to meet the shortfalls. To address this cyclicality, I use an instrumental variable design exploiting the cross-sectional drivers of funding status as indicated in figure 3.

4 Estimating the Pass-through of Funding Status on Migration

The conceptual framework in section 3.2 points to a directed acylic graph of causal effects. Worse funding status → worse local taxes and amenities → out-migration. A central endogeneity concern in estimating the effect of public pension underfunding on household location decisions is the possible simultaneity of the two phenomena. States with higher underfunding may simply be more fiscally profligate, running persistent deficits. While higher taxes in such states may exert a "push" force on out-migration, these same states may also offer more generous welfare programs or superior public infrastructure, generating an offsetting "pull." Alternatively, optimistic discount rate assumptions may mask the true state of local fiscal health (Giesecke and Rauh, 2023). These concerns highlight the need for an empirical strategy that credibly isolates the impact of pension underfunding from confounders.

To address this, I leverage the IRS migration data, which report annual bilateral flows of tax returns, number of individuals, and adjusted gross income (AGI) between counties. This rich panel allows me to restrict attention to interstate moves and to implement the estimating equation (2) with both origin-time and destination-time fixed effects within each origin-destination pair, thereby controlling for time-varying shocks at both ends of the migration decision. Estimating migration directly on funding gaps raises several concerns. First, omitted variable bias may arise if time-varying factors beyond funding gaps, rents, wages, and fixed amenities also drive location choice. Second, measurement error in funding gaps—stemming from heterogeneous actuarial smoothing and liability assumptions—can attenuate estimates. Third, tax-base shrinkage may itself constrain revenue-raising capacity, further biasing OLS interpretations.

To address the endogeneity of public pension funding gaps in our analysis of household relocation, I employ a two-stage least squares (2SLS) design utilizing an instrument based on synthetic portfolio returns. Specifically, I construct a state-level synthetic excess return, ω_{it}, by interacting the weighted-average portfolio allocation shares to public equities and fixed income as of 2001 at the state-level, by the contemporaneous aggregate S&P 500 and the Bloomberg Global Aggregate Treasuries Index returns, respectively, and netting out the state's 2001 actuarial return assumption. The instrument for the bilateral pension funding gap is the cumulative difference in these synthetic returns between a destination state d and an origin state o, defined as

$$\begin{aligned} Z_{odt} &= \sum_{h}^{t} (\omega_{dh} - \omega_{oh}) \\ \text{Where, } \omega_{it} &= \text{Allocation to Equity}_{i,2001} \times \text{S\&P 500 Return}_t \\ &+ \text{Allocation to Fixed Income}_{i,2001} \times \text{Bond Index Return}_t \\ &- \text{Return Assumption}_{i,2001} \end{aligned} \tag{4}$$

The primary exclusion restriction requires that, conditional on the suite of fixed effects and controls, this relative synthetic performance is orthogonal to unobserved drivers of bilateral migration. Because the synthetic returns rely strictly on historical 2001 asset allocation weights, they isolate variation driven exclusively by aggregate national market fluctuations. This effectively purges the instrument of endogenous, contemporaneous investment decisions or correlated local economic shocks, ensuring that Z_{odt} affects household migration solely through its impact on the pension funding gap and the subsequent, necessary adjustments to local taxes and amenities.

To implement the regression, I utilize IRS's county-to-county migration files between years 2000-2022. Each observation is at the origin-county-to-destination-county by year level. I use the public pension data to measure funding gaps. If the local funding status is available through the city or county-level pension fund, I apply that to the relevant county. If neither is available for a given county, I use the funding ratio of the county's state pension plan. I restrict it to county-pairs where the destination is located in a different state. I cluster standard errors by destination-origin county-pair to control for correlation of errors within county-pairs. The results of the regression are reported in table 1.

Panel A reports the first stage of the 2SLS, using the difference in synthetic cumulative returns measured keeping the 2001 allocation in fixed income and public equities as the instrument. Across all specifications, the instrument is positive and highly significant, with first stage F-stats»40, indicating that past relative investment performance strongly predicts current funding gaps. The second stage therefore captures the local average treatment effect of relative portfolio performance on migration through its impact on funding

Table 1: Migration Odds vs. Funding Gap

This table reports the bilateral county-level migration odds on the pension funding gap between destination and origin counties. Panel A presents the first-stage of the two-stage least squares where the logged funding gap between destination and origin is instrumented with the difference in synthetic returns as mentioned in equation 2. Panel B shows the second stage results with ln(Out-migrants Returns/Non-Migrant Returns) as the dependent variable. All columns in the first and second stage results contain log rent and log wage ratio of the destination vs. origin counties as controls. Column (1) has destination-county and origin-county fixed effects. Columns (2)-(8) contain destination-origin county pair fixed effects. Column (3) contains origin state × year fixed effects. Column (4) contains destination state × year fixed effects. Column (5) contains destination census region × origin census region × year fixed effects. Column (6) contains origin county × year fixed effects and column (7) contains destination county × year fixed effects. Standard errors are clustered by destination × origin pair.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: IV - 1st St., Dep. Var:	Funding Gap						
Synthetic Investment Performance$_{ij}$	0.0704***	0.0838***	0.0731***	0.0936***	0.0789***	0.0742***	0.0943***
	(39.31)	(37.91)	(45.98)	(52.69)	(36.47)	(45.92)	(51.73)
Panel B: IV - 2nd St., Dep. Var:	Ln(Out Migrant Returns/Non-migrant Returns)						
Funding Gap	0.518***	0.372***	0.0626	0.466***	0.0782***	0.0726	0.497***
	(11.26)	(12.35)	(1.18)	(12.03)	(2.67)	(1.43)	(14.13)
N	839892	818137	818137	818137	818136	809319	809353
Destination, Origin County-FE	Y						
Destination × Origin County-FE		Y	Y	Y	Y	Y	Y
Origin State × Year-FE			Y				
Destination State × Year				Y			
Dest. Reg. × Org. Reg. × Yr-FE					Y		
Origin County × Year-FE						Y	
Destination County × Year-FE							Y

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

gaps, had the portfolio allocations remained as in 2001.

Focusing on the economic magnitudes of the second-stage results in Panel B, the estimates suggest a substantial, albeit specification-sensitive, relationship between pension funding gaps and household relocation. Because both the dependent variable, ln(Out Migrant Returns/Non-migrant Returns), and the endogenous funding gap are specified in natural logarithms, the coefficient β represents an elasticity. Specifically, β indicates the percentage change in the odds of bilateral migration associated with a one percent increase in the relative funding gap.

In the robust specifications that maintain high statistical significance - namely those controlling for baseline dyadic differences (Column 2) and destination-time shocks (Columns 4 and 7) - the point estimates range from 0.372 to 0.497. Taking the coefficient from the stringent destination county-by-year fixed effects model (Column 7) as a primary example, which effectively controls for all the “pull" factors at the destination, a point estimate of $\beta = 0.497$ implies that a 10% increase in the bilateral funding gap is associated with roughly a 4.97% increase in the odds of migrating from the origin to the destination county. In terms of magnitudes, this raises odds by 2 times more than the mean odds. I report the outflow of adjusted gross income per non-migrant return in the appendix table 9. This translates to about a \$70 outflow per tax-payer.

However, the magnitude of this effect diminishes after controlling for “push" factors using origin × year fixed effects. This keeps the funding at origin at fixed In Columns (3) and (6), the elasticities shrink to 0.0626 and 0.0726, respectively, and lose statistical significance. Controlling for the push factors leaves only the weaker "pull" margin (do movers pick better-funded destinations?) rather than the "push" margin (do people leave states whose funding deteriorated?) that my mechanism is really about. Interestingly, this effect returns when I drop the pandemic years of 2020-2022 period in table 7 Panel I with statistically significant coefficient of 0.11.

Overall, the results suggest that migration responds to pension underfunding when relative funding differences across origin and destination counties are salient. Push factors are more likely to drive these migration patterns over pull from better funded states. These findings are robust to (i) using the public-sector unionization instrument from Mittal (2024), (ii) truncating the sample in 2019 to exclude pandemic migration years, and (iii) dropping 2014–2016 to address IRS data measurement concerns noted in DeWaard et al. (2022) [7]

4.1 Intermediate Channels

As Table 1 shows the pass-through of funding gaps to migration, it follows the following directed acyclic graph, taking a leap over the third step: Worse investment performance → worse funding status → *worse amenities and higher taxes* → out-migration. To confirm the intermediate channels, I test whether state and local level fiscal outcomes respond to widening public pension funding gaps. To implement this regression, I use the following regression specification:

$$ln(Y_{dt}/Y_{ot}) = \beta \times [\ln(f_{dt}) - \ln(f_{ot})] + \gamma X_{odt} + \epsilon_{odt}$$

Where the left-hand side variables use the logged ratio of destination on origin outcomes and the right-hand side variables also carry the same ratio structure. I successively control for destination-origin pair fixed effects, and variations of origin × year and destination × year fixed effect over the seven regression specification. I also control for the ratio of rents, real wages, state-debt-to-revenue, county-level GDP growth, and the share of US House of Representative seats of the Republican party (relative political leaning). I instrument the relative pension funding gap with the synthetic investment performance instrument in equation (4). The interpretation of β is thus the local average treatment effect of relative public pension investment performance, if public equity and fixed income allocations were fixed in 2001, at the destination county relative to the origin, on relative fiscal outcomes.

The results are reported in table 2. The first row shows that a 10% higher funding gap between destination vs. origin counties predicts a 9.6-13.7% point higher government capital expenditure in destination versus origin counties. State and local government capital expenditure may directly indicate a higher level of public services or amenities. Panel B shows that even when taking the share of capital expenditures in the state budget. Consistent with Panel A, capital expenditure shares are higher by 18-25 percentage points for 10 percentage points better funding status at the destination relative to origin counties. Panel C uses the net-of-tax rate of the top-marginal income taxes in the destination vs. the origin counties. A 10% worse funding status increases the tax burden by 30-83 basis points in the origin county relative to the destination county. Panel D uses the gap in corporate taxes across the two counties as the dependent variable. A 10% worse funding status increases the gap between origin and destination counties' corporate taxes by about 1.5 to 2.4 percentage points. The coefficients are statistically significant across specifications which include destination × year and origin × year fixed effects. This means changes in public pension funding status at the local level translates to changes to public services and taxes that likely drive migration patters between the destination-origin pair. In the next regression, I test the heterogeneity of response among tax-filers from aggregated-state-level migration data.

[7] I also report net migration from counties with worsening funding status in the appendix table 10. It helps me quantify the net loss in terms of taxable income - a 10 percentage point worse pension funding status results in outflows of $265.44 per non-migrant return, which is equivalent to a $540 million loss for Cook County, which had two million non-migrant returns in 2022.

Table 2: Fiscal Outcomes and the Funding Gap

This table reports the bilateral county-level second-stage results of state and local fiscal outcomes regressed on the instrumented pension funding gap between destination and origin counties. Panel A shows the second stage results with the gap in state capital outlays of the destination county state versus the origin county state as the dependent variable. Panel B has capital expenditure share of the state budget as the dependent variable. Panel C has the log net-of-top-marginal state income tax rate ratio. Panel D has the log net of corporate tax ratio of the All columns in the first and second stage control for the ratio of rents, real wages, state-debt-to-revenue, county-level GDP growth, and the share of US House of Representative seats of the Republican party (relative political leaning). Column (1) has destination-county and origin-county fixed effects. Columns (2)-(8) contain destination-origin county pair fixed effects. Column (3) contains origin state × year fixed effects. Column (4) contains destination state × year fixed effects. Column (5) contains destination census region × origin census region × year fixed effects. Column (6) contains origin county × year fixed effects and column (7) contains destination county × year fixed effects. Standard errors are clustered by destination × origin county pair.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: IV - 2^{nd} St., Dep. Var:				$\text{Ln}(\text{CapEx}_d/\text{CapEx}_o)$			
Funding Gap	1.376***	1.358***	1.330***	0.965***	1.513***	1.329***	0.978***
	(27.14)	(25.82)	(41.42)	(45.10)	(24.08)	(41.55)	(44.58)
Panel B: IV - 2^{nd} St., Dep. Var:				$\text{Ln}(\text{CapEx Share}_d/\text{CapEx Share}_o)$			
Funding Gap	2.458***	2.346***	2.385***	1.871***	2.603***	2.426***	1.920***
	(30.03)	(28.81)	(35.59)	(43.88)	(27.69)	(35.58)	(43.53)
Panel C: IV - 2^{nd} St., Dep. Var:				$\text{Ln}(1\text{-}\tau_d/1\text{-}\tau_o)$			
Funding Gap	0.0630***	0.0548***	0.0822***	0.0305***	0.0628***	0.0836***	0.0308***
	(14.61)	(12.83)	(17.27)	(9.89)	(15.15)	(17.02)	(9.59)
Panel D: IV - 2^{nd} St., Dep. Var:				$\text{Ln}(1\text{-}\tau_d^{corp}/1\text{-}\tau_o^{corp})$			
Funding Gap	0.212***	0.197***	0.242***	0.155***	0.206***	0.243***	0.156***
	(25.81)	(24.46)	(28.58)	(31.10)	(25.16)	(28.10)	(30.27)
N	797297	777652	777652	777652	777651	769219	769495
Destination, Origin County-FE	Y						
Destination × Origin County-FE		Y	Y	Y	Y	Y	Y
Origin State × Year-FE			Y				
Destination State × Year				Y			
Dest. Reg. × Org. Reg. × Yr-FE					Y		
Origin County × Year-FE						Y	
Destination County × Year-FE							Y

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.2 Heterogeneity by Age and Tax Brackets

Using state-level gross-migration flows I estimate the association between different tax brackets interacted by the funding ratio. I run the following regresison specification

$$Y_{it} = \sum_k \beta_k \times 1(AGI \in bracket\ k) \times \text{Funding Ratio}_{it-1} + \gamma X_{it-1} + \tau_t + \theta_i + \epsilon_{it}$$

Where $1(AGI \in \text{bracket } k)$ is an indicator for the age-bracket of tax-filers in the state. The main outcomes variable is the Net out-migration rate measured as the ratio of Out-migrant net of in-migrant tax-returns divided by non-migrant tax-returns in the state. The coefficients of interest are β_k which measure the relative net-out-migration rate of the AGI bracket $\in k$ in response to variation in funding ratios of the state. The Table 3 shows the results. We can see that statistical significance shows up in the bottom-right corner

Table 3: Heterogeneity of Movers by Age and Income Bracket

Using IRS SOI's gross migration files from 2010-2022, I estimate the heterogeneity in the association of net-out-migration rate across different age brackets. Column (1) represents the youngest age bracket of tax-filer ages<26 (2) Ages-26-35 (3) Ages 35-45 (4) Ages 45-55 (5) Ages 55-65 (6) Ages 65 and above. AGI 10k-25k is an indicator for tax filers with annual gross income between $10,000 and 25,000. Each regression includes controls for lagged average rents, average wages, crime per 100k residents, political leaning of the state, average property taxes, state-top-income tax as well as state, AGI-slab and year fixed effects. Robust-standard errors are reported in the parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
	Net Out-migration rate					
	Ages<26	Ages 26-35	Ages 35-45	Ages 45-55	Ages 55-65	Age>65
Funding Ratio (FR)	0.00960	0.0163*	0.0121**	0.00518	0.00907**	0.00677**
	(0.72)	(2.08)	(2.81)	(1.70)	(2.96)	(2.82)
AGI 10k-25k × FR	0.00321	0.00120	0.00102	0.00131	0.00128	0.00166
	(0.49)	(0.25)	(0.31)	(0.47)	(0.49)	(0.76)
AGI 25k-50k × FR	-0.00922	-0.00144	0.00116	0.00306	0.00219	-0.000388
	(-1.44)	(-0.32)	(0.38)	(1.24)	(0.93)	(-0.22)
AGI 50k-75k × FR	-0.0155*	-0.00488	-0.000527	0.00211	-0.00213	-0.00402*
	(-2.37)	(-1.10)	(-0.17)	(0.87)	(-0.99)	(-2.50)
AGI 75k-100k × FR	-0.0178	-0.00757	-0.00288	0.000132	-0.00619**	-0.00752***
	(-1.91)	(-1.64)	(-0.91)	(0.05)	(-2.88)	(-4.62)
AGI 100k-200k × FR	-0.00300	-0.00927	-0.00635	-0.00420	-0.0156***	-0.0167***
	(-0.23)	(-1.70)	(-1.93)	(-1.65)	(-5.76)	(-7.87)
AGI > 200k × FR	0.00535	0.0208	-0.00268	-0.00851*	-0.0228***	-0.0219***
	(0.27)	(1.82)	(-0.54)	(-2.32)	(-4.68)	(-6.43)
N	3809	3815	3815	3815	3815	3815
Controls	Lagged Rents, Wages, Crime, Political Leaning, Property Taxes, Top-Income Tax					
Fixed Effects	State, AGI Slab and Year					

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

of the table. This means that the relative net out-migration rate for a 10 percentage point lower funding ratio is 22bps for tax-filers aged 55 and above in the highest tax bracket. The coefficients are progressively lower for younger tax-filers in the same tax-bracket as well as tax-filers in lower tax-brackets within the same age. This indicates that the migration flows is largely associated with the migration of the richer and older sections of tax-filers.

Thus, in sum: (i) defined benefit public pension funding gaps between two states predict migration flows within the states controlling for various destination and origin specific characteristics, (ii) higher underfunding leads to a loss in the taxable adjusted gross income in states with higher underfunding, and (iii) the relative gap between destination and origin taxes and capital expenditures widens with the relative gap between their respective public pensions' funding (iv) richer and older taxpayers are more likely to out-migrate due to the worsening funding status. This signals that that worse funding could create a fiscal-migratory spiral for states with worse relative funding status. In the next section I investigate how this migratory feedback might affect public plans.

5 Migration Risk and Public Pension Risk-taking

How do state governments and public pension respond to higher underfunding? Giesecke and Rauh (2023) document the pervasive lack of sufficient contribution rates due to differences in discounting and other political factors. Combined with political incentives to risk-shift through raising assumed discount rates on pension plans (see Andonov et al. (2017)), states governments can trade-off making lower contributions with riskier investment strategies. Further, Reach-for-yield behavior by public pensions has been extensively studied in extant literature such as Lu et al. (2019), Myers (2023), Giesecke and Rauh (2023) and Mittal (2024).

Fully funding obligations would require raising contributions, potentially through higher taxes. This path is complicated by the mobility of the tax base: if households and firms are sensitive to tax changes, raising contributions may prompt out-migration. If states fear higher taxes or uncertainty about tax policy could drive firms and households to relocate, they may likely seek higher returns or mask volatility on their pension investments. This paper adds to that literature by examining allocation to alternative asset classes varies across states with heterogeneous migration responses, which could reflect both reach-for-yield and volatility smoothing. Specifically, it asks: do states invest differently if their local populace are more sensitive to tax changes than other states? I test that by first estimating "migration" risk for each state - what is the net-migration impact of increases in state income taxes. I subsequently explore the heterogeneity of portfolio allocation in response to differential migration risk.

5.1 State-wise Migration Risk Measurement

How sensitive a local population is to taxes or deteriorating public services depends on several factors. Work in migration across states model and document various agglomeration and congestion forces that both draw as well as repel people from locating in a particular region (see Foschi et al. (2025)). Estimating state-wise migration betas might thus entail controlling for confounding variation that might drive migration other than taxes. Previous work such as Rauh and Shyu (2024), use rich administrative data to estimate the behavioural response of top income earners to increases in effective tax rates. I come up with three approaches to estimate migration responses to taxes by state: (i) OLS migration betas (ii) Moretti and Wilson (2017) elasticities and (iii) net migration post-Tax Cuts and Jobs Act (2017). The objective of each measure is to create a *relative* sensitivity to changes in tax rates which helps me rank states by their respective out-migration risk.

I report (i) and (ii) in the appendix and discuss net migration post-TCJA State and Local Tax deduction here.

Post-SALT Cap Net-outflows

I exploit the heterogeneous exposure of states to the state and local tax (SALT) deduction cap introduced under the Tax Cuts and Jobs Act of 2017. This policy change limited federal deductibility of state and local taxes upto $10,000, raising effective state tax burden, especially in states with ex-ante higher tax rates. Figure 5 panel (a) shows the spatial distribution of top income tax bracket returns across contiguous United States. This shows a high concentration of top income shares in urban counties of California, Illinois, New England, Texas and Florida. Contrast this with panel (b) which shows the net AGI outflow per tax payer after the introduction of SALT deduction cap - while California, Illinois, and New England show net outflows, whereas Florida and Texas show net-in migration - indicating that migrants moved, from high tax regions to low tax regions (consistent with Rauh (2022)). Figure 5 panel (c) shows the correlation between the increase in federal state and tax liability post-SALT against their top marginal tax rates, estimated using NBER's TAXSIM software. High tax states see a larger impact on both federal and state tax liabilities of the highest single-filer tax bracket. I then regress net out-migrant individual returns to total returns in the state ratio against the change in tax liability controlling for state-time varying controls and year-fixed effects. I then predict the net cumulative outflow by state predicted by the estimation over the time period of 2018-2019. I stop at 2019 to exclude migration driven by the pandemic.

$$Y_{s,t} = \beta \times \Delta \text{Federal and State Tax Liability}_s + \Gamma X_{s,t-1} + \tau_t + \epsilon_{s,t}$$

Controls include state-level estimates of average rents, real wages, crime, infrastructure quality, public school quality, state debt-to-revenue and time-fixed effects. Standard errors are clustered by state. The regression shows a positive relationship between tax liability increases and net-outflow rate in appendix table 8. The predicted outflows are displayed in figure 5 panel (d). The benefit of using this measure is that the tax shock is plausibly exogenous to the states. The possible cost is that due to the nature of the tax shock, treatment is proportional to the ex-ante levels of taxes.

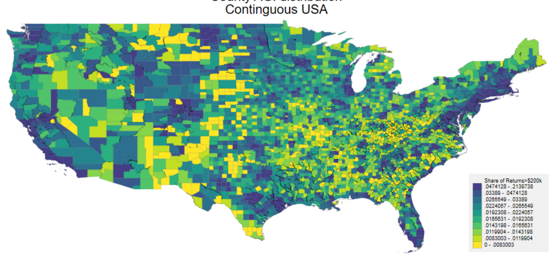
The three methods gives us the state-wise relative migration risk measures in response to changes in state income tax rates. All three migration risk measures are positively correlated with each other, with the correlation coefficient between OLS migration beta and Moretti and Wilson (2017) style state-wise elasticity (henceforth MW-2017 elasticity) estimate being 0.26, correlation between the MW-2017 and post-SALT cap predicted outflows being 0.33 and the correlation between the OLS migration beta and post-SALT cap outflows being 0.04.

