2002

Study of area deprivation in Connecticut and Maine

Jonathan H. Ryder
Colby College

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A Study of Area Deprivation in Connecticut and Maine

Jonathan H. Ryder
Colby College
Spring 2002

Abstract
This paper accounts the development of an area deprivation index for two New England states, Connecticut and Maine. The index incorporates data from the 1990 U.S. Census. By applying methodology used in previous projects that created similar indices for areas in Britain, an area deprivation index is created at the 5-digit zip code level for these two states in the year 1990. This project provides an example of how such a study can be applied to and completed in the United States. Foremost, it is an attempt to evaluate the relative merits of examining a comprehensive measure of area deprivation, as well as examine the interrelationships between fields of deprivation, within the chosen areas. Utilizing geographic mapping software, the index is incorporated into an interactive and accessible geographic information system, with which the distribution of deprivation within these two states in 1990 is examined and documented.
Acknowledgments

I would like to take this opportunity to thank the following people for their support and assistance throughout this project, for it would not have been completed without the help of others.

Professor Michael R. Donihue of the Colby College Economics Department, my primary advisor, for the tremendous amount of time that he has sacrificed, for his consistent help and advice throughout every stage of this project, and for having enough confidence in me to encourage me to pursue and complete this paper.

Professor Henry A. Gemery of the Colby College Economics Department, for the time and effort that he has given me in acting as my secondary advisor, and for also granting me the trust and confidence to allow me to continue this project through the spring semester.

Mike McGuire of the Miller Library research staff, for his instrumental assistance in accessing the data on which this project is founded.

Professor Robert Gastaldo of the Colby College Geology Department for advising me in selecting mapping software.

The Office of the Dean of Faculty of Colby College, for funding the software costs incurred in this project.

Christine Christensen of Colby Information Technology Services, for acquiring software on my behalf, and for arranging for it to be accessible to me.

Rurik Spence also of Colby Information Technology Services, for installing software on the General Server and for being extraordinarily accessible and helpful when minor problems arose involving it.
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Introduction

Poverty and Deprivation

Poverty is traditionally, and most basically defined in terms of financial resources, an insufficiency of which may result in the inability to meet basic needs and, ultimately, to sustain oneself. This definition, however, may be expanded by introducing the concept of relativity, where by, a minimally defined level of resources may not correspond to subsistence levels, but instead to that necessary to achieve a minimum standard of living as defined by the society in which one lives. Living in an economically and socially developed society may not preclude one from a struggle to meet basic needs, as exemplified by the intensity of poverty visible in every corner of the world. Nonetheless, relative poverty can be thought to also reflect living conditions that, while sustainable, are significantly lower than those typically experienced. Such a standard of living may involve low levels of material consumption, limited access to services and recreation, and limited social participation, all of which may result from a relative lack of financial resources.

The idea of deprivation is an even broader understanding of poverty, incorporating personal and exogenous circumstances that contribute to or exacerbate the effects of financial poverty. Previous works have discussed deprivation and social exclusion interchangeably and sighted three distinct features of this concept: relativity; agency; and dynamics (Kearns, Gibb and Mackay, 2000). Deprivation therefore incorporates a combination of factors contributing to, compounding, or resulting from poverty that further limit the social participation, power, and well being of individuals relative to those around them at a specific time and place, are outside of the control of those individuals, and inhibit them from improving their situation as time progresses.

Area Deprivation

The study of area deprivation can be defined as a multidimensional examination of the geographic concentration and distribution of relative poverty and social exclusion. It is a study of the relative levels of deprivation between areas. An area may be deprived in the sense that its occupants exhibit relatively poor personal circumstances and/or an area may exhibit geographically specific exogenous conditions that intensify the levels of
deprivation experienced by its occupants. Such conditions and circumstances characterizing deprived areas have been comprehensively explained in the following way:

- "A high level, or proportion, of individuals or households, who experience a range of negative or undesirable circumstances, either singularly, or in combination, which significantly reduce their overall well being, e.g. low incomes, unemployment, poor health, bad housing conditions, and poor education."

- "The concentration of these 'deprived' households and individuals in an area coupled with the undesirable aspects of that area: poor environment, poor housing neglected open spaces, abandoned shops and houses, high crime levels, lack of services, lack of job opportunities, all of which can act to reinforce the level of deprivation experienced by the community." (Mason 1999, pp29)

Additionally, it has been argued that a concentration of deprived persons can, in and of itself, be interpreted as an exogenous detriment on the lives of those in an area. A recent working paper released by the Center for the Analysis of Social Exclusion, of the London School of Economics, noted examples of extra-personal disadvantages that may be associated with concentrations of deprived persons (Smith 1999). The first such possibility is that by straining local public and private services, such concentration may reduce their quality and availability. Occupants of areas with a high concentration of deprivation are also potentially subject to discrimination based on perceptions of and generalizations made about the area. Such discrimination may manifest itself through limitations on access to credit, insurance and employment. Furthermore, the likelihood of selective migration from within pockets of deprivation may serve to reinforce its concentration, as the occupants with the greatest ambition, skills, and means will generally be those to leave such an area. Finally, and most intangibly, concentrations of deprived persons have been argued to produce "cultural effects," wherein local attitudes, values and typical behaviors reinforce social exclusion and collectively become less conducive to positive development. It is notable that the author sights the culture-related argument as "particularly associated with commentaries on America's poor neighborhoods." (Smith 1999, pp29)

The existence of geographically specific circumstances of deprivation, be they fixed to an area or to its occupants, can therefore be expected to further intensify and
prolong the hardships of deprived individuals. Such a scenario demonstrates the potentially self-reinforcing nature of area deprivation.

Area-Based Initiatives

There is a significant body of research relating to area deprivation, however it has been almost exclusively completed in Britain. The study of the geographic distribution of relative poverty and deprivation is an important endeavor in and of itself, however it is generally completed to aid policy makers in implementing area-based economic initiatives. Such approaches attempt to alleviate geographically concentrated pockets of economic and social deprivation through locally targeted programs, which may be either comprehensive or narrowly tapered. State and federal efforts in the United States to improve educational access in impoverished areas, or at least political discussion of such efforts, are examples of a similar area focus. However, local initiatives targeting other aspects of deprivation, particularly within the fields of employment and health, are simply less focal components of the political agenda in this country than they are in Britain.

The discrepancy in attitudes concerning health care is explained by the fact that the National Health Service operates within Britain, and the U.S. does not have a nationalized health care system. Inconsistencies in health care access between areas in Britain are, therefore, inequalities in the distribution of public services, and the demand to address them politically is more immediate than that to address the unequal distribution of resources in the United States. British attitudes concerning the government’s role in local economies are similarly, in part, a product of its significantly more socialist leaning general political economy relative to that of the United States. The demand for government intervention at the local level may also be somewhat attributed to the intensity and concentration of area decline that has occurred in Britain as a result of the structural shift from industrial manufacturing. The United States’ more vigorous avowed reliance on free markets should implicitly condone a greater acceptance of area decline. Moreover, structural change has not so drastically distorted the demographic landscape of this country in the second half of the 20th century, as it has in Britain. Overall, the concept of area deprivation and the demand on government to address such
circumstances is more familiar within the British political and economic landscape, than that of the United States. Research on this subject has, therefore, largely centered on the existence and effects of area deprivation in the United Kingdom.

The practice of addressing deprived areas is of course intended to improve the lives of deprived persons living in those areas. However, deprived persons and families are additionally distributed throughout areas that would not be considered deprived, and such policies will not benefit these groups. Area-based initiatives must therefore be justified by fundamental area specific deficiencies or by the self-reinforcing effects of concentrations of deprivation. While government benefits such as income assistance are obviously more appropriately allocated through other criteria, programs to correct deficient financial markets, housing stocks, infrastructure, school systems\(^1\) or labor markets may be effectively specified geographically.

**Evidence of the Effects of Area Deprivation**

Previous literature has outlined slight empirical evidence within Britain that area conditions do, in fact, intensify and prolong the effects of individual poverty and deprivation. The most significant information pertaining to this issue comes from the British Office for National Statistics *Longitudinal Study of England and Wales*, a linkage study revealing individual characteristics of 1% of the population through the 1971, 1981, and 1991 national censuses. By following the changing fortunes of individuals, the study reveals the dynamic effects of deprived circumstances. A further analysis of this study specifically addresses the relative effects of living in deprived areas (election wards) and experiencing individually deprived circumstances (Sloggett and Joshi, 1998). It was found that, generally, individually deprived circumstances did increase the chances for future deprivation, though much “churn ing” did occur particularly among those who were unemployed. It was also concluded, importantly, that continuing to live in a deprived

\(^1\) Voucher programs provide an example of a non-geographically specific educational benefit, and, interestingly, the most obvious criticisms of such a program exemplify the necessity of area targeting. Distributing extra educational resources evenly, instead of allocating them to the most needy areas, may be expected to cause, through selective migration of students and involved parents to private schools, a further reduction in the quality of education among the most deprived areas.
was more likely than the repetition of any other individual circumstance. These results evidence the self-perpetuating nature of individual deprivation, and the difficulty for persons to remove themselves from deprived circumstances, particularly those defined by areas. While past individual characteristics were found to have stronger explanatory power, the history of area residence was a significant predictor of personal circumstances in 1991, an implication that simply living in a deprived area, though not as significant as more personally specific circumstances, may in fact contribute to prolonging and intensifying the effects of poverty.

The ward deprivation measure compiled by Sloggett and Joshi does not include indicators relating to health, however, the authors devote a section of their paper to testing the explanatory power of this measure over health outcomes. Its effects on personal health are found to be similar to those on other personal circumstances. A clear positive relation is shown to exist between ward deprivation scores and future premature death and long-term illness among individuals who lived in that ward. Though, the association is stronger with personal deprivation measures than it is with area measures. Other economists have interpreted the ONS longitudinal study as suggesting that area affects health outcomes even after personal characteristics are held constant (Smith 1999). However, Sloggett and Joshi’s work, incorporating the same data, concluded that the “association of poor health and poor places is basically an association amongst individuals” (Sloggett and Joshi 1998, pp 1057).

While it is a very difficult hypothesis to test, there seems to be some statistical evidence that, in Britain, extra-personal area specific conditions do exist and affect prolonged levels of personal deprivation. The association between personal conditions and future personal conditions is, however, much stronger. Nevertheless, the evidence that deprived persons are generally stuck in deprived places supports the importance of relative area deprivation in the circumstances of individuals.

Aside from the complicated question of dynamic circumstances, there is also much more simple and conclusive evidence of the self-perpetuating nature of area-specific deprivation: the continuing particular coexistence of prosperous and

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Footnote: Within this study the relative deprivation of wards is measure by a simple index of area deprivation, the methodology of which will be discussed in the next section.
impoverished areas. While there is evidence of such a phenomenon in Britain, this circumstance is clearly exhibited in the United States and there is no need to interpolate evidence from abroad. The two states chosen for this study, CT and ME, have exhibited enduring patterns of poverty distribution, in which areas within each continually suffer substantially higher levels of poverty than the rest of the state. Furthermore, in Connecticut between 1991 and 1998 the poorest areas became poorer, in nominal terms, while the affluent areas became more affluent\(^3\), evidencing that area-specific poverty is not only self-perpetuating, but self-intensifying (Swift 2001).

**Indexing Deprivation**

Indices comprising various contributing fields have been developed in past studies and used as tools to measure and examine relative levels of deprivation. If compiled “correctly” an index score may be an exceptionally valuable comprehensive measure of deprived circumstances. The catch, however, is that there is no “correct” method with which to compile an index. By its nature such a project involves making subjective decisions akin to adding apples and oranges, and any method may be subject to just criticism.

Indices are relatively common within the broader study of poverty and development; the United Nations’ Human Poverty Index (HPI) and Human Development Index (HDI), each compiled at the national level, are examples of such applications. However, indexing deprivation among small areas is uncommon outside of the United Kingdom, and no previous such project was discovered within the United States. To develop an index of area deprivation in CT and ME, four particular related indices produced in Scotland, England (2) and South Africa were studied in depth.

*Previously Developed Indices*

**Area Deprivation Index of Scotland**

(Kearns, Gibb, and Mackay 2000)

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\(^3\) According to Swift, personal income in the most affluent postal area in CT grew by more then 250% in this time.
This paper uses non-census indicators from 1996 to create an area deprivation index for Scotland at the spatial level of the postal code sector. The introduction provides a lengthy explanation of the nature of area deprivation and the need to examine such broad measures of inequality and deficiency of resources in addition to income based poverty measures. The authors also cite the potential importance of such a measure in the use of area-based policy intervention as the cause for applying it to geographical localities.

Discussion is also given to the choice of the particular spatial scale used for the index; important in this decision were data limitations and policy applications. The authors note the problem of ecological fallacy associated with studies of larger area units, that deprived areas will more likely be hidden by variance within the area unit being studied. Additionally, they note that given an extremely small unit of study, the results may display a patchwork of very small, deprived areas, which are difficult for policy makers to target.

Six domains are specified within which the index measures deprivation; these are housing, crime/environment, health, education, labor market and income poverty. Deficiency in any of these domains may demonstrate social exclusion, and may constitute a direct contribution to or result of poverty, therefore an index examining all of them may provide substantial information for policy makers aiming to address poverty and deprivation with both preventative and/or relief objectives.

An outline is provided of the methods of data collection as well as the statistical techniques used to create the index. The process of data collection is not significantly relevant to the current application of this project because many of the sources used, such as the NHS and local housing authorities, do not exist within the US. The statistical techniques, however, are very important. All indicators were first converted to chi-squared values. This value compares the raw value of the indicator with its expected value based on the average for the entire country. The indicators were also logged to diminish the effects of extreme values. The last step taken was to set all negative indicator scores to zero, thus creating an asymmetric index. The rational for this decision was to not allow exceptionally good circumstances in one or more fields to mask deprivation in others. As a result, the index simply highlighted areas that were multiply

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deprived while showing very little about the relative affluence of those that were not. No
further steps were taken to weigh the indicators, and thus all were assigned equal weights.

Within the five chosen fields the authors collected data on 15 indicators. Having
standardized and transformed these, they created a bilateral correlation matrix of all 15.
Observing this table they removed indicators that correlated weekly or exceptionally
strongly with the others, sighting .30-.80 as an appropriate range for the correlation of
indicators that should be kept. They also removed census indicators for which there
seemed to be a suitable non-census alternative. The remaining eight indicators were
subjected to a factor analysis, to determine whether each indicates deprivation in its
domain alone. From this final step two more indicators were dropped leaving only one
for each domain. The final six indicators chosen are the unemployment claimant count,
mortality ratio 0-64, non-participation rate for higher education, number claimants of
income support benefits, overcrowding, and insurance weightings (to approximate levels
of crime). The index score was calculated by simply summing the six logged, chi-
squared indicators.

