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Quantifying the Effect of Neighbourhood on Individuals: Challenges, Alternative Approaches, and Promising Directions

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Abstract

Six major challenges confront statistical researchers attempting to quantify accurately the independent effect of neighbourhood context on individuals: (1) defining the scale of neighbourhood; (2) identifying mechanisms of neighbourhood effect; (3) measuring appropriate neighbourhood characteristics; (4) measuring exposure to neighbourhood; (5) measuring appropriate individual characteristics; and (6) endogeneity. The paper describes these challenges, prior attempts to meet them, and their respective shortcomings. It notes several approaches on the horizon that offer the promise of surmounting these challenges: experiments with varied scales of bespoke neighbourhoods; databases with multi-domain measures of neighbourhood characteristics; statistical models testing for non-linear neighbourhood effects that are stratified by residential group, density of local social interactions, and duration of residency; and econometric devices involving instrumental variables and residuals. It argues that further progress can be made on this front if we take advantage of natural quasi-experiments and push toward fielding a major, new social survey employing a people / place panel design.

JEL Classifications: B40, R00, C9, C01, C49

1. Introduction

In both Western Europe and the United States, the scholarly and political salience of quantifying the effects of neighbourhood context on individuals has grown rapidly in the past two decades. In academic circles, the number of research papers on this subject has expanded exponentially; compare Gephart (1997), van Kempen (1997), Friedrichs (1998), Leventhal / Brooks-Gunn (2000); Sampson / Morenoff / Gannon-Rowley (2002); Friedrichs / Galster / Musterd (2003); Ellen / Turner (2003); Galster (2005). In political circles, de-

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bates have intensified over the degree to which policies for increasing the "social mix" of neighbourhoods can be justified on the basis of the evidence; for examples, see: Galster / Zobel (1998); Atkinson / Kintrea (2001); Ostendorf / Musterd / de Vos (2001); Friedrichs (2002); Kearns (2002); Musterd (2003); Kleinhans (2004); Delorenzi (2006); Joseph (2006); Joseph / Chaskin / Webber (2006); and Galster (2002, 2007a, b). Given the saliency of the issue, accurately quantifying neighbourhood effects emerges as a concern of more than pedantic, methodological interest.

In this paper I attempt to respond to this concern. I begin by forwarding a model of neighbourhood effects that establishes a framework within which methodological challenges can be understood. Second, I discuss what I consider to be the six paramount challenges facing scholars who seek to obtain unbiased estimates of the independent effect of neighbourhood on individuals. These are: (1) defining the scale of neighbourhood; (2) identifying mechanisms of neighbourhood effect; (3) measuring appropriate neighbourhood characteristics; (4) measuring exposure to neighbourhood; (5) measuring appropriate individual characteristics; and (6) endogeneity. Third, I review and evaluate the various methods that researchers have employed in their attempts to confront the aforementioned challenges. Fourth, I note for each of the six challenges emerging strategies and directions that I view as promising. Finally, I advance two suggestions for new sources of data that could significantly advance the field of measuring neighbourhood effects. Throughout I attempt to bring to bear methodological sensitivities and studies emanating from a variety of disciplines and continents.

2. A General Model of Neighbourhood Effects on Individuals

In general terms, one can specify that the outcome of interest (O) observed at time t for individual i residing in neighbourhood j in metropolitan area k can be expressed:

$$[1] \qquad O_{it} = \alpha + \beta[P_{it}] + \gamma[P_i] + \varphi[UP_{it}] + \partial[UP_i] + \theta[N_{jt}] + \mu[M_{kt}] + \varepsilon$$

where:

$[P_t]$ = observed personal characteristics that can vary over time (e.g., marital or fertility status, educational attainment)

$[P]$ = observed personal characteristics that do not vary over time (e.g., year and country of birth)

$[UP_t]$ = unobserved personal characteristics that can vary over time (e.g., psychological states, interpersonal networks and relationships)

$[UP]$ = unobserved personal characteristics that do not vary over time (e.g., IQ, prior experiences, certain values and beliefs)

$[N_t]$ = observed characteristics of neighbourhood where individual resides during t

$[M_t]$ = observed characteristics of metropolitan area in which individual resides during t (e.g., area unemployment rates)

ε = a random error term with statistical properties discussed below

i = individual

j = neighbourhood

k = metropolitan area

t = time period (typically a year)

All Greek letters represent parameters to be estimated through some sort of multivariate statistical technique.

The six central empirical challenges facing analysts attempting to measure neighbourhood effects accurately (i.e., get a precise, unbiased measure of θ) can been seen through the framework of equation [1].

- What is the appropriate geographic scale(s) that define $[N]$?
- What are the causal processes that underlie the relationship θ between $[N]$ and O?
- What are the appropriate characteristics to measure when operationalizing $[N]$?
- What is the intensity and duration of individual i's exposure to $[N]$? Does $[N]$ affect O immediately, with a lag, or cumulatively?
- How can we comprehensively operationalize and measure the key components of $[P]$ and $[P_t]$? Given that one cannot do so for $[UP]$ and $[UP_t]$, what can be done to minimize bias in estimated θ from omitted individual variables associated with neighbourhood selection?
- What are endogenous relationships between $[N]$ and $[P_t]$, and what can be done to minimize bias in estimated θ from such relationships?

3. The Six Paramount Challenges

The methodological concerns associated with empirical investigation of the behavioral and psychological impacts of neighbourhoods have been the subject of several excellent treatises; see especially Manski (1993, 1995, 2000); Duncan / Connell / Klebanov (1997); Duncan / Raudenbush (1999); Sampson / Morenoff / Gannon-Rowley (2002); Durlauf / Cohen-Cole (2004). I draw liberally from these works, while providing supplements and syntheses.

3.1 Defining the Scale of Neighbourhood

In an earlier survey of the neighbourhood literature, I noted the multiplicity of conceptualizations of neighbourhood (Galster, 2001). Many scholars have employed a purely ecological perspective, while others have attempted to integrate social and ecological perspectives. The upshot is that, whatever "neighbourhood" is, it undoubtedly has distinct social, economic, and psychological meanings at various geographic scales. The first to recognize this was Suttles (1972), who argued that households engaged indistinct social relationships within four scales of neighbourhood, which he labeled: (1) "block face;" (2) "community of limited liability;" (3) "expanded community of limited liability:" and (4) "sector of a city." Suttles' and subsequent empirical work has confirmed the ability of households to recognize multiple scales of neighbourhood; see, e.g., Birch et al. (1979). I have since formulated theories of nested scales of neighbourhood based on the nature of the spatial variations in externalities of amenities impinging on a household (Galster, 1986) and of the geographic nature of the various attributes of the bundle comprising neighbourhood (Galster, 2001).

The challenge for empirical researchers of neighbourhood effects that logically follows from the above is daunting: [*N*] should be operationalized at *multiple scales.* However, such can easily produce variables that are too highly correlated across scales to produce distinct estimates of θ at various scales. Even more fundamentally, often there is a great deal of interpersonal variance in the boundaries of neighbourhoods, both within and across scales. This means that data gathered from administratively defined spaces may not correspond well or consistently to the "neighbourhood" experienced by households residing in these spaces.

3.2 Identifying Mechanisms of Neighbourhood Effect

There have been several comprehensive reviews of the potential theoretical links between neighbourhood processes and individual outcomes; see especially Jencks / Mayer (1990); Duncan / Connell / Klebanov (1997); Gephart (1997); Friedrichs (1998); Dietz (2002); Sampson / Morenoff / Gannon-Rowley (2002); and Ioannides / Loury (2004). I therefore will list these mechanisms and describe them only briefly here. I employ the useful distinction introduced by Manski (1995; 2000) between endogenous, correlated, and exogenous effects.

Three Types of Neighbourhood Effect Mechanisms

To be sure, it is feasible to estimate equation [1] without consideration of the causal mechanisms that underlie the correlations. However, such a mechanical approach is to be avoided. As I shall amplify below, the proper speci-

fication of neighbourhood variables comprising [*N*] and the appropriate scale of geography over which they are measured can only be accomplished by consideration of these mechanisms.

Endogenous Neighbourhood Effects. Endogenous neighbourhood effects are those that occur when the behaviors or attitudes of one neighbourhood resident has a direct influence on (at least a portion of) his or her neighbors. This mechanism can be thought of as a social externality. Numerous versions of endogenous effects have been forwarded:

- Socialization: Behaviors and attitudes of all individuals may be changed (for better or worse) by contact with role models or peers who may be neighbors. When these changes occur they are often referred to as "contagion effects." For example, the actions by some to informally police and clean common neighbourhood spaces may encourage all others in the area to do the same.
- Epidemic / Social Norms: This is a special subset of socialization effects that are characterized by a minimum threshold being achieved before noticeable consequences ensue from collective socialization. The need for some subset of the neighbourhood population to reach a critical mass before their social norms begin to influence others to conform is a case in point. Another is the influence of local acts of crime and violence: when neighbors finally perceive the neighbourhood as too dangerous they will restrict their activities outside the home.
- Selective Socialization: This process is another special type of socialization process wherein neighbors are not all equally affected by others. Employed residents are often viewed as positive role models encouraging (only) their unemployed neighbors to find work, for example. Conversely, secondary school dropouts may discourage only their same-age peers from attending school.
- Social Networks: Though one may say that socialization proceeds through social networks, I specify this as a distinct process involving the interpersonal communication of information and resources. One local group may intensify the density and multi-nodal structure of their social networks (create "strong ties") by clustering, thereby increasing the sources of assistance in times of need. On the other hand, such situations may lack the "weak ties" that offer the prospect of bringing new information and resources into the community, thereby increasing social isolation.
- Competition: Under the premise that certain local resources are limited and not public goods, this theory posits that groups within the neighbourhood will compete for these resources amongst themselves. Because the context is a zero-sum game, social conflict will arise as one group more successfully competes. The control of a local public park for the specialized group activities provides one example.

- Relative Deprivation: This mechanism suggests that residents who have achieved some socioeconomic success will be a source of disamenities for their less-well off neighbors. The latter will view the successful with envy or will make them perceive their own relative inferiority as a source of dissatisfaction.
- Stigmatization: Endogenous stigmatization of a place transpires when important institutional, governmental or market actors negatively stereotype all residents of a place and / or reduce the flows of resources flowing into the place because of its household composition. This might occur as the percentage of households in some disadvantaged ethnic group in the neighbourhood exceeds the threshold of where they are perceived by these external actors as "dominant."
- Exposure to Violence: Neighbors who engage in visibly violent and abusive behaviors can create negative externalities in the form of psychological damage to others nearby, especially if these people are themselves victimized.
- Economic Development Spillovers: Changes in the neighbourhood income distribution may be reflected in the density of retail and entertainment employment opportunities in or near the locale potentially available to residents.

Correlated Neighbourhood Effects. Correlated neighbourhood effect mechanisms do not vary by alterations in neighbourhood household composition, but rather are determined by larger structural forces in the metropolitan area, like locations of jobs and geographic disamenities and the structures of local government. These external forces may impinge differentially of different neighbourhoods, but within any given neighbourhood they affect all residents roughly equally, producing thereby correlations in neighbors' outcomes. Several such mechanisms have been forwarded in the literature:

- Spatial mismatch: certain neighbourhoods have little accessibility (in either spatial proximity or as mediated by transportation networks) to job opportunities appropriate to the skills of their residents
- Local institutional resources: certain neighbourhoods have access to fewer and / or weaker private, non-profit, or public institutions and organizations
- Public services: certain neighbourhoods are located within local political jurisdictions that offer inferior services and facilities
- External stigma: certain neighbourhoods may be stigmatized regardless of their current population, because of their history, environmental or topographical disamenities, style, scale and type of dwellings, or condition of their commercial districts and public spaces
- Environmental contamination and pollution

Exogenous Neighbourhood Effects. Exogenous neighbourhood effects occur if the behaviors or attitudes of one neighbor depend on the exogenous characteristics of the individual's neighbors, such as ethnicity, religion, or race. For example, a recent immigrant may feel a special comfort and security because of proximity to another from the same national background, what is often termed "ethnic solidarity." Or, expressed in a less positive version, one may have an aversion to proximity to a neighbor because of racial or religious differences and may therefore behave differently in the neighbourhood context. Yet another version of this mechanism may be termed "social cohesion:" the notion that residential contact among groups that differ in their exogenous characteristics will increase their social interactions and thereby reduce intergroup prejudices and misapprehensions.

The Likelihood of Non-Linear Neighbourhood Effects

Several of the aforementioned potential mechanisms of neighbourhood effect in all probability should manifest themselves in a non-linear, or threshold-like fashion. Indeed, because there are compelling theoretical reasons for such manifestations in certain cases, one can in principle deduce from the observation of non-linearities what the underlying causal mechanism might be (Galster, 2005). The challenge confronting researchers is therefore to experiment with statistical methods that will allow non-linear relationships to emerge from the data (for a review of these methods, see Galster / Quercia / Cortes, 2000).

There are several, not mutually exclusive, behavioral mechanisms suggested by extant theory through which a non-linear, threshold-like relationship between neighbourhood characteristics and individual outcomes measured as continuous variables may be produced. Some rely upon collective actions and social intercourse to create thresholds; others involve more atomistic attitudes and behaviors. There is also another source of non-linearity that inherently arises when considering individual outcomes that are measured in discrete, dichotomous terms. Consider each.

Collective socialization theories focus on the role that social groups exert on shaping an individual's attitudes, values and behaviors (e.g., Simmel, 1971; Weber, 1978). Such an effect can occur to the degree that: (1) the individual comes in social contact with the group, and (2) the group can exert more powerful threats or inducement to conform to its positions than competing groups. These two preconditions may involve the existence of a threshold. Given the importance of interpersonal contact in enforcing conformity, if the individuals constituting the group in question were scattered innocuously over urban space, they would be less likely to be able either to convey their positions effectively to others with whom they might come in contact or to exert much pressure to conform. It is only when a group reaches some critical mass of density or power over a predefined area that it is likely to become effective in shaping the behaviors of others. Past this threshold, as more members are

recruited, the group's power to sanction non-conformists probably grows non-linearly. This is especially likely when the position of the group becomes so dominant as to become normative in the area.[1]

The basic tenet of contagion models is that if decision makers live in a community where some of their neighbors exhibit non-normative behaviors, they will be more likely to adopt these behaviors themselves. In this way, social problems are believed to be contagious, spread through peer influence. Crane (1991) proposes a formal contagion model to explain the incidence and spread of social problems. He contends that the key implication of the contagion model is that there may be critical levels of incidence of social problems in neighbourhoods. He states that if "the incidence of problems stays below a critical point, the frequency or prevalence of the problem tends to gravitate toward some relatively low-level equilibrium. But if the incidence surpasses a critical point, the process will spread explosively. In other words, an epidemic may occur, raising the incidence to an equilibrium at a much higher level" (p. 1227).

Gaming models assume that, in many decisional situations involving neighbourhoods, the personal costs and benefits of alternative courses of action are uncertain, depending on how many other actors choose various alternatives. The individual's expected payoff of an alternative varies, however, depending on the number or proportion of others who make a decision before the given actor does. Thus, the concept of a threshold amount of observed prior action is central in this type of model. The well-known prisoners' dilemma is the simplest form of gaming model (Schelling, 1978), but more sophisticated variants have been developed and applied to a variety processes occurring in neighbourhoods (Granovetter, 1978; Granovetter / Soong, 1986).

Logic also suggests that neighbourhood effect of stigmatization operates through a threshold. Opinions held by the larger community about the residents and reputation of a particular neighbourhood are unlikely to altered in a linear fashion by marginal changes in the population of the neighbourhood group that is the prime basis of the stigmatization. It is only when a critical mass of this group has been attained that public opinion is likely to turn against this place and its inhabitants.

Finally, non-linearities can arise out of the very nature of the dichotomous choice process being investigated. For example, individual choices to move, switch housing tenures, or participate in the labour market are conventionally

[1] More modern sociological treatises closely related to collective socialization also suggest thresholds, such as Wilson's (1987) contention that as a critical mass of middle class families leave the inner-city, low-income blacks left behind become isolated from the positive role models that the erstwhile dominant class offered. Economists also have developed several mathematical treatises involving collective socialization effects in which thresholds often emerge as solutions to complex decision problems under certain assumptions (Akerlof, 1980; Galster, 1987: ch. 3; Brock / Durlauf, 2001).

modeled with a logit or probit functional relationship. This fact will have important methodological implications, as I explain below.

3.3 Measuring Appropriate Neighbourhood Characteristics

It is one thing to identify several neighbourhood processes that we posit have behavioral impacts. It is entirely another matter to ascertain how these processes can be adequately measured (Raudenbush / Sampson, 1999).

Different categories of potential neighbourhood effect mechanisms are likely more straightforward to operationalize than others. For example, many correlated effects have been readily measured with off-the-shelf administrative data that are freely available from governmental agencies, such as job accessibility variables used to operationalize spatial mismatch. Other correlated effects could be measured in obvious ways but likely require accessing administrative data that are not easily available, such as institutional resources and public services. At the other extreme, measuring endogenous effect mechanisms directly will always involve detailed, multi-item social surveys conducted with residents of neighbourhoods under investigation and (in the case of endogenous stigmatization) those outside of these places as well.

I am confident that we have developed sufficiently sophisticated survey instruments to accurately measure such things as networks, peer groups, role models, feelings of relative deprivation and competition, and stereotypes. The research challenge is one of resources; "off-the-shelf" information of the type needed above is rarely, if ever, provided by governmental social surveys. This implies the assembling of substantial resources to conduct purposive surveys of the requisite depth and breadth to measure directly the various potential neighbourhood effect mechanisms (I will suggest such a survey below). As a second-best response, one needs to develop robust proxy measures for these mechanisms involving only prosaic data, a daunting challenge indeed.

3.4 Measuring Exposure to Neighbourhood

Researches can readily identify the neighbourhoods in which subjects reside, but it is a far greater challenge to identify the degree to which they are exposed to the processes thought to convey neighbourhood effects, whether these processes work instantaneously to generate outcomes for individuals or with substantial lag or cumulative impact. As is the case with so much of research design in the context of neighbourhood effects, what is appropriate depends on which underlying process is assumed to operate.

If, e.g., endogenous stigmatization were the predominant mechanism through which neighbourhood effects transpired, one could reasonably posit that the effect would apply equally to all residents of the popularly demarcated

place that is stigmatized and that the stigmatization effect would occur immediately upon a new resident's arrival. If socialization via role models were the predominant mechanism, however, the intensity of exposure to such an influence would depend on the degree to which the individual's social networks were contained within the neighbourhood. Moreover, the degree to which such a socialization process would change the individual's behavior would be directly related to the duration of the individual's exposure to these role models. Thus, within the context of the socialization mechanism we would expect neighbourhood effects to be strongest for those who have only intra-neighbourhood social relationships and who have lived there on extended time. The empirical challenge is to operationalize these exposures and duration effects and allow for the measured neighbourhood effect to be contingent upon them.

3.5 Measuring Appropriate Individual Characteristics

As is clear from equation [1], the researcher should to the extent feasible control for all time-varying [P_t] and time-invariant [P] characteristics of the sampled individuals that may be correlated with the outcome in question O_{it}. To the extent that any of these personal characteristics are correlated with both O_{it} and [N_{it}], failure to control for them will bias the estimate of θ. Of course, virtually every database available to neighbourhood research is incomplete in its coverage of desired [P_{it}] and [P_i]

The research challenge for neighbourhood researchers is to devise databases where such gaps are minimized.

But even in the most comprehensive databases the specter of [UP_{it}] and [UP] lurks. A special case of this specter results in selection biases in estimated θ.

The most basic selection issue is that certain types of individuals who have certain (unmeasured) characteristics will move from / to certain types of neighbourhoods. Any observed relationship between neighbourhood conditions and outcomes for such individuals may therefore be biased because of this systematic spatial selection process, *even if all the observable characteristics of are controlled* (Manski, 1995, 2000; Duncan / Connell / Klebanov, 1997). This selection problem can be formulated as a type of omitted variables bias. Is the observed statistical relationship between individual outcomes and neighbourhood indicative of a neighbourhood's independent effect, or merely [UP_{it}] and / or [UP] that truly affected individuals' outcomes but also (spuriously, in the extreme) led to their neighbourhood choices as well? The direction of this bias has been the subject of debate, with Jencks / Mayer (1990) and Tienda (1991) arguing that measured neighbourhood impacts are biased upwards, and Brooks-Gunn / Duncan / Aber (1997) arguing the opposite. The challenge is to overcome this selection / omitted variables bias, whatever its direction.

3.6 Endogeneity

The central challenge related to endogeneity is that some individual characteristics [P_{it}] and associated neighbourhood characteristics [N_{it}] may be mutually causal. Elsewhere I have argued (Galster, 2003; Galster, Marcotte et al., forthcoming a) that individuals jointly make decisions about [N], whether to own or rent their dwelling, and how long they plan on residing there. To illustrate the argument, those who wish to buy a home and remain in it an extended time will try to avoid neighbourhoods with a poor quality of life and gloomy prospects for home appreciation.

One obvious empirical implication is that certain variables comprising [P_{it}] and [N_t] may suffer from multicollinearity. Another is more subtle. If neighbourhood, tenure, and household residential mobility are simultaneously determined, and all have effects upon O, to what extent is the measured ij an estimate of the *independent* impact of [N_t]?

3.7 Interrelationships Among the Challenges

Even though the foregoing discussion considered six challenges to the precise, unbiased estimation of θ as if they were independent, it is readily apparent that the first four are closely interrelated. Different mechanisms through which neighbourhood effects transpire are likely associated with distinct differences in: (1) the geographic scale over which they operate; (2) how they are appropriately measured; (3) the degree to which residents are equally exposed; and (4) the speed at which exposure affects outcomes. At this point yet another complication can be introduced: different neighbourhood processes are likely to have differential consequences over a variety of interesting outcomes. Unfortunately, in most cases our theory is insufficiently developed to permit us to know with certainty which mechanisms generate which outcomes. The upshot is that researchers are challenged to investigate, for any given O, a wide set of potential causal mechanisms, each holding an associated suite of implications for measurement, including scale, exposure, and duration.

4. Efforts to Meet the Six Paramount Challenges

In this section I do not attempt a comprehensive review of the empirical neighbourhood effects literature. Such would not only be beyond the scope of this paper but would be redundant, given the large number of reviews extant; see Gephart (1997); van Kempen (1997); Friedrichs (1998); Robert (1999); Leventhal / Brooks-Gunn (2000); Earls / Carlson (2001); Sampson / Morenoff / Gannon-Rowley (2002); Friedrichs / Galster / Musterd (2003); Ellen / Turner

(2003); and Galster (2005). Instead, I illustrate representative responses from the literature that attempt to address the six paramount challenges.

4.1 Defining the Scale of Neighbourhood

The literature is replete with alternative specifications of neighbourhood geography because data are collected at various scales by different institutions. The U.S.-based studies typically employ the census tract, an area bounded by local planners who employ transportation routes and / or topographical features to create as demographically homogeneous areas as possible containing roughly 4,000 inhabitants, on average. Western European-based studies evince a greater variety of scales. For example, U.K.-based work has used administrative data from wards (similar to tracts), lower super output areas (roughly 1,400 inhabitants), and school catchment areas (various sizes); e.g., see Buck (2001, 2007) and Bramley / Karley (2007). Postal code areas have often been employed, though these vary from 9,000 – 17,000 inhabitants in Germany (e.g., Drever, 2004; 2007) to 1,700 in the Netherlands (e.g., Van der Laan Bouma-Doff, 2007a). Still other work has employed "city districts" of various sizes (cf. Blasius / Friedrichs, 2007; Oberwittler, 2007). Farwick (2007) has considered the "apartment complex" as neighbourhood. The challenge in examining this work is in deducing the influence of different neighbourhood scales, when so much is different across these studies.

The most direct way of answering the question "what scale(s) of neighbourhood matter in generating individual outcomes" is to conduct parallel analyses of a particular outcome where [*N*] is measured at different scales and estimates of ij are compared. Several studies have taken this tack: Buck (2001), Bolster et al. (2004) and Knies (2007). All find statistically significant relationships at various scales, but stronger correlations between outcomes and neighborhood variables when the latter are measured at smaller spatial scales.

4.2 Identifying Mechanisms of Neighbourhood Effect

As noted above, extant theory has identified numerous potential mechanisms that might explain the observed correlations between neighbourhood characteristics and a variety of individual outcomes. So what, in fact, is going on in the "black box" of neighbourhood? While current empirical evidence is not decisive, it is certainly strongly suggestive of several mechanisms described above (Van Kempen, 1997; Dietz, 2002; Sampson / Morenoff / Gannon-Rowley, 2002; Ellen / Turner, 2003; Galster, 2005). Four kinds of empirical studies have emerged that may be distinguished by their approaches: (1) studies of intra- and inter-group relations in neighbourhoods; (2) regression models of linear neighbourhood effects; (3) regression models of non-linear

neighbourhood effects; and (4) miscellaneous studies. The first and fourth sets attempt to measure the mechanism directly; the others attempt to draw inferences about underlying mechanisms.

Studies of Intra- and Inter-Group Relations in Neighbourhoods

There have been numerous investigations into social processes within neighbourhoods, most of which have employed ethnographic and other qualitative approaches. One set has examined processes among low-income residents of disadvantaged neighbourhoods and another between low-income and higher-income residents of more diverse neighbourhoods. Though revealing and remarkably consistent in their findings, these studies provide circumscribed help in answering the question above because their qualitative nature cannot tell us about the relative importance of alternative mechanisms present.

Studies that have examined the social relationships in disadvantaged U.S. neighbourhoods typically have emphasized the importance of peer and role model influences (see Sullivan, 1989, Anderson, 1990, 1991; Diehr et al., 1993; South and Baumer, 2000; and Ginther, Haveman and Wolfe, 2000). One of the most notable because of its sophisticated efforts to avoid statistical bias is Case and Katz's (1991) investigation of youth in low-income Boston neighbourhoods. They find that neighbourhood peer influences among youth are strong predictors of a variety of negative behaviors, including crime, substance abuse, and lack of labor force participation.

The other set of U.S. studies has focused upon the social relationships among low-income households who are located among predominantly higher-income neighbors, often as the result of some sort of innovation, experiment, or court-mandated modification to an assisted housing program. Examples include: racial desegregation rental housing vouchers (Rosenbaum, 1991, 1995; Rosenbaum et al., 1991; Rosenbaum / Reynolds / DeLuca, 2002; Mendenhall, 2004), Moving To Opportunity class desegregation housing vouchers (Popkin / Harris / Cunningham, 2002; Rosenbaum / Harris / Denton, 2003), scattered-site public housing (Briggs, 1997, 1998; Kleit, 2001a, 2001b, 2002, 2005), and mixed-income public or private developments (Schill, 1997; Clampet-Lundquist, 2004)

In sum, these studies consistently show that the social relationships among members of different economic groups are quite limited, even within the same neighbourhood or housing complex. Members of the lower-status group often do not take advantage of propinquity to broaden their "weak ties" and enhance the resource-producing potential of their networks, instead often restricting their networks to nearby members of their own group or to those remaining in the "old neighbourhood". This suggests that social networking may be a powerful neighbourhood force *among* members of a given group, but less so

in an inter-group context, where perhaps the role model and social control mechanisms operate more strongly. These studies also are noteworthy for what they did *not* find: evidence of relative deprivation or competition that led to worse outcomes for the less-advantaged neighbors.