5.2 Mapping Migration Risk to Public Pension Portfolio choice

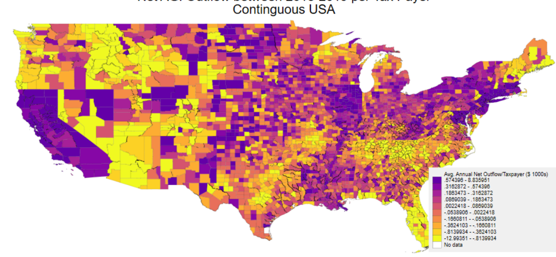
What do migration betas mean for the pension fiduciary? Migration betas are a reflection of the state-wise ability to raise revenue through raising taxes. States which are more likely to lose tax base when they raise taxes, are less likely to fulfill future pension obligations through higher contributions, given their unfunded liabilities. To test this, I plot how states with higher out-migration risk (i) contribute to their pension plans relative to the actuarially estimated required contributions (ii) maintain their funding status relative to low-migration risk states. Figure 6 panel (a) shows the value-weighted average percentage of required contributions paid by states classified as above median migration beta estimated as per the Moretti

Figure 5: Top-AGI shares, Out-migration and and Migration Betaa

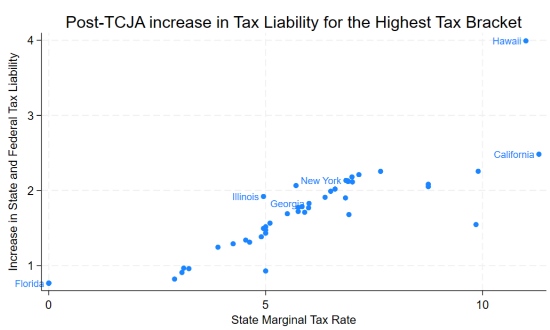
Panel (a) plots the spatial distribution of high AGI tax returns, where each county is colored according to the share of tax returns > $200k in 2017. Dark blue regions show highest shares and yellow regions are the lowest. Panel (b) plots the average annual net migration measured as the Net AGI outflow per tax payer for the period of 2018-2022. Dark purple region have higher out-migration whereas yellow show net in-migration. Panel (c) plots the increse in state and federal tax liability, estimated from NBER TAXSIM following the enactment of Tax Cuts and Jobs Act (2017) by state of the filer, against the top-marginal state income tax rate. Panel (d) plots the predicted net-outmigration due to TCJA from the regression of the net out-migration by state regressed on the increase in state and federal tax liability due to the SALT deduction cap. Data is from IRS Statistics of Income.



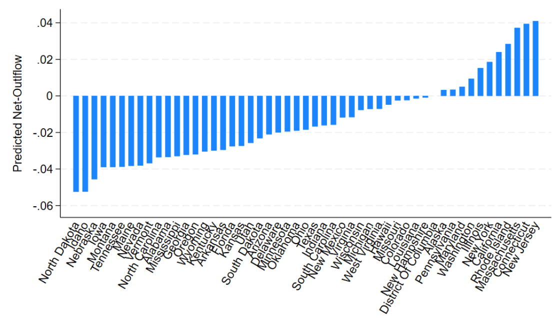
(a) Top AGI Distribution in 2017



(b) Average Annual Net Outflow

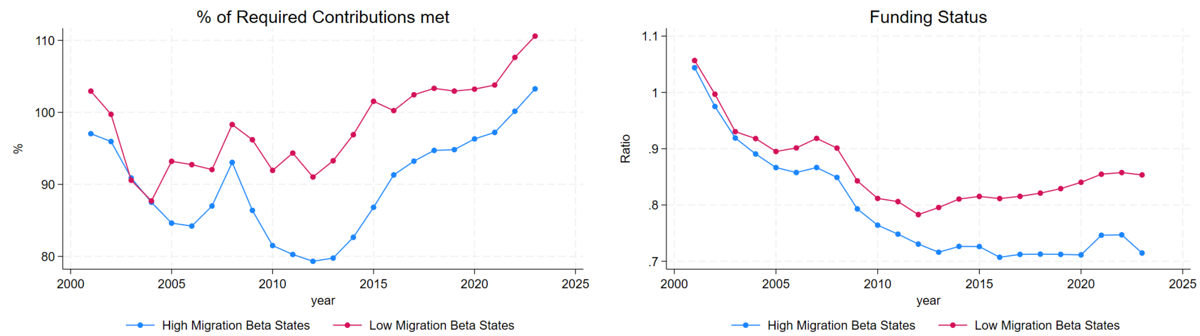


(c) Post-SALT cap correlation with State Tax Rates



(d) Post-SALT cap Net Outflows

and Wilson (2017) approach (thus “High Migration Beta States") versus the below median states. We can see that there is a considerable gap - high migration beta states under-contribute to their public pensions relative to low migration beta states. In panel (b) I plot their funding status, which also turns out to be lower for the high migration beta states. Therefore, migration betas sort states by their systemic pension under-contribution and subsequent underfunding. This possibly results in fiduciaries taking higher risks on their pension portfolios, which I test next.



(e) Required Contribution Heterogeneity

(f) Funding Status

Figure 6: How do migration betas affect public pension fiduciaries?

This figure represents the weighted trends in contribution rates and funding status for states which lie above median migration risk - measured by their Moretti and Wilson (2017)-style migration response to tax changes. Panel (a) represents the plan contributions relative to the actuarially-required level for high-migration risk and low-migration risk states. Panel (b) shows their respective asset-weighted funding ratios.

I track the allocation patterns of public pension funds with respect to migration risk using pension plan level data. To test heterogeneity I estimate this specification which involves using the interaction between high migration risk and Underfunding ratio (which is simply 1-Funding Ratio) with the following specification:

$$Y_{it+1} = \beta \times 1(\text{High Migration Risk})_s \times \text{Underfunding}_{i,t} + \text{Underfunding}_{i,t} + \Gamma X_{it} + \theta_t + \kappa_i + \varepsilon_{it+1}$$

Where Y_{it+1} is the portfolio allocation between 0 and 1 for a given asset class for pension fund i at time $t+1$. *High Migration Risk* refers to the dummy of whether state s has above median migration response to changes in local tax-liability. Controls include lagged contribution rate growth, and changes in investment return assumption, discount rates, valuation methods or other assumption changes. All specifications include plan and year fixed effects. The coefficient of interest β is the relative difference between the allocation to an asset class, between pension funds belonging to high and low migration risk states, for a given level underfunding. Standard errors are two-way clustered at the state and year level to correct for within state correlation of allocations [8]

The results are displayed in table 4. Columns (1)-(3) track allocations to alternative asset classes such as private equity, real estate, hedge funds, commodities and other miscellaneous asset classes. Columns (4)-(6) track allocations to fixed income securities and (7)-(9) track equity allocations. In Columns (1),(4) and (7), the migration risk measure is the indicator for whether the Moretti and Wilson (2017) migration

[8] A version with Driscoll-Kraay standard errors is presented in the appendix.

estimates of state s lies above median. Columns (2),(5) and (8) use the cumulative predicted net-outflows after the tax liability increase due to the SALT deduction cap in 2017. Columns (3), (6) and (9) use the OLS regression betas as the migration response measure to sort states by high versus low risk. What emerges consistently across different measures of migration risk is the relative increase in alternative allocations for high migration risk states. Column (1) predicts a 75 basis point increase in alternative allocations in response to a one percentage point increase in underfunded ratio in states which face a higher than median out-migration response relative to baseline. In columns (2) and (3) that increase is equivalent to 100 basis points and 141 basis points respectively.

Conversely Columns (4), (5), (7) and (8) show that the relative allocation in fixed income or equity allocations are not different from zero for high migration risk states. However columns (6) and (9) show that both equity and fixed income allocations are negative and statistically significant for states with a higher OLS tax beta, suggesting re-balancing towards higher expected return assets.

Table 4: Allocation Heterogeneity by Migration Risk

This table presents results from the regressions of public pension portfolio allocations on under-funded ratio (1-Funding Ratio) interacted with the three different measures of migration risk. Columns (1), (2) and (3) use alternative allocations - which is the sum of allocations to private equity, real estate, hedge funds, commodities and other miscellaneous alternative asset classes - as the dependent variable. Columns (4), (5) and (6) use fixed income allocation and columns (7), (8), and (9) use equity allocation as the dependent variable respectively. Columns (1), (4) and (7) show the interaction of the underfunded ratio with above-median Moretti and Wilson (2017) migration elasticity as the main indicator for migration risk. Columns (2), (5) and (8) use use the dummy for above median post-SALT cap net-outflows in response to tax increases as the high migration risk indicator. Columns (3), (6) and (9) use the above-median OLS migration beta. All specifications control for pensions contribution growth, changes in actuarial assumptions and plan and year fixed effects. Standard errors are clustered by State × Year pair.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Alternative Allocations			Fixed Income Allocation			Equity Allocations		
Underfunded Ratio (UR)	-0.0654***	-0.0916***	-0.113***	-0.0127	-0.0257	0.0584***	-0.0615*	-0.0313	0.0210
	(0.0234)	(0.0314)	(0.0253)	(0.0223)	(0.0296)	(0.0222)	(0.0356)	(0.0469)	(0.0390)
1(AM Beta Moretti-Wilson (2017)) × UR	0.0749**			0.0355			0.0601		
	(0.0301)			(0.0311)			(0.0516)		
1(AM Post SALT-Outmig) × UR		0.0996***			0.0480			0.000112	
		(0.0338)			(0.0328)			(0.0521)	
1(AM OLS Migration Beta)=1 × UR			0.141***			-0.0883***			-0.0866*
			(0.0295)			(0.0303)			(0.0516)
N	4251	4251	4251	4251	4251	4251	4251	4251	4251
R-Sq	0.728	0.728	0.730	0.577	0.577	0.578	0.602	0.601	0.602
Pension Plan and Year-FE	Y	Y	Y	Y	Y	Y	Y	Y	Y

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To measure the dynamic response of migration risk and underfunding, I replicate the specification in a local projections framework. This exercise helps map out allocation patterns over time and how does migration risk contribute to the changes we see over time. I use the following specification for testing this:

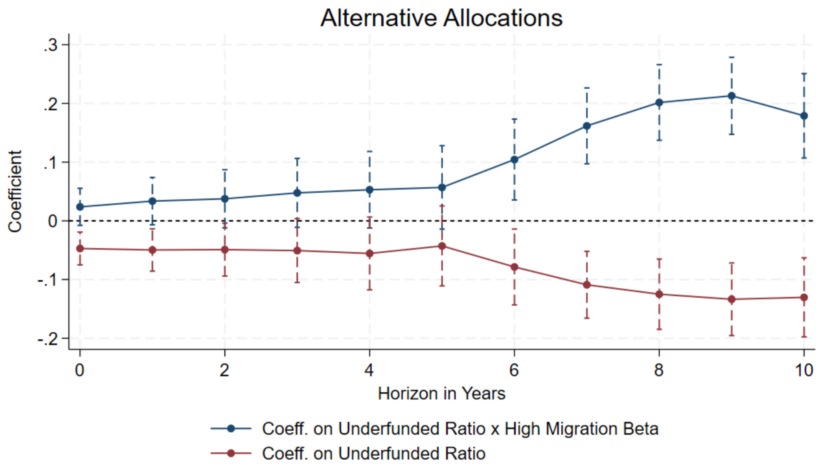
$$Y_{it+h} = \beta \times 1(\text{High Migration Risk }) \times \text{Underfunding}_{i,t} + \text{Underfunding}_{i,t} + \Gamma X_{it} + \theta_t + \kappa_i + \varepsilon_{it+h}$$

Over horizons $h \in (0, 10)$. Y_{it} is the allocation to asset classes such as equities, fixed income and alternative asset classes. Figure 15 shows the results for three asset classes, with the high migration risk measure being 1(AM Post-SALT Out-migration)[9]. The dynamic plot shows persistence as well as rising allocation to alternative asset classes which reaches 20 percentage points by year-9. In the appendix, allocations to fixed income and equities are relatively flat or negative (for OLS migration betas), suggesting a re-balancing among high-migration risk states over time.

[9] Other migration risk measures are shown in the appendix

Figure 7: Dynamic Allocation by Funding Status and Migration Risk

These graphs plot the regression coefficients of the public pension allocations to alternative asset classes on the interaction of state migration betas and underfunded ratio. The navy-blue line represents the coefficient on the interaction of migration beta and underfunding, while the maroon line represents the coefficient on underfunded ratio.



Higher allocation to alternative asset classes such as private equity, hedge funds and real estate points to several incentives. Firstly, it signifies a reach-for-yield behavior as fiduciaries receive contributions lower than actuarially required levels as shown in figure 6. Faced with chronic underfunding and under-contribution from their state sponsors, state investment boards may pivot to alternatives to fill the shortfall through higher returns. Secondly, it could signify a reach-for-opacity that smooths the volatility of pension assets. This prevents sudden spikes in required contributions if investment performance goes south in the short-term, but also delays the fiscal pain, as it masks the true economic risk of the underlying illiquid assets [10].

I have therefore shown that (i) pension underfunding correlates with higher tax liabilities and worsening public expenditures (ii) pension funding gap between regions and underfunding by itself thus predicts net-out-migration from worse funded states (iii) states with populations more sensitive to tax changes are more likely to pivot to alternative asset classes.

What role does tax migration play in portfolio choice of public pension fiduciaries? What is the channel through which tax mobility induces the trade-off between raising contributions versus reaching for yield or opacity on pension assets among state and local governments? What is the welfare maximizing investment policy if a planner that sets both tax rates and acts as fiduciary for the defined benefit pension plans, internalizing the migration impact? To try to rationalize the findings and get address possible mechanisms, I setup a spatial model in the next section.

6 Model

The previous sections show evidence of a possible trade-off that state and local governments face when addressing their defined benefit pensions: raising contributions through taxes or gambling for resurrection by investing in high-yield assets. To conceptualize the trade-off, I develop a two-period spatial model to

[10]In the appendix section B.4 I test whether pension managers in high migration risk states taken on more risk on their equity portfolios using 13-F data. I do not find evidence of higher portfolio volatility among managers from high-migration risk states. Therefore reach-for-yield behavior possibly manifests across asset class allocation.

test the public pension problem across states. The objectives of this model are (i) to formalize households' location as a function of local taxes and amenities subject to employment and housing market (ii) to study the trade-off faced by state governments between raising taxes and investing in risky securities. The economy consists of S states indexed by $s = 1, \ldots, S$, populated by a unit measure of mobile, infinitely-divisible households indexed by i. Time is discrete with two substantive periods, $t \in \{1, 2\}$. Each state hosts (i) a representative competitive firm, (ii) a competitive housing sector, (iii) a political executive who sets taxes and pension contributions, and (iv) a pension fiduciary who allocates plan assets between a risk-free and a risky asset. State governments inherit defined-benefit legacy pension liabilities L_s and assets A_s that differ across states. The timing is as follows: (i) States are endowed with population shares $\{N_{s,1}\}$, productivity $z_{s,1}$, amenities B_s, legacy pension stocks (A_s, L_s), and exogenous expenditure plans $\{X_{s,1}, X_{s,2}\}$ (ii) Taking the fiduciary's optimal investment policy as given, each political executive simultaneously sets the tax rate $\tau_{s,1}$ and pension contribution rate $c_{s,1}$ (iii) Fiduciaries observe contributions and choose the risky portfolio share θ_s (iv) Wages, rents, consumption, and housing demands clear (v) Idiosyncratic taste shocks $\xi_{is,1}$ realize and households choose next-period locations, generating period-2 population shares $\{N_{s,2}\}$. (vi) The risky-asset shock ϵ realizes; the fiduciary's gross return R_s is determined; the political executive sets $(\tau_{s,2}, c_{s,2})$ to satisfy the period-2 budget constraint and the residual pension obligation; consumption and housing markets clear.

6.1 Household Preferences and Location Choice

To obtain a closed-form logit and a tractable migration elasticity, I specify *log* Cobb–Douglas preferences over the homogeneous consumption good c and housing services h, augmented by an additive idiosyncratic taste shock:

$$\ln U_{is,t}(c,h) \;=\; \ln B_s \;+\; \alpha \ln\!\left(\tfrac{c_{s,t}}{\alpha}\right) \;+\; (1-\alpha)\ln\!\left(\tfrac{h_{s,t}}{1-\alpha}\right) \;+\; \xi_{is,t}, \tag{5}$$

subject to the static budget constraint

$$c_{s,t} + r_{s,t}\, h_{s,t} \;=\; w_{s,t}\big(1-\tau_{s,t}\big), \tag{6}$$

where $w_{s,t}$ is the local wage, $r_{s,t}$ the rental rate of housing, $\tau_{s,t}$ the effective state-plus-federal tax rate, B_s a stationary amenity, and the price of c is normalized to one. Households supply one unit of labor inelastically. The shock $\xi_{is,t}$ is i.i.d. Type-I extreme value (Gumbel) with scale $\sigma_v > 0$.[11]

Static optimization gives the familiar Cobb–Douglas demands $c^*_{s,t} = \alpha\, w_{s,t}(1-\tau_{s,t})$ and $h^*_{s,t} = (1-\alpha)\, w_{s,t}(1-\tau_{s,t})/r_{s,t}$. Substituting into (5) and absorbing additive constants yields the indirect (location-specific) payoff:

$$V_{is,t} \;=\; \underbrace{\ln B_s + \ln w_{s,t} + \ln(1-\tau_{s,t}) + (\alpha-1)\ln r_{s,t}}_{v_{s,t}\;\equiv\;\text{location-specific payoff}} + \xi_{is,t}. \tag{7}$$

Indirect utility rises in amenities and after-tax wages and falls in rents. With Gumbel taste shocks of scale σ_v, the probability that a representative household chooses state s is the multinomial logit

$$N_{s,t+1} \;=\; \Pr\!\big(V_{is,t} \geq V_{ik,t}\;\forall k\big) \;=\; \frac{\exp\!\big(v_{s,t}/\sigma_v\big)}{\sum_k \exp\!\big(v_{k,t}/\sigma_v\big)}. \tag{8}$$

Since households have unit mass, $N_{s,t+1}$ is simultaneously the choice probability and next period's population

[11] Specifying utility in logs is the standard convention in spatial discrete-choice models (Diamond, 2016; Suárez Serrato & Zidar, 2016) because it makes the location-payoff additively separable from the Gumbel shock and yields the elasticity in Proposition 6.2 without auxiliary scaling.

share. After receiving the taste shock, households essentially chose the location that yields the highest indirect utility. In expectation, the maximum across S Gumbel-shifted alternatives is

$$\mathbb{E}\Big[\max_s V_{is,t}\Big] \;=\; \sigma_v \,\ln\!\left(\sum_s \exp\!\big(v_{s,t}/\sigma_v\big)\right) + \sigma_v\,\mathcal{C}, \tag{9}$$

where $\mathcal{C}$ is the Euler–Mascheroni constant.[12] A spatial equilibrium requires that (9) be common across locations *ex ante*; cross-state differences in amenities, after-tax wages, and rents are exactly offset by the differential probability of being a marginal mover.

6.2 Housing Market

Housing supply in state s is iso-elastic in rent: $H^S_{s,t} = (\bar{H}\,r_{s,t})^{\phi_s}$, where $\bar{H}$ is a productivity shifter common across states and $\phi_s > 0$ is the state-specific housing supply elasticity (taken as a primitive, e.g., the Saiz (2010) measure aggregated to the state level). Landowners earn zero profit. Aggregating Cobb–Douglas housing demand across $N_{s,t}$ residents and equating to supply,

$$N_{s,t}\,h^*_{s,t} \;=\; \big(\bar{H}\,r_{s,t}\big)^{\phi_s} \qquad \Longleftrightarrow \qquad \frac{N_{s,t}\,w_{s,t}\,(1-\tau_{s,t})\,(1-\alpha)}{r_{s,t}} \;=\; \big(\bar{H}\,r_{s,t}\big)^{\phi_s}. \tag{10}$$

Solving for the equilibrium rent:

$$r_{s,t} \;=\; \left(\frac{N_{s,t}\,w_{s,t}\,(1-\tau_{s,t})\,(1-\alpha)}{\bar{H}^{\,\phi_s}}\right)^{1/(1+\phi_s)}. \tag{11}$$

Rents are increasing in population and after-tax wages, decreasing in housing productivity, and approach the standard fully-elastic limit (r independent of N) as $\phi_s \to \infty$. This parametric form helps inform the cross-sectional drivers of the tax-elasticity of migration. States are endowed with heterogeneous elasticity of housing supply and productivity. This leads to a prediction of housing elasticity and migration, in line with Diamond (2017):

Proposition 1: ***Migration elasticity and housing supply*** *The elasticity of population share with respect to net-of-tax income is*

$$\frac{\partial \ln N_{s,2}}{\partial \ln(1-\tau_{s,1})} \;=\; \big(1-N_{s,2}\big)\,\frac{1}{\sigma_v}\,\frac{\alpha+\phi_s}{1+\phi_s} \;\approx\; \frac{1}{\sigma_v}\,\frac{\alpha+\phi_s}{1+\phi_s} \quad \text{for large } S. \tag{12}$$

The elasticity is increasing in the housing supply elasticity ϕ_s and decreasing in the dispersion of taste shocks σ_v.

