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Do People Move to Reduce Tax Burdens? The Tax Reform Act of 1986 as a Natural Experiment

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Existing studies of tax-induced migration commonly suffer from the endogeneity issue of the tax inputs. Using the Tax Reform Act of 1986 as a natural experiment, we identify an exogenous component of the cross-state variation in income tax changes and estimate the causal effects of tax burdens on interstate migration using instrumental variables and first differencing. We consistently find that an increase in state-specific income tax rates promotes migration outflows and discourages migration inflows of the families of prime-age householders in the United States, with the latter effect being typically stronger than the former. Despite the presence of significant marginal effects, income taxes and other fiscal policies account only for a small portion of the total variance in migration during the analyzed periods, 1985–1990 and 1975–1980. Rather, the effects of gravity and spatial interaction, the cost of living and other economic factors are more important in explaining the variance in migration.

Keywords: federal and state income taxes, migration, tax competition, tax reform, Tiebout model
JEL classification: C36, H24, H73, J61

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1 Introduction

Tiebout (1956) hypothesized that people may vote with their feet by moving to the community in which local government best satisfies their preferences. Following this argument, Tullock (1971) explicitly stated that differential local taxes may affect individuals' migration decision. This paper empirically examines the presence and extent of tax-induced migration in the United States. Specifically, we utilize the Federal Tax Reform Act of 1986 (TRA86) as a natural experiment and investigate the impacts of tax differences on interstate migration during periods 1985–1990 and 1975–1980.

Fiscally induced migration has important policy implications as it provides incentives for jurisdictions to compete with their neighbors in making fiscal policies. Studies suggest that state governments compete with their neighbors in terms of taxes (Case, 1993), and they may also copycat each other regarding expenditure policies (Bucovetsky and Wilson, 1991; Case, Hines, and Rosen, 1993; Mintz and Tulkens, 1986; Wildasin, 1988).[1] This policy importance also presents a challenge in estimating the causal effect of taxes on migration. Because state tax policies and migration may be changing simultaneously in response to one another, the observed policy changes and migration are both endogenously determined, and the causal effect in a chosen direction cannot be isolated without an exogenous source of variation in the cause of interest.[2] For our purpose of estimating the causal effect of tax differences on migration, we need an exogenous source of cross-state variation in tax burdens.

The endogeneity of tax and/or fiscal policy controls has been a shortcoming shared by existing empirical studies in the migration literature.[3] Among the studies that consider the role of taxes and/or other fiscal policies in inter-jurisdiction migration decisions, data from Canada and European countries are frequently used (Day, 1992; Day and Winer, 2001; Finnie, 1999; Kallandranis and Karidis, 2014; Liebig, Puhani, and Sousa-Poza, 2007).[4] For the United States, the empirical studies of tax-induced

[1]Another heavily studied topic is on welfare competition among states; for example, Shroder (1995) and Figlio, Kolpin, and Reid (1999).

[2]For example, states may change their tax laws to counter an ongoing migration pattern.

[3]As stated in a review paper by Kleven et al. (2020), the lack of credible tax variation is one of the two main challenges in identifying the causal effects of taxation on migration, the other challenge being the lack of suitable migration data.

[4]In some of these studies, the effect of taxes on migration is implied in the effect of after-

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migration largely focus on migration patterns specific to certain ages or ethnicities (Cebula, 2002; Cebula, Kohn, and Vedder, 1973, 1976; Clark and Hunter, 1992; Clark, Knapp, and White, 1996; Conway and Houtenville, 1998, 2001; Conway and Rork, 2006; Dresher, 1994; Gale and Heath, 2000; Voss, Gunderson, and Manchin, 1988).[5] The measures of tax burdens vary greatly across studies, as do the estimated effects of taxes on migration. Several studies obtained some support for tax-induced migration, while many others found no systematic relationship between taxes and migration behaviors. A recent development in the literature has focused on the international or inter-state migration of the top-earners due to tax differences, and the top earners are found to be highly mobile internationally or across jurisdictions in response to tax incentives (Kleven, Landais, and Saez, 2013; Kleven et al., 2014; Moretti and Wilson, 2017, 2019). The primary notion of this identification strategy is that, for the wealthiest few individuals in the global population, the effective average tax rates relevant to their migration decisions are close to their last-dollar marginal tax rates, the latter being conveniently the marginal tax rate for the top income tax bracket in a country or jurisdiction. The country/jurisdiction-specific top marginal tax rates therefore serve well as an explanatory variable for predicting the international/inter-jurisdictional migration behaviors of the very wealthy since these rates are readily observable and, unlike the last-dollar marginal tax rates for the general population which vary with individual income, the top-bracket marginal tax rate in a county/jurisdiction is not endogenous to migration-induced income changes of the individuals.

Despite the various efforts to address the relevant empirical challenges, the majority of the studies mentioned above adopted baseline measures of jurisdiction-specific tax policies or burdens that predate their measures of migration behaviors. For example, a study by Conway and Rork (2006) used state panel data of four migration periods and estimated elderly migration as a function of baseline measures of estate, inheritance and gift taxes

tax income, which requires the assumption that individuals have equal knowledge about the prospective tax liabilities and prospective earnings.

[5]A number of U.S. studies not reported above focused on the impact of taxes on the overall migration pattern. Unfortunately, these studies typically lacked a formal theoretical foundation and employed highly inadequate quantitative methods. For example, Saltz (1998) estimated the U.S. interstate migration for the same period, 1985–90. The study used a simple predictor, a dummy variable indicating the presence of state income tax, and concluded that people moved to minimize state income tax liabilities.

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along with state and time fixed effects. Their results suggested that state tax policies had no significant effect on elderly migration.[6] While the timing of baseline measurement prevents the observed tax measures from being direct outcomes of the measured migration (as would be a concurrent change in tax policies), this approach is inadequate because it omits the recent changes in tax burdens that occurred during the period of measured migration, which may have been taken into account in migration decisions. One exception is the analysis of elderly migration by Gale and Heath (2000), which controlled for both the baseline measures of government policies and the concurrent changes in these policies, including taxes. The authors found evidence that the elderly was attracted to states where the tax burdens are borne disproportionally more by wage earners. While the authors recognized that the change variables were endogenous, they did not address the endogeneity of tax changes in their analysis.[7]

The present paper contributes to the literature by being the first study to utilize the Federal Tax Reform Act of 1986 (TRA86) as a natural experiment for analyzing cross-state migration and formally construct an exogenous measure of state-level tax changes for that purpose. As a federal-level reform, TRA86 changed income tax burdens in a way that is dependent on an individual's state of residence and yet exogenous to the concurrent migration across states. We first simulate the state-variant impacts of TRA86 on tax burdens for a fixed sample of individuals who filed federal income tax returns in 1985. We then estimate the interstate migration in the United States between 1985 and 1990 as a function of the baseline tax burdens and the concurrent tax changes during this period, with the latter instrumented by the simulated impacts of TRA86. In addition, we estimate a change-in-migration equation by first-differencing the migration in 1985–1990 and the migration in 1975–1980. In the change-in-migration regression, the tax changes between these two periods are again instrumented by the simulated impacts of TRA86. First-differencing with the two-period panel allows us to eliminate time-invariant state unobservables that may be associated with the migration patterns specific to each state.

[6]The study also explored the possibility of reverse causality by specifying their key state tax policy as a function of past migration patterns. They found some evidence that elderly migration behaviors may have influenced the state tax policy.

[7]They only controlled for the endogeneity issues with the changes in government expenditure in their regression analysis, while all other change variables were treated as exogenous.

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TRA86 reduced the marginal tax rates for higher income tax brackets; at the same time, it broadened the federal tax base in various ways, including the removal of the deductibility of state sales tax liabilities. While these policy changes were made at the federal level, their impacts on individual income tax burdens are not constant across states. The cross-state variation in the effects of TRA86 is present in terms of state income tax liabilities as well as federal income liabilities specific to the residents of a state. We calculate the combined changes of the two. The impacts on state income tax liabilities depend on the way in which the states' income taxes are tied to federal income taxes. For example, in the states that followed federal definitions of gross income or adjusted gross income for state income taxation, their residents would face greater state income tax liabilities. On the other hand, in states where income tax systems are not connected to the federal code, TRA86 would have no or little impact on their state income taxes (Ladd, 1993; Marshall, 1991; Wildasin, 1993). With respect to the changes in federal income tax liabilities, the state-level variation results from the removal of state and local sales tax deductions from federal taxable income. Because states differ greatly in their sales tax rates, the extent to which the deductible amount of income is reduced is not the same for individuals residing in different states. This effect is sizable but largely ignored in prior studies on the impacts of TRA86.

While conceptually straightforward, these exogenous variations in state-specific tax burdens are not readily observed, and they need to be imputed. The observed, actual changes in per-capita state-specific tax burdens depend on the income levels and other characteristics of a state's residents post reform and are thus endogenous to individuals' re-optimization behaviors, including the inter-state migration during the same period. To isolate the exogenous part of the tax changes, we simulate the pre- and post-reform income tax liabilities specific to each state for selected taxpayers in the IRS 1985 Individual Public Use Tax File (IPUTF), using NBER's TAXSIM simulation program.[8]

We estimate tax-induced migration by income and marital groups to examine the potential differences in responsiveness across family types. The

[8]TAXSIM is a collection of programs and data sets, including a database of real tax returns, a tax calculator compiling federal and state tax laws, and a table generator producing tables of population-weighted aggregate statistics, for tax calculations. Please refer to Feenberg and Coutts (1993) for the details of its uses, methods and limitations.

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group-specific migration responsiveness to tax changes has great policy relevance; for example, for the purposes of maximizing tax revenue and pursuing other political interests, a state government may prefer a tax policy that retains or attracts individuals of higher income. We exclude elderly population from our analysis because their migration behaviors are likely driven by a different set of factors than for the rest of the population.

The remainder of the paper is structured as follows. Section 2 provides a detailed discussion on the differential impacts of TRA86 across states. Sections 3 and 4 describe our empirical strategies, data, and measures. The estimation results are presented and discussed in Section 5. Section 6 concludes the paper.

2 The impacts of TRA86 on state-specific tax burdens

In December 2017, the Tax Cuts and Jobs Act (TCJA) of the United States was signed into law under the administration of President Donald J. Trump. Commonly known as Trump's 2017 tax reform, it includes major changes such as lowering the individual and business tax rates, raising the standard deductions and eliminating personal exemptions. The 2017 tax reform is considered one of the most comprehensive federal-level tax reforms, and it is reminiscent of another influential tax reform that took place thirty years ago, namely the 1986 tax reform.

