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Research Paper

The socio-economic context of form-based codes

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HIGHLIGHTS

- I provide a quantitative assessment of form-based codes (FBCs) in the U.S.
- ANOVA regression assesses the equity, density and diversity of FBC tracts.
- Median rent tends to be lower for FBC tracts.
- Percent rental and percent high density housing are higher in FBC tracts.
- Equity, density and diversity associations are strongest in suburban FBC tracts.

1. Introduction

Conventional zoning codes, particularly in the U.S., often prohibit the building of compact, diverse, walkable urban places, and thus present a significant impediment to sustainable urban form. One approach to stemming the negative impact of car-dependent urbanism – sprawl – is to reform conventional zoning by implementing new kinds of codes that, it is hoped, will foster the creation of compact, well-designed, diverse urban places (Parolek et al. 2008). Form-Based Codes (FBCs) are the most popular example of this revised coding approach, and have been especially popular in the U.S. "FBC" is an umbrella term that encompasses other aligned regulatory efforts: Traditional Neighborhood Development ordinances, Mixed-Use and Live/Work codes, TOD ordinances, Transit Area Codes, Smart Growth codes and Green Building Codes of various stripes (Morris, 1996; Crawford, 2004; Clarion, 2008; Garde and Hoff, 2017). The goal of FBCs is to create environments that support walkable urbanism, in contrast to conventional zoning regulations that make it difficult to create mixed-use, pedestrian-oriented environments. Communities adopt FBCs to implement a prescriptive vision about community form rather than apply a set of rules designed to prohibit incompatibilities. FBCs are also thought to provide a number of associated benefits, such as expanded strategies of job creation and competitive economic development (Borys and Benfield 2019).

Despite their increasing popularity, little systematic research has been done on the extent of FBC reform efforts and the socio-economic contexts of places that have adopted FBC codes. What kinds of places adopt FBCs and is there evidence that such places are becoming denser and more socially diverse, years after the codes are implemented? This paper makes a detailed, quantitative assessment of FBCs that have been adopted in the U.S. in the past several decades. I use census tract data associated with FBC locations to assess the socio-economic differences between tracts with and without FBC adoption. I focus on three hypothesized correlates of FBCs, pertaining to equity, density and diversity. Specifically, I assess whether FBC tracts are associated with tracts that are wealthier and Whiter (equity), that have higher population growth and an increase in housing unit production (density), and have higher diversity in terms of housing unit type (diversity). Although there are several individual accounts of these attributions, the associations have not been subjected to large scale empirical analysis.

2. Literature review

The emphasis on form, pattern and mixed use – the defining qualities of FBCs – has pervaded code reform efforts in the last two decades (Tracy, 2004; Morris, 2009). FBCs differ from conventional zoning in several ways. First, conventional zoning prioritizes the regulation of land use, focusing on what uses need to be separated. Housing types are generally not mixed within a zone. FBCs prioritize the shape, size and placement of buildings, and only regulate land use secondarily, usually with much less restriction on what kinds of uses are permitted within a zone. In fact, housing types and land uses are purposefully allowed to mix. Second, conventional zoning is kept separate from a land use plan. In contrast, FBCs integrate regulation and plan. Proponents argue that this will result in a more coherent arrangement of land uses, where zone placement is guided by long term planning objectives rather than an ad hoc arrangement that is typical of conventional codes. Third, FBCs regulate in a way that is intended to support pedestrian life, meaning that parking requirements and setbacks are minimized. Blank walls are

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prohibited and windows and doors are required to front the sidewalk. Conventional zoning is not directed at such objectives, and is notoriously focused on supporting car-based access, meaning that parking is required, and parking lots are permitted in front of buildings.

Although regulations directed at controlling form have been around for centuries (Talen 2011), the modern FBC emerged in the 1980s as a way to deliver a more predictable, pre-determined urban quality. One of the first modern-era FBCs was employed for the 1982 master-planned community of Seaside, Florida (see Krieger, 1991). Subsequent FBCs have sought to create straightforward rules that would require an urban form conducive to pedestrians, such as a continuous urban frontage. FBCs usually have an open approach to land use, such that use is regulated secondarily after form.

Soon after the emergence of FBCs in the 1990s, publications focused on documenting the rise of FBCs and providing resources for more widespread adoption: *Smart Growth Zoning Codes: A Resource Guide* (Tracy, 2004), and *Form-Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers* (Parolek, Parolek and Crawford, 2008). FBCs are strongly linked to smart growth, seen as a way to address sprawl via coding reform (Freilich, 2010; Williamson and Dunham-Jones, 2021). The Form Based Codes Institute (www.formbasedcodes.org) was created in 2004 to advance the approach, and is now a part of the larger umbrella organization Smart Growth America.

Miami, Florida was the first large American city to adopt an FBC, in 2010, followed by Denver, Colorado. Other large cities with recent FBC adoption include Buffalo, Dallas and San Diego. While these codes are all considered to be FBCs, there are many variations. Different kinds of FBCs have emerged, for example the "SmartCode", which is a specific type of FBC that regulates urban form on the basis of intensity, from rural to urban (Duany and Talen, 2002). Some zoning revisions might be seen as partially FBC-related, for example when jurisdictions increase the number of mixed-use districts (Hirt, 2013).

Research that focuses on FBCs specifically is not as well established as research on zoning more generally, although FBC scholarship has been growing in the last decade. While some research has pursued the applicability of FBCs in non-U.S. contexts, mostly with positive reviews (e.g., Sabri and Ahmed, 2019; Nel, 2016; Sung et al., 2015), most of the literature is U.S. specific. One area of interest has been to better understand the urban outcomes of FBCs from a place quality point of view. For example, Hansen (2014) used an auditing tool to verify the link between FBCs and urban design qualities like imageability, complexity and human scale. Others have been involved in developing modeling tools to both create and evaluate FBCs (Schnabel et al., 2017; Zhang and Schnabel, 2018). FBCs are sometimes evaluated indirectly by looking at the relationship between urban design quality of the kind that FBCs promote and outcomes like walking behavior (Ameli et al., 2015; Sung et al., 2015). Faga (2014) interviewed planning leaders in Cincinnati, Denver and Miami in an effort to better understand the reasons motivating code reform and found that strong leadership, anticipated development and a desire for better design were key factors.

Another focus has been on the ability of FBCs to advance sustainability goals. For example, one study looked at the ability of an FBC to help reduce greenhouse gas emissions (Senbel et al., 2013). The authors found that while per capita emissions in denser communities with FBCs decreased, total city-wide emissions did not. A study of watershed protection showed that FBCs can correlate with improved environmental conditions, although the effects depend on other variables like training and leadership (Berg and Bendor, 2010).