Proof. Differentiating (8): $\partial \ln N_{s,2}/\partial v_{s,1} = (1-N_{s,2})/\sigma_v$. From (7) and (11), $\partial v_{s,1}/\partial \ln(1-\tau_{s,1}) = 1 + (\alpha-1)\,\partial \ln r_{s,1}/\partial \ln(1-\tau_{s,1}) = 1 + (\alpha-1)/(1+\phi_s) = (\alpha+\phi_s)/(1+\phi_s)$. Multiplying yields (12). $\square$

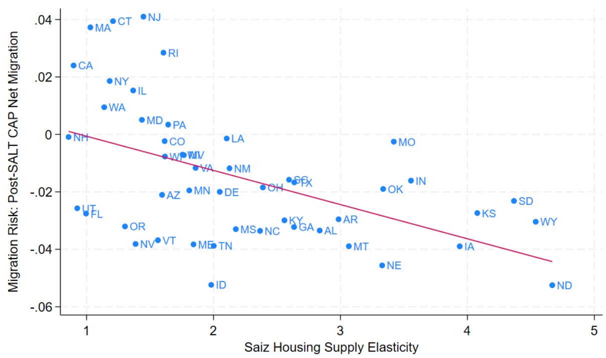
The mechanism: higher taxes lower after-tax income directly, but they also slacken local housing demand and depress rents, which partially offsets the tax shock for *stayers*. The offset is stronger when housing supply is elastic (ϕ_s large), so people in elastic-supply states have less reason to move. The prediction is mapped to the data in Figure 8 panel (a) which plots the net-out migration rate following the introduction of

[12] If $\xi_{is} \overset{iid}{\sim}$ Gumbel$(0,\sigma_v)$ then $\Pr\big(M \le x\big) = \prod_s \exp\big(-\exp(-(x-v_s)/\sigma_v)\big) = \exp\big(-\exp(-(x-\mu^*)/\sigma_v)\big)$ with $\mu^* = \sigma_v \ln\sum_s \exp(v_s/\sigma_v)$, hence $M \sim$ Gumbel(μ^*,σ_v) and $\mathbb{E}M = \mu^* + \sigma_v\mathcal{C}$.

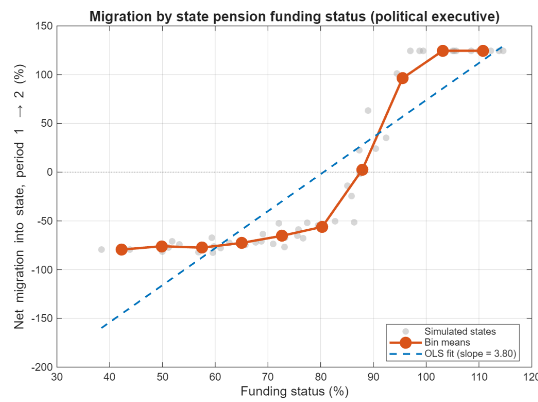
SALT deduction caps on the population-weighted average MSA-level housing supply elasticity of Saiz (2010) aggregated up to the state level. The negative relationship shows that states with an inelastic housing supply were more likely to lose more taxpayers when the local tax liability increased. I next map out the implications on the economy and the tax base.

Figure 8: Model Predictions

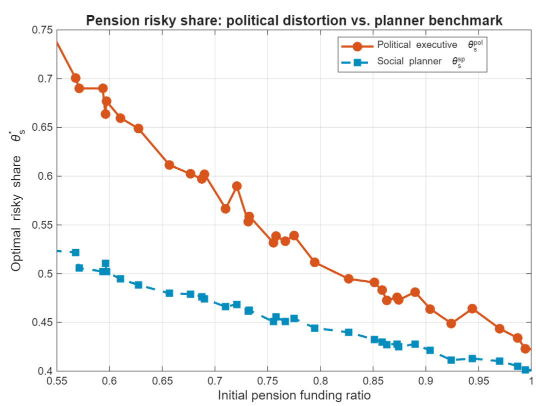
These graphs present the three predictions from the stylized spatial model. Panel (a) represents the scatter plot and linear fit of Net Migration Rate measured as the out-migrant tax-filers minus in-migrant tax filers over the non-migrant tax filers from IRS migration data in the 2017-2019 period for a given state against the Saiz (2010) housing suppply elasticity aggregated up to the state-level using MSA population weights. Panel (b) plots a simulation of the net-migration into a state given it's legacy funding status in period-1. Panel (c) plots the risky-asset share set by fiduciary when the principal is a politician facing re-election pressures versus the social planner that internalizes the migration feedback and doesn't face re-election uncertainty.



(a) Migration and Housing Supply Elasticities



(b) Funding and Migration



(c) Political Risk-Shifting

6.3 Firms

A representative competitive firm in each state has constant-returns-to-scale technology in labor only: $\pi(z_{s,t}, L_{s,t}) = z_{s,t}\, L_{s,t} - w_{s,t}\, L_{s,t}$. Profit maximization implies $w_{s,t} = z_{s,t}$. Since labor is supplied inelastically, labor-market clearing gives $L^D_{s,t} = N_{s,t}$, so output is $Y_{s,t} = z_{s,t}\, N_{s,t}$. The state's GDP — equivalently, its tax base — grows at

$$\frac{Y_{s,t+1}}{Y_{s,t}} = \frac{z_{s,t+1}}{z_{s,t}} \cdot \frac{N_{s,t+1}}{N_{s,t}} = (1 + g_z)\,(1 + g_{s,N}). \tag{13}$$

In the current quantitative version I shut down state-specific productivity (common g_z) to isolate the role of fiscal policy; cross-state heterogeneity in realized growth g_s then comes entirely from differential net migration $g_{s,N}$. [13].

6.4 State Government: Political Executive

The state government is comprised of two entities: political executives that set state fiscal policy and state investment boards that decide how state pension funds allocate their assets. The political executive sets taxes ($\tau_{s,1}$) and pension contributions ($c_{s,1}$) in period 1 and ($\tau_{s,2}, c_{s,2}$) in period 2, where $c_{s,t} \equiv C_{s,t}/Y_{s,t}$ are pension contributions scaled by GDP and $x_{s,t} \equiv X_{s,t}/Y_{s,t}$ exogenous expenditure ratios. Because pension benefits are part of the operating budget under balanced-budget rules, states effectively borrow only via underfunding the plan, in the spirit of Lucas and Zeldes (2009). Politicians face a trade-off: voters punish high taxes. The probability of re-election (equivalently, the inverse of period-1 political cost) is the logistic form

$$p(\tau_{s,1}) \;=\; \frac{1}{1+\exp\!\big(\pi_s\,(\tau_{s,1}-\bar{\tau}_s)\big)}, \qquad p'(\tau_{s,1}) \;=\; -\pi_s\, p(\tau_{s,1})\big(1-p(\tau_{s,1})\big) < 0, \tag{14}$$

where $\bar{\tau}_s$ is the median voter's preferred tax rate and $\pi_s > 0$ governs the sensitivity of voters to deviations from $\bar{\tau}_s$. The executive maximizes the population-weighted indirect utility of the period-1 electorate plus the discounted, re-election-weighted continuation welfare:

$$\max_{\{\tau_{s,1},\,\tau_{s,2},\,c_{s,1},\,c_{s,2}\}} \quad v_{s,1}\,N_{s,1} \;+\; \beta\, p(\tau_{s,1})\,\mathbb{E}\big[\,v_{s,2}\,N_{s,2}\,\big] \tag{15}$$

$$\begin{aligned}
\text{s.t.}\quad &\text{(i)}\quad \tau_{s,1} = x_{s,1} + c_{s,1},\\
&\text{(ii)}\quad \tau_{s,2} = x_{s,2} + c_{s,2},\\
&\text{(iii)}\quad c_{s,2}(1+g_s) + (a_s + c_{s,1})\,R_s \;=\; \ell_s,\\
&\text{(iv)}\quad R_s \;=\; 1 + r_f + \theta_s\big(\mu - r_f\big) + \theta_s\,\sigma_R\,\epsilon, \qquad \epsilon \sim \mathcal{N}(0,1),
\end{aligned}$$

where lower-case letters $\ell_s = L_s/Y_{s,1}$ and $a_s = A_s/Y_{s,1}$ denote liabilities and legacy assets scaled by period-1 GDP. The executive takes the fiduciary's optimal θ_s^* (derived below) as given.

First-order conditions Combining (i)–(iii) gives $\tau_{s,2}$ as a function of $\tau_{s,1}$. Differentiating (15) with respect to $\tau_{s,1}$ and using $\partial\mathbb{E}[v_{s,2}N_{s,2}]/\partial\tau_{s,1} = \mathbb{E}\big[\partial v_{s,2}/\partial\tau_{s,1}\cdot N_{s,2} + v_{s,2}\cdot\partial N_{s,2}/\partial\tau_{s,1}\big]$ yields

$$\underbrace{\frac{\partial v_{s,1}}{\partial \tau_{s,1}}\,N_{s,1}}_{\text{static welfare loss}} \;+\; \underbrace{\beta\, p(\tau_{s,1})\,\mathbb{E}\!\Big[\tfrac{\partial v_{s,2}}{\partial \tau_{s,1}}\,N_{s,2} \;+\; v_{s,2}\,\Phi_s(1-\Phi_s)\,\sigma_v^{-1}\,\tfrac{\partial v_{s,1}}{\partial \tau_{s,1}}\Big]}_{\text{intertemporal welfare term incl. migration response}} \;+\; \underbrace{\beta\, p'(\tau_{s,1})\,\mathbb{E}\big[v_{s,2}\,N_{s,2}\big]}_{\text{electoral wedge}} \;=\; 0, \tag{16}$$

[13] A more rigorous formulation would also include firm-migration as firms may relocate businesses to capitalize on tax savings. I adopt a simpler technology - where production scales with population. Households moving would be equivalent to business relocation, as well as a loss of the origin state's tax base

with auxiliary derivatives

$$
\begin{aligned}
\frac{\partial v_{s,1}}{\partial \tau_{s,1}} &= -\frac{1}{1-\tau_{s,1}} \cdot \frac{\alpha+\phi_s}{1+\phi_s} + \bar{B}_s \varphi_s \exp(-\varphi_s(\tau_{s,1} - c_{s,1})), \\
\frac{\partial v_{s,2}}{\partial \tau_{s,1}} &= -\frac{1}{1-\tau_{s,2}} \cdot \frac{\alpha+\phi_s}{1+\phi_s} \cdot \frac{\partial \tau_{s,2}}{\partial \tau_{s,1}} \;+\; (\alpha-1)\,\frac{1}{1+\phi_s} \cdot \frac{\partial \ln N_{s,2}}{\partial \tau_{s,1}}, \\
\frac{\partial \tau_{s,2}}{\partial \tau_{s,1}} &= -\frac{R_s}{1+g_s} \;-\; \frac{\ell_s - (a_s + \tau_{s,1} - x_{s,1})\,R_s}{(1+g_s)^2} \cdot \frac{\Phi_s(1-\Phi_s)}{\sigma_v\, N_{s,1}} \cdot \frac{\partial v_{s,1}}{\partial \tau_{s,1}}, \\
\Phi_s &= \frac{\exp(v_{s,1}/\sigma_v)}{\sum_k \exp(v_{k,1}/\sigma_v)} \;=\; N_{s,2}.
\end{aligned}
\tag{17}
$$

The first term reflects the static welfare loss from higher taxes in period one. Period-1 taxes directly lowers period-1 utility. The second-term reflects the inter-temporal impact. The first object within the second term traces to effects. The first captures the impact on state budgets as higher taxes directly translate to higher contribution rates for state pensions (since expenditures are fixed), thus lowering future tax liability. The second choice captures the location choice rule. Period-1 taxes delineate period-2 population shares as households choose where to locate. A relatively higher tax rate in period-1 would predict lower population share in period-2. This has two effects - first the state is left with a lower tax base and second the rents in the location adjusts as housing demand falls. These act as countervailing forces on that periods' utility. The third term of the first-order condition captures the electoral wedge - as politicians raising taxes in period-1 face a lower probability of getting re-elected in period-2. The third term is unambiguously negative which indicates the incentives to under-contribute - politicians are more likely to kick the can down the road when re-election hinges upon tax-levels. In comparison, a utilitarian social planner who internalizes welfare across both periods, but does not face an electoral constraint, solves (16) with $p(\tau_{s,1}) \equiv 1$ and $p' \equiv 0$. The planner's FOC drops the third term in (16):

$$
\frac{\partial v_{s,1}}{\partial \tau_{s,1}}\, N_{s,1} \;+\; \beta\, \mathbb{E}\Big[\tfrac{\partial v_{s,2}}{\partial \tau_{s,1}}\, N_{s,2} + v_{s,2}\, \Phi_s(1-\Phi_s)\, \sigma_v^{-1}\, \tfrac{\partial v_{s,1}}{\partial \tau_{s,1}}\Big] \;=\; 0. \tag{18}
$$

The *political wedge* $\beta\, p'(\tau_{s,1})\, \mathbb{E}[v_{s,2} N_{s,2}] < 0$ pulls the politician toward setting *lower* period-1 taxes than the planner would. The financing gap is closed via lower contributions $c_{s,1}$, higher leverage on the pension fund's risky asset, and (in expectation) higher period-2 taxes. Heterogeneity in legacy funding $f_{s,1} \equiv a_s/\ell_s$ and in fixed expenditures $x_{s,t}$ translates one-for-one into cross-state dispersion in equilibrium tax rates, even when states share the same conjectured growth rate. This motivates the proposition below below.

Proposition 2: *Funding status, tax-rates and migration*

Holding $(x_{s,1}, x_{s,2}, \bar{\tau}_s)$ fixed, lower legacy funding ($\downarrow a_s/\ell_s$) implies higher equilibrium $\tau_{s,1}$, higher θ_s^* (when the fiduciary problem is solved below), and a higher predicted out-migration rate from (12).

A fall in a_s or rise in ℓ_s raises the right-hand side of (15) (iii) for any conjectured $\tau_{s,2}$. The budget shock is split between higher $\tau_{s,1}$, higher $\tau_{s,2}$, and (via Proposition 3 below) a higher θ_s^*. Because $N_{s,2}$ is decreasing in $\tau_{s,1}$ and the elasticity in (12) is positive, out-migration rises. This channel underlines the mechanism in the first part of the paper - legacy unfunded pension liabilities pushes up tax-liability on local residents which induces the migration patterns seen in data. The fiduciary's problem yields the risky asset share as a function of contribution rates and legacy funding status. Figure 8 panel (b) shows the simulation of migration rates to corresponding funding status.

6.5 State Pension Fiduciary

State investment boards are large institutional investors that choose defined benefit pension portfolios. These fiduciaries comprise of representatives of public employees (union members), political appointees, investment professionals and consultants (Andonov et al. (2018)). Setting aside the effect of the composition on investment policy, I model the fiduciary as a risk-averse investor. The fiduciary takes contributions $c_{s,1}$ as given and chooses the share θ_s of plan assets invested in the risky asset (excess return $\mu - r_f$, volatility σ_R) in order to maximize the end of period funding ratio $f_{s,2}$. It is given as follows:

$$f_{s,2} \;=\; \frac{a_s + c_{s,1}}{\ell_s}\Big[\,1 + r_f + \theta_s(\mu - r_f) + \theta_s\,\sigma_R\,\epsilon\,\Big] \;\equiv\; m_s + s_s\,\epsilon, \tag{19}$$

Where a_s refer as legacy pension assets to state-GDP, $c_{s,1}$ is the contribution rate from period-1, l_s is legacy pension liabilities, r_f refers to the risk-free rate of return, θ_s is the share of assets invested in risky-asset, which is a normally distributed random variable with mean return μ and standard deviation of σ_R. with $m_s = q_s\big(1 + r_f + \theta_s(\mu - r_f)\big)$, $s_s = \theta_s\,q_s\,\sigma_R$, and $q_s = (a_s + c_{s,1})/\ell_s$ is the short-form of effective funding ratio prior to investment.

The fiduciary has CARA utility over a linear payoff $\Pi(f_{s,2}) = k + \kappa\,f_{s,2}$:

$$\max_{\theta_s}\;\; \mathbb{E}\big[-\exp\!\big(-\gamma\,(k + \kappa\,f_{s,2})\big)\big]. \tag{20}$$

In this model, the fiduciary gets rewarded proportionally to the pension investment performance net of fiscal support. The state government guarantees pension obligations, the cost of meeting them through state coffers is higher than meeting them through investment income. This forms the basis of “risk" in the state pension fiduciary's objective - reducing the cost of meeting legacy obligations from non-investment sources.

Another way of formulating this problem would be to model the fiduciary's payoff being positive conditional on meeting or maintaining pension funding status above a threshold. In that case $\Pi(f_{s,2}) = k + \kappa\,(f_{s,2} - \tilde{f})^{+}$, and this would resemble the fiduciary holding a call option on the funding ratio, generating convex preferences over risk and a stronger risk-shifting response near the threshold $\tilde{f}$, in the spirit of Carpenter (2000). The closed-form risky share is reported in Appendix A. Standard CARA–Normal algebra yields the optimal risky share

$$\theta_s^{*} \;=\; \frac{\mu - r_f}{\gamma\,\kappa\,q_s\,\sigma_R^2}. \tag{21}$$

The risky-asset share is thus negatively proportional to the legacy funding status, period-1 contribution, fiduciary risk-aversion γ and pay-for-performance coefficient κ, and positive in risk-adjusted returns. Contribution policy can thus shift pension risk-taking especially if legacy funding status is low enough. This results in the third proposition on risk-shifting by state-governments.

Proposition 3: *Risk-shifting in pension portfolios*

The optimal risky share θ_s^* is higher with a political executive setting contributions relative to a utilitarian social planner

Direct partial derivatives of (21) give us the direction of the risky asset share with respect to effective funding ratio. Comparing equations (16) and (18), with $p(\tau_s, 1) \in (0, 1)$ and $p'(\tau_{s,1}) < 0$, social planner sets a higher contribution rate than the political executive. This lowers the effective funded status before pension returns are realized relative to the planner benchmark. A fiduciary with linear payoffs in funding ratio sets higher risky-asset allocations in response. Figure 8 panel (c) shows the simulated risky-asset allocation of the political executive versus a social planner that doesn't face re-election constraints.

The interaction of Propositions 2 and 3 is the central economic mechanism: low-funded states impose higher current-period taxes (driving out-migration) *and* take on more pension portfolio risk to plug the residual funding gap. An adverse return draw in period 2 then forces an even larger period-2 tax hike in precisely those states whose tax base has already shrunk via migration.

A *spatial–fiscal equilibrium* for given primitives $\{B_s, \phi_s, z_s, x_{s,1}, x_{s,2}, a_s, \ell_s, \bar{\tau}_s, \pi_s\}_{s=1}^{S}$ and $\{\alpha, \beta, \sigma_v, r_f, \mu, \sigma_R, \gamma, \kappa, \bar{H}\}$ is a collection $\{\, w_{s,t}, r_{s,t}, c^*_{s,t}, h^*_{s,t}, \tau_{s,1}, \tau_{s,2}, c_{s,1}, c_{s,2}, \theta_s, N_{s,t} \,\}_{s,t}$ such that (i) households solve (5) and (6) and choose locations via (8); (ii) firms optimize by setting ($w_{s,t} = z_{s,t}$); (iii) housing markets clear at rents (11); (iv) the political executive solves (15) taking θ^*_s from (21) as given; (v) fiduciaries solve (20) taking $c_{s,1}$ as given; (vi) period-1 population shares are predetermined ($N_{s,1}$ given) and period-2 shares are consistent with (8). For σ_v bounded away from zero and $\phi_s > 0$ for all s, the right-hand side of (8) is a contraction in $N_{s,2}$ once (11) is substituted in, and (16) is monotone in $\tau_{s,1}$ over the relevant range, so the equilibrium exists and is unique.

The model isolates three channels by which legacy pension burdens translate into state-level tax and growth dispersion, even absent productivity heterogeneity: Lower legacy funding status raises required contributions $c_{s,1}$ and hence $\tau_{s,1}$ (Proposition 2). Higher $\tau_{s,1}$ triggers out-migration with elasticity $(\alpha + \phi_s)/[\sigma_v(1+\phi_s)]$ (Proposition 1). Inelastic-housing states lose population fastest because rents do not absorb the tax shock. Worse-funded states also push pension portfolios further into risky assets (Proposition 3), so realized $\tau_{s,2}$ is more volatile in precisely the states most exposed to migration risk. The political wedge in (16) amplifies all three channels relative to the social-planner benchmark (18): incumbents under-tax in period 1 to preserve re-election odds, transferring the burden into period 2 either through higher future taxes or through riskier portfolios, both of which are borne by an already-shrinking tax base. This is the empirical finding of 4, where states with higher migration risk are more likely to shift portfolios to higher-risk or opaque alternative asset classes. In the next section I explore optimal policy with a planner that consolidates the function of the tax-setting authority and the portfolio manager.

6.6 Optimal Policy with a Consolidated Government

What is the wedge between the optimal versus observed pension risk given tax rates and other state-level fundamentals? In the previous section, I rationalize that political costs of raising taxes and myopia leads to over or underinvestment in risky assets across state governments. In this section, I look at the consolidated state government planner internalizes the migration feedback of taxes as well as the investment risk transfer to households in the form of endogenous amenities which depend on pension returns and tax receipts net of pension expenditures and obligations. Pension contributions are set to an exogenous actuarial level, while taxes set the level of non-pension expenditures. Amenities are a function of per-capita tax revenue net of pension expenditures. States vary in their ability to transform revenues to public services, which is reflected by the "Public Service Efficiency" parameter. The rest of the setup remains as before. I calibrate the model using data on state-level taxes, pension assets and liabilities as of 2023. I invert the calibrated model to recover amenity-provision parameters by state and then compare the optimal versus real risky asset share by state.

Endogenous amenities I endogenize location specific amenities B_s as increasing in non-pension spending per capita:

$$B_{s,t} = F(x_s) = \exp(\psi_s(\tau_s - \zeta l_s)) \tag{22}$$

Where $-\psi_s$ is indicative of the state's semi-elasticity of amenities generation for given level of expenditure per capita. This is to capture the efficiency of government's expenditures and a reduced form way to capture differential responses to higher tax rates as some states could charge higher marginal rates but maintain amenities more efficiently. This means the residual resources left to the state after paying for legacy liabilities pins down the level of amenities in the state each period.