The 1986 Tax Reform Act, on the one hand, reduced the number of tax brackets and tax rates; on the other, it broadened the tax base and simplified the tax code by eliminating many tax shelters. As a result of changes in tax brackets and tax rates, TRA86 considerably reduced the marginal federal income tax rates facing higher-income individuals. In particular, the federal income tax after the TRA86 has a much flatter rate schedule compared to the pre-reform one, with the highest marginal tax rate reduced from 50% to 33% and the lowest marginal tax rate raised from 11% to 15%. Meanwhile, taxpayers with taxable income higher than a certain level were taxed at an effective rate of about 28% beginning year 1988.[9] Concerning the tax base

[9]For example, married couples filing jointly with taxable incomes above $124,000 were subject to an effective rate of 28% based on the calculation through a worksheet listed on page 51, Tax Rate Schedules in Instructions for 1988 Form 1040, Internal Revenue Service (1987). Consequently, the highest marginal income tax rate of 33% was applicable to the second highest income bracket, namely, $59,700 to $12,400 for the married joint filers, but

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and tax shelters, TRA86 made two main changes. One of them involves the taxability of capital gains. Before TRA86, 60% of net capital gains were tax exempt, leaving only 40% of net capital gains taxable. TRA86 removed the exemption, making the full 100% of net capital gains taxable. Taken together with the tax rates in both eras, the top marginal tax rate on capital gains changed from 20% (40% multiplied by the top marginal tax rate, 50%) before the reform to a rate that could be as high as 33% after the reform. The other change was the removal of some previously tax-deductible items, including interest payments on consumer loans and state/local sales taxes. Overall, the combined effect of base broadening and rate reduction by TRA86 reduced the federal tax liability by about 10% on average while substantial variations in tax changes were created across groups of income (Gold, 1991; Ladd, 1993).

Aside from their direct impacts on individuals' federal income tax liabilities, these changes in federal income tax codes also indirectly affected individuals' state income taxes. These indirect effects mainly arise from the varying ways in which state income taxes were tied to federal taxable income definitions. Specifically, 15 of the 50 states in the United States followed the federal definitions of gross or adjusted gross income for their state income taxation. In another 19 states, an individual's state income tax liability was calculated as an increasing function of his/her federal income tax liability. In the remaining 16, state income taxes had little or no connection to federal income tax, among which 7 had no or very limited personal income tax and the other 9 either did not couple to the federal tax code or coupled only to a few isolated provisions.[10] Ladd (1993), Marshall (1991), and Wildasin (1993) described these the state-varying "windfall" effects of TRA86. For the states that closely followed federal definitions of taxable income, TRA86 increased their tax revenues in the absence of any change in state policies and individual behaviors; in other words, TRA86 increased the tax burdens on individuals residing in these states. For the states whose income tax positively depends on federal income tax, the change in individuals' state tax

not the highest-income. Also see Figure 1 in Eissa (1995, p. 52) for a visual comparison of the federal income tax schedules before and after TRA86.

[10]The first 15 states are CO, DE, IL, KS, LA, MD, MI, MO, MT, NM, NY, OH, OK, UT, and VA; the second 19 are AZ, CA, GA, HI, IA, ID, IN, KY, MA, ME, MN, ND, NE, OR, RI, SC, VT, WI, and WV; the third 7 are AK, FL, NV, SD, TX, WA, and WY; and the last 9 are AL, AR, CT, MS, NC, NH, NJ, PA, and TN. See Marshall (1991) for details.

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burdens shares the same sign as the change in their federal income tax burden. TRA86 would have little or no impact on the state tax systems that held little or no connection to federal income tax. Based on the calculation of these studies, there are sizable cross-state differences in the windfalls. For example, Marshall (1991) calculated the per-capita windfall by state, ranging from −$32.64 to $64.37. Ladd (1993) reported the windfall as a percentage of state income tax revenue, which ranges from −5.7% to 62.2%.[11]

Among the tax shelters removed in TRA86, the deductibility of state/local sales taxes is of particular importance in terms of the resulting cross-state variations. On top of its influence on state income taxes as described above, the removal of sales tax deductibility also led to cross-state variations in "federal" income tax liabilities that the same individual would have if residing in a given state. Because states differ greatly in sales tax rates and taxable items, the pre-reform deductibility provided different levels of federal income tax relief for individuals residing in different states.[12] The removal

[11]In response to the windfalls, some, but not all of the states adjusted their personal income tax systems. According to the reports by Benker (1987a,b), among the 34 states with positive windfalls, 19 returned part of the windfalls to the taxpayers by reducing tax rates, providing additional tax exemptions or deductions, or changing the number of tax brackets. The other 15 did not make any return or adjustment in response to TRA86. The various state responses further add to the cross-state variation following TRA86. Ladd (1993) estimated that the average state returned about 43% of the windfalls, and about 67% of the windfalls were returned to the taxpayers for the states with positive windfalls as a whole. Based on questionnaires to the state governments regarding their preliminary decisions, the states with positive windfalls planned to return 60% of the windfalls on average and 81% for the states combined. One problem with the state responses to TRA86 is that they may be potentially endogenous to migration pressure; therefore, the added variation due to state responses is not a good source of exogenous variation for our purpose.

[12]It is worth noting that individuals who made purchases of the same dollar amounts did have to pay different amounts of sales taxes in different states to begin with. The market prices of goods and services may have adjusted to eliminate the cross-state differences brought about by sales taxes to some extent. Taken together with the fact that, in many states, sales taxes are substitutes for state incomes taxes, it is unclear whether sales taxes caused state differences and by how much. Therefore, it is unclear whether allowing sales taxes to be deducted from federal taxable income helped reduce or create state differences, and the answer to the above question also depends on individuals' income levels and marginal tax rates. However, this does not concern our study because what matters is the direction and magnitude of tax liability changes during the period of interest, regardless of whether the changes are equalizing or the contrary.

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of this deductibility, therefore, affects residents of various states differently. For example, consider the hypothetical federal income tax liabilities in the states of Oregon and Washington for the same family of four whose income was subject to the 15% marginal tax rate before and after TRA86, regardless of sales tax deductibility. Given the same level of consumption spending, they were assumed to have paid no sales taxes if they lived in Oregon, but $341 in Washington.[13] If the family lived in Oregon, the removal of sales tax deductibility would have no effect on their income tax liability. If the family lived in Washington, they could deduct the $341 from their taxable income before TRA86 (if itemizing); however, they could not deduct any after the reform. Multiplying the increase in federal taxable income of $341 post-reform by 15% (the marginal tax rate), we obtain an increase in federal income tax of about $51. This is a sizable amount, as it is comparable to the maximum windfall of state income tax per capita calculated by Marshall (1991), $64.37.[14] However, to the best of our knowledge, this feature of TRA86 has never been addressed or utilized in existing studies. This feature, when ignored, would greatly bias the estimated changes in individual tax burdens, especially because the size of state sales tax revenue is often comparable to that of state income tax revenue, and many states treat revenues from sales taxes and state income taxes as substitutes–in some extreme cases, a state imposes only sales taxes or state income taxes but not both. Oregon and Washington are two interesting examples. While being neighboring states, Oregon had no sales taxes and considerable income taxes (5% for the lower income bracket and 9% for the higher income bracket), and Washington imposed substantial sales taxes (6.5%) but no income taxes. Given the importance of state sales taxes, it is critical to take the impact of the removal of sales tax deductibility into account.

In sum, TRA86 provided cross-state variations in two aspects. One is the varying influences on state income tax burdens due to the different dependence of state income taxes on federal income taxes. The other is the state-variant changes in federal income tax liabilities due to the removal of

[13]These two numbers are the minimum deductible amounts of state sales taxes, with no evidence required, for a family of four whose income fell between $15,000 and $20,000 and resided in Oregon and Washington, respectively.

[14]Notice that the removal of state tax deductibility is only relevant for taxpayers who itemize, so the aggregate impact of this tax change may not be as great as suggested in the example.

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state and local sales tax deductibility. In the following sections, we measure these exogenous variations across states and use them to instrument the actual tax changes in the regressions of interstate migration.

3 Methodology

3.1 Modeling migration

The decision to migrate is often rationalized using two different specifications of the utility maximization problem. One approach regards the migration decision as a sequential process of two separate decisions. The decision maker first decides whether to move, and then he/she decides where to move if the decision of moving was chosen. The other approach argues that the decision to move cannot be separated from the choice of destination because the decision to stay or move is based on a rational comparison between the present location and the alternatives. Despite the differences, both utility-maximizing processes of individuals can be specified with a logistic framework. Theoretically, the process assumed in the second approach is more general, as it will lead to the more efficient allocation. Therefore, we adopt the notion of simultaneous decision making for moving and destination choice to form our regression model.

Under the hypothesis that the decisions of moving and of destination are made simultaneously, the probability of an individual moving from a certain state to another is frequently specified with a conditional logit model, which allows the probability of migration from one state to another to be influenced by the characteristics of not only the two corresponding states but also by all other possible destinations (Cushing, 2005; Davies, Greenwood, and Li, 2001; Day, 1992; Day and Winer, 2001). The conditional logit specification is consistent with the notion that an individual will decide to move to state j (from state i) if the maximum level of utility that the individual expects to enjoy in state j is greater than that in any alternative state (including the origin state). With distribution assumptions on the utility disturbance term reflecting unobserved variations in attributes and errors in the perception and optimization by the individual, the probability of an individual s from state i moving to state j can be expressed as the ratio of the exponential value of the maximum utility that he/she expects to receive in state j to the sum of that of all possible destinations, including staying in the origin:

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$$p_{sij} = \frac{\exp\left(EU_{sij}\right)}{\Sigma_{j=1}^{J} \exp\left(EU_{sij}\right)}, \quad s = 1, \cdots, n_i; \quad i, j = 1, \cdots, J, \quad (1)$$

where EU_{sij} represents the expected maximum utility of residing in state j in the post-migration period for an individual s who resides in state i in the pre-migration period. Assuming homogenous preferences within subgroup g of individuals from state i, we then substitute the subscript s with g in equation (1) to represent the group-wise probability and attributes. This assumption will allow us to apply aggregate data of migration flows, especially in the absence of sufficient information to identify tax burdens facing a specific individual. Therefore, we have

$$p_{gij} = \frac{\exp\left(EU_{gij}\right)}{\Sigma_{j=1}^{J} \exp\left(EU_{gij}\right)}, \quad g = 1, \cdots, G; \quad i, j = 1, \cdots, J, \quad (2)$$

and the log odds ratio of moving to staying is

$$\ln\left(\frac{p_{gij}}{p_{gii}}\right) = EU_{gij} - EU_{gii}, \quad i \neq j. \quad (3)$$

Following Day (1992), we replace the actual probabilities with the observed aggregate migration ratio and add the corresponding approximation error to the right-hand side of the equation. The resulting equation is

$$\ln\left(\frac{M_{gij}}{M_{gii}}\right) = EU_{gij} - EU_{gii}, + \varepsilon_{gij}, \quad i \neq j, \quad (4)$$

where M_{gij} indicates the gross out-migration flow (the number of movers) from state i to j for group g, M_{gii} indicates the number of stayers in state i for group g, and the error term $\varepsilon_{gij} = \ln(M_{gij}/M_{gii}) - \ln(p_{gij}/p_{gii})$.[15] Assuming that EU_{gij} and EU_{gii} are linear in parameters, least square estimations can be applied to this equation, for which the control set includes aggregate variables determining the expected utilities in the origin state as well as in the destination state.

[15] As shown by Theil (1970) and applied in Day (1992), if M_{gij} are generated by independent random drawing from a multinomial distribution, the approximation error ε_{gij} will also be normally distributed with zero means and variance-covariance matrix Ω_{gi}, where Ω_{gi} depends on the expected values of M_{gij}. In this study, we calculate robust standard errors (as reported) and experiment with weighted least squares approach to account for error structures that may be specific to an origin/destination state (not reported). The regression results are not sensitive to these treatments.