Garde and Hoff (2017) evaluated the differences between FBCs, LEED-ND (a neighborhood rating system developed by the U.S. Green Building Council), and conventional zoning codes in Denver and found that developments zoned under FBCs were more likely to incorporate sustainable design principles. A related study of Miami 21′s FBC found some support for the ordinance's ability to incorporate sustainability criteria, with limitations related to green building certification and a focus on mixed-income development (Garde et al, 2015). In another study, Garde and Kim (2017) compared the integration of sustainability criteria in FBC development (as opposed to conventionally zoned development) across 26 municipalities in Southern California. The authors found that most FBCs were more successful in incorporating sustainability criteria than conventional codes, although there were significant instances where FBCs did comparatively worse (see also Faga, 2014).

Researchers have also examined the legal challenges of FBCs (Lawlor, 2011). One study argued that FBCs should be optional for most areas but mandatory for business districts (Barry, 2008). Others have argued that to avoid legal challenges, FBCs should only apply to new development and preserve conventional coding for existing development (Woodward, 2013; Bauman, 2019).

Another focus of research has been the impact of FBCs on developer decisions and profits. Hughen and Read (2017) argued that FBCs allow developers to mix land uses, and this creates opportunities for private development in markets where investment has traditionally been weak or where the market is more volatile. Rangwala (2013) compared FBCs and conventional zoning to showcase the economic development potential of FBCs and their ability to stimulate private investment. There is some evidence that neighborhoods regulated by FBCs held their value and even increased in worth during the 2008 economic downturn, while most other locations lost value. An EPA report compared appreciation in home resale values in smart growth developments (associated with FBCs) vs. conventional suburban developments (associated with conventional zoning) and found comparatively faster appreciation in smart growth developments (Sobel 2011).

A few studies have looked at the equity implications of FBCs. Park (2017) studied residential turnover in Austin, Texas to assess whether New Urbanist development, implemented using FBCs, stimulated turnover. She found that turnover rates were higher as compared to traditional single-family developments, citing the impact of amenities. Tagtachian et al. (2019) used case studies of Nashville and Miami-Dade County to argue that more attention should be given to the socio-economic implications of FBCs. While recognizing that FBCs can be revitalizing, the effect on existing residents in areas transitioning under an FBC can be harmful, especially in traditionally marginalized communities excluded from the political process. The authors argued that FBCs can result in the displacement of lower income and non-White communities, and that FBCs neglect to incorporate communities in the planning process, even though public participation can strengthen existing populations.

Several other criticisms of FBCs have surfaced. One critique is that FBCs treat urban problems superficially, affecting merely the symptoms of deeper problems, and therefore communities should not attempt to use FBCs as a panacea. Zoning reform is seen as unlikely to offer a solution to problems of social inequity and environmental degradation. Improved physical form via a reformed zoning code will simply not go far enough to redress structural economic and social problems (Denoon-Stevens and Nel 2020). Local governments should therefore spend their energies on reconnecting local economic networks and empowering small-scale, independent improvement efforts (Pyatok, 2002).

There are more basic critiques as well. A study of Miami's FBC argued that it did not go far enough to require parking policy reform (Nuworsoo and Hananouchi 2010). Property owners may be concerned that FBCs are associated with tax increases, and residents may be fearful of density increases. From the architectural community, a long-standing critique is that FBCs try to dictate style and infringe on architectural creativity (Inniss 2007).

Proponents of zoning reform, on the other hand, have made substantial claims about the value of FBCs. In an extensive literature review, Borys and Benfield (2019) compiled the results of 135 studies that include some form of measurement of the impact of form-based codes. Drawing from these studies, they created a "Code Score" linking urban form to "health, safety, welfare, and the environment," relating outcomes to form based codes. The results of their study are summarized in

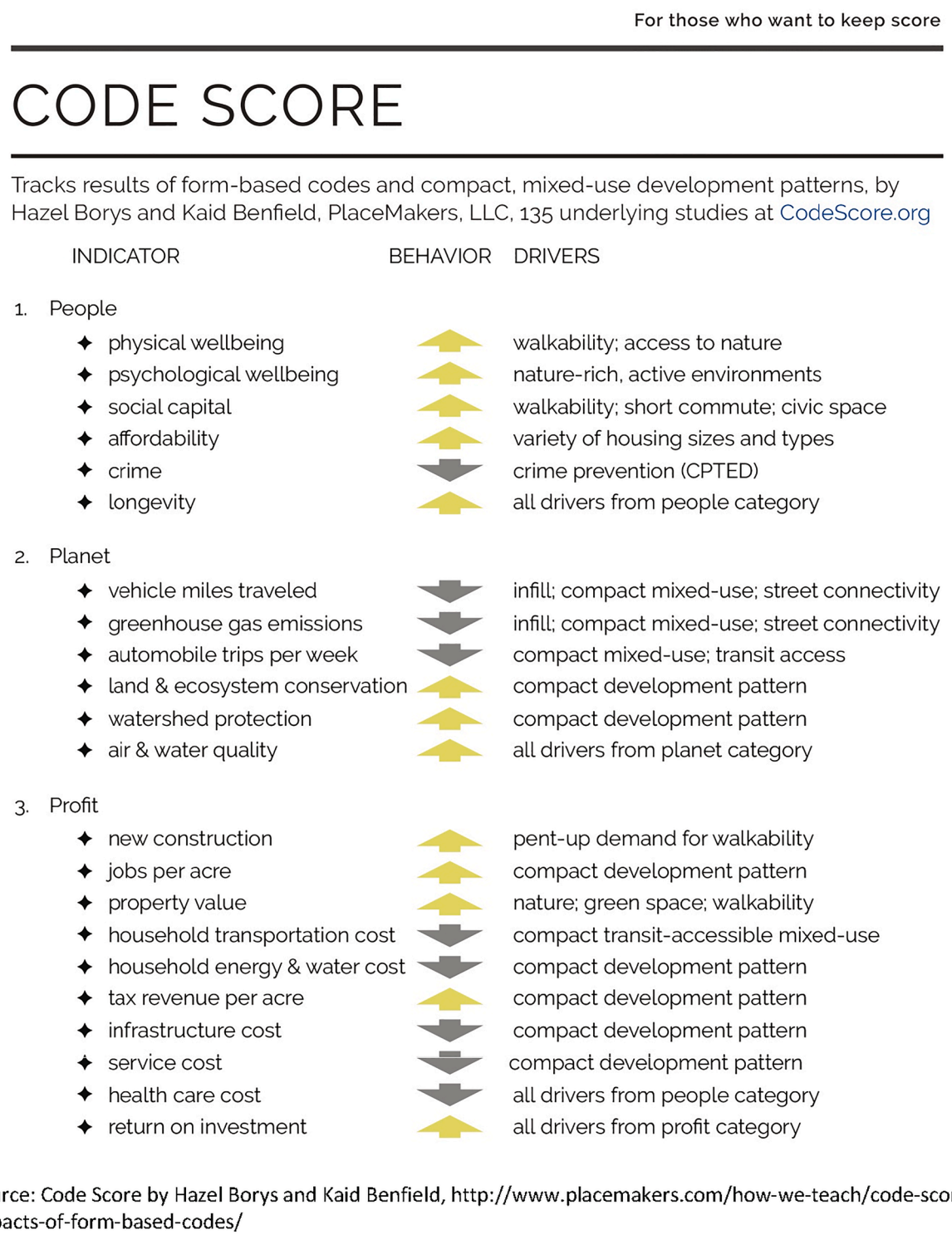


Fig. 1. Summary of Code Score Analysis. Source: Code Score by Hazel Borys and Kaid Benfield, http://www.placemakers.com/how-we-teach/code-scoreimpacts-of-form-based-codes/.

