COMMENT ON HERTING, GRUSKY, AND VAN ROMPAEY, *ASR*, APRIL 1997

THE LOGLINEAR MODELING OF INTERSTATE MIGRATION: SOME ADDITIONAL CONSIDERATIONS*

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In their recent paper, Herting, Grusky, and Van Rompaey (1997, henceforward HGV) apply loglinear models to study interstate migration streams revealed by the 1980 U.S. census. As variants of the levels model developed by Hauser (1979), HGV's loglinear models effectively identify patterns of regional affinity and disaffinity, the manifestation of which HGV associate with "social geography." Three levels of social geography are considered by HGV: regions (4 categories), subregions (10 categories), and states (48 categories).

The HGV paper is a significant contribution to the literature, not only for its substantive findings of what they call the "structuration" of interstate migration but also for its methodological innovation. Migration analysis has for a long time been troubled by the lack of proper methods for disentangling structural forces from the confounding factors of population size and distance (Plane 1994). In their paper, HGV show how loglinear models can be profitably borrowed from the social mobility literature for studies of migration. We applaud their effort and hope that other researchers will follow their lead.

In this comment, we wish to extend HGV's models, and in doing so we offer some alternative interpretations. Our extension takes four forms. First, we take into account the unique role of New York State in determining the holding power of the Northeast. Second, we incorporate higher orders of contiguity. Third, we consider economic factors that are glossed over by HGV. And fourth, we apply the loglinear models to more recent data from the 1990 census.

NEW YORK STATE AND NORTHEAST HOLDING POWER

At the core of the HGV paper lies their emphasis on sociocultural structuration, which they operationalize as spatial persistence (within regions, subregions, and states) and affinities (between states) that are effects of social and cultural forces. It is assumed that the propensity of staying within a unit of geography reflects the extent of sociocultural structuration within the geographic boundary after geographic distance, population size, and some dispersistence effects are accounted for. A prime example is the South. It is argued that many southerners would otherwise leave the region if it were not due to the South's unique regional culture (Reed 1986). The propensity of staying within a region or a subregion is captured by loglinear parameters measuring persistence, while other factors (e.g., distance and state contiguity) are purged. This can be shown in HGV's key model (their equation 2). Let m_{ij} stand for the expected migration flow from origin state, i, to destination state, j:

$$m_{ij} = \alpha \beta_i \gamma_j d_{ij}^{-\delta} \varepsilon_1 \varepsilon_2 \varepsilon_3 \pi_b^1 \pi_c^2 \pi_d^3 \eta_e \psi_f \phi_g, \quad (1)$$

where α, β_i, and γ_j are parameters that absorb marginal distributions of origin and destination, $d_{ij}^{-\delta}$ is a distance-decay function, ε_a (a = 1, 2, 3) stands for three types of contiguity effects (respectively within subregions, straddling subregional boundaries, and straddling regional boundaries), and π_b^1, π_c^2, and π_d^3 represent the persistence (or holding power) of region, subregional, and state, respectively. The last three terms in equation 1 denote, respectively, the excess exchange between northern states and warm-weather retirement destinations (η_e), the disaffinity be-

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tween Utah and other nonwestern states (ψ_f), and the tendency for Florida and California to exchange with states outside their respective regions (ϕ_g). In this framework, regional persistence is tantamount to a high value of π_b^1, and likewise, subregional persistence to a high value of π_c^2. In HGV's study, the persistence parameter is found to be relatively large for the South but small for the Northeast. We reestimated HGV's model using maximum-likelihood. We report this model's key parameter estimates and goodness-of-fit statistics in Model 1 of Table 1. HGV were surprised by their finding that "regional structuration has become so weak in the Northeast and Midwest as to disappear altogether" (p. 286). Contradicting expectations from cultural geography (e.g., Zelinsky 1973), this finding also is at variance with earlier works on interstate migration for the 1950s and 1960s, which showed that movers from most parts of the Northeast had strong propensities for staying within the Northeast region (Long 1988; Taeuber and Taeuber 1971).