Regression Coefficients from Models of Linear Neighbourhood Effects

A second source of information about neighbourhood effect mechanisms can be gleaned inferentially from regression analyses of non-experimental data for individual households and their neighbourhoods, typically based on a nationally representative, longitudinal sample. The notion is that if particular sorts of descriptors within a neighbourhood's population profile prove to be statistically and economically significant predictors of outcomes, these may be suggestive of the underlying processes shaping given outcomes.

Here the U.S. literature suggests that both the "advantaged" and the "disadvantaged" aspects of the neighbourhood's population need to be included in predicting most outcomes (though the latter seems more important for most outcomes), and different neighbourhood aspects predict different outcomes. On this point, the theoretical and empirical research on neighbourhood effects summarized in Brooks-Gunn / Duncan / Aber (1997) seems particularly compelling. They argue that some measure of the of "high risk" neighbors is important, where "risk" is typically operationalized in U.S. empirical work as neighbourhood rates of poverty, single-parent households, idleness among adults, or welfare benefit receipt. So, too, are measures of a conceptually distinct effect: the absence or presence of more affluent, middle-class neighbors, operationalized as adults with college degrees or adults in "middle class" occupations. More recent studies have reached similar conclusions in several international contexts; see Kohen et al. (2002); Kauppinen (2004), Musterd / Andersson (2005), and Andersson et al. (2007).

But is it the socioeconomic composition of neighbourhood *per se* that matters, or the lack of social order and cohesion that might be associated with it, as first suggested by Aneshensel / Sucoff (1996)? It appears that it is not social mix alone or directly that may influence outcomes but, rather, the internal social dynamics of the place that often is only partly measured by its socioeconomic status (see the review in Sampson / Morenoff / Gannon-Rowley, 2002; and Turley, 2003). This theme has been emphasized in a number of studies by Sampson and his colleagues (Sampson, 1992; 1997; Sampson / Groves, 1989; Sampson / Raudenbush / Earls, 1997; Sampson / Morenoff / Earls, 1999; Morenoff / Sampson / Raudenbush, 2001). To understand the effects of disadvantaged neighbourhoods on mental distress and criminality, they argue, one must understand their degree of social organization, which entails the context of community norms, values and structures enveloping residents' behaviors (what has been labeled as "collective efficacy"). This raises the issue, ad-

dressed further below, of how well readily available proxies measure the social processes underlying neighbourhood effects.

Regression Coefficients from Regression Models of Non-Linear Neighbourhood Effects

Different types of intra-neighbourhood processes yield distinctive, typically non-linear functional forms for the relationship between the percentage of disadvantaged residents in a neighbourhood and the amount of externality being generated (Galster, 2007a). This can be used to draw out implications for underlying mechanisms of neighbourhood effects if the statistical procedures used to investigate the relationship between a neighbourhood indicator and an individual outcome permit the estimation of non-linear relationships.

Unfortunately, few extant empirical studies test for non-linear relationships between neighbourhood poverty conditions and various individual outcomes. The key U.S.-based exceptions include: Krivo / Peterson (1996), Vartanian (1999a, b), and Weinberg / Reagan / Yankow (2004). A prior analysis (Galster, 2002) suggests that the independent impacts of neighbourhood poverty rates in encouraging negative outcomes for individuals like criminal behavior, school leaving, and duration of poverty spells appear to be nil unless the neighbourhood exceeds about 20 % poverty, whereupon the externality effects grow rapidly until the neighbourhood reaches approximately 40 % poverty. Subsequent increases in the poverty population appear to have little marginal external effect. Analogously, the independent impacts of neighbourhood poverty rates in discouraging positive behaviors, such as employment, appear to be nil unless the neighbourhood exceeds about 15 % poverty, whereupon the effects grow rapidly until the neighbourhood reaches roughly 30 % poverty. Again, subsequent increases in poverty appear to have little marginal effect.

As far as non-linear relationships between individual outcomes and neighbourhood percentages of affluent residents in the U.S., the work of Crane (1991), Duncan / Connell / Klebanov (1997), and Chase-Lansdale et al. (1997) is relevant. Unfortunately, though they all suggest the existence of a threshold of affluence they differ on where this occurs. Crane's (1991) analysis finds strong evidence of epidemic-like effects on both secondary school leaving and teenage childbearing associated with the share of affluent (professional-managerial occupation) neighbors dropping below five percent. For the same outcome, Duncan et al. (1997) find that the effect of percentage of affluent neighbors becomes dramatically stronger when the percentage exceeds the national mean for the neighbourhood. Chase-Lansdale et al. (1997) find that the percentage of affluent neighbors is positively associated with higher intellectual functioning scores for black children and female children only when the percentage exceeds the 25th percentile and is less than the 75th percentile; for other children the effect is linear. Both the Duncan et al. (1997) and Chase-Lansdale et al. (1997) findings support the notion of collective socialization.

Turley (2003) analyzes behavioral and psychological test scores for youth as measured in a special supplement of the U.S. Panel Study of Income Dynamics. She relates these scores to the median family income of the census tract, so one cannot be certain whether the observed relationship is being generated by the relative share of affluent or poor residents. She tests for nonlinearities by employing a quadratic version of neighbourhood income and finds that it is statistically significant and negative for the self-esteem outcome, implying that improving the economic environment of youth has a much greater impact for those initially in disadvantaged circumstances.

The European evidence related to potential non-linear neighbourhood effects is even more limited and often contradictory (see the review in Galster, 2007b). Most relevant evidence focuses on individual economic outcomes as they relate to percentages of disadvantaged neighbors. Here the findings regarding nonlinearities are inconsistent in the extreme; cf. Ostendorf / Musterd / de Vos, (2001); Buck (2001); Musterd / Ostendorf / de Vos (2003); Van der Klaauw / van Ours (2003); Gordon / Monastiriotis (2006); Musterd / Andersson (2005); Oberwittler (2007). The two studies using European data to investigate potential nonlinear effects of affluent neighbors on children's education both find increasing marginal positive effects; Kauppinen (2004) and Gordon / Monastiriotis (2006). Van der Laan Bouma-Doff (2007a) discovers that the labor force participation of ethnic minorities in Rotterdam is inversely related to the percentage of own-group neighbors only when that percentage exceeds 20 percent. In a separate study (2007b), she finds that ethnic minorities have substantial social interactions with native Dutch neighbors only after the share of Dutch neighbors exceeds 60 percent. Buck (2007) observes a variety of non-linearities and thresholds associated with relationships between measures of social capital and an index of deprivation in U.K. neighbourhoods. Galster et al. (2007) use Swedish register data to explore the relationships between neighbourhood income mix and subsequent earnings of adults. They find a wide variety of nonlinear neighbourhood effects, which they claim are consistent with negative role modeling and job information network mechanisms.

Miscellaneous Studies of Neighbourhood Mechanisms

This last category of studies cannot be easily labeled either by focus or method, and addresses a variety of prospective mechanisms. One group, for example, establishes support for a variety of correlated neighbourhood effects mechanisms. Numerous studies (see reviews by Kain, 1992; Ihlanfeldt, 1999) have investigated the issue of differential accessibility to work (the "spatial mismatch" hypothesis) in the U.S. context. This literature generally suggests that mismatch can be an important aspect of opportunity differentials in at least some American metropolitan areas, though it seems of less importance than the social conditions of neighbourhoods (O'Regan / Quigley, 1996; Weinberg et al. 2004).

Other studies have documented the differences in both public services and private institutional resources serving different U.S. neighbourhoods (e.g., Kozol, 1991; Wolman et al., 1991; Card / Krueger, 1992; Drier / Mollenkopf / Swanstron, 2004). Still others have shown how the internal workings of institutions serving poor communities shape expectations and life chances of their clientele (Rasmussen, 1994, Bauder, 2001). Although the evidence linking these differences to various outcomes for children has been subject to challenge (e.g., Burtless, 1996; Morenoff / Sampson / Raudenbush, 2001; Popkin / Harris / Cunningham, 2002), there is increasing evidentiary prominence of some institutions, such as the public schools, serving as important mediators of neighbourhood effects in the U.S. (Ennett et al., 1997; Teitler / Weiss, 1996). The comparative influences of neighbourhood and school effects in the U.K. has been investigated by Bramley / Karley (2007).