Two Period Optimization The objective of the two-period optimization is to pin down optimal policy subject to legacy pension underfunding and mobility constraints. States trade-off between providing higher services through funding amenities which are residual tax revenues after accounting for states' fixed pension contributions. The amount of end-period pension obligation is a function of legacy liabilities net of investment income. Thus, higher risk shares could potentially decrease the need for raising taxes. Each state government sets the tax rates and risky-asset share of the pension investment in order to maximize the discounted sum of expected welfare of its constituents. The timeline is as follows: each state is endowed with an initial population share and legacy pension fundamentals. Each state government then optimizes the expected utility of their states at the beginning of period 1 by setting optimal tax rates for the two periods and the risky asset share, given a mandatory early contribution rule. Given government policies across states, households with idiosyncratic location preferences choose states which give them the highest indirect utility in period 2. In period 2 market returns on pension assets are realized and government has to pay remaining pension liabilities. The optimization can be summarized as:

$$\max_{\{\theta_s, \tau_{s,1}, \tau_2\}} V_{s,1}N_{s,1} + \delta\mathbb{E}(V_{s,2}N_{s,2}) \tag{23}$$

subject to period-by-period budget constraints:

$$\tau_{s,1} = x_{s,1} + \zeta l_s \qquad \tau_{s,2} = x_{s,2} + \frac{1}{1+g_s}\left(l_s - (a_s + \zeta l_s)R_s\right) \tag{24}$$

where ζl_s is the actuarial required contribution to pensions, R_s is the gross return on pension investment. Household location choice is given by the previous period's realized utility:

$$N_{s,2} = \frac{\exp(v_{s,1}/\sigma_v)}{\sum_k \exp(v_{k,1}/\sigma_v)} \tag{25}$$

given public service or amenities provision function:

$$B_{s,t} = 1 - \exp(-\psi_s x_{s,t}) \tag{26}$$

Thus, this government is faced with a problem to optimize welfare by providing amenities which are an increasing function of the resources it raises over two periods.

$$\max_{\tau_{s,1},\tau_{s,2},\theta_s}(1-\exp(-\underbrace{\psi_s(\tau_{s,1}-\bar{c}_s)}_{\delta_{s,1}})\underbrace{K_s(w(1-\tau_{s,1})N_{s,1})^{\varphi_s}}_{v_{s,1}}+$$
$$\left[1-\exp\left(-\underbrace{\psi_s\left(\tau_{s,2}-\frac{l_s}{1+g_s}+\mu_R(\theta_s)\left(\frac{a_s+\bar{c}_s}{1+g_s}\right)-\psi_s\left(\frac{a+\bar{c}_s}{1+g_s}\right)^2\frac{\sigma^2\theta_s^2}{2}\right)}_{\delta_{s,2}}\right)\right]\times \tag{27}$$
$$\underbrace{K_s((1-\tau_{s,2})wN_{s,2})^{\varphi}}_{v_{s,2}}$$

First-order conditions

(i) FOC with respect to the statutory tax rate $\tau_{s,1}$

$$v_{s,1}\left[\frac{\varphi_s}{(1-\tau_{s,1})}-\psi_s\exp(-\delta_{s,1})\right]=\frac{v_{s,2}\epsilon_s\psi_s\exp(-\delta_{s,2})}{\tau_{s,1}}\times$$
$$\left[\frac{l_s}{1+g_s}-\mu_R(\theta_s)\frac{a_s+\bar{c}_s}{1+g_s}-\psi_s\sigma^2\theta_s^2\left(\frac{a_s+c_s}{1+g_s}\right)^2\right]+ \tag{28}$$
$$\frac{\varphi_s\epsilon_s}{\tau_{s,1}}v_{s,2}(1-\exp(-\delta_{s,2}))$$

Where the first term of the LHS reflects the impact of raising labor income tax rates on today's amenities, the second term is the impact on today's disposable income, the third term is the impact on housing rents going down as disposable income goes down. The combined fourth terms relates to change in the state population tomorrow and it's knockdown affect on state's tax base which changes it's amenities, the change in rents as housing markets gets either more crowded or less congested, the third term is documenting the per-capita change in utility of households tomorrow. Rest of the derivation is in the appendix. This FOC leads to possibly multiple solutions for optimal $\tau_{s,1}$ as $N_{s,2}$ is dependent on indirect period 1 utility $V_{s,1}$.

(ii) FOC with respect to the statutory tax rate τ_2

$$\tau_{s,2}=1-\frac{(1-\exp(-\delta_{s,2}))\varphi_s}{\exp(-\delta_{s,2})\psi_s}=1+(1-\exp(\delta_{s,2}))\frac{\varphi_s}{\psi_s} \tag{29}$$

Where the first term captures the impact on expected future amenities due to higher tax rates, the second term captures the negative impact on wages and the third term captures the impact on rents. Since period 2 tax rates only affect period 2 outcomes, it is safe to say that the trade-off is in equating the cost of lower disposal income against higher amenities and lower rents.

(iii) FOC with respect to the portfolio share θ_s

$$\theta_s=\frac{\mu-r_f}{\psi_s\sigma^2}\frac{1+g_s}{a_s+\bar{c}_s} \tag{30}$$

Thus optimal risky share is directly proportional to the excess return to variance ratio of the risky investment but inversely proportional to pension assets per capita and the public service provision efficiency of the state government. As the expression of amenities is similar to a CARA normal utility, we can analogously equate the "risk-aversion" of the social planner as the public service efficiency multiplied by pension assets per capita.

6.7 Inversion and Wedge Estimation

I calibrate the model using data from 2023. I use tax-rate data by state using tax data from NBER TAXSIM. I take data on pension assets, liabilities and required contributions from the Public Plans Database. I normalize wage rate to 1. I take housing supply elasticity from Saiz (2010). I use the tax-migration elasticity using the Moretti and Wilson (2017) method by state. I assign an equity risk premia of 6% and volatility of 18%. Consumption share of household expenditures is set to 66%. I take population data by state from US census bureau. Using these data, I obtain the measure of public service efficiency by state by solving for the first-order-conditions of taxes[14].

Panel (a) of figure 9 shows that public service efficiency parameter is positively correlated with the funding ratio of the state. Though noisy, this in essence captures the structural variation possibly driving the patterns we see in data. States with high public service provision ability are more likely to have better funding status. In other words, pension funding is correlated with a measure of "governance quality". A worse funding status would be costlier in states with lower public service efficiency - as a drop in public spending could result in worse amenities relative to other states. This means a common shock to pension funding, such as a financial crisis, would translate into a heterogeneous impact - states with better public service efficiency could recover faster while states with worse ψ_s would find it costlier, lose residents to better funded states and thus end up at a worse position.

Assuming their tax-rates correspond to optimal, are states investing optimally? The optimal risky-asset-share formula tells us that states with lower public service efficiency parameters thus should invest more in risky assets. How different are these investment observed in the data versus those implied by the model. Panel (b) of figure 9 plots the observed and model-implied allocations. The scatter in red represents allocation to public equities. We see that about 12 states' public equity allocations are equal or similar to their optimal risky asset shares implied by the model. However, if we account for the additional allocation to alternative asset classes, we find that states allocate much higher than the model-implied optimum. This gap quantifies the excess allocation towards riskier or opaque asset classes than the one purported by the model.

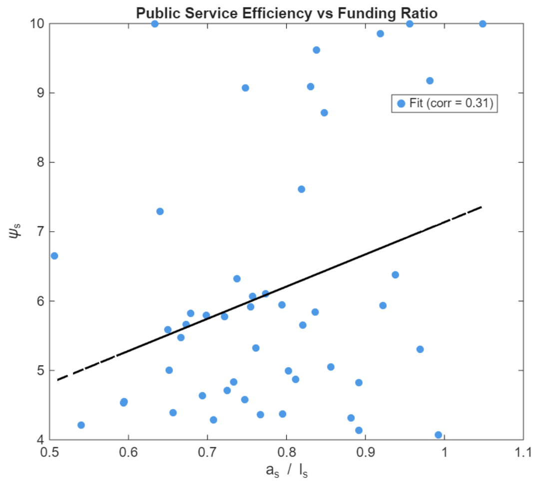
7 Conclusion

Public sector pension underfunding remains a significant challenge for US state and local governments. This paper traces the link between chronic funding gaps and migration. Persistent shortfalls coincide with higher taxes, reduced public service quality, and other adverse local economic conditions that encourage households and firms to relocate. Governments face a stark choice: raise taxes, under-invest in public services, or pursue riskier investment strategies within their pension portfolios. I show that migration limits fiscal capacity and is associated with states under-contributing to their defined benefit pensions. I then find that states that face higher migration risk pivot towards riskier alternative investments.

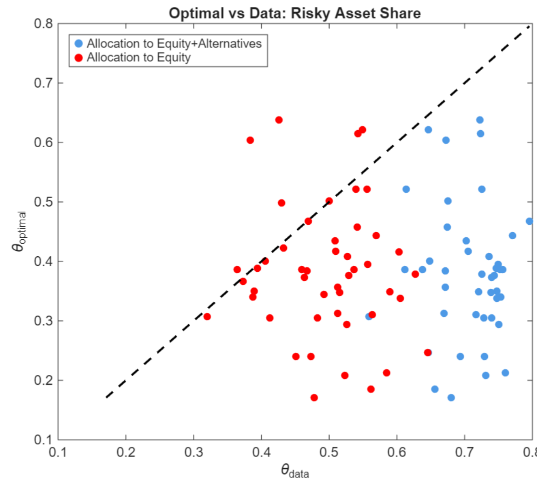
I further examine the impact of statutory pension reforms on funding status in Appendix Section B.3. Using data from the National Association of State Retirement Administrators (NASRA)[15] , I collect 180 instances of reforms enacted by state and local pensions between 2005 and 2022. The most common measures involve raising employee contribution rates and reducing pension benefits. On average, funds in states that implement such reforms exhibit improved funding status following their adoption. However, when I

[14] Details of the inversion are reported in appendix D.2

[15] `https://www.nasra.org/pensionreform`



(d) ψ_s vs. FR



(e) θ_{optim} vs. θ_{data}

Figure 9: Optimal Porfolio Choice

These graphs show the relationship between the public service efficiency parameter and funding ratio as well as the wedge between optimal and observed risky-asset shares. Panel (a) plots the public service efficiency parameter ψ_s against the funding ratio of the respective state. Panel (b) plots the model-implied optimum risky asset share against the observed risky asset share in data. The red-dots show the model θ vs. allocation to public equities observed in the data. The blue-dots show the sum of allocations to public equity and alternative asset classes.

explore heterogeneity by migration risk, I find that plans in high-migration-risk states experience smaller improvements in funding ratios relative to other states enacting the same reforms. This pattern underscores the constrained policy space these states face, which may in turn push them toward risk-seeking investment strategies.

That said, there are several promising directions for extending this research, both empirically and theoretically. On the data and measurement side, I could expand beyond the 228 state and local pensions in the Public Plans Database by incorporating GASB 67 statements, and adjust funding status using discount rates based on risk-free benchmarks rather than reported assumptions (Giesecke and Rauh, 2023). Empirically, my current strategy shows that relative synthetic portfolio performance of defined-benefit pensions affects local government budgets, which, in turn, influences household location decisions through higher tax burdens and deteriorating public amenities. To establish a stronger causal link, however, future work would need to compare the effects of local funding and tax shocks against other drivers of migration, and examine how these forces interact.

Theoretically, my model captures how heterogeneous legacy pension obligations, and re-election constraints force local governments to set heterogeneous contribution rates, and households migrate in response to realized tax burdens and amenities, seeking the locations that maximize their utility. Future work could microfound richer mechanisms behind migration. One channel is reduced labor demand in underfunded regions, as firms relocate to better-funded states with lower tax burdens—a pattern well documented in Suárez Serrato and Zidar (2016) and Giroud and Rauh (2019). I do not model or test firm location choice, largely because of limited data relative to the richness of IRS migration flows and the complexities of firms apportioning income across tax jurisdictions (see Suárez Serrato and Zidar (2016)). A deeper analysis could leverage datasets such as the Longitudinal Business Database or the National Establishment Time Series to track both firm relocation and regional business dynamism by funding status. A richer structural exercise could estimate key parameters using the Simulated Method of Moments or related techniques, allowing quantification of the welfare costs of public pension risk-taking. Such a framework would also enable counterfactual analyses to evaluate which place-based policies could mitigate the distortionary effects of chronic underfunding.

Another potential channel is expectations and uncertainty: households may migrate not only in response to realized taxes and amenities, but also in anticipation of future fiscal stress or uncertainty about future tax policy. In Appendix Table 18, I provide suggestive but noisy evidence from the Federal Reserve Bank of New York's Survey of Consumer Expectations, which asks respondents whether they expect higher taxes over the next 12 months. I find a negative association between pension funding status and expected tax increases, consistent with households in more underfunded states anticipating heavier tax burdens ahead.

Therefore, this paper makes two incremental contributions: (i) it links household migration to local pension funding status, and (ii) it documents how pension fund allocations toward riskier or opaque asset classes vary with relative migration risk. Together, these findings open the door to broader questions on regional economic dynamics and the consequences of public risk-taking for household outcomes.

References

Aiello, Darren, Asaf Bernstein, Mahyar Kargar, Ryan Lewis, and Michael Schwert, "The Marginal Value of Public Pension Wealth: Evidence From Border House Prices," 2024.

Andonov, Aleksandar, Rob MMJ Bauer, and KJ Martijn Cremers, "Pension fund asset allocation and liability discount rates," *The Review of Financial Studies*, 2017, *30* (8), 2555–2595.

_ , Yael V Hochberg, and Joshua D Rauh, "Political representation and governance: Evidence from the investment decisions of public pension funds," *The Journal of Finance*, 2018, *73* (5), 2041–2086.

Anzia, Sarah F, "Pensions in the trenches: How pension spending is affecting US local government," *Urban Affairs Review*, 2022, *58* (1), 3–32.

Begenau, Juliane, Pauline Liang, and Emil Siriwardane, "The rise of alternatives," *Available at SSRN*, 2024.

Carpenter, Jennifer N, "Does option compensation increase managerial risk appetite?," *The journal of finance*, 2000, *55* (5), 2311–2331.

DeWaard, Jack, Mathew Hauer, Elizabeth Fussell, Katherine J Curtis, Stephan D Whitaker, Kathryn McConnell, Kobie Price, David Egan-Robertson, Michael Soto, and Catalina Anampa Castro, "User beware: Concerning findings from the post 2011–2012 US internal revenue service migration data," *Population Research and Policy Review*, 2022, *41* (2), 437–448.

Diamond, Rebecca, "Housing supply elasticity and rent extraction by state and local governments," *American Economic Journal: Economic Policy*, 2017, *9* (1), 74–111.

Drechsler, Itamar, Alexi Savov, and Philipp Schnabl, "The deposits channel of monetary policy," *The Quarterly Journal of Economics*, 2017, *132* (4), 1819–1876.

Fajgelbaum, Pablo D, Eduardo Morales, Juan Carlos Suárez Serrato, and Owen Zidar, "State taxes and spatial misallocation," *The Review of Economic Studies*, 2019, *86* (1), 333–376.

Foschi, Andrea, Christopher House, Christian Proebsting, and Linda Tesar, "Should I stay or should I go? The response of labor migration to economic shocks," Technical Report, National Bureau of Economic Research 2025.

Gao, Pengjie and Xiaodan Gao, "Municipal Finance and Labor Mobility," 2025.

Giesecke, Oliver and Joshua Rauh, "Trends in state and local pension funds," *Annual Review of Financial Economics*, 2023, *15* (1), 221–238.

Giroud, Xavier and Joshua Rauh, "State taxation and the reallocation of business activity: Evidence from establishment-level data," *Journal of Political Economy*, 2019, *127* (3), 1262–1316.

Inman, Robert P, "Public employee pensions and the local labor budget," *Journal of Public Economics*, 1982, *19* (1), 49–71.

Koijen, Ralph SJ and Motohiro Yogo, "A demand system approach to asset pricing," *Journal of Political Economy*, 2019, *127* (4), 1475–1515.

Lu, Lina, Matt Pritsker, Andrei Zlate, Kenechukwu Anadu, and James Bohn, "Reach for yield by US public pension funds," *FRB of Boston Supervisory Research & Analysis Unit Working Paper No.# RPA*, 2019, pp. 19–2.

Lucas, Deborah J and Stephen P Zeldes, "How should public pension plans invest?," *American Economic Review*, 2009, *99* (2), 527–532.

Mittal, Vrinda, "Desperate capital breeds productivity loss: Evidence from public pension investments in private equity," *Available at SSRN 4283853*, 2024.

Moretti, Enrico and Daniel J Wilson, "The effect of state taxes on the geographical location of top earners: Evidence from star scientists," *American economic review*, 2017, *107* (7), 1858–1903.

Myers, Sean, *Public employee pensions and municipal insolvency*, SSRN, 2023.

Novy-Marx, Robert and Joshua D Rauh, "The liabilities and risks of state-sponsored pension plans," *Journal of Economic Perspectives*, 2009, *23* (4), 191–210.

_ **and** _ , "Fiscal imbalances and borrowing costs: Evidence from state investment losses," *American Economic Journal: Economic Policy*, 2012, *4* (2), 182–213.

_ **and Joshua Rauh**, "The revenue demands of public employee pension promises," *American Economic Journal: Economic Policy*, 2014, *6* (1), 193–229.

Pennacchi, George and Mahdi Rastad, "Portfolio allocation for public pension funds," *Journal of Pension Economics & Finance*, 2011, *10* (2), 221–245.

Rauh, Joshua and Ryan Shyu, "Behavioral responses to state income taxation of high earners: evidence from California," *American Economic Journal: Economic Policy*, 2024, *16* (1), 34–86.

Rauh, Joshua D, "Taxes, Revenues, and Net Migration in California," *Available at SSRN 4037764*, 2022.

Saiz, Albert, "The geographic determinants of housing supply," *The Quarterly Journal of Economics*, 2010, *125* (3), 1253–1296.

Serrato, Juan Carlos Suárez and Owen Zidar, "Who benefits from state corporate tax cuts? A local labor markets approach with heterogeneous firms," *American Economic Review*, 2016, *106* (9), 2582–2624.

Tiebout, Charles M, "A pure theory of local expenditures," *Journal of political economy*, 1956, *64* (5), 416–424.

A Empirical Appendix

Table 5: Summary-Statistics

This table presents the summary statistics of the data used in this paper. The first panel shows state-level data. Tax data comes from NBER Taxsim and the Tax Foundation. Public School Data comes from NCES. Net AGI outflow and migration data comes from the IRS Statistics of Income, Real Wage comes from CPS, Rent comes from ACS, State Finances data comes from Census Bureau, Job openings data comes from Bureau of Labour Statistics, Crime statistics are from the FBI, Road Condition is from Bureau of Transportation. Pension plan level data comes from Center for Retirement Research. 13-F holdings and stock return data comes from LSEG and Pensions' Balance Sheet Data comes from Worldscope. Data ranges 2001-2023.

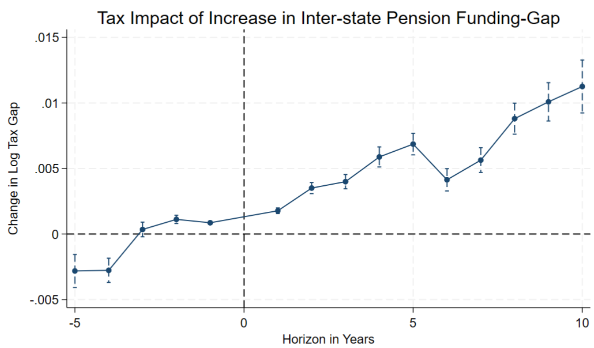
	Mean	Median	SD	Min	Max	Count
State-level Data						
State Marginal Income Tax Rate for AGI >$250k (%)	5.14	5.75	2.92	0.00	12.90	1070
State Corporate Tax Rate (0-1)	0.06	0.07	0.03	0.00	0.12	1121
Ln(Public School Capital Expenditure) Ln($)	20.25	20.40	1.17	16.84	23.17	1100
Net AGI outflow per taxpayer ($ 1000)	-0.08	0.00	0.84	-4.86	6.25	1109
Ln(Real Wage)	1.05	1.03	0.21	0.41	1.69	1121
Ln(Rent)	6.85	6.83	0.28	6.20	7.70	1121
State Debt/Revenue (0-1)	0.54	0.47	0.29	0.06	2.46	1094
State Debt/GDP (0-100)	68.88	62.61	35.23	8.27	203.61	1094
Annual Property Tax/Household Income (0-1)	0.06	0.03	0.13	-0.52	2.92	1121
House Price Index	201.30	188.05	57.77	100.80	574.37	1121
Job Openings (%)	3.62	3.30	1.31	1.60	8.90	1121
Violent Crimes/100k population	400.51	356.05	200.58	78.24	1637.86	1070
Pupil-Teacher Ratio	15.37	14.90	2.65	10.31	24.33	1097
Road Condition (0-100)	80.85	83.85	15.21	3.10	99.90	1018
State GDP Growth (0-1)	0.04	0.04	0.04	-0.15	0.25	1121
State Employment Growth (0-1)	0.01	0.01	0.02	-0.11	0.08	1121
Pension-plan level Data						
Funded Ratio (PPD)	0.78	0.79	0.20	0.00	2.66	5035
1-year Investment Return	0.07	0.08	0.11	-0.36	0.39	5128
1(Assumption Change)	0.13	0.00	0.33	0.00	1.00	4837
Contribution Growth (0-1)	0.16	0.05	2.07	-1.00	98.54	4862
1-year Investment Return Assumption	0.08	0.08	0.01	0.03	0.09	5070
Payroll Growth	0.03	0.03	0.08	-1.00	2.50	4583
Payroll Growth Assumption	0.04	0.04	0.01	0.00	0.08	2629
Allocation to Equities	0.52	0.53	0.12	0.00	1.00	4302
Allocation to Fixed Income	0.26	0.25	0.09	0.00	1.00	4302
Allocation to Private Equity	0.06	0.05	0.07	0.00	0.43	4302
Allocation to Hedge Funds	0.05	0.00	0.07	0.00	0.52	4302
Allocation to Commodities	0.02	0.00	0.04	0.00	0.31	4302
Allocation to Real Estate	0.06	0.06	0.05	0.00	0.34	4302
Pension Fund Cash	0.02	0.01	0.02	0.00	0.37	4302
Allocation to Other Assets	0.00	0.00	0.02	0.00	0.47	4302
IRS County-to-County Migration Data						
Out-Migrant Returns/Non-Migrant Returns	0.0004	0.0001	0.0014	0.0000	0.2251	866,804
Out-Migrant AGI ($1000s)/Non-Migrant Returns	0.0209	0.0074	0.0638	-5.7001	6.7045	866,801
Destination-Origin Pension Funding Ratio	0.0113	0.0125	0.1985	-1.7417	1.7417	880,751
Destination-Origin Cum. Abnorm. Returns	0.0060	0.0000	0.3239	-2.0360	2.0360	927,008
Destination-Origin Abnormal Returns	0.0006	0.0004	0.0642	-0.4898	0.4754	880,751
Destination-Origin Cum Synthetic Returns	0.0112	0.0006	0.3468	-2.7898	2.7898	880,751
IRS County-level Migration Data						
Z_r	-0.16	-0.23	0.29	-0.64	1.63	67,984
Z_{union}	0.58	0.59	0.22	-0.15	1.18	64,820
Net Out-Migrant Returns/Non-Migrant Returns	-0.00	0.00	0.03	-1.12	1.00	64,770
Net Out-Migrant AGI/Non-Migrant AGI	-0.14	-0.01	1.22	-83.92	29.46	64,770

Figure 10: Impact of increase in Funding gap on Capital Share and Taxes

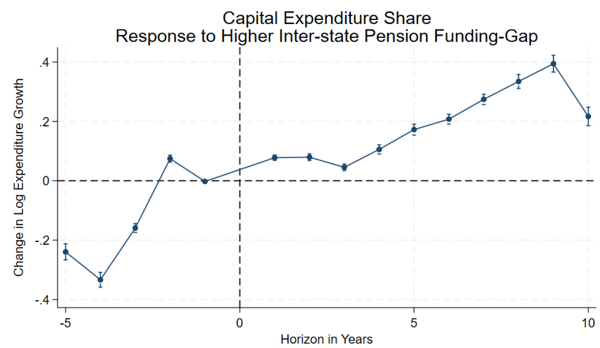
This graph reports the coefficients of a two-stage least squares regressions of the tax gaps between destination and origin counties on their respective pension funding gaps instrumented by the relative performance of the pensions' investment portfolios. The specification is as follows:

$$\ln\left(\frac{Y_{d,t+h}}{Y_{o,t+h}}\right) - \ln\left(\frac{Y_{d,t}}{Y_{o,t}}\right) = \beta_h D_{odt} + \gamma X_{odt} + F_{odt} + \epsilon_{od,t+h}$$

Where the denotes the change in the ratio of destination and origin tax gaps from periods t, t+h, a higher gap pointing to lower taxes in the destination relative to the origin. The dependent variable is a dummy measuring the change in funding gap today between destination and origin counties: It is 1 if the funding gap widens, -1 if it shrinks and zero otherwise. The dummy is instrumented with the relative surprises measured as $Z_r = (r_{d,t} - r^a_{d,2001}) - (r_{o,t} - r^a_{o,2001})$ where r_{it} is the t-period's investment return and $r^a_{i,2001}$ is the investment return assumption as of 2001. X_{odt} contain ratios of destination-and-origin state debt-to-revenue ratio and state corporate tax ratio. F_{odt} represents US Census Region of Origin $\times$ Region of Destination $\times$ Year fixed effects. All standard errors are clustered at the destination-origin pair level.



