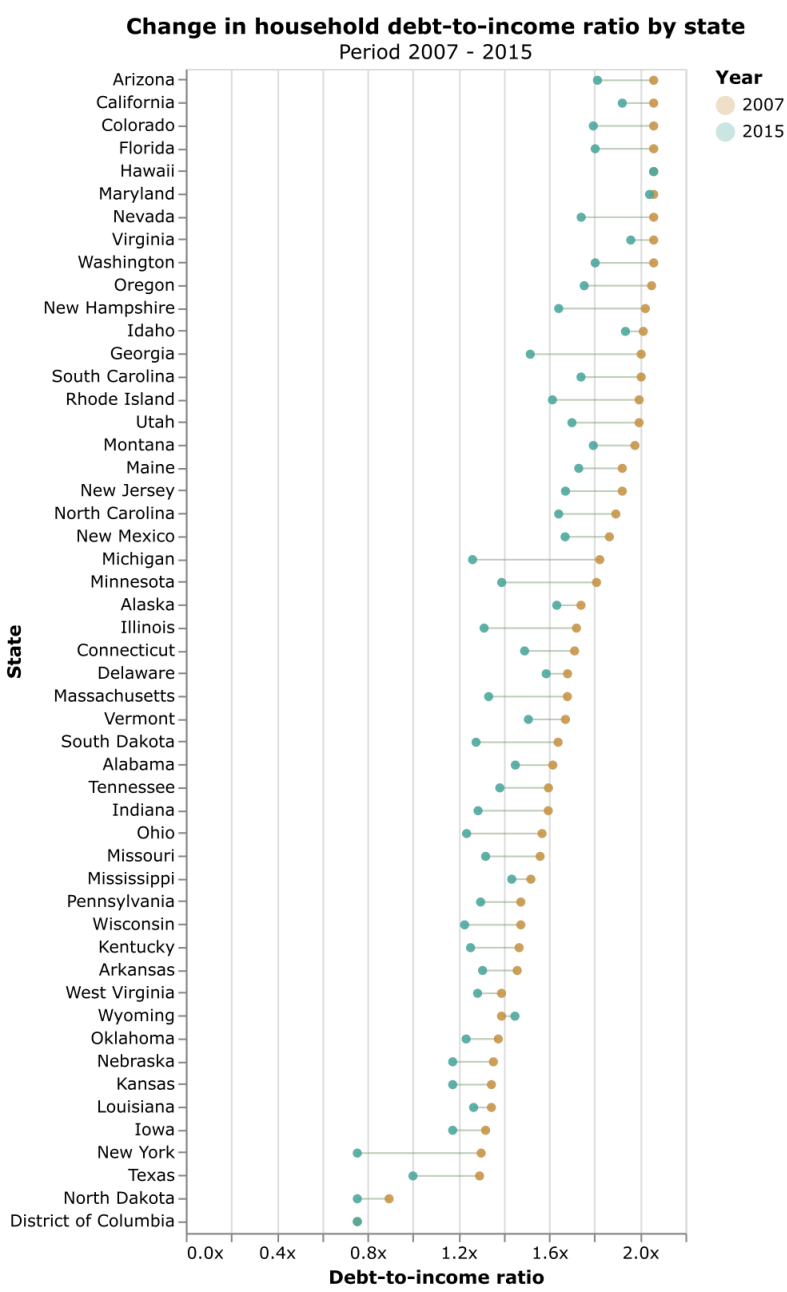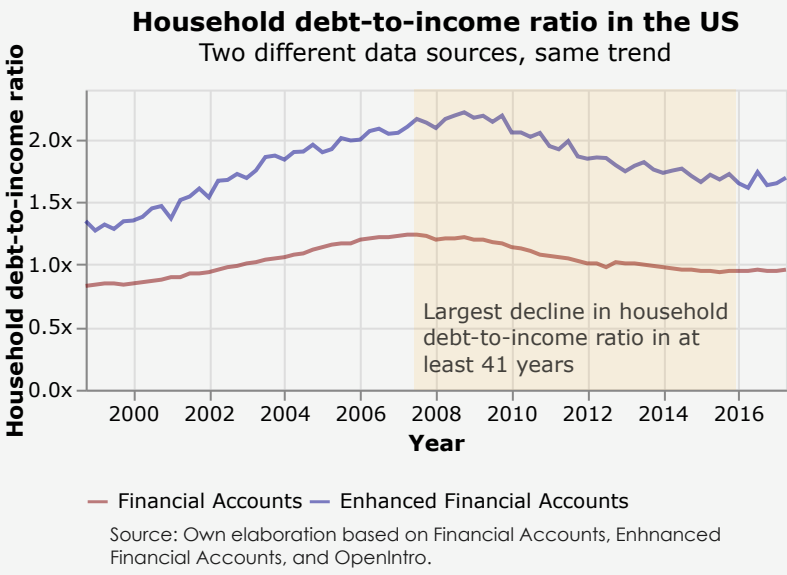# Analyzing the reduction of the debt-to-income ratio in the United States between 2007 and 2015 at the state and county level