We argue that one explanation for the low measured holding power in the Northeast is the high exchange rates between New York and states outside the Northeast. This pattern may well reflect more on the cosmopolitan nature of New Yorkers residing in New York State than the lack of cultural structuration for the Northeast region in general. As in the case of California, we can add two special parameters—New York inflow and New York outflow—to account for the "dispersistence" of New York. The New York outflow is specified as the movement originating from New York to the rest of the Northeast region, and New York inflow as the movement to New York originating from the rest of the Northeast region.[1] The results of this expanded model are reported in Model 2 of Table 1. Explaining 8,720 in L^2, or 5 percent of L^2 for Model 1, for two additional degrees of freedom, Model 2 is a significant improvement as is shown by all goodness-of-fit statistics. Also, once the excess exchanges between New York and states in regions outside the Northeast are controlled, the regional holding power for the Northeast becomes the strongest (from .007 in Model 1 to .374 in Model 2). In addition, the holding power of the New England subregion is reduced (from .888 to .490), and that of the Middle-Atlantic subregion is increased (from .023 to .255). Thus, we conclude that the sociocultural structuration of the Northeast region is strong, except for excess exchanges between New York and other states outside the Northeast.

CONTIGUITY EFFECTS

Recognizing the potential confounding role of contiguity, the HGV model of equation 1 above controls for high exchange rates between states that are geographically contiguous to each other, denoted by three parameters—ε_1, ε_2, and ε_3—which represent *contiguity* within subregions, across subregions, and across regions. The reason for controlling contiguity is the simple fact that states close to each other exchange more with each other than do states that are far apart. To be sure, part of this affinity is captured by the distance parameter. However, contiguity effects net of distance do exist, as shown by HGV. One anomaly, unexplained by HGV, is that the estimated contiguity effect is the strongest for states straddling regions and the weakest for states within subregions, with the states straddling subregions falling in between. Recall that HGV grouped the states into regions and subregions according to their supposed sociocultural affinities. If we take these groupings seriously, the boundaries defining these geographic units should present nontrivial barriers to movement, yielding the following expectation: Contiguous states within subregions should have the strongest affinity, and contiguous states straddling regions the weakest affinity, with contiguous states straddling subregions falling somewhere in between.

HGV's finding contradicts the pattern hypothesized above. We attribute their finding to the structure of the levels model, which allows overlapping parameterization for contiguous states within regions or subregions. Pontinen (1982) has warned of this difficulty of interpretation associated with

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[1] Our parameterization of dispersistence is consistent with HGV's. An alternative is to parameterize the excess flows between California and New York with states outside their respective regions. The two parameterizations yield the same estimates but with opposite signs.

Table 1. Maximum Likelihood Coefficients from the Regression of Holding Power on Selected Independent Variables: 1980 U.S. Census Data