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3.2 Empirical specifications

In this study, we use families of the householders as the units of migration flows. To account for differences in tax burdens and preferences related to migration, families are classified according to the householder's marital status and family income levels; group-specific regressions are then estimated accordingly.[16] With respect to the marital status of the householders, families are divided into two groups: married with the spouse present or otherwise. Within each marital group, families are further divided into three income groups based on their position in the national income distribution: 75 percentile or above, between 25 and 75 percentiles, and below 25 percentile.

Individuals form the expectation of state-specific utilities based on their expectation of the variables in the utility function.[17] On the aggregate, any information up to the end of the migration period may be utilized by some decision makers to form the expectation of the relevant state attributes, albeit the causality between the aggregate migration and the concurrent changes in state attributes are not always clear. For our key variable, the state-specific income tax burdens, we incorporate the information up to the year prior to the end of a five-year migration period by controlling for both the tax burden observed at the beginning of the period (called the "baseline" measure) and the subsequent tax changes. The tax burdens in both the baseline and the change measures are defined as the combined rates of the federal and state income tax liabilities specific to the residents of a state. Because the concurrent tax changes are not fully observable to all individuals at the point of decision making, their effects on migration may differ from those of the baseline tax burdens. Including the baseline and the change measures separately allows their coefficients to be different while we address the endo-

[16] It should be noted that the family unit in our paper is referring to the householder's family where present or the householder alone when he/she does not live with a related person. Per definition set forth by the U.S. Bureau of the Census (n.d.), a "household" includes all the people who occupy a housing unit (such as a house or apartment) as their usual place of residence. On the other hand, a "family" consists of those who live in the same household and are related to each other by birth, marriage or adoption. Therefore, it is possible for one household to consist of multiple families, in which case we take into account only the family members of the householder in our analysis. On the other hand, if a householder does not live with any family member, we define his/her family income as the householder's own income.

[17] Linearity of the expectation operator provides that $EU(X) = U(EX)$.

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geneity issue of the latter using the impacts of TRA86. All other attributes are only measured at baseline to minimize endogeneity, as we do not have the means to isolate the exogenous parts of their concurrent changes. Therefore, for group g and a pair of origin state i and destination state j, we specify

$$\ln\left(\frac{M_{gij}}{M_{gii}}\right) = \beta_0 + \beta_1 \text{Tax}_{gi} + \beta_2 \text{Tax}_{gj} + \beta_3 \Delta\text{Tax}_{gi} + \beta_4 \Delta\text{Tax}_{gj} + \beta_5' X_{gi} + \beta_6' X_{gj} + \beta_7' X_{ij} + \varepsilon_{gij}, \quad (5)$$

where $\ln(M_{gij}/M_{gii})$ is the log migration ratio for group g observed in a five-year period, Tax_{gi} and Tax_{gj} indicate the vectors of baseline income tax rates facing group g in the origin state and the destination state, respectively, ΔTax_{gi} represents the observed change in the group's income tax rates in the original state during the four years following the baseline year, ΔTax_{gj} is that of the destination state, and X_{gi} and X_{gj} are the vectors of other baseline characteristics of the origin and destination states relevant to the underlying migration decisions.[18] These characteristics include other tax or non-tax state policies, cost of living, and other economic, demographic, and environmental variables measured in 1985. Vector X_{ij} represents variables associated with the pair of states (i, j), specifically the spatial associations commonly used in a gravity model of migration, such as the cost-weighted distance and border dummies.[19] Finally, ε_{ij} is the error term of the regression, and β_0 through β_7 are unknown parameters to be estimated. It is important to note that all income tax variables are specific to each income-marital group. If a householder is married with the spouse present, he/she is assumed to file joint income tax returns with the spouse; otherwise, the householder is assumed to file a single income tax return. The measures of sales tax burdens also vary across income groups due to the differences in consumption patterns. The other control variables are invariant across groups. We will describe the variable measures in details in section 4.

As discussed in the previous sections, the observed changes in income tax rates in equation (5) are endogenous to migration. We address this endogeneity in our regressions using TRA86-induced changes as the instruments for the actual tax changes during the migration period. The detailed specification of our instrumental variable approach will be described below.

[18] X_{gi} and X_{gj} contain both group-specific and group-invariant variables.

[19] Specifically, we will use gasoline-price-weighted distance instead of distance to approximate the monetary cost of transportation. This will be further discussed in Section 4.2.

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Another issue that arises is that the error structure of equation (5) likely depends on the specific states associated with an observation. Conway and Rork (2006) weighted their regressions of elderly migration rates by state population to address potential heteroskedasticity resulting from the more variable migration in lower-populated states. Following this approach, we weight all our migration regressions by the arithmetic average of the populations in the pair of states corresponding to an observation. We also calculate robust standard errors to account for other potential sources of heteroskedasticity and error correlation.[20]

Instrumental Variable Approach

If a state's tax policy is influenced by the migration to and from other states, the reduced form of the actual tax change in state i is a function of the exogenous variables in all 48 states. Therefore, we estimate equation (5) (referred to as the "main" equation) with ΔTax_{gi} instrumented by the TRA86-induced tax rate changes specific to group g in state i as well as those in the other states. However, due to the large number of variables from all other states, it is necessary to impose restrictions on the parameters of the inter-state dependence terms to prevent exhaustion of the degree of freedom.[21] For this reason, we classify "the other states" into two groups: "neighboring states" and "non-neighboring states" of state i. Specifically, a pair of states are defined as neighboring if they are adjacent to one another. We then assume that the average tax change in each group of states has a constant marginal effect on the tax change in state i. For the other exogenous variables (collectively referred to as X), we assume that they have no direct effect on other states' tax changes and include only a state's own X in the tax change equation to be estimated in the first stage. The resulting first stage equation of the IV regression is as follows:

[20] For example, unadjusted standard errors may be biased, possibly downward, due to error correlation across observations that share the same origin or destination states.

[21] Since the unrestricted reduced form of the "change in taxes" equation includes the characteristics of all 48 states, the number of right-hand-side variables of this equation would be far greater than the number of observations. Restrictions on the effects of the variables from other states are thus necessary to allow for estimation.

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$$\Delta \text{Tax}_{gi} = \delta_0 + \delta_1 Z_{gi} + \delta_2 Z_{gi}{}_{\text{neighbor}} + \delta_3 Z_{gi}{}_{\text{non-neighbor}} + \delta_4' X_{gi} + u_{gi}, \quad (6)$$

where ΔTax_{gi} and X_{gi} are as defined for the main equation, δ_0, δ_1, δ_2, δ_3, and δ_4 are unknown parameters, Z_{gi} denotes the instrument, the simulated change in tax rates due to TRA86 for group g in state i, and the variables $Z_{gi}{}_{\text{neighbor}}$ and $Z_{gi}{}_{\text{non-neighbor}}$ denote the averages of Z_{gi} in the neighboring and non-neighboring states of state i, respectively.[22]

It should be noted that the state-variant impacts of TRA86 are not entirely random events, but are instead associated with some characteristics of the states' baseline tax systems, such as the sales tax rates and the association between the state income tax liabilities and federal income tax base. To ensure that our empirical strategy effectively isolates the tax changes from other factors and that the identifying variation is relevant and valid, we conduct a number of analyses and tests, such as computing the partial R^2 suggested by Bound, Jaeger, and Baker (1995) and performing the test of over-identifying restrictions by Godfrey (1991). We will discuss these statistics and tests in the result section.

Change-In-Migration Model

The instrumental variable (IV) approach isolates the exogenous component of concurrent tax changes in explaining migration. However, the coefficient estimates may still suffer from omitted variable bias if the other control variables in equation (5) are associated with some unobserved state characteristics that contribute to the long-run migration patterns. These long-run unobservables can be differenced away with the use of panel migration data. Therefore, we also estimate a change-in-migration model by first-differencing the migration equations for the periods 1985–1990 and 1975–1980. In the change-in-migration regression, the tax changes between these two periods are again instrumented by the simulated impacts of TRA86.

Ideally, we would like to estimate the first-differenced version of equation (5). Unfortunately, state-specific income taxes cannot be identified prior to 1977, which prevents us from distinguishing between the effects of the baseline tax burden and the concurrent tax changes for the migration

[22] Equation (6) is equivalent to a spatial cross-regressive model with spatially lagged Z.

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period 1975–1980. Therefore, we replace the two separate tax measures in equation (5) with the combined term, the income tax burden observed in the year prior to the end of each migration period (denoted by $\text{Tax}_{gi(t+4)}$ for the origin state and $\text{Tax}_{gj(t+4)}$ for the destination state). The resulting equation for migration period $(t, t+5)$ is given below:

$$\begin{aligned}\ln\left(\frac{M_{gij}}{M_{gii}}\right)_{(t,t+5)} &= \gamma_0 + \gamma_1\left(\text{Tax}_{git} + \Delta\text{Tax}_{gi(t+4)}\right) \\ &\quad + \gamma_2\left(\text{Tax}_{gjt} + \Delta\text{Tax}_{gj(t+4)}\right) \\ &\quad + \gamma_3' X_{git} + \gamma_4' X_{gjt} + \gamma_5' X_{ijt} + \varepsilon_{gij(t,t+5)}, \\ &= \gamma_0 + \gamma_1\text{Tax}_{gi(t+4)} + \gamma_2\text{Tax}_{gj(t+4)} + \gamma_3' X_{git} \\ &\quad + \gamma_4' X_{gjt} + \gamma_5' X_{ijt} + \varepsilon_{gij(t,t+5)}, \end{aligned} \tag{7}$$

where $t = 1975$ and 1985. We then estimate the first-difference of equation (7) with the income tax changes between the two periods instrumented. Thus, the following two equations (8) and (9) provide the main equation and the first stage equation of the change-in-migration model:

$$\begin{aligned}\Delta\ln\left(\frac{M_{gij}}{M_{gii}}\right)_{\substack{(75,80)\\-(85,90)}} &= \gamma_1\Delta\text{Tax}_{gi(79-89)} + \gamma_2\Delta\text{Tax}_{gj(79-89)} \\ &\quad + \gamma_3'\Delta X_{gi(75-85)} + \gamma_4'\Delta X_{gj(75-85)} \\ &\quad + \gamma_5'\Delta X_{ij(75-85)} + v_{gij}, \end{aligned} \tag{8}$$

$$\begin{aligned}\Delta\text{Tax}_{gi(79-89)} &= \delta_0 + \delta_1 Z_{gi} + \delta_2 Z_{gi}{}_{\text{neighbor}} + \delta_3 Z_{gi}{}_{\text{non-neighbor}} \\ &\quad + \delta_4'\Delta X_{gi(75-85)} + u_{gi}. \end{aligned} \tag{9}$$

A disadvantage of the change-in-migration model is that the estimation utilizes only the over-time variation within a state and not the variations across states. Consequently, any variable that is constant over time drops out of the equation.

