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MIDDLE-CLASS AFFORDABILITY OF BROADBAND:
AN EMPIRICAL LOOK AT THE THRESHOLD QUESTION

Abstract: To receive subsidies to expand broadband to unserved areas under the "Broadband Equity, Access, and Deployment" ("BEAD") program provided by the Infrastructure Investment and Jobs Act of 2021, the National Telecommunications and Information Administration ("NTIA") requires states to implement plans to ensure middle-class affordability. Since the NTIA did not conclude that broadband was unaffordable for middle-class households, the threshold question is whether broadband is affordable to the middle-class. The purpose of this BULLETIN is to answer that question, and to do so in a way that respects Congressional intent expressed in the Infrastructure Act. Affordability, which has no formal definition, is defined by reference to adoption. An analysis of broadband adoption rates by income groups, both nationally and for individual states, suggests that broadband is at present affordable for middle-class households. Until affordability is a concern, no direct intervention is required, though states might monitor affordability over time to comply with the NTIA's requirement.

I. Background

The Infrastructure Investment and Jobs Act of 2021 allocated nearly $43 billion in subsidies to expand broadband networks to unserved and underserved areas via the "Broadband Equity, Access, and Deployment" ("BEAD") program.[1] These BEAD funds are to be administered and allocated by the National Telecommunications and Information Administration ("NTIA").[2] To this end, in May 2022, NTIA released its *Notice of Funding Opportunities* ("*NOFO*") which set forth

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[1] Public Law 117–58.

[2] *See* Infrastructure Act at Section 60102(b).

the processes, deadlines, and expectations for the BEAD program.[3] Yet, rather than conduct a straightforward process, the NTIA imposed several conditions to qualify for BEAD funding beyond those required by the statute,[4] drawing the ire of several U.S. Senators.[5]

One of NTIA's extra-statutory conditions is a requirement that states (i.e., "Eligible Entities") craft "a middle-class affordability plan to ensure that *all* consumers have access to *affordable* high-speed internet."[6] While NTIA's middle-class affordability requirement smells of *de facto* price regulation,[7] the NTIA permits states to "adopt diverse strategies to achieve this objective" so long as the end result ultimately ensures that "high-quality broadband services are available to all middle-class families in the BEAD-funded network's service area at reasonable prices."[8] Notably, the *NOFO* does not conclude that broadband service is unaffordable for the middle-class, only that states must plan for such a scenario. To comply with the *NOFO's* requirement, therefore, the most obvious approach is for a state to have a plan to ensure that service is affordable to the middle-class in BEAD-funded deployments to unserved areas. However, if a state is interested in evaluating middle-class affordability throughout its jurisdiction, then it will want to look at how middle-class adoption compares to other groups. If broadband service is found to be "affordable" for the middle-class generally, then no immediate action is required. Monitoring of affordability thus may serve as an initial "plan" on middle-class affordability, with a plan to review the situation if broadband service ever is deemed unaffordable based on objective criteria.

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[3]   *Notice of Funding Opportunity*, BROADBAND EQUITY, ACCESS, AND DEPLOYMENT PROGRAM, NTIA (May 13, 2022) (available at: https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf) at p. 66 (emphasis in original).

[4]   Apparently, the Biden Administration learned little from the muddle the Obama Administration made of the Broadband Technology Opportunity Program ("BTOP") in 2009 by imposing onerous net neutrality requirements that discouraged participation by the nation's most successful broadband providers and led to the waste of billions in subsidy dollars. T.R. Beard, G.S. Ford and M. Stern, *Bridging the Digital Divide: An Empirical Analysis of Public Programs to Increase Broadband Adoption*, 67 TELEMATICS AND INFORMATICS (February 2022) (available at: https://www.sciencedirect.com/science/article/abs/pii/S0736585321001933?via%3Dihub) (originally published as PHOENIX CENTER POLICY PAPER NO. 56: *Bridging the Digital Divide: What Has Not Worked But What Just Might*).

[5]   *Letter to Secretary Raimondo* (August 18, 2022) (available at: https://www.romney.senate.gov/wp-content/uploads/2022/08/letter_to_secraimondobeadnofoaug182022.pdf).