**Personal Deprivation Index of South Africa**

(Klasen 2000)

This project draws data from a 1993 survey sampling 9,000 South African
households. From a number of variables in this survey the authors create a composite
index of deprivation and compare its distribution to that of a simple expenditure based
measure of poverty. The introduction of this paper also provides a discussion of the need
to observe welfare more directly through a broad measure of deprivation, particularly
pointing to the theoretical shortcomings of using income/expenditure as a proxy for
poverty. Some such shortcomings noted are the inability of such a measure to reflect
access to public goods or welfare components that are not derived monetarily. The
authors therefore find it attractive to define poverty as “the inability of individuals to
achieve a minimal level of capabilities to function,” and attempt to create a composite
deprivation measure that directly reflects these capabilities.

The deprivation index is created from fourteen indicators of such capabilities for
which the survey provided data:
For each of these indicators the authors, using theoretical intuition, quantified the level of welfare associated with possible survey responses to scores of 1 through 5. The components were then weighted based on principle component analysis. This analysis interprets the first principle component of the fourteen individual components as the measure of deprivation, thus basing the weights of the individual components on their correlation to the deprivation measure. The authors found that with the exception of the variable for safety, which was assigned an exceptionally weak weighting, all components contributed very evenly to the measure of deprivation. The weighted scores of the components were then averaged to provide the deprivation score for the household. The author footnotes the potential problems associated with weighting variables based on their correlation with one another; that to do so implicitly assumes that all factors contributing to social exclusion necessarily correlate with one another and using such a technique may eliminate variables that though weekly correlated, are important. The author sights the low weighting of the safety variable as an example of this problem. However, given the alternative explanation of the safety variable’s lack of correlation that has already been footnoted, this does not seem like an example of such a problem; it would be only if the safety variable accurately reflected the household’s safety relative to that of others.

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4 The variable for safety is intuitively problematic because, assuming opinions can be viewed as consistent statistics in the first place, the level of perceived safety relative to five years earlier tells nothing about the level of safety that a household experiences absolutely or relative to other households. Therefore, the fact that it was found not to be correlated with the other variables and was therefore not weighted heavily is not surprising.

5 This finding substantiates the claim made by Kearns, Gibb and Daniel, that research had not provided compelling reasons to weight the indicators.
This index differs from the others examined, because it measures the relative deprivation of each household, rather than the level of an entire area. The author is therefore able to examine the demographic as well as geographic distribution of this measure of deprivation and compare those results to the distribution of the expenditure-based measure of poverty. A second deprivation index was also constructed from seven core indicators, and the results were very close to those of the larger index. It was also determined that the results were not sensitive to changes in individual variables.

It was found that the expenditure variable correlated strongly with the deprivation measure as well as with all of its components. However, among the most deprived households correlation between expenditure and deprivation declines and the fuel and sanitation indicators become more strongly correlated with the index. This evidence leads to an important implication, that as levels of deprivation rise in South Africa an expenditure-based measure of poverty becomes less able to accurately reflect relative levels of overall welfare. In particular the expenditure-based measure underestimates both the extent and depth of poverty among Africans, rural households, and de facto female-headed households, all exceptionally deprived demographic groups in South Africa. It is apparent from this evidence that basing welfare policies on expenditure/income data may not accurately allocate resources among groups needing assistance.

The author notes circumstances particular to South Africa that may explain why these groups are more deprived than income figures would suggest. The legacy of apartheid has left Africans more deprived than the expenditure measure suggests, and, most significantly, the lack of amenities and public goods available in rural areas leaves the people living in these areas much more deprived than they are simply poor. In fact, 92% of those households that are deprived, though they are not distinguished as poor by the expenditure measure, reside in rural areas.

Though this index is one of household rather than area deprivation, this paper serves as a valuable resource. The suggestion and discussion of indicators is useful; while some of the components used in this index, such as water and energy, do not apply well to an index made in the United States because they affect so few people in a developed country, the author’s choice of other core components reinforces confidence in
their theoretical value. This paper also serves to suggest the creation of an index based singularly on an income measure to compare with a deprivation index, testing whether income statistics are in fact a sufficient proxy for poverty, and whether or not the two will provide conflicting evidence for policy makers.

Department of the Environment, Transportation and the Regions (DETR) Indices of Local Deprivation of England and Wales

The DETR has produced three separate indices of local deprivation, in 1991, 1998 (Robson and team 1998), and in the year 2000 (Noble and team 2000). The 1998 Index of Local Deprivation is simply an updated version of the 1991 Index of Local Conditions and the two are therefore very similar. In each of these projects the index was developed at three special levels, local authority district, ward, and enumeration district, which are each consecutively smaller areas. The 1991 IDC combines six indicators at the ED scale and seven at the ward scale, all of which are taken from the 1991 Census. The local authority index includes six additional non-census indicators that were not available within the other, smaller, geographic definitions, and is thus comprised of thirteen indicators of deprivation. The complete set of indicators incorporated includes:

- Unemployment*
- Housing lacking amenities*
- Overcrowded housing
- Children in unsuitable accommodation*
- Children in low earning households*
- Households lacking a car*
- Low educational participation among 17 yr olds*
- Low educational attainment (15 yr olds)
- Standard Mortality ratios
- Home Insurance weightings
- Derelict land
- Male long-term unemployment
- Income support

* = Data from the 1991 Census

The DETR notes that none of these indicators measure population groups at risk of deprivation such as minority or elderly populations, arguing that deprived measures of such groups should be identified by the more direct measures of actual deprivation.

The 1998 local authority ILD incorporated 1998 data for the six non-census indicators, and also included updated, surrogate indicators for two of the census indicators. Of the remaining 1991 Census indicators one was simply dropped from the
index, while the others were retained in their somewhat outdated versions. However, unlike for the Scottish deprivation index discussed earlier, no non-census data were found to be available at the ward and ED levels and the 1998 modifications of those indices, therefore, continued to include only 1991 Census data.

The statistical methods incorporated in developing these indices were similar to those incorporated by Kearns, Gibb and Mackay. Insurance weightings and mortality ratios were compiled in already standardized form, and were only adjusted so that zero scores coincided with the English average. Each of the other indicators were however, converted to Chi-squared statistics. To make uniform the distribution ranges of the indicators they were each additionally logarithmically transformed. Deprivation scores in 1991 were calculated by simply summing the standardized values of the indicators. The 1998 index, however, implemented a few adjustments, the first of which was to set all negative indicator values (those expressing lower than average deprivation) to zero. This technique, also incorporated in the Scottish index, avoids the potential for deprived circumstances to be hidden by other positive attributes. The other adjustment made between 1991 and 1998 is that the standardized scores of the two indicators not converted to Chi-squared statistics were doubled because it was noted that their distribution ranges, and thus their weights in the index, were significantly lower than those of the other standardized indicators.

It is important that in each of these projects, other than the final adjustment of two indicators in the 1998 local area level ILD, no steps were taken to weight indicators and they were therefore all granted equal value within the index. It is also notable that the number of indicators reflecting each field of deprivation varies; implicitly, certain fields are therefore more heavily weighted than others. Additionally, among the smaller areas, relative levels of crime and health are not approximated at all. (Robson and team 1998)

The DETR "Indices of Deprivation 2000" is a set of indices of area deprivation completely distinct from the earlier ILC and ILD. The set includes an overall ward level Index of Multiple Deprivation, a supplementary ward level index of Child Poverty, and six summaries at the local authority district level of the IMD, all incorporating newly available small area data. The methods used to develop the overall IMD are those most relevant to the present project.
The IMD combines 33 total indicators to describe overall deprivation at the ward level. These indicators are compiled within six specified domains of deprivation: income; employment; health deprivation and disability; education, skills and training; housing; and geographic access to services. It is noted that the domains of crime/social order and physical environment are not represented in the index due to a lack of data availability.

Instead of directly combining the set of indicators to calculate an index score, as other projects have done, for the 2000 IMD the DETR developed six separate Domain Indexes each measuring deprivation with one of the specified domains. Within the fields of income and employment, each indicator is a percentage statistic of the portion of an area's population that suffers in some way from deprivation in these fields. The domain indices for these fields are therefore created by summing each of the indicator values in each area; so the income domain index score is, for example, the rate of adults in Income Support families, plus the rate of children in IS families, plus a number of related rates. The remaining four domains of deprivation are, however, approximated by indicators that are not as easily combined. Within each of these, indicators are weighted through factor analysis and then summed.

To calculate a total deprivation measure each domain index was standardized and transformed to an exponential distribution. For the purposes of this project, the DETR deemed it inappropriate to equally weigh each domain index, and through theory, intuition and, it can be argued, through arbitrary determination, the following weightings were applied to each domain:

- Income 25%
- Employment 25%
- Health Deprivation and Disability 15%
- Education, Skills and Training 15%
- Geographic Access to Services 10%
- Housing 10%

The weighted domains are summed to generate the overall Index of Multiple Deprivation. (Noble and team 2000)

Similar to those of that developed in Scotland, the results of these indices focus primarily on the specific distribution of deprivation in the areas that they are compiled
for. Their validity is judged based on comparisons with other similar indices for the same areas, however given the acceptance of the theoretical value of such a study in the UK, less focus is given to whether or not the results support the use of such an application. The results are therefore not very useful in the present project.

**Longitudinal Index of Deprivation of England and Wales**

(Slogget and Joshi 1998)

This paper has already been mentioned for the information it contains about the prolonged effects of area deprivation. The relatively simple ward level index that was created for this analysis serves as another example of methodology for the development of an index of area deprivation. This index includes only four components, the unemployment rate, households with no car access, households not owner occupied, and employed men and women in social class four or five, all of which are compiled from census data. Due to its highly positively skewed distribution, proportions unemployed are logarithmically transformed. The deprivation measure is constructed by summing the normal (z) scores of the four indicators.

This component of this project provides yet another example of an index compiled through basic transformation and standardization, and without any further weighting, of indicators of deprivation. The relevant results of this project have already been discussed.

**Application in the United States**

The political economy of the United States is much less socially leaning then that of Britain, and small area based initiatives, particularly in certain fields, are likely never to be as prevalent a political tool as they are in Britain. There is, however, serious justification for the application of the study of area deprivation to the United States, the most pressing of which is the intensity and geographically consistent nature of poverty in this country. Boasting the world's most wealthy economy, the United State exhibits, by many measures, the most significant poverty of any developed western country. Poverty

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6 As defined by the British census.
in this country is traditionally and consistently area specific, concentrated in urban neighborhoods, and distributed more broadly over exceptionally rural areas.

The United States’ problems of area dependent poverty can be argued to surpass those of Britain. Income and consumption in the U.S. are less evenly distributed, as evidenced by the fact that the poorest 10% of this country’s population consumes only 1.8% of nationwide personal income; an alarming statistic even lower than the corresponding figure of 2.3% in the United Kingdom (World Bank 2002). Furthermore, this stratified distribution is largely area specific. Amazingly, area deprivation in America, specifically the prevalence of “inner city ghettos and urban unrest,” has been cited as an impetus for research and proactive attention in Britain at the birth of this field in the 1960s (Smith 1999). Yet, these issues are still not as widely studied in this country.

This project creates an index of area deprivation to explore the distinct variation in area conditions in a region of the United States. Connecticut and Maine were chosen for this study because they respectively exhibit typical and prolonged examples of urban and rural poverty. Connecticut, perhaps more than any other state, is defined by the dichotomy of white, suburban, upper middleclass communities, and deprived, and largely minority populated, urban neighborhoods. It has been cited as one of the richest states with three of the ten poorest cities in the country. To witness the immediate juxtaposition of deprived and affluent areas one must only drive a few hundred feet of route 44, leaving the visible poverty of Hartford, crossing a brief open space and, yes, a railroad track, and entering West Hartford to the company of large houses and lush green lawns.

While the geographic distribution of poverty in Maine may be less abrupt, it can also be seen to demonstrate consistent discrepancies between areas. This distribution has been described by the “two state” phenomenon; that the reputation of southern ME, exemplified by the quaint, aesthetic nature of Freeport, Cape Elizabeth, Camden/Rockport, and parts of Portland, does little to represent the sparsely populated northern regions of the state, and the significant poverty that is experienced there.

To explore the distribution of poverty and social exclusion within CT and ME, this project develops an index of area deprivation at the 5 digit zip code level, within these two states. The index reflects relative conditions within the fields of income,
wealth, employment, health, and education, and provides a picture of the relative
distribution of deprivation between and within each of these states. Such an index has
not before been created for these areas; this project therefore also serves to test the
validity of applying such an approach in the United States.

Indicator Choice and Collection

Following the examples and theoretical foundations outlined in previous
deprivation indices seven core fields, or domains, were initially chosen in which to
measure relative deprivation: income, wealth, employment, education, housing, health,
and crime/environment. As previously mentioned, data pertaining to these fields were
ultimately compiled from the 1990 US Census of Population and Housing, specifically,
from the Summary Tape File 3B. Initially, however, a number of more recent sources
were explored. The 2000 Census is an ideal source of data, unfortunately it was
discovered that census data pertaining to small geographic areas, particularly the STF3B
summary file, would not be released until summer of 2002. The annually completed
Current Population Survey, was also examined, but found to only record countywide
statistics. It was determined that no other comprehensive source of demographic data
was available.

More recent data pertaining to health and income and separated by zip code were
discovered; income data can be obtained from the IRS and some health statistics are
available from each state’s Department of Health. Unfortunately, statistics measuring
deprivation in other fields are not available by zip code. More recent general
demographic statistics, including education and unemployment figures, are available by
town, but again only provide information within a few fields. Additionally, to raise the
spatial scale of the index from zip codes to towns would weaken the analysis by hiding
characteristics of small areas within large towns and cities. Regardless, there are simply
too few indicators available outside of the census to create a reliable index at even the
town level.

In resorting to the incorporation of 1990 census data a degree of antiquation is
introduced into the project; the distribution of relative deprivation presented by this index
is that of 1990. This study does, however, present a model for the application of such an
index to areas within the United States, particularly when 2000 data become available. More importantly, within these areas, it will serve to test the validity and importance of such a comprehensive view of poverty as well as the interrelationships between fields of deprivation, information that is pertinent to any contemporary examination of local poverty.

From the STF3B summary file of the 1990 US Census, twenty-one indicators were initially identified, each of which is classified within one of the fields mentioned above. Every field is not, however, represented by an indicator because the census contains no variables that can be assumed to approximate relative levels of crime. As a result the index does not reflect deprivation within the field of crime/environment and is weakened accordingly.