(a) Gap in Net-of-State Income Tax



(b) Gap in Capital Expenditure Share of State Budget

Table 6: Migration Odds vs Funding Gap: Public Unionization Instrument

This regression tables shows the results of regressing county-level migration odds against the pension funding gap between destination and origin counties. Panel A shows the OLS regression with logged ratio of out-migrant returns , from the origin county o to destination county-d, to the non-migrant returns of origin county-o as the dependent variable. Panel B has the logged ratio of the out-migrant adjusted growth income to non-migrant returns as the dependent variable. Panel C contains the first-stage of the two-stage least square regression with the funding gap between the destination and origin counties being the endogenous variable and the difference of the ratio of public union members by total government employs (union density) between the destination and origin counties being the instrument. Panel D shows the log odds ratio of migration and Panel E shows the logged out-migrant AGI per non-migrant tax payer as the dependent variable with instrumented funding gap being the main independent variable. Column (1) carries no fixed effects, while column (2) has destination fixed effects and origin fixed effect. Columns (3)-(8) carry destination × origin-county-FE. Column (4) additionally contains origin-state × year fixed effects whereas Column (5) contains regressions with destination state × year fixed effects. Column (6) contains regressions with destination region × origin region × year fixed effects, where region corresponds to one of the nine US Census Bureau regions designated to the county's state. Column (7) contains origin-county × year fixed effects while Column (8) contains destination-county × year fixed effects. All regressions include the logged ratio of destination rents and origin rents and the logged ratio of destination wages and origin wages as controls. Standard errors are clustered by destination-origin pair.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: OLS, Dep. Var:	Ln(Out Migrant Returns/Non-migrant Returns)							
Funding Gap	0.190***	-0.00194	0.00817**	0.00424	-0.0156***	-0.0466***	0.0422***	0.0118**
	(10.14)	(-0.40)	(2.07)	(1.07)	(-3.96)	(-11.22)	(6.62)	(2.04)
Panel B: OLS, Dep. Var:	Ln(Out Migrant AGI/Non-migrant Returns)							
Funding Gap	0.277***	0.00495	0.0136**	-0.00362	0.0154***	-0.0405***	0.0570***	0.0213**
	(15.09)	(0.70)	(2.11)	(-0.63)	(2.67)	(-6.65)	(6.31)	(2.53)
Panel C: IV - 1^{st} St, Dep. Var:	Funding Gap							
Z_{union}	0.0650***	0.0416***	0.0384***	0.0408***	0.0628***	0.00122	0.0462***	0.0670***
	(64.97)	(12.74)	(11.33)	(14.45)	(22.29)	(0.39)	(16.17)	(23.41)
Panel D: IV - 2^{nd} St, Dep. Var:	Ln(Out Migrant Returns/Non-migrant Returns)							
Funding Gap	3.266***	6.373***	7.216***	7.303***	3.552***	-107.3	7.014***	2.986***
	(38.57)	(11.76)	(10.54)	(13.49)	(17.04)	(-0.36)	(15.15)	(17.62)
Panel E: IV - 2^{nd} St, Dep. Var:	Ln(Out Migrant AGI/Non-migrant Returns)							
Funding Gap	3.190***	11.44***	12.71***	9.073***	4.643***	-126.7	8.789***	3.860***
	(38.86)	(11.83)	(10.51)	(13.32)	(16.47)	(-0.36)	(14.95)	(16.65)
N	840217	839892	818137	818137	818137	818136	809319	809353
Destination, Origin County-FE		Y						
Destination × Origin County-FE			Y	Y	Y	Y	Y	Y
Origin State × Year-FE				Y				
Destination State × Year					Y			
Dest. Reg. × Org. Reg. × Yr-FE						Y		
Origin County × Year-FE							Y	
Destination County × Year-FE								Y
Controls:	Ln(Destination Rent/Origin Rent), Ln(Destination Real Wage/Origin Real Wage)							

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Migration Odds vs. Funding Gap: Robustness by Sample period

This table reports regressions of county-level migration odds on pension funding gaps between destination and origin counties. Panel I restricts the sample to 2019 to avoid pandemic migration, and Panel II drops 2014–2016 to address IRS data concerns in DeWaard et al. (2022). Panel A uses the log ratio of out-migrant to non-migrant returns as the dependent variable; Panel B replaces this with the log ratio of out-migrant AGI to non-migrant returns. Panel C reports the first stage of the 2SLS, instrumenting the funding gap with cumulative excess returns (relative to 2001 assumptions) of destination minus origin pension plans. Panel D presents second-stage estimates for log migration odds, and Panel E for log out-migrant AGI per non-migrant return. All specifications follow table 1.

Panel I: Sample Ranging 2001-2019

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: OLS, Dep. Var:	Ln(Out Migrant Returns/Non-migrant Returns)							
Funding Gap	0.208***	0.0196***	0.0330***	0.0621***	0.0263***	-0.00655	0.0675***	0.0250***
	(10.99)	(4.10)	(8.74)	(9.88)	(4.49)	(-1.61)	(10.82)	(4.50)
Panel B: OLS, Dep. Var:	Ln(Out Migrant AGI/Non-migrant Returns)							
Funding Gap	0.297***	0.0345***	0.0471***	0.0875***	0.0286***	0.00237	0.0926***	0.0259***
	(16.04)	(5.08)	(7.79)	(9.69)	(3.32)	(0.38)	(10.26)	(3.09)
Panel C: IV - 1^{st} St, Dep. Var:	Funding Gap							
Synthetic Investment Performance	0.0995***	0.0799***	0.0974***	0.0925***	0.104***	0.0828***	0.0939***	0.104***
	(21.17)	(42.73)	(41.68)	(61.07)	(62.10)	(35.56)	(60.71)	(60.86)
Panel D: IV - 2^{nd} St, Dep. Var:	Ln(Out Migrant Returns/Non-migrant Returns)							
Funding Gap	-0.0800	0.389***	0.239***	0.134***	0.305***	0.169***	0.110**	0.324***
	(-0.59)	(9.18)	(9.34)	(2.95)	(8.23)	(5.81)	(2.51)	(9.62)
Panel E: IV - 2^{nd} St, Dep. Var:	Ln(Out Migrant AGI/Non-migrant Returns)							
Funding Gap	0.297***	0.0345***	0.0471***	0.0875***	0.0286***	0.00237	0.0926***	0.0259***
	(16.04)	(5.08)	(7.79)	(9.69)	(3.32)	(0.38)	(10.26)	(3.09)
N	753167	752844	732063	732063	732063	732062	724350	724331
Destination, Origin County-FE		Y						
Destination × Origin County-FE			Y	Y	Y	Y	Y	Y
Origin State × Year-FE				Y				
Destination State × Year					Y			
Dest. Reg. × Org. Reg. × Yr-FE						Y		
Origin County × Year-FE							Y	
Destination County × Year-FE								Y
Controls:	Ln(Destination Rent/Origin Rent), Ln(Destination Real Wage/Origin Real Wage)							

Panel II: Sample without 2014-2016

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: OLS, Dep. Var:	Ln(Out Migrant Returns/Non-migrant Returns)							
Funding Gap	0.188***	-0.00255	0.0111***	0.0395***	0.0183***	-0.0483***	0.0422***	0.0184***
	(10.21)	(-0.52)	(2.72)	(6.13)	(2.98)	(-11.37)	(6.66)	(3.20)
Panel B: OLS, Dep. Var:	Ln(Out Migrant AGI/Non-migrant Returns)							
Funding Gap	0.271***	0.00589	0.0180***	0.0553***	0.0317***	-0.0417***	0.0584***	0.0300***
	(15.12)	(0.82)	(2.68)	(5.96)	(3.56)	(-6.65)	(6.39)	(3.49)
Panel C: IV - 1^{st} St, Dep. Var:	Funding Gap							
Synthetic Investment Performance	0.0925***	0.0659***	0.0797***	0.0689***	0.0898***	0.0755***	0.0699***	0.0904***
	(23.41)	(35.86)	(35.83)	(42.45)	(49.03)	(34.96)	(42.34)	(48.09)
Panel D: IV - 2^{nd} St, Dep. Var:	Ln(Out Migrant Returns/Non-migrant Returns)							
Funding Gap	-0.0386	0.567***	0.399***	0.0543	0.479***	0.0793**	0.0742	0.511***
	(-0.31)	(11.56)	(12.30)	(0.98)	(11.92)	(2.56)	(1.39)	(13.97)
Panel E: IV - 2^{nd} St, Dep. Var:	Ln(Out Migrant AGI/Non-migrant Returns)							
ln_f_gap	-0.410***	0.671***	0.508***	-0.125	0.406***	0.175***	-0.0929	0.450***
	(-2.68)	(8.71)	(9.41)	(-1.56)	(6.18)	(3.53)	(-1.21)	(7.06)
N	773752	773428	751696	751696	751696	751696	744009	744003
Destination, Origin County-FE		Y						
Destination × Origin County-FE			Y	Y	Y	Y	Y	Y
Origin State × Year-FE				Y				
Destination State × Year					Y			
Dest. Reg. × Org. Reg. × Yr-FE						Y		
Origin County × Year-FE							Y	
Destination County × Year-FE								Y
Controls:	Ln(Destination Rent/Origin Rent), Ln(Destination Real Wage/Origin Real Wage)							

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Post-SALT net-outflow

This table estimates the net outflow of individuals following the $10,000 SALT deduction cap. The dependent variable, from IRS migration files, is the ratio of net out-migrants (outflows minus inflows) to total taxpayers in a state. Column (1) regresses this measure on the increase in tax liability for top-AGI taxpayers from NBER's TAXSIM. Columns (2)–(3) interact the Post-SALT Cap dummy (post-2018) with the 2017 top-AGI share. Controls include lagged rents, real wages, house price growth, crime, job openings, debt-to-revenue, and public school capital expenditure. All models have year fixed effects, and column (3) also adds state fixed effects. Panel A covers 2017–2022; Panel B covers 2017–2019.

Panel A: Sample Ranging 2017-2022

	(1)	(2)	(3)
	Net Out-Migration/Total Tax-Filers		
ΔTax Liability	0.187**		
	(2.16)		
Share of Filers in Top Income Bracket		-0.162	
		(-1.30)	
Post-TCJA × Share of Filers in Top Income Bracket		0.101***	0.0694***
		(3.47)	(2.84)
N	246	246	245
R-Sq	0.279	0.293	0.921
Within R-Sq	0.274	0.288	0.154
FE	Year	Year	State and Year

Panel B: Sample Ranging 2017-2019

	(1)	(2)	(3)
	Net Out-Migration/Non-Migrants		
ΔTax Liability	0.183*		
	(1.70)		
Share of Filers in Top Income Bracket		-0.188*	
		(-1.70)	
Post-TCJA × Share of Filers in Top Income Bracket		0.0522**	0.0378*
		(2.58)	(1.91)
N	148	148	147
R-Sq	0.248	0.263	0.959
Within R-Sq	0.242	0.257	0.106
FE	Year	Year	State and Year

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Bilateral AGI vs. Funding Gap

This table reports the bilateral county-level migration odds on the pension funding gap between destination and origin counties. Panel A presents the first-stage of the two-stage least squares where the logged funding gap between destination and origin is instrumented with the difference in synthetic returns as mentioned in equation 4. Panel B shows the second stage results with ln(Out-migrant AGI/Non-Migrant Returns) as the dependent variable. All columns in the first and second stage results contain log rent and log wage ratio of the destination vs. origin counties as controls. Column (1) has destination-county and origin-county fixed effects. Columns (2)-(8) contain destination-origin county pair fixed effects. Column (3) contains origin state × year fixed effects. Column (4) contains destination state × year fixed effects. Column (5) contains destination census region × origin census region × year fixed effects. Column (6) contains origin county × year fixed effects and column (7) contains destination county × year fixed effects. Standard errors are clustered by destination × origin pair.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: IV - 1st St., Dep. Var:				Funding Gap			
Synthetic Investment Performance$_{ij}$	0.0704***	0.0838***	0.0731***	0.0936***	0.0789***	0.0742***	0.0943***
	(39.31)	(37.91)	(45.98)	(52.69)	(36.47)	(45.92)	(51.73)
Panel B: IV - 2nd St., Dep. Var:				Ln(Out Migrant AGI/Non-migrant Returns)			
Funding Gap	0.974***	0.916***	0.00967	0.671***	0.0440	0.0565	0.700***
	(15.03)	(17.53)	(0.13)	(12.27)	(1.08)	(0.82)	(13.73)
Destination, Origin County-FE	Y						
Destination × Origin County-FE		Y	Y	Y	Y	Y	Y
Origin State × Year-FE			Y				
Destination State × Year				Y			
Dest. Reg. × Org. Reg. × Yr-FE					Y		
Origin County × Year-FE						Y	
Destination County × Year-FE							Y

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A.1 Measuring Net Migration

Bilateral migration flows provide a lens to study how funding gaps affect migration while leveraging a rich set of fixed effects to absorb confounding variation. I now focus on the reduced-form effect of deteriorating county funding ratios on *net* out-migration (outflows minus inflows). Using IRS county-level migration data, I subtract county-wise inflows from outflows to construct the main outcome variables as the ratios of net outflows of tax returns and adjusted gross income normalized by the number of non-migrant returns in a county in a given year.

To account for local conditions, I include lagged controls for real wages, rents, county GDP growth, state debt-to-revenue, property and state income taxes, property crime incidence, and the political leaning of the state (measured by the lagged share of Republican congressional representatives). This specification tests the reduced-form effect of underfunding on migration while conditioning on key economic, fiscal, and political factors.

Residual confounding variation from state- and county-specific time-varying shocks, as well as potential measurement error, is addressed by instrumenting funding status with cumulative excess returns on state and local defined benefit pension assets relative to their 2001 return assumptions.

$$\tilde{Z}_r = \sum_{h=0}^{t}(r_h - r^a_{2001})$$

The exclusion restriction rests on portfolio shocks only affecting migration through their effect on pension balance sheets, conditional on controlling for county and time fixed effects along with time-varying county and state parameters. The results are presented in table 10.

Column (1) shows a positive and statistically significant relationship between funding ratios and cumula-

Table 10: County-wise Net Migration

This table reports regressions of county-level net out-migration on defined benefit pension funding ratios, controlling for local time-varying factors and county and year fixed effects. Column (1) presents the first stage, instrumenting the funding ratio with cumulative excess returns relative to the 2001 investment return assumption ($\tilde{Z}_r$). Columns (2) and (3) show the regressions with the net outflow of tax returns relative to non-migrant tax returns as the dependent variable. Columns (4) and (5) shows the net outflow of adjusted gross income relative to non-migrant returns. Columns (2) and (4) show the OLS version of the regressions whereas columns (3) and (5) show the second stage with funding ratio of the county instrumented with the return instrument. Each specification contains the following controls: lagged log rents, real wages, property tax-to-household income ratio, top marginal state income tax rates, state debt to revenue, county-GDP growth and percentage of state's House of Representatives congressmen that belong to the Republican party. Standard errors are clustered at the county-level.

	(1)	(2)	(3)	(4)	(5)
	Funding Ratio	$\frac{\text{Net Out Migrant Returns}}{\text{Non-Migrant Returns}}$		$\frac{\text{Net Out Migrant AGI}}{\text{Non-Migrant Returns}}$	
	First-Stage	OLS	IV	OLS	IV
$\tilde{Z}_r$	0.0607***				
	(10.22)				
Funding Ratio$_{t-1}$		-0.000468	-0.0205**	0.105	-1.896**
		(-0.39)	(-2.07)	(1.31)	(-2.45)
N	59403	56312	56312	56312	56312
R-Sq	0.812	0.269	-	0.425	-
F-Stat	208.3				
FE	County and Year				
Controls	Rents, Wages, S&L Taxes, Debt/Rev, County-growth, Crime, Political				

Table 11: Second-stage: Using Public Unionization instrument

This table reports the regression results of the two-stage least square regressions of net migrant returns to non-migrant returns and net adjusted gross income outflow per non-migrant tax payer against state pension underfunding. The first column represents the first-stage results of the aggregate funding ratio in the region (county or state if county-data is missing) against the instrument which is the ratio of union members in the state to the total number of public employees. Columns (2) and (3) show the regressions with the net outflow of tax returns relative to non-migrant tax returns as the dependent variable. Columns (4) and (5) shows the net outflow of adjusted gross income relative to non-migrant returns. Columns (2) and (4) show the OLS version of the regressions whereas columns (3) and (5) show the second stage with funding ratio of the county instrumented with the return instrument. Each specification contains the following controls: lagged log rents, real wages, property tax-to-household income ratio, top marginal state income tax rates, state debt to revenue, county-GDP growth and percentage of state's House of Representatives congressmen that belong to the Republican party. Standard errors are clustered at the county-level.

	(1)	(2)	(3)	(4)	(5)
	Funding Ratio	$\frac{\text{Net Out Migrant Returns}}{\text{Non-Migrant Returns}}$		$\frac{\text{Net Out Migrant AGI}}{\text{Non-Migrant Returns}}$	
	First-Stage	OLS	IV	OLS	IV
Z_{union}	-0.0309***				
	(-4.36)				
Funding Ratio$_{t-1}$		0.00102	-0.413	0.111	-26.52*
		(1.05)	(-1.64)	(1.34)	(-1.68)
N	59403	56312	55245	56312	55245
R-Sq	0.804	0.268		0.425	
F-Stat	125.5				
FE	County and Year				
Controls	Rents, Wages, S&L Taxes, Debt/Rev, County-growth, Crime, Political				

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12: County-wise Net Migration: Sample Restrictions

This table reports regressions of net-out migration of tax returns from a county on its defined benefit funding ratio, controlling for local time-varying controls and county and time fixed effects. Column (1) shows the first stage where the instrument Z_r is the cumulative excess return relative to the 2001 investment return assumption. Columns (2) and (3) show the regressions with the net outflow of tax returns relative to non-migrant tax returns as the dependent variable. Columns (4) and (5) shows the net outflow of adjusted gross income relative to non-migrant returns. Columns (2) and (4) show the OLS version of the regressions whereas columns (3) and (5) show the second stage with funding ratio of the county instrumented with the return instrument. Each specification contains the following controls: lagged log rents, real wages, property tax-to-household income ratio, top marginal state income tax rates, state debt to revenue, county-GDP growth and percentage of state's House of Representatives congressmen that belong to the Republican party. Panel A restricts the sample to 2001-2019 as robustness to avoid pandemic mobility. Panel B drops 2014-2016 to alleviate methodological concerns in IRS migration data raised by DeWaard et al. (2022). Standard errors are clustered at the county-level.

Panel A: Restricting Sample to 2019

	(1)	(2)	(3)	(4)	(5)
	Funding Ratio	$\frac{\text{Net Out Migrant Returns}}{\text{Non-Migrant Returns}}$		$\frac{\text{Net Out Migrant AGI}}{\text{Non-Migrant Returns}}$	
	First-Stage	OLS	IV	OLS	IV
Z_r	0.0844***				
	(12.38)				
Funding Ratio$_{t-1}$		0.00134	-0.00505	0.161***	-1.268***
		(1.01)	(-0.56)	(2.74)	(-2.73)
N	50219	47960	47960	47960	47960
R-Sq	0.824	0.259	0.00383	0.380	-0.00508
Within R-Sq	0.0695	0.00414		0.00653	
F-Stat	166.4				
FE	County and Year				
Controls	Rents, Wages, S&L Taxes, Debt/Rev, County-growth, Crime, Political				

Panel B: Dropping 2014-2016 data

	(1)	(2)	(3)	(4)	(5)
	Funding Ratio	$\frac{\text{Net Out Migrant Returns}}{\text{Non-Migrant Returns}}$		$\frac{\text{Net Out Migrant AGI}}{\text{Non-Migrant Returns}}$	
	First-Stage	OLS	IV	OLS	IV
Z_r	0.0570***				
	(9.89)				
Funding Ratio$_{t-1}$		-0.000583	-0.0239**	-0.0220	-1.635*
		(-0.55)	(-2.44)	(-0.24)	(-1.79)
N	47055	43973	43973	43973	43973
R-Sq	0.798	0.368		0.414	
F-Stat	184.0				
FE	County and Year				
Controls	Rents, Wages, S&L Taxes, Debt/Rev, County-growth, Crime, Political				

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Leave-one-out-robustness

This table reports a leave-one-out robustness check of the 2SLS regressions in table 10. Each row is a separate second-stage regression of county-level migration on the funding ratio, instrumented by cumulative abnormal returns relative to the 2001 benchmark, excluding one Census region at a time. Column (1) uses the ratio of net out-migrant returns to non-migrant returns as the dependent variable, while column (2) replaces it with net out-migrant AGI to non-migrant returns.