4 Data and measures

We use the 1980 and 1990 Public Use Microdata Samples of the U.S. Census (PUMS) to construct aggregate migration measures and state demographic variables. Each Census collects information on respondents' locations of residence in April of the census year and five years earlier. Therefore, the 1990 PUMS provides migration data for the period 1985–1990,

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and the 1980 PUMS provides migration data for 1975–1980. The PUMS data have several advantages. First, the large sample size provides reliable identification of variations in state-to-state migration. In addition, it allows us to differentiate migration flows by demographic criteria, such as income levels. A major shortcoming of PUMS is that it does not contain sufficient information to reasonably impute tax burdens for a specific respondent. Despite the drawback, the PUMS provides the best available data for analyzing migration behaviors and has been employed in the majority of the related studies. For the purpose of our analysis, we restrict the sample to householders who resided in the 48 contiguous states of the United States aged 25 to 55 years old in each census year (aged 20–50 at the beginning of each migration period).[23]

In addition to PUMS, we utilize various other sources of data to collect information on taxes and other explanatory variables. In particular, we obtain data on actual taxpayers in the United States from IRS Individual Public Use Tax File (IPUTF), which contains over 100,000 tax-filing units each year. Following the same sample filtering criteria as we use for PUMS, the size of analysis sample from IPUTF for year 1985 is 93,100. The information on taxpayers of this particular year is used together with NBER's TAXSIM program to simulate the state-specific tax burdens before and after TRA86. As mentioned previously, PUMS data does not contain sufficient income and tax information for the TAXSIM simulation of tax liabilities; IRS's IPUTF data serves as an excellent substitute for this purpose since it contains detailed information from actual tax records.

Other control measures are constructed using information from the Statistical Abstract of the United States, Consumer Expenditure Survey, Significant Features of Fiscal Federalism by U.S. Advisory Commission on Intergovernmental Relations, state welfare benefit data collected by U.S. House Committee on Ways and Means, and other resources.

The group-specific state-to-state migration flows M_{gij} for each five-year period are calculated as a 48 by 47 matrix of numbers of migrants based on the PUMS respondents' states of residence at the beginning and end of the period. Our key explanatory variable is the observed changes in state- and group-specific income tax rates instrumented by TRA86-imposed changes. We also control for baseline *levels* of state-specific tax rates, including the

[23] Excluding potential movers above 50 years of age prevents the inclusion of retirement-related moves, which may depend on a very different set of factors.

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rates of income taxes, sales taxes, and property taxes. The baseline tax rates are measured at the beginning of the analyzed migration period. Unless otherwise noted, all other covariates are also measured at this baseline to minimize endogeneity problems. We will discuss in detail the measures of income tax rates and other covariates below.

4.1 Income tax measures and the instrument

For each relevant year, we divide the actual income tax liability of a tax-filing unit by its adjusted gross income to obtain the individual unit's income tax rates based on the data from IRS IPUTF. The individual rates are then averaged within each group and state to obtain the observed aggregate income tax rates Tax_{gi} and their changes ΔTax_{gi} in the estimated equations (5)–(9).

To construct the instrumental variable, the exogenous tax changes imposed by TRA86, we use NBER's TAXSIM program (Internet version 9.1) to simulate income taxes of the selected taxpayers in the 1985 IPUTF, for all 48 contiguous states and for both before and after TRA86. In particular, TAXSIM is a simulation program developed by NBER for calculating tax liabilities from individual data under the federal and state income tax laws in the United States. With TAXSIM, researchers can compute the hypothetical tax liabilities and marginal tax rates for both federal and state from individual data that contain income and family characteristics but no tax variables. It also allows for tax calculations with hypothetical state of residence or specific tax year. For the purpose of this study, each individual tax unit is placed in each of the 48 states to calculate the unit's hypothetical tax burden if it had resided in the specific state, regardless the actual state of residence. For both before and after TRA86, the individuals' incomes and all other relevant family characteristics are fixed at the 1985 level for the tax simulation.[24]

Since the individual income data used for the simulation are identical for both tax policy regimes and for all states, our simulated taxes are not subject

[24]Specifically, the following income variables and family characteristics are needed for tax calculation with TAXSIM: case id, tax year, state, marital status, dependent exemptions (including children of all ages), age of primary taxpayer, age of spouse, wage and salary income of primary taxpayer, wage and salary income of spouse, dividend income, other property income, taxable pensions and IRA distributions, gross social security benefits, other non-taxable transfer income, rent paid, real estate taxes paid, other itemized deductions, child care expenses, unemployment compensation received, number of dependents under age 17 for the child tax credit, mortgage interest and other deductible items, capital gains or losses.

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to endogenous changes in state income composition. Furthermore, in order to minimize the potential endogeneity caused by states' policy responses to migration during this period, we measure the tax change for the shortest interval spanning the pre- and post-era of TRA86, from 1986 and 1988.[25] Therefore, our simulated change in tax burdens caused by TRA86 for state i can be expressed as

$$\Delta \text{Tax}_{i,\text{TRA86}} = \text{Tax}_i\,(Y_{85}, S_{88}, F_{88}) - \text{Tax}_i\,(Y_{85}, S_{86}, F_{86})\,, \qquad (10)$$

where $\text{Tax}_i\,(Y_{85}, S_{86}, F_{86})$ and $\text{Tax}_i\,(Y_{85}, S_{88}, F_{88})$ refer to the simulated tax burdens based on income data of individuals (Y), state tax codes (S), and federal tax codes (F) in the year indicated by the subscripts. As described in Section 2, the effects of TRA86 vary across states in terms of state income tax burdens as well as federal income tax burdens. $\Delta \text{Tax}_{i,\text{TRA86}}$ is the combination of these two components.[26] The federal component of the combination measures the changes in federal income tax burdens caused by the removal of sales tax deductibility, which vary across states. For calculating these changes, we take the families that itemized in 1985 and assume that their post-reform itemized deduction amounts decreased by the pre-reform allowable state sales tax deductions that require no evidence for the family size and income level.[27] We then divide $\Delta \text{Tax}_{i,\text{TRA86}}$ by individuals' adjusted

[25] TRA86 was signed into law in 1986, went into effect in 1987 with a transitional tax code, and was fully implemented in the tax year of 1988. We take comfort in the short interval and assume that state tax codes did not change significantly in response to migration pressure during these two years. An alternative approach is to use the pre-reform state tax codes for both policy regimes and avoid any endogenous change in state tax codes; this is, however, not a feasible option when using the Internet TAXSIM program.

[26] It should be noted that TRA86 also changed federal income tax burdens in ways that are constant across states. These constant federal changes are excluded from the federal component of our simulated tax change since they would not contribute to the regression. However, their subsequent effects on state income tax burdens do vary across states and are therefore reflected in the state component of the simulated tax change.

[27] The pre-reform allowable deduction amounts specified here refer to the amounts of general sales tax paid that individuals may claim for their itemized deduction with no records of sales tax payments required. These allowable deduction amounts can be found on the 1986 Optional State Sales Tax Tables in the instruction section of Form 1040 (Internal Revenue Service, 1987, pp. 44–45). Because taxpayers may claim a higher amount of sales tax deduction if evidence of such is retained, the allowable deduction amounts assumed in our calibration are the lower bound measures for the itemizers.

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gross income in 1985 to obtain the rates of simulated tax changes (equal to the changes in tax rates since income data are held constant over time in the simulation). Our instrumental variable Z_{gi} is the average of these rates for each demographic group and state.

4.2 Non-Income state tax burdens and other control variables

Our baseline measures of non-income state tax burdens include rates of sale taxes and property taxes. Because property taxes are imposed at the local level but not at the state level, we aggregate these local tax burdens for a state using the self-reported information on property tax liabilities and property values for the families in the 1990 PUMS. The state-level property tax rate for each group of families is therefore defined as the state average of "property tax liability to property value ratio" for that family group.

For measuring the sales tax burden specific to each state, we calculate an effective sales tax rate, which considers the locally imposed sales taxes as well as the differential tax treatments on food and clothing in the states. Certain localities impose substantial sales taxes on top of their statewide sales taxes. In such cases, the statewide sales tax rates may be highly misleading when used alone for cross-states comparison. Because local taxes are only applicable to isolated parts of a state, their overall impact on the state needs to be calculated with a weighting approach. We incorporate the local sales tax burdens into our measure of general sales tax rates using the relative size of local sales tax revenues in a state. Specifically, we calculate a "general state and local sales tax rate" using the following formula:

$$\begin{aligned}\text{State and local sales tax rate} \equiv\ & \text{State sales tax rate} \\ & \times \frac{\text{State and local sales tax revenue}}{\text{State sales tax revenue}}.\end{aligned}$$

This adjustment for local sales tax burdens makes a remarkable difference. For example, the statewide general sales tax rate in Tennessee was only 5.5% in 1985, but the general state and local rate was as high as 7.12%.

With respect to the tax treatments on food and clothing, among the 45 states that collected sale taxes in 1985, 28 states exempted food purchases from sales taxes, and 6 of these 28 states also exempted clothing purchases. The extent to which these exemptions affect a family depends on the share of consumption spending on the exempted items. We calculate the shares

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of consumption spending in 1985 using the data from the Consumer Expenditure Survey. The spending on food and clothing of a typical family in the lower 25% of income distribution make up 33.9% and 17.5%, respectively, of its total spending on consumption goods to which sales taxes typically apply.[28] For the families in the upper 25% of income distribution, the spending shares are 18.7% for food and 19.1% for clothing. For middle-income families, the shares are 26.3% and 18.3%. We use these shares of spending as weights and calculate the weighted average of the sales tax rates in a state, namely our effective sales tax rates. For example, in a state that exempted food items in 1985, the effective rate for the low-income group is defined as the general state and local sales tax rate multiplied by 0.661, the share of consumption spending on non-food items. In a state that did not offer food/clothing exemption, the effective rate is the same as the general rate in the state. Table 1 shows the food/clothing exemptions and the effective sales tax rates in 1985 in all 50 states by ranges of the general state and local sales tax rates. We can see that the general rates and the effective rates would yield dramatically different results of cross-state comparison. For example, the general sales tax rates in Connecticut and Tennessee were among the highest in the nation (7.5% and 7.12%), while the general rate in Georgia was one of the lowest (3.9%). However, Connecticut had the lowest effective sales tax rate for the low-income group (3.65%) among these three states, since food and clothing were exempted from the collection of sales taxes in Connecticut but not in the other two states. We also calculate the shares of consumption spending and the effective sales tax rates in 1975 by the same method for the change-in-migration model.

Also controlled in our regression analysis are government expenditure policies, costs of living, and other economic, demographic, environmental, and spatial characteristics of the states. Unless otherwise noted, all variables are measured at the baseline of a migration period. All dollar amounts are measured in real 1990 dollars.

Measures of expenditure policies include state welfare benefit levels, measured by maximum AFDC and food stamps combined benefits for a family of three, per-capita state and local government spending on education, and

[28] Shelter costs, utilities, fuels, public services, transportation, health care, education, insurance, and others are excluded from the set of consumption items because they typically are not subject to sales taxes.

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Table 1: General state & local sales tax rates, exemptions, and effective rates by income groups, 1985

General State & Local Sales Tax Rate Range	Exempting food & clothing				Exempting food				No exemption	
		Mean effective rate				Mean effective rate				Mean effective rate
	States	lower 25%	middle	upper 25%	States	lower 25%	middle	upper 25%	States	all income groups
7–7.99%	CT	3.65%	4.16%	4.66%	NY, LA, WA	4.91%	5.48%	6.04%	TN	7.12%
6–6.99%	MN, NJ, PA, RI	2.92%	3.33%	3.74%	IL	4.38%	4.88%	5.39%	MS	6.00%
					AZ, CA, NV, CO, OH, TX, FL, IN, ME,				AL, UT, OK,	
5–5.99%	MA	2.43%	2.77%	3.11%	MD, WV, WI	3.51%	3.92%	4.32%	MO, SC	5.51%
									SD, NM, AR,	
4–4.99%					NE, IA, MI,				NC, VA, HI,	
					ND, VT	2.65%	2.96%	3.26%	ID	4.28%
3–3.99%					KY	1.98%	2.21%	2.44%	GA, KS, WY	3.74%
No sales tax	AK, DE, MT, NH, OR									

Note: The effective rates are computed using state & local sales tax rates as bases and then adjusted to account for food and clothing exemptions using the family consumption pattern from Consumer Expenditure Survey data as weights. Information on state general sales tax rates and state/local sales tax revenues is obtained from The Significant Features of Fiscal Federalism by ACIR.