Attempts were made to find an alternative source of data relating to crime, though they were unsuccessful. Resources explored include the FBI office of statistics, the National Archive of Criminal Justice Data within the University of Michigan's Inter-University Consortium for Political and Social Research, and the Justice Research and Statistics Association, a “national organization of state Statistical Analysis Center directors as well as analysts, researchers and practitioners throughout the justice system” (JRSA 2001). Through contact with various members of these organizations, including the SAC directors of CT and ME, it was determined that crime data did not, in the past, exist for areas that correspond with zip code boundaries. However, data are being collected at ever more precise geographical levels, and crime statistics will be separated by zip code within the next few years. The technique of measuring relative levels of crime with insurance premiums, creatively executed by Kearns, Gibb and Mackay, was not attempted because insurance carriers vary between the two states being studied.

The census also provides very little data pertaining to health, and other sources for indicators within this field were explored as well. It was found that both CT and ME departments of public health maintained birth weight statistics separated by zip code, however, problems arose in collecting compatible data sets from these two agencies. Additionally, an examination of the rates of low-weight births led to the conclusion that the denominators (# of total births) were simply too small in many zip codes to provide reliable information about relative levels of nutrition. Given the tremendous variation in
the number of births between zip codes, due largely to variation in population, such relative comparisons could not accurately be drawn from using an indicator of total underweight births rather than a share statistic.

The twenty-four indicators that were compiled from the census were categorized within the remaining six fields:

Income

The concept of area deprivation is founded on the premise that there may exist multiple factors specific to an area that either intensify or soften the hardships of financial poverty for those living in that area. These factors are inherently tied to financial means through cause or effect, even if only due to that fact that greater financial means increase the ability to relocate. This relationship does not negate the importance of non-income factors, for their examination certainly may provide a deeper understanding of local experiences of poverty. It does, however, imply that income is an essential component to relative levels of deprivation.

Three indicators were compiled to reflect income poverty, each of these being taken from the STF3B file of the census. The first was per capita income in 1989, a statistic taken directly from the census file. To reflect deprivation, negative per capita income was recorded for each zip code. The next indicator to be recorded was the percent of persons designated as having poverty status in 1989, of those for whom poverty status is determined.7 Poverty status as presented by census publications is defined by a minimum level of income that is adjusted according to household size and age structure; the specific definition was developed by the Social Security Administration in 1964 and the threshold is revised annually.8 The statistic, percent poverty status, was calculated by summing the number of persons whose 1989 income was below the poverty threshold (separated in the census by age), and dividing this figure by the universe of persons for whom poverty status is determined.

The final indicator recorded to reflect income deprivation was the difference between average monthly household income and average monthly comprehensive

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7 Poverty status is determined for all persons except those who are institutionalized, in military group quarters, in college dormitories, or are unrelated and under 15 years old.
housing costs. For renting households, "comprehensive housing costs" refers to gross rent, a census variable that includes contract rent as well as the costs of utilities and fuels. For home owning households this term refers to selected monthly owner costs, a census variable summing of the costs of debts, taxes and insurance on the property, as well as utility and fuel costs. This difference between income and costs was compiled to approximate discretionary household income. By adjusting for the fixed cost of living specific to an area (approximated by the comprehensive housing costs) this figure more precisely indicates relative levels of income deprivation between areas than would a simple measure of household income. This statistic was calculated by separately recording the aggregate monthly income of housing units that are rented, owned with a mortgage, and owned without a mortgage, then subtracting the aggregate monthly comprehensive housing costs for each of these categories of housing units. By weighting this difference for each category of unit by its percent of the total number of housing units in the area and then summing the three figures, an average discretionary income statistic was created, the negative of which was recorded for each zip code.

Wealth

Within the field of wealth two indicators were chosen to measure deprivation. The first such indicator was the percentage of households without access to a vehicle. Because vehicles are valuable and exceptionally common in the United States they generally account for a significant portion of a household’s portfolio of assets, particularly when a household has few assets. Therefore a lack of vehicle ownership may indicate a substantial deficiency in a household’s stock of wealth and access to credit. Additionally, the absence of an available vehicle may significantly exacerbate the suffering of a deprived household more so than the absence of some other value holding asset because of the inconvenience and costs associated with other forms of transportation. The effects of not having a private vehicle are obviously strongly dependent on the availability of alternative transportation, and thus on the specific area in

8 STF Appendix B27
9 STF Appendix B44
10 The percentages of rented, owned, and mortgaged housing units were calculated from the census variables of condominium status by tenure and mortgage status.
which the household is located. In particular it should be expected that lack of vehicle
ownership should correlate with other indicators of deprivation more strongly in rural
areas then in urban areas.

The second indicator that was compiled to approximate relative wealth was a
measure of real estate wealth. To reflect real estate wealth a statistic was created by
multiplying median value of owner-occupied housing units in each zip code, as taken
from the census, by the percent of units that are owned in that area. The median value
was weighted by the percent of owned units to adjust for the fact that tenants have no real
estate wealth, thus the statistic approximates the relative real estate wealth of all
occupants of an area rather then of only those who own homes. Again, the negative value
of this statistic was recorded to reflect relative deprivation within the field of wealth
instead of relative wealth.

It is important to note that, given the information contained in this statistic, high
rates of tenancy will bias an area towards higher levels of measured wealth deprivation.
This implication is in line with the theoretical underpinnings of this statistic; however,
given that rates of tenancy alone are potential measures of deprivation, steps were taken
so that the combination of these statistics could be examined.

Tenancy status alone implies a degree of deprivation not reflected by levels of
income poverty or lack of wealth. For many people, particularly those in a later stage of
life who tend to value stability, renting imposes a level of insecurity and vulnerability not
experienced by those who own their own living quarters. However, for some occupants,
particularly younger people who may place a high priority on mobility, renting may not
be as much of a burden, and may in fact be an indication of freedom. This theory of
tenancy as it relates to the life cycle was heavily supported by the findings of Sloggett
and Joshi who found tenant status to be more closely related to poverty as individuals
aged between censuses (1998).

The rate of tenancy in part falls within the domain of housing because it does
provide information about the housing market of an area; for instance frequent tenancy
may reflect that houses are not readily available and many occupants must settle for
apartments, as is more common in urbanized areas. However, the rate of tenancy may
also reflect a population within an area that is unable to accumulate sufficient wealth to
become homeowners and must therefore rent; in this sense the statistic may approximate deprivation in the field of wealth. Given its individual importance, the total rate of tenancy was recorded for each zip code. Additionally, to analyze and potentially account for the relationship of this statistic to the life cycle, the rate of tenancy was recorded separately for occupants over 25, over 35 and over 45. Unfortunately, incorporating tenancy rates as separate indicators would potentially over-emphasize their importance if the adjusted measure of median value of housing units was also used. It should also be noted that the discretionary income statistic contains information about tenancy as well; though it may be a means of making due without being able to accumulate a large amount of wealth, renting may generally incur higher monthly costs than home owning, implying lower levels of discretionary income for renters. In light of these issues the unadjusted median value of owned housing units was also recorded so that the interrelationships and individual value of all of the statistics relating to tenancy could be later analyzed.

**Housing**

It has already been mentioned that tenancy rates may provide some information about local housing markets; in addition to these figures two other indicators were compiled to approximate deprivation in this field. The first of these was the rate of vacancy, calculated by simply dividing the number of vacant housing units in each zip code by the total number of units in the area. Vacancy rates provide information about local housing markets because they reflect demand for housing units, which is dependent on, among other things, the relative quality of the housing stock of an area. High rates of vacancy may indicate that available housing is in disrepair or undesirable for some other reason, and that an area is in relative decline. It is important to note that there are certainly other factors that may affect rates of vacancy, such as local job markets; the prolonged tightening of which would drive down demand for local housing. In fact, any change that reduces the living standards of an area would be expected to negatively impact the demand for housing; as such, all indicators of area deprivation can be argued to interact somewhat with levels of vacancy. The interconnection of indicators is obviously central to the theory and application of this project, so while such potential
overlaps between fields may cause difficulty in some parts of the analysis they do not obstruct the validity of measuring relative aggregate deprivation between areas.

A composite statistic reflecting a lack of basic amenities was also constructed to indicate deprivation in the field of housing. The percentages of occupied households without a telephone and those that lacked complete plumbing facilities were recorded separately. Similarly, the percentage of housing units lacking complete kitchen facilities was recorded, though the census does not provide information about this amenity in relation to occupancy. The fact that these statistics were taken from different universes is not a significant problem because it can be confidently assumed that the relative share of housing units lacking complete kitchen facilities accurately reflects the relative share of occupied units lacking such facilities. The composite statistic was calculated by simply summing the three previously mentioned percentages; a technique which implicitly gives weight to each deficiency in any unit that lacks more than one amenity.\textsuperscript{11} It should be noted that though absence of a telephone does not indicate as permanent an inadequacy in a housing structure as do the other two components, it is none the less an important indication of the level of convenience and support that a home provides its occupants. Telephone access is therefore assumed to be as pertinent as the other amenities. In addition to the composite statistic, those pertaining to each separate amenity were also included to later assess their individual value, as well as their combined significance.

The effects of poverty are significantly intensified within households lacking these basic resources due to the inconvenience, inefficiency, and hardship introduced by such deficiencies. Additionally, a family living in such conditions would most likely be so because they were already suffering from deprivation within other fields. As a result, the statistics relating to amenities are intuitively clear indicators of deprivation.

Health

Unfortunately the census does not provide a great deal of information concerning health, however it was possible to derive one statistic with strong intuitive value to approximate the relative levels of deprivation within this field. By calculating the percent
of civilian non-institutionalized persons, sixteen years and older, having a mobility, or self care limitation and/or a work disability, a statistic was compiled that reflected the relative levels of long term illness, injury, and general disability within each zip code. In measuring the relative levels of health between populations of different areas an attempt is being made to capture potentially immeasurable conditions in that area that affect people's health. Some determinants of health specific to an area, such as climate, general aesthetics, and levels of pollution, can be expected to affect the population uniformly. Others, however, such as quality of health care access, social patterns of nutrition and exercise, and working conditions, are also dependent on social class variations, though, they too should be expected to depend significantly on geographical relativity. Relative levels of health may also vary independently of area conditions, in that some densities of unhealthy people may simply be coincidental. As a result, the degree to which this statistic highlights relatively unhealthy conditions or deficiencies in health care of an area cannot be determined, and it may at times be, in fact, highlighting a coincidentally dense population of unhealthy people. This would still be valuable information given that such a population is further deprived than levels of income poverty would imply. It is essential to note, though, that such a result would not mean that living in that area is detrimental to everyone, and a measured rate of relative health deprivation may only reflect that experienced by the immediately affected minority of the population.

This issue address the fundamental decision between highlighting deprived groups of people or examining only factors of deprivation that are specific to an area and independent of the demographic make up of the population. Of course neither of these goals can be achieved independently of the other and both are of primary interest in the study of area deprivation. The question is where should the heavier focus be placed and at what point should a line be drawn between the two on a case-by-case basis. The resolution of this issue, as it applies to various indicators, will be discussed when indicators are chosen from the pool of those collected.

Indecision about how significantly the age distribution of an area should be allowed to affect this statistic (i.e. how much emphasis should be placed on examining

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11 This technique of summing related rates of deprivation is defended and incorporated in the DETR 2000 IMD in the calculation of the domain indices for income and employment, described within the earlier
the population relative to examining how the area affects the population) led to the inclusion of this rate for persons 16-64 as well as for all persons 16 and over.

Employment

To measure deprivation within the field of employment, an unemployment rate was recorded within each zip code by dividing the number of unemployed civilians by the total labor force. Occupants in the armed forces were considered to be in the labor force. The unemployment rate is a prime example of a statistic of deprivation that while it may only count a small deprived portion of the population, those unemployed, it reflects conditions that affect all occupants in an area. Rising unemployment reflects slowing demand for labor, which in turn may reduce wages, hours, and opportunities for advancement or career changes for those who are employed. It is also important to note that rates of unemployment can be closely linked to deprivation in other fields, in particular crime rates tend to be positively correlated with unemployment as people without jobs resort to illegal means of living.

Mean travel time to work was also recorded to reflect the relative distance of a zip code from the primary labor market that its occupants participate in. This indicator measures deprivation within the field of employment by capturing the excess inconvenience and inefficiency associated with commuting when areas are not closely situated to labor markets. This condition is very specific to the geographical relativity of areas, and it would be overlooked within a less comprehensive study of local poverty.

Education

The domain of education is an exceptionally important component of an index of area deprivation, due to its particular area-specific nature and influence over future outcomes. Educational access and quality is generally dependent on geographic locality; while some families have the resources to send their children to distant private schools most make use of local educational resources. There is also an important relationship between this field and other circumstances of disadvantage, in that educational deprivation may contribute significantly to many forms of future deprivation.

Indexing Deprivation section.
The census provides a good deal of data relating to education, and as a result a number of indicators were initially compiled within this field. The census groups all persons 25 and older into one of seven categories of educational attainment: less than 9th grade; 9th to 12th grade, no diploma; high school graduate; some college, no degree; associate degree; bachelor’s degree; graduate or professional degree. Within every zip code the percentage of occupants in each category was calculated and recorded. Then, by assigning each of these categories a numerical value of attainment, 1 through 7 respectively, an average (numerical) level of relative educational attainment (25+) was calculated for each zip code. This statistic is similar to one of average years of education except that each number corresponds to an educational benchmark rather than directly to a year of schooling.\(^\text{12}\)

The census provides the exact same data for all persons, 18 years and older, so average educational attainment of persons 18+ was recorded as well. It is important to note that within this universe it is more likely that, due to their age, occupants may be in the process of attaining a higher educational category than that which they are grouped into. Thus, this statistic may be more dependent on the age structure of an area than that for those 25 and older. Additionally, attainment may affect differently those who are still working on their education; for example the lack of a degree may not inhibit a present college student as much as it would a 26 year old. Regardless, for later examination the 18 and older statistic was recorded in addition to the 25 and older statistic.

To emphasize its specific importance as an educational benchmark, the percentage of persons 25 and older with no high school diploma was also recorded as an indicator of educational deprivation. This statistic highlights the relative number of occupants who lack an essential foundation of education and can thus be considered significantly deprived within the field.

Each of these indicators provides direct information about the relative level of education of the population of each zip code; though, the percent no high school diploma statistic tells little about the extent of deprivation or lack thereof, focusing instead on the relative quantity of educational deprivation. This information is very useful, in that, a

\(^{12}\) The census does not provide variables pertaining to the specific number of years of schooling, however this variable is just as appropriate.
relative lack of education directly deprives those who experience it, reducing many types of opportunities and smothering chances for improvement. Therefore an area with a relatively uneducated population will be more deprived than other factors alone would suggest.

In addition to approximating the relative present stock of human capital within an area, these indicators can also be expected to indirectly reflect the relative accessibility and quality of educational opportunities, as well as social expectations about education. High levels of education within an area may generally imply that local schools are good enough to keep students interested and motivated, and/or they may imply that local parents and role models successfully encourage students to continue their education. There is also a perpetuating effect of educational expectations, in that adults with relatively high levels of educational attainment may tend to place a higher premium on their children's education than do other parents. Indicators pertaining to educational attainment, particularly for occupants 25 and older, should not, however, be expected to reflect recent changes in the quality of local educational access; as such changes would have a delayed effect on the stock of human capital of those who remain in the area.\(^{13}\)

Information was also available in the census to create another indicator, the dropout rate among 16-19 year-olds, which may reflect more immediate educational conditions within each zip code. This statistic was calculated by summing the number of 16 to 19 year-olds who were not enrolled in school and not high school graduates, than dividing this figure by the universe of occupants in this age group. This drop out rate should reflect the present quality of, and importance placed on, education within a community by interpreting the students' reaction to the system. Additionally, by measuring educational deprivation within this age group this statistic reflects the relative qualifications that this area's young adults will carry into the coming years, and the opportunities that they will have.

A final indicator was taken from the census that can be loosely grouped within the field of education though it does not necessarily reflect local conditions within the traditional educational system. This indicator was the percent of linguistically isolated

\(^{13}\) For example educational attainment statistics from the 2000 census may not pick up any effects of the radical improvements in Hartford's learning corridor that began in the two years prior to the census.
households, by any language, calculated from the universe of all households within the area. Linguistic isolation is defined within census publications as having no household members over fourteen years of age that either speak English as a first language or speak English "very well." Any such household would be expected to necessarily have a more difficult time socially involving itself in the community, accessing public resources, and earning a private income, than similar households that do not face a language barrier. This form of deprivation could affect the education of children within such a household because linguistically isolated parents may have trouble involving themselves in their child's schoolwork. However, it is reasonable to assume that this statistic does not significantly reflect adults and teenagers who have grown up within American schools and have trouble speaking English, which would imply a serious deficiency in educational quality, but more generally is referring to households of first generation immigrants. More importantly, though, this statistic was placed within the field of education because it reflects a lack of skills that could be developed within an expanded local system of adult education.

Analysis and Selection of Indicators

As outlined in the previous section, the various preliminary statistics were compiled on the basis of theoretical and logical arguments justifying each as a hypothetical indicator of area deprivation. It is however necessary to analyze the real world interrelationships of these statistics before assessing their value and developing an index. Of the twenty-four identified, nine indicators were chosen to be included in the index. Table 1 outlines the results of the indicator selection process, and is followed by a thorough discussion of, and justification for these decisions.

In each of the previous works found to outline the creation of a similar index, the techniques incorporated by the authors to choose and weight indicators demonstrate a consensus between them that the merit and importance of a specific indicator is best measured by its correlation with the other indicators. While Kearns, Gibb and Mackay

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14 STF Appendix B-25
15 Though there are communities in which languages other than English, particularly Spanish within some urban areas in Connecticut, are spoken heavily enough that English may be of secondary importance within that small area, linguistic isolation may still significantly limit opportunities outside of such a bubble.
Table 1. Summary of Indicator Selection

<table>
<thead>
<tr>
<th>Field of Deprivation</th>
<th>Compiled Indicators</th>
<th>Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
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<tr>
<td></td>
<td>Per capita income</td>
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<td></td>
<td>Percent poverty status</td>
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<tr>
<td></td>
<td>Discretionary household income</td>
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<tr>
<td>Wealth</td>
<td>Percent no vehicle access</td>
<td></td>
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<tr>
<td></td>
<td>Unadjusted median unit value</td>
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<td></td>
<td>Real estate wealth</td>
<td></td>
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<tr>
<td>Housing</td>
<td>Tenancy rate</td>
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<tr>
<td></td>
<td>Tenancy rate (25+)</td>
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<tr>
<td></td>
<td>Tenancy rate (35+)</td>
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<tr>
<td></td>
<td>Tenancy rate (45+)</td>
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<tr>
<td></td>
<td>Vacancy rate</td>
<td></td>
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<tr>
<td></td>
<td>Compilation of amenities</td>
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<tr>
<td>Health</td>
<td>Mobility/self care limitation and/or work disability (16+)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mobility/self care limitation and/or work disability (16-64)</td>
<td></td>
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<tr>
<td>Labor market</td>
<td>Unemployment rate</td>
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<tr>
<td></td>
<td>Mean travel time to work</td>
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<tr>
<td>Education</td>
<td>Mean educational attainment (25+)</td>
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<tr>
<td></td>
<td>Mean educational attainment (18+)</td>
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<tr>
<td></td>
<td>Percent of persons 25+ with no high school diploma</td>
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<tr>
<td></td>
<td>Drop out rate among 16-19 year olds</td>
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<tr>
<td></td>
<td>Percent of linguistically isolated households</td>
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</tbody>
</table>

(1999) use the correlation between variables to choose indicators. Klasen (2000), rather than eliminating variables with low correlation, assigns them insignificant weights. The two techniques basically produce the same results. Klasen’s warning about the possible problems of such an approach is valid to the extent that deficiency in one field can certainly deprive households and areas without the existence of other negative indicators, and deprivation in various fields does not always occur simultaneously. However, the correlation between indicators is a solid basis on which to judge their significance. By attempting to study deprivation, or social exclusion, we are examining an intangible measurement that is assumed to be a combination of these many factors. It is presumed that these factors interact with and exacerbate one another; that implicitly they are all measurements of, as well as factors contributing to, an undesirable state of well being. Once this definition is accepted, an indicator that does not correlate with the others is not

16 (Median Value)*(% of owner occupied units)
empirically shown to cause or result from this undesirable state defined by them. Such an indicator is therefore not a significant component of this measure.

Utilizing this logic, a decision was made to examine a bilateral correlation matrix of the compiled indicators to evaluate their relative significance. The loose standard of .80 to .30, sighted by Kearns, Gibb and Mackay, was adopted as an appropriate range for the correlation between indicators that are chosen to be included in the index. The implications of low correlation statistics have already been discussed, however, there is also an upper bound to this range because there may be problems with those that are excessively high; such results may imply that multiple indicators are measuring the same effect and are thus redundant. Logically, it follows that indicators within one field would, in theory, correlate very highly with one another. Nevertheless, indicators can be hoped only to approximate a more comprehensive measure of deprivation within a field and may each capture distinct aspects of this measure. In this paper there are a few instances in which an indicator measures the mean level of deprivation of an area while another in the same field measures the relative quantity of deprivation within that area. An example of such a pair of indicators is negative per capita income and the percent of persons below the poverty level, each of which clearly provides a different picture of relative income deprivation in an area. In light of these issues, unexceptional levels of correlation between indicators in the same field should not be reason for alarm. Additionally, the inclusion of multiple indicators in each field is a reasonable potential outcome and could possibly be expected to more comprehensively approximate deprivation.

Given the evidence in previous papers that the various fields contribute evenly to overall deprivation, this process was embarked upon with the intention of eventually assigning equal weight to those indicators deemed valuable as components of the index. Including and weighing all of the collected indicators using a technique such as primary component analysis, and relying completely on correlation statistics, seems inappropriate given the importance of theory, intuition and judgment in the construction of this index. The possibility of weighting some indicators was not altogether disregarded; rather, the discussion was put on hold until an analysis of the correlation matrix was complete.
Examining the correlation matrix, included as Attachment A., it is clear that each of the three indicators compiled within the field of income demonstrates consistently high levels of correlation with other indicators; an expected result given a high level of confidence in the importance of this field and the value of these statistics. The redundant nature of per capita income (PCI) and discretionary income, in that one is an adjustment of the other, is statistically verified by the extremely high correlation between (.91). As a result, only one of these statistics can be included in the index. The two have very similar relationships with the other indicators, and though PCI is slightly more strongly correlated with some, it was dropped from the index in favor of discretionary income. This decision was made in light of the stronger interpretive value of discretionary income, that it is adjusted for local costs of living and thus tells more about area conditions.

It should also be noted that both of these indicators correlate solidly, but unexceptionally, with the percent of persons below poverty level. This is a somewhat surprising outcome, though, as mentioned earlier, explained by the fact that they separately approximate the average level and quantity of relative income deprivation. This result does in fact help to justify the inclusion of both discretionary income and percent below poverty level, evidencing that they each provide different information about local income deprivation.

The indicators of wealth also appear to have solid relationships within the matrix, though the two real estate value statistics are redundant because one incorporates the other. The median value of housing units adjusted for tenancy, described earlier as real estate wealth, had slightly stronger relationships with the other indicators than did the unadjusted value. In light of this evidence and the logical argument leading to the initial inclusion of the adjusted statistic (that renters have no real estate wealth), the unadjusted median value of housing units was discarded and the adjusted statistic was included. This indicator’s excessively strong correlation with discretionary income (.87) is expected given the obvious relationship between income and wealth, and though the correlation coefficient between them is concerningly high, these two are assumed to be individually important enough to each be maintained.
Lack of vehicle access was also maintained though it correlates weaker than would be expected with discretionary income. This weak relationship may be due to the fact that discretionary income is again, a level measure of the entire population, and the percent of persons with no vehicle ownership designates a relative quantity of deprived persons.

It was mentioned earlier that the focus of the study must find a balance between highlighting deprived groups of people or measuring factors that are specific to an area and would be expected to deprive incoming occupants as well. This discussion is particularly applicable to the field of wealth. Indicators of the relative wealth of an area are arguably not directly indicative of any exogenous factors such as labor markets or public services, however, levels of wealth are clearly important when discussing the relative deprivation of a population of an area. Lack of vehicle access, as an indicator, is slightly problematic because in only addressing a small portion of the population and, not necessarily reflecting conditions that affect the rest, it potentially contains little information about the relative deprivation experienced by the entire area. This indicator, nonetheless, does have significant intuitive value, reflecting both wealth deficiency and inconvenience for those it highlights, and its performance within the correlation matrix provides sufficient evidence of its relationships with other indicators to justify its inclusion in the index.

Rates of tenancy, for all age groups, have weak correlation statistics across the board and appear to have significant relationships with only two other indicators, vehicle access and linguistic isolation. It is notable that rates of tenancy correlate most strongly with the lack of vehicle ownership, in that there is a temptation to interpret this result as evidence that tenancy indicates deficiency in the field of wealth, as was earlier hypothesized. This argument, however, is somewhat countered by the lack of relationship between tenancy and real estate value statistics, though real estate value does not measure relative wealth of tenants. The more probable explanation is that renting and lack of vehicle ownership are both strongly tied to population density, high levels of each coinciding with more urbanized areas where public transportation is available and apartments are common. The relationship between tenancy and linguistic isolation is also interesting, and will be discussed further within the context of that indicator's other
relationships within the matrix. Overall, however, tenancy appears to have little value as a measure of deprivation within the observed areas due to the fact that it does not appear to be tied to the other indicators, correlating weakly with them. The percentage of rented housing units, for any of the four age groups, was therefore not included in the index.

This outcome is disappointing given tenancy's theoretical value as an indicator of deprivation. It would be expected to be strongly significant as an indicator of deprivation within a study completed at the household level, but it simply does not appear to be applicable as an indicator of area deprivation within the examined areas.

The separation of rates of tenancy by age does, however, provide information about tenancy, poverty, and the life cycle. Specifically, the strength of the relationship between tenancy and the indicators of deprivation consistently rises as the observed population is narrowed to an older age group. This result is consistent with the findings of Sloggett and Joshi (1998), and implies that renting imposes a greater burden, or reflects more significant poverty, as people move through the life cycle.

Within the field of housing deprivation, the percent of units lacking basic amenities correlates strongly with indicators from every other field, specifically, all those included in the index. These statistical relationships reinforce the theory that such deficiencies cause or result from deprivation in other fields and verify the indicator's value within the index. This indicator was therefore chosen as a component of the index.

It is also interesting to note that each of the components of the basic amenities statistic, kitchen facilities, telephone and plumbing, are individually related to other indicators of deprivation. This result helps to place confidence in the compilation of the statistic by evidencing that all of its components are, in fact, important.

The rate of vacancy, as an indicator of housing deprivation, is slightly more difficult to interpret within the matrix. This indicator has an insignificant relationship with the poverty level statistic, real estate wealth, health limitations, vehicle ownership, education statistics, and unemployment, and has an unmistakable relationship with discretionary income and lack of basic amenities. The distinctly stronger relationships with the last two indicators mentioned are intuitively logical because rising housing costs reduce discretionary income and would be expected to increase rates of vacancy, and the basic amenity statistic is assumed to measure deprivation within the same field as
The fact that vacancy is correlated with lack of basic amenities does provide evidence that vacancy is dependent on the quality of housing stock, supporting its theoretical basis as an indicator, however this relationship is not as strong as would be expected.

There also may be an explanation for the relatively low correlation between vacancy and unemployment; that high rates of vacancy imply that the labor force of an area has already dwindled. There is also the simple possibility that these statistics represent circumstances in areas that, though they are each detrimental to the quality of life, do not generally occur simultaneously in the geographic areas chosen for this study. This explanation may, in fact, be more applicable to the relatively insignificant relationships between vacancy and the indicators of education and health. The age and decline of an area's housing stock, partially captured by vacancy rates, may simply be a problem affecting regions other than those with significant health care and educational deficiencies. It can even be argued that education and housing exemplify two fields that though they each contribute to deprivation and are linked to all other fields, are not directly linked to one another. One would, however, expect to see a direct link between housing and health given the influence of living conditions on physical health. Furthermore, it is important that the basic amenities statistic, more directly capturing units that are ill equipped, appears to represent an aspect of housing stock deficiency that does occur simultaneously with deprivation in the fields of education, health and employment in the examined area.

Though partially explainable, the lack of correlation between vacancy and a number of important indicators is concerning and implies that this statistic does not reliably indicate deprivation within the areas studied. Given that the lack of basic amenities appears to provide an accurate approximation of deprivation within the field, vacancy was deemed expendable and removed from the index.

There is an interesting relationship between vacancy and tenancy that should be explored, though each was determined to be inadmissible in the index. Vacancy in an area is negatively correlated with tenancy among every age group. This result can be explained intuitively by acknowledging that the market for rented housing units should be significantly more fluid than that for owned units. It is easier to quickly find a renter for
a unit than a buyer, particularly if that unit is run down and therefore more likely to be acceptable only as a temporary living space. Thus, housing markets with significant renting would be expected to exhibit less vacancy.