Other literature, both qualitative and quantitative, has documented how exposure to violence may produce serious and long lasting emotional trauma for young children (e.g., Martinez / Richters, 1993; Richters / Martinez, 1993; Aneshensel / Sucoff, 1996). The U.S Moving To Opportunity (MTO) demonstration study and the Yonkers Family and Community Survey also provided strong support for the perceived importance of this factor, since safety concerns were cited as a prime reason for participating in these mobility programs by most public housing families (Briggs, 1997; Goering / Feins, 2003).

Galster / Santiago (2006) provide a unique study of parental perceptions of neighbourhood effect mechanisms. Findings indicate that low-income parents perceive the following primary neighbourhood mechanisms at these frequencies: (1) the degree (or lack) of social norms and collective efficacy (24 %); (2) influence of children's peers (12 %); (3) exposure to crime and violence (11 %); and (4) the presence and quality of institutional resources (3 %). Approximately one-third of all parents reported that their neighbourhood had no impact at all on their children, citing that their children were either "too young" to be affected by these mechanisms or that parents had sufficient resources to buffer any deleterious effects of the neighbourhood. Parents residing in high-poverty neighbourhoods were much more likely to perceive a neighbourhood effect, however.

Finally, U.S.-based studies have observed that inter-ethnic group tolerance and subsequent social contacts have been enhanced with greater interracial neighbourhood contacts, especially earlier in life (Allport, 1954; Ihlanfeldt / Scafidi, 2002; Emerson / Kimbro / Yancey, 2002). This implies that there may be some case for the social solidarity neighbourhood effect mechanism. The picture is less clear from Western European evidence (e.g., see Farwick, 2007).

4.3 Measuring Appropriate Neighbourhood Characteristics

There have been many efforts on both sides of the Atlantic to measure directly the social processes within neighbourhoods that, in theory, produce endogenous neighbourhood effects. These efforts have taken the form of purposive social surveys administered at a high sampling density within a limited number of neighbourhoods. These surveys often employ multi-item scales to operationalize sophisticated measures of such things as social networks, inter-group interactions and stereotypes, perceptions of disorder and anti-social behavior, neighbourhood evaluations, etc. Notable examples of these efforts include Sampson / Raudenbush / Earls (1997); Friedrichs / Blasius (2003); Farwick (2007), Oberwittler (2007), Blasius / Friedrichs (2007), and Permentier / Bolt / Ham (2007). Unfortunately, these efforts involve resource-intensive data collection activities, and thus are rarely (if ever) replicated in the same neighbourhoods.

More common, neighbourhood-effects researchers have relied upon more general social surveys (sometimes in a panel format) that have been collected by other entities for different or wider-ranging purposes. This raises the question of whether these databases may contain reasonable proxies for the unmeasured social processes. Several notable efforts to discover such have been conducted.

Potential Proxies for Intra-Neighbourhood Social Processes

There are several studies that find strong evidence that U.S. census tract-level socioeconomic and demographic indicators (often collapsed into factor indices) are strongly related to various intra-neighbourhood social processes, networks, and subjective impressions held by neighbors, as measured by surveys of residents. However, the studies are not perfectly consistent, and suggest that tract-level socioeconomic-demographic indicators are, at best, imperfect proxies (Sampson / Morenoff / Gannon-Rowley, 2002).

Sampson / Raudenbush / Earls (1997) interviewed residents in 343 Chicago "neighbourhood clusters" composed of about 8,000 people each. They developed multi-item scales of "informal social control" and "social cohesion and trust," which they found so highly correlated that they could be combined into a single index of "collective efficacy." The collective efficacy index was, in turn, regressed on three composite factor-score indexes based on aggregate, census data for the neighbourhoods: "concentrated disadvantage," "immigrant concentration", and "residential stability". The authors find that all were highly statistically significant predictors of collective efficacy (stability was positively correlated). All three aggregate level indicators also proved strongly correlated with residents' perceptions of neighbourhood violence, and in Sampson (1997) the level of youth delinquency.

A companion study related these same three neighbourhood factors to three different aspects of social organization within the neighbourhood, using a

sample of 238 British communities (Sampson / Groves, 1989). They found that: neighbourhood residential stability was directly related to local friendship networks, neighbourhood socioeconomic status was inversely related to unsupervised peer groups and directly related to organizational participation, and neighbourhood ethnic heterogeneity was directly related to unsupervised peer groups.

In related work, Sampson / Morenoff / Earls (1999) statistically relate three dimensions of social capital for children's well-being to 1990 census tract information:

- "intergenerational closure" [degree to which adults and children in community are linked]
- "reciprocated exchange" [intensity of inter-family and -adult interaction with respect to child rearing]
- "expectations for informal social control of children" [whether adults expect each other to intervene on behalf of children]

Both the first two were strongly related to neighbourhood stability and concentrated affluence, not concentrated poverty; the last was negatively related to concentrated poverty.

Cook / Shagle / Degirmencioglu (1997) conducted interviews of parents in 137 census tracts in Prince George's County, MD, and their 11 – 15 year-old offspring in their local middle schools. A comprehensive array of subjective multi-item scales related to "social process" were developed from these surveys, ranging from social control and cohesion, to neighbourhood resources, satisfaction, and participation rates; they were aggregated to the tract level. These scales were then analyzed in light of ten census tract variables. They found that they were able to use tract demographic variables to predict "very high percentages of the neighbourhood-level variation in social process" [p. 109 – 110]. Correlations among the neighbourhood social process variables and the tract demographics averaged .37. The combination of percentage white (or black), median income, and percentage in professional-technical occupations alone produced a multiple R of .77 when predicting variation in a global neighbourhood social process measure. Their principal components analysis resulted in one dominant factor, wherein virtually all the social process and tract demographic variables loaded heavily. They conclude that they "do not find clear demarcation into process and demographic factors" [p. 113].

Elliott et al. (1996) gathered statistical and interview information from neighbourhoods in Chicago and Denver. From aggregating parents' responses about their neighbourhoods they created three measures of neighbourhood organization: informal control, social integration, and informal networks. Interviews with youths in these areas produced three constructs related to their outcomes: "pro-social competence" (personal efficacy, educational performance,

activities, and expectations, commitment to conventionality); "conventional friends" (proportions of friends who are pro-social, and proportion who are delinquents); "problem behaviors" (variety of criminal behaviors and drug usage types). They found that tract-level factor-score "neighbourhood disadvantage" was strong by negatively correlated with informal control in both sites and social integration in Denver, but was unrelated to informal social networks in either site.

Coulton / Korbin / Su (1999) interviewed parents in 20 different block groups in Cleveland and derived neighbourhood-level subjective measures of neighbourhood quality, facilities, disorder, and control over children. These were then correlated with three factor-analyzed objective indices of neighbourhood structure available from administrative databases: impoverishment, child care burden, and residential instability. Only two pairs of measures (out of a possible 12) proved statistically significantly related: perceived quality and neighbourhood impoverishment score and perceived disorder and neighbourhood impoverishment score.

Kohen / Brooks-Gunn / Leventhal / Hertzman (2002) examined a national sample of Canadian youth and their neighbourhoods during the 1990s. They found that the neighbourhood statistical variables: percent poor, percent affluent and percent female heads all correlated to a significant degree (rho in absolute value between .24 – .30) with respondents' subjective assessments of social disorder. The neighbourhood percent poor was correlated with the subjective assessment of social cohesion at .21.

Potential Proxies for Extra-Neighbourhood Processes

Unfortunately, in contrast to intra-neighbourhood social processes, there is little to suggest appropriate proxy measures of such extra-neighbourhood processes as stigmatization. To my knowledge, only one study has attempted to statistically relate perceptions of key actors about neighbourhoods to socio-economic or demographic indicators measured in those places. Permentier / Bolt / Ham (2007) ask households and real estate agents to evaluate a variety of neighbourhoods in their city of Utrecht in which they do not live, on multiple grounds. They find that neighbourhood reputations are significantly correlated with their socio-economic characteristics, while their physical and functional features are of less importance. Other correlated effects typically have seen measured directly, if incompletely, as noted above.

Conclusions about Proxies for Neighbourhood Processes

U.S. evidence suggests that readily available, census tracts data on socio-economic and demographic of composition administrative may serve as reasonable operationalizations of intra-neighbourhood social processes, though a wide range of such variables should be used, and the set varies depending on

the outcome in question being modeled. However, these indicators are imperfect measures, so there remains a crucial need for future research efforts to measure such social process variables directly (Gephart, 1997; Friedrichs, 1998; Raudenbush / Sampson, 1999; Sampson / Morenoff / Gannon-Rowley, 2002). Besides those noted above, the development of proxy measures of institutional resources, organizational participation, collective supervision of youth, clarity and consensus regarding group norms, intra- and extra-neighbourhood social networks for adults and children, are especially salient. In addition, much more needs to be done to measure perceptions held by external actors that may affect opportunities of neighbourhood residents and, thereby, their behaviors.

The Methodological Importance of Non-Linear Effects of Neighbourhood Characteristics

Even if neighbourhood social processes were directly and precisely measured, it still may not be possible to distinguish statistically the source of some observed correlation between [*N*] and *O*, what Manski (1993, 2000) has called the "reflection problem." Manski (1993, 2000) demonstrates that it is mathematically impossible to distinguish endogenous and exogenous processes if both are related in a linear fashion to a continuous variable measuring behavioral outcomes.