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per-capita state and local government spending for all other purposes.[29] We expect the effects of these expenditure policies, especially welfare generosity and education spending, to vary across income and/or marital groups.

We measure the cost of living in each state using the state-level consumer price index constructed by Berry, Fording, and Hanson (2000). Assuming constant parameters over time and across the nation, Berry and colleagues regressed the cross-sectionally adjusted consumer price indexes (CSA-CPI) at the SMSA and NMUR level on a set of area/regional attributes, including the national CPI, median housing value, per capita personal income, population, and regional dummies. The authors then applied the coefficient estimates to the corresponding state-level variables and obtained the predicted price index for each state.

Other measures of state economic conditions are selected based on human capital theory and the previous literature (Cullen and Levitt, 1999; Cushing, 1993; Davies, Greenwood, and Li, 2001; Fox, Herzog, and Schlottmann, 1989; Isserman and Rephann, 1993; Lee and Roseman, 1999). We include the unemployment rate and the five-year average growth rate of state gross products prior to the migration period. These two variables reflect prospects of income and employment opportunities in a state.

Our demographic controls include per-capita income, population, population density, education, age, and race. Controlling for population is in accordance with the "gravity model" in migration literature. We will further describe the gravity model in the next paragraph. The education, age, and racial compositions are measured as percentages of population in a state. Several other amenity and environmental indicators are included in our study. First, we control for the "crimes-to-population ratio" in a state. Past studies suggest that frequency of crime may affect migration into an area (Cullen and Levitt, 1999; Cushing, 1993; Lee and Roseman, 1999). In addition, we control for the number of colleges, the percentage of metropolitan area, and state climate, measured by the normal daily maximum temperature in January. The climate variable, along with population density and measures of economic conditions, is expected to capture the general migration pattern across regions.[30]

[29] Because food stamps benefits are reduced by the recipients' income, including cash benefits, cash and food stamps benefits should be considered together to accurately represent states' welfare generosity.

[30] We also experimented with dummy variables for census divisions to control for the

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Finally, we control for the spatial association between a pair of states, including the distance between a pair of states and a border dummy indicating whether the two states are adjacent to each other. Costs and motivations of moving are related to the distance between two states. Migration activities are likely higher between near states (compared to distant states) or adjacent states (compared to non-adjacent states) due to the lower monetary and adjustment costs of moving. This is also a key implication of the gravity model, which states that migration between two locations will increase with their populations and decrease with their distance.[31] We weight the geographical distance by average gasoline prices in the states' division(s) to consider the variation in unit fuel costs so that it can be a better proxy for the transportation cost.[32]

Table 2 reports the summary statistics of the variables as well as the data sources. It is worth noting that the actual and simulated changes in tax rates vary greatly across the income-marital groups. For example, the mean change in income tax rates due to TRA86 range from −0.65 percentage points for the high-income families of married householders to 0.87 percentage points for the high-income families of single householders. The least treated group is the middle-income families of single householders, whose simulated income tax rates reduced by only 0.02 percentage points on average. This confirms the importance of considering the heterogeneity in tax impacts according to households' income and tax filing status.

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potential fixed effects, and we found no significant changes in our results. We choose to report the version with no division dummy variable, as we believe that direct measures for the migration-related characteristics of geographic areas are better controls than the ad-hoc area indicators.

[31] See Anderson (1979) and Lowry (1966) for the theoretical foundation of the gravity model and additional references.

[32] There was significant cross-state variation in gasoline prices. In 1975, the state gasoline prices (in 1990 dollars) ranged from 34.5 to 52.6 cents per gallon. In 1985, the prices (in 1990 dollars) ranged from 73.8 to 123.4 cents per gallon. There were also notable changes over the decade in the spatial distribution of gasoline prices. Although we can control for both distance and gasoline price as two separated variables in the regression alternatively, the estimated coefficient of distance would have a different meaning compared to the one with our gasoline-price-weighted distance. We choose the latter as it better reflects the marginal effect of transportation cost.

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Table 2: Summary statistics

Variables (unit)	1985–90		1975–80	
	Mean	S. D.	Mean	S. D.
Migration Ratio: Mij/Mii, 5-year period[a]	0.0032	0.0061	0.0022	0.0044
Single, lower 25%	0.0070	0.0104	0.0033	0.0057
Single, middle	0.0048	0.0072	0.0028	0.0049
Single, upper 25%	0.0093	0.0119	0.0037	0.0054
Married, lower 25%	0.0050	0.0086	0.0027	0.0051
Married, middle	0.0033	0.0058	0.0021	0.0042
Married, upper 25%	0.0057	0.0073	0.0026	0.0043
Income Taxes				
Δ (Income Tax Rate)$_{\text{Actual}}$ (%)[b]	−0.5945	0.4859	−0.2991	0.4166
Single, lower 25%	−0.0389	0.1289	−0.0359	0.1304
Single, middle	−0.1110	0.2668	−0.0299	0.2281
Single, upper 25%	−0.5154	0.8491	0.1840	0.6791
Married, lower 25%	−0.4930	0.4527	−0.2104	0.3401
Married, middle	−0.8543	0.7309	−0.0894	0.5677
Married, upper 25%	−0.8177	2.1259	−0.3497	2.1797
Δ (Income Tax Rate)$_{\text{TRA86}}$, 1986–88 (%)[b,c]	0.0278	0.4216		
Single, lower 25%	−0.0794	0.3736		
Single, middle	−0.0231	0.6132		
Single, upper 25%	0.8663	1.0543		
Married, lower 25%	−0.3269	0.6530		
Married, middle	0.2788	0.9709		
Married, upper 25%	−0.6462	5.4470		
Income Tax Rate (%)[b]	2.2779	1.3478	1.8348	1.1626
Single, lower 25%	0.0244	0.0416	0.0199	0.0274
Single, middle	0.5138	0.3607	0.3921	0.2774
Single, upper 25%	3.5762	1.9668	2.5272	1.5938
Married, lower 25%	0.9826	0.6487	0.5588	0.4006
Married, middle	3.3681	1.9119	2.2208	1.4543
Married, upper 25%	4.5906	2.4432	3.8886	2.3649
Sales Tax Rate (%)[d,e]				
lower 25%	3.0620	1.2178	2.7950	1.1034
middle	3.2707	1.2331	2.9358	1.1056
upper 25%	3.4802	1.2751	3.0771	1.1321
Property Tax Rate (%)[d]	1.2606	0.5459	1.7348	0.5798

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Table 2: Summary Statistics (Continued)

	1985–90		1975–80	
Variables (unit)	Mean	S. D.	Mean	S. D.
Government Expenditures				
Education Expenditure (1990$)[g]	960.68	185.52	905.02	148.89
Other Non-welfare Expenditure (1990$)[g]	1,409.09	324.16	685.75	188.39
Max. Welfare Benefit (1990$) [f]	7,125.78	1,231.82	8,036.49	1,612.28
Cost of Living & Economic Factors				
Cost of Living (index)[k]	58.47	4.63	29.61	2.42
Income (1990$)[g]	15,830	2,366	13,459	1,772
Unemployment Rate (%)[g]	7.06	1.92	8.06	2.19
Growth Rate (%)[h]	8.46	2.02	10.67	2.27
Gravity Model Factors				
Population (persons)[g]	4,912,042	5,053,844	4,399,813	4,449,278
Border (dummy)	0.09	0.29	0.09	0.29
Gasoline Price* Distance (1990$*mi)[i, j]	111,284	66,310	96,348	58,715
Other Explanatory Variables				
Population Density (persons/sq. mi)[g]	0.16	0.23	0.14	0.22
Temperature (F degress)[g]	40.48	12.06	41.24	11.83
Crime (#/100,000 population)[g]	4,718.45	1,293.90	4,848.98	1,469.68
Number of College (#)[g]	68.42	64.44	56.56	53.36
Metropolitan (%)[g]	63.28	21.92	56.73	25.44
Age: % 35–45 (%)[a]	18.00	1.76	18.68	1.45
Race: % White (%)[a]	87.77	8.85	88.90	7.51
Education: % Some College (%)[a]	28.51	4.38	39.08	6.01

Sources: [a] PUMS, 1980, 1990; [b] IPUTF, 1975, 1979, 1985, 1989; [c] NBER's TAXSIM program (Internet, v.9); [d] Significant Features of Fiscal Federalism (SFFF) by ACIR; [e] Consumer Expenditure Survey, with authors' calculations added; [f] U.S. Department of Health and Human Services, Administration for Children and Families, Office of Family Assistance; [g] Statistical Abstracts of the United States; [h] US Bureau of Economic Analysis; [i] Energy Information Administration; [j] Geography Division of U.S. Census Bureau, with authors' calculations using Haversine formula; [k] Berry, Fording, and Hanson (2000).

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5 Empirical results

5.1 IV regressions of log migration ratios

We will first discuss the results from the IV regression model of log migration ratios between 1985 and 1990, as outlined in equations (5) and (6). In the first stage regressions, the simulated change in tax rates consistently and significantly explains the actual change in tax rates in the same state at the one percent level.[33] Their coefficients range from 0.31 to 0.53 across family types. The coefficients of the average simulated tax change in the neighboring states and non-neighboring states are only significant for some of the family types (the middle- and low-income families of married householders). When testing the joint significance of all simulated tax change variables as a whole, the F statistics are significant across the board at the one percent level.[34]

To further confirm the relevance of our instruments, we calculate the partial R2, namely the population R2 from the regression of the actual changes in tax rates on the instruments once the common exogenous variables have been partialled out of both. The partial R2 are markedly large for all family types (ranging from 0.667 to 0.995), indicating that the inconsistency of our IV estimates is relatively small when compared to OLS.[35] In addition, we conduct the over-identifying restriction test and fail to reject the null hypothesis that the instruments are uncorrelated with the error term

[33] Complete results of the first stage regressions and IV quality checks are available upon request.

[34] In addition, the joint F statistics of the first stage regressions are significant and large in size (ranging from 16 to 1713), which suggests that the finite sample bias of the IV estimates is negligible compared to those of OLS (about 1/1713 to1/16 of the bias of the corresponding OLS estimates).

[35] Intuitively, the large partial R^2 also suggest that our empirical strategy effectively isolates the changes in tax policies from other factors. This is particularly important due to the fact that the state-variant impacts of TRA 86 are associated with states' baseline tax systems, which raises a question as to how much of the TRA86-induced changes in income tax burdens are predicted by the baseline taxes and other characteristics of the states. In the process of obtaining the partial R^2, we regressed the TRA86-induced tax changes on all other exogenous characteristics of the states. We find that the majority of the coefficients and the joint F statistics are statistically insignificant. All together, the state characteristics explain only 0.01%–0.26% of the total variation in the TRA86-induced changes in income tax rates. Complete results are available upon request.

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of the main equation. This strengthens our confidence that the simulated tax changes are valid instruments.

Table 3 reports the regression results for the main equation.[36] For both the baseline income tax rate and the instrumented change in income tax rate, we consistently find positive coefficients for the origin states and negative coefficients for the destination states. A majority of these coefficients are statistically significant. In particular, the coefficients of the baseline tax rates are significant for all family types, and over half of the coefficients of the tax rate changes are significant. These results provide strong support for the role of income taxes in migration: higher income tax burdens encourage out-migration and discourage in-migration.

In general, the coefficients of the baseline income tax rates are greater than those of the concurrent tax changes. This is plausible since the concurrent tax changes are not fully observable to all individuals at the point of migration decision. We also find great variation across family types in terms of the sizes of these effects. In general, the marginal effects of income tax rates are markedly greater for the low-income group than for their higher-income counterparts in the same marital class. Similarly, the marginal effects of income tax rates are typically larger for the single groups than for their married counterparts of the same income class. Consequently, the largest marginal effects are found for the low-income families of single householders.

For this particular group, a one percentage point increase in the baseline income tax rate of a destination state would reduce the migration ratio by as much as 199 percent, and the same change in the origin state would increase the migration ratio by 130 percent. The concurrent changes in income tax rates also have sizable effects: the migration ratio between a specific pair of

[36] All reported results are from population-weighted regressions. However, the results from the non-weighted versions (not reported) are very similar to our reported results. We report the robust standard errors for all regressions. The differences between the robust and unadjusted standard errors vary across variables and family types. With few exceptions, the differences are well within 10% of the robust measure. Some explanatory variables included in the regression but not reported in the table are income ($+^*$, $+^*$), population density ($-$, $+^*$), temperature ($+^*$, $+^*$), crime ($+^*$, $+^*$), number of college ($+^*$, $+^*$), metropolitan ($-^*$, $-^*$), age: % 35–45 ($-^*$, $-^*$), race: % white ($+^*$, $+^*$), education: % some college ($+^*$, $-$), for both origin and destination states. The majority signs and significance of these coefficient estimates are shown in the parentheses, where the first coordinate indicates the origin and the second coordinate indicates the destination, and the symbol * denotes significance at 10% or below. Complete results are available upon request.

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Table 3: Determinants of log migration ratios by income group, IV regression

		Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
Δ (Income Tax Rate)	orig.	0.3352**	0.1448*	0.0094	0.0378	0.0595*	0.0176**
		(0.1337)	(0.0791)	(0.0271)	(0.0735)	(0.0339)	(0.0089)
	dest.	−0.3802***	−0.0087	−0.0837***	−0.0676	−0.0073	−0.0476***
		(0.1419)	(0.0856)	(0.0276)	(0.0710)	(0.0370)	(0.0091)
Income Tax Rate	orig.	1.2968***	0.2239***	0.0313***	0.2434***	0.0471***	0.0275***
		(0.3347)	(0.0515)	(0.0115)	(0.0528)	(0.0134)	(0.0076)
	dest.	−1.9878***	−0.2575***	−0.0846***	−0.1241**	−0.0545***	−0.0576***
		(0.3260)	(0.0560)	(0.0119)	(0.0518)	(0.0149)	(0.0076)
Sales Tax Rate	orig.	0.0031	0.0447***	0.0012	0.0462***	0.0178	0.0168
		(0.0113)	(0.0135)	(0.0124)	(0.0131)	(0.0126)	(0.0120)
	dest.	−0.0014	−0.0280**	−0.0508***	−0.0131	−0.0031	−0.0508***
		(0.0113)	(0.0131)	(0.0127)	(0.0136)	(0.0132)	(0.0127)
Property Tax Rate	orig.	0.0386	0.0411	0.0318	0.0310	0.0458	0.0817**
		(0.0331)	(0.0360)	(0.0376)	(0.0355)	(0.0377)	(0.0368)
	dest.	−0.0109	−0.0632*	−0.0287	−0.0363	−0.0632*	−0.1327***
		(0.0322)	(0.0363)	(0.0381)	(0.0339)	(0.0384)	(0.0354)
Education Expenditure	orig.	−0.0002	−0.0002	<.0001	−0.0001	0.0001	0.0001
		(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
	dest.	<.0001	0.0005***	<.0001	<.0001	0.0004***	0.0003**
		(0.0001)	(0.0001)	(0.0001)	(<.0001)	(0.0001)	(0.0001)

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Table 3: Determinants of log migration ratios by income group, IV regression (Continued)

		Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
Other Non-welfare Expenditure	orig.	−0.0001	−0.0002	−0.0001	<.0001	−0.0001	−0.0001
		(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
	dest.	0.0003***	0.0002**	0.0004***	<.0001	0.0001	0.0002**
		(0.0001)	(0.0001)	(0.0001)	(<.0001)	(0.0001)	(0.0001)
Max. Welfare Benefit	orig.	−0.0001***	−0.0001***	−0.0001*	−0.0001***	−0.0001***	−0.0001
		(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
	dest.	0.0001***	0.0001***	0.0001***	0.0001***	<.0001***	<.0001**
		(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
Cost of Living	orig.	0.0111	0.0116	0.0080	0.0398***	0.0179**	0.0084
		(0.0085)	(0.0090)	(0.0088)	(0.0090)	(0.0089)	(0.0089)
	dest.	−0.0521***	−0.0875***	−0.0827***	−0.0440***	−0.0801***	−0.0632***
		(0.0083)	(0.0087)	(0.0086)	(0.0089)	(0.0088)	(0.0088)
Unemployment Rate	orig.	0.0095	0.0274*	0.0132	0.0009	0.0136	0.0094
		(0.0143)	(0.0156)	(0.0152)	(0.0156)	(0.0153)	(0.0157)
	dest.	−0.0215	−0.0192	−0.0204	−0.0104	−0.0240	−0.0188
		(0.0155)	(0.0160)	(0.0156)	(0.0156)	(0.0158)	(0.0160)
Growth Rate	orig.	−0.0204	−0.0076	−0.0315**	−0.0137	−0.0156	−0.0023
		(0.0140)	(0.0148)	(0.0142)	(0.0144)	(0.0144)	(0.0145)
	dest.	0.0381***	0.0796***	0.0484***	0.0735***	0.1098***	0.0282*
		(0.0144)	(0.0145)	(0.0137)	(0.0142)	(0.0145)	(0.0145)

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Table 3: Determinants of log migration ratios by income group, IV regression (Continued)

		Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
ln (Population)	orig.	0.1739***	0.4061***	0.2545***	0.3412***	0.3858***	0.4009***
		(0.0486)	(0.0487)	(0.0475)	(0.0488)	(0.0480)	(0.0504)
	dest.	1.0186***	0.8318***	1.0546***	0.8634***	0.8231***	0.9066***
		(0.0532)	(0.0522)	(0.0499)	(0.0498)	(0.0486)	(0.0513)
ln (P^*_{gasline} Distance)		−0.3635***	−0.4847***	−0.3206***	−0.4698***	−0.5960***	−0.3930***
		(0.0237)	(0.0245)	(0.0252)	(0.0243	(0.0240)	(0.0250)
Border		0.6616***	0.7875***	0.5111***	0.7886***	0.7512***	0.5556***
		(0.0523)	(0.0541)	(0.0569)	(0.0527)	(0.0516)	(0.0549)
Constant		9.4288***	6.7143***	14.2502***	6.5483***	6.4143***	9.8169***
		(1.3776)	(1.5076)	(1.4722)	(1.4418)	(1.4928)	(1.4304)
Observations		2,256	2,256	2,256	2,256	2,256	2,256
Adj. R-squared		0.7575	0.7246	0.7706	0.7278	0.7288	0.7462
F Statistics (Prob > F)		191.18(<0.01)	147.53(<0.01)	189.14(<0.01)	162.94(<0.01)	159.50(<0.01)	165.98(<0.01)

Note: Robust standard errors adjusted for clustering and general heteroskedasticity are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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states would decrease by 38 percent if the income tax rate of the destination state increased by an additional one percentage point, and the ratio would increase by 34 percent if the same event occurred in the origin state.

It may seem surprising that income tax rates have such large marginal effects on the migration of low-income families of single householders. Largely due to the progressive nature of the nation's income tax system, taxes are not commonly perceived to have much relevance to low-income individuals.[37] However, literature shows that poor families may face substantial state tax liabilities in many states.[38] Our finding affirms that the role of income tax policies may not be overlooked in the migration decision of the poor. Meanwhile, the magnitude of the marginal effects for the single low-income group is in fact reasonable when the corresponding increment in tax rates is compared to the group's typical tax burdens. In our data, the average effective state income tax rate for this group was only 0.024 percent in 1985. Therefore, a one-percentage-point increase in the tax rate would represent a dramatic change for these families, a change that is 41 times as large as their typical tax rates. In contrast, for the high-income families of married householders, the same change in the tax rate is only 22 percent of their average state income tax rate in 1985 (4.59 percent). For the latter group, such an increase in the baseline income tax rate of the destination (origin) state would reduce (increase) the migration ratio by 5.8 percent (2.7 percent), and the same increase in the concurrent change in the tax rate of the destination (origin) state would reduce (increase) the migration ratio by 4.8 percent (1.8 percent).[39]

[37]An example is the scholarly research on the relationship between social policies and the migration behaviors of low-income individuals. While this subject has received great attention in poverty research, existing studies generally focused on the incidence of state welfare policies, namely the "welfare magnet effect", and gave little attention to the closely related tax policies. See for example Allard and Danziger (2000) and Bailey (2005).

[38]For example, Levitis and Johnson (2006) reported that two-parent families of four with incomes below the federal poverty line are liable for state income taxes in 19 out of the 42 states that levy income taxes, and poor single-parent families of three pay state income taxes in 16 of the 42 states. Similar results were reported in Oliff and Singham (2010) as well.

[39]We thus calculate the predicted change in migration ratio for an increase in tax rates equivalent to (1) 100% of the group average rate in 1985, and (2) the group mean of the observed changes in state income tax rates between 1985–1989, which is −0.0389 for the single low-income and −0.8177 for the married high-income. Calculation (1) of the destination (origin) effect yields a 4.85% reduction (3.16% increase) in the migration ratio for the single

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As can be seen in the results summarized above, the coefficients associated with the destination state are often greater in size than those with the origin state (the case for 9 out of 12 pairs of coefficients). This is likely a result of the high fixed costs associated with moving. Attachment to home, social network, and the monetary costs required for an inter-state move may deter individuals from moving out of a state, even when the living conditions in the state have become somewhat less desirable (for example, due to higher taxes). In contrast, for those who are planning or willing to move, they can avoid destinations that are less desirable with no additional costs. This result is particularly insightful as it stresses the role of taxes on the margin, even though they are likely not the primary consideration in a family's decision to move.

The coefficients of the other policy variables are largely consistent with expectation. In particular, higher non-income tax burdens (sales or property tax rates) also discourage in-migration and encourage out-migration for some family types. For example, property tax rates have the greatest impact on the migration ratio of the high-income families of married householders.[40] With respect to expenditure policies, migration into a state significantly increases with state welfare generosity and non-welfare expenditures, but only the former has a significant (and negative) effect on out-migration.

low-income group and 26.42% (12.62%) for the married high-income group. Calculation (2) of the destination (origin) effect leads to a 7.73% change (5.05%) in the migration ratio for the single low-income and 4.71% (2.25%) for the married high-income.