By Miguel Pérez

After a long period of a constant increase in the debt-to-income ratio in the US that goes back at least since 1983, following the Great Recession American households reduced their debt-to-income ratio importantly, from a peak of 1.24x in 2007 to 0.94x in 2015 (based on the Financial Accounts data).

This fact raises the questions of how this reduction was at a more granular level and if the heterogeneity behind this debt decrease had socio-economical differentiation and impacts.

Household debt-to-income ratio in the US
Two different data sources, same trend

Largest decline in household debt-to-income ratio in at least 41 years

— Financial Accounts — Enhanced Financial Accounts

Source: Own elaboration based on Financial Accounts, Enhanced Financial Accounts, and OpenIntro.

Change in household debt-to-income ratio by state
Period 2007 - 2015

Source: Own elaboration based on Enhanced Financial Accounts.

Significant differences in debt-to-income ratios by state

A first approach to see a more granular impact is to analyze the data at the state level. The data with granularity at a state and county level is available at the Enhanced Financial Accounts dataset, which has different criteria than the Financial Accounts dataset resulting in larger debt-to-income ratios (as observed in the graph above).

As it can be seen in the graph on the left, there were important differences at the state level both in the base level of debt in its average peak in 2007 and in its change from 2007 to 2015.

Regarding the base levels at a state level in 2007, the range of the debt-to-income ratios goes from 0.8x to 2.6x. There were 14 states with a debt-to-income ratio higher than 2.0x, with states like Arizona, California, Colorado, and Florida having a ratio of 2.6x or higher. On the other side, there were 15 states with ratios lower than 1.5x, led by the District of Columbia (a district considered in the dataset, 0.8x), North Dakota (0.9x), Texas (1.3x), and New York (1.3x).

Regarding the change in those ratios from 2007 to 2015, the range of change among states goes from a reduction of -0.6x to an increase of 0.1x, with 48 states reducing their debt-to-income ratios, and 12 states having a reduction larger than 0.3x.

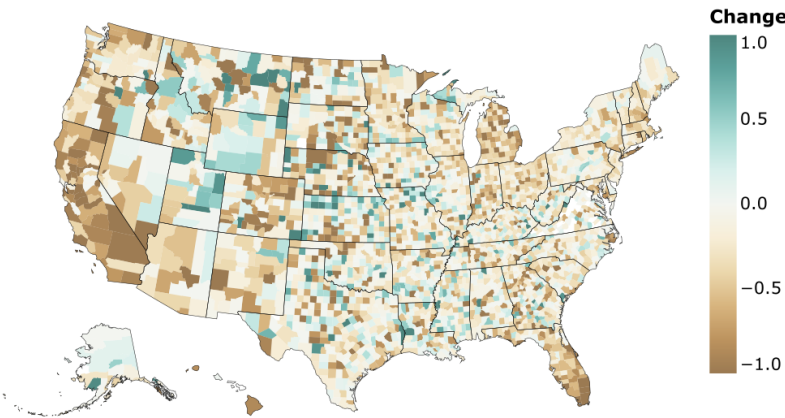# The data shows a huge disparity in the level and in the change of the debt-to-income ratio among counties

