Detailed Child Care Gap Mapping Methodology

Child Care Supply and Need Data

This analysis set out to produce neighborhood level estimates of the child care gap in 25 states. The child care gap is the number of children under six who have all parents in the labor force and do not have access to child care within reasonable driving distance.

To calculate the gap, BPC first needed to collect data on the need for and supply of child care by geographic location. This analysis defined the potential need for child care as the number of children under six years of age with all parents in the labor force. This need data was available via the census's American Community Survey (ACS) 5-year 2014-2018 sample at the block group level—the most detailed level of census geography available. Child care supply data came from capacities reported by each state's child care officials, and from the Office of Head Start, American Indian and Alaska Native tribes, and the Department of Defense's facility data. To assign each child care location an *x,y* coordinate, each facility was geocoded.

Each block group was then assigned a search radius that estimated the driving distance families from the block group could reasonably travel to access child care facilities. The number of child care slots from the facilities that fell within a block group's search radius were considered the available supply of child care for that block group. Figure 1 illustrates a typical search. A radius of 3.5 miles was used for urban areas and a radius of 10 miles for rural areas. This distance is consistent with findings from a national parent survey conducted by BPC and calculations of the average actual distance parents drove from home to child care using address-level household data in Maine and Idaho. Based on the recommendations of certain states, the analysis in some states utilized different sized search radii.

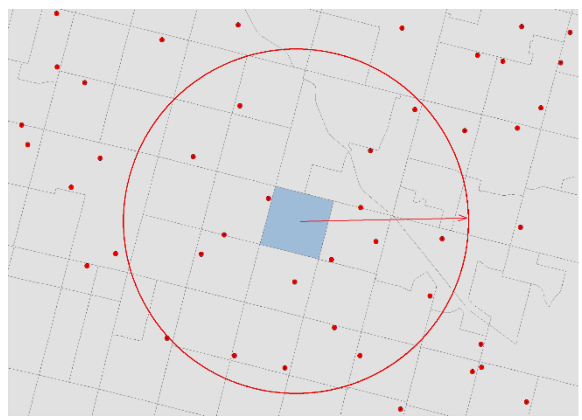

Figure 1: Child care supply available to each block group included all daycare sites within a 3.5-mile search radius of the block group.

Using Driving Distance to Estimate Parent Access to Child Care Facilities

The analysis determined whether a child care facility was accessible (within the search radius) by measuring the distance between the *x,y* coordinates of the census block group centroids and the location of the child care facility. Rectilinear or Manhattan style distances were used to reflect travel on gridded street systems found in most urban areas.

Approximating access distances through reference to geographic coordinates is a computationally efficient method and eliminates the need for an underlying roadway network and complicated algorithm for computing actual travel paths. One limitation of this approach is that it ignores the presence of geographic features (e.g., rivers) that distort road networks and therefore accessibility.

The application of a search radius identified the collection of child care sites that were accessible to the population in each block group. In most cases, however, the entire capacity at each site was not only available to one block group; there was often *competition* from other block groups. Each facility tended to fall into the accessible search areas of many block groups. From the child care facility point of view: most providers served a market area covering several block groups in the surrounding area. Competition for slots in each child care facility had to be accounted for so as to avoid double-counting capacity. A solution was needed to assure that each child care slot was not used multiple times by populations from different block groups.

Allocating the Need: Maximizing Assignment to Child Care Facilities

This analysis faced a classic allocation problem: how to assign *m* children to *n* slots so as to maximize the number of children assigned while assuring that child care facilities were never assigned a number of children that exceeded facility capacity. To address this problem, BPC looked to an adaptation of analytical methods that had long been applied in travel demand forecasting models. In this case, an allocation table (or matrix) was constructed that identified for each census block group the set of eligible child care sites that were accessible to it. The potential need for child care (children under the age of 6 with all parents in the labor force) was then allocated to each site. With a technique known as iterative proportional fitting (IPF), the allocation table was then factored to assure that need for each child care site never exceeded capacity. IPF is a standard matrix manipulation technique dating back to the 1930s for proportionally adjusting the assignment of populations to sites when there are constraints; in this analysis there were dual constraints: (1) a fixed number of children from each block group to be assigned to (2) a limited and fixed number of child care slots.

To handle these constraints, an adaptation of the IPF procedure was used in this analysis. In a traditional IPF application, row and column totals of the matrix must be equal. This was not the case in the present analysis because each facility often had far less capacity (number of child care slots) than the potential need for child care that could access that facility. Also, a typical IPF application seeks to adjust the matrix so that total row and column allocations match need and capacity targets precisely. This analysis only needed the allocations to be less than the capacity targets. The adjustment procedure therefore observed dual constraints, as expressed by:

$$\forall i \sum_{i} A_{ij} \leq Pop_i$$

and

$$\forall j \sum_{j} A_{ij} \leq Cap_j$$

Where:
A_{ij} is the allocation of child population in block group *i* to child care provider *j*, and
Pop_i is the child population in block group *i* and
Cap_j is the capacity provided by child care provider *j*

Quantifying the Child Care Gap

If sufficient capacity was available, the procedure fully allocated child care need from census block groups to facilities. However, the full need from most census block groups could not be fully assigned to facilities for either one or both of the following reasons:

- No child care sites were accessible (within the search distance) of the block group
- Candidate child care sites were accessible, but need from the block group could not be fully allocated due to capacity limitations and competition from other block groups for those limited spaces

Such situations produced child care gap. Potential need from each block group was initially allocated to each eligible site based on capacity and then adjusted to ensure that all sites remained within capacity. The initial allocation is known as the "seed" for the IPF procedure. Initial allocations could have, alternatively, taken travel distance and/or other cost factors into consideration, making the procedure a predictive model of what specific child care sites parents in each block group would have chosen. However, such predictions were not incorporated due to the lack of a comprehensive understanding of the factors that influence parent child care decisions. **This analysis only sought to arrive at a solution that maximized the need allocated to facilities and minimized the child care gap.**

Ultimately, this analysis produced estimates of the number of children with unmet need for child care—the gap. It should be noted that IPF allocations generate floating point solutions (decimals), as opposed to integers (whole numbers). Ultimately, the desired integer solution for this analysis was generated via a technique called bucket rounding, whereby allocated values were rounded to integers while preserving the fractional parts lost through the process. Bucket rounding minimized the propagation of rounding errors.