Fig. 1. The authors conclude that FBCs and the compact, mixed-use development they enable have substantial benefits for people (in terms of, e.g., physical well-being, affordability, social capital), the planet (e.g., reduction of greenhouse gas emissions, land conservation), and profit (e.g., jobs per acre, property value).

The studies reviewed by Borys and Benfield focus on small-scale effects associated with individual jurisdictions, not large-scale quantitative analyses linking FBCs to socio-economic data. To date, I am not aware of research that has connected socio-economic measures to the specific case of FBCs. Large scale quantitative assessment has instead focused, to date, on conventional zoning. Most often, research has connected conventional zoning to negative socio-economic outcomes, specifically showing that zoning correlates with social inequities (Reps, 1964; Pendall, 2000; Shen, 1996; Feitelson, 1993; Levine, 1999; Wickersham, 2006; Knaap et al., 2007), and in fact has been the cause of racial injustice (Angotti and Morse, 2016; Trounstine, 2018; Bronin, 2021).

3. Analytical framework

To make an assessment of FBCs, I focus on three dimensions, each of which is testable using socio-economic data: equity, diversity and density. The first, equity, pertains to the degree to which FBCs are associated with socio-economic change that might be perceived as exacerbating inequities: where tracts with FBCs become Whiter and more affluent. Often the social equity implications of FBCs are focused on ensuring community participation in decision-making (e.g., Tagtachian et al., 2019), but it is also possible to evaluate equity implications by looking at whether FBCs are associated with rising affluence, indicative of gentrification, and/or the decreasing presence of Black, Hispanic, or low-income populations. FBCs are intended to create urban environments that are safe, well-connected, well-serviced and qualitatively better than sprawl – are these pro-actions, directed at qualitative improvement, equally distributed in a socio-economic sense? Or, is there evidence the places that have adopted FBCs are becoming wealthier and Whiter?

The other two dimensions I explore – diversity and density – are more directly tied to FBC objectives. Diversity is thought to be achieved through the mixing of housing types, thus reversing the rules by which social segregation has been achieved: allowing multi-family units where previously excluded, and modifying rules that obviate higher density and infill (for example, minimum lot size and setback requirements). Some FBCs even require certain percentages of housing types within each zone in a neighborhood, helping to ensure unit type diversity. For example, in the SmartCode, a type of FBC, the General Urban Zone requires three types of housing units within a specified neighborhood area (Duany et al. 2008). A mix of uses might also be encouraged in an FBC as a way of supporting the social diversity that unit type diversity is thought to engender.

These kinds of diversity-supporting requirements do not exist in conventional zoning, which tends to block the mixing of housing types, allowing only one family per lot, prohibiting any form of attached housing in single-family zones, and requiring that all lots have street frontage (which means bungalow courts, mews, or courtyard housing is prohibited). The mixing of residential and commercial uses is usually not allowed, either within the same building or within the same zone. FBCs, by contrast, apply frontage, setback, building type and other "form" related rules to help successfully integrate townhomes, duplexes and single-family residences in relatively close proximity. Attention to form avoids degrading situations like single-family housing adjacent to large format commercial structures, and multi-family housing isolated by open space.

FBCs are also intended to promote higher density development, replacing sprawl with compact urban form and helping to correct the U.S.'s housing imbalance, where 61% of existing housing stock is in the form of single-family detached dwellings while 2/3 of housing demand in the coming years will be in the form of 1 or 2 person households (Nelson, 2013). Density is promoted by allowing smaller dimensions than conventional codes, such as smaller unit sizes and narrower street widths. The FBC of Miami (Miami21), for example, allows lot sizes as small as 16 ft. in more urban locations, and 50 ft. widths in more sub-urban areas – significantly smaller lot dimensions than many contemporary zoning codes. Often, FBCs seek to provide "missing middle" housing by allowing duplexes and triplexes in single family zones (which is aligned with recent zoning reform efforts in which single-family zoning is eliminated). Some FBCs allow 100 percent lot coverage, minimal setbacks, and prohibit ground level parking.

4. Data and method

The research involves a three step process: selection of codes, selection of tracts, and analysis. The steps are described below and conceptualized in a flow chart shown in Fig. 2.

Tracking FBC adoption is not straightforward. One complication is that FBCs have taken on their own complexity, where cities now merge FBCs with priority areas, or create hybrid zones that have some form-based emphasis mixed in with conventional use-based coding. The result may be a mixture, as in New York City, where two types of rules are enforced: contextual, where buildings define space, or non-contextual, where buildings simply exist within it (NYC Department of City Planning, 2021). The codes may be optional overlays, floating zones, district regulations, or FBC-type requirements that are appended to existing design standards. The codes may by project-specific and apply only to a station area, a central business district, or section of street, or they may apply to a neighborhood, a section of town, or an entire city or region. They may be hybrid codes, in which form-based coding requirements are added to a conventional zoning code.

To help sort through these complexities, an initiative called the "Codes Study" was launched with the aim of developing a robust accounting of FBC adoption in the U.S. and globally (Borys and Talen 2016).[1] The organizers of the Codes Study rely on crowd-sourced material as a starting point, and then apply a set of criteria established by the Form-Based Codes Institute (FBCI) to determine whether a code is appropriate for inclusion. Codes are included only if they focus primarily on regulating urban form, if they are regulatory rather than advisory (thus urban design guidelines are excluded), and are tied to specific locations on a regulating plan.

The Codes Study lists 728 codes that meet the criteria established by FBCI, of which 439 have been adopted (as of 2019). The vast majority (91%) have been adopted since 2001; Fig. 3 a histogram of code adoption year. For my analysis of socio-economic correlates, I narrowed the selected set of FBCs by excluding the following types of codes: codes not yet adopted; codes at the regional, county and state level; non-U.S. codes; codes not within a core-based statistical area; and codes that cover entire large metropolitan areas (like Miami and Denver). However, codes for sections of large cities (parts of Phoenix, for example) are not excluded.

The decision to exclude large cities is based primarily on the fact that because of the extensive area involved, it would be difficult to discern "FBC" vs. "non-FBC" tracts in a meaningful way, as the "non-FBC" group would likely include a vast surrounding territory (tracts in the same core area, as explained below). Because of their more constrained geographic area, focusing on medium and small cities, towns and neighborhoods, as well as parts of larger cities, allows a clearer distinction between FBC tracts and tracts in nearby areas that are not regulated by FBCs. The final tally of FBCs used in this analysis, listed in Table 1, is 274 codes.