Region Left Out	(1) $\frac{\text{Net Migrant Returns}}{\text{Non Migrant Returns}}$	(2) $\frac{\text{Net Migrant AGI}}{\text{Non Migrant Returns}}$
East North Central (IL, IN, MI, OH, WI)	-0.0192*	-1.499*
	(-1.88)	(-1.82)
East South Central (AL, KY, MS, TN)	-0.0298**	-2.952***
	(-2.06)	(-2.67)
Middle Atlantic (NJ, NY, PA)	-0.0198	-1.379
	(-1.49)	(-1.39)
Mountain (AZ, CO, ID, MT, NV, NM, UT, WY)	-0.0147	-2.797***
	(-0.86)	(-2.90)
New England (CT, MA, ME, NH, RI, VT)	-0.0196*	-2.173***
	(-1.95)	(-2.82)
Pacific (AK, CA, HI, OR, WA)	-0.00900	-1.020
	(-1.04)	(-1.51)
South Atlantic (DE, DC, GA, MD, NC, SC, VA, WV)	-0.0171***	-1.279**
	(-2.66)	(-2.46)
West North Central (IA, KS, MN, MO, NE, ND, SD)	-0.0340***	-1.668
	(-3.45)	(-1.45)
West South Central (AS, LA, OK, TX)	-0.0226**	-2.165**
	(-2.01)	(-2.50)

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

tive excess returns relative to 2001 assumptions, confirming instrument relevance. Columns (2)–(3) use net outflows of returns relative to non-migrant returns as the dependent variable, while Columns (4)–(5) use net AGI outflows per non-migrant return. The OLS results in Columns (2) and (4) show no effect. By contrast, the 2SLS estimate in Column (3) indicates that a one–standard deviation decline in funding (14%) increases net outflows of returns by 29 basis points. Column (5) implies that the same decline raises AGI outflows by \$265.44 per non-migrant return—equivalent to a \$540 million loss for Cook County, which had two million non-migrant returns in 2022.

These results are robust to (i) using the unionization instrument from Mittal (2024), (ii) restricting the sample till 2019 to exclude pandemic-driven migration, and (iii) excluding 2014–2016 to address IRS data concerns raised by DeWaard et al. (2022), and reported in the appendix. I also perform a leave-one-region-out robustness test where I drop data of one of the nine US census bureau regions at a time, to test for whether particular regions drive the results. The results are qualitatively similar and are reported in the appendix. Overall, the evidence suggests that underfunding signals weaker state fiscal health, with the resulting tax and amenity pressures prompting households to relocate from underfunded to better-funded regions.

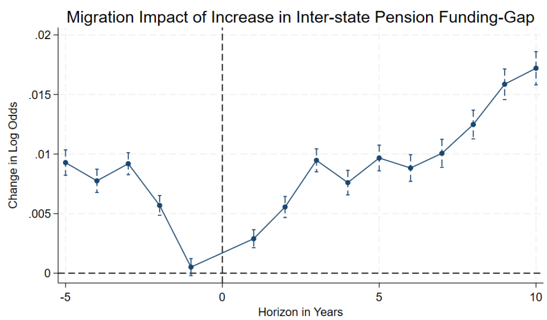
The next section examines the timing of this channel: does pension underfunding affect household migration immediately, or with a lag?

A.2 Dynamic Migration response to Pension Funding Gaps

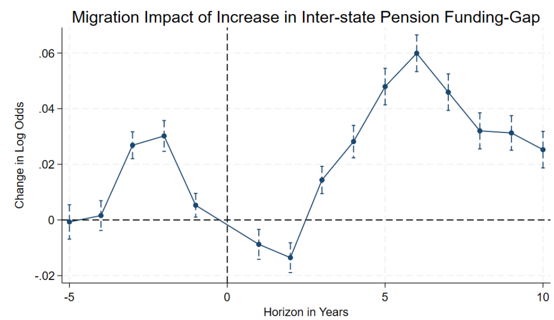
The previous section documents how funding gaps and underfunding predict migration response from the migrants' origin states. In this section, I explore what is the time lag of response in migration when funding gap between two states increases. I use the empirical strategy used in Moretti and Wilson (2017), by using an indicator for the change in the funding gap between the destination and origin counties. The funding gap measure remains the same as in the previous section, but now I regress the *change* in log odds of migration on the change in funding gap indicator over different horizons. I create an indicator variable D_{odh} which is equal to 1 when the funding gap increases, -1 if the funding gap decreases and 0 if the funding gap stays constant. I then estimate the following specification:

$$\ln\left(\frac{Y_{od,t+h}}{P_{oo,t+h}}\right) - \ln\left(\frac{Y_{od,t}}{P_{oo,t}}\right) = \eta_h D_{odh} + \gamma X_{odt} + F_{odt} + \epsilon_{od,t+h}$$

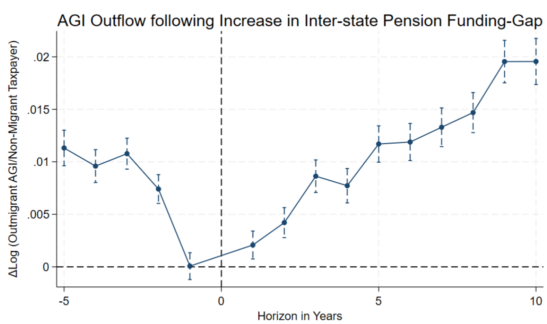
Where $\ln\left(\frac{Y_{od,t+h}}{P_{oo,t+h}}\right)$ is the logged ratio of returns (or AGI) that migrate from county o to county d in year $t+h$



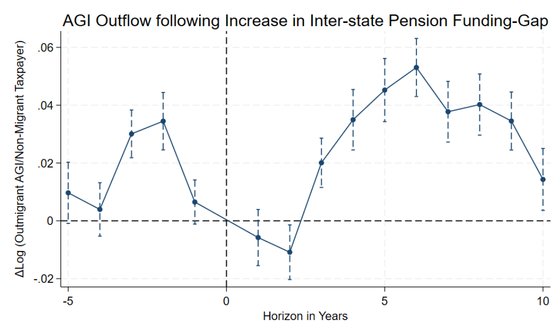
(c) OLS: Log Odds



(d) 2-SLS: Log Odds



(e) OLS: AGI Outflow



(f) 2-SLS: AGI outflow

Figure 11: Migration Response to Inter-state Funding Gaps

and non-migrant returns that stay in county o in period $t+h$. X_{odt} contains the rent and wage ratio of the origin counties at the time of the change in funding gap. F_{odt} is the region of origin $\times$ region of destination $\times$ year fixed effects, where a region is described as per the 9 US Census Bureau division combining a cluster of states.

As migration and pension funding gap could co-move due to other confounding local and bilateral variation, I also run a two-stage least squares version of the specification where I instrument D_{odh} with the following instrument:

$$Z'_{odt} = (r_{dt} - r^a_{d,2001}) - (r_{ot} - r^a_{o,2001})$$

Where r_{it} is the realized one-year rate of return on pension assets and $r^a_{i,2001}$ is the investment return assumption by the pension actuaries for $i \in \{o, d\}$ as of 2001. The instrument essentially is the difference in return "surprises" between the destination and origin county-pension funds relative to an ex-ante investment return assumption. The exclusion restriction is that the difference in return surprises only affects migration through its impact on pension funding gap between the two counties and is exogenous to factors driving migration, conditional from region-pair-year-wise variation and destination-county rent and real wage ratio. The first stage F-stat >> 40 for each horizon. Standard Errors in both the OLS and 2-SLS specifications are clustered by origin $\times$ destination county pair to control for within county-pair correlation of errors. The results are presented in figure 11. In all specifications I find that log odds of out-migration consistently increases when the funding gap between two counties increases. To interpret magnitudes, in the OLS panel (a) I find that the when destination counties become relatively better funded than origin counties, the odds of out-migration rise by 1% in 5 years and 2% over 10 years. The two stage results in Panel (b) show that change in out-migration odds rise to 6% by the sixth year but then fall to about 3% by the tenth year. Panels (c) and (d) also capture similar dynamic responses of measured in terms of AGI outflow per non-migrant tax-payers.

B Alternative Migration Risk Measures

Here I report the OLS and Moretti and Wilson (2017) migration betas with respect to taxes.

B.1 OLS Migration Betas

Akin to deposit betas which measure changes in bank deposits when the Federal Funds Rate changes estimated by Drechsler et al. (2017), I estimate regressions of net migration of individuals from IRS migration data on increase in the statutory tax rates for each state separately, controlling for local real wages, rent, house price index, employment growth, job openings, state GDP growth, crime, state debt to revenue ratio, pupil-teacher ratio and infrastructure quality. The rationale behind putting in the rich set of controls is to proxy for local economic performance and outlook, cost of living, and measures of public amenities that might drive migration response. I measure an increase in marginal tax rate as a positive change in marginal tax rates in any of the state income tax brackets.

For each state, I run the regression:

$$Y_{st+1} = \beta_s \times 1(\Delta\text{Marginal State Income Tax Rate}{>}0)_t + \Gamma X_{st} + \varepsilon_{st}$$

Where Y_{st+1} is the net out-migrant returns relative to non-migrant returns, β_s parameter captures the relationship between tax increases and migration after controlling for confounding determinants of migration, for state s. I plot the OLS "migration" betas in an ascending order in panel figure 12.

The benefit of using this approach is that it shows the relationship between migration responses to any increase in the state marginal tax rate controlling for other possible drivers of migration by state. The drawback is that this is equivalent to running a time-series regression for each state, which might result in issues of stationarity and, of course, endogeneity. Also several states have consistently zero state income taxes which means dropping them from the estimation.

B.2 Moretti and Wilson (2017) Approach for Each State

Moretti and Wilson (2017) study the impact of state marginal tax rates on the location of star scientists in the United States. They exploit the gap between the tax rates of the destination and origin states to document the migration elasticity to tax changes in the origin or destination states. Just as before, I use IRS county-to-county migration files, restricting to out-of-state migration, and employ the following specification, running it for each state:

$$\ln\left(\frac{P_{od,t}}{P_{oo,t}}\right) = \eta_o(\ln(1-\tau_{d,t}) - \ln(1-\tau_{o,t})) + \eta_{o,c}(\ln(1-\tau^c_{d,t}) - \ln(1-\tau^c_{o,t})) + \gamma_o + \gamma_d + \gamma_{od} + \epsilon_{od,t}$$

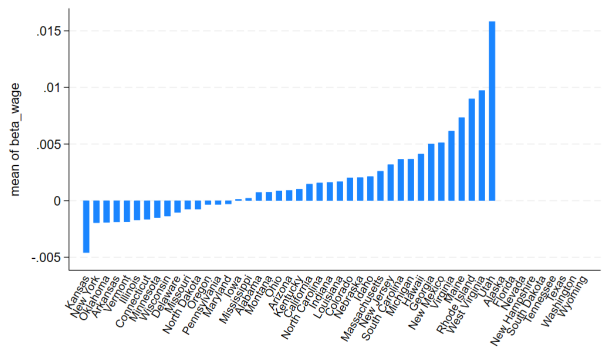
Where $P_{od,t}$ is the number of individuals that migrate from county o to county d (in a different state), while $P_{oo,t}$ is the number of individuals that do not migrate. The right-hand side variables are the logged tax gap, where $\tau_{d,t}$ is the destination top-marginal income tax rate and $\tau_{o,t}$ is the origin counterpart. τ^c_{it} is the state corporate tax rate of state of county i. The specification controls for state of origin, state of destination, and origin-destination pair fixed effects. Standard errors are clustered by destination $\times$ origin pairs. The specification draws from the logit-share based location choice models standard in quantitative spatial models that yield migration elasticity to taxes as $\frac{\partial \ln N_{s,t}}{\partial \ln(1-\tau_s,t)}$. This approach helps document migration responses of both households and firms in response to location-based tax rates, and Moretti and Wilson (2017) show that the resulting coefficient on the state income tax gap is equivalent to the equilibrium migration elasticity. I run the specification for each state and recover the coefficient on the income tax gap, which I plot in panel (b) of figure 12. The benefit of this approach is that it takes into account the structural parameters driving migration responses to tax gaps between two states and effectively controls for state of origin, destination and destination $\times$ origin fixed characteristics. The issue however is that it still depends on the difference in levels of taxes, and does not necessarily evade confounding factors such as destination-origin-time varying trends that might affect location choices of households and firms.

Table 14: Growing Alternative Allocation with Migration Risk - Table for Figure 15

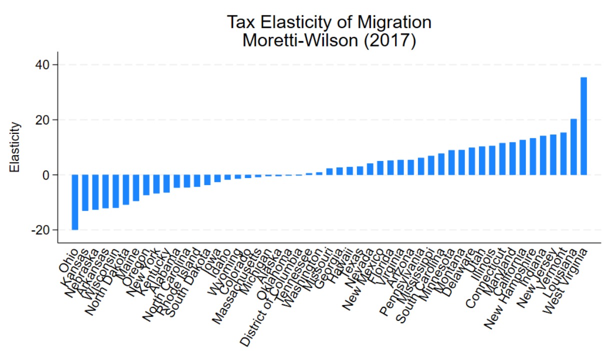
This table presents the regression results for pension fund allocations in response to migration risk. Data on pension allocations, and pension funding information are from the Public Pension Data. I estimate migration betas as the response of net migration to increases in the top marginal tax rate, controlling for rents, wages and other economic confounders. I control for pension contribution rates, dummies for change in assumptions, and growth in pension payroll along with pension and year fixed effects.

	Allocation to Alternative Asset Classes										
	0	+1 year	+2 years	+3 years	+4 years	+5 years	+6 years	+7 years	+8 years	+9 years	+10 years
Underfunded Ratio$_{t-1}$	-0.0255**	-0.0231	-0.0176	-0.00623	-0.0177	-0.0202	-0.0487*	-0.0543**	-0.0698***	-0.0908***	-0.106***
	(-2.33)	(-1.60)	(-0.96)	(-0.29)	(-0.69)	(-0.71)	(-1.75)	(-2.16)	(-2.74)	(-3.34)	(-3.65)
High Migration $\beta\times$ Underfunded Ratio$_{t-1}$	-0.0146	-0.00748	-0.0101	-0.0209	-0.00183	0.0364	0.0734**	0.0953***	0.140***	0.180***	0.175***
	(-0.96)	(-0.38)	(-0.42)	(-0.76)	(-0.06)	(1.08)	(2.21)	(2.92)	(4.40)	(5.45)	(4.99)
N	4237	4035	3832	3635	3435	3235	3035	2838	2645	2450	2237
R-Sq	0.890	0.832	0.787	0.760	0.750	0.758	0.772	0.783	0.791	0.796	0.801
Within R-Sq	0.599	0.378	0.202	0.0887	0.0198	0.0167	0.0326	0.0486	0.0584	0.0560	0.0395
Pension Fund and Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Allocation to Equities										
Underfunded Ratio$_{t-1}$	0.0124	0.00334	-0.00360	-0.0101	-0.00286	0.00205	0.0236	0.0339	0.0459**	0.0506**	0.0694***
	(1.08)	(0.22)	(-0.21)	(-0.50)	(-0.12)	(0.08)	(0.94)	(1.47)	(2.06)	(2.24)	(2.94)
High Migration $\beta\times$ Underfunded Ratio$_{t-1}$	0.00687	0.0204	0.00944	0.00777	-0.00409	-0.0253	-0.0596**	-0.109***	-0.139***	-0.144***	-0.138***
	(0.48)	(1.10)	(0.44)	(0.31)	(-0.15)	(-0.84)	(-2.07)	(-4.15)	(-5.45)	(-5.50)	(-5.00)
N	3556	3365	3178	2989	2805	2623	2451	2273	2111	1944	1763
R-Sq	0.896	0.837	0.796	0.763	0.743	0.751	0.777	0.799	0.816	0.831	0.847
Within R-Sq	0.652	0.439	0.279	0.143	0.0444	0.0139	0.0212	0.0461	0.0635	0.0580	0.0623
Pension Fund and Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Allocation to Fixed Income Securities										
Underfunded Ratio$_{t-1}$	0.0120	0.0322**	0.0424**	0.0446**	0.0473**	0.0463**	0.0547***	0.0438***	0.0426**	0.0399**	0.0221
	(1.05)	(2.25)	(2.57)	(2.55)	(2.57)	(2.51)	(2.94)	(2.59)	(2.44)	(2.33)	(1.21)
High Migration $\beta\times$ Underfunded Ratio$_{t-1}$	-0.000617	-0.0180	-0.0118	-0.0119	-0.0117	-0.0231	-0.0375*	-0.0162	-0.0141	-0.0345	-0.0366
	(-0.05)	(-1.11)	(-0.62)	(-0.59)	(-0.56)	(-1.14)	(-1.79)	(-0.80)	(-0.69)	(-1.63)	(-1.62)
N	3556	3365	3178	2989	2805	2623	2451	2273	2111	1944	1763
R-Sq	0.823	0.743	0.698	0.674	0.661	0.683	0.697	0.707	0.724	0.746	0.767
Within R-Sq	0.525	0.311	0.204	0.127	0.0632	0.0311	0.0193	0.00892	0.00645	0.00477	0.00943
Pension Fund and Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

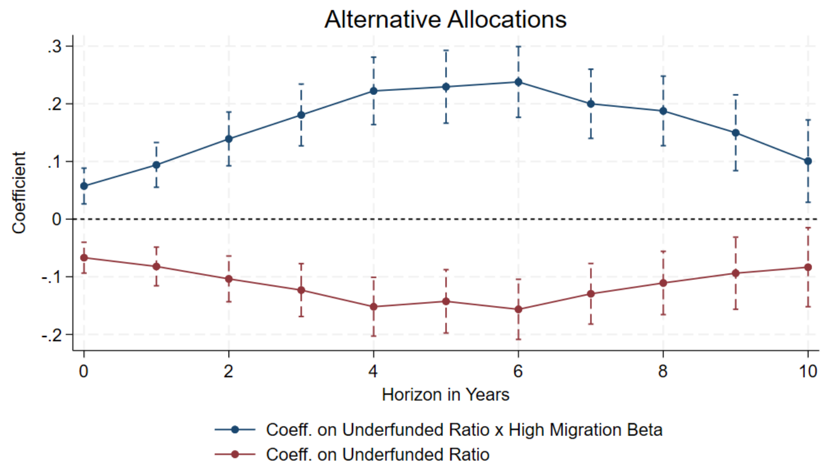


(a) OLS Migration Betas

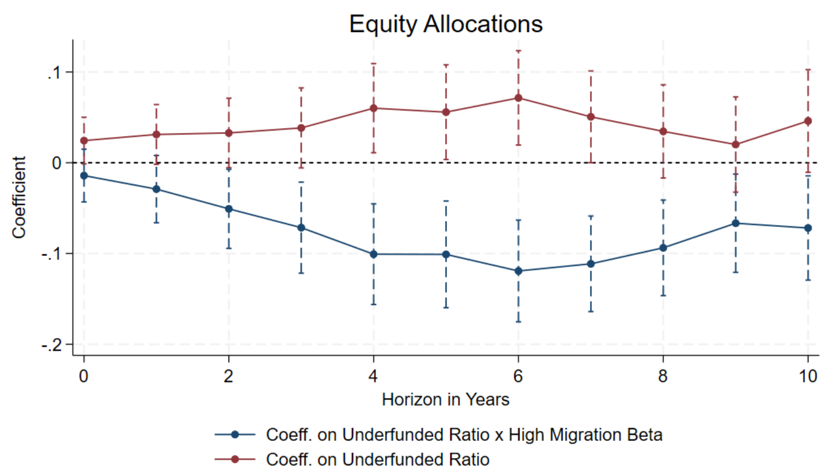


(b) Moretti-Wilson (2017) Migration Elasticity

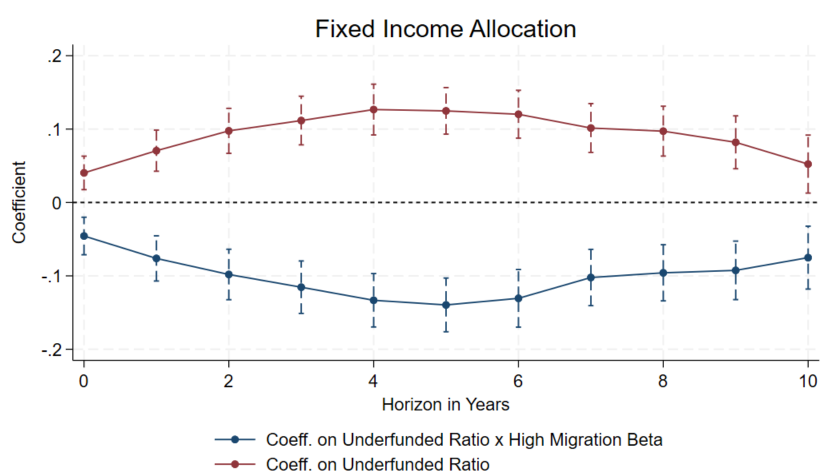
Figure 12: Migration Betas



(a) Alternative Allocations



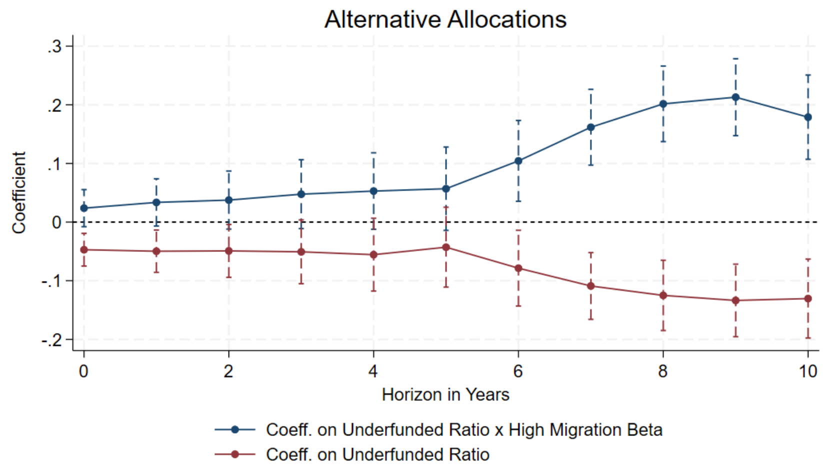
(b) Allocation to Equities



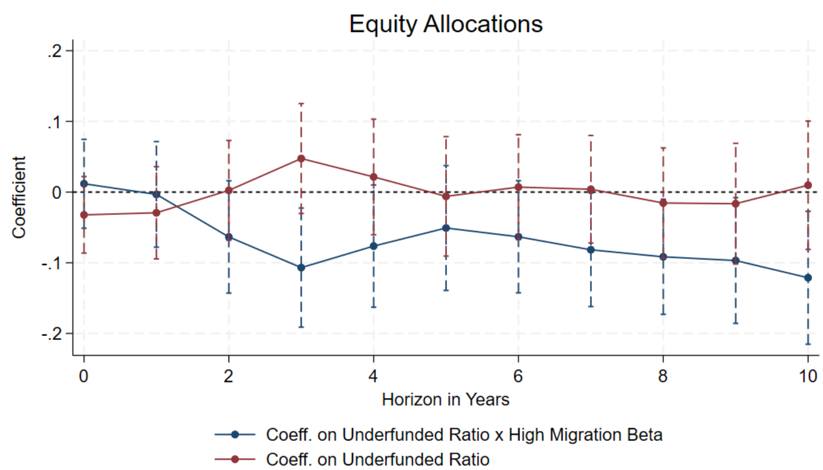
(c) Allocation to Fixed Income

Figure 13: Local Projections: Allocation by Funding Status and Migration Risk - OLS Betas