There are several potential avenues out of this bind (Manski, 2000). For our purposes, however, one of the most useful is non-linearity. If the endogenous effect occurs in a non-linear fashion it is possible to identify it empirically. Of course, the prior theoretical and empirical sections suggest strongly that this is precisely the case for a wide range of behaviors of interest. Moreover, Brock / Durlauf (2001) have explored the non-linearity associated with a dichotomous outcome, and have developed a discrete choice model of social interactions wherein the endogenous effect can be clearly identified. In sum, exploring non-linearity in neighbourhood effects is not merely an academic curiosity; it may be considered a fundamental empirical requirement in advancing the field.

Moreover, non-linearity permits the unambiguous clarification of whether neighbourhood effects are primarily generated by endogenous or exogenous intra-neighbourhood processes. Such clarification holds important implications for the expected magnitude of a potential policy impact. Endogenous processes imply social multipliers among neighbors. Thus, a policy that positively affects one individual or household may end up yielding a multiplied benefit as the altered behavior of the direct beneficiary of the policy is spread to neighbors (Dietz, 2002).

Considerably more attention therefore needs to be paid to exploring non-linear relationships between *O* and [*N*] in future investigations on both sides of

the Atlantic, regardless of how [*N*] is measured. However, it would indeed be surprising were these investigations to reveal cross-national similarities in non-linear neighbourhood effects, given the differences in welfare states, labour markets, race and class segregation, and housing policies (Musterd, 2002). Indeed, the aforementioned brief review of U.S. and Western European evidence confirms this suspicion.

4.4 Measuring Exposure to Neighbourhood

It is rare for a study to model the magnitude of the endogenous neighbourhood effect as contingent upon the spatial extent of the individual's social networks. In an exceptional study, Farwick (2007) investigates the probability of Turkish immigrants having native German friends as a function of ethnic composition of the apartment building. He finds an inverse relationship between this probability and the proportion of non-Germans in the building, but only if most of the Turkish individuals' social networks were limited to their buildings.

There have been a few attempts to measure neighbourhood duration effects. Wheaton / Clarke (2003) use a cross-nested, random effects model applied to National Survey of Children data to assess current and past neighbourhood effects on children's health outcomes. They find a lagged effect of neighbourhood socioeconomic indicators on early adult mental health, which they see as supporting hypotheses of cumulative mediating effect of and chronic ambient stress in the neighbourhood. Galster / Marcotte et al. (2007) use neighbourhood poverty rate averaged over all years of childhood as a predictor of multiple outcomes for young adults. Compared with otherwise identical children raised by otherwise identical parents in a neighbourhood with a low average poverty rate of five (5) percent, children experiencing an average 40 percent rate are predicted through their simulation with estimated parameters to have a: (1) 24 percentage-point greater chance of having a child before age 18; (2) 14 percentage-point lower probability of graduating from high school; (3) 10 percentage-point lower probability of graduating from college; and (4) $13,334 lower annual earnings, all else equal.

4.5 Measuring Appropriate Individual Characteristics

There have been three general approaches adopted in response to the challenge of selection bias following from omitted individual characteristics. The first two use experimental or natural designs to generate random or quasi-random assignments of households to neighbourhoods. The last approach consists of a variety of econometric techniques applied to non-experimentally generated data.

Experimental Evidence from Random Assignment

Data on outcomes that can be produced by an experimental design whereby individuals or households are randomly assigned to different neighbourhoods clearly is the preferred method for avoiding biases from selection. In this regard, the U.S. Moving To Opportunity (MTO) demonstration has been touted conventionally as *the* study from which to draw conclusions about the magnitude of neighbourhood effects (e.g., Ludwig / Duncan / Pinkston, 2000; Katz / Kling / Liebman, 2001; Ludwig / Ladd / Duncan, 2001; Ludwig / Duncan / Hirschfield, 2001; Rosenbaum / Harris, 2001; Goering / Feins, 2003). Although the research design indeed randomly assigns those public housing residents who volunteer to one of three experimental groups (controls remaining in public housing in disadvantaged neighbourhoods; recipients of rental vouchers; recipients of rental vouchers and relocation assistance who had to move to neighbourhoods with less than 10 percent poverty rates), it does not fully control the assignment of neighbourhood characteristics of the two experimental groups receiving tenant-based rental subsidies, and thus does not fully purge the relationship between neighbourhood characteristics and unmeasured individual characteristics (Sampson / Morenoff / Gannon-Rowley, 2000). Of course, the group that receives only a rental subsidy with no mobility counseling and no geographic restrictions can select from a wide range of neighbourhoods. But even the treatment group receiving intensive mobility counseling and assistance, though constrained to move initially to a neighbourhood with less than 10 percent poverty rates, has the ability nevertheless to choose neighbourhoods varying on their school quality, home ownership rates, racial composition, local institutional resources, etc. Moreover, subsequent to their initial, constrained location they are free after one year to move to different, higher-poverty neighbourhoods should they choose; indeed, 85 percent have done so (Kingsley / Pettit, 2007).

Thus, MTO does not fully finesse the selection bias issue. Unless a social experiment is designed wherein the precise neighbourhood conditions are randomly assigned to participants and then these locations fixed for a substantial period, data gathered will still need to be analyzed using one of the econometric methods described below.

Quasi-Random Assignment Natural Experiments

It is sometimes possible to observe interventions into households' residential locations that mimic random assignment. In this way they may be viewed as second-best options for removing selection effects.

There are several prominent examples of such opportunistic research that have provided valuable insights into U.S. neighbourhood impacts. The Gautreaux (Chicago) and Yonkers (NY) court-ordered, public housing racial-ethnic desegregation programs (Rosenbaum, 1995; Rubinowitz / Rosenbaum, 2000;

Briggs, 1997, 1998; Fauth / Leventhal / Brooks-Gunn, 2003a, b) are illustrative. The Gautreaux study compares two groups of Black tenants originally residing public housing who moved out to private apartments using rental vouchers: movers to low-poverty, low-minority suburban neighbourhoods and movers to low-minority but higher-poverty, city neighbourhoods. The Yonkers study compares a combined sample of Black and Latino movers to low-minority, low-poverty neighbourhoods in Yonkers (NY), to a similar sample of those who had applied to move out of high-poverty, predominantly minority-occupied neighbourhoods in the city but were not randomly selected to do so. In other national contexts, Oreopolis (2003) compared outcomes for young adults whose families had been assigned to public housing in Toronto and those whose parents occupied private-sector housing. Edin / Fredricksson / Aslund (2003) and Aslund / Fredricksson (2005) analyze neighbourhood effects for immigrants relocated across Sweden as part of a government-sponsored settlement plan.

Although these natural experiments may indeed provide some exogenous variation in neighbourhood locations, the selection problems are unlikely to be avoided completely. There typically is selection involved in who chooses to participate in these programs. In some cases (Gautreaux, e.g.), participants have some non-trivial latitude in which locations they choose, both initially and subsequently. In other cases (Yonkers, e.g.), there are limitations in the range of neighbourhoods to which participants moved. Finally, many programs must contend with low take-up rates, which likely reduce the power to identify program experimental effects.

There are several prominent examples of such opportunistic research that have provided valuable insights into the mechanisms of neighbourhood impact that are less likely to be tainted by selection, however. Rosenbaum / Reynolds / DeLuca (2002) recently probed qualitatively how the neighbourhoods of *Gautreaux* program movers into Chicago suburbs have enhanced their self-efficacy. Similarly, Briggs (1997, 1998) assessed social relationships through interviews with poor, minority youth who moved to scattered-site public housing in white, middle class neighbourhoods under the auspices of the *Yonkers* (NY) desegregation consent decree. Kleit (2001a, b, 2002) conducted insightful social network analysis of low-income residents of mixed-income housing developments mandated by inclusionary zoning regulations in Montgomery County, MD.

Econometric Models Based on Non-Experimental Data

Most American and Western European studies of neighbourhood effects have used cross-sectional or longitudinal data collected from surveys of individual households residing in a variety of neighbourhoods as a result of mundane factors, not random assignment or idiosyncratic public policies. They use multiple regression or other multivariate analysis techniques to control for [P_i] and [P_{it}] to ascertain the relationship between [N] and a variety of outcomes.

Several methods have been used to deal with the omitted variables-selection issue; only the first two are applicable to both panel and cross-sectional databases; the others require at least one repeated observation per individual.

Instrumenting Neighbourhood. A core technique for dealing with selection bias is using instrumental variables (IV). It can be implemented with either cross-sectional or panel data. In the first stage of this technique, a regression is estimated wherein the characteristic of neighbourhood in question is regressed on one or more explanatory variables that, ideally, are highly correlated with the neighbourhood characteristic but uncorrelated with unmeasured individual characteristics and are not causally related to the outcome in question (Murray, 2006). The predicted values for the neighbourhood characteristic yielded by this first stage regression, which presumably are purged of spurious correlation with unmeasured parental characteristics, are employed as the IV in a second-stage regression explaining outcomes. These IV's ideally capture the exogenous variation in the [*N*]. The challenge of this method, of course, is identifying first-stage variables that reasonably meet the aforementioned criteria.