Once a final selection of FBCs was made, I selected corresponding census tracts. To determine those tracts, it was first necessary to obtain the spatial boundaries of the area regulated by each FBC. To find those locations, my team searched through online planning documents and zoning ordinances to obtain the boundaries of impacted areas—i.e., areas regulated by the FBC. A tract was flagged as an "FBC tract" if it was wholly or partially within an FBC regulated area. The final selection was 1,079 FBC tracts.

The next task was to select a comparative set of tracts – i.e., a group of tracts not regulated by an FBC code that could be used to compare socio-economic differences. Rather than include all U.S. tracts, I constrained the comparative set in several ways. First, I included only those tracts that were within a Core-Based Statistical Area (CBSA), and only CBSAs that had an FBC tract. CBSAs are made up of counties that have either an urban cluster of 10,000–50,000 population, or include an urbanized area of 50,000 or more. Surrounding counties that are integrated, based on commuting patterns, are also included in a CBSA. In addition, following common practice in the literature (e.g., Sampson et al 2015), I retained only census tracts that had at least 50 households in 2010. The final tally of tracts in the comparative group was 36,685.

[1] The Codes Study, organized by the urban design firm Placemakers, is available online here: http://www.placemakers.com/wp-content/uploads/2019/06/Codes-Study_June-2019.htm

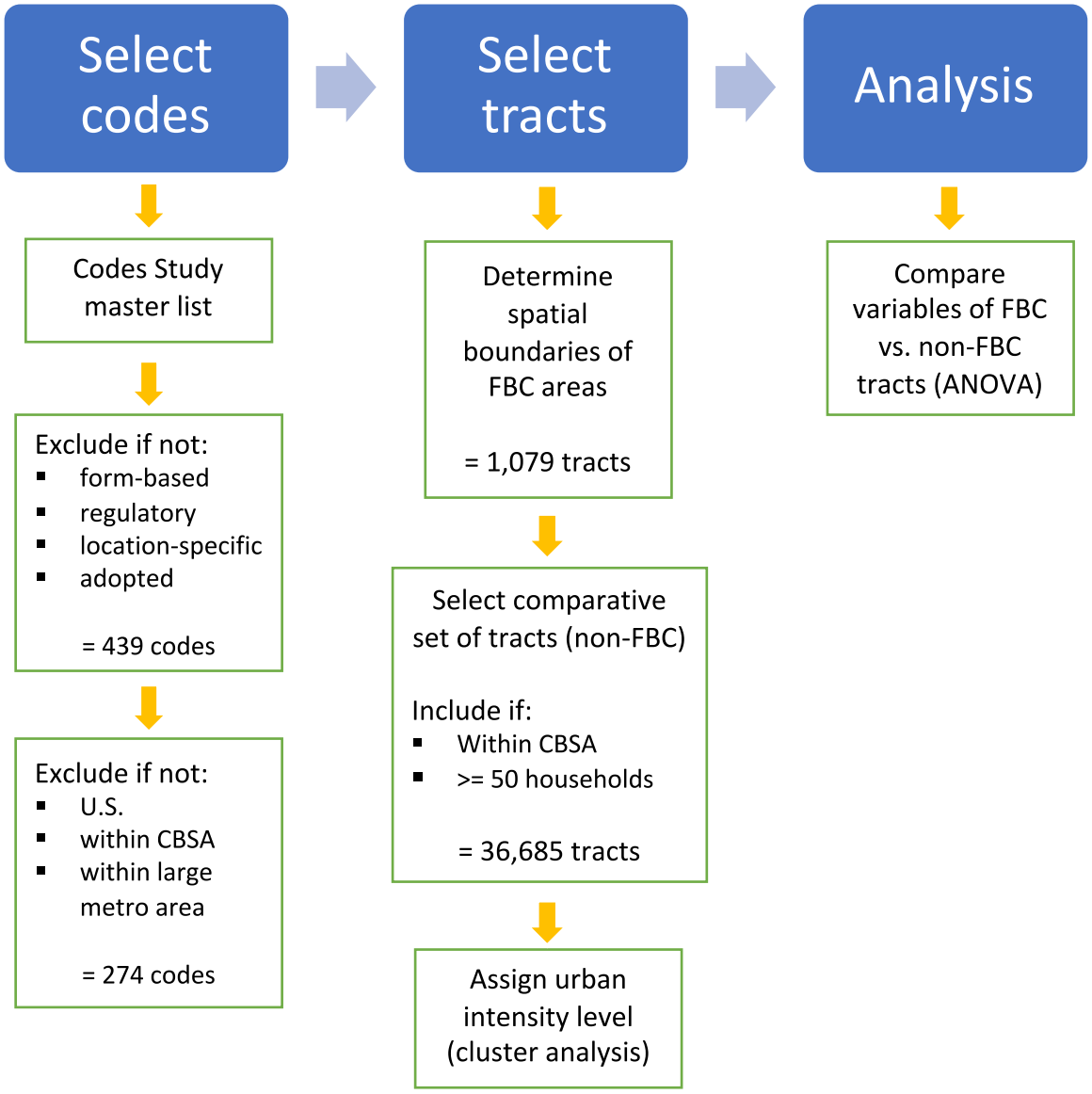


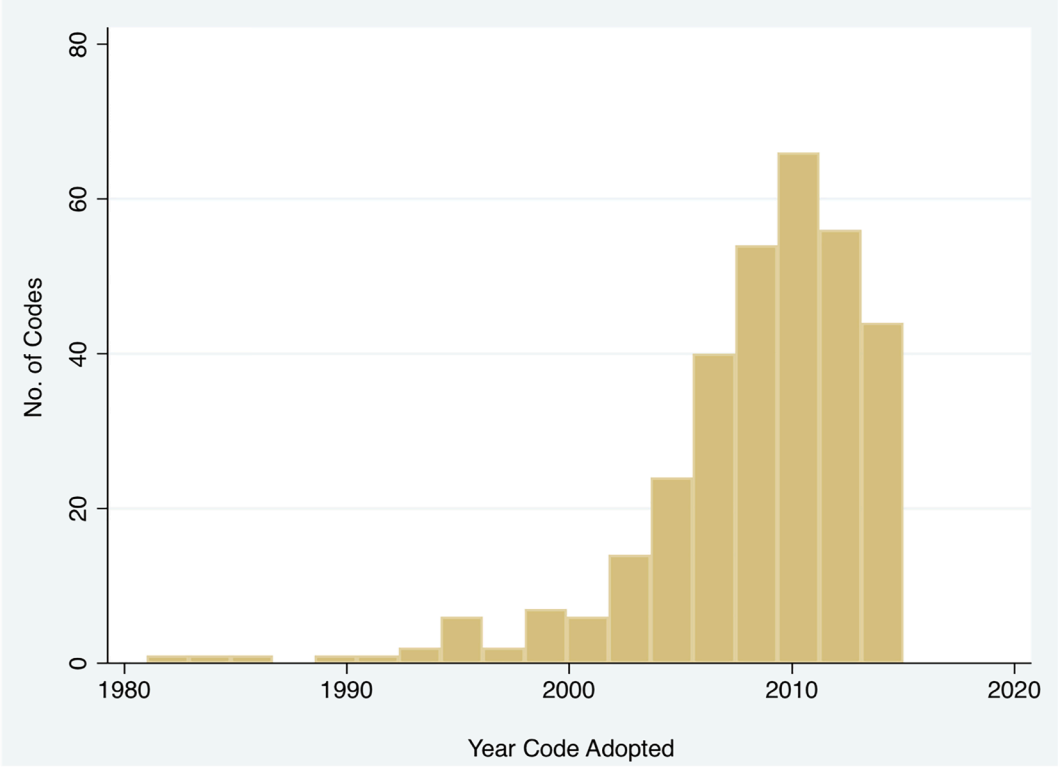
Fig. 2. Flow chart of analytical process.