	Model 1		Model 2		Model 3	
Variable	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Regional Persistence						
Northeast	.007	(.008)	.374	(.008)	.362	(.008)
North Central	.027	(.006)	.002	(.006)	.049	(.006)
South	.234	(.005)	.218	(.005)	.130	(.005)
West	.242	(.009)	.196	(.009)	.328	(.009)
Subregional Persistence						
New England	.888	(.009)	.490	(.010)	.515	(.010)
Middle Atlantic	.023	(.009)	.255	(.009)	.258	(.009)
East North Central	–.288	(.007)	–.269	(.007)	–.114	(.007)
West North Central	.905	(.007)	.933	(.007)	.767	(.008)
South Atlantic	.246	(.006)	.255	(.006)	.326	(.006)
East South Central	.371	(.010)	.405	(.010)	.362	(.010)
West South Central	.185	(.008)	.197	(.008)	.096	(.008)
North Mountain	.335	(.021)	.365	(.021)	.229	(.021)
South Mountain	–.371	(.012)	–.322	(.012)	–.340	(.012)
Pacific	.541	(.009)	.560	(.009)	.503	(.009)
Retirement Effects						
Florida outflow	1.057	(.007)	1.052	(.007)	.866	(.008)
Florida inflow	.716	(.010)	.708	(.010)	.661	(.010)
Arizona outflow	.509	(.014)	.527	(.014)	.510	(.014)
Arizona inflow	1.186	(.011)	1.213	(.011)	.996	(.011)
Utah Disaffinity						
Utah inflow and outflow	–.552	(.013)	–.553	(.013)	–.406	(.013)
Dispersistence Effects						
California outflow	–.576	(.009)	–.574	(.009)	–.641	(.009)
California inflow	–1.059	(.009)	–1.062	(.009)	–1.086	(.009)
Florida inflow	–.482	(.008)	–.482	(.008)	–.269	(.008)
New York outflow	—		–.700	(.009)	–.666	(.009)
New York inflow	—		–.861	(.011)	–.832	(.011)
Contiguity Effects						
Region contiguity	.782	(.005)	.801	(.005)	1.126	(.008)
Subregion contiguity	.619	(.004)	.687	(.004)	1.004	(.008)
State contiguity	.470	(.004)	.461	(.004)	.822	(.008)
Second-order	—		—		.313	(.005)
Third-order	—		—		.141	(.004)
Fourth-order	—		—		.132	(.004)
Fifth-order	—		—		.053	(.004)
Economic Factors						
Economic growth	—		—		.111	(.002)
North-to-South flow	—		—		.611	(.006)
North-to-West flow	—		—		.410	(.006)
Distance						
Interstate distance	–.827	(.003)	–.841	(.003)	–.722	(.004)
L^2	167,998		159,278		137,067	
Degrees of freedom	2,135		2,133		2,126	
BIC	137,312		128,622		106,511	
Index of dissimilarity (percent)	11.95		11.56		1.87	

Note: N = 1,745,327. See Herting, Grusky, and Van Rompaey (1997) for flow parameterization of Model 1. New flow parameters introduced in Models 2 and 3 are (in HGV notation): New York outflow ($i = 7, j < 10$), New York inflow ($j = 7, i < 10$), North-to-South ($i < 15, 25 < j < 30$), and North-to-West ($i < 15, j > 40$ except $j = 44$).

parameterization, although his discussion pertains to levels models in the context of mobility research. For the interstate migration table, 78 percent (164) of 210 pairs of states within all the subregions are contiguous, and 9 percent (52) of 554 pairs of states within regions, but not subregions, are contiguous. Due to this overlap, some of the contiguity effects within regions or subregions are captured by regional or subregional persistence parameters. In contrast, contiguous states straddling regions appear to have strong affinity because they do not share regional or subregional parameters. Given the complicated and overlapping parameterization of the HGV model, it is not always easy to give a "purist" interpretation to all the parameters. For the problem at hand, it is reasonable to argue that some of the contiguity effects within subregion and region are absorbed by regional and subregional effects, making the average effect of contiguity within subregions the smallest. Conversely, it can be argued that the interpretations of persistence effects of regions and subregions are complicated by the overlapping of region, subregion, and contiguity effects. This may be particularly problematic when all the states in a subregion are contiguous (e.g., Middle Atlantic, North Mountain). In such cases, one must interpret the subregional effect in addition to the corresponding contiguity effect.

One way to counterbalance the variation in the proportion of contiguous states within subregions and regions is to consider higher-order contiguity. We illustrate this mainly as a methodological exercise, since its inclusion does not qualitatively alter substantive conclusions. Higher-order contiguity is a generalization of simple contiguity: The fewer states that a person needs to cross, the more likely that a move will take place. This pattern is similar to the one for intervening opportunities (Stouffer 1940) and can be purged systematically by crossing parameters in a two-dimensional space. Formally, "crossing" is defined as the smallest number of states that an individual must cross to move from one state to another. For instance, the second-order crossing is defined as two states that are bordered by another state but do not share a common boundary. We generated five-level crossing parameters.[2] This parameterization saturates all possible pair-wise relationships between two states within any region or subregion.