Additionally, given the strong correlation between tenancy and lack of vehicle access, both linked to urban proximity, this tenancy-vacancy relationship helps to explain the extreme lack of correlation between vacancy and vehicle ownership.

Within the field of health there is only one potential indicator, the percent of persons with work disability and/or mobility or self care limitation, however, it was calculated for all persons 16 and older, as well as for all persons 16 through 64. Each of these statistics exhibits strong, and almost identical, statistical relationships with all other important indicators, evidencing that either would suffice to approximate relative health deprivation within an area. The fact that an area has a sizeable elderly population would tend to upwardly bias the more inclusive statistic because persons over 65 generally have more health problems than young people. This effect would not reflect levels of health care or nutrition, and younger occupants in such an area, or incoming occupants, would not be as deprived within this field as such a statistic would imply. Nevertheless, given that it is important to measure both the deprivation of a population as well as exogenous effects on health, and the index otherwise does not take into account the age distribution of the population, the rate for all persons 16 and older was chosen over that for all persons 16 through 64.

The unemployment rate was shown to correlate solidly with all other mildly significant indicators, demonstrating the strong link between labor markets and all other fields of deprivation. A good deal of confidence had already been placed in the value of this indicator and these statistical results served to reinforce that confidence, it was therefore included in the index. Average travel time to work was also calculated as a potential indicator within the field of employment, however, the correlation matrix exposed serious problems in its interaction with other indicators and it was deemed inappropriate as an indicator of deprivation.

Mean travel time to work either correlates negatively or exhibits no relationship at all with each of the other indicators. It can still be argued that a long commute is inherently an inconvenience; yet, within the areas studied such a situation does not
consistently occur simultaneously with other types of deprivation. This effect can be explained by the fact that both of these states have wealthy and undeprived suburban areas, in which occupants chose to locate their families though it means a longer commute to work. Connecticut, even more so than Maine, is very much a commuter state. In addition to the many occupants employed in Hartford that commute from all over the state, the most well-off areas of CT, in Fairfield county, accommodate a sizeable population that commutes into NY city. When the final deprivation score was calculated it was shown to correlate weakly (.02) with travel time in Maine, and in fact correlated meaningfully and negatively (-.37) with travel time in Connecticut; evidencing that there are various factors, particularly in CT, that counterbalance the inconvenience of a long commute.

This negative relationship between travel time and deprivation also serves to illustrate a theory that local labor market conditions are more critical for deprived persons then for others (Smith 1999). Persons in otherwise deprived conditions may lack the resources to travel a long distance to work every day, and therefore may be more dependent on local job opportunities. The statistical evidence that less deprived people travel farther to work supports this theory and thus implies that high unemployment rates significantly reflect local conditions within zip codes, strengthening their importance in this project.

Within the field of education, the first issue that must be addressed is the redundant nature of the two negative educational attainment statistics, that for persons 18 and over and that for persons 25 and over. Each of these correlate strongly with all other included indicators, and would each be expected to aptly approximate deprivation in this field. The high levels of correlation between these statistics and other fields, particularly health with which a link is less apparent than with income or employment, serve to validate the interdependence of fields of deprivation. Also interestingly, the exceptionally strong relationships between educational attainment and income makes apparent the significant returns to academic qualifications, as well as the tendency for financial means to dictate how long people remain in school. The two attainment

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17 Among this group of commuters one major counter-advantage to the long commute is the lower taxes relative to those they would face in NY. The undeprived and attractive suburbs of Fairfield County were.
statistics correlate almost identically with the other indicators, so the choice between them does not greatly affect the index. Therefore, the logical reservations about measuring people who were still in school, previously outlined, led to the elimination of the 18 and over statistic in favor of the average educational attainment of all persons 25 years and older.

The percent of persons 25 and older with no high school diploma also performed well within the correlation matrix, appearing to be an additional appropriate indicator of educational deficiency. The extremely high level of correlation between the diploma statistic and negative educational attainment does, however, fall outside of the designated appropriate range, giving reason for hesitation in including both of these indicators. Those persons lacking a high school diploma are measured within and add weight to the educational attainment statistic; nevertheless, they represent a substantially deprived portion of the area’s population, who may otherwise be hidden within that statistic. Additionally, though each is trying to capture the same implicit circumstances, the relative quality and importance of education within an area, these indicators view the results of the educational system from different perspectives; one measures the mean effect, while the other examines how many persons are left behind. The fact that they interact with other indicators differently implies that they are not entirely redundant, just closely tied to one another. Thus, given the importance of high school graduation as an educational benchmark, it was determined that the diploma statistic would be maintained in addition to the educational attainment indicator.

Unfortunately, the high school dropout rate among 16-19 year olds exhibits unsubstantial relationships with other indicators, even those also within the field of education. This statistic potentially provides significant information about present educational conditions; however, it is simply not shown to consistently reflect such conditions within zip codes. An examination of the data reveals that this inconsistency is likely a result of insufficient populations of persons in this age group, making the calculation of drop out rates unreliable. Many zip codes have few teenagers and though those who drop out are individually deprived by the fact that they did not finish high school, the small denominator appears to cause such variation in the rate that it cannot be
expected to consistently reflect local conditions. This result is disappointing because the two remaining educational indicators only provide information about local high schools with a seven-year lag. These indicators are important, in that they do reflect attitudes about education, which affect immediate conditions, as well as the stock of human capital among the adult population. Within a study of larger areas, however, in which drop out rates would be more consistent, this statistic would be expected to serve as an additional useful indicator of educational deprivation.

The final potential indicator analyzed within the correlation matrix, also falling loosely within the field of education, is the percentage of linguistically isolated households. It is clear that linguistic isolation may greatly intensify the level of relative deprivation and social exclusion that a family may otherwise be experiencing; that everyday professional and social interactions are more difficult and less efficient for such a household. However, this indicator is potentially problematic for the same reasons that lack of vehicle access is; it is a circumstance affecting only a very small portion of people in the areas studied and it implies little about conditions that affect other occupants. It can therefore be argued that this indicator does not accurately reflect levels of deprivation among an entire population, nor does it significantly reflect independent characteristics of an area. In this instance, such concern is validated by the fact that this statistic does not correlate significantly with a number of important indicators of area deprivation. Unlike vehicle ownership, linguistic isolation was, therefore, not chosen to be included in the index.

Some relationships between linguistic isolation and other indicators are, however, interesting and notable. Specifically, the hypothesis that linguistically isolated households are generally first generation immigrants is supported by some of these relationships. The indicators that this statistic does appear to be tied to, tenancy, lack of car ownership and lack of a high school diploma, are also logically characteristic of recently immigrated households. The correlations between areas with relatively high linguistic isolation and those deprived in these specific fields may imply that immigrant populations in these areas contribute to each of the statistics. These relationships would be expected and therefore serve as a reassurance of the value of such a correlation analysis.
The indicator selection process, incorporating a bilateral correlation matrix, left nine indicators chosen to approximate deprivation within six fields. Having completed a similar selection process while developing their index, Kearns, Gibb and Mackay further reduced their set of indicators through primary component analysis, eliminating two indicators found to reflect deprivation in more than one field (Kearns 2000). In this project no similar step was taken because less concern was given to the possibility that an indicator crossed fields. Additionally, no adjustment was made for the fact that three fields of deprivation are each represented by two indicators, and the remaining fields are only singularly represented. This decision should, however, not be misinterpreted as a careless one. In creating this index an effort is being made to examine deprivation on a more comprehensive level than could be accomplished through a study of relative income or financial poverty; as such, every appropriate indicator that is included brings valuable information to the analysis. The fields in which they are categorized provide a context for understanding and discussion of the way in which these deficiencies affect persons within an area. Nevertheless, each of the nine indicators chosen have been demonstrated to reflect relative deprivation beyond that which is captured by income statistics, and therefore each contribute to the comprehensive nature of the index, regardless of the field in which they measure deprivation. A second reliable health or housing statistic, if available, would potentially improve the index, but dropping valuable indicators from other fields should not be expected to compensate for such deficiencies. It is important also to reemphasize that of the three pairs of indicators grouped within single fields each includes a statistic approximating a mean level of deprivation and one measure of the relative size of the population deprived in that field. Thus, each of these pairs approximate deprivation within a field from two different perspectives, and therefore bring distinctly valuable information to the index.

**Standardization and Weighting**

Before combining these nine chosen statistics within an index it was necessary to make choices about their standardization and weighting. During the process of data collection some such decisions were already made as the statistics were made somewhat compatible so they could be reasonably analyzed. All indicators that were not already
collected on such a basis were calculated as a per capita or per household statistic to adjust for the variations in population size between areas. While other indices have incorporated the use of chi-squared variables to take into account both the absolute and the relative size of their indicators (Keams 2000), such an approach was decided against in light of the significant discrepancies in population size among zip codes in the areas being studied. The per capita/per household adjustment more precisely identifies the relative magnitudes of indicators though it disregards their absolute levels. Additionally, three statistics, educational attainment, discretionary income and real estate wealth, were collected as negative values so that larger positive magnitude would consistently reflect greater deprivation among all indicators.

After the selection process, each of the nine chosen indicators were normally standardized. As noted above, the use of chi-squared values was not necessary for the purpose of measuring relative magnitudes of indicators as they were already adjusted to relative measures. Additionally, it was deemed inappropriate to standardize the indicators "by hand" as Klasen was able to do in developing his household deprivation index for South Africa.\(^\text{18}\) Such a method was effective in that study because the author was able to reasonably assert the ranges in which each indicator reflected a defined level of deprivation within a household. However, such a procedure does not seem applicable to statistics that indicate deprivation over an entire area. Thus, the indicators were simply converted to z-scores.\(^\text{19}\)

It was noticed that exceptionally high levels of wealth and income in some areas were skewing the standardization of those indicators and greatly biasing the index scores of those areas. To compensate for the existence of such outliers, negative discretionary income and real estate wealth were replaced with their negative logged values.

Intuitively, this step reduces the negative contribution to the deprivation measure of such exceptionally positive circumstances, which otherwise had the potential to dually bias the measure and cause it to inaccurately reflect other forms of deprivation in those areas. It was not necessary, however, or reasonable to log any other indicators given that their

\(^{18}\) The author scored each indicator on a scale of 1 to 5 relying on his ability to categorize each statistic among five levels of deprivation. Klasen, pg 39

\(^{19}\) \(Z(x) = (x - \text{mean}(x))/(\text{standard deviation}(x))\). Thus a z-statistic measures a random variable's deviation from the mean, relative to that of the others in the sample.
values ranged below or close to one. Additionally, the effects of outlying deprived circumstances should not be dampened because they are exactly what the index is attempting to capture and expose. This step was found to not significantly affect the relationships of correlation between the two adjusted statistics and the remaining indicators.

Dissimilar to two of the previously developed indices, negative indicator values were not set to zero, and the magnitude to which deprived circumstances were below average was also allowed to affect the index. It has been argued that such a situation may allow deprived circumstances to be hidden behind favorable conditions in other domains (Kearns, Gibb and Mackay, 2000; Robson, 1998). However, general arguments and factors specific to this project led to the decision not to take a step to correct for such a possibility. The first is that one of the proposed functions of the presently developed deprivation index is a comparison with an income-based measurement of poverty; it therefore should be symmetrical as would be such a measure. Secondly, it can be convincingly argued that coexisting positive circumstances may reduce the burden of deprived circumstances in other fields. It seems reasonable that many occupants of rural ME may consider themselves compensated for a lack of local propitious employment opportunities, by the tranquility of their environment, or that a family may accept poor housing conditions in return for exceptional local public education for their children. In such examples positive circumstances may not be "hiding" deprivation, but in fact easing it. The final argument for accepting negative indicator scores is that once a geographical information system is created incorporating both the deprivation index as well as its individual indicators, it will be very easy to see the relative effects of individual fields when examining specific areas and any "masked" circumstances will be exposed.

Following the examples provided by the DETR Index of Local Deprivation and Index of Local Conditions, as well as that of Kearns, Gibb and Mackay, the deprivation score was calculated for each zip code by summing the nine standardized indicators, implicitly giving each equal weight within the index. Given the relatively consistent empirical relations, as measured through bilateral correlation, between the nine included indicators, weighting based on principle component analysis would not be expected to greatly affect the resulting deprivation scores. Such a procedure would be expected to
weight the indicators almost equally. Another option, to weight the indicators through theory and intuition, would add an unacceptable level of subjectivity to the project.

It was also noted, and deemed acceptable, that the fields of education, income, and wealth are implicitly weighted more heavily than the remaining three fields because they are each represented by two indicators. This situation, also apparent in the 1991 ILC and 1998 ILD, relates back to the discussion of the initial inclusion of multiple indicators in these fields; they each individually and uniquely contribute to overall deprivation within an area. The lesser importance of the other three fields within the index, as well as the lack of representation within the field of crime, are weaknesses resulting from a lack of data. The data available provide a very useful and comprehensive index but cannot be expected to capture all aspects of relative area deprivation.

Properties of the Index

Frequency Distribution

The general properties of the index are presented in the frequency distribution below. Deprivation scores are calculated for 669 postal areas, 407 in ME and 262 in CT, and range between 31.94 and -14.66, positive magnitude reflecting relatively higher levels of deprivation. Because all indicators are normalized the mean of the deprivation index is necessarily zero, however, scores are not evenly distributed around the mean as there are evidently outlying zip codes exhibiting extreme relative deprivation. The standard deviation of the index is 6.73.

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20 The fourteen indicators included in Klasen's index may be easily categorized into fewer unequally represented fields, but the situation was not found to be a problem in the analysis of that project.

21 Deprivation scores are not calculated for some zip code as a result of missing data, see Appendix A.
The individual frequency distributions of deprivation in CT and ME provide additional information about the index, as well as the two states. Clearly, postal areas in Maine generally exhibit higher levels of deprivation than those in CT. Furthermore, there are only a few areas in ME that appear to be free of deprivation to the extent that a substantial portion of CT areas are, particularly those with index scores less than negative seven. Interestingly, however, deprivation in Connecticut is not tightly distributed and a number of areas are shown to experience deprivation similar to, and even greater than, that of the most deprived areas in ME. As such, these charts provide the first statistical indication of the isolation of intensely deprived areas within the otherwise exceptionally affluent areas of Connecticut. Further examination exposes the two most deprived postal areas of all, shown by the chart to be in CT, each with index scores greater than 31, to be located within downtown Hartford and downtown Waterbury.