In the seminal example of instrumental variables applied to residential neighbourhood, Foster / McLanahan (1996) used city-wide labor market conditions as identifying variables instrumenting for neighbourhood high school dropout rates in a model predicting individual children's school dropout probabilities. These city-wide instruments have several shortcomings, however. First, not only the neighbourhood context but also the city context may influence outcomes for a given neighbourhood's residents. Put differently, the "opportunity structure" has several spatial scales of potential importance (Galster / Killen, 1995). Thus, the neighbourhood variable instrumented in the above fashion will embody an amalgam of both spatial scales; the distinct impacts of the neighbourhood scale cannot be discerned. Second, if families choose their city on the basis of the average quality of its neighbourhoods (or particular neighbourhoods of intended residence), the instrument will not be completely purged of unmeasured parental characteristics. Third, the city-level variable's correlation with the corresponding tract-level variable may be modest, raising the specter of a weak instrument (Murray, 2006).

More recent applications of IVs have been more persuasive. For example, Moschion (2007) analyzes the relationship between an individual French woman's probability of participating in the labor market as a function of the labor force participation rates of her nearest female neighbors. She instruments for the latter with the gender mix of these neighbors' children (for those neighboring women who have two or more children).

Modeling Selection Explicitly. This strategy also involves a two-step process. In the first, a model is estimated where elements of $[N_{it}]$ are regressed on individual characteristics $[P_{it}]$, $[P_i]$. The (transformations of) predicted values of these selection equations are then added to equation [1] to control explicitly

for selection. To my knowledge, this strategy has not been applied in the neighbourhood effects literature, probably because of its limitations. First, datasets often do not provide sufficient data on individuals to precisely estimate the selection equation. Second, such predictors must include some powerful ones that do not include $[P_i]$ and $[P_{it}]$ employed in the second-stage model [1]. Third, if measures for $[UP_i]$ and $[UP_{it}]$ are unavailable for [1] they will be unavailable for the first-stage selection equation, and the fundamental problem is not skirted.

Differencing. When observations of neighbourhood and individual outcomes occur at two points in time, a differencing approach can be applied. The panel structure of the data allows one to write analogues of equation [1] for both times t and $t + 1$. Taking the difference in these two equations, thereby expressing all variables as changes over time, eliminates the unobserved fixed (time-invariant) effect $[UP]$. However, it does not remove the potential role of unobserved, time-varying effects $[UP_t]$ and $[UP_{t+1}]$. This approach has been used by Bolster et al. (2004) and Galster, Andersson et al. (2007) in the study of neighbourhood effects. The potential problem with this approach is that the variation in the key variables of interest (O, $[N]$) is likely reduced by differencing, making it more challenging statistically to obtain precise parameter estimates.

Fixed Effects. A fixed-effect approach requires a panel dataset with multiple observations of all variables in equation [1] over time. Under these circumstances, $[UP_i]$ can be collapsed into a set of person-specific dummy variables. This strategy has been applied by Weinberg / Reagan / Yankow (2004) and Knies (2007), for example. The first shortcoming of this approach is that it consumes substantial degrees of freedom. The second is that it does not control for time-varying individual characteristics $[UP_{it}]$.

Sibling Studies. Sibling studies investigate the effect of neighbourhoods on children by exploiting longitudinal datasets with large samples of siblings (Aaronson, 1997, 1998; Plotnick / Hoffman, 2000). Assuming that families do not move across neighbourhoods in response to differences in unmeasured characteristics of children, one can use the inter-temporal variations in neighbourhood conditions experienced by the family to assess impacts on siblings. The central logic is that estimating a model of the *differences* in outcomes between siblings allows the researcher to eliminate the unobserved parental fixed effect $[UP]$ and thus more accurately discern the impacts of different neighbourhood environments the siblings may have experienced at different ages.

To estimate this specification accurately, however, several concerns must be addressed (Aaronson, 1998). First, if parents' effectiveness in parenting evolves over time, younger children may be exposed to a different unobserved effect than their older siblings. The analysis should therefore control for birth

order. Second, outcomes may be affected by *changes* in family circumstances (unemployment, divorce, etc.) that also may affect neighbourhood choice. This implies that the analysis must control to the extent possible for such measured changes, and assume that they are changing consonant with unmeasured characteristic changes [UP_t]. Third, there remains a concern that typically there is limited variation in the characteristics of neighbourhoods that families move among under circumstances *not* associated with major changes in family circumstances (Levine / Painter, 2000), resulting in imprecise estimates (Aaronson, 1998). Fourth is the problem of small samples of siblings typically available even in the largest datasets

4.6 Endogeneity

The literature is replete with examples of efforts to estimate econometric models of elements of the joint neighbourhood / ownership status / residential mobility expectation selection that underpins the endogeneity problem. The modeling of housing ownership and mobility as a joint decision has, for example, become quite conventional; see Zorn (1988), and Ioannides / Kan (1996) for seminal work. Similarly, modeling tenure choice jointly with expected future mobility has been undertaken for some time; see Boehm (1981), Ioannides (1987) and Rosenthal (1988). In a recent and noteworthy work, Kan (2000) models three simultaneous equations predicting: current year's housing ownership choice, current year's mobility choice, and expected future mobility behavior. Only one work to my knowledge has modeled the joint housing ownership / neighbourhood choice process: Deng / Ross / Wachter (2003). More to the point, none has tried to use these predictions in a two-stage selection-adjustment strategy (described above) to control for endogeneity in a model estimating the effect of neighbourhood choice on subsequent individual outcomes

5. Promising New Directions

5.1 Defining the Scale of Neighbourhood

In this realm I think that further efforts that conduct within-sample tests of the effect on θ from varying the scale at which [N] is measured hold a good deal of promise. As noted above, a few studies have already done so, with interesting consequences. A particularly fertile approach is one that defines concentric circle ("bespoke") neighbourhoods of varying radii centered on each sampled individual, using geographical information system techniques. With this technique one can readily compare estimates of θ across a wide variety of "neighbourhoods" defined at various radii around the individual. Seminal illustrations of this are provided by Bolster et al. (2004) and Andersson /

Musterd (2006). A more technically challenging but potentially intriguing advance here would be to overlay street and topographical patterns around the individual instead of concentric circles, given the evidence that such human-made and natural structures shape the spatial patterns of social interactions (Grannis, 1998).

The data requirements for explorations using bespoke neighbourhoods are intensive, however. It is most feasible when it can be applied to a database containing information about all households in the geographic area under investigation, as is the case in social register-based datasets in Sweden and the Netherlands, for example.

5.2 Identifying Mechanisms of Neighbourhood Effect

Qualitative and ethnographic research has and will hopefully continue to provide invaluable insights into the processes that lead to neighbourhood effects. I thus add my voice to others encouraging such efforts previously (Ellen / Turner, 2003). However, such studies will, I fear, inevitably fall short in helping us *quantify* which particular mechanisms may dominate the causal processes in which circumstances. Here is where I think that further explorations with econometric analyses that employ non-linear relationships between [*N*] and *O* and stratify by advantaged and disadvantaged groups (so that the nature of the inter-neighbor externalities can be more clearly seen) hold great promise. For fuller explanation, see Galster (2007a, b). An example of how this can be done is provided by Galster / Andersson, et al. (2007).

5.3 Measuring Appropriate Neighbourhood Characteristics

Raudenbush / Sampson (1999) have already provided a comprehensive and creative analysis of how the measurement of neighbourhood characteristics can fruitfully be advanced, so I will not attempt to tread heavily here. In sum, they argue that survey-based neighbourhood assessments can usefully be constructed by aggregating over multiple-item responses of multiple informants in that place. They experiment with measures derived from interviews, direct observations, and videotapes of streetscapes, and then relate them to theoretically related measures obtained from official administrative data from the same areas.

Following Raudenbush / Sampson (1999) there remains a crucial need for neighbourhood effects researchers to measure variables related to organizational participation, collective supervision of youth, clarity and consensus regarding group norms, and intra- and extra-neighbourhood social networks for adults and children. The same is true for robust measures of neighbourhood institutional resources and extra-neighbourhood processes involving, e.g., stig-

matizing of neighbourhood by key actors. This probably will require the merging of information from a variety of sources, ranging from administrative databases to purposive social surveys.

5.4 Measuring Exposure to Neighbourhood

In responding to this challenge there are several directions I would suggest. First, theory and limited evidence suggests that neighbourhood effects should be stronger for those whose social worlds are more comprehensively bound up in them. This, in turn, suggests that the sociological literature on the individual correlates of the geographic extent of social relationships offers a rich vein of useful information. At a heuristic level, if this literature suggests that individual characteristic Z strongly discriminates among those with different geographic extents of social relationships, our sample for estimating equation [1] might well be stratified according to Z. In a more precise way, the literature may provide parameters of a strongly predictive multivariate equation of geographic extents of social relationships. These, in turn, could be used to develop "propensity scores" of the same for each individual in our sample, presuming that we do not have direct measures of the geographic extents of their social relationships but do have measures of their predictive variables. Finally, these propensity scores could be interacted with the [N] variables in our model [1], as per theory.