Another factor to consider in determining what tracts to compare FBC tracts to is the degree of urban intensity—distinguishing between places that are more suburban places vs. places that are more urban. For example, it might not make sense to compare socio-economic data for a neighborhood in a suburban location near a small city with an urban commercial core in a larger city. In order to account for these differences, I carried out a cluster analysis of all tracts within the CBSAs of FBCs, based on three land cover variables: low-intensity, medium-intensity and high-intensity land use. The description of these categories is given in Table 2. The data originates from the US National Land Cover Database (NLCD), which uses remotely sensed (satellite) data maintained by the U.S. Geological Survey (USGS). NLCD data have been aggregated to the US census tract level by the National Neighborhood Data Archive (Clarke and Melendez, 2019).[2]

Using tract level percentages of low-, medium- and high-intensity land cover, I performed a cluster analysis to create groups of tracts in land intensity categories. I used a k-means clustering method using 6 groups (this number was selected because increasing it did not improve the total within-cluster sum of squares). A representative center for each cluster is listed in Table 3. Table 4 lists the number of tracts assigned to each cluster. The objective of the k-means algorithm is to minimize the sum of distances from the observations in each cluster to a representative center for that cluster.[3] Table 3 shows that clusters 1, 2 and 3 have relatively high percentages of low and medium-intensity development and small amounts of high-intensity development. Clusters 4 and 5 have relatively small amounts of low-intensity development and more medium- and high-intensity development. Cluster 6 is defined by a high amount of high-intensity development; however, because cluster 6 only contains 18 FBC tracts (Table 4), I did not include it in the analysis. I therefore focus on two main groups which I label "Suburban" and "Urban": tracts in clusters 1, 2 and 3, which are lower-intensity (the "Suburban" group), and tracts in clusters 4 and 5, which are medium to high intensity (the "Urban" group).Fig. 4 is a map of the final set of

[2] Land cover measures are derived from the National Land Cover Database: https://www.mrlc.gov/data/nlcd-land-cover-conus-all-years. The National Neighborhood Data Archive is part of the University of Michigan's Inter-university Consortium for Political and Social Research (ICPSR).

[3] We apply the k-means method as implemented in GeoDa version 1.14.



Source: Histogram created using data from The Codes Study, 2019

Fig. 3. Year of FBC adoption Source: Histogram created using data from The Codes Study, 2019.

Table 1
FBCs used in this study, by state

State	No. FBCs
CA	39
FL	32
TX	22
GA	14
VA	13
MI	9
NC	9
IL	8
LA	8
NY	8
KY	7
MO	7
MS	7
NJ	7
SC	7
TN	7
AL	6
PA	6
WA	6
CT	5
AZ	4
AR, MA, OH, OK, OR, UT	3 each
IA, IN, KS, MD, NE, NH, NM, RI	2 each
CO, ID, ME, MN, MT, NV, WI, WV, WY	1 each
Total	274

census tracts included in the study.

To test the FBC valuation laid out in the analytical framework—i.e., the degree to which FBCs can be associated with equity, diversity and density – I use analysis of variance (ANOVA), comparing FBC tracts to the comparative set as described above. The variables I use, and how

Table 2
Land Cover categories used to create clusters

Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
Developed High Intensity	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.

Source: National Land Cover Database, https://www.mrlc.gov/data/nlcd-land-cover-conus-all-years.

Table 3
Cluster Summary

Cluster centers:	Low n*	Med. n*	High n*
C1	0.2008	0.1135	0.0369
C2	0.3149	0.363	0.1065
C3	0.4892	0.192	0.0466
C4	0.1683	0.6352	0.1357
C5	0.1024	0.435	0.3782
C6	0.0216	0.2294	0.7214

* = intensity.
The total within-cluster sum of squares: 21183.9.
The between-cluster sum of squares: 92123.1.
The ratio of between to total sum of squares: 0.81304.

Table 4
Tracts within clusters

Clusters FBC	1	2	3	4	5	6	Total
0	11,019	8,269	6,882	4,640	3,690	2,185	36,685
1	317	280	197	130	137	18	1,079
Total	11,336	8,549	7,079	4,770	3,827	2,203	37,764

they are linked to each dimension, are listed in Table 5. The data are from the Minnesota Population Center (Manson et al., 2020) and, for 2000 normalized tract boundaries and 2020 ACS estimates, the Geolytics Neighborhood Change Database. All data are normalized to 2010 census tract boundaries.

The dependent variable in my analysis is a dummy variable indicating whether the tract is associated with (regulated by) an FBC. All

Fig. 4. Tracts used in the analysis: FBC tracts and surrounding tracts Shown are the tracts used in this analysis. These include tracts regulated by an FBCs, and a comparative set of surrounding tracts. Comparative tracts are within the core-based statistical areas that have an FBC; they also have a minimum threshold of 50 or more households.

Table 5
Independent variables.

Equity	% White, non-Hispanic
	% Black, non-Hispanic
	% Hispanic
	% under 18
	% over 65
	Median income
	Median housing value
	Median rent
	% college education
	Poverty rate
	% rental units
Diversity	Unit type diversity
Density	Population density
	% low density
	% medium density
	% high density

Anova regressions were run for three time periods: 2000, 2010 and 2020[4], as well as change between 2010 and 2020.

The independent variables were selected as indicators of equity, diversity and density. For equity, I look at variables related to income, wealth and housing costs, as well as race, ethnicity and age. For diversity, I focus on the diversity of housing unit types since FBCs are specifically meant to support the mixing of housing types. I use the Simpson Diversity Index to measure variation in unit type per tract, using four housing type variables from the census' "units in structure" variable: 1 unit attached or detached, duplexes, 3–4 units and 5 + units. For density, I look at population density (population of tract divided by land area of tract). I also look at percentages of unit types associated with different densities: low density (single-family detached dwellings), medium density (units in 1 unit attached, duplexes or 3–4 unit

[4] 2020 data is from Geolytics population estimates, with the exception of unit type, which is ACS 2019 (2015–2019 average) obtained from IPUMS/NHGIS (Manson et al., 2020).

structures), and high density (units in structures with 5 or more units).