Household debt-to-income ratio by county

Year 2007

Year 2015
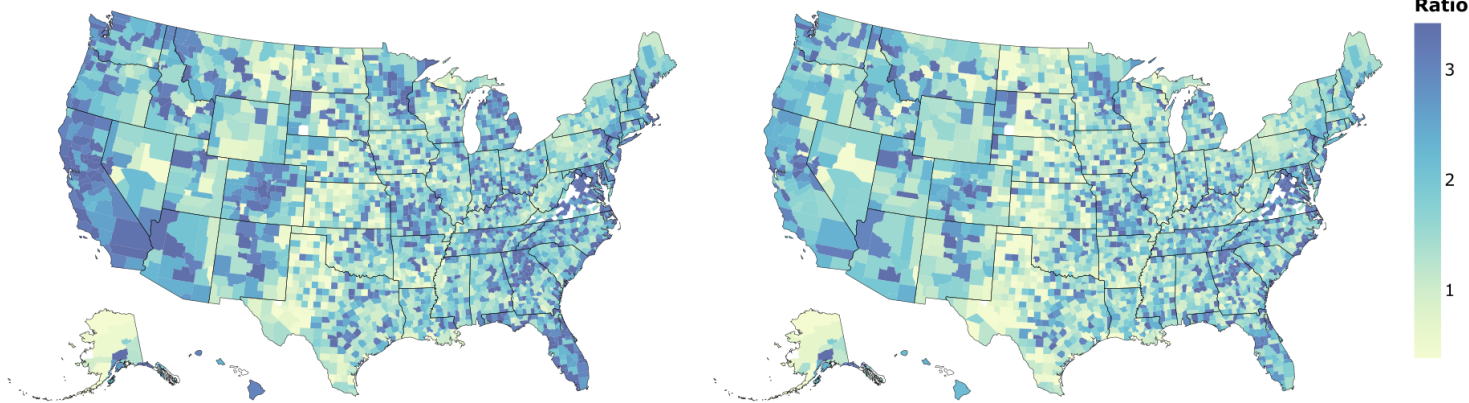
Change in debt-to-income ratio by county
Period 2007 - 2015

Source: Own elaboration based on Enhnanced Financial Accounts.

Even larger differences by county level

The analysis of the county-level data (after removing outliers, more on this in the Appendix) illustrates further the widespread variation of this change.

As it can be seen in the histogram on the right, while the national mean of the change in the debt-to-income ratio is -0.22x, 6.6% of the counties had a reduction larger than 0.8x, 21.5% of the counties reduced their ratios between 0.4x and 0.8x, and 24.3% of the counties faced an increase in their debt-to-income ratios.