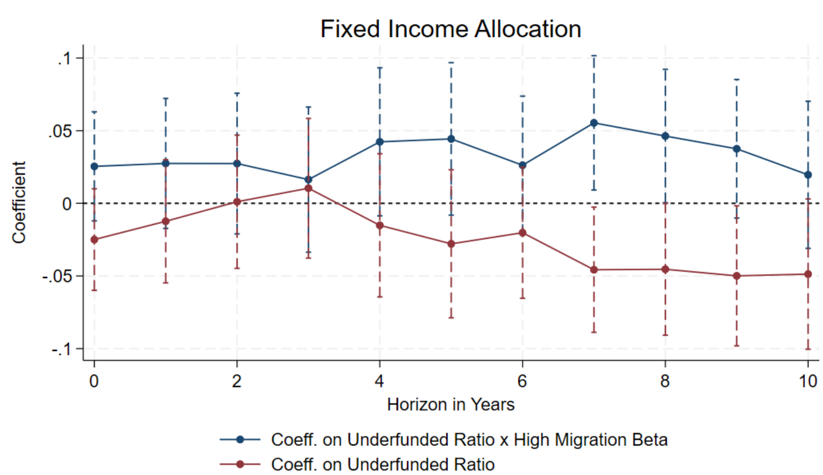
These graphs plot the regression coefficients of the public pension allocations on the interaction of state migration betas and underfunded ratio. The navy-blue line represents the coefficient on the interaction of migration beta and underfunding, while the maroon line represents the coefficient on underfunded ratio. Panel (a) plots the coefficients for alternative allocations (b) plots the coefficients for allocations to equities and (c) plots the coefficient on fixed income securities. The axes represents the leads of the dependent variable in years.



(a) Alternative Allocations



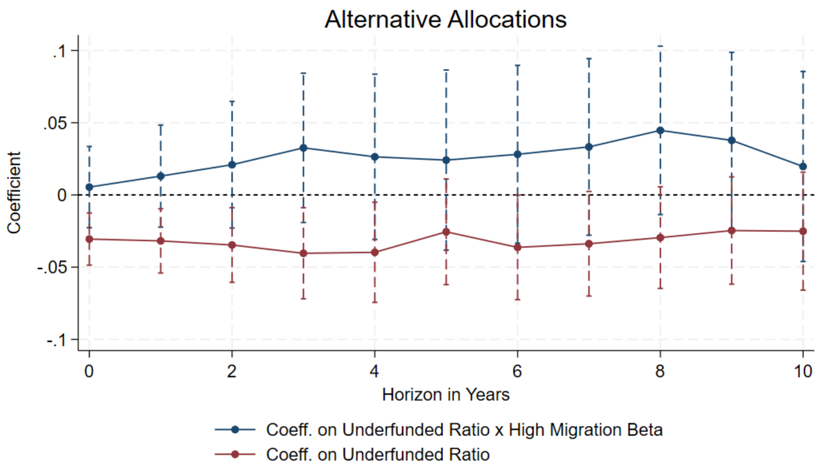
(b) Allocation to Equities



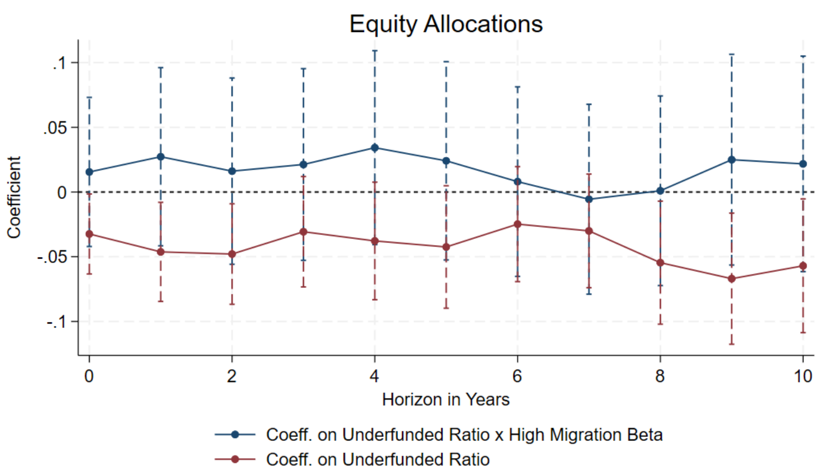
(c) Allocation to Fixed Income

Figure 14: Local Projections: Allocation by Funding Status and Migration Risk - Post-SALT Net Outflows

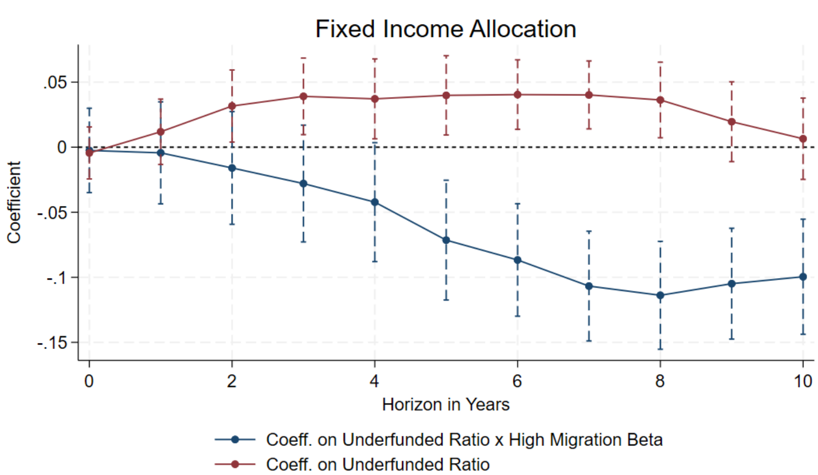
These graphs plot the regression coefficients of the public pension allocations on the interaction of state migration betas and underfunded ratio. The navy-blue line represents the coefficient on the interaction of migration beta and underfunding, while the maroon line represents the coefficient on underfunded ratio. Panel (a) plots the coefficients for alternative allocations (b) plots the coefficients for allocations to equities and (c) plots the coefficient on fixed income securities. The axes represents the leads of the dependent variable in years.



(a) Alternative Allocations



(b) Allocation to Equities



(c) Allocation to Fixed Income

Figure 15: Local Projections: Allocation by Funding Status and Migration Risk - Moretti and Wilson (2017) Betas

These graphs plot the regression coefficients of the public pension allocations on the interaction of state migration betas and underfunded ratio. The navy-blue line represents the coefficient on the interaction of migration beta and underfunding, while the maroon line represents the coefficient on underfunded ratio. Panel (a) plots the coefficients for alternative allocations (b) plots the coefficients for allocations to equities and (c) plots the coefficient on fixed income securities. The axes represents the

B.3 Exploring Pension Reforms

Allowin Following a decline in funding status of state pensions, these bodies pursue reforms which include reducing pension benefits, increasing rates of contributions, changing defined-benefit pension plans to direct contribution plans or to a hybrid tier-based system for new hires versus existing employees and retirees. Using Chat-GPT's o1 model, I track 180 pension reforms since 2005-2022 from the National Association of State Retirement Administrators (NASRA) reports, and document who they effect and what they stipulate. On average reforms often bundle several changes to pensions and are also staggered within a state over years.

Table 15: Reform Statistics

This table documents reform measures undertaken by state and local pensions during the period of 2005-2022 according to the National Association of State Retirement Administrators. Reforms incorporate legislative and executive changes adopted at the state government level. I classify reforms into the following classifications which are not mutually exclusive from each other. The first panel documents who the reform affects, whereas the bottom panel documents the specific policy stipulation of the reform.

	Share	Count
Who do reforms affect?		
1(Affects Current Employees)	0.72	180
1(Affects New Hires)	0.72	180
1(Affects Retirees)	0.26	180
1(Affects General Public Employees)	0.68	180
1(Affects Teachers)	0.52	180
1(Affects Police Officers)	0.42	180
1(Affects Firefighters)	0.39	180
Reform Description		
1(Increased Employee Contribution)	0.58	180
1(Reduced Pension)	0.58	180
1(Increased Age or Service Requirement)	0.48	180
1(New Tiers for Future Hires)	0.42	180
1(Reduced Cost of Living Adjustment)	0.37	180
1(Change in Final Annual Salary Calculation)	0.36	180
1(Plan Funding Policy Changes)	0.33	180
1(Plan Change: DB to DC/Hybrid)	0.28	180
1(Reduced Benefits Multiplier)	0.22	180
1(Change in Vesting Requirements)	0.22	180
1(Change in Plan Design)	0.21	180
1(COLA Mechanism Changes)	0.21	180
1(Employer Contribution Changes)	0.20	180
1(Early Retirement Penalties Change)	0.19	180
1(Withdrawing Members Employer Contribution Policy)	0.18	180
1(Retiree Medical/Healthcare Provisions)	0.13	180
1(Disability Benefits Reforms)	0.11	180
1(Survivor/Spousal Benefit Changes)	0.08	180
1(Changes in Service plus Age Formulas)	0.08	180
1(One-time Infusions or Supplement)	0.06	180
1(Governance or Oversight Changes)	0.02	180
1(Decreased Employee Contribution)	0.01	180

As we can see from table 15, reforms are mostly geared towards current empoyees and new hires, and are less likely to affect retirees. Among the employee-types, reforms are generally geared towards general state-level public employees and less likely for public safety workers such as police or firefighters.

Among the specific reforms measures, increasing employee contributions and reduced pension benefits are the broad categories which appear in 58% of cases. Increased service requirements and new tiers for future or new hires are the additional reforms that appear in over 40% of the cases. Cost of Living Adjustment (COLA) which effectively inflation index the last drawn salary of retirees, feature in over 37% of reforms and the way final annual salary is calculated also change in 36% of the cases. Changes from defined-benefit pension plans, where investment risk lies with the employer (which in this case are the respective adminstering governments), to direct contribution plans where employees bear the burden of investing their pension savings, are less common and happen in only 28% of cases. Legally mandated changes to employer contributions are less common and so are other direct reforms to the pension plans themselves.

To test how different pension reforms affect funding status I run the following regression:

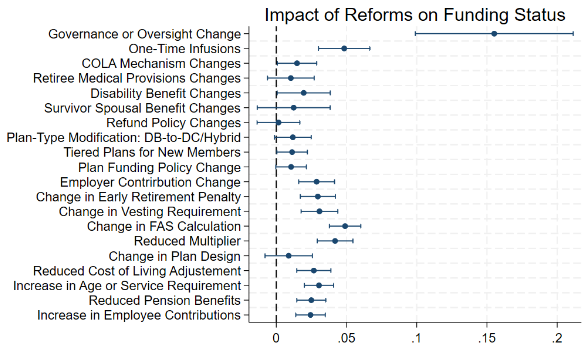
$$\text{Funding Ratio}_{i,t+1} = \beta \times 1(\text{Reform}_j)_{it} + \gamma X_{it}\tau_t + \eta_i + \epsilon_{it+1}$$

Where the dependent variable is the pension fund's funding ratio and the independent variable is the indicator for any reform enacted by the state and local governments. I control for indicators for changes in actuarial assumptions, lagged investment annual investment returns and payroll growth, along with pension plan and year fixed effects. I run this regression for each reform measure that I extract. Panel (a) Reports the baseline regression which show the relationship between reforms and funding status. In general, for after most reforms, except governance and oversight changes, funding status improves between 1-5 percentage points within each plan. Governance and oversight changes reflect reforms enacted by the state of Indiana, which has considerably improved its funding status by 17 percentage points after enacting such reforms.

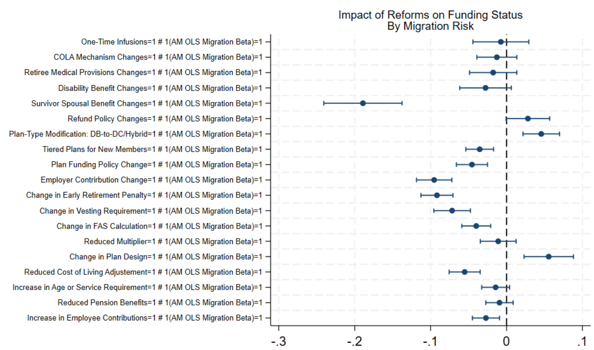
To test how pension funds in states which face higher migration risk fare when they enact pension reforms, I run interaction regressions across the three different measures.

$$\text{Funding Ratio}_{i,t+1} = \beta \times 1(\text{Reform}_j)_{it} \times 1(\text{High Migration Risk})_{s(i)} + \gamma X_{it}\tau_t + \eta_i + \epsilon_{it+1}$$

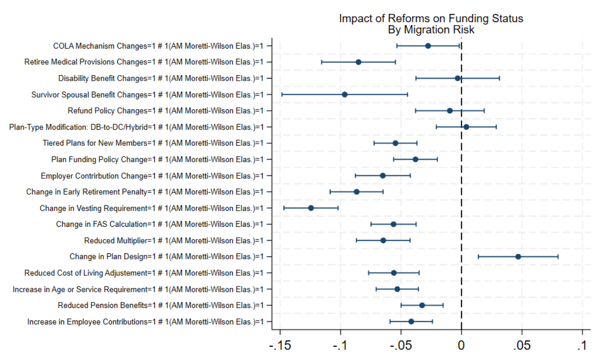
Panels (c), (d) and (e) present the results. Across all panels, I find that the coefficient on the interaction is negative and significant for states with higher migration betas - which suggests that pension funds located in these states see a relatively poorer funding performance when reforms are undertaken. For instance, while the baseline regression suggests a boost in the funding ratio of about 2 percentage points when a reform such as increasing employee contributions is enacted, panel (c) suggests that pension funds in states which lie in the above-median category of migration risk measured through the Moretti and Wilson (2017) effect, see a funding ratio lower by 4 percentage points. Overall this paints the picture, that most commonly undertaken reforms have a muted effect in states which face higher migration outflows.



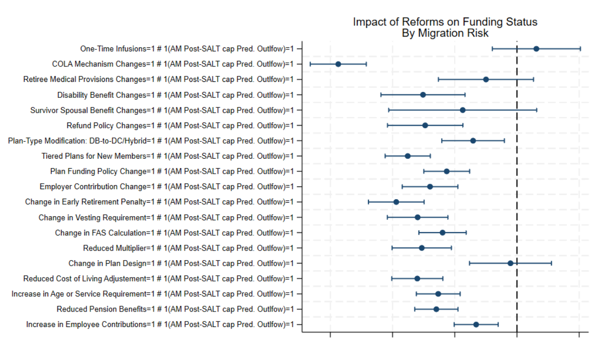
(a) Baseline



(b) By OLS Migration Betas



(c) By Moretti and Wilson (2017) Elasticity



(d) By Post-SALT cap Net Outflows

Figure 16: How do Reforms Impact Funding Status?

B.4 Risk-taking within Asset Classes: Evidence from 13-F Pensions

As equities still remain the largest investment class for public pensions, I first document how public pension fund managers in 13-F differ from private pension managers. Using the holdings data of large institutional investors from SEC-13-F filings, I use the list of pension fund managers identified by Koijen and Yogo (2019) to track portfolio performance. I merge the data with public pensions data. I identify 28 public pension managers[16] and 22 private pension fund managers[17] for which I was able to map balance sheet data from Worldscope, out of the 114 pension fund managers in the 13-F managers file.

	Mean	Median	SD	Min	Max	Count
13-F Pensions Balance Sheets						
Funded Ratio	0.81	0.81	0.18	0.00	4.27	2877
1(Public Pension)	0.73	1.00	0.44	0.00	1.00	3089
Ln(Pension Assets)	19.03	18.22	2.90	7.14	25.41	2898
Portfolio Return	0.09	0.04	0.47	-0.53	15.44	2482
Annual Portfolio Volatility	0.16	0.13	0.12	0.01	0.88	383
Public Pension Portfolio Return	0.09	0.04	0.48	-0.38	15.44	1804
Private Pension Portfolio Return	0.10	0.04	0.46	-0.53	5.88	678
Number of Stocks	1232.90	1008.00	960.90	1.00	4497.00	2482
Number of Stocks of Public Pensions	1575.78	1550.00	890.28	1.00	4497.00	1804
Number of Stocks of Private Pensions	320.57	137.00	354.97	1.00	1564.00	678

Table 16: Summary Statistics for 13-F Pensions

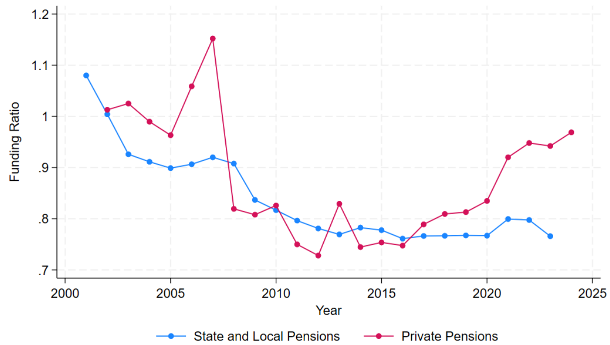
I then plot funding status by pension manager type in figure 17 panel (a). We can see that both private and public pension managers see a decline in funding ratios post-2008 recession. However, we can see a divergence in funding status, since 2016, where private pension funds have recovered near full funding in 2022, but public pensions' funding status remains relatively flat. One caveat is that the gap could be due mechanical difference in discounting, where private pensions could anchor their discount rates to the prevailing policy rates, while public pensions have used past or expected investment returns as discount rates, which may decouple funding status with interest rate cycles, and also understate the level of underfunding for public pensions (Giesecke and Rauh (2023)). Panel (b) plots the quarterly value-weighted portfolio returns of the public and private pensions since 2007Q4. Panel (c) tracks the annual portfolio volatility. There does not seem to be a remarkable difference in group-wise performance. Those this may arise due to the sampling bias - large 13-F public pensions are not qualitatively different in their investment performance relative to their private counterparts. I therefore look within the portfolio risk heterogeneity of public pension managers by their state's tax migration risk group.

B.4.1 Portfolio Risk Heterogeneity in Public Pensoins by Migration Risk

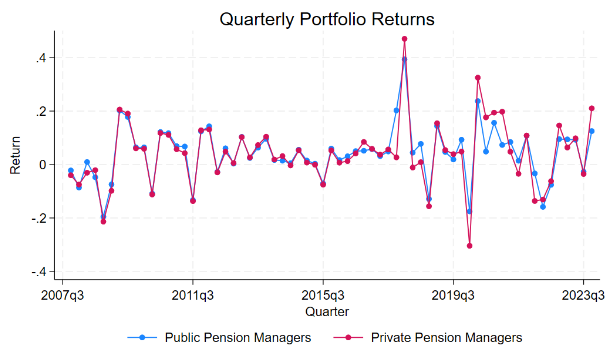
Do public pensions based in states with high tax mobility carry more risk on their equity portfolios? In order to test this, I regress the annual portfolio volatility of public pension managers against their underfunded ratio and migration risk measure. Similar to table 4, the I use the three measures of migration response to tax increases interacted with the underfunded ratio of the pension fund.

[16] Public pension managers could refer to the state investment boards which manage the investment of multiple constituent state and local level pension funds. The 25 public pension managers represent 41 public pension funds in the public plans data.