5. Results

Table 6 shows the significant Anova results for all three decades: 2000, 2010 and 2020 (full results are given in Appendix A). Variables that did not show any significance in any decade are shown in light gray; the only variable that did not show any significance was % over 65. The table shows that FBC tracts had higher percentages of White population in both suburban and urban locations in 2010 and 2020. Percent Black was lower for urban locations in all three decades, but there was no significant difference for Black population in suburban locations. Hispanic population was higher in the year 2000 for both suburban and urban locations, but there were no differences in either location in subsequent decades. Under 18 percentage was lower for FBC tracts in suburban locations in all three decades.

Median income for FBC tracts was lower in suburban locations and higher in urban locations (with the exception of 2000, when median income was lower in both locations). Poverty rates were higher for FBC tracts in both suburban and urban locations in 2000 and again in 2020. Percent college education was higher in suburban locations in 2010 but not in the other decades or locations. Median housing value was lower only in suburban 2000 locations, but not in other time periods or locations. Median rent was consistently lower for FBC tracts in all time periods and locations with the exception of 2020 urban locations.

Table 6
Summary of Significant ANOVA Results

	2000		2010		2020	
	Suburban	Urban	Suburban	Urban	Suburban	Urban
% White, non-Hispanic			+	+	+	+
% Black, non-Hispanic		–		–		–
% Hispanic	+	+				
% under 18	–		–	–	–	
% over 65						
Median income	–	–	–	+	–	+
Median housing value	–					
Median rent	–	–	–	–	–	
% college education			+			
Poverty rate	+	+			+	+
% rental units	+	+	+	+	+	+
Unit type diversity	+		+		+	
Population density		–		–		–
% low density			–			
% medium density		–				–
% high density	+	+	+	+	+	+

Notes:
Full results are given in Appendix A
"Suburban" pertains to clusters 1, 2 or 3; "Urban" pertains to clusters 4 or 5 (see tables 2 and 3)
% low density = % single-family detached housing units
% medium density = % units in structures with 1-4 attached units
% high density = % units in structure with 5 or more units
Unit type diversity based on Simpson diversity index using the following 4 categories derived from the census "units in structure" variable: 1 unit attached or detached, duplexes, 3-4 units, and 5+ units.

Two variables were consistently higher for FBC tracts in all time periods and both locations: percent rental units and % high density housing unit (units in structure with 5 or more units). Interestingly, unit type diversity was significantly higher for FBC tracts in suburban locations only, and in all three decades. Unit type diversity was not different in urban locations.

Finally, population density was lower for FBC tracks in urban locations in all decades. There was no significant difference in suburban locations. The other measure of density I analyzed was housing unit type: single-family detached housing (low), small structures of attached units (medium), and structures with 5 or more units (high). The low and medium density housing was sporadically lower; what is interesting is the sustained level of higher levels of high-density housing forms for FBC tracts, in all time periods and both suburban and urban locations.

Table 7 shows results in terms of change between 2010 and 2020. For FBC tracts, there was significantly more decline in percent White in both suburban and urban locations, and in suburban locations, the percentage of Blacks increased more. Suburban FBC tracts also had more significant increases in terms of children, seniors, income and housing value. The only significant gain for FBC tracts in urban locations was percentage of children. Both locations saw declines in college education percentages between 2010 and 2020. In terms of density, suburban locations saw lower growth of single-family detached housing and more multi-unit (5+) structures, although population density change was not significantly different. FBC tracts in urban locations had a lower rate of medium density building type.

6. Discussion and conclusion

In the quest for sustainable cities, many planners support the idea that a new approach to development regulation is necessary, and form-based codes have emerged as the dominant approach. Locating FBCs and tracking their impact is not a straightforward task, but despite the complexity, it is important to try to understand how and where FBCs are being employed and what their possible effect might be. This study did not evaluate causality, but it did tease out the socio-economic context of FBCs and evaluate how that context might be differentiated. While there

Table 7
Summary of Significant ANOVA Results, change variables

	2010 – 2020 change	
	Suburban	Urban
% change, White, non-Hispanic	–	–
% change, Black, non-Hispanic	+	
% change, Hispanic		
% change, under 18	+	+
% change, over 65	+	
% change, median income	+	
% change, median housing value	+	
% change, median rent		
% change, college education	–	–
% change, poverty rate		
% change, rental units		
% change, unit type diversity		
% change, population density		
% change, low density	–	
% change, medium density		–
% change, high density	+	

Notes:
Full results are given in Appendix A
"Suburban" pertains to clusters 1, 2 or 3; "Urban" pertains to clusters 4 or 5 (see tables 2 and 3)
% low density = % single-family detached housing units
% medium density = % units in structures with 1-4 attached units
% high density = % units in structure with 5 or more units
Unit type diversity based on Simpson diversity index using the following 4 categories derived from the census "units in structure" variable: 1 unit attached or detached, duplexes, 3-4 units, and 5+ units.

is a continual need to assess the impact of FBCs "on the ground" – i.e., understanding the degree to which they are producing better quality urbanism – there is also value in understanding their socio-economic context.

In terms of the goals one might associate with FBCs – equity, diversity and density—the picture is mixed. In terms of the equity metric, FBCs do seem to be a phenomenon associated with places that are Whiter and less Black, although the 2010–2020 trend was that FBC tracts became less White and, in suburban locations, more Black. Further, there is no indication that FBCs are associated with higher wealth and income in a consistent way. Interestingly, median income and median rent were actually *lower* for FBC tracts in suburban locations across all decades—although in terms of percent change (2010–2020), suburban FBC tracts became wealthier at a faster rate. The picture is somewhat different for more urbanized locations, where FBCs had higher income in single decades, but the trend from 2010 to 2020 was not significant. Overall, then, the results suggest that, as of yet, FBCs have not translated to a picture of gentrification and White affluence. Suburban FBC tracts made more gains in terms of housing value and income, but in any given decade median housing value was not higher and median rent was actually lower. To the extent that gentrifying areas have more college educated population, FBC tract data does not support that narrative either.

For the other two metrics – diversity and density, again the significance for FBCs is in lower-intensity places, as there is some support for the conclusion that FBCs are associated with unit type diversity in suburban areas. But while unit type diversity was higher in FBC suburban tracts, it did not appear to be a growing trend. And, there is not strong support that FBC tracts are densifying overall. They are, however, associated with higher levels of multi-unit structures. In suburban areas, the upward trend is significant.