To test for timing and duration effects, I believe it may be fruitful to focus in a panel study on a subset of individuals who do not move over some extended period. For them one can estimate a series of models like [1] for some outcome O in year t, except that the period over which [N] is measured differs in each. In one variant, [N] might be measured for t only; in another, $t-1$; in another, $t-2$. Other variants could test for duration effects by comparing [N] measured as average scores over $t-1,\ldots,1-2$, or $t-1,\ldots,1-n$. Still other variants might flag the *extreme* values of [N] experienced during the period, to assess this sort of exposure mechanism.

5.5 Measuring Appropriate Individual Characteristics

Recall that a central methodological hurdle that quantitative studies of neighbourhood impact must surmount relates to unobserved individual (or parental) characteristics that simultaneously may be guiding both neighbourhood choice and individual (or child and youth) outcomes. Obviously, if we can measure directly a wider array of such individual (or parental) characteristics as motivations (or parenting behaviors), the issue of selection can be dealt with in a straightforward manner with control variables, instead of the more challenging econometric approaches discussed above. Thus, the challenge is

to gather data that directly allow us to measure comprehensively key characteristics of individuals (or their parents) in ways that minimize the need for econometric fixes. Below I will suggest such a data collection exercise.

Short of this, there are two promising strategies for dealing with unobserved individual characteristics that can produce selection bias. The first involves confining the panel analysis to the subset of individuals who do not move during a period, thereby removing the element of selection that may be associated with both time-invariant effects [UP_i] and time-varying effects [UP_{it}]. If such a period were reasonably lengthy, one would expect to observe sufficient exogenous variation in neighbourhood characteristics, which by definition cannot be correlated with either fixed- or time-varying unobserved personal characteristics. Thus, for each set of non-movers one can estimate a form of [1], without fear of obtaining a biased estimate of θ. The shortcoming of this non-moving sample approach is the potential lack of generality of this subset of households. This strategy has recently been employed by Knies (2007).

A second promising approach computes a "residual" proxy variable for both [UP_i] and [UP_{it+1}] through a two-step method. This approach requires observations from (at least) two periods. It first estimates equation [1] for period t; the residuals (R) from this regression can be expressed:

$$[2] \qquad R_i = O_{it}^{actual} - O_{it}^{predicted} = \varphi[UP_{it}] + \partial[UP_i] + \varepsilon \ .$$

Now to the extent that R_i is correlated with both [UP_i] and [UP_{it+1}], its inclusion in a second regression of form [1] but with all other variables measured for period $t + 1$ will presumably help reduce the omitted variable bias when this equation is estimated. To my knowledge, this method has been tried only by Musterd et al (forthcoming). Consistent with the foregoing arguments about reducing bias from omitted variables, they found that its inclusion reduced the measured magnitude of the neighborhood income mix on immigrant adult earnings in Sweden. The technique still needs to be subjected to rigorous simulation and mathematical experiments to discern its statistical properties before its use can be recommended unequivocally.

5.6 Endogeneity

Galster / Marcotte, et al. (2007) have recently attempted to tackle the endogeneity problem directly in their investigation of the cumulative impact of neighbourhood poverty rates upon children. They specify structural equations for the endogenous variables: housing ownership choice, neighbourhood choice (poverty rate), expected mobility during the next year, and actual mobility during the next year. The exogenous predictors in all of these equations

serve as grist for constructing an IV for neighbourhood poverty rate for each year of the observed children's lives. First, using the 1968 – 1974 birth cohorts from the US Panel Study of Income Dynamics they estimate an OLS regression based on observations of individual child-years wherein the left-hand side is the observed value of the census tract poverty rate in a given child's neighbourhood in a particular year and the right-hand side contains observed values of every exogenous variable in the system of equations. These exogenous variables include contemporaneous values of *countywide* characteristics corresponding to the endogenous variables and dummy variables for calendar year. In this first step, the regression is estimated based on all observations from age 1 to 18 of each child. In the second step, the aforementioned regression is employed to generate predicted values of neighbourhood poverty for each of the first 18 years of each child's life, based on values of all exogenous variables appropriate for the given year. In the third step they compute the *average* of these predicted values over all observed years of childhood, the IV for neighbourhood poverty experienced during childhood. Unfortunately, this procedure did not produce a sufficiently strong, precisely measured instrument for the authors to place much confidence in the estimates it yielded. Nevertheless, the conceptual approach holds promise, I believe, if better fist-stage exogenous predictors can be employed.

6. A Call for Two New Sources of Data

In this section I argue for efforts to acquire data from two types of sources. I believe that these sources offer fertile ground for overcoming many, if not all, of the aforementioned challenges associated with precisely and accurately measuring the effect of neighbourhood conditions on individuals. The first source of data comes from natural experiments, the second from a new, two-wave, people / place panel survey.

6.1 Toward A Renewed Focus on Natural Experiments

As noted above, in the past there have been a few investigations employing "natural quasi-experiments:" idiosyncratic public policy initiatives in various locales that create exogenous variation in neighbourhood environments for the individual households involved. These can be considered, at best, quasi-experimental designs insofar as tenants being observed may still have some latitude in choosing neighbourhoods, although their choices typically are limited by the program design. However, I believe that the potential of self-selection to bias conclusions regarding the *mechanisms* of neighbourhood impact are considerably less serious than in the case of measuring *magnitude* of effects.

More efforts along these lines would prove fruitful. Either classic anthropological case study, control vs. experimental group, or pre-post longitudinal designs (including retrospective comparisons) could be contemplated. There are ample opportunities emerging in the U.S. public policy arena, including HOPE VI mixed-income redevelopments of distressed public housing complexes, court-ordered public housing authority desegregation consent decrees, and innovative local housing authority initiatives. My colleague, Anna Santiago, and I are currently gathering retrospective data from one such natural experiment involving scattered-site public housing in Denver, CO. In the Western European context, several nations are adopting policies for increasing the income and / or tenure diversity of large social housing estates, which may offer additional opportunities for testing neighbourhood impacts in a quasi-experimental context (Kearns, 2002; Musterd, 2002).

6.2 Towards a New Sort of Database

A second initiative I recommend is the initiation of a new, large-scale survey that would be purposively designed to test neighbourhood effects and provide ways for overcoming the aforementioned methodological challenges. I call it a *people / place panel design.* In overview, it would combine the depth, comprehensiveness, and spatial specificity that characterize many sociological, cross-sectional surveys of individuals in specific neighbourhoods, and the crucial inter-temporal but a-spatial features of many ongoing, representative panel surveys of individuals. The former is required for adequate measurement of neighbourhood social processes and physical environments within particular places; the latter is required for observing exposure effects and providing econometric ammunition for overcoming selection and endogeneity biases. The design must include at least two waves of interviews in several neighbourhoods in (preferably) several cities. The minimum elements of the proposed survey would be:

- *Wave 1 person-in-place:* in-depth, comprehensive questionnaire administered to spatially clustered samples of households; multiple clusters within each city; multiple cities sampled; assesses baseline characteristics of individuals and (via aggregation of these individuals' responses) of neighbourhoods sampled
- *Wave 2 person:* comprehensive questionnaire administered to the households originally living at addresses as in wave 1 but now have moved; assesses characteristics of original individuals sampled who moved since wave 1
- *Wave 2 place:* comprehensive questionnaire administered to the households now living at same addresses as in wave 1; assesses later-period characteristics of sampled neighbourhoods and individuals who did not move

Such an endeavor would clearly require a significant investment of resources from a large governmental, institutional, or philanthropic concern(s).[2] Nevertheless, I believe that such an investment in a person / place panel design is necessary if we are to convincingly quantify neighbourhood effects.

7. Conclusions

In order to advance the quantitative investigation of the impact of neighbourhood on a variety of individual human outcomes, researchers must surmount six methodological challenges. These are: (1) defining the scale of neighbourhood; (2) identifying mechanisms of neighbourhood effect; (3) measuring appropriate neighbourhood characteristics; (4) measuring exposure to neighbourhood; (5) measuring appropriate individual characteristics; and (6) endogeneity. Prior attempts to meet these challenges, though representing vast methodological strides in a short period, nevertheless have been only partially successful. The result is that the answer to the increasingly important question: *How much independent causal effect does the neighbourhood have on individuals?* still remains uncertain within broad parameters.

There are, however, several approaches on the horizon that offer the promise of surmounting these challenges. These include: (1) experiments with varied scales of bespoke neighbourhoods; (2) databases with multi-domain measures of neighbourhood characteristics; (3) statistical models testing for non-linear neighbourhood effects that are stratified by household group, density of local social interactions, and duration of residency; and (4) econometric devices involving instrumental variables and residuals. Further progress can be made on this front if we take advantage of natural quasi-experiments and push toward a major, new social survey employing a people / place panel design.

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[2] In many respects the survey recently completed as part of the European Commission-funded URBEX program may be seen as a prototype of the one I am suggesting (Musterd, 2007). However, my proposal differs importantly in its people / place panel design.

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