ECONOMIC FACTORS

We further consider some economic factors that are unaccounted for in HGV's analysis. First, it is well known that individuals migrate in response to regional economic conditions. The classical formulation of migration in terms of "pushes" and "pulls" is centered around economic factors. Economic factors could confound HGV's findings concerning regional and subregional persistence, because economic boom and bust can happen in the same region or in different regions. When a depressed area and a growth area exist in the same region, people tend to move within the region (Clark and Ballard 1980); when the two areas are in different regions, migration tends to take place between regions. Examples of fluctuations in regional economy and related migration adjustments have been witnessed in almost every part of the United States (Gober 1994). Thus, it is useful to control for economic conditions at the state level. For simplicity, we parameterize the "push" and "pull" factors as $g_j \times \frac{1}{g_i}$, where g_i and g_j are state-specific economic growth rates for origin and destination, respectively. Economic growth rates are measured by three-year averages of annual growth rates of state domestic products for 1977, 1978, and 1979. This linear-by-linear association term is analogous to similar models used in the social mobility literature (notably Hout 1984). Further, we recognize two major shifts in manufacturing locus during the 1970s and 1980s—North-to-South and North-to-West—and their impact on internal migration. We parameterize the North-to-

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[2] Note that the crossing parameter defined here is different from its usual use in mobility and homogamy models (e.g., Mare 1991). In typical mobility or homogamy models, the vertical distance between two categories is unidimensional, but geographic space has two dimensions. Therefore, a third-level crossing in geographic space cannot be directly inferred by addition of first- and second-level crossings as in Mare's (1991) study.

South and North-to-West migration flows accompanying the shifts in manufacturing jobs by two dummy variables. The North is defined as the states of the manufacturing belt, which covers the New England, Middle Atlantic and North East Central subregions. The South refers to the deep South, including all the states in the South Atlantic subregion except Delaware, Maryland, and Virginia. The West includes all the states in the West region except Montana, Wyoming, Idaho, and Utah. Thus the North-to-South and North-to-West flows are from the northern manufacturing belt to the South and the West, respectively. We present this final model as Model 3 in Table 1. Like the HGV model, Model 3 also falls short of fitting the observed data according to conventional levels of statistical significance. This is not surprising, given the enormous sample size of the census data. However, what is notable is that our model fits substantially better than the HGV model after adding only a few additional parameters: L^2 decreases from 159,278 (Model 2) to 137,067—a 14-percent reduction—for 7 degrees of freedom. Since the sample size is unusually large, the BIC statistic developed by Raftery (1995) is a better measure. As a descriptive measure of goodness-of-fit, we also report the index of dissimilarity between observed and predicted frequencies. According to BIC, Model 3 is also much preferred over Models 1 and 2 by 22 and 17 percent, respectively. We also observe that the index of dissimilarity decreases from 11.95 percent in Model 1 and 11.56 percent in Model 2 to 10.87 percent in Model 3. All the estimated coefficients for the additional parameters are statistically significant, and in expected directions. We observe, in particular, that higher-order contiguity effects decline in size as order increases. The orders of magnitude for the three first-order contiguity effects are still opposite the direction expected, although they are much closer to each other in Model 3, where we include higher-order contiguity, than in Models 1 and 2.

REPLICATION USING 1990 CENSUS DATA

HGV's research is based on data from the 1980 census. Like the 1980 census, the 1990 census also asked the question of place-of-residence five-years ago (i.e., 1985).[3] In their recent unpublished work (Grusky, Herting, and Van Rompaey 1997), the authors apply similar models to data from other censuses. In Table 2, we present our replication of their model and our extensions to the 1985–1990 interstate migration table from the 1990 census. For Model 3, we use updated economic growth rates from 1987, 1988, and 1989.