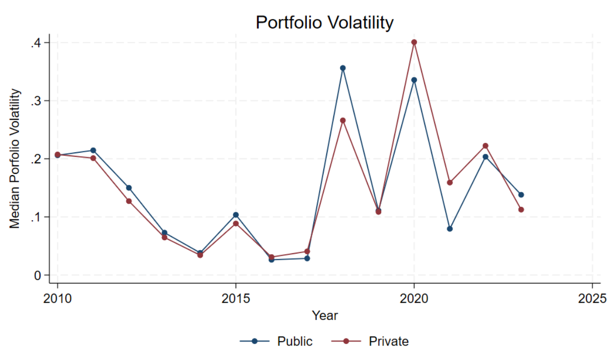
[17] These, for example, are United States Steel and Carnegie Pension Fund, Dow' Employees Pension or Sears Holdings Pension Fund which consists of frozen defined benefit, defined contribution or multi-employer retirement benefits, and non-contributory defined benefit pension plans



(a) Funding Status by Manager Type



(b) Quarterly Portfolio Returns



(c) Riskiness of Investments

Figure 17: Public vs. Private Pension Managers

These figures plot the relative performance of public pensions relative to private pension fund managers identified in 13-F and Worldscope data. Panel (a) plats the assets-to-liabilities ratios. Public pension assets and liabilities come from the Public Plans Data from Center for Retirement Research. I measure private pension assets as the ratio of their actuarial assets and accumulated benefit obligations made available through Worldscope. Panel (b) plots the value-weighted portfolio returns of public and private managers from 13-F. Panel (c) plots the median annual portfolio volatility of the respective manager groups.

$$Y_{it+1} = \beta \times 1(\text{High Migration Risk }) \times \text{Underfunding}_{i,t} + \text{Underfunding}_{i,t} + \Gamma X_{it} + \theta_t + \kappa_i + \varepsilon_{it+1}$$

Where controls include dummies for changes in pension plan's actuarial assumptions and contribution growth, along with manager and year fixed effects. The results are displayed in table 17

Table 17: Equity Portfolio Volatility

This table shows regressions of annual portfolio volatility in the 13-F equity investments of public pension managers matched using the list of pension funds given by Koijen and Yogo (2019) on underfunding (1-funding ratio) interacted with a migration risk indicator. Column (1) uses the 1(Above Median OLS Migration Beta) indicator, column (2) uses the 1(Above Median Moretti and Wilson (2017) Elasticity) and column (3) uses 1(AM Post-SALT Cap Predicted Outflows) as the migration risk indicators respectively. All specifications include controls for lagged manager size, contribution growth and dummy for actuarial assumption changes along with manager and year fixed effects.

	(1)	(2)	(3)
	Annual Portfolio Volatility		
Underfunded Ratio$_{t-1}$ (UR)	0.360*	0.0710	0.126*
	(1.81)	(0.89)	(1.89)
1(AM OLS Mig. Beta) × L.(lastnm) UR	-0.325*		
	(-1.78)		
1(AM Moretti and Wilson (2017) Elas) × UR		0.183	
		(1.04)	
1(AM Post-SALT CAP Pred. Outflows) × UR			0.0352
			(0.29)
N	305	305	305
R-Sq	0.864	0.860	0.859
FE	Plan and Year		

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Across all columns underfunded ratio is positively correlated with portfolio volatility. We can see that in column (1), the interaction with OLS state tax beta produces a negative coefficient for the same level of underfunded relative to baseline - meaning managers of states sorted by the OLS migration beta risk cut equity portfolio volatility as they move to alternative asset classes. Columns (2) and (3) however suggest an opposite result where the coefficient on the interaction terms are positive and weakly significant for column (3). This reflects the different rankings accorded to states by different beta estimates. However given, the statistically insignificant results, high migration risk do not have a different equity portfolio volatility relative to their low migration risk counterparts. Notwithstanding the sampling bias, this means that public pensions in states with higher migration risk are more likely to pivot to higher risk or opaqueness across asset classes than within them.

Table 18: Evidence from Survey of Consumer Expectations

This regressions reports results from the Federal Reserve Bank of New York's Survey of Consumer Expectations. Columns (1), (2) and (3) have an indicator for whether the survey respondent thinks that the their federal, state and local tax liability would go up in the next 12 months. Columns (4), (5) and (6) ask how much tax rates are about to change in the next 12 months, in percentage points. The main independent variable is the respondent's state funding ratio. Controls include Log Real Wage, Log Rent, Log Top-Marginal Income Tax Rate, (%) of Republican congressman from the state of the respondent, and the State's Debt-to-Revenue ratio. Columns (1) and (4) do not absorb any fixed effects. Columns (2) and (5) control for education category, age category, region, household income category and year fixed effects. Columns (3) and (6) include all aforementioned fixed effects interacted with year. Standard errors are clustered by state.

	(1)	(2)	(3)	(4)	(5)	(6)
	1(Tax Increase in Next 12 months)			Exp Pct Tax Inc in Next 12 months)		
Funding Ratio	-0.0158	-0.0734*	-0.0669*	-0.574	-1.589	-1.662*
	(0.0461)	(0.0366)	(0.0384)	(1.186)	(1.028)	(0.963)
N	24804	24479	24479	24804	24479	24479
R-Sq	0.000738	0.0344	0.0422	0.000906	0.00682	0.0228
Educ, Reg, Inc, Age, Year-FE	N	Y	N	N	Y	Y
Educ-Yr, Reg-Yr, Inc-Yr, Age-Yr FE	N	N	Y	N	N	Y
Controls	Wage, Rent, Inc Tax, Pol Leaning, Debt/Rev					

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

C Fiduciary Payoff Extension: Threshold based Payoff

The objective of this exercise is to model a fiduciary pay-off structure where fiduciaries target a threshold funding status in the end-period. Let's call this funding ratio as $\tilde{f}$. The fiduciary's payoff thus looks as follows:

$$\Pi(F) = k + \xi(f - \tilde{f})^+ \tag{31}$$

Where ξ is compensation linked to funding status remaining above a prespecified funding status level $\tilde{f}$. The payoff thus resembles a call option in the pension funding status. I assume a CARA utility form for pension fund managers which leads to the following optimization:

$$\max_{\theta} \mathbb{E}[-\exp(-\gamma(k + \xi(f - \tilde{f})^+)] \tag{32}$$

Using the log normal form of the expectations, we get:

$$\max_{\theta} - \exp(-\gamma k) \left[\Phi(\kappa) + \exp(\gamma\xi(\tilde{f} - m) + \frac{1}{2}\gamma^2\xi^2 s^2)[1 - \Phi(\kappa + \gamma\xi s)] \right] \tag{33}$$

Where $\kappa = \frac{\tilde{f}-m}{s}$ and Φ is the standard normal CDF.

The FOCs produce

$$\begin{aligned} \phi(\kappa) \left[\frac{\mu - r_f}{\theta\sigma} + \frac{\tilde{f} - m}{\theta^2 q\sigma} \right] &= \exp\left(\gamma\xi(\tilde{f} - m) + \frac{1}{2}\gamma^2\xi^2 s^2 \right) \times \\ \left[(\gamma^2\xi^2 q^2\sigma^2\theta - \gamma\xi q(\mu - r_f))(1 - \Phi(\kappa + \gamma\xi s) \right. &+ \left. \phi(\kappa + \gamma\xi s) \left(\frac{\mu - r_f}{\theta\sigma} + \frac{\tilde{f} - m}{\theta^2 q\sigma} - \gamma\xi q\sigma \right) \right] \end{aligned} \tag{34}$$

I can solve for the optimal investment problem as a fixed point and then compare the optimal policy for the linear pay structure against the threshold pay structure. The result is presented in figure 18. As we can see, risky asset shares are very similar when effective contributions q are considerably above the threshold of 0.8. Once effective contributions reach below 0.88, the risky asset share in the option payoff exponentially diverges from the risky share under the linear payoff.

D Recovering Public–Service Efficiency ψ_s by Inversion of the Fiscal First–Order Conditions

This appendix documents the numerical procedure used to recover ψ_s, the state-level intensity of the public-service / amenity motive. Because ψ_s is not observed, it is *inverted* out of the government's first-order conditions for the two tax instruments $\tau_{s,1}$ and $\tau_{s,2}$, taking observed taxes, funding ratios, elasticities, and period-1 population as data and holding the migration-noise parameter σ_v fixed. The optimal risky-asset share θ_s is *not* used to identify ψ_s, so the portfolio equation becomes an over-identifying restriction: the gap between the model-implied θ_{model} and the observed θ_{data} measures how far actual pension risk-taking departs from the mean–variance optimum implied by the fiscally-recovered preferences.

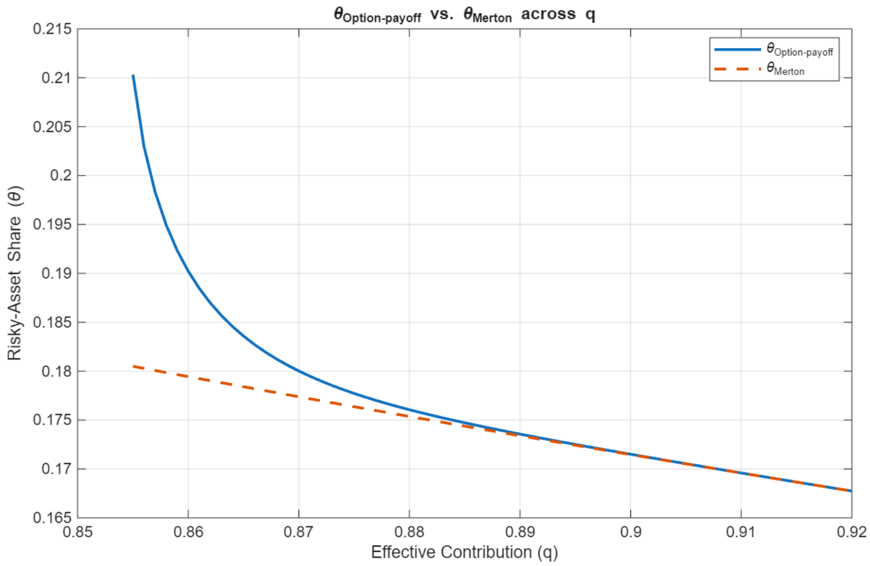


Figure 18: Investment Policy under Option-like payoff vs. Linear pay

This figure shows how optimal risky asset share varies under a linear payoff structure versus an option-like payoff structure where the fiduciaries get rewarded if the end of period funding is above a threshold $\tilde{f}$. I set the threshold at $\tilde{f} = 0.8$ and vary effective contributions which are $q = (a_s + c_{s,1})/l_s$ across a grid. I set parameters $\xi = 2, \gamma = 4, \mu - r_f = 0.04, \sigma = 0.18$. Option-payoff shares are shown in solid blue line, whereas the linear payoff shares are dashed red lines.

D.1 Setup and Notation

The economy has S states indexed by s and T periods indexed by t; the inversion is run independently for each period, so the time index is suppressed below. Table 19 collects the objects.

Equilibrium blocks. To keep the equations compact, define for each state the pension, liability, expected-return, and variance terms

$$P_s = \frac{a_s + c_s}{1 + g_s}, \qquad L_s = \frac{l_s}{1 + g_s}, \qquad \mu_s^\theta = r_f + \theta_s(\mu_{\text{mkt}} - r_f), \qquad V_s = \frac{\psi_s}{2}\, P_s^2\, \sigma^2\, \theta_s^2. \tag{35}$$

Optimal risky-asset share (Eq. 38). The mean–variance / Merton-type portfolio rule applied to the pension fund is

$$\theta_s = \frac{\mu_{\text{mkt}} - r_f}{\psi_s\, \sigma^2} \cdot \frac{1 + g_s}{a_s + c_s} \qquad \text{(clipped to } [0.01, 0.99] \text{ during iteration).} \tag{36}$$

Risk-taking falls with the preference weight ψ_s and the funding base $a_s + c_s$, and rises with the equity premium and with population growth.

Fiscal wedges. The two multipliers that summarize the after-tax value of each period are

$$\delta_{s,1} = \psi_s\, \tau_{s,1}, \tag{37}$$

$$\delta_{s,2} = \psi_s\big(\tau_{s,2} - L_s + \mu_s^\theta\, P_s - V_s\big)\,. \tag{38}$$

Symbol	Meaning	Source
$\tau_{s,1},\ \tau_{s,2}$	tax rates, periods 1 and 2	data
$N_{s,1}$	period-1 population / workers	data
a_s	pension assets	data
c_s	contribution / cost term	data
l_s	pension liabilities	data
ϕ_s	housing supply elasticity	data
$\varphi_s = (\phi_s + 0.66)/(1 + \phi_s)$	transformed elasticity	derived
ϵ_s	labor / amenity elasticity	data
$K_s \equiv 1,\ w \equiv 1$	normalizations	fixed
$\sigma^2 = 0.18$	equity return variance	calibrated
$r_f = 0.02,\ \mu_{\text{mkt}} = 0.08$	risk-free and market returns	calibrated
$\sigma_v = 0.5$	migration (logit) noise scale	fixed
ψ_s	public-service efficiency / amenity intensity	inverted
g_s	endogenous population growth $N_{s,2}/N_{s,1} - 1$	solved
θ_s	optimal risky-asset share	solved

Table 19: Notation. "Inverted" is the target parameter; "solved" objects are equilibrium outcomes that depend on ψ_s.

Migration block (endogenous g_s). Period-1 indirect utility and its post-tax counterpart are

$$v_{s,1} = \big(K_s\, w\, (1 - \tau_{s,1})\, N_{s,1}\big)^{\varphi_s}, \qquad v_s = v_{s,1}\, e^{-\delta_{s,1}}. \tag{39}$$

Households re-sort across states through a logit rule with fixed scale σ_v, pinning down period-2 population and hence growth:

$$N_{s,2} = \frac{e^{\,v_s/\sigma_v}}{\sum_{s'} e^{\,v_{s'}/\sigma_v}} \sum_{s'} N_{s',1}, \qquad g_s = \frac{N_{s,2}}{N_{s,1}} - 1. \tag{40}$$

Equations (36)–(40) make θ_s, the δ's, and g_s all functions of ψ_s; this is the source of the nested fixed point.

First-order condition for the period-1 tax (Eq. 36). With utility flows $u_{s,i} = K_s\big(w(1 - \tau_{s,i})N_{s,i}\big)^{\epsilon_s}$ for $i = 1, 2$, the optimality condition for $\tau_{s,1}$ driven to zero is

$$\begin{aligned} \mathcal{F}^{(1)}_s(\psi_s) = u_{s,1}\left(\frac{\phi_s}{1 - \tau_{s,1}} - \psi_s e^{-\delta_{s,1}}\right) - \frac{u_{s,2}\, \psi_s\, \phi_s\, \epsilon_s\, e^{-\delta_{s,2}}}{\tau_{s,1}} \\ + \big(L_s - \mu^{\theta}_s P_s\big) - \psi_s\, \sigma^2\, \theta^2_s\, P^2_s + \frac{\psi_s\, \phi_s\, c_s}{\tau_{s,1}}\, u_{s,2}\big(1 - e^{-\delta_{s,2}}\big) = 0. \end{aligned} \tag{41}$$

First-order condition for the period-2 tax (Eq. 37). The period-2 instrument satisfies the implicit rule

$$\tau_{s,2} = 1 + \big(1 - e^{-\delta_{s,2}}\big)\frac{\varphi_s}{\psi_s}, \qquad \text{i.e.} \qquad \mathcal{F}^{(2)}_s(\psi_s) = \tau_{s,2} - \left[1 + \big(1 - e^{-\delta_{s,2}}\big)\frac{\varphi_s}{\psi_s}\right] = 0. \tag{42}$$

D.2 The Inversion Algorithm

The parameter ψ_s enters every equilibrium relation, so it cannot be read off directly. Instead we ask which value of ψ_s makes the observed taxes optimal: for each (s, t) we solve the two moment conditions (41)–(42) for ψ_s. Because $\mathcal{F}^{(1)}$ and $\mathcal{F}^{(2)}$ also depend on the migration equilibrium g_s—which itself depends on ψ_s through (36)–(40)—the problem is a nested (doubly iterated) fixed point:

- **Inner loop** (migration): given a trial ψ, iterate (36), (37), (39), (40) until g_s converges.
- **Outer loop** (preference): given the resulting g_s, invert each FOC for ψ, average the two roots, damp, and repeat until ψ converges.

Two separate one-dimensional root-finds are used because (41) and (42) are, in principle, redundant restrictions on the same scalar ψ_s; averaging their solutions $\psi_s = \frac{1}{2}\psi_s^{(1)} + \frac{1}{2}\psi_s^{(2)}$ reconciles them and adds numerical robustness. The residual disagreement between $\psi_s^{(1)}$ and $\psi_s^{(2)}$ (reported as the FOC1-only vs. FOC2-only means) is itself a diagnostic of model fit.

Algorithm 1 Inversion of ψ_s from the fiscal FOCs (one period t)

Require: data $\{\tau_{s,1}, \tau_{s,2}, N_{s,1}, a_s, c_s, l_s, \phi_s, \epsilon_s\}$; calibrated $\{\sigma^2, r_f, \mu_{\text{mkt}}, w, \sigma_v\}$

$\varphi_s \leftarrow (\phi_s + 0.66)/(1+\phi_s)$; $\quad v_{s,1} \leftarrow \big(K_s w(1-\tau_{s,1})N_{s,1}\big)^{\varphi_s}$
initialize $\psi_s \leftarrow 1$ for all s
for outer iteration $= 1, \dots, 100$ **do** ▷ preference loop
  $\psi^{\text{old}} \leftarrow \psi$; $\quad$ initialize $g_s \leftarrow 0.02$
  for inner iteration $= 1, \dots, 50$ **do** ▷ migration loop
    $\theta_s \leftarrow \dfrac{\mu_{\text{mkt}} - r_f}{\psi_s \sigma^2} \dfrac{1+g_s}{a_s + c_s}$, clip to $[0.01, 0.99]$ ▷ Eq. (36)
    form $P_s, L_s, \mu_s^{\theta}, V_s$ and $\delta_{s,1}, \delta_{s,2}$ ▷ Eqs. (35)–(38)
    $v_s \leftarrow v_{s,1}\, e^{-\delta_{s,1}}$
    $N_{s,2} \leftarrow \text{softmax}_s(v_s/\sigma_v) \cdot \sum_{s'} N_{s',1}$; $\quad g_s \leftarrow N_{s,2}/N_{s,1} - 1$, clip to $[-0.5, 0.5]$ ▷ Eq. (40)
    break if $\max_s |\Delta g_s| < 10^{-8}$
  end for
  for each state s **do**
    $\psi_s^{(1)} \leftarrow \textsc{fzero}\big(\mathcal{F}_s^{(1)}(\cdot) = 0\big)$ on $[0.01, 10]$ ▷ Eq. (41); FMINBND fallback
    $\psi_s^{(2)} \leftarrow \textsc{fzero}\big(\mathcal{F}_s^{(2)}(\cdot) = 0\big)$ on $[0.01, 10]$ ▷ Eq. (42); FMINBND fallback
    $\psi_s^{\text{new}} \leftarrow \frac{1}{2}\psi_s^{(1)} + \frac{1}{2}\psi_s^{(2)}$; keep ψ_s^{old} if NaN/Inf
  end for
  $\psi_s \leftarrow \frac{1}{2}\psi_s^{\text{new}} + \frac{1}{2}\psi_s^{\text{old}}$ ▷ damping
  break if $\max_s |\psi_s - \psi_s^{\text{old}}| < 10^{-8}$
end for
return ψ_s, and $\theta_{\text{model},s} \leftarrow \dfrac{\mu_{\text{mkt}} - r_f}{\psi_s \sigma^2} \dfrac{1+g_s}{a_s + c_s}$ clipped to $[0, 1]$

Numerical guards. The routine bounds v_s and e^{v_s/σ_v} to avoid over/under-flow, floors $1 + g_s$ away from zero in the δ terms, clips θ_s and g_s, and substitutes the previous iterate whenever a root-find returns a non-finite value. These guards do not change the fixed point; they only stabilize the path to it. The bracketed root-find FZERO on $[0.01, 10]$ presumes a sign change of the FOC residual on that interval; when none is found the code falls back to minimizing $|\mathcal{F}|$ with FMINBND.

What identifies ψ_s. Intuitively, (41) says the marginal political value of taxing today (the housing/amenity term $\phi_s/(1-\tau_{s,1})$) must balance its marginal cost through the fiscal wedge $\psi_s e^{-\delta_{s,1}}$ and through the pension/portfolio channel; (42) ties the period-2 tax to the transformed elasticity φ_s scaled by $1/\psi_s$. Holding elasticities and funding fixed, a more aggressive observed tax schedule is rationalized only by a larger public-service weight ψ_s—which is what the inversion returns.

D.3 The Gap between θ_{data} and θ_{model}

What each object is.

- $\theta_{\text{model},s}$ — the risky-asset share predicted by the portfolio rule (36), evaluated at the inverted ψ_s and the equilibrium growth g_s. It is the mean–variance optimum a planner with preference ψ_s and funding base $a_s + c_s$ should choose.
- $\theta_{\text{data},s}$ — the observed total risky allocation of the state pension fund (equity + alternatives), taken from the data.
- $\theta_{\text{eq},s}$ — the observed allocation to equity only, a narrower measure overlaid for comparison in the scatter plot.

Why the gap is informative (over-identification). The key point is that θ plays no role in identifying ψ_s: the parameter is pinned down entirely by the tax FOCs (41)–(42). Equation (36) is therefore an out-of-sample, over-identifying restriction. If the same structural ψ_s that rationalizes fiscal policy also rationalizes the fund's observed risk-taking, then $\theta_{\text{model}} \approx \theta_{\text{data}}$ and points lie on the 45° line. The residual

$$e_s = \theta_{\text{model},s} - \theta_{\text{data},s} \tag{43}$$

is thus a genuine test of the model rather than a fitted error, and its spread is summarized by the reported mean error, standard deviation, RMSE $= \sqrt{\frac{1}{S}\sum_s e_s^2}$, and the correlation $\text{corr}(\theta_{\text{model}}, \theta_{\text{data}})$.

Economic reading of the sign.

- $e_s > 0$ ($\theta_{\text{model}} > \theta_{\text{data}}$): the fund holds *less* risk than the fiscally-implied optimum—consistent with prudential constraints, statutory caps, liquidity or governance frictions, or risk aversion not captured by the calibrated σ^2, ψ_s.
- $e_s < 0$ ($\theta_{\text{model}} < \theta_{\text{data}}$): the fund takes *more* risk than optimal—the classic risk-shifting / reach-for-yield pattern often seen in under-funded plans (low a_s/l_s) that gamble to close the gap.
- Comparing the total-risky gap with the equity-only measure θ_{eq} reveals how much of the discrepancy is driven by equities proper versus alternatives.

Two views. The histogram of $\theta_{\text{model}} - \theta_{\text{data}}$ shows the distribution of prediction error and whether it is centered on zero (unbiased) or shifted (systematic over/under-prediction of risk). The scatter of θ_{data} against θ_{model} with the 45° line shows fit state by state: vertical distance to the line is e_s, and a slope flatter than one indicates the model over-predicts risk for aggressive funds and under-predicts it for conservative ones.

Caveat on levels. Because θ_{model} is clipped to $[0, 1]$ and (36) is highly sensitive to $a_s + c_s$ and to the calibrated σ^2, the *level* of the gap partly reflects those calibration choices. The cross-sectional pattern of e_s against funding ratios, growth, and ψ_s is the more robust object to interpret.