Geographical correlations by region

Looking at the county data we can see that base levels and changes in debt-to-income ratios are even more widespread in the US. With a glance at the geographical distribution, it is direct to see that (in general) counties on both coasts started with a larger debt-to-income ratio in 2007 (with multiple ratios of 2x and even 3x), while multiple counties in the middle of the country began with lower levels of debt (around 1x or lower).
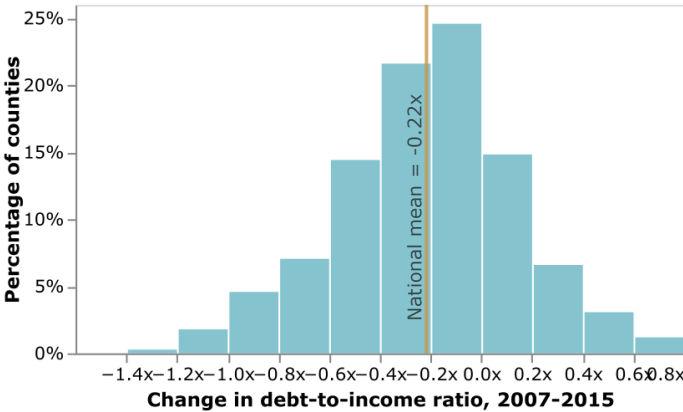
We can also see an overall reduction from this geographical perspective, which is more concentrated on the West Coast and Florida, areas that, as mentioned before, had higher base debt-to-income ratios.

### Distribution of change in debt-to-income ratios

Source: Own elaboration based on Enhnanced Financial Accounts and OpenIntro.

In the context of this large variation both in base levels and change in their debt-to-income ratios, one question that arises is if counties with higher base levels had a higher reduction in their ratios.
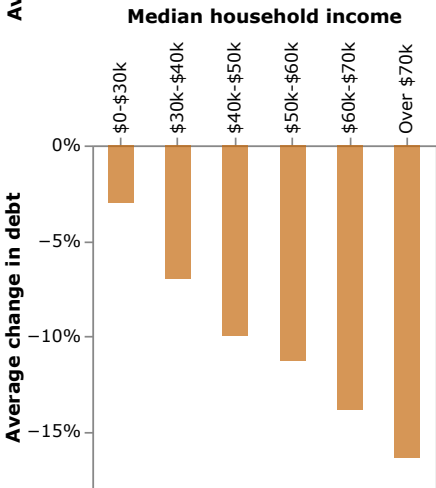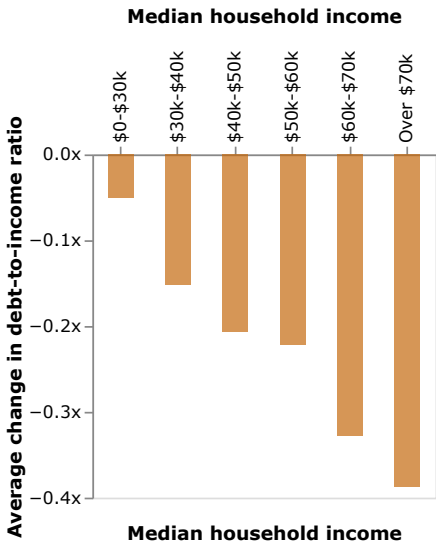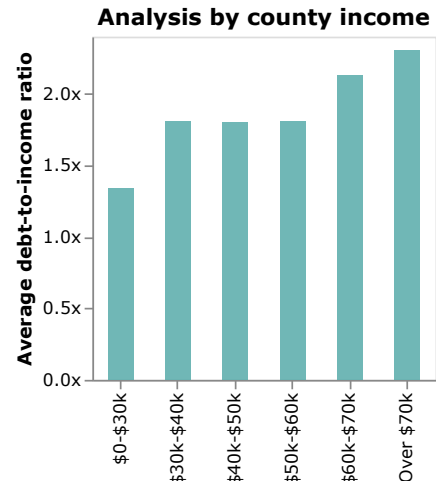
The heatmap on the left provides evidence of a strong correlation between a higher base ratio and its decrease between 2007 and 2015.