[6]   *NOFO, supra* n. 3 at p. 66 (emphasis in original).

[7]   *See generally,* L.J. Spiwak, *USTelecom and its Aftermath*, 71 FEDERAL COMMUNICATIONS LAW JOURNAL 39 (2019); G.S. Ford and L.J. Spiwak, *Tariffing Internet Termination: Pricing Implications of Classifying Broadband as a Title II Telecommunications Service,* 67 FEDERAL COMMUNICATIONS LAW JOURNAL 1 (2015).

[8]   *NOFO, supra* n. 3 at 66. Under Section 60102(i)(D), NTIA is expressly prohibited from regulating the rates charged for broadband service facilitated by the Infrastructure Act.

In this BULLETIN, I address the issue of state programs for middle-class affordability. With neither a formal definition of "middle-class" or "affordability" provided by the NITA—or any other government agency—affordability is defined here as the adoption rate of lower-income households that do not qualify for the Affordable Connectivity Program ("ACP"),[9] thus linking my analysis to Congressional intent expressed in the Infrastructure Act. If the broadband adoption rate of the middle-class exceeds the adoption rate Congress implicitly deemed "affordable" by withholding subsidies, then a state need not engage in immediate intervention to address middle-class affordability. Nonetheless, to follow the NTIA's demands, the states are encouraged to develop a plan to regularly evaluate affordability. If intervention is required (now or later), then states should recognize that the cost of deploying a network is linked directly to regulatory interventions, raising the subsidy requirements for network deployment (to compensate for the *de facto* price regulation) and thus reducing the marginal effectiveness of available subsidy dollars at shrinking the Digital Divide.

II. Conceptual Framework

It is well established that broadband service is a normal good—adoption is positively related to income. Lower-income households have significantly lower adoption rates, and this fact almost certainly influenced Congress to establish the Affordable Connectivity Program to make broadband "affordable."[10] The ACP provides a $30 monthly subsidy to eligible lower income households and $75 for households in tribal areas. According to the Infrastructure Act, the income threshold for ACP eligibility is 200% of the poverty level,[11] an *income*-threshold encompassing nearly 30% of all households (see Table 2, *infra*).[12] Most broadband providers offer low-priced ACP-compliant plans, meaning broadband is essentially free to eligible households (at least from a financial perspective).[13]

To comply with the *NOFO*'s middle-class affordability requirement, definitions of "middle-class" and "affordability" are critical to policy formulation. Yet, neither "middle-class" nor "affordable" have formal definitions and the *NOFO* is silent on this matter. Thus, states must first define such terms. Several definitions of "middle-class" are plausible and income data exists to devise one. Defining "affordability," on the other hand, is more difficult. Affordability sensibly relates to adoption—people buy things they want if they can afford them, and, of course,

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[9] *See generally, In the Matter of Affordable Connectivity Program, Emergency Broadband Benefit Program,* FCC 22-2, REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING, __ FCC Rcd. __ (rel. January 21, 2022).

[10] Details of the ACP program are available at: https://www.usac.org/about/affordable-connectivity-program.

[11] Infrastructure Act at Section 60502(b)(1)(A)(i)(I).

[12] Other eligibility criteria sweep in even more households.

[13] *See generally,* G.S. Ford, *EBB, Lifeline, and ACP: Some Guidance,* PHOENIX CENTER POLICY PERSPECTIVE NO. 22-01 (January 13, 2022) (available at: https://www.phoenix-center.org/perspectives/Perspective22-01Final.pdf).

people do not buy things they do not want whether they can afford them or not. Thus, adoption statistics may serve as a useful, if imperfect, benchmark of affordability, and some sort of benchmark (either price or adoption) is required for a definition of "affordable."

In setting the ACP income threshold, Congress established an income boundary at which broadband adoption was "too low," presumably because it was unaffordable. At the same time, Congress decided that broadband adoption at incomes just above the threshold was not "too low," implying broadband was affordable at these income levels. This logic forms the foundation of my analysis of middle-class affordability. That is, if an adoption rate of A^* implies affordability, then if adoption by some relevant group equals or exceeds A^* broadband must be deemed "affordable" for that group.