It appears that most deprived areas in Maine are generally less relatively deprived in relation to the rest of the state, as the frequency distribution is significantly tighter. Though, there do exist some significant outliers. The farthest outlier, sitting above the distribution (to the left on the chart), was found to be Oxbow, with an index score of 28.3 it is the most deprived postal area in Maine.
Because a similar index of area deprivation has not before been completed for the areas examined within this study, there are no existing past or parallel results with which the validity of this index can be measured against. The value of its results, therefore, can be most strongly supported by the theoretical and statistical justifications for the decisions made in developing the index. Its validity can, however, be somewhat assessed by exploring how it relates to the distribution of income in these areas; such a comparison is appropriate in light of the fact that relative poverty can most generally be defined in terms of income.
As can be seen in Table 2, the deprivation index correlates strongly with an index of per capita income in CT and ME. The correlation coefficient of .76 between deprivation scores and (negative) per capita income among the entire sample of zip codes implies that variation in income levels can explain a substantial part of the relative deprivation within these two states. Measures of deprivation and social exclusion, regardless of how broad, should be expected to relate strongly to financial poverty, and this result therefore provides confidence in the precision of this index. On the other hand, this result also serves to validate the need for such a comprehensive comparison of areas due to the fact that much of the relative deprivation is left unexplained by per capita income. This result implies that there are auxiliary circumstances intensifying or easing the deprivation experienced in these areas, and furthermore that these circumstances are not entirely dependent on or tied to levels of income. An index of relative income alone may therefore fail to capture important area conditions, and may misrepresent the distribution of economic and social deprivation.

Table 2. Deprivation Index and PCI

<table>
<thead>
<tr>
<th>Subset of zip codes:</th>
<th>CC between PCI and deprivation:</th>
<th>Mean deprivation score:</th>
<th>Mean PCI:</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% most deprived</td>
<td>0.462</td>
<td>9.650</td>
<td>$10,003</td>
</tr>
<tr>
<td>21-40%</td>
<td>0.449</td>
<td>3.315</td>
<td>$11,375</td>
</tr>
<tr>
<td>41-60%</td>
<td>0.217</td>
<td>-0.195</td>
<td>$13,568</td>
</tr>
<tr>
<td>61-80%</td>
<td>0.427</td>
<td>-4.115</td>
<td>$17,377</td>
</tr>
<tr>
<td>81-100% (133 areas)</td>
<td>0.685</td>
<td>-8.719</td>
<td>$25,841</td>
</tr>
<tr>
<td>All</td>
<td>0.764</td>
<td>0.000</td>
<td>$15,617</td>
</tr>
</tbody>
</table>

More telling are the relationships between income and deprivation within certain subgroups of zip codes, also expressed within Table 2. It is clear that while the variation in per capita income explains a good deal of the variation in relative deprivation within the least deprived quintile of postal areas, it can account for much less of the variation of the deprivation index among more deprived areas. The correlation coefficient between deprivation and income is below .5 within each of the first four quintiles, and this relationship is, in fact, shown to be weakest within the areas experiencing intermediate levels of deprivation. The absolute strength of the correlation

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22 To provide some perspective of relative and absolute poverty in each quintile the mean levels of deprivation and per capita income for each are included in the table.
relationship within each quintile is lower than that of the index because by reducing the sample of areas the impact of random noise on the correlation coefficient has been amplified. Nevertheless, regardless of how many or few segments the ordered index was divided into, such an analysis was found to tell the same story; that deprivation is tied to income most strongly in affluent areas, not particularly strongly outside of those areas, and least strongly in intermediately deprived areas.

These results imply that in postal areas other than the most affluent in CT and ME the level of relative deprivation experienced by the population is very much dependent on factors other than income. This evidence reinforces the validity of an examination of auxiliary conditions and circumstances in an analysis of relative poverty within these areas.

Interestingly, these findings are similar to those of a recent South African study of deprivation (Klasen 2000). The index of household deprivation developed in that project, was found to correlate most strongly with household expenditure among the least deprived segments of the population. The author concluded that the expenditure variable was “apparently better able to differentiate among the better-off than to identify the deprived” (Klasen 2000, pp46). Acknowledging the distinction between income and expenditure, yet relying on their correspondence to draw the comparison, the relationships between income and deprivation in CT and ME imply a similar yet modified conclusion; that income is able to aptly differentiate among the better-off, yet unable to reliably differentiate among the remaining areas.

To further examine the inconsistencies between indexing a measure of relative deprivation and one of relative income in these areas, the following table was constructed illustrating the number of deprived postal areas that are not suffering from a corresponding mean level of income deficiency.

<table>
<thead>
<tr>
<th>Subset of postal areas:</th>
<th>Total:</th>
<th>Not among 10% lowest PCI areas:</th>
<th>Not among 20% lowest PCI areas:</th>
<th>Not among 33% lowest PCI areas:</th>
<th>Not among 50% lowest PCI areas:</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% most deprived</td>
<td>67</td>
<td>27</td>
<td>17</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>20% most deprived</td>
<td>134</td>
<td>49</td>
<td>22</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>33% most deprived</td>
<td>223</td>
<td>45</td>
<td>45</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>50% most deprived</td>
<td>334</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

48
This table clearly presents a substantial weakness of area comparisons based entirely on relative income; that such a technique will fail to highlight a significant portion of deprived areas. Of the most deprived decile of postal areas, over one quarter are not considered to be within even the 20% poorest of all areas; and may accordingly not be judged in need of attention given only income-based criteria. Amazingly, two such areas are not even within the 50% most financially deprived, though other important factors have left them multiply deprived. Closer examination revealed these two areas to be zip codes 06051 and 06901, areas of New Britain, CT and Stamford, CT respectively, each of which exhibited significant health and educational deficiencies, and had above average rates of persons below the poverty level, unemployment, and lack of car ownership. Consequently, though they each exhibited per capita income above that of the mean for CT and ME, these two postal areas were significantly deprived, and serve to exemplify the importance of such a multidimensional examination of area conditions.

The most probable explanation for such a result is that within these two areas a financially affluent, though minor, segment of the population has offset levels of per capita income, hiding the otherwise deprived circumstances of the area in a mean level income based analysis.

The previous result demonstrates another substantial benefit of area deprivation indexing, that it allows for precise and comprehensive analysis of specific areas. Beyond the general patterns of deprivation exposed by such an index, it allows one to step back and scrutinize the interaction of individual components of deprivation within particular areas. Such an exploration becomes more interesting and efficient, and provides further insights, once a deprivation index is incorporated into a Geographic Information System, an application that will later be discussed more detail.

In assessing the value of this index, as well as area deprivation indexing in the United States, the potential application of area-based initiatives must also be addressed. While such an index can clearly address extra-financial circumstances important to any assessment of area poverty, there are still problems associated with geographically specific solutions. One such problem is that deprived persons are not only confined to deprived places. There is no available indicator of individual deprivation, however, Table 4 presents the proportions of those persons below the poverty line living within
deprived areas, as well as the share of persons in deprived areas who are in fact impoverished.

Table 4. Poverty in Deprived Areas

<table>
<thead>
<tr>
<th></th>
<th>% of Population of CT and ME</th>
<th>% of All Impoverished Persons* in CT and ME</th>
<th>% of persons in specified area who are Impoverished</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 10% most deprived areas:</td>
<td>7.2</td>
<td>23.1</td>
<td>25.7</td>
</tr>
<tr>
<td>Within 20% most deprived areas:</td>
<td>14.8</td>
<td>38.6</td>
<td>20.8</td>
</tr>
<tr>
<td>Within 33% most deprived areas:</td>
<td>24.2</td>
<td>53.3</td>
<td>17.6</td>
</tr>
<tr>
<td>Within 50% most deprived areas:</td>
<td>37.1</td>
<td>68.3</td>
<td>14.7</td>
</tr>
</tbody>
</table>

* Defined by census as below PL

While clear majority of impoverished persons reside in those areas that suffer from above average levels of deprivation, a substantial portion of such persons live outside of the most intensely deprived areas. It can be inferred therefore, that successful efforts to improve conditions within only the most deprived areas in CT and ME would likely not improve the lives of the majority of deprived individuals.

Nonetheless, area-based initiatives may be appropriate and exceptionally useful in combating general and specific deprived conditions within many local areas in these two states given the isolation of intensely deprived areas. This result, however, serves to emphasize that such a focus is not a solution of poverty in and of itself.

General Analysis

Relative Deprivation in CT and ME

As was made apparent by the frequency distributions discussed in the previous section, the index demonstrates that postal areas in Maine are, generally, more deprived than those in Connecticut. It can, however, also provide a more thorough exploration of this comparison. The following table presents the mean deprivation scores within each state, as well as the mean levels of each index component.23

From Table 5 it can be ascertained that the average postal area in Maine suffers from a significantly higher level of deprivation than does that of Connecticut. Maine zip
Table 5. Statewide Means

<table>
<thead>
<tr>
<th></th>
<th>Health Lim.</th>
<th>Unemp</th>
<th>Ed. Attain</th>
<th>HS Dip</th>
<th>PL</th>
<th>Amen</th>
<th>Car</th>
<th>Val</th>
<th>Disc Inc</th>
<th>Disc</th>
<th>Deprivation Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT</td>
<td>0.12</td>
<td>0.05</td>
<td>4.0</td>
<td>0.19</td>
<td>0.05</td>
<td>0.03</td>
<td>0.07</td>
<td>125,034</td>
<td>40,537</td>
<td>-4.18</td>
<td></td>
</tr>
<tr>
<td>ME</td>
<td>0.16</td>
<td>0.08</td>
<td>3.5</td>
<td>0.22</td>
<td>0.12</td>
<td>0.12</td>
<td>0.06</td>
<td>58,653</td>
<td>17,856</td>
<td>2.69</td>
<td></td>
</tr>
</tbody>
</table>

**Key to Tables 5 - 8: Indicator Abbreviations**

Health Lim. ............. Mobility/self-care and/or work disability
Unemp. .................... Unemployment rate
Ed.Attain .................. Mean educational attainment (25+)
HS Dip ...................... Percent of persons 25+ with no high school diploma
PL ......................... Percent of persons under the poverty level
Amen ...................... Compilation of amenities
Car ....................... Percent no vehicle access
Val ....................... Real estate wealth
Disc Inc .................. Discretionary household income

codes are shown to generally be more deprived within every field, exhibiting higher rates of health limitations and unemployment, lower levels of educational attainment, and substantially more frequent housing deficiencies, as measured by the amenities indicator. Most significant, however, may be the discrepancies between CT and ME in the fields of income and wealth, as measured by average discretionary household income and average real estate wealth, respectively.

Each of these indicators show the average postal area in CT to be more than twice as affluent as that in ME. In fact, the only indicator implying a higher level of deprivation in the average CT zip code is the percent of persons lacking vehicle access. This result can, however, be explained by the greater necessity of cars in ME given the more rural nature of the state.

Table 5 provides significant information concerning the relative differences between CT and ME, nevertheless, statewide averages, while interesting, tell very little about deprivation and poverty concentrated within small areas in these regions. To explore the relative conditions and circumstances among deprived areas in each of these states a further analysis was completed of the 15% most deprived postal areas in the entire sample. Conveniently, the most deprived 15% of the sample includes 100 areas, and these areas can be justified as distinctly deprived because their index scores are approximately (within .1) equal to or greater than one standard deviation above the mean.

For the purpose of the discussion of this analysis “deprived areas” will be defined as those within this subgroup.

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23 The component measures are presented in their unstandardized forms, and the negative and log transformations of educational attainment, real estate wealth, and discretionary income have been reversed.
To examine the relative level of deprivation expressed by each indicator, their average standardized levels among deprived areas were calculated within each state, and presented in Table 6. The standardized component scores measure the degree to which each indicator reflects deprivation above the mean value of that indicator, which is zero, and therefore provide more intuitive information about the relative intensity of deprived conditions than do unstandardized component scores. For example, the mean standardized component score of the high school diploma indicator, HS dip, is 2.26 among deprived areas in CT. This score implies that, within these areas, the level of this indicator is more than two standard deviations above its mean for the entire sample. Additionally, each component’s contribution to the deprivation measure, expressed as a percent of the total index score, was calculated among both the deprived areas in ME and those in CT. This measure of indicator contribution demonstrates the relative extent to which each contributes to deprivation within a typical deprived area in each state.

Table 6. Deprived Areas in CT and ME

<table>
<thead>
<tr>
<th>Component Score</th>
<th>Health Lim.</th>
<th>Unemp Attain</th>
<th>Ed. Dip</th>
<th>HS Amen</th>
<th>Car Inc</th>
<th>Val Disc</th>
<th>Dep Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT (18 areas)</td>
<td>0.90</td>
<td>1.37</td>
<td>1.26</td>
<td>2.26</td>
<td>1.87</td>
<td>0.55</td>
<td>3.99</td>
</tr>
<tr>
<td>ME (82 areas)</td>
<td>1.28</td>
<td>1.42</td>
<td>1.12</td>
<td>1.20</td>
<td>1.40</td>
<td>1.35</td>
<td>0.33</td>
</tr>
</tbody>
</table>

The first interesting conclusion apparent from the above table, is that deprived areas in Connecticut, though there are fewer than exist in Maine, are more deeply deprived than those in Maine. The eighteen deprived areas in CT exhibit a mean deprivation score of 13.73, while the eighty-two such areas in ME exhibit a score of 10.32. Reaffirming that though area deprivation in CT is less prevalent then it is in ME, its intensity is greater.

An examination of the individual components of the index provides further information. Within Connecticut it is most notable that among deprived areas, relative discretionary income is not exceptionally low, its average (negatively transformed) score
in these zip codes being only .3 standard deviations above the mean. These areas do, however, exhibit high rates of persons below the poverty level, as do such areas in ME, evidencing that financial poverty is a problem though it is not reflected in one indicator of relative income. This result can, in part, be attributed to the generally low levels of income in ME which bring down the sample mean, nevertheless, it implies that deprived areas in CT consistently suffer from auxiliary detrimental circumstances, which are less commonly experienced in ME, and that account for their exceptional levels of relative deprivation. Educational deficiencies in CT appear to be among the most poignant of such circumstances; with the educational attainment and high school diploma statistics contributing 9.2% and 16.4%, respectively, to the overall deprivation score, the domain of education accounts for just over a quarter of the deprivation measured in the average deprived CT postal area. Levels of average educational attainment are slightly lower (farther from the mean), yet similar to those in deprived areas of ME, however, such areas in CT apparently have far more substantial populations of adults who lack a high school diploma, and are thus acutely deprived within the domain of education.

Housing units that lack basic amenities appear not to be especially prevalent within the deprived areas of CT, and this particular deficiency imparts a notably small contribution the mean deprivation measure in those areas. Conversely, in Maine, the regularity of ill-equipped housing facilities is shown to be a considerable detriment within deprived areas. A similar, yet more mild, contrast is shown to exist within the domain of health, wherein the deprived areas of Maine exhibit more substantial health related disadvantages among their populations then do those in Connecticut.