Counties by debt-to-income ratio and its change
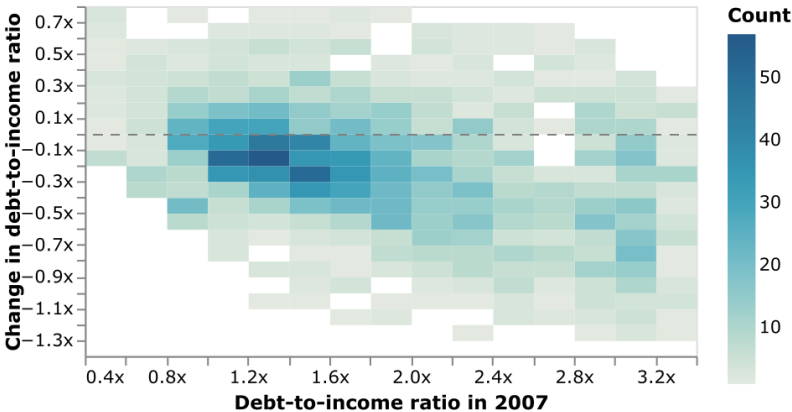
Source: Own elaboration based on Enhnanced Financial Accounts and OpenIntro.

These changes in debt-to-income ratios were handled more by richer counties, with no correlation with socioeconomic impacts

Analysis by county income

Average debt-to-income ratio vs **Median household income**

Average change in debt-to-income ratio vs **Median household income**

Average change in debt vs **Median household income**

Source: Own elaboration based on Enhnanced Financial Accounts and OpenIntro.

What about income heterogeneity?

Another question is how was the relationship between socioeconomic level and this trend in debt-to-income ratios. In the bar plots from the left it can be observed, firstly, that average base levels of debt-to-income ratios in 2007 were larger in wealthier counties: while counties with income between $0 to $30,000 had a base ratio of 1.3x, counties with income over $70,000 had a base ratio of 2.3x.
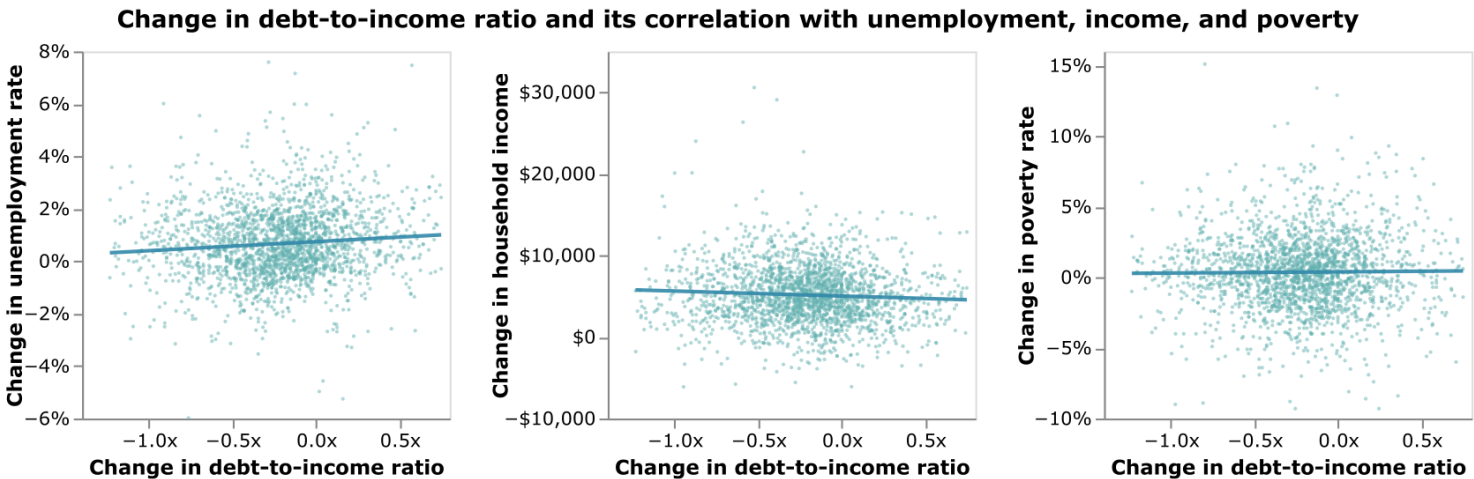
But whose counties had a higher reduction in their debt levels? As it can be seen, both measured in the reduction in debt-to-income ratios or in percentual reductions in debt, richer counties had a higher reduction in debt. For example, while counties with income between $0 to $30,000 had a ratio reduction of -0.05x, associated with a decrease of 3.0% of its base debt, the counties with income over $70,000 had a ratio reduction of -0.39x, associated with a decline of 16.4% of its base debt.