To assess middle-class affordability, I define three income classes: (1) lower income (g_L); (2) middle income (g_M); and (3) high income (g_H). The low income group is divided into two parts: (1) lower income households eligible for ACP (g_{L1}); and (2) lower income households ineligible for ACP (g_{L0}). Each group has a mean adoption rate: A_{L1}, A_{L0}, A_M, and A_H. Within the lower-income group, the statute implies A_{L1} (that is, the adoption rate of lower-income, ACP-eligible households) is "too low" and thus that broadband is unaffordable, whereas for A_{L0} broadband is affordable since no subsidies or other interventions for this group were provided in the Infrastructure Act. We may (or must) infer that Congress did not believe the adoption rate for this group was sufficiently low to warrant a subsidy, thus we may define $A_{L1} = A^*$, the threshold adoption rate that established "affordability." The relevant condition for immediate action on middle-class affordability is, therefore, $A_{L0} < A_M$. Using data on internet adoption and income levels, this condition may be evaluated, both nationally and for individual states, using available data.

III. Data

Data on internet adoption and income levels are obtained from the 2016-2020 American Community Survey ("ACS").[14] Income is measured using household income in 2020 dollars. Since the ACP funds both fixed and mobile connections, Internet adoption is measured as fixed or mobile internet adoption, excluding dialup services. The data also include household size, which can be broken into adult and child members. For 2020, poverty-level income is $12,760 for a single person plus an additional amount of income per additional person of $4,480.[15] ACP-eligible income is twice the poverty level, though there are other qualifications correlated with,

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[14]   Data available at: https://www.census.gov/data/developers/data-sets/acs-5year.html.

[15]   *2020 Poverty Guidelines*, Health and Human Services (January 17, 2020) (available at: https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/prior-hhs-poverty-guidelines-federal-register-references/2020-poverty-guidelines).   The 2022 Thresholds for ACP eligibility are available at: https://www.affordableconnectivity.gov/do-i-qualify.

but not the same as, income. The final sample is restricted to households of eight persons or less (99.7% of the full sample) and any observation with a non-positive income is excluded (1.2% of the full sample). The final sample includes 5,928,225 observations: a very large sample. Throughout this analysis, descriptive statistics are weighted by the ACS-provided household weight.

IV. Defining Income Groups

While the *NOFO* asks for states to evaluate middle-class affordability, the document provides no definition of either "middle-class" or "affordability." As an alternative, it might seem sensible to look to the Census Bureau for a definition, but the Census Bureau also has no formal definition of middle income.[16] In various reports, the Bureau uses different income thresholds when it describes the "middle-class," including setting the lower bound of middle income at 400% of the poverty level.[17] With ACP eligibility at 200% of the poverty level, defining the middle-class as starting at 400% of the poverty level creates a group of lower-income households that are ACP-ineligible (g_{L0}, as defined above); other definitions of income groups may do the same.

A frequently cited definition of the middle-class is by the Pew Foundation, where middle income (adjusted for household size) is bounded by two-thirds to twice median income.[18] I adopt the Pew Foundation's general approach here. Income is measured as household income (in 2020 dollars). To address the non-linearity in income requirements and household size, I employ the Census Bureau's equivalency adjustment to construct an adjusted household size variable.[19] The median income for a single-person household is defined as the sample median of income divided by the sample median of adjusted household size, which is then multiplied by adjusted household size for each observation and a state-level cost-of-living index to established the

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[16] *Narrative on Income Inequality (Middle Class)*, Census Bureau (September 2010) ("The Census Bureau does not have an official definition of the `middle class,' but it does derive several measures related to the distribution of income and income inequality.") (available at: https://www.census.gov/topics/income-poverty/income-inequality/about/middle-class.html).