The results from the 1990 census are similar to those from the 1980 census. Hence, HGV's general conclusion concerning the existence of structuration holds true over time. However, some changes are evident in regional and subregional persistence effects across the censuses. These changes reflect fluctuations in regional economic conditions and other internal and external factors. Based on Model 3, for instance, we observe that the subregional persistence of the Middle Atlantic subregion increased from .258 to .449, suggesting a stronger holding power of the subregion in 1985–1990 than in 1975–1980. In contrast, the subregional persistence effect of West South Central decreased from .096 to .035. In addition, some state-specific effects also changed. For instance, Arizona lost some attractiveness as a retirement destination; the effect of retirement inflow decreased from .996 to .809. This suggests that elders in the late 1980s were not as eager to move to Arizona as their predecessors, due, perhaps, to a perceived overcrowding of retirement communities (Longino et al. 1984).

Among the parameters we have introduced in this comment, three notable differences emerge from the 1980 to 1990 comparison. First, North-to-South migration flow strengthened, and North-to-West flow weakened, reflecting a structural shift since the 1970s (Frey 1987). Second, the effect of economic growth declined appreciably from

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[3] We thank Herting, Grusky, and Van Rompaey for providing us with the migration table from an 8-percent sample of the 1980 census along with their GLIM code. Our 1985–1990 migration table was computed from the 5-percent Public Use Microdata Sample (PUMS) of the 1990 census at the University of Michigan's Population Studies Center; the table is available upon request. Our calculation of BIC statistics is based on the number of interstate migrants (i.e., after blocking out the number of observations on the diagonal cells; see Xie 1994).

Table 2. Maximum Likelihood Coefficients from the Regression of Holding Power on Selected Independent Variables: 1990 U.S. Census Data

	Model 1		Model 2		Model 3	
Variable	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Regional Persistence						
Northeast	−.007	(.010)	.332	(.011)	.383	(.011)
North Central	.081	(.008)	.057	(.008)	.095	(.008)
South	.200	(.006)	.189	(.006)	.176	(.007)
West	.447	(.011)	.408	(.011)	.431	(.011)
Subregional Persistence						
New England	.873	(.012)	.510	(.013)	.523	(.013)
Middle Atlantic	.238	(.011)	.454	(.012)	.449	(.012)
East North Central	−.192	(.010)	−.174	(.010)	−.076	(.010)
West North Central	.968	(.011)	.993	(.011)	.852	(.011)
South Atlantic	.208	(.007)	.213	(.007)	.267	(.007)
East South Central	.533	(.013)	.565	(.013)	.504	(.013)
West South Central	.136	(.010)	.144	(.010)	.035	(.010)
North Mountain	.436	(.029)	.460	(.029)	.372	(.029)
South Mountain	−.253	(.014)	−.212	(.014)	−.237	(.014)
Pacific	.585	(.011)	.607	(.011)	.563	(.011)
Retirement Effects						
Florida outflow	1.147	(.008)	1.144	(.008)	.879	(.009)
Florida inflow	.705	(.012)	.699	(.012)	.672	(.013)
Arizona outflow	.767	(.016)	.785	(.016)	.752	(.017)
Arizona inflow	.860	(.013)	.876	(.013)	.809	(.013)
Utah Disaffinity						
Utah inflow and outflow	−.419	(.017)	−.422	(.017)	−.333	(.017)
Dispersistence Effect						
California outflow	−.845	(.011)	−.855	(.011)	−.888	(.011)
California inflow	−.913	(.011)	−.915	(.011)	−.921	(.011)
Florida inflow	−.380	(.009)	−.379	(.009)	−.224	(.009)
New York outflow	—		−.594	(.011)	−.577	(.011)
New York inflow	—		−.859	(.014)	−.846	(.014)
Contiguity Effects						
Region contiguity	.726	(.007)	.745	(.007)	.935	(.010)
Subregion contiguity	.581	(.006)	.642	(.006)	.821	(.010)
State contiguity	.396	(.006)	.388	(.006)	.593	(.010)
Second-order	—		—		.191	(.007)
Third-order	—		—		.068	(.006)
Fourth-order	—		—		.055	(.005)
Fifth-order	—		—		.028	(.005)
Economic Factors						
Economic growth	—		—		.077	(.007)
North-to-South flow	—		—		.659	(.007)
North-to-West flow	—		—		.369	(.008)
Distance						
Interstate distance	−.805	(.003)	−.817	(.003)	−.757	(.005)
L^2	99,704		95,190		85,053	
Degrees of freedom	2,135		2,133		2,126	
BIC	70,131		65,645		55,605	
Index of dissimilarity (percent)	11.99		11.75		11.10	