For the most part, the various index components contribute remarkably evenly to the deprivation measure within Maine’s deprived zip codes. The only exception to this pattern is the indicator measuring relative rates of vehicle access, the effect of which is incredibly unbalanced between CT and ME. Consistently among deprived postal areas in Connecticut, an incredibly high relative proportion of persons lack access to a vehicle, as evidenced by the fact that the average Z-score of this indicator is four standard deviations above the mean. As a result this component accounts for an exceptional portion of the deprivation measure in these areas. However, in Maine even within the most deprived
areas only a small proportion of persons lack access to a vehicle; the circumstance therefore does not significantly contribute to corresponding measures of area deprivation.

This situation is in part explained the fact that the relative geographic dispersion of persons and society in ME makes vehicle ownership practically essential. Connecticut is significantly less dispersed in general, however, the discrepancy in vehicle ownership is principally intensified by the fact that area deprivation in CT is largely an urban phenomenon, of the 15% most deprived areas, in fact, all are urban, while that in ME often involves exclusively rural areas. Deprived urban areas in CT encompass, generally speaking, the vast majority of areas within these states in which substantial rates of people do not own vehicles, and the high Z-scores of this indicator in those areas are an inherent result of that discrepancy. The relationship between vehicle access and urban status, as well as the particular nature of this indicator as a component of deprivation, is discussed more thoroughly in the following section.

Rural and Urban Deprivation

Given the contrasting nature of area deprivation in Connecticut and Maine, largely associated with urban and rural areas respectively, it is appropriate to also explore the index for information concerning urban and rural deprivation. For this purpose, information was also recorded from the census concerning the relative distribution of residents in each zip code between urban, outside of urban (suburban) and rural areas. Postal areas considered to have urban status in this study are those in which more then 90% of residents live in urbanized areas. Similarly, rural areas are defined as those in which 100% of occupants reside in rural areas. The distinction between the two definitions, that urban status requires less then complete urbanization of an area, was made in light of the fact that persons living in an almost entirely urban postal area can be assumed to all have similarly urbanized life styles as those residing in a completely urban area. On the other hand, some urban areas within an otherwise rural zip code may potentially imply a close geographical relativity of the entire zip code to an urban area and therefore its occupants would not experience the disadvantaged circumstances singularly associated with rural deprivation, such as distance from services and resources.
As previously mentioned, urban and rural poverty are, in general, individually isolated within CT and Maine respectively. The following table presents the distribution of rural and urban deprived areas between CT and ME, again defining deprived areas as having index scores among the highest 100.

Table 7. Deprivation and Urban Status by State

<table>
<thead>
<tr>
<th>Number of the 100 Most Deprived Areas</th>
<th>Total</th>
<th>Urban Status</th>
<th>Rural Status</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Connecticut</td>
<td>18</td>
<td>18</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>In Maine</td>
<td>82</td>
<td>2</td>
<td>78</td>
<td>2</td>
</tr>
</tbody>
</table>

Given the close association between the urban status of deprived areas and their state location, an analysis of the 100 most deprived zip codes as separated between rural and urban areas, produces results almost identical to those of the similar previous analysis of CT and ME. These results are presented in the table below.

Table 8. Deprived Rural and Urban Areas

<table>
<thead>
<tr>
<th>Urban Areas (20)</th>
<th>Health Lim.</th>
<th>Unemp Attain</th>
<th>Ed Attain</th>
<th>HS Dip</th>
<th>PL Amen</th>
<th>Car</th>
<th>Val</th>
<th>Disc Inc</th>
<th>Dep Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Standardized Component Score: 0.89</td>
<td>1.28</td>
<td>1.19</td>
<td>2.13</td>
<td>1.84</td>
<td>0.51</td>
<td>3.90</td>
<td>1.28</td>
<td>0.31</td>
<td>13.32</td>
</tr>
<tr>
<td>% Contribution to Deprivation Score: 6.7</td>
<td>9.6</td>
<td>8.9</td>
<td>16.0</td>
<td>13.8</td>
<td>3.8</td>
<td>29.2</td>
<td>9.6</td>
<td>2.3</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rural Areas (78)</th>
<th>Health Lim.</th>
<th>Unemp Attain</th>
<th>Ed Attain</th>
<th>HS Dip</th>
<th>PL Amen</th>
<th>Car</th>
<th>Val</th>
<th>Disc Inc</th>
<th>Dep Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Standardized Component Score: 1.29</td>
<td>1.45</td>
<td>1.13</td>
<td>1.19</td>
<td>1.39</td>
<td>1.41</td>
<td>0.25</td>
<td>1.09</td>
<td>1.15</td>
<td>10.35</td>
</tr>
<tr>
<td>% Contribution to Deprivation Score: 12.4</td>
<td>14.0</td>
<td>10.9</td>
<td>11.5</td>
<td>13.5</td>
<td>13.6</td>
<td>2.5</td>
<td>10.5</td>
<td>11.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Though Table 8 is almost identical to Table 6, it provides a more appropriate context within which to analyze the vehicle ownership component of the index, as the urban status of the areas in question must no longer be inferred but is explicitly presented. As previously touched upon, vehicle access may be a vital resource in rural areas, where public transportation is not available and walking is not an option given the shear distances that must be traveled. While in urban areas vehicle ownership may be an exceptionally convenient though less crucial amenity.
Though lack of vehicle access is significantly less of a disadvantage in an urban area than a rural area, it is a substantial disadvantage. Residents of Hartford or Waterbury may be more likely to sacrifice owning a vehicle than persons in rural ME because it is possible for them to live without one. Such a sacrifice may, nonetheless, represent a serious deficiency in wealth bearing assets and access to credit, as well as a substantial inconvenience and mobility limitation; as no urban areas in CT or ME happen to be exceptionally pedestrian friendly.

Deprived persons only able to regularly travel as far as their feet or local public transportation can take them, are also vastly more dependent on local labor markets than those with access to a vehicle. Furthermore, commuters hold many preferred jobs in Connecticut cities. Consequently, for many urban residents a lack of vehicle ownership may greatly intensify labor market specific deprivation, in addition to the negative implications already associated with such a disadvantage.

The large contribution of this component to the deprivation measure of urban areas, though explainable, is, nevertheless, somewhat exceptional. On the one hand, this contribution may be criticized as a biasing outlier; however, it can also be argued to represent a substantial disadvantage simply not experienced in other areas, and its effect can be appropriately justified. Any further concerns over this issue can be reassured by the fact that the varying contribution of this indicator does not greatly affect the results of the index. Table 8 confirms Connecticut’s underprivileged urban areas to be multiply and substantially deprived beyond and aside from any effect of the vehicle ownership indicator. Even if this indicator was removed, and a high portion of persons lacking access to a vehicle was not considered a detriment, the average deprived urban area would be expected to exhibit a deprivation score of just under 10, and the most deprived two areas in CT would still exhibit scores over 25.

Geographic Analysis

To visually explore the specific geographic distribution of deprivation in Connecticut and Maine the deprivation index was incorporated into a 5-digit zip code
boundary file of these areas using the geographic mapping software, Mapviewer4.\textsuperscript{24} The interactive nature of this software, as well as the amount of information imported into the mapping program, allow the assembled program file to be classified as a geographic information system. This specific integration of information pertaining to area deprivation into a GIS allows for an exceptionally informative, accessible, and interactive representation of the distribution of poverty and disadvantage in CT and ME.

\begin{center}
Geographical Information Systems
\end{center}

Geographic Information System is a label applicable to a broad variety of digital collections of information. GIS vary widely in complexity, function and focus, but all can fundamentally be defined as systems of data organized by geographic position. Organizations using such data have provided a number of more formalized definitions, here are a few:

- "Special-purpose digital databases in which a common spatial coordinate system is the primary means of reference." (OGC, 2002)
- "Automated systems for the capture, storage, retrieval, analysis, and display of spatial data." (Freundschuh, 2002)

Geographic information systems have been incorporated into economic analysis through a number of applications; the most common examples being within the study of environmental resources and through their use in the market for real estate. On a limited basis GIS have also been applied to the study of poverty. A particular example of such an application, published recently in the \textit{World Bank Economic Review}, involved the integration of a number of poverty specific demographic data into a GIS of Burkina Faso (Bigman, 2000). This project exhibits tremendous similarities to the current application within this study, in that it was undertaken to direct community targeting as a means to reduce poverty.

\textsuperscript{24} Mapviewer4 is a product of Golden Software. Further information concerning this program as well as other Golden Software products can be attained at www.goldensoftware.com.
GIS of Deprivation

As previously mentioned, the base map of the GIS of deprivation in Connecticut and Maine includes the boundaries of the two states as well as each five-digit zip code within it. The imported data source of this system contains, for each zip code area, the deprivation measure (index score), the unstandardized index component scores and a handful of other relevant demographic data, including population, county, per capita income, percent of rural and urban occupants, percent minority status of the population, and the rates of tenancy and vacancy.

The most simple and necessary application of this GIS is to display a thematic map of the deprivation (index) scores in these two states; see Map 1 and Map 2. From these maps two exceptionally distinct statewide situations are clearly presented.

Within Maine, the distribution of deprivation can be generally described as a geographic-specific spectrum of disadvantage ascending along a wide north-north-eastern path from the southwestern corner to the northeastern corner of the state. There is a small island of significant deprivation in downtown Portland, and the least deprived postal areas in the entire state are shown to be almost exclusively isolated just outside of the city, in Portland’s affluent suburbs. Surrounding these areas in all directions, except into the ocean, are slightly more, yet not significantly deprived areas. As one progresses their focus north into larger and less densely populated areas, deprivation is shown to be consistently greater. Aside from two small, relatively advantaged areas in the northeastern corner, the entire northern two thirds of the state is shown to experience above average levels of deprivation; the most deeply deprived zip codes most often appearing in northwestern, north-central, and eastern ME. The postal area with the highest deprivation score in all of Maine is a relatively small and very unpopulated area in the center of the northern half of the state; it is zip code 04764, Oxbow.

The thematic map of Connecticut, however, exposes an entirely different pattern of area deprivation. For the most part CT is shown to be an affluent state, exhibiting low

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25 White areas in these maps are postal areas for which data is missing. Again, for further information on missing data see Appendix B.
26 The only other postal area within ME in the most affluent grouping is located further up the coast near Camden/Rockport.
levels of deprivation in the vast majority of its postal areas. There is a band of intermediately deprived areas through the more rural northeastern corner of the state down into the moderate urban center of Norwich. Otherwise, all deprivation in CT, mild and intense, is isolated in urban areas. Furthermore, deprived areas appear in almost every urban center in CT, including moderate and small cities such as Willimantic, New London, and New Britain, and otherwise affluent urban areas such as Danbury and Stamford. Connecticut's larger cities, Bridgeport, New Haven, Waterbury, and Hartford, are each shown to encompass pockets of extreme area deprivation, exhibiting more concentrated intense disadvantage then any areas in Maine.

The further, more interactive, operations of this GIS can only be described and the results exemplified in the written portion of this project; they are, however, exceptionally interesting and useful. The mapping software allows one to zoom in and out, and move freely around the thematic maps of CT and ME; and by selecting an area one can access all statistics from the data file specific to that area as well as the zip code and post office name corresponding to it. Similarly, the program will locate and select an area on the map corresponding to a chosen zip code or post office name, and the deprivation and demographic data specific to that area will again be accessed from the data file. These tools allow for a thorough, comprehensive, and multidimensional examination of deprivation in specific areas. For example it can be easily found that the second most deprived postal area of the entire index, located in Hartford, CT, has a population of seventeen thousand, which is terribly deprived in all domains, 61% having no high school diploma, 51% being below the poverty line, 19% being unemployed, 28% having a health limitation etc; and also which is predominantly of minority status, 98% in fact. Similar examinations can be completed of other areas of interest, and one can ascertain relative differences in specific deprived circumstances between areas. The results of this application, however interesting it is to complete, are less valuable for a current discussion of area deprivation because they involve specific demographic circumstances that are now more then ten years out of date. It therefore serves as an example of the information that can be easily accessed from a similar GIS using 2000 Census data when it becomes available. It must be reemphasized however, that the general patterns of

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27 Zip code 06120. The most deprived area is in Waterbury, CT, zip code 06702.
deprivation, and relative disadvantages experienced in CT and ME are important in that they are, at least in part, indicative of the present pattern and situation.

A final application of the GIS developed in this project is an examination of the distribution of various components of the data file other than the deprivation measure. This can be completed very quickly by simply selecting a different portion of the data file for which the thematic map will express relative levels. Using this tool of the software, one can easily see how educational attainment, unemployment, or per capita income is distributed throughout these states, and with this information have a better understanding of the overall distribution of disadvantage, and the potential implementation of area based initiatives.

Conclusions

This project has sought to demonstrate the potential application of area deprivation indexing to the study of relative poverty and social disadvantage in the United States. It has been found that in the two New England states of Connecticut and Maine there exist area specific and population specific conditions, auxiliary to income levels, that produce significant discrepancies in the degrees of relative poverty and social deprivation experienced within small-scale geographically defined areas.

While among postal areas in these states, per capita income has been shown to explain a substantial portion of the variation in the measure of area deprivation, much of that variation must be attributed to other factors of relative disadvantage. It is also important to note that per capita income explains less variation among the deprivation measure within exceptionally and intermediately deprived areas than it does within areas that experience low levels of deprivation; implying that within deprived areas, circumstances of disadvantage other than financial poverty more significantly affect residents than they do within the least deprived areas. Furthermore, it has been shown that postal areas may, in fact, be significantly deprived without experiencing correspondingly low levels of income.

This project has also served to examine the relative distribution of area deprivation in Connecticut and Maine, as it stood in 1990. It has exposed two vastly different examples of statewide economic and human development. While Maine, by and large, suffers more area specific poverty and deprivation than does Connecticut, this
deficiency is distributed over much of the central and northern regions of the state. It appears to be tied to the rural and undeveloped nature of these regions, which contribute to a lack of high paying employment opportunities, greater rates of health deficiencies, and more widespread housing decline than that experienced in more developed areas.

Conversely, Connecticut is shown to exhibit predominantly affluent and advantaged areas juxtaposed against small, isolated pockets of intense deprivation within its urban centers. The disadvantages experienced in these areas generally consist of a substantial deficiency within the domain of education, as well as limitations on other resources vital to advancement, including personal mobility, access to the labor market, and financial means. The experience of those persons restricted from high paying employment in CT differs from that of those in rural ME due to the fact that healthy labor markets do exist in CT cities; however, deprived urban residents may lack the resources, skills, and qualifications to access these predominantly service oriented markets, which are otherwise at their front door.