[17] *See*, *e.g.*, N. Bennett, D. Hays, and B. Sullivan, *The Wealth of Households: 2019*, P70BR-180 (July 2022) (available at: https://www.census.gov/content/dam/Census/library/publications/2022/demo/p70br-180.pdf); *Frequently Asked Questions Related to the Poverty Guidelines and Poverty*, Assistant Secretary for Planning and Evaluation (last visited September 20, 2022) (available at: https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines/frequently-asked-questions-related-poverty-guidelines-poverty); K. Burns, L. Fox and D. Wilson, *Child Expansions to Child Tax Credit Contributed to 46% Decline in Child Poverty Since 2020*, Census Bureau (September 13, 2022) (available at: https://www.census.gov/library/stories/2022/09/record-drop-in-child-poverty.html).

[18] R. Kochhar, R. Fry, and M. Rohal, *The American Middle Class is Losing Ground* (December 9, 2015) (available at: https://www.pewresearch.org/social-trends/wp-content/uploads/sites/3/2015/12/2015-12-09_middle-class_FINAL-report.pdf).

[19] *Equivalence Adjustment of Income*, Census Bureau (last visited September 20, 2022) (available at: https://www.census.gov/topics/income-poverty/income-inequality/about/metrics/equivalence.html).

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boundaries of the middle-class group.[20] ACP threshold income levels are defined as 200% of the poverty level. While there are other qualifications for the ACP, they are ignored here since the focus is on income, and qualifications such as "Veteran Pension and Survivor Benefit" need not be related to income.[21] The results are summarized in Table 1.

Table 1. Income Groups

Household Size	ACP Threshold	Lowest Income	Middle Income	Highest Income
1	< 25,546	30,802	30,802 – 91,945	> 91,945
2	< 34,516	43,729	43,729 – 130,536	> 130,536
3	< 43,488	61,114	61,114 – 182,428	> 182,428
4	< 52,458	71,180	71,180 – 212,476	> 212,476
5	< 61,440	81,633	81,633 – 243,679	> 243,679
6	< 70,426	93,040	93,040 – 277,732	> 277,732
7	< 79,431	105,566	105,566 – 315,122	> 315,122
8	< 88,468	117,613	117,613 – 351,083	> 351,083
Share	26.8%	35.9%	49.3%	14.8%

A few things in the table are worth mentioning. First, the middle-income group accounts for approximately half the population, which makes sense and comports with other research. Second, the upper bound on middle income is quite large for larger households, reaching $351,000 for eight-person households. Third, the ACP-income eligibility threshold does not cover all households in the lowest income group—9.2% of lower-income households (as defined here) do not qualify for the ACP subsidy based on income. As such, the relevant adoption variables—primarily A_{L0} and A_M—may be calculated from the data.

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[20] Cost of living data available at: https://www.bea.gov/data/prices-inflation/regional-price-parities-state-and-metro-area.

[21] The relevant condition for "no immediate action" is still satisfied if these additional qualifications are included.

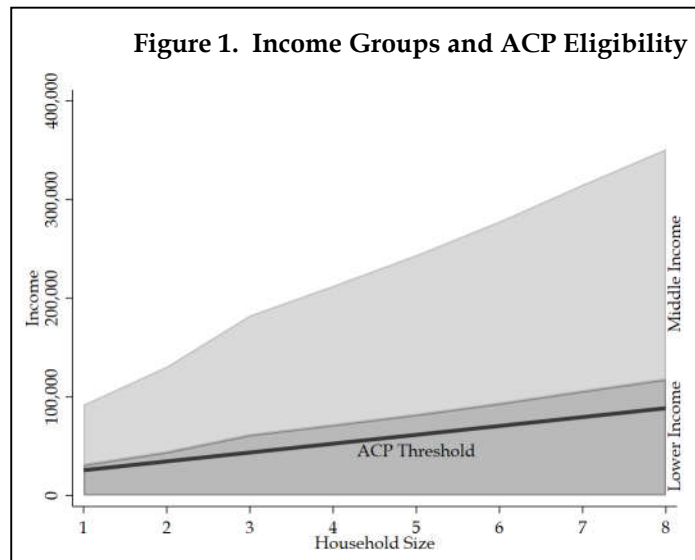**Figure 1. Income Groups and ACP Eligibility**

Figure 1 illustrates the range of incomes and ACP-eligible incomes by household size. No middle-income households are eligible for the program based on income. Yet, as shown in the figure and confirmed by Table 1, there are lower income households that do not qualify for the ACP subsidy. (In the figure, these households are those in the dark shaded area but above the ACP Threshold line.) This group provides the benchmark adoption differential that Congress deemed sufficiently small not to warrant a subsidy ($A_{L0} = A^*$).
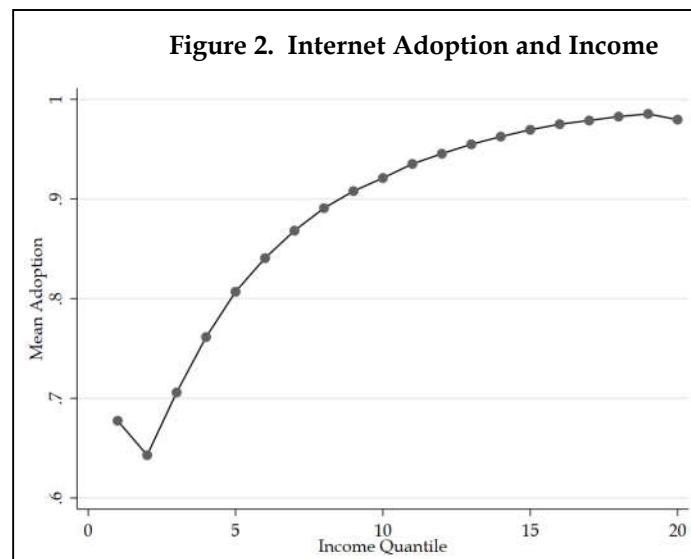
Figure 2. Internet Adoption and Income

Internet adoption is a normal good, so income and adoption are positively and nearly monotonically related. Figure 2 illustrates the relationship between mean internet adoption and twenty quantile groupings of income. The relationship between adoption and income is non-linear and adoption and income are monotonically related over much of the range of income. Plainly, adoption rates are lower at low incomes, presumably motivating Congress to establish and fund the ACP. In large part, Figure 2 suggests that the relevant condition for immediate state action on middle-class affordability will be satisfied—adoption in the lowest-income group ineligible for the ACP will fall below that of the middle-income group.

V. Analysis

The empirical analysis is straightforward. Adoption rates for each group—A_{L0}, A_{L1}, A_M, and A_H—are computed. These mean adoption rates are summarized in Table 2 along with (weighted) sample size shares. Lower-income, ACP-eligible households have an adoption rate of 75.1% (including home and mobile adoption), which is materially lower than the other income groups. Nearly one-third of households qualify for the ACP, a huge share. Lower-income, ACP-ineligible households have an adoption rate of 87.0%, which is much higher than the ACP-eligible group. The adoption rate for middle-income households is quite high and only about four percentage points below that of the high-income group.

Table 2. Adoption by Income Group

Group	Adoption	Sample Share
Lower Income, ACP Eligible (g_{L1})	0.751	0.267
Lower Income, ACP non-Eligible (g_{L0})	0.870	0.092
Middle Income (g_M)	0.929	0.493
High Income (g_H)	0.973	0.148

As discussed above, the adoption rate of the lowest income households in the U.S. was sufficiently low for Congress to establish the ACP to subsidize adoption for this group. But, the higher adoption rates for some lower-income households (87%) was not found sufficiently low to warrant a subsidy (and is quite high), implying that at these income levels Congress decided broadband service was affordable and no costly policy interventions were required. An adoption rate of about 87% sets a boundary on adoption differentials that warrant a policy intervention by the states. Recall from above that if $A_M > A^*$ (where $A^* = A_{L0}$) then affordability is presumed, and no immediate state action is required to address middle-class affordability, though continued evaluation of adoption rates is encouraged to comply with the NTIA's requirements. From Table 2, we see this condition is easily satisfied: 0.929 > 0.870. A statistical test of equal adoption between the two groups is rejected at the 1% level. These data are national, however, and it is states that must address middle-class affordable, so I turn next to a state-level analysis.

VI. State-by-State Analysis

States must formulate middle-class affordability plans, so it is worth analyzing the adoption condition individually for each state. If the condition $A_M > A^*$ is satisfied, then no immediate state action is required as affordability is implied. States should continue to monitor adoption rates each year as new data becomes available.

