WORKING paper

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Measuring and Comparing Consumption Inequality between France and the United States

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ABSTRACT

This paper constructs an annual dataset of consumption by income quintiles for France since 1989 in order to make a granular comparison of consumption inequality with the United States. First, we match consumption data from a survey run every five years with the national accounts, and then use a Kalman filter to interpolate missing observations, leveraging the yearly national accounts data to improve the performance of the Kalman filter. We validate this technique by applying it to a US dataset with pseudo-missing data comparable with our French data. Second, we construct a US consumption dataset compatible with the French classification of consumption items and compare consumption inequality trends between the US and France. We find consumption inequality to be overall lower than income inequality, and not to follow the dynamics of income inequality. Consumption inequality is also higher in the US than in France. Finally, based on the weights of the different consumption items, we construct annual consumption deflators by quintiles. We find that dispersion in price pressures across income groups is less marked in France than in the United States, and overall quite small in both countries.

Keywords: Inequality, Consumption, Income, Inflation.

JEL classification: D31, E21, E31.

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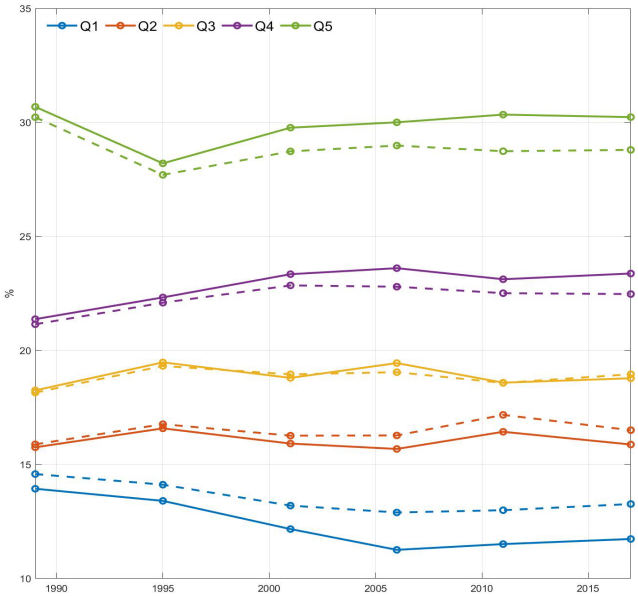
NON-TECHNