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Asymmetric Policy Interaction among Subnational Governments: Do States Play Welfare Games?

David N. Figlio
Department of Economics
University of Oregon
E-mail: dfiglio@oregon.uoregon.edu

Van W. Kolpin
Department of Economics
University of Oregon

William E. Reid
Department of Economics
University of Oregon

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Abstract

This paper explores the possibility that states respond asymmetrically to increases versus decreases in their neighboring states' welfare benefit levels. We present a theoretical model suggesting that states respond more to decreases than to increases in their neighbors' benefit levels. To test this proposition empirically, we use a panel of annual state-level data from 1983 to 1994 for each of the contiguous United States and the District of Columbia, and we observe changes in state demographic and economic characteristics as well as changes in state welfare benefits. We find substantial empirical evidence that uniformly supports our argument. State responses to neighbor benefit decreases tend to be at least twice as large as their responses to neighbor benefit increases. Our empirical results are robust to modeling neighbor benefits as endogenous. Our results, therefore, have substantial implications for public policy in the wake of the increased decentralization of welfare policy associated with the welfare reforms of 1996.

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This paper presents a theoretical model suggesting that states respond asymmetrically to increases versus decreases in their neighboring states' welfare benefit levels. To test this proposition empirically, we use a panel of annual state-level data from 1983 to 1994 for each of the contiguous United States and the District of Columbia, and we observe changes in state demographic and economic characteristics as well as changes in state welfare benefits. We find empirical evidence that uniformly supports our argument. Our empirical results are robust to modeling neighbor benefits as endogenous, using an approach similar to that employed by Besley and Case (1995). Our results, therefore, have substantial implications for public policy in the wake of the increased decentralization of welfare policy associated with the welfare reforms of 1996.

Few current public policy issues have received the attention that has been focused on the decentralization of welfare benefit-setting. The Personal Responsibility and Work Opportunity Reconciliation Act of 1996, passed with bipartisan support, considerably increased individual states' autonomy in supervising their own welfare programs. Specifically, the new law replaced the federally managed Aid to Families with Dependent Children (AFDC) program with a system of block grants to states. Although states now have considerably more flexibility to devise their own welfare programs than they did under the previous law, further decentralized benefit-setting may exacerbate an interjurisdictional externality. That is, the new law increases the possibility, at least in theory, that states will be affected by their neighbors' welfare benefit policies. We are by no means the first authors to make this argument. For instance, researchers such as Stigler (1957), Gramlich (1987), and Brown and Oates (1987) have suggested that decentralized welfare benefit-setting could lead to a "race to the bottom."

How do states respond to their neighbors' policies? Several interesting recent papers address the issue of state policy interdependence. Case, Rosen, and Hines (1993), for instance, find empirical evidence that state fiscal policies are interdependent. Besley and Case (1995) also show that a state's tax changes are significantly correlated with those of the state's neighbors. The existing evidence on state welfare policy interdependence is much less conclusive. While Gramlich and Laren (1984) find evidence of a positive correlation between own-state and neighbor-state benefits, Shroder (1995), estimating a structural model and reviewing a different time period, uncovers little evidence to suggest that states set welfare benefit policies interdependently. Ribar and Wilhelm (1994), in the only paper to our knowledge to empirically treat states' benefit levels as simultaneously determined, find mixed evidence concerning the interrelationship of states' benefit levels.

Every paper in the empirical literature on state policy interdependence, be it related to welfare benefit-setting or a host of other policies, has effectively imposed the restriction that governments respond symmetrically to each others' policy changes.[1] That is, prior authors have forced a state's response to *increases* in a neighbor's welfare benefit (or fiscal policy changes) to be symmetric to the state's response to *decreases* in a neighbor's welfare benefit (or fiscal policy change) of the same magnitude. This, however, may not characterize a state's responses to others' policy changes. We present a theoretical argument suggesting that states should systematically respond differently to increases versus decreases in their neighbors' welfare benefits. In particular, we show that under a relatively innocuous set of assumptions, states match their neighbors' benefit decreases more closely than they follow their neighbors' benefit increases. While our illustration pertains explicitly to welfare benefit-setting, a similar type of argument could be made for many other types of policies, such as the setting of tax rates, industrial investment incentives, or other expenditure policies.

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[1]Brueckner (1996) and Brueckner and Saavedra (1997) explore policy interdependence at the *local* level. These papers also impose symmetry restrictions.

We find substantial empirical evidence that states indeed respond to changes in neighbor benefits in this manner. Using state welfare benefit data from the late 1980s and early 1990s, and modeling state welfare benefit decisions as simultaneous, we show that while states do not appear to follow each other's welfare benefit increases, they do seem to respond to each other's benefit decreases. We also theorize that this asymmetric response becomes greater as the expected costs of potential welfare migrants increase. This proposition is also supported in the data, to the extent that racial dissimilarity is a reasonable proxy for perceived differences in costs of providing welfare. States appear to respond more to states with racial composition less similar to their own, all else being equal. Since the new welfare law allows even more state independence in setting benefit levels, we expect our results to be strengthened by the new policy regime.

1. A MODEL OF INTERSTATE COMPETITION IN WELFARE BENEFIT-SETTING

This section provides a theoretical foundation upon which our empirical results can be interpreted. We begin by presenting an abstract framework for analyzing welfare gaming between multiple states. We then use this framework to argue that it is exceedingly unlikely for states consistently to behave symmetrically in response to the potential increases and decreases in the welfare benefits offered by a competitor. Moreover, one may well expect benefit decreases to induce a more pronounced impact than would benefit increases of a comparable magnitude.

The set of all state governments, the strategic players of the game, is represented by the set N={1,...,n}. Each state begins the game with an initial welfare benefit level. The profile of initial benefit levels of each respective state is denoted by the vector $(b_i)_{i\in N}\in\Re_+^N$. The state's strategic choice variable is β_i , the degree to which state i chooses to modify its benefits. States are free to set their final benefits at any non-negative level, implying that state i's set of feasible strategies is represented by $[-b_i , +\infty)$. Each state $i \in N$ is also endowed with an initial population of welfare recipients denoted by R_i . The final population of welfare recipients is determined by this initial population, mobility between workforce and welfare populations, and migration between states. For convenience, we simply assume that the latter two factors are linear in $(\beta_i)_{i \in N}$.[2] To be precise, for each $i \in N$ we assume there exists $\lambda_i > 0$ such that the "creation" of new welfare recipients out of the state's own work force is represented by $\lambda_i \beta_i$. Migration is modeled by assuming that for each $j \neq i$ there exists a positive constant $\mu_{ij} = \mu_{ji}$ such that migration from state i to state j is given by $\mu_{ij}(\beta_i - \beta_j)$, migration being into state i if this term is positive and out of state i if it is negative. The final total of state i welfare recipients is thus given by $R_i + \lambda_i \beta_i + \sum_{j \neq i} \mu_{ij}(\beta_i - \beta_j)$.[3]

Now consider the incentives that states face when modifying their benefit levels. As in Brown and Oates (1987) or Gramlich (1987), we assume that each state effectively views its own benefits as a public good. Let $W_i : \Re_+ \rightarrow \Re_+$ characterize the social welfare induced by publicly provided benefits. We assume that W_i is concave and that $W_i'(0) > 0$, i.e., W_i is initially increasing.[4]

State benefits also impose costs on society. For simplicity, we initially assume that these costs can be decomposed into two additive components. The first component involves direct expenditure costs, the product of per capita benefits and the number of recipients. The second cost component represents indirect costs attributable to welfare recipients, which we assume are characterized by an increasing

[2]Of course, worker mobility and migration can be formally modeled by introducing elements of worker productivity and preferences for state residence into our model. However, the introduction of such complexity does not alter the central insight that benefit increases and decreases cannot be expected to have a symmetric impact on competing states.

[3]Note that this specification implicitly assumes that initial benefits and recipient population are in a "migrational equilibrium" in the sense that recipient populations will change only if there is a change in the benefits offered.

[4]The social welfare function we consider should be thought of as accounting for changes in the benefits received by those dependent on aid, as well as changes in productivity which result from changes in the size of the work force. This detail can formally be captured by introducing labor markets similar to that considered in Wildasin (1991). As noted in footnote 2, these additional elements of realism are superfluous in the sense that they in no way alter our central conclusion regarding the asymmetry of benefit-setting behavior.

convex function $C_i^r:\Re_+ \rightarrow \Re_+$. Such costs may, for instance, be due to increased expenditures on public health care, education, or other public programs as a consequence of increased welfare population.

In the welfare benefits game we have just constructed, states simultaneously modify their benefits seeking to maximize net welfare. Formally, the net welfare of state i is defined by $W_i(b_i+\beta_i)$ - $(b_i+\beta_i)(R_i+\lambda_i\beta_i + \sum_{j\neq i} \mu_{ij}\bullet(\beta_i-\beta_j))$ - $C_i^r(R_i+\lambda_i\beta_i +\sum_{j\neq i} \mu_{ij}\bullet(\beta_i-\beta_j))$, where the second component is the direct expenditure cost of welfare spending and the third component reflects the indirect costs attributable to welfare recipients. A profile of strategies $(\beta_i{}^*)_{i\in N}$ is an equilibrium if no state can unilaterally choose an alternative strategy to increase its net welfare.

We are particularly interested in determining how equilibria respond to symmetric disturbances in this interactive environment. To clarify the comparison sought, we offer the following formal definition.

> DEFINITION: Let Γ be a welfare game that is initially in equilibrium, i.e., β_i=0 for all $i\in N$ constitutes an equilibrium. Suppose a perturbation of Γ affects only the preferences of states in $J\subseteq N$. We shall say that there has been a ***positive shock*** to J if $\beta_j{}^*>0$ for all $j\in J$ and we shall say that there has been a ***negative shock*** to J if $\beta_j{}^*<0$ for all $j\in J$; where $(\beta_i{}^*)_{i\in N}$ denotes the post-shock equilibrium. Positive and negative shocks to J are said to be ***symmetric*** if $\beta_j^+=\beta_j^-$ for all $j\in J$; where $(\beta_i^+)_{i\in N}$ is the positive shock equilibrium and $(-\beta_i^-)_{i\in N}$ is the negative shock equilibrium.

Note that this definition does not measure shocks by the impact on primitives such as state preferences. Instead, a shock is classified as either positive or negative on the basis of whether equilibrium benefits have increased or decreased. Consequently, the observed magnitude of a shock depends on the physical change in primitives as well as the anticipated reactions of *all* states in the system. Note also that symmetric shocks need not have been caused by perturbations of the same magnitude. An advantage of defining shocks in this manner is that empirically we only observe the change in a state’s benefit level, which reflects not only the initial perturbation but also the equilibrium responses to other states, rather than ever directly the exogenous perturbation itself.

PROPOSITION 1: Symmetric positive and negative shocks to $J \subseteq N$ will necessarily have a symmetric impact on benefits offered by each state $i \notin J$ if and only if the social welfare and indirect cost functions of each state $i \notin J$ are quadratic (that is, have constant second derivatives) throughout the range of feasible equilibria.

Proposition 1, which we prove in the Appendix, reveals that only an exceedingly narrow class of welfare games will induce symmetric behavior as a response to symmetric shocks. Indeed, the class of "quadratic" welfare games described above is negligible within the space of all possible welfare games. Consequently, one would generally expect asymmetric responses to symmetric shocks to be the rule.

Although we have asserted that asymmetry will typically prevail, this conclusion does not specify which direction, if any, the asymmetry will be biased. Later in this paper, we shall address this question empirically. For now, we consider it reasonable to expect that negative shocks will be followed more closely by neighboring states than will positive shocks. Recall that each state's social welfare function embodies both concern for the quality of life of welfare recipients and concern for lost productivity when citizens are lured out of the work force by attractive benefit levels. Recall also that we are attempting to model the decisions made by those in charge of setting these benefit levels. Decreases in state productivity levels and increases in unemployment levels are likely to be factors that such agents are particularly concerned about. Consequently, it seems plausible to assume that over the observable range of benefits, marginal social welfare is itself concave, i.e., marginal social welfare decreases at an increasing rate. Similarly, it is easy to imagine that increasing masses of benefit recipients become increasingly a marginal "political liability" due to indirect costs such as increased expenditures on health care, education, etc. Thus marginal indirect costs may very well be expected to be convex, i.e., marginal indirect costs increase at an increasing rate. These two assumptions, concavity of marginal social welfare and convexity of marginal indirect costs, allow us to "sign" the asymmetry, as proven in the Appendix:

PROPOSITION 2: A negative shock to $J \subseteq N$ has a larger impact on benefits offered by each state $i \notin J$ than does a symmetric positive shock whenever W_i' is concave and $C_i^{r\prime}$ is convex for all $i \in N$.

As a concrete example of such an environment, consider the following. Let us assume that social welfare for a particular state i is in actuality a function of state benefits and aggregate production. To be precise, suppose that $W(B,Y)=\alpha BY$; where $B=b+\beta$, Y represents aggregate production, and $\alpha>0$, and subscripts are omitted for convenience. Thus social welfare characterizes simple Cobb-Douglas preferences defined over benefits to the poor and aggregate production. Aggregate productivity is, of course, a function of labor employment. Let us suppose that $Y=L-\epsilon L^2$ when the L-most productive workers are employed; where ϵ is less than the reciprocal of twice the state's entire population so that Y is strictly increasing throughout the feasible range of potential employment levels, i.e., $\epsilon<1/2P$ where P is the largest possible work force. Lastly, we shall assume that the least productive workers are the first to leave the work force and seek welfare benefits, implying $L=P-\lambda B$. Social welfare can thus be expressed in a reduced form as $W(B)=W(B,Y(B))=\alpha B[(P-\lambda B)-\epsilon(P-\lambda B)^2]$. As the reader may readily check, this reduced form of social welfare is initially increasing and concave, and its first derivative is concave as well. Regarding indirect costs, suppose that indirect costs per capita can be expressed by $Ac^r(T)=\mu+\delta T^2$; where T is the total recipient population, and μ, $\delta>0$. We suppose that δ is "small" so that average costs are approximately constant throughout the feasible range of possible recipients. It follows that $C^r(T)=\mu T+\delta T^3$. Again, it is easy to check that indirect costs are increasing and convex, and that marginal indirect costs are also convex. It follows that social welfare and indirect costs as modeled satisfy all necessary conditions required for Proposition 2.

We now extend our basic model to note that the costs associated with new welfare migrants may differ depending on their state of origin. For instance, an influx of migrants with ethnic backgrounds foreign to the host state may create a need for social services that would not otherwise exist. Alternatively, one could imagine states having greater uncertainty about the costs that will be induced by a population of migrants significantly distinct from the host-state population. Obviously a variety of plausible explanations for this effect can be offered. To capture such effects, we assume that for each $j\neq i$

there exists a convex function $C_{ij}^{m}:\Re\rightarrow\Re_{+}$ such that $C_{ij}^{m}(M_{ij})$ represents the migration costs associated with a migration of M_{ij} welfare recipients from state j into state i. We further assume that $C_{ij}^{m\prime}(x)\geq 0$ for all $x\in R$, $C_{ij}^{m}(x)=0$ for all $x\leq 0$, and the migration of welfare recipients is represented by $M_{ij} = \mu_{ij}(\beta_i - \beta_j)$.[5]

The introduction of these state-specific effects does not affect the central conclusions of Propositions 1 and 2. It does, however, yield a new conclusion that applies to the relative impact of benefit shocks with regard to the costs attributable to state-specific migration. Specifically, the following proposition is proven in the Appendix:

> *PROPOSITION 3: A negative shock to $J\subseteq N$ has a larger impact on benefits offered by each state $i\notin J$ the larger are the state-specific marginal migration costs that states J impose on i.*

The expected costs from migration may vary depending on the relative differences between the characteristics of the low-income populations of states i and j. One possible difference across states involves differential racial and ethnic low-income populations. A state with a low-income minority fraction of 40 percent likely has more information about the potential costs of welfare migration from a neighbor state with a low-income minority fraction of 30 percent, as opposed to the case in which the neighbor state has a low-income minority fraction of 10 percent. Proposition 3 concludes that a state would follow the neighbor state's benefit decrease more closely in the latter setting than in the former.

Walker (1994) finds very little evidence for the existence of welfare-benefit–induced migration from state to state. It is important to note, however, that our theoretical results do not actually require the presence of welfare-induced migration. Nor do they require migration, when it occurs, to impose varying costs depending on the state of origin. All that is required is that policymakers behave *as if* these features were present. This is not to say that a lack of observed migration cannot itself be the result of strategic

[5]The condition that $C_{ij}^{m}(x)=0$ for all $x\leq 0$ ensures that we are indeed considering just costs affiliated with an inflow of out-of-state migrants.

reaction explicitly designed to mitigate migration.[6] Instead, our point is that when modeling this behavior one must recognize that public policy is often founded on the “reality” of public opinion as much as, if not more than, on economic fact.

Our model generates two testable implications. First, we expect that states will respond asymmetrically to other states’ benefit decreases versus other states’ benefit increases. Failure to empirically model this asymmetry (when directed in Proposition 2) could lead to downward-biased (in absolute value) estimates of responses to other states’ benefit decreases and upward-biased estimates of responses to other states’ benefit increases, though signing this asymmetry is not necessary for this insight to hold. Our second testable implication is that the *asymmetry* in responses to other states’ increases and decreases should increase with the expected migration costs from the state changing its benefits. Since we do not have information on state government expectations of migration costs from other states, we use differences in population characteristics (specifically, the fraction of the low-income population that is black or Hispanic) between states as proxies for differences in a state’s appraisal of the variance of possible costs associated with migration from different states. If we assume that ethnic dissimilarity is indeed a proxy for costs of welfare migration, then a second testable implication of our model is that the asymmetry in responses to other states’ increases and decreases should increase with the absolute difference between the two states’ fractions of the low-income populations that are black or Hispanic.

[6]One can also think of the phenomenon of Tiebout competition, in which “foot voting” need not be observed for its potential presence to have an effect on local government decision-making.

2. DO STATES RESPOND ASYMMETRICALLY TO NEIGHBOR BENEFIT CHANGES?

Our theoretical model suggests that states are unlikely to respond symmetrically to their neighbors' increases versus decreases in welfare benefit levels. This insight has significant implications for empirical studies of interdependence of states' policy choices. If states respond more to neighbors' benefit decreases than to benefit increases, for instance, then a researcher who models responses as symmetric will systematically understate the magnitude of the response to a neighbor's benefit decrease while systematically overstating the response to a neighbor's benefit increase.

We are interested in estimating the relationship between changes in real own-state welfare benefits and changes in real neighbor welfare benefits,[7] in which we treat neighbor benefits as endogenous. Our dependent variable is the change in the real (1982 dollars) combined maximum AFDC and food stamp benefits for a family of three in a state,[8] and our explanatory variable of interest is the weighted sum of changes in neighbors' maximum AFDC and food stamp benefits for a family of three.[9] We express all variables in differences because our theoretical model describes predictions regarding *changes* in welfare benefits rather than the benefit *levels* themselves. The pertinent data are published in the *Green Book, Background Material and Data on Programs within the Jurisdiction of the Committee on Ways and Means*, for each relevant year. In a handful of cases, these data were clearly miscoded in the *Green Book*; in the analysis that follows we omit seven suspicious observations from the analysis. However, it turns out that the choice of including or excluding these observations does not fundamentally change our results.

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[7]All dollar values are adjusted to be in constant dollars using the consumer price index.

[8]We have also estimated models in which the dependent variable is solely the AFDC benefit, and in each case have obtained similar results to those reported herein.

[9]We describe how we derive neighbor weights later in this section.

Determining Neighborhood

One important task in determining the relationship between a state's benefit level and that of its neighbors involves defining a state's neighbors. Our empirical approach requires us to take a stand on how states weight each others' decision-making when devising their own policies. While there are countless possible ways of identifying which states are neighbors, we propose two admittedly arbitrary measures of "neighborhood." The first relies strictly on proximity and size of other states. In this measure, states are weighted on two dimensions: (1) the road mile distance between the state's border and the closest of the neighbor state's three largest cities; and (2) the population of the neighbor state. Holding neighbor population constant, the closer a large city in a neighbor state is to the state's border, the greater weight that neighbor state is assigned. Holding interstate distances constant, the larger the neighbor state is, the greater its weight. Hence, in our first weighting scheme, state i assigns to each neighbor state j a weight of

$$w_{ij} = \frac{p_j}{d_{ij}} \Big/ \sum_{j=1}^{k} \frac{p_j}{d_{ij}}$$

where p_j is state j's population and d_{ij} is the road mileage between state i's border and the closest of the three largest cities in state j. State i gives itself a weight of zero, and (obviously) all states' weights sum to one. Note that this weighting scheme does not require contiguity, as is required by Gramlich and Laren (1984) and Ribar and Wilhelm (1994), and it assigns different weights among contiguous states based on population differences and relative differences in distance.

Our second alternative measure of neighborhood has nothing to do with proximity, but is instead based on state-to-state migration flows from 1985 to 1990, using U.S. Census data. In this scheme, state i assigns each neighbor state j a weight of

$$w_{ij} = res_j \Big/ \sum_{j=1}^{k} res_j,$$

where res_j is the number of 1990 residents of state i who resided in state j in 1985.[10] We choose one-way migration inflows, rather than two-way net migration flows, to avoid the possibility of negative neighbor weights as well as to avoid assigning equal weights to states with virtually no migration flows in either direction and to states with large but offsetting population flows in both directions.[11] We use total population migration rather than low-income migration to mitigate the potential endogeneity of the weighting scheme. We adopt the two alternative weighting schemes because neither one is perfect: state-to-state migration flows might be endogenous, and geographic proximity might be too restrictive a basis on which to weight. Since both weighting schemes (as well as a purely contiguity-based measure, as used in Ribar and Wilhelm, 1994) turn out to yield comparable results, our fears that results might be driven solely by idiosyncracies of our definition of neighborhood are moderated.[12]

Before formally estimating the relationship between states' benefit levels, we first provide suggestive evidence that states respond asymmetrically to their neighbors' increases versus decreases in benefit levels. To initially gauge the degree of this asymmetric response, we present in Table 1 the mean state responses to neighbor increases and neighbor decreases, using the migration-based measure of neighborhood.[13] Row 1 of Table 1 presents these means for the entire sample. We observe that the mean response to neighbor benefit increases is \$2.34, while the mean response to neighbor decreases is \$7.86. This difference is not simply due to the fact that states have generally been decreasing their benefits over the time period; the mean response to a neighbor benefit decrease (as a fraction of the mean neighbor

[10] Shroder (1995) also uses a migration-based neighbor-weighting scheme.

[11] To illustrate our concerns with using net migration flows as our basis for this weighting scheme, doing so would lead us to conclude, for instance, that Oregon weights Vermont higher than it does California when determining its policies.

[12] Our results from the migration-based model are similar if we do not constrain the sum of neighbor weights to equal one.

[13] These results are similar if we use the proximity-based neighborhood measure instead of the migration-based neighborhood measure.

TABLE 1

Changes in State Welfare Benefits When Neighboring States Change Their Benefits
Dependent Variable: Real Monthly Combined AFDC and Food Stamp Benefits

	(1) Mean Increase in Benefits When Neighbors Increase Theirs (Fraction of Neighbor Change in Parentheses)	(2) Mean Decrease in Benefits When Neighbors Decrease Theirs (Fraction of Neighbor Change in Parentheses)	(3) Difference between (2) and (1). (Standard Error of Difference in Parentheses)	(4) Percentage Difference between (2) and (1) in the State Benefit Change as a Fraction of Neighbor Change
Full sample	\$2.335 (67%)	\$7.856 (90%)	\$5.521 (1.088)	34%
Neighbor change by >\$10 per month	4.174 (33%)	11.322 (84%)	7.148 (2.202)	155%
Neighbor change by >\$5 and <\$10 per month	3.607 (56%)	8.328 (100%)	4.721 (1.948)	79%
Neighbor change by <\$5 per month	1.979 (80%)	0.692 (40%)	-1.287 (1.724)	-50%

Note: Calculated using migration-based measure of neighborhood described in text.

decrease) is 34 percent larger than the mean response to a neighbor increase. The difference between these two responses is statistically significant at conventional levels.

If this difference is a mere artifact of the data, one might expect that the relative response to decreases rather than increases would be similar when the neighbor benefit change is “negligible” versus when the neighbor change is “large.” Specifically, one would expect states to have similar relative responses to small neighbor benefit changes, such as $2 per month, say, as to larger neighbor changes, such as $15 per month. In this spirit, we subdivide the set of absolute neighbor benefit changes into three categories: less than $5 per month, between $5 and $10 per month, and over $10 per month. We find suggestive evidence indicating that the gap increases as the absolute magnitude of the neighbor benefit change increases. For instance, no statistically significant difference is seen between responses to small neighbor benefit increases and small neighbor benefit decreases, and in fact, the mean response to small neighbor increases is slightly larger than the mean response to small neighbor decreases. But for larger changes, the response is considerably different. The mean response to a neighbor benefit decrease of more than $10 per month (expressed as a fraction of the mean neighbor benefit decrease) is 155 percent larger (and significantly different at conventional levels) than the mean response to a neighbor benefit increase of the same magnitude. Hence, the results presented in Table 1 provide initial suggestive evidence that states respond asymmetrically to their neighbors’ benefit changes.

Evidence of Simultaneous Asymmetric Benefit-Setting

Although the evidence presented above is compelling, it is not fully convincing, since we do not model neighbor benefit-setting as simultaneous, and our results may merely be reflecting a tendency for neighboring states’ benefit levels to trend down together. Hence, we now explore more formally the degree to which states respond asymmetrically to neighbor benefit increases versus decreases. As we are interested primarily in gauging the degree to which states respond asymmetrically to each other, we adopt the set of control variables used in prior empirical papers on the topic of welfare policy interdependence. Specifically, we control for changes in the ratio of families on AFDC to those not on AFDC (the "recipiency ratio"),[14] changes in the Republican share of votes in congressional elections[15] (we also looked at the "conservativeness" of voting behavior by the state's congressional contingent, as captured by Americans for Democratic Action voting scores, which led to no real difference in the results), changes in real per capita state disposable income, changes in the state's federally set AFDC funds matching rate, changes in the state's percentage of AFDC recipients who are white, changes in the state's percentage of AFDC recipients who are unmarried, changes in the state's female unemployment rate, changes in the state's ratio of females to employed males, and changes in the state's average weekly wages in variety stores.[16] The last three variables are intended to represent characteristics of the female and low-skill labor market.[17] Our results are robust to changes in this control variable set. Specifically, our results hold up qualitatively regardless of the set of control variables employed.

In order to treat states' benefit policy determination as potentially interdependent, we must model state benefit-setting as simultaneous. To do so, we model neighbor benefit changes as endogenous with a two-stage instrumental-variables approach similar to that used by Besley and Case (1995) to capture simultaneity of tax policy across states. Since we propose theoretically that changes in benefit

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[14]Gramlich and Laren (1984) and Shroder (1995) model the recipiency ratio as endogenous; indeed, Shroder imposes the restriction that neighbor benefits affect a state's benefits only through the recipiency ratio. Later in this paper we model both the recipiency ratio and neighbor benefits as endogenous, as well as model the recipiency ratio as endogenous and neighbor benefits as exogenous, as has been done in prior studies. The results are qualitatively similar across model specification.

[15]In non-election years, we take the average Republican vote shares from the two nearest elections.

[16]We obtained our control variable data from the 1990 Census, the Survey of Current Business (August 1987, 1992 and 1995), the *Green Book* (see text), the Social Security Administration's *Social Security Bulletin* (various years), the *Statistical Abstract of the United States*, the U.S. Department of Health and Human Services's publication *Characteristics and Financial Circumstances of AFDC Recipients*, and the Bureau of Labor Statistics's *Geographic Profile of Employment and Unemployment*. Specific data citations are available on request from the authors.

[17]Shroder (1995) also uses these variables to explain differences in the state's recipiency ratio.

levels occur because of a change in one state's (or a set of states') primitives, we seek instruments that are likely to reflect these types of changes. We instrument for neighbor benefit levels using changes in the neighbor states' female unemployment rate, changes in the neighbor states' ratio of females to employed males, and changes in the neighbor states' average weekly wages in variety stores.[18] All three variables satisfy two criteria: from Wald tests, we find that each has significant independent power in explaining variation in neighbor benefit levels, but in overidentification tests we fail in each case to reject the null of instrument exogeneity. In addition, using a Hausman Lagrange multiplier test of the joint exogeneity of the three instruments, we also fail to reject the null of instrument exogeneity. That is, at least in a statistical sense, the relationship between our instruments and own-state benefits comes solely through changes in neighbor states' benefit levels.

At first, it may seem strange that these variables are appropriate instruments for neighbor benefit levels. For instance, they measure a state's labor market characteristics that are likely to be correlated within a region. However, since we include these variables for both the home state and the neighbor states in the first stages of our model, our instrumental variables reflect *differences* between home state and neighbor state measures of these labor market characteristics. In this respect, it therefore makes sense that our instruments are significantly related to neighbor benefits but, in models with home state variables in them, not to home state benefits.

We use annual state-level benefit data from 1983 through 1994. The federal AFDC regime changed substantially with the Family Support Act of 1988, which could have confounding effects on an analysis of this sort. However, it turns out that our results are qualitatively similar (and statistical significance is comparable) before and after 1988, although the magnitudes of the effects are somewhat larger after 1988 than before the regime shift. We considered including a full set of time effects in

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[18]Ribar and Wilhelm (1994) use similar variables to instrument for neighbor benefit levels.

addition to the set of state-specific time trends and time-varying covariates, but eventually opted against this since the time effects would likely pick up a considerable amount of states' strategic interaction, if it exists. While we show that our results are constant across policy regime shifts, such as the Family Support Act of 1988, and later in this section present evidence suggesting that our results are not merely picking up national patterns in welfare benefit-setting, we are sensitive to the possibility that we are not adequately capturing some common shock or policy shift in our current specification.

Table 2 presents the estimated coefficients on neighbor benefits generated from each weighting specification described above. Each column represents a different neighbor definition. Row A of Table 2 presents the results of simple univariate regressions of changes in a state's benefits on changes in neighbor benefits. To provide a baseline for comparison, Columns 1 and 5 of Table 2 provide the correlation between neighbor benefit changes and a state's benefit change when the response is constrained to be symmetric. When we model responses to increases versus decreases as symmetric, the simple correlations suggest that a state changes its benefit level by 79 cents for every dollar change in neighbor benefits (if defined using the migration-based measure) or 55 cents for every dollar change in neighbor benefits (if defined using the proximity-based measure).[19] Contrast these results with those when we allow responses to neighbor increases and decreases to be different. While the estimated response to a neighbor decrease is $1.02 for a dollar change in neighbor benefits (87 cents in the proximity-based measure of neighborhood), the estimated response to a neighbor increase is just 17 cents (14 cents with the proximity-based measure). The differences between responses to neighbor increases and responses to neighbor decreases are statistically significant at any traditional level. Hence, the initial parametric findings suggest that failure to differentially treat neighbor increases versus decreases leads to an overstatement of responses to neighbor benefit increases and an understatement of responses to

[19]The standard errors are virtually identical whether or not we correct for heteroskedasticity.

TABLE 2
Differences in Estimated State Responses to One Dollar Increases and Decreases in Neighbor Welfare Benefits
Dependent Variable: Change in State's Welfare Benefit for Family of Three (532 observations)

Model Specification	(1) Estimated Symmetric Response to Neighbor Benefit Change: Migration-Based Measure	(2) Response to Benefit Increase: Migration-Based Measure	(3) Response to Benefit Decrease: Migration-Based Measure	(4) Difference Between Responses to Decrease vs. Increase (and P-value): Migration-Based Measure	(5) Estimated Symmetric Response to Neighbor Benefit Change: Proximity-Based Measure	(6) Response to Benefit Increase: Proximity-Based Measure	(7) Response to Benefit Decrease: Proximity-Based Measure	(8) Difference Between Responses to Decrease vs. Increase (and P-value): Proximity-Based Measure
(A) OLS regression: no covariates included in estimation	0.793 (0.057) p=0.000	0.170 (0.208) p=0.412	1.015 (0.091) p=0.000	0.845 (p=0.002)	0.545 (0.049) p=0.000	0.140 (0.098) p=0.154	0.867 (0.083) p=0.000	0.727 (p=0.000)
(B) OLS regression: includes covariates mentioned in text	0.714 (0.067) p=0.000	0.132 (0.219) p=0.547	0.921 (0.100) p=0.000	0.789 (p=0.006)	0.437 (0.053) p=0.000	0.033 (0.099) p=0.740	0.774 (0.087) p=0.000	0.741 (p=0.000)
(C) IV estimation: neighbor benefits are endogenous	1.363 (0.354) p=0.000	-0.775 (0.977) p=0.428	1.559 (0.346) p=0.000	2.334 (p=0.020)	0.701 (0.303) p=0.021	-0.474 (0.619) p=0.443	1.418 (0.449) p=0.002	1.892 (p=0.029)
(D) IV estimation: recipiency ratio is endogenous	0.766 (0.075) p=0.000	0.379 (0.279) p=0.176	0.884 (0.105) p=0.000	0.505 (p=0.087)	0.449 (0.056) p=0.000	0.048 (0.101) p=0.638	0.781 (0.089) p=0.000	0.733 (p=0.000)
(E) IV estimation: both are endogenous	1.452 (0.365) p=0.000	-0.262 (0.239) p=0.876	1.575 (0.349) p=0.000	1.837 (p=0.080)	0.879 (0.426) p=0.040	-0.255 (0.823) p=0.757	1.365 (0.511) p=0.008	1.620 (p=0.091)

Notes: Standard errors are in parentheses beneath estimated effects. Covariates and instruments are as described in the text.

neighbor benefit decreases. The estimated effects of neighbor benefits are only slightly different when the other covariates described above are included (but all right-hand-side variables still treated as exogenous); we estimate that a state changes its benefit level by 71 cents for every dollar change in neighbor benefits (if defined using the migration-based measure) or 44 cents for every dollar change in neighbor benefits (if defined using the proximity-based measure) when constraining responses to neighbors to be symmetric, and the differential estimated responses to neighbor benefit decreases versus increases are of a similar magnitude to those reported in row 1 of the table.

Row C of Table 2 reports the estimated relationship between own-state and neighbor-state benefits when neighbor benefits are treated as endogenous. We observe that the estimated constrained relationship between the two (and the estimated gap between responses to neighbor decreases versus increases) is about double the magnitude found when not modeling the simultaneity between state benefit level-setting. While the differential effects are less precisely estimated than in the ordinary least squares (OLS) case, they remain statistically significant at conventional levels. Therefore, it appears that the differential response to neighbor increases versus decreases is *understated* if neighbor benefit changes are treated as exogenous.

We also report the results of specifications in which we treat neighbor benefits as exogenous, but rather treat the recipiency ratio as endogenous, in a specification closer to that used by Gramlich and Laren (1984) and Shroder (1995), although unlike Shroder we still allow neighbor benefits to have a direct effect on own-state benefits. Alternatively, we report the results of specifications in which both the recipiency ratio and neighbor benefits are endogenous. The results are comparable to those reported above. No matter which specification we estimate, one theme remains constant: In no case is the estimated response to an increase in neighbor benefits statistically significant at traditional levels, while in every case the estimated response to a decrease in neighbor benefits is statistically significant at the 1 percent level. Therefore, we can conclude that there are substantial apparent differences in a state's responses to its neighbors' benefit levels, depending on whether neighbors increase or decrease their real benefits. That is, we can empirically corroborate the theoretical implications put forth in Propositions 1 and 2 above.

Neglect as an Alternative Hypothesis

In any given year, the modal change in nominal AFDC benefits is zero, though nominal food stamp benefits have increased somewhat for most states from year to year.[20] Since we deflate benefits by the consumer price index, we consider a nominal zero change in benefits as a real decline in benefits. As such, a chance remains that our results do not really reflect strategic interaction among the states but rather reflect a "neglect hypothesis." Specifically, our results could conceivably be generated if most states simply change their nominal benefits occasionally, and increase their nominal benefits independently. In this case, we would observe little relation between neighboring states' increases in benefits, but most states would appear to be moving in lock-step to each others' benefit declines. Of course, this "neglect hypothesis," if true, could very well be a manifestation of strategic behavior, in which states, cognizant of their neighbors' actions, strategically elect not to change their nominal benefits when their neighbors do not change their nominal benefits. Hence, simply not raising benefits and letting real benefits atrophy is consistent with a strategic welfare benefit-setting equilibrium. However, the fact that we cannot with certainty distinguish strategic behavior from nonstrategic neglect is somewhat unsatisfying. We note, however, that the findings presented in Table 1 (that the difference between responses to increases versus decreases is apparently present in response to larger neighbor benefit changes but not smaller neighbor benefit changes) make the "neglect" story less plausible as an explanation for our findings.

[20]We note, however, that real combined benefits *increased* from year to year in 34 percent of the observations.

There are, however, other ways to determine the degree to which our results are merely picking up a general pattern of failure to change nominal benefits, rather than strategic behavior. Specifically, if our results are merely picking up a general pattern of benefit neglect, it would not really matter how we define neighborhood—we should observe the same types of effects as we report above. To explore this possibility, we construct two new types of neighborhood definitions, one based on the relative position of states in alphabetical order and another in which neighborhood is determined using a random number generator. If we find results similar to those reported above when we carry out these types of exercises, it is less likely that our aforementioned results are due to strategic interaction among the states.

This, however, is not what we find. We randomly generated 500 neighborhood definitions, constructed either directly from random number generators or based on arbitrary features of states' relative positions in the alphabet. In each case, the predicted response to neighbor benefit changes is still positive (and usually statistically significant), but nowhere near as large as those found when using state-to-state migration or geographic proximity and population as the bases for neighborhood definition. For instance, refer back to columns 1 and 5 of row B in Table 2, where we report that the relationship between changes in neighbor benefits and changes in own-state benefits, after holding constant state-specific trends and time-varying covariates, is either 0.714 or 0.437, depending on neighborhood specification. In contrast, the mean predicted response from these 500 randomly generated neighborhood definitions is 0.132, and the *largest* of the 500 predicted responses is less than 0.2. In columns 1 and 5 of row C in Table 2, we report that the relationship between changes in neighbor benefits and changes in own-state benefits, after holding constant state-specific trends and time-varying covariates and treating neighbor benefit changes as endogenous, is either 1.363 or 0.701, depending on neighborhood specification. In contrast, the mean predicted response from these 500 randomly generated neighborhood definitions is 0.018, and the *largest* of the 500 predicted responses is less than 0.25.

Similarly small effects are observed when we differentiate responses to decreases from responses to increases to randomly determined neighbors' benefits. In the case of the instrumental-variables estimates corresponding to row C of Table 2, in only two iterations is the predicted response to a neighbor benefit increase significantly different from the predicted response to a neighbor benefit decrease, and in both of these cases, the predicted response to an increase is *larger* in magnitude than the predicted response to a decrease. Models similar to row B of Table 2, but with randomly determined neighborhoods, are much more likely to find larger responses to neighbor decreases than to neighbor increases, but these predicted asymmetries average only one-fifth the magnitude of those found when neighborhood is determined on the basis of proximity and population, or interstate migration, and the largest asymmetry found in these random neighborhood determinations is less than one-third the magnitude of those reported in row B of Table 2.

In sum, while we find evidence that is potentially suggestive of our results when we randomly assign neighbors to states, the predicted responses to neighbor benefit changes are dramatically smaller in magnitude (and statistical significance) than are those reported in Table 2. Therefore, while a portion of our results may be due to nonstrategic inaction, we can conclude that it is not the driving force behind our results. Even though the modal behavior is to not change one's nominal benefits from year to year, our results indicate that a state is much more likely to follow suit if its neighbors do not change their benefits than if some more distant or marginal state does not change its benefits.

An alternative way to determine whether states truly respond more to neighbor decreases than to increases would be to restrict our analysis to *nominal* benefit changes. This, of course, would treat a scenario in which states do not change their nominal benefits as a "no change" rather than a "decrease," as above, and so we would be categorizing potential strategic behavior as nonstrategic. In our sample there are only a few cases of nominal benefit decreases (nominal increases are much more common) and so we have insufficient observations to estimate the differential response to nominal neighbor decreases versus nominal neighbor increases. However, we can at least qualitatively investigate this possibility. We observe that the mean response to a nominal neighbor decrease is larger than the mean response to a nominal neighbor benefit increase of similar magnitude. While this result is merely suggestive, it still provides additional evidence that our findings of asymmetric responses to neighbor benefit changes are robust.

3. DOES NEIGHBOR SIMILARITY AFFECT THESE RESPONSES?

The preceding discussion suggests that states pay attention to their neighbors when setting their welfare benefit levels. Our finding that states apparently respond more to decreases in neighbor benefits than to increases suggests that state policymakers might set benefit levels to reduce the likelihood of welfare-induced in-migration. Might state policymakers care more about potential in-migration from some neighbors than from others?

To investigate this question, we repeat our analysis, but this time allow state responses to vary with the *population composition* of the neighbor states that change their benefit levels. Proposition 3 from our theoretical model suggests that the more costly potential migrants from neighbor states are to the state making the policy decision, the larger the asymmetry between responses to increases versus decreases in neighbor welfare benefits. One possible measure of cost differences may be population dissimilarity. We choose minority composition as the basis for illustrating this point. Surely, many other possible candidates for measuring population differences across states could be selected, but minority composition seems as good as any other and has been used by other authors (e.g., Case, Rosen, and Hines, 1993) to define neighborhood in other studies.

We model this potential nonlinearity in benefit responses by including in our estimation two variables weighting other states' benefit levels. In addition to including weighted (as before) neighbor benefit changes, we also include neighbor benefit changes weighted both by proximity or migration and also by relative minority composition. The weights for computing this second variable are calculated as follows:

$$w_{ij} = \frac{p_j \cdot m_j}{d_{ij}} \Big/ \sum_{j=1}^{k} \frac{p_j \cdot m_j}{d_{ij}}$$

in the proximity-based weighting scheme, and

$$w_{ij} = \frac{res_j \cdot m_j}{\sum_{j=1}^{k} res_j \cdot m_j}$$

in the migration-based weighting scheme, where m_j is the absolute value of the difference in the percentages of the population in states i and j that is black or Hispanic (all other notation is as before). In these weighting schemes, states respond to differences in *relative differences* in (across a state's set of neighbors) minority shares, rather than *absolute* levels of neighbor minority shares.[21] We report the results of the OLS specifications of this exercise in Table 3, because OLS tends to give the most modest results of the three principal alternative types of specification used previously.

The first two rows of Table 3 present the estimated difference in a state's response to a decrease versus an increase in a hypothetical neighbor's benefit levels in two situations. In the first case, the neighbor has a relatively (in comparison to the other neighbors) *low* difference from state i in the share of minorities (75 percent of the neighbor mean difference) in its population. In this situation, the models suggest that a state will decrease its benefits by 41 or 76 cents more when its neighbor decreases its benefits than it will increase its benefits when its neighbor increases its benefits, depending on

[21]We have also estimated models in which states weight neighbors by absolute minority share and find that states generally tend to respond more to high-minority neighbors than to low-minority neighbors. In other models where we distinguish responses to black population shares from responses to Hispanic population shares, we find that states appear to respond more to high neighbor Hispanic concentrations than to high neighbor black concentrations.

TABLE 3

Estimated Differences in State Responses to Changes in Neighbor Welfare Benefits: Differences Based on Minority Population in Neighboring States

OLS Regression

Dependent Variable: Change in State's Welfare Benefit for Family of Three

(532 observations)

	Neighbor Definition: Migration-Based Measure	Neighbor Definition: Proximity-Based Measure
(1) Estimated difference in response to decrease vs. increase in benefit of neighbor with 75% of the average neighbor difference in minority share	0.757 (p=0.011)	0.410 (p=0.000)
(2) Estimated difference in response to decrease vs. increase in benefit of neighbor with 125% of the average neighbor difference in minority share	1.296 (p=0.000)	0.810 (p=0.000)
(3) p-value of difference due to differences in minority shares of neighbor states	0.062	0.092
(4) Difference between (2) and (1) if responding state's minority percentage is 1 standard deviation below the mean	0.471	0.210
(5) Difference between (2) and (1) if responding state's minority percentage is 1 standard deviation above the mean	0.406	0.197
(6) p-value of importance of own-state minority percentage in determining the degree of apparent race-based response to neighbors	0.096	0.664

Note: Covariates and instruments are as described in the text.

specification. In the second case, the neighbor has a relatively *high* difference from state i in the share of minorities (125 percent of the neighbor mean) in its population. In this situation, the results suggest that a state will decrease its benefits by $1.30 or 81 cents more, depending on specification (both are statistically significant at any conventional level), when its neighbor decreases its benefits than it will increase its benefits when its neighbor increases its benefits. The relationship between minority population share and differential responses to neighbor benefits is statistically significant at about the 6 percent or 9 percent level (row 3 of Table 3), depending on the basis of neighborhood definition. We therefore find evidence suggesting that states may respond more to changes in the benefit levels of states with relatively large minority populations, which is supportive of our finding from Proposition 3. However, this evidence is not as strong as our general findings of differential responses to changes in neighbor benefits.

Our model suggests that states respond more to neighbors with larger differences in minority percentage from their own. But we might expect that this differential response would be higher if the state making the comparison has a lower minority population than if it has a relatively high minority population. To investigate this possibility, we further interact our minority-based weighted neighbor benefit measure with the proportion of a state’s current welfare recipients who are black or Hispanic. Row 4 of Table 3 reports the difference between the values that would be reported in the first two rows of Table 3 if the state’s percentage of minority recipients were one standard deviation below the national mean. Row 5 of Table 3 reports the difference between the values that would be reported in the first two rows of Table 3 if the state’s percentage of minority recipients were one standard deviation above the national mean. We observe that states apparently respond less to neighbor minority differences if they have a higher minority welfare recipient population (although this result is only statistically significant in the case of the migration-based neighbor definition). Therefore, these results provide additional suggestive evidence that differences in neighbor population composition affect state welfare benefit-setting policies.

4. DISCUSSION

Do states play welfare games? We present a theoretical argument for why states would respond asymmetrically to increases versus decreases in their neighbors' benefits, and we find substantial empirical evidence to suggest that this is the case. States apparently set their welfare benefits to a considerable degree with their neighbors in mind. This result is robust to model specification, and while the results do not imply that states are engaging in a "race to the bottom," they do suggest that states are more concerned about being "left ahead" in welfare benefit levels than they are about being "left behind." Just as other researchers have found that states formulate their tax and expenditure policies interdependently (Besley and Case, 1995; Case, Rosen, and Hines, 1993), we provide evidence that states also set their social welfare policies interdependently. We note, too, that our insight that states might respond asymmetrically to their neighbors' policy changes may be generalizable to other types of policies, such as tax rate-setting.

Moreover, it is likely that our results understate the degree to which states may set benefit levels with each other in mind in a new policy regime with even greater state autonomy in benefit-setting. If states were engaged in a strategic trend toward lower welfare benefits before 1996, it is possible that this trend will accelerate under the current system.

Surely, our approach is not perfect. We can only speculate as to which states are really neighbors to one another, and we certainly have introduced measurement error into our neighbor weighting schemes. However, if we are assigning weight to states to which a state really does not assign weight, we probably are *understating* the effects of neighbors' welfare benefit-setting policies rather than overstating these effects. It is possible that we have omitted an important variable that, holding constant the variables included in our regressions, affects the benefit-setting policies of all states in a “neighborhood.” But it is difficult to conceive of such a variable that only drives mutual *decreases* in benefits, but is not present in times when benefits increase.

Appendix: Proofs of Propositions 1, 2, and 3

In the analysis to follow, note that if $\beta_i{*}$ is a best reply to $(\beta_j{*})_{j\neq i}$ it then follows that

(A.1) $W_i'(b_i + \beta_i{*}) = R_i{*} + (b_i + \beta_i{*})(\lambda_i + \sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i{*})(\lambda_i + \sum_{j\neq i} \mu_{ij})$; where

$R_i{*} = R_i + \lambda_i\beta_i{*} + \sum_{j\neq i} \mu_{ij}(\beta_i{*} - \beta_j{*})$.

This formula merely states that the marginal return from benefits equals its marginal cost, where costs include both expenditure costs and indirect recipient costs.

LEMMA A.1: *A positive shock to $J\subseteq N$ causes the equilibrium benefits to increase and the equilibrium recipient set to decrease for each state $i\notin J$.*

PROOF: Let $(\beta_i^+)_{i\in N}$ denote the equilibrium profile of benefit modifications after a positive shock to $J\subseteq N$. Pick $i\notin J$ such that $\beta_i^+ \leq \beta_j^+$ for all $j\notin J$. Suppose $\beta_i^+ \leq 0$. As $\beta_j{*}>0$ for all $j\in J$, it follows that

(A.2) $R_i^+ = R_i + \lambda_i\beta_i^+ + \sum_{j\neq i} \mu_{ij}(\beta_i^+ - \beta_j^+) < R_i$.

Therefore,

$$W_i'(b_i + \beta_i^+) \geq W_i'(b_i) = R_i + b_i(\lambda_i + \textstyle\sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i)(\lambda_i + \sum_{j\neq i} \mu_{ij})$$
$$> R_i^+ + (b_i + \beta_i^+)(\lambda_i + \textstyle\sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i^+)(\lambda_i + \sum_{j\neq i} \mu_{ij}).$$

The first inequality follows from concavity of W_i, the equality follows from the fact that the system was in equilibrium prior to the shock on J, and the final inequality follows from convexity of C_i^r and (A.2). It follows that β_i^+ is not a best reply to $(\beta_j^+)_{j\neq i}$, a contradiction. We conclude that $\beta_i^+>0$ for all $i\notin J$.

Suppose there exists $i\notin J$ such that $R_i^+=R_i + \lambda_i\beta_i^+ + \sum_{j\neq i} \mu_{ij}(\beta_i^+ - \beta_j^+) \geq R_i$. As we have already established that $\beta_i^+>0$ for all $i\notin J$, it follows that

$$W_i'(b_i + \beta_i^+) < W_i'(b_i) = R_i + b_i(\lambda_i + \textstyle\sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i)(\lambda_i + \sum_{j\neq i} \mu_{ij})$$
$$\leq R_i^+ + (b_i + \beta_i^+)(\lambda_i + \textstyle\sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i^+)(\lambda_i + \sum_{j\neq i} \mu_{ij}).$$

The first inequality follows from concavity of W_i, the equality follows from the fact that the system was in equilibrium prior to the shock on J, and the final inequality follows from convexity of C_i^r and the supposition that $R_i^+ \geq R_i$. It follows that β_i^+ is not a best reply to $(\beta_j^+)_{j\neq i}$, a contradiction. We conclude that $R_i^+ < R_i$ for all $i\notin J$. ■

LEMMA A.2: *If $(\beta_i^+)_{i\in N}$ is the equilibrium profile of benefit modifications after a positive shock to $J\subseteq N$, then $W_i'(b_i - \beta_i^+) <=> R_i{*} + (b_i - \beta_i^+)(\mu_{ii} + \sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i{*})(\mu_{ii} + \sum_{j\neq i} \mu_{ij})$ for each $i\notin J$;*

where $R_i{*} = R_i - \mu_{ii}\beta_i^{+} - \sum_{j\neq i} \mu_{ij}(\beta_i^{+} - \beta_j^{+})$, *depending on whether or not* $[W_i'(b_i) - C_i^{r\prime}(R_i)(\mu_{ii} + \sum_{j\neq i} \mu_{ij})] - [W_i'(b_i - \beta_i^{+}) - C_i^{r\prime}(R_i{*})(\mu_{ii} + \sum_{j\neq i} \mu_{ij})] > = < [W_i'(b_i + \beta_i^{+}) - C_i^{r\prime}(R_i^{+})(\mu_{ii} + \sum_{j\neq i} \mu_{ij})] - [W_i'(bi) - C_i^{r\prime}(R_i)(\mu_{ii} + \sum_{j\neq i} \mu_{ij})]$.

PROOF: First note that Lemma A.1 implies $\beta_i^{+}>0$ and $R_i^{+}<R_i$ for all $i\notin J$; where $R_i^{+} = R_i + \lambda_i\beta_i^{+} + \sum_{j\neq i} \mu_{ij} (\beta_i^{+} - \beta_j^{+})$. It follows that $R_i{*} = R_i - \lambda_i\beta_i^{+} - \sum_{j\neq i} \mu_{ij}(\beta_i^{+} - \beta_j^{+})>R_i$ for each $i\notin J$. Since zero benefit modification was the equilibrium prior to the positive shock to J and $(\beta_i^{+})_{i\in N}$ is the equilibrium after the positive shock, applying equation (A.1) to both equilibria and subtracting yields

$$\text{(A.3)}\quad \begin{aligned} W_i'(b_i + \beta_i^{+}) - W_i'(b_i) &= [R_i^{+} + (b_i + \beta_i^{+})(\lambda_i + \textstyle\sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i^{+})(\lambda_i + \sum_{j\neq i} \mu_{ij})] \\ &\quad - [R_i + (b_i)(\lambda_i + \textstyle\sum_{j\neq i} \mu_{ij}) + C_i^{r\prime}(R_i)(\lambda_i + \sum_{j\neq i} \mu_{ij})] \\ &= \lambda_i\beta_i^{+} + \textstyle\sum_{j\neq i}\mu_{ij}(\beta_i^{+} - \beta_j^{+}) + (\beta_i^{+})(\lambda_i + \sum_{j\neq i}\mu_{ij}) \\ &\quad + [C_i^{r\prime} (R_i^{+}) - C_i^{r\prime} (R_i)](\lambda_i + \textstyle\sum_{j\neq i} \mu_{ij}). \blacksquare \end{aligned}$$

PROOF of Proposition 1: If the stated quadratic conditions are satisfied, equality holds in Lemma A.2 and symmetry in equilibrium response follows from (A.1). If the stated quadratic conditions are not satisfied for some $j\in N$, then there exists some initial endowment of recipients $(R_i)_{i\in N}$ and initial equilibrium benefits $(b_i)_{i\in N}$ for which net welfare of state i is not quadratic in β_i local to $\beta_i=0$. Consequently, there exists an equilibrium $(\beta_i^{+})_{i\in N}$ resulting from a positive shock to J for which $[W_i'(b_i) - C_i^{r\prime}(R_i)(\mu_{ii} + \sum_{j\neq i} \mu_{ij})] - [W_i'(b_i - \beta_i^{+}) - C_i^{r\prime}(R_i{*})(\mu_{ii} + \sum_{j\neq i} \mu_{ij})] \neq [W_i'(b_i + \beta_i^{+}) - C_i^{r\prime}(R_i^{+})(\mu_{ii} + \sum_{j\neq i} \mu_{ij})] - [W_i'(bi) - C_i^{r\prime}(R_i)(\mu_{ii} + \sum_{j\neq i} \mu_{ij})]$. That $(-\beta_i^{+})_{i\in N}$ cannot be an equilibrium resulting from a symmetric negative shock to J is a direct consequence of Lemma 2 and (A.1). ■

PROOF of Proposition 2: Let $(\beta_i^{+})_{i\in N}$ and $(-\beta_i^{-})_{i\in N}$ denote the equilibria of the symmetric positive and negative shocks respectively. Lemma A.1 implies $\beta_i^{+}>0$ for all $i\notin J$. Pick $i\notin J$ such that $\beta_i^{-} - \beta_i^{+} \leq \beta_j^{-} - \beta_j^{+}$ for all $j\notin J$. Suppose $\beta_i^{-}\leq\beta_i^{+}$. It follows that

$$\text{(A.4)}\quad R_i^{-} = R_i - \lambda_i\beta_i^{-} - \textstyle\sum_{j\neq i} \mu_{ij}(\beta_i^{-} - \beta_j^{-}) \geq R_i - \lambda_i\beta_i^{+} - \sum_{j\neq i}\mu_{ij}(\beta_i^{+} - \beta_j^{+}) = R_i{*} .$$

But Lemma A.2 and the concavity assumptions imposed on net welfare imply $R_i{*} + (b_i - \beta_i^{+})(\lambda_i + \sum_{j\neq i}\mu_{ij}) + C_i^{r\prime}(R_i{*})(\lambda_i + \sum_{j\neq i}\mu_{ij}) > W_i'(b_i - \beta_i^{+})$. Thus inequality (A.4), convexity of C_i^{r}, and concavity of W_i imply that $-\beta_i^{-}$ cannot be a best reply to $(-\beta_j^{-})_{j\neq i}$, a contradiction. We conclude $\beta_i^{-} > \beta_i^{+}$ for all $i\notin J$ as claimed. ■

PROOF of Proposition 3: Our proof is analogous to that of Lemma A.1. We begin by noting that in the presence of state-specific migration costs, the first-order conditions for β_i* to be a best reply to $(\beta_j^*)_{j\neq i}$ can be stated as follows:

(A.5) $W_i'(b_i + \beta_i^*) = R_i^* + (b_i + \beta_i^*)(\lambda_i + \sum_{j\neq i}\mu_{ij}) + C_i^{r\prime}(R_i^*)(\lambda_i + \sum_{j\neq i}\mu_{ij}) + \sum_{j\neq i}C_{ij}^{m\prime}(\mu_{ij}(\beta_i^* - \beta_j^*))\mu_{ij}$;

where $R_i^* = R_i + \lambda_i\beta_i^* + \sum_{j\neq i}\mu_{ij}(\beta_i^* - \beta_j^*)$.

Let $(-\beta_j^-)_{j\in N}$ denote the equilibrium following the given negative shock to $J\subseteq N$ and let $(-\beta_j^*)_{j\in N}$ denote the equilibrium that results for the given negative shock if the state-specific marginal migration costs imposed on some state $i\notin J$ are increased for the states in J. Find $k\in N$ such that $\beta_k^* - \beta_k^- \leq \beta_j^* - \beta_j^-$ for all $j\in N$. Suppose that $\beta_k^* \leq \beta_k^-$, implying that

(A.6) $R_k^* = R_k - \lambda_k\beta_k^* - \sum_{j\neq k}\mu_{kj}(\beta_k^* - \beta_j^*) \geq R_k - \lambda_k\beta_k^- - \sum_{j\neq k}\mu_{kj}(\beta_k^- - \beta_j^-) = R_k^-$.

Appealing to the concavity of W_k and the convexity of both C_k^r and C_{kj}^m, we conclude that

(A.7) $$W_k'(b_k - \beta_k^*) \leq R_k^* + (b_k - \beta_k^*)(\lambda_k + \sum_{j\neq k}\mu_{kj}) + C_k^{r\prime}(R_k^*)(\lambda_k + \sum_{j\neq k}\mu_{kj}) + \sum_{j\neq k}C_{kj}^{m\prime}(\mu_{kj}(\beta_k^* - \beta_j^*))\mu_{kj} .$$

If (A.7) is a strict inequality, there is an immediate contradiction of β_k* being a best reply to $(\beta_j^*)_{j\neq k}$. If (A.7) is an equality, it follows that $\beta_k^* = \beta_k^-$ and thus there must exist at least one $j\in N$ for which $\beta_j^*>\beta_j^-$ (due to the change in state i's marginal migration costs, there must be a change in at least one state's behavior). This, however, implies that $R_k^*>R_k^-$, which in turn implies that (A.7) could not have been an equality after all. We conclude that $\beta_j^*>\beta_j^-$ for all $j\in N$, and this is particularly true of state i that experienced the increased marginal moving costs. ■

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