Note: N = 1,036,468. See Herting, Grusky, and Van Rompaey (1997) for flow parameterization of Model 1. New flow parameters introduced in Models 2 and 3 are (in HGV notation): New York outflow ($i = 7, j < 10$), New York inflow ($j = 7, i < 10$), North-to-South ($i < 15, 25 < j < 30$), and North-to-West ($i < 15, j > 40$ except $j = 44$).

.111 for 1975–1980 to .077 for 1985–1990. This change indicates a lesser role played by economic factors in the 1985–1990 period than in the 1975–1980 period (Gober 1994). Third, the contiguity effects of all orders also decreased substantially. This pattern is consistent with Grusky, Herting, and Van Rompaey's (1997) finding of a downward trend in the importance of geographic distance since 1935. For Model 3, for example, the region contiguity effect changed from 1.126 in 1980 to .935 in 1990; the second-order contiguity changed from .313 to .191. The three first-order contiguity effects (region, subregion, and state), however, are ranked in the opposite order as would be predicted by HGV's structuration thesis.

CONCLUSION

We have provided four concrete extensions to HGV's loglinear analysis of interstate migration streams. Our results confirm HGV's conceptualization of spatial structuration based on sociocultural factors while demonstrating the relevance of purely geographic factors (such as higher-order contiguity) and economic pushes and pulls. This basic conceptualization and empirical framework is generalizable to the more recent data from the 1990 census. In addition, we find that the low holding power that was observed by HGV for the Northeast region is attributable to the high exchange rates between New York State and other states in other regions.

HGV's study has made substantive and significant contributions to the migration literature, but we call attention to its methodological importance as well. We agree with HGV that loglinear modeling is appropriate for studies of migration streams because it can effectively isolate effects due to such confounding factors as population size, geographic distance, and state contiguity. We extend HGV's ideas by showing the applicability of loglinear models for controlling for higher-order contiguity and for ascertaining influences on holding power due to economic factors. Given the overlapping structure of parameterization, however, caution should be exercised in interpreting parameters from such loglinear models. We commend HGV for their innovativeness in borrowing loglinear models to study migration and recommend this modeling framework to other researchers.

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REPLY TO LIN AND XIE

THE SIMPLE VIRTUES OF DESCRIPTIVE MODELING*

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In delivering their wide-ranging commentary, Lin and Xie (1998, henceforward L&X) adopt such a constructive and collegial tone that some readers might be lulled into assuming that their various criticisms are, in the end, a noncontroversial elaboration of our original analyses (Herting, Grusky, and Van Rompaey 1997, henceforward HGV). This reaction should probably be discouraged. Indeed, while L&X's complimentary tone places pressure on us to respond in kind, we are impolite enough to take this opportunity to air differences of opinion that are perhaps more substantial than L&X appreciate. As is conventional, we shall elaborate on these differences by addressing each of their points in turn and, when necessary, supplying additional analyses.

If there is any theme in our reply, it is that purely descriptive models are well worth defending. We shall show that the L&X analysis, for all its insight and innovation, proceeds as if the usual rules of causal model-building can be directly applied to descriptive problems. In evaluating their comment, recall that the principal objective of our original study was simply to map total holding power, which we defined as the residual densities of persistence after the nuisance factors of contiguity, population size, geographic distance, and lower-order persistence are purged. The models that L&X offer evidently proceed from a different objective, because various additional factors that we view as constituent of total holding power are parsed out (e.g., economic factors). Although we shall emphasize below the virtues of a purely descriptive approach, our intention is to advance this argument without in any way questioning the usefulness of conventional explanatory models, such as those offered by L&X.

ARE CORRELATED REGRESSORS PROBLEMATIC?

We begin by asking whether the overlapping persistence (OP) parameters are indeed as difficult to interpret as L&X would have it.

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