State	Lower Income, No ACP $(A_{LO}=A^*)$	Middle Income (A_M)	Spread	State	Lower Income, No ACP $(A_{LO}=A^*)$	Middle Income (A_M)	Spread
Alabama	0.824	0.898	0.074*	Montana	0.850	0.911	0.061*
Alaska	0.932	0.936	0.004*	Nebraska	0.882	0.924	0.042*
Arizona	0.876	0.938	0.062*	Nevada	0.870	0.926	0.055*
Arkansas	0.830	0.883	0.053*	New Hampshire	0.882	0.952	0.071*
California	0.900	0.951	0.051*	New Jersey	0.871	0.944	0.073*
Colorado	0.904	0.951	0.046*	New Mexico	0.820	0.889	0.069*
Connecticut	0.853	0.933	0.080*	New York	0.866	0.932	0.065*
Delaware	0.876	0.934	0.058*	North Carolina	0.859	0.923	0.064*
Dist. of Columbia	0.770	0.923	0.153*	North Dakota	0.866	0.923	0.057*
Florida	0.884	0.938	0.054*	Ohio	0.853	0.920	0.067*
Georgia	0.864	0.928	0.064*	Oklahoma	0.839	0.902	0.064*
Hawaii	0.897	0.936	0.039*	Oregon	0.903	0.947	0.043*
Idaho	0.898	0.927	0.028*	Pennsylvania	0.827	0.921	0.094*
Illinois	0.861	0.927	0.066*	Rhode Island	0.868	0.943	0.075*
Indiana	0.850	0.907	0.057*	South Carolina	0.833	0.914	0.081*
Iowa	0.859	0.914	0.055*	South Dakota	0.860	0.920	0.060*
Kansas	0.869	0.919	0.050*	Tennessee	0.839	0.908	0.069*
Kentucky	0.852	0.911	0.059*	Texas	0.864	0.929	0.065*
Louisiana	0.831	0.900	0.069*	Utah	0.923	0.962	0.038*
Maine	0.866	0.930	0.065*	Vermont	0.850	0.933	0.083*
Maryland	0.869	0.942	0.073*	Virginia	0.857	0.926	0.069*
Massachusetts	0.873	0.947	0.074*	Washington	0.907	0.954	0.047*
Michigan	0.856	0.920	0.064*	West Virginia	0.816	0.890	0.075*
Minnesota	0.871	0.934	0.064*	Wisconsin	0.845	0.921	0.076*
Mississippi	0.836	0.871	0.035*	Wyoming	0.871	0.927	0.055*
Missouri	0.863	0.916	0.054*	Average	0.862	0.925	0.062*

Table 3. State-by-State Analysis

* Stat. Sig. 1%

Table 3 summarizes the state-specific results for adoption rates for the two relevant groups and the difference between them.[22] If the spread is positive, then the condition for "no immediate action" is satisfied. In all states the adoption rate of middle-income households exceeds that of

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22 The condition for no immediate intervention is satisfied in all states for fixed broadband.

unsubsidized lower-income households. Thus, the condition is satisfied and affordability, at least by statutory standards, is satisfied for middle-class households.

VII.   Conclusion

To receive subsidies to expand broadband to unserved areas, the NTIA requires states to implement plans to ensure middle-class affordability. Since the NTIA did not conclude that broadband was unaffordable for middle-class households, the threshold question is whether broadband is affordable to the middle-class. The purpose of this BULLETIN is to answer that question, and to do so in a way that respects Congressional intent expressed in the Infrastructure Act. Affordability, which has no formal definition, is defined by reference to adoption, which is sensible. An analysis of broadband adoption rates by income groups, both nationally and for individual states, suggests that broadband is now affordable for middle-class households.

In implementing a middle-class affordability plan, states are encouraged to employ this analysis (or something like it), which is straightforward and relies on publicly-available data. When new data are released, the analysis can be reproduced with the new data to determine whether affordability is a concern. If affordability problems for middle-class households becomes a problem, then states may consider solutions. Until affordability is a concern, however, no direct intervention is required.