It might be the case the FBCs are having the most impact in locations with lower land use intensity (suburban) as opposed to higher intensity (urban) locations. In suburban locations, FBC tracts are less White, more Black, have more children and more seniors. It is also in suburban locations that FBC tracts are associated with more income growth and housing value. There was no indication that these suburban locations are denser in terms of population density (a key goal of FBCs), but in terms of the form of high density housing, it is significant that FBC tracts had higher percentages of multi-unit structures in all time periods and in both locations. Clearly the trend in FBC tracts is less single-family detached housing and more growth in multi-unit buildings.

Several limitations with the methodological approach of this study should be noted. First, the exclusion of large metropolitan areas in the study limits the generalizability of the results. Perhaps the FBCs of large metropolitan areas are having a different socio-economic impact. Second, the study relies on the Codes Study as the source for codes, which in turn relies on crowd sourcing. This is not a failsafe approach to determining code adoption. Third, the measure of diversity relies on housing unit type, which might not be the best gauge of social diversity. Nor does it include a broader understanding of land use diversity (which would likely require incorporating localized parcel data). Finally, reliance on census tract-level data from the American Community Survey (ACS) is not without limiations, given the high margins of error that have been found in some jurisdictions (Jurjevich et al., 2018).

This is but one study and one methodological approach seeking to determine if FBCs are associated with desirable social outcomes. Future research could vary and improve upon the methodology I employed. For example, the way in which non-FBC tracts are determined could be varied, such as including a wider set of surrounding tracts, or including large metropolitan areas. More could be done to differentiate FBC tracts based on regional location and level of urban intensity. In addition, more research could be done on understanding the appropriate time period to employ in FBC outcomes research. When is change resulting from an approved FBC likely to be visible, and what period of time is needed to understand social and economic impact? While this is likely to be dependent on local economic factors, planners should be ready to investigate social changes that FBCs might be having—preferably as change occurs.

Beyond the social realm, more research is needed on the ground-level impact of FBCs. Existing economic and aggregate analyses are mostly directed at conventional zoning; the linkage between FBCs and urban form should extend beyond case studies to include large-scale quantified analysis that can be generalized. Then, based on results, in-depth case study research is needed to dig deeper into those places where FBCs are correlated with equity, diversity and density. Where are positive impacts being seen and what are the particular political, social and economic conditions associated with such places?

Though rooted in past practices, form-based coding is still a relatively recent idea whose effects remain unknown. FBCs may not yet be accomplishing the equity, diversity and density goals that proponents seek, but neither is it valid to claim they are failing in these regards. Planners are right to be hopeful about zoning reform, but it is also important to be realistic about what FBCs can accomplish and how far they can go in addressing the substantial problems besetting U.S. cities – from the lack of housing affordability to the impacts of climate change. Many believe that cities need to be less wasteful and more efficient, less land consumptive and more compact, less dispiriting and more equitable – and planners are looking to zoning reform to be the driver of that change. In support of meeting those expectations, FBCs should be subjected to regular evaluation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.landurbplan.2021.104182.

References

Ameli, S. H., Hamidi, S., Garfinkel-Castro, A., & Ewing, R. (2015). Do better urban design qualities lead to more walking in Salt Lake City, Utah? *Journal of Urban Design, 20* (3), 393–410. https://doi.org/10.1080/13574809.2015.1041894.

Angotti, T., & Morse, S. (2016). *Zoned Out! Race, Displacement and City Planning in New York City*. New York: Terreform.

Barry, J. M. (2008). Form-based codes: Measured success through both mandatory and optional implementation. *Connecticut Law Review, 41*, 305.

Bauman, Andrew. (2019). Legally Enabling a Modern-Day Mayberry: A Legal Analysis of Form-Based Zoning Codes. Urban Lawyer 50, 1. https://www.americanbar.org/groups/state_local_government/publications/urban_lawyer/2019/50-1/zoning-codes/ Accessed March 1, 2021.

Berg, H. E., & BenDor, T. K. (2010). A case study of form-based solutions for watershed protection. *Environmental Management, 46*(3), 436–451.

Borys, Hazel and Kaid Benfield. (2019). Code Score. http://www.placemakers.com/how-we-teach/code-score-impacts-of-form-based-codes/ Accessed September 10, 2020.

Borys, Hazel, and Emily Talen. (2016). The codes study. Retrieved from http://www.placemakers.com/how-we-teach/codes-study/ Accessed September 10, 2020.

Bronin, Sara C. (2021). Exclusion, Control, and Consequence in 2,622 Zoning Districts. SSRN Scholarly Paper. Rochester, NY: Social Science Research Network. doi: 10.2139/ssrn.3792544.

Inc, C. (2008). *Sustainable Community Development Code: A Code for the 21st Century*. Denver: Rocky Mountain Land Use Institute.

Clarke, Philippa, and Melendez, Robert. (2019). National Neighborhood Data Archive (NaNDA): Land Cover by Census Tract, United States, 2001-2016. Ann Arbor, MI: Inter-university Consortium for Political and Social Research [distributor], 2019-09-11. doi: 10.3886/E110663V1.

Crawford, P. (2004). *Codifying new urbanism*. Chicago: Planners Press.

Denoon-Stevens, S. P., & Nel, V. (2020). Towards an understanding of proactive upzoning globally and in South Africa. *Land Use Policy, 97*, 104708. https://doi.org/10.1016/j.landusepol.2020.104708.

Duany, A., & Talen, E. (2002). Transect planning. *Journal of the American Planning Association, 68*(3), 245–266. https://doi.org/10.1080/01944360208976271.

Duany, Andres, Sandy Sorlien, and William Wright. (2008). The SmartCode version 9 and Manual (www.smartcodecentral.com). Accessed September 20, 2020.

Faga, Barbara. (2014). Formers versus Zoners; How and Why Communities Shift to Form-Based Zoning. https://smartech.gatech.edu/handle/1853/53081.

Feitelson, E. (1993). The spatial effects of land use regulations: A missing link in growth control evaluations. *Journal of the American Planning Association, 59*(4), 461–472.

Freilich, R. H. (2010). *From sprawl to sustainability: Smart growth, new urbanism, green development, and renewable energy*. Chicago: Section of State and Local Government Law, American Bar Association.

Garde, A., & Hoff, A. (2017). Zoning reform for advancing sustainability: Insights from Denver's form-based code. *Journal of Urban Design, 22*(6), 845–865. https://doi.org/10.1080/13574809.2017.1337495.

Garde, A., & Kim, C. (2017). Form-based codes for zoning reform to promote sustainable development: Insights from cities in Southern California. *Journal of the American Planning Association, 83*(4), 346–364. https://doi.org/10.1080/01944363.2017.1364974.

Garde, A., Kim, C., & Tsai, O. (2015). Differences between Miami's form-based code and traditional zoning code in integrating planning principles. *Journal of the American Planning Association, 81*(1), 46–66. https://doi.org/10.1080/01944363.2015.1043137.

Hansen, G. (2014). Design for healthy communities: The potential of form-based codes to create walkable urban streets. *Journal of Urban Design, 19*(2), 151–170. https://doi.org/10.1080/13574809.2013. 870466.