No evidence of an impact of debt changes on unemployment, income, and poverty

A final point for this document is to see if there is any correlation between the huge variation in debt-to-income ratios and other socioeconomic outputs, such as unemployment rates, household incomes, and poverty rates.

The graphs below show evidence that (i) counties with a larger reduction in debt-to-income had a not statistically significant smaller increase in their unemployment rates, and (ii) there is no clear correlation between the change in the debt-to-income ratios and poverty change or income variation in the period.

In other words, it seems from the data at a county level that important reductions in debt (with its corresponding monetary restriction) were not negatively correlated with these 3 socioeconomic outputs.

Change in debt-to-income ratio and its correlation with unemployment, income, and poverty

Change in unemployment rate vs **Change in debt-to-income ratio**

Change in household income vs **Change in debt-to-income ratio**

Change in poverty rate vs **Change in debt-to-income ratio**

Source: Own elaboration based on Enhnanced Financial Accounts and OpenIntro.

Data Management and Sources

Appendix about Data Management

Due to confidentiality, the County-Level and State-Level Household Debt-to-Income Ratio database is in ranges instead of specific values. Particularly, each county and state has a range between a minimum and a maximum value related to its debt-to-income ratio.

The analysis presented in this document uses the average of the middle point of the range for 12 consecutive quarters to have a more precise metric for the debt-to-income ratio and its variation across time.

Additionally, some counties are excluded from the analysis because (i) their change in debt-to-income ratios is limited by the range system of the database, or (ii) they have extreme values probably due to problems in the sampling of the data.

In this context, the criteria for a county to be considered as an outlier is the following:
- Counties with a population under 7,000 (those counties represent 0.56% of the total population of the United States).
- Base debt ratio (2007) over 3.3x (its change is limited by the range system of the original database).
- Base debt ratio (2007) below 0.5x (its change is limited by the range system of the original database).
- Increase of the debt-to-income ratio (from 2007 to 2015) higher than 0.75x (this represents 0.9% of the counties of the database).
- Decrease of the debt-to-income ratio (from 2007 to 2015) lower than 1.25x (this represents 1.2% of the counties of the database).

Using these criteria keeps counties of the dataset that represent 85.3% of the total population in the United States. It is worth noting that the results from the analysis remain the same if these outliers are not excluded from the data, this has been done mainly with the objective for the graphs to be clearer about the overall message of the document.

Sources

The main data source for this project comes from the data on household debt-to-income ratios at the state and county level provided by the Enhanced Financial Accounts project (EFA). That data was obtained from https://www.federalreserve.gov/ and is used in all the data analysis through the project.

The secondary sources for this project are:

- The aggregated household debt-to-income ratios at the national level, from the Financial accounts of the United States. Data obtained from https://www.federalreserve.gov/ and used for the first graph ("Household debt-to-income ratio in the US").

- Data about population and socioeconomic characteristics such as income, unemployment, and poverty by county was obtained from OpenIntro, particularly https://www.openintro.org/data/?data=county_complete. This website has combined data from http://census.gov, the tidycensus R package, the Bureau of Labor Statistics, the Census Bureau, and USDA, among others. The data from this website is used in the process of generating data for the first graph ("Household debt-to-income ratio in the US"), for the data cleaning, and for the analysis related to median household income, unemployment, and poverty.

- I acknowledge inspiration in the format of part of the layout of this project from the document "An examination of food insecurity in the United States, and the case for food rescue", by John Greer.