For the direction of area-based initiatives, deprivation indexing, and particularly its incorporation into Geographic Information Systems, appears to be a very useful tool. Such initiatives appear to be particularly appropriate in Connecticut given the geographic isolation of such a substantial portion of disadvantage in the state. They, however, may be less applicable to the more widely distributed deprivation of the sparsely populated and exceedingly rural areas of Maine. Area development in northern Maine may rely heavily on migration and population expansion, and as such may not be appropriately driven by government policies. Though, infrastructure and other public resources in such areas may require improvement.

As an example, a revisable model or a directly exploitable format, the index developed in this project is applicable to a wider such study of other areas in the United States. The data incorporated in this study is available for every postal area in the country, and the indexing methodology may be straightforwardly replicated. If further developed, this index may certainly be improved upon through the introduction of additional indicators from newly available sources. Furthermore, adjustments in the methodology of this project may be warranted within a wider application; in particular the vehicle access indicator must be scrutinized in light of the fact that, in other parts of
this country, there exist affluent urban areas with excellent public transportation in which a lack of vehicle ownership may not reflect any disadvantage at all.

Though this project exemplifies an applicable study of poverty and social exclusion, and supports its importance in CT and ME, some of the information it provides is out of date. Many of the patterns of deprivation exposed by this index have clearly continued, however the present relative magnitudes of disadvantage among the studied areas cannot be interpreted until more recent data are available. Such an index incorporating Census 2000 data should, however, be expected to provide not only a more recent picture of geographic deprivation in these areas, but a conclusive ex-post assessment of a decade of area and human development within these two states.
## Attachment A. Correlation Matrix

|       | PCI  | POVERTY | DISCINC | CAR   | VALUETEN | VALUE  | TENANCY | TEN25UP | TEN35UP | TEN45UP | VACANT | AMEN  | KITCH  | PHONE  | PLUMB  | DIS16UP | DIS16TO64 | UNEMP  | TT    | ED25UP | ED18UP | HSDIP | DROPOUT | LINGISO |
|-------|------|---------|---------|-------|----------|--------|---------|---------|---------|---------|--------|-------|-------|--------|--------|--------|---------|----------|--------|-------|--------|--------|-------|---------|--------|
| PCI   |      |         |         |       |          |        |         |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| POVERTY | 0.59 |         |         |       |          |        |         |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| DISCINC | 0.91 | 0.56    |         |       |          |        |         |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| CAR   | 0.26 | 0.57    | 0.26    |       |          |        |         |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| VALUETEN | 0.91 | 0.61    | 0.87    | 0.35  |          |        |         |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| VALUE  | 0.92 | 0.55    | 0.87    | 0.14  | 0.94     |        |         |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| TENANCY | 0.03 | 0.22    | 0.06    | 0.68  | 0.23     | -0.08  |         |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| TEN25UP | 0.02 | 0.22    | 0.05    | 0.69  | 0.22     | -0.09  | 1.00    |         |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| TEN35UP | 0.04 | 0.28    | 0.06    | 0.72  | 0.24     | -0.06  | 0.97    | 0.97    |         |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| TEN45UP | 0.07 | 0.29    | 0.06    | 0.73  | 0.24     | -0.03  | 0.90    | 0.91    | 0.94    |         |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| VACANT | 0.33 | 0.29    | 0.62    | -0.02 | 0.30     | 0.37   | -0.23   | -0.22   | -0.23   | 0.25    |        |       |       |        |        |        |         |          |        |       |        |        |       |         |        |
| AMEN  | 0.48 | 0.58    | 0.50    | 0.22  | 0.48     | 0.50   | -0.06   | -0.06   | -0.03   | -0.04   | 0.45   |        |       |        |        |        |         |          |        |       |        |        |       |         |        |
| KITCH | 0.32 | 0.35    | 0.37    | 0.04  | 0.32     | 0.37   | -0.15   | -0.15   | -0.13   | -0.13   | 0.43   | 0.88   |        |        |        |        |         |          |        |       |        |        |       |         |        |
| PHONE | 0.49 | 0.69    | 0.46    | 0.54  | 0.52     | 0.45   | 0.24    | 0.24    | 0.28    | 0.28    | 0.28   | 0.24   | 0.41   |        |        |        |         |          |        |       |        |        |       |         |        |
| PLUMB | 0.42 | 0.44    | 0.01    | 0.37  | 0.44     | -0.23  | -0.23   | -0.21   | -0.23   | 0.45    | 0.86   | 0.67   | 0.51   |        |        |        |         |          |        |       |        |        |       |         |        |
| DIS16UP | 0.54 | 0.56    | 0.50    | 0.36  | 0.58     | 0.58   | 0.03    | 0.03    | 0.08    | 0.12    | 0.17   | 0.45   | 0.29   | 0.40   |        |        |         |          |        |       |        |        |       |         |        |
| DIS16TO64 | 0.55 | 0.57    | 0.48    | 0.34  | 0.57     | 0.58   | 0.03    | 0.03    | 0.07    | 0.10    | 0.16   | 0.44   | 0.25   | 0.49   | 0.38   | 0.93   |        |         |          |        |       |        |        |       |         |        |
| UNEMP | 0.49 | 0.60    | 0.46    | 0.33  | 0.50     | 0.49   | 0.06    | 0.06    | 0.09    | 0.10    | 0.28   | 0.59   | 0.41   | 0.59   | 0.50   | 0.57   | 0.56   |        |         |          |        |       |        |        |       |         |        |
| TT   | -0.16 | -0.17  | -0.18   | -0.29 | -0.27    | -0.17  | -0.40   | -0.39   | -0.38   | -0.34   | 0.02   | 0.01   | 0.01   | -0.05  | 0.07   | -0.14  | -0.09  | 0.00   |        |         |          |        |       |        |        |       |         |        |
| ED25UP | 0.79 | 0.58    | 0.68    | 0.33  | 0.77     | 0.77   | 0.07    | 0.06    | 0.10    | 0.14    | 0.18   | 0.46   | 0.30   | 0.55   | 0.38   | 0.64   | 0.64   | 0.59   | 0.07   |        |          |        |       |        |        |       |         |        |
| ED18UP | 0.81 | 0.59    | 0.70    | 0.32  | 0.79     | 0.78   | 0.08    | 0.07    | 0.11    | 0.15    | 0.19   | 0.49   | 0.31   | 0.56   | 0.39   | 0.84   | 0.64   | 0.59   | -0.06  | 0.99   |          |        |       |        |        |       |         |        |
| HSDIP | 0.58 | 0.60    | 0.48    | 0.49  | 0.59     | 0.52   | 0.24    | 0.24    | 0.27    | 0.33    | 0.41   | 0.22   | 0.56   | 0.29   | 0.58   | 0.54   | -0.08  | 0.87   | 0.86   |        |        |          |        |       |        |        |       |         |        |
| DROPOUT | 0.19 | 0.26    | 0.18    | 0.27  | 0.22     | 0.16   | 0.24    | 0.24    | 0.26    | 0.26    | 0.02   | 0.12   | 0.00   | 0.31   | 0.00   | 0.25   | 0.28   | 0.18   | -0.03  | 0.27   | 0.27   | 0.31   |        |        |        |       |       |         |        |
| LINGISO | 0.05 | 0.23    | 0.01    | 0.50  | 0.13     | -0.03  | 0.48    | 0.48    | 0.50    | 0.52    | -0.20  | -0.03  | -0.11  | 0.22   | -0.18  | 0.13   | 0.16   | 0.16   | -0.14  | 0.24   | 0.23   | 0.44   | 0.16   |        |        |        |       |       |         |        |
### Key to Attachment A.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCI</td>
<td>Per capita income</td>
</tr>
<tr>
<td>POVERTY</td>
<td>Percent poverty status</td>
</tr>
<tr>
<td>DISCINC</td>
<td>Discretionary household income</td>
</tr>
<tr>
<td>CAR</td>
<td>Percent of household w/out access to a vehicle</td>
</tr>
<tr>
<td>VALUETEN</td>
<td>Real estate wealth (Median value of units adjusted for tenancy)</td>
</tr>
<tr>
<td>VALUE</td>
<td>Median value of housing units (unadjusted)</td>
</tr>
<tr>
<td>TENANCY</td>
<td>Tenancy rate</td>
</tr>
<tr>
<td>TEN25UP</td>
<td>Tenancy rate for persons 25 and older</td>
</tr>
<tr>
<td>TEN35UP</td>
<td>Tenancy rate for persons 35 and older</td>
</tr>
<tr>
<td>TEN45UP</td>
<td>Tenancy rate for persons 45 and older</td>
</tr>
<tr>
<td>VACANT</td>
<td>Rate of Vacancy</td>
</tr>
<tr>
<td>AMEN</td>
<td>Compilation of basic amenity deficiency rates</td>
</tr>
<tr>
<td>KITCH</td>
<td>Rate of units lacking complete kitchen facilities</td>
</tr>
<tr>
<td>PHONE</td>
<td>Rate of occupied units a phone</td>
</tr>
<tr>
<td>PLUMB</td>
<td>Rate of occupied units lacking complete plumbing facilities</td>
</tr>
<tr>
<td>DIS16UP</td>
<td>Rate of persons, 16 and older, having a disability or health limitation</td>
</tr>
<tr>
<td>DIS16TO64</td>
<td>Rate of persons, 16 to 64, having a disability or health limitation</td>
</tr>
<tr>
<td>UNEMP</td>
<td>Unemployment rate</td>
</tr>
<tr>
<td>TT</td>
<td>Mean Travel Time to Work</td>
</tr>
<tr>
<td>ED25UP</td>
<td>Mean educational attainment of persons 25 and older</td>
</tr>
<tr>
<td>ED18UP</td>
<td>Mean educational attainment of persons 18 and older</td>
</tr>
<tr>
<td>HSDIP</td>
<td>Rate of persons 25 and older with no high school diploma</td>
</tr>
<tr>
<td>DROPOT</td>
<td>Drop out rate among 16-19 year-olds</td>
</tr>
<tr>
<td>LINGISO</td>
<td>Percent of linguistically isolated households</td>
</tr>
</tbody>
</table>
Map 1. Deprivation in CT

Deprivation Score by Equal Intervals

-14.66 to -6.89
-6.89 to 0.88
0.88 to 8.64
8.64 to 16.41
16.41 to 24.18
24.18 to 31.94
Map 2. Deprivation in ME

Deprivation Score by Equal Intervals
-14.66 to -6.89
-6.89 to 0.88
0.88 to 8.64
8.64 to 16.41
16.41 to 24.18
24.18 to 31.94
## Appendix A. Census Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Code(s)</th>
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<tbody>
<tr>
<td>Persons</td>
<td>P0010001</td>
</tr>
<tr>
<td>Households</td>
<td>P0050001</td>
</tr>
<tr>
<td>Households by Urban and Rural Status</td>
<td>P0060001-P0060004</td>
</tr>
<tr>
<td>Household Language and Linguistic Isolated</td>
<td>P0290002, P0290004, P0290006</td>
</tr>
<tr>
<td>Aggregate Travel Time to Work</td>
<td>P0510001</td>
</tr>
<tr>
<td>Educational Attainments (25+)</td>
<td>P0570001-P0570007</td>
</tr>
<tr>
<td>Educational Attainments (18+)</td>
<td>P0600001-P0600001</td>
</tr>
<tr>
<td>16 to 19 year olds not HS graduate and not in HS</td>
<td>P0610004, P06100011-P0610013</td>
</tr>
<tr>
<td>Sex by Age by Work Disability Status by Mobility and Self Care Limitation Status</td>
<td>P0680001-P0680016</td>
</tr>
<tr>
<td>Per capita income</td>
<td>P114A001</td>
</tr>
<tr>
<td>Poverty Status by Age</td>
<td>P1170001-P1170024</td>
</tr>
<tr>
<td>Occupancy Status</td>
<td>H0040001, H0040002</td>
</tr>
<tr>
<td>Condominium Status by Tenure and Mortgage Status</td>
<td>H0070001-H0070006</td>
</tr>
<tr>
<td>Tenure</td>
<td>H0080001, H0080002</td>
</tr>
<tr>
<td>Tenure by Age</td>
<td>H0130001-H0130014</td>
</tr>
<tr>
<td>Tenure by Telephone in Housing Unit</td>
<td>H0350001-H0350004</td>
</tr>
<tr>
<td>Tenure by Vehicles Available</td>
<td>H0370001-H03700012</td>
</tr>
<tr>
<td>Kitchen Facilities</td>
<td>H0420001, H0420002</td>
</tr>
<tr>
<td>Aggregate Gross Rent</td>
<td>H0440001</td>
</tr>
<tr>
<td>Aggregate Selected Monthly Owner Costs by Mortgage Status</td>
<td>H0530001, H0530002</td>
</tr>
<tr>
<td>Aggregate Monthly Household Income by Tenure and Mortgage Status</td>
<td>H0630001-H0630003</td>
</tr>
<tr>
<td>Median Value of Owner-Occupied Housing Units</td>
<td>H061A001</td>
</tr>
<tr>
<td>Plumbing Facilities</td>
<td>H0640001-H0650002</td>
</tr>
</tbody>
</table>

* United States Census Bureau, 1990 U.S. Census of Population and Housing, Summary Tape File 3B.
### Appendix B. Missing Data

<table>
<thead>
<tr>
<th>Explanation why deprivation measure not calculated:</th>
<th>Affected Postal Areas (population):</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 persons counted by 1990 census, thus division by zero to calculate the unemployment rate.</td>
<td>04013 (0) 04279 (0)</td>
</tr>
<tr>
<td>0 persons in labor force, thus division by zero again.</td>
<td>04109 (28) 04570 (3) 06243 (25)</td>
</tr>
<tr>
<td>0 employed persons, thus division by zero to calculate mean travel time.</td>
<td>04563 (12)</td>
</tr>
<tr>
<td>No owned housing units, thus 0 real estate wealth which cannot be logarithmically transformed</td>
<td>04737 (30) 06103 (1220)</td>
</tr>
</tbody>
</table>

- Postal areas without deprivation scores are blank (white) areas on the two thematic maps.
- Additionally, the oldest base maps available are from 1996, thus the boundary-file for these maps outline postal areas as they stood in 1996. These changes are minimal, however, there are therefore other blank areas corresponding to zip codes that did not exist in 1991. There is only one such area in CT, 06451 in Meriden, and 17 such areas in ME.
Bibliography


Smith, Gillian R. *Area Based Initiatives: The rational and options for area targeting*. CASEpaper 25, Center for Analysis of Social Exclusion, London School of Economics. May 1999


World Bank Development Indicators 2002. Table 2.8 “Distribution of income or consumption” www.worldbank.org/poverty/data/2.8wdi2002.pdf