Hirt, S. (2013). Form follows Function? How America zones. *Planning Practice & Research, 28*(2), 204–230. https://doi.org/10.1080/02697459.2012. 692982.

Hughen, W. K., & Read, D. C. (2017). Analyzing form-based zoning's potential to stimulate mixed-use development in different economic environments. *Land Use Policy, 61*, 1–11. https://doi.org/10.1016/j.landusepol.2016.11.010.

Inniss, Lolita Buckner. (2007). Back to the future: Is form-based code an efficacious tool for shaping modern civic life? University of Pennsylvania Journal of Law and Social Change 11: SSRN Electronic Journal. doi: 10.2139/ssrn.962354.

Jurjevich, J. R., Griffin, A. L., Spielman, S. E., Folch, D. C., Merrick, M., & Nagle, N. N. (2018). Navigating Statistical Uncertainty: How Urban and Regional Planners Understand and Work With American Community Survey (ACS) Data for Guiding Policy. *Journal of the American Planning Association, 84*(2), 112–126. https://doi.org/10.1080/01944363.2018.1440182.

Knaap, G., Haccou, H. A., Clifton, K. J., & Frece, J. W. (2007). *Incentives, regulations and plans*. Northhampton, MA: Edward Elgar Publishing.

Krieger, A. (1991). *Towns and town-making principles*. Cambridge, MA: Harvard University Graduate School of Design.

Lawlor, M. (2011). Gaining ground in the final frontier: Surveying legal issues raised by New England's form-based codes. *Urban Lawyer, 43*.

Levine, N. (1999). The effects of local growth controls on regional housing production and population redistribution in California. *Urban Studies, 36*(12), 2047–2068.

Manson, Steven, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. (2020). IPUMS National Historical Geographic Information System: Version 15.0. Minneapolis, MN: IPUMS. 2020. doi: 10.18128/D050.V15.0.

Morris, M. (1996). *Creating transit-supportive land-use regulations*. Chicago: American Planning Association.

Morris, M. (2009). *Smart Codes*. Chicago: Planners Press.

Multi-Resolution Land Characteristics Consortium (2019). National Land Cover Database (CONUS), all years [Data set]. https://www.mrlc.gov/data/nlcd-land-cover-conus-all-years. Accessed February 20, 2020.

Nel, V. (2016). A better zoning system for South Africa? *Land Use Policy, 55*, 257–264. https://doi.org/10.1016/j.landusepol.2016.04.007.

Nelson, A. C. (2013). *Reshaping metropolitan America: Development trends and opportunities to 2030*. Island Press.

New York City Department of City Planning. (2021). New York City Zoning Reference. https://www1.nyc.gov/site/planning/zoning/districts-tools.page.

Nuworsoo, Cornelius, Robert Hananouchi. (2010). Comparison of parking requirements in zoning and form-based codes. Focus, 7 (1). doi: 10.15368/focus.2010v7n1.11.

Park, Y. (2017). Does new urbanist neighborhood design affect neighborhood turnover? *Land Use Policy, 68*, 552–562. https://doi.org/10.1016/j.landusepol.2017.07.013.

Parolek, D. G., Parolek, K., & Crawford, P. C. (2008). *Form based codes: A guide for planners, urban designers, municipalities, and developers*. New York: Wiley.

Pendall, R. (2000). Local land use regulation and the chain of exclusion. *Journal of the American Planning Association, 66*(2), 125–142. https://doi.org/10.1080/01944360008976094.

Pyatok, Michael. (2002). The Narrow Base of the New Urbanists. Progressive Planning Magazine. Spring Issue. http://www.plannersnetwork.org/2002/04/the-narrow-base-of-the-new-urbanists/. Accessed September 10, 2020.

Rangwala, K. (2013). Assessing criticisms of form-based codes. Retrieved from the Better Cities website: http://bettercities.net/article/assessing-criticisms-form-based-codes-19967. Accessed April 15, 2020.

Reps, J.W. (1964). Requiem for Zoning. Planning 1964. Chicago: American Society of Planning Officials.

Sabri, A. K., & Ahmed, K. G. (2019). Replacing land-use planning with localized form-based codes in the United Arab Emirates: A proposed method. *Land, 8*(3), 47. https://doi.org/10.3390/land8030047.

Sampson, R. J., Mare, R. D., & Perkins, K. L. (2015). Achieving the middle ground in an age of concentrated extremes: Mixed middle-income neighborhoods and emerging adulthood. *The Annals of the American Academy of Political and Social Science, 660*, 156–174.

Schnabel, M. A., Zhang, Y., & Aydin, S. (2017). Using parametric modelling in form-based code design for high-dense cities. *Procedia Engineering, 180*, 1379–1387. https://doi.org/10.1016/j.proeng.2017.04.301.

Senbel, M., van der Laan, M., Kellett, R., Girling, C., & Stuart, J. (2013). Can form-based code help reduce municipal greenhouse gas emissions in small towns? The case of Revelstoke, British Columbia. *Canadian Journal of Urban Research, 22*, 1.

Shen, Q. (1996). Spatial impacts of locally enacted growth controls: The San Francisco Bay Area in the 1980s. *Environment and Planning B: Planning and Design, 23*, 61–91.

Sobel, L. S. (2011). *Market acceptance of smart growth*. Washington, D.C.: U.S. Environmental Protection Agency.

Sung, H., Go, D., Choi, C., Cheon, S., & Park, S. (2015). Effects of street-level physical environment and zoning on walking activity in Seoul, Korea. *Land Use Policy, 49*, 152–160. https://doi.org/10.1016/j.landusepol.2015.07.022.

Tagtachian, D. A., Barefoot, N., & Harreveld, A. (2019). Building by right: Social equity implications of transitioning to form-based code. *Journal of Affordable Housing & Community Development Law, 28*(1), 71–115.

Talen, E. (2011). *City rules: How regulations affect urban form*. Washington, DC: Island Press.

Tracy, S. (2004). *Smart growth zoning codes: A resource guide*. Sacramento, CA: Local Government Commission.

Trounstine, J. (2018). *Segregation by design: Local politics and inequality in American Cities*. Cambridge: Cambridge University Press.

Wickersham, J. (2006). *Legal framework: The laws of sprawl and the laws of smart growth*. Westport, CT: Greenwood Press.

Williamson, J., & Dunham-Jones, E. (2021). *Case studies in retrofitting suburbia: Urban design strategies for urgent challenges*. New York: Wiley.

Woodward, K. A. (2013). Form over use: Form-based codes and the challenge of existing development. *Notre Dame Law Review., 88*, 2627–2654.

Zhang, Y., & Schnabel, M. A. (2018). Parametric thinking in form-based code evaluation. *International Journal of Environmental Science & Sustainable Development, 3*(2), 89. https://doi.org/10.21625/essd.v3iss210.21625/essd.v3iss2.37910.21625/essd.v3i2.379.s117.