[40]In contrast to the typical results in existing studies, we consistently find that high property tax rates encourage out-migration and decrease in-migration. Previous studies on interstate migration, for example Clark and Hunter (1992) and Conway and Houtenville (1998, 2001), commonly encountered a so-called "same sign" problem with property taxes, namely, the estimated effects of property taxes on in- and out-migration share the same sign. The common explanation for this anomalous result was that property taxes vary greatly within a state and that the state-level property tax measure likely captures some unobserved differences across states, such as the quality of public services. However, these studies typically measured the property tax burden in a state using the ratio of property tax revenue to state expenditure or the property tax revenue per capita. We believe that these measures do not effectively capture the role of property taxes as a component of housing costs, and they likely reflect the differences in property values and therefore the amenity levels across states. Unlike these studies, we use state averages of effective property tax rates, namely the ratio of property tax liability to property value, and our coefficients have the correct signs. Our results provide an alternative explanation for the same sign problem that has plagued previous studies.

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Among the non-policy controls, state cost of living proves to be an important factor in explaining migration ratios, especially for the destination states. A one-percentage-point increase in the cost of living index for the destination state would significantly reduce the migration ratio by 4.4 to 8.7 percent. State growth rate is another economic factor that appeared to attract migrants. Their coefficients for the destination states are statistically significant with a size ranging from 0.028 to 0.110. Like the cost of living, the growth rate in the origin state does not significantly affect migration ratios for most family types. We also find evidence supporting the gravity model: Migration ratios significantly increase with state population (origin or destination) and decrease with the fuel-cost weighted distance. Similarly, we find that migration ratios are significantly higher between states sharing a border than those that do not.

For most other control variables, the coefficients for the origin and destination states share the same signs when significant. These include the demographic controls (such as income, age and race) and other general characteristics of the states (such as temperature, crime-to-population ratio, number of colleges and metropolitan dummy).[41] These coefficients likely capture the general mobility of a demographic group or the population turnover associated with the state attribute. The same-sign results are commonly found in literature for these variables.

5.2 Change-in-migration model

Table 4 reports the main equation results from the change-in-migration model (first-differenced IV regression).[42] With all between variations dif-

[41] These coefficients are unreported but instead summarized in a footnote of the table.

[42] The results from the first stage regression and the tests for IV are available upon request. The simulated change in tax rates due to TRA86 significantly explain the observed change in tax rates in the same state between 1979 and 1989. We calculate the partial R2 and perform the OIR test with satisfactory results. Some explanatory variables included in the regression but not reported are income ($-^*$, $-^*$), population density ($-^*$, $-^*$), temperature ($+^*$, $+^*$), crime ($+$, $-^*$), number of college ($-^*$, $-^*$), metropolitan ($+$, $+^*$), age: % 35–45 ($+$, $-$), race: % white ($+^*$, $-$), education: % some college ($+^*$, $+$), for both origin and destination states. The majority signs and significance of parameter estimates for each variable are shown in parentheses, where the first coordinate indicates the origin and the second coordinate indicates the destination, and the symbol * denotes significance at 10% or below. Complete results are available upon request.

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Table 4: Determinants of change in log migration ratios by income group, first-differenced IV regression

		Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
Δ (Income Tax Rate)$_{79--89}$	orig.	0.0616	0.0837	0.0359	0.0733	0.0733*	0.0105
		(0.1355)	(0.0777)	(0.0507)	(0.0568)	(0.0392)	(0.0077)
	dest.	−0.2339*	−0.1051	−0.0123	−0.1795***	−0.0252	−0.0134*
		(0.1391)	(0.0859)	(0.0490)	(0.0554)	(0.0392)	(0.0080)
Sales Tax Rate	orig.	0.0244	0.0122	0.0438	0.0429	0.0171	0.0322
		(0.0283)	(0.0281)	(0.0269)	(0.0290)	(0.0283)	(0.0269)
	dest.	−0.0595**	−0.0731***	−0.0216	−0.0121	−0.0785***	−0.0215
		(0.0279)	(0.0277)	(0.0282)	(0.0280)	(0.0263)	(0.0267)
Property Tax Rate	orig.	0.0822	0.0053	0.0274	0.0259	0.0182	0.0287
		(0.0587)	(0.0589)	(0.0598)	(0.0585)	(0.0583)	(0.0591)
	dest.	−0.0715	−0.0341	−0.1168**	−0.1801***	−0.1022*	−0.1541***
		(0.0613)	(0.0600)	(0.0587)	(0.0597)	(0.0570)	(0.0582)
Education Expenditure	orig.	−0.0004	−0.0003	−0.0004*	−0.0001	−0.0005**	−0.0004
		(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
	dest.	0.0006***	0.0004*	0.0004	<.0001	0.0004*	0.0003
		(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Other Non-welfare Expenditure	orig.	−0.0001	−0.0001	−0.0001	−0.0001	−0.0002**	−0.0001
		(<.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
	dest.	0.0003***	0.0002**	0.0001	0.0003***	0.0002	0.0002**
		(<.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Max. Welfare Benefit	orig.	−0.0001***	−0.0001***	−0.0001***	−0.0001*	−0.0001**	−0.0001***
		(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)
	dest.	−0.0001	−0.0001	<.0001***	−0.0001	<.0001**	<.0001
		(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(<.0001)

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Table 4: Determinants of change in log migration ratios by income group, first-differenced IV regression (continued)

		Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
Cost of Living	orig.	0.0395***	0.0409***	0.0150	0.0480***	0.0484***	0.0361**
		(0.0138)	(0.0143)	(0.0138)	(0.0146)	(0.0148)	(0.0157)
	dest.	−0.0002	−0.0204	−0.0190	−0.0691***	−0.0413***	−0.0188
		(0.0137)	(0.0139)	(0.0139)	(0.0148)	(0.0143)	(0.0152)
Unemployment Rate	orig.	0.0036	0.0172	0.0004	0.0154	0.0051	0.0032
		(0.0135)	(0.0131)	(0.0131)	(0.0132)	(0.0130)	(0.0142)
	dest.	−0.0269**	−0.0291**	−0.0652***	−0.0267**	−0.0009	−0.0450***
		(0.0131)	(0.0133)	(0.0137)	(0.0135)	(0.0134)	(0.0141)
Growth Rate	orig.	−0.0353***	−0.0520***	−0.0118	−0.0186	−0.0385***	−0.0279**
		(0.0133)	(0.0125)	(0.0144)	(0.0134)	(0.0139)	(0.0134)
	dest.	0.0309**	0.0144	0.0732***	0.0377***	0.0275*	0.0575***
		(0.0127)	(0.0133)	(0.0146)	(0.0137)	(0.0143)	(0.0131)
ln (Population)	orig.	1.5875***	1.2685***	0.4877*	1.4143***	1.5925***	0.7657***
		(0.2490)	(0.2819)	(0.2757)	(0.2743)	(0.2656)	(0.2812)
	dest.	0.3127	0.3406	1.0429***	0.4785*	0.1106	1.3945***
		(0.2594)	(0.2776)	(0.2696)	(0.2871)	(0.2662)	(0.2815)
ln ($P^*_{gasoline}$ Distance)		−5.8957***	−7.1163***	−4.5397***	−1.4168	−4.2937***	−2.0481*
		(1.1171)	(1.1092)	(1.1991)	(1.1528)	(1.1398)	(1.2335)
Constant		−0.5848	−1.8189***	0.0755	−1.7414***	−1.9429***	0.7799
		(0.6266)	(0.6286)	(0.6431)	(0.6312)	(0.6578)	(0.6913)
Observations		2,256	2,256	2,256	2,256	2,256	2,256
Adj. R-squared		0.1988	0.1591	0.2089	0.2839	0.2134	0.2463
F Statistics		17.91(<0.01)	13.95(<0.01)	19.88(<0.01)	26.73(<0.01)	19.02(<0.01)	23.82(<0.01)

Note: Robust standard errors adjusted for clustering and general heteroskedasticity are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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ferenced away, the marginal effects of income tax burdens appear smaller and/or less significant for most family types, compared to the level regression results shown in Table 3. However, the directions and patterns of these effects are similar in the two models. In particular, the instrumented changes in the income tax rates of the destination states between 1979 and 1989 have negative coefficients, and those of the origin states have positive coefficients. The coefficients of the destination states are statistically significant in three out of six family types, while the coefficients of the origin state are insignificant except for the middle-income families of married householders. We again find that the income tax effects (especially those of the destination states) are typically larger for the lower income families than for the higher income. For the most influenced family type, the low-income families of single householders, an additional one-percentage-point increase in the income tax rate of the destination state led to a reduction in the migration ratio by 23.4 percent between the two migration periods.

The effects of the other control variables are also robust to the differencing approach in terms of their directions. We continue to find increased migration ratio when the destination/origin state experienced a reduction/increase in the undesirable attributes (such as their non-income taxes, cost of living and unemployment rate) or an improvement/reduction in the desirable attributes (such as public expenditures, welfare generosity and growth rate). We again find support for the gravity model that increased population or reduced fuel-cost weighted distance would lead to significant increases in log migration ratios. Interestingly, the coefficients of the fuel-cost weighted distance are much greater in the differenced specification, compared to those in Table 3. Since the over-time changes in this variable come from changing gasoline prices, the large marginal effects suggest a significant role of transportation costs in migration behaviors.

5.3 Sensitivity checks

For both models presented above, we compare our results among alternative specifications. We first inspect whether and how the coefficients of the baseline tax control are affected by the inclusion of the instrumented tax changes. We then check for the sensitivity of the income tax coefficients to the inclusion of other state characteristics.

Table 5a compares the coefficients of the income tax variables from alternative regressions of log migration ratio, including those from the full

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specification. When the concurrent tax change is removed from the control list (see Specification (2)), the coefficients of the baseline income tax rates maintain the same signs. However, the size difference between the destination and origin effects reduces: The greater destination effects previously observed in the full specification (see Specification (1)), become less pronounced and even reversed in one occasion when tax changes are omitted from the regressions. When we control for both income tax variables but exclude all other state characteristics (see Specification (3)), the coefficients change in magnitudes but they all retain the same signs as in the full specification.

For the change in migration model, we compare the full specification to the short regression which includes only the instrumented tax changes on the right-hand side. The coefficients of the tax changes are reported in Table 5b. We again find identical signs between the two specifications. The robustness of the signs adds to our confidence for the effects of income taxes on interstate migration.

5.4 How important are taxes in explaining migration?

To assess the overall and relative importance of taxes and other factors in explaining migration, we group the explanatory variables in five categories and calculate the portion of the total variance in the dependent variable attributable to the marginal effects of each group, namely the effect size measured by the ratio of marginal sum of squares to total sum of squares (in percentage).[43] The five categories are: 1) tax factors, 2) government expenditures, 3) cost of living and economic factors, 4) gravity and spatial interaction, and 5) other control variables.[44]

Table 6a and 6b present the measures for the analysis of variance corresponding to the regression models. It should be noted that a marginal sum of squares does not include the indirect effects of the group through the correlation with the other explanatory variables. Consequently, the sum of marginal sums of squares is considerably smaller than the explained sum of squares from the full model.

[43] The marginal sum of squares for each group is the difference between the explained sum of squares from the full regression model and the regression that exclude the specified group of explanatory variables.

[44] See Table 2 for a list of variables in each category.

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Table 5a: Coefficients of income tax variables in alternative specifications, IV regression

		Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
(1) *Full control list*							
Δ (Income Tax Rate)$_{85-89}$	orig.	0.3352**	0.1448*	0.0094	0.0378	0.0595*	0.0176**
		(0.1337)	(0.0791)	(0.0271)	(0.0735)	(0.0339)	(0.0089)
	dest.	−0.3802***	−0.0087	−0.0837***	−0.0676	−0.0073	−0.0476***
		(0.1419)	(0.0856)	(0.0276)	(0.0710)	(0.0370)	(0.00918)
Income Tax Rate $_{85}$	orig.	1.2968***	0.2239***	0.0313***	0.2434***	0.0471***	0.0275***
		(0.3347)	(0.0515)	(0.0110)	(0.0528)	(0.0134)	(0.0076)
	dest.	−1.9878***	−0.2575***	−0.0846***	−0.1241**	−0.0545***	−0.0576***
		(0.3260)	(0.0560)	(0.0119)	(0.0518)	(0.0149)	(0.0076)
(2) *Drop* Δ *Tax*							
Income Tax Rate $_{85}$	orig.	1.5413***	0.2701***	0.0285***	0.2668***	0.0655***	0.0226***
		(0.3235)	(0.0459)	(0.0078)	(0.0264)	(0.0086)	(0.0071)
	dest.	−1.7106***	−0.2602***	−0.0590***	−0.1660***	−0.0567***	−0.0446***
		(0.3086)	(0.0472)	(0.0080)	(0.0264)	(0.0087)	(0.0073)
(3) *Tax variables only*							
Δ (Income Tax Rate)$_{85-89}$	orig.	0.6761***	0.0417	0.0142	0.1698	0.1567***	0.0633***
		(0.1611)	(0.1167)	(0.0434)	(0.1051)	(0.0520)	(0.0111)
	dest.	−1.2782***	−0.0745	−0.0829**	−0.1234	−0.1084**	−0.0240*
		(0.1693)	(0.1218)	(0.0357)	(0.1024)	(0.0540)	(0.0127)
Income Tax Rate $_{85}$	orig.	3.5422***	0.2153***	0.0199	0.0874	0.0513***	0.0125
		(0.5455)	(0.0740)	(0.0166)	(0.0688)	(0.0190)	(0.0112)
	dest.	−7.9313***	−0.6967***	−0.1036***	−0.3185***	−0.1304***	−0.0458***
		(0.5696)	(0.0762)	(0.0158)	(0.0700)	(0.0199)	(0.0111)

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Table 5b: Coefficients of income tax variables in alternative specifications, first-differenced IV regression

		Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
(1) *Full control list*							
Δ (Income Tax Rate)$_{79-89}$	orig.	0.0616	0.0837	0.0359	0.0733	0.0733*	0.0105
		(0.1355)	(0.0777)	(0.0507)	(0.0568)	(0.0392)	(0.0077)
	dest.	−0.2339*	−0.1051	−0.0123	−0.1795***	−0.0252	−0.0134*
		(0.1391)	(0.0859)	(0.0490)	(0.0554)	(0.0392)	(0.0080)
(2) *Tax variables only*							
Δ (Income Tax Rate)$_{79-89}$	orig.	0.1354	0.0255	0.0417	0.1300**	0.1182***	0.0230***
		(0.1122)	(0.0617)	(0.0261)	(0.0520)	(0.0297)	(0.0062)
	dest.	−0.3115**	−0.2021***	−0.1548***	−0.0013	−0.1474***	−0.0006
		(0.1220)	(0.0737)	(0.0261)	(0.0521)	(0.0318)	(0.0071)

Note: Robust standard errors adjusted for clustering and general heteroskedasticity are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Table 6a. Analysis of variance (ANOVA), log migration ratio, IV regression

Marginal-to-Total SS Ratio (%) by Groups of Predictors	DF	Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
Tax Factors	8	0.68% (8.11)***	0.62% (8.72)***	0.76% (10.25)***	0.44% (18.25)***	0.39% (14.48)***	1.34% (10.71)***
Government Expenditures	8	0.33% (5.07)***	0.83% (10.97)***	0.59% (9.01)***	0.53% (7.00)***	0.44% (6.36)***	0.15% (2.41)***
COL & Economic Factors	10	1.22% (13.72)***	1.41% (15.39)***	1.13% (14.86)***	1.71% (18.46)***	1.84% (20.06)***	0.75% (9.23)***
Gravity & Spatial Interaction	4	17.15% (371.30)***	24.81% (488.05)***	12.65% (281.58)***	24.24% (509.31)***	29.81% (611.43)***	14.77% (316.68)***
Other Control Variables	16	4.38% (24.93)***	3.34% (16.77)***	2.94% (16.13)***	3.36% (18.55)***	3.70% (19.60)***	1.00% (5.96)***
Sum of marginal SSs		632.01	797.50	538.49	782.86	929.53	526.41
Explained SS of full model	46	2,027.38	1,876.95	2,309.56	1,895.34	1,885.54	2,194.12
Residual SS of full model	2,209	633.05	695.05	670.87	690.91	683.87	727.80
Total SS	2,255	2,660.43	2,572.00	2,980.43	2,586.25	2,569.41	2,921.92

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Table 6b. Analysis of variance (ANOVA), change in log migration ratio, first-differenced IV regression

Marginal-to-Total SS Ratio (%) by Groups of Predictors	DF	Families of Single Householders			Families of Married Householders		
		lower 25%	middle	upper 25%	lower 25%	middle	upper 25%
Tax Factors	6	0.42% (2.26)***	0.43% (1.78)*	0.30% (1.40)	0.77% (4.67)***	0.63% (3.14)***	0.50% (2.63)***
Government Expenditures	8	0.86% (3.91)***	0.58% (2.61)***	0.67% (3.15)***	0.46% (2.51)***	0.63% (3.01)***	0.71% (3.20)***
COL & Economic Factors	10	3.04% (11.43)***	2.60% (9.25)***	5.20% (17.22)***	5.40% (21.09)***	2.53% (8.86)***	6.33% (24.40)***
Gravity & Spatial Interaction	3	2.09% (20.56)***	1.91% (17.07)***	1.42% (13.39)***	0.92% (9.61)***	1.43% (14.51)***	1.27% (13.57)***
Other Control Variables	16	4.55% (9.79)***	4.60% (9.05)***	4.79% (9.99)***	7.03% (15.78)***	5.65% (11.73)***	5.17% (11.52)***
Sum of marginal SSs		116.22	101.89	132.02	183.57	118.85	173.08
Explained SS of full model	43	225.33	174.77	237.42	373.03	248.50	321.11
Residual SS of full model	2,212	834.50	831.86	829.02	885.98	846.19	916.97
Total SS	2,255	1,059.84	1,006.63	1,066.44	1,259.00	1,094.69	1,238.08

Note: Each column represents a separate regression. Values in parentheses are F-statistics for the joint significance of the group. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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With the exception of the high-income families of married householders, for which the marginal-to-total sum of squares ratio is 1.34% in the model of log migration ratio, the direct effects of taxes explain less than one percent of the total variance in log migration ratio. The explanatory power of the tax effects is the greatest for the high-income families in each marital class, followed by the low-income and the-middle income. However, these differences across family types are generally unremarkable.

The effects of the other type of state fiscal policies, government expenditures, have comparably small explanatory power. They account for only 0.15% to 0.83% of the variance in log migration ratio. Compared to the fiscal policies, costs of living and other economic factors have a somewhat greater role, explaining around one to two percent of migration variance. Among all five groups of control variables, the gravity and spatial interaction factors account for by far the greatest portion of total variance in log migration ratio, from 12.65% to nearly 30%. The remaining control variables, including demographic and environmental factors, account for 1% to 4.38% of the total variance in log migration ratio.

Interestingly but not surprisingly, the importance of the gravity and spatial interaction effects diminishes in the change in migration model. As all time-invariant elements are differenced away, the border dummy drops from the regressions and the marginal effects of the changes in populations and fuel-cost weighted distance explain merely two percent or less of the variance in the change in log migration ratios over the decade. On the other hand, the explanatory power of the cost of living and other economic factors rises, accounting for 2.5% to 6.33% of the variance in the change in migration. The marginal-to-total sum of squares ratios of taxes, government expenditures, and other control variables in the change in migration model are largely comparable to those in the regressions of log migration ratio.

6 Conclusions

In this paper, we utilize TRA86 as a natural experiment to isolate the causal effects of income taxes on interstate migrations. For the migration period of 1985 to 1990, we estimate the 48 by 47 pairs of interstate migration ratios in the United States as a function of the baseline income tax rates as well as the subsequent changes in these rates during the period. To address the endogeneity issue of the observed changes in income tax rates, we simulate the state-variant impact of TRA86 on income tax rates and use it as

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an instrument for the observed tax changes. To further eliminate potential bias arising from an association between the baseline controls and unobserved state fixed effects, we also estimate a first-differenced IV regression model, in which we regress the changes in migration between the periods of 1975–1980 and 1985–1990 on the changes in state characteristics, including the instrumented changes in income tax rates between 1979 and 1989.

Our results suggest that, though not a primary consideration, income tax burdens do affect migration decisions on the margin. Baseline income tax rates and concurrent changes in these rates both have significant marginal effects on log migration ratios during 1985–1990. More importantly, we consistently find positive effects for the income tax measures in the origin states and negative effects for those in destination states, even when all time-invariant components of the migration equation have been differenced away. The destination effects are generally more prominent than the origin effects. This pattern is reasonable and reassuring as it conveys that the effects of income taxes on migration are more prevalent on the marginal individuals who are prepared to move. Taken together, these results provide strong evidence that an increase in state-specific tax burdens would promote migration outflows and discourage migration inflows.

The comparison across family types also provides interesting insights. Contrary to the common perception, income tax rates have significant marginal effects on the migration ratios of low-income families. In terms of the explained proportion of total variance in migration in the analyzed periods, the effects of tax factors are largely comparable across family types.

What have we learned, then, from these results? Skeptics of tax-induced migration may stress that jobs, schools, and life styles are the determining factors of migration behaviors and expect a complex and subtle matter such as income taxes to have little relevance in this costly decision. This skepticism is partially confirmed in our analysis, in which the direct effects of tax factors explain less than 1% of the total variation in our migration measures. However, the significant marginal effects of the taxes suggest that their roles in migration decisions should not be ignored. With sufficiently large changes in tax burdens, a state can experience sizable differences in migration patterns, especially in terms of attracting or repelling future immigrants to the state.

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為避稅而遷徙? 以美國1986年稅制改革法案為自然實驗

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現有文獻中, 稅負誘發的遷徙研究常受限於財稅政策變數的內生性問題。本文利用美國 1986 年的稅制改革法案爲自然實驗, 以此擷取出所得稅變動在各州間的外生變異, 並使用工具變數迴歸模型及一次差分的計量方法, 估算稅負差異對於美國跨州遷徙行爲的因果效應。本研究結果顯示, 一州所得稅率的提高會促進其青壯年人口外流並降低人口移入, 而對後者的影響通常比前者更強。但儘管所得稅及其他財稅變數對遷徙行爲有顯著的邊際影響, 我們發現重力模型、地域關聯性、生活成本及其他經濟因素, 對跨州遷徙行爲的變異有更高的解釋力。

關鍵詞: 中央與地方所得稅, 遷徙行爲, 租稅競爭, 稅制改革, Tiebout 模型
JEL 分類代號: C36, H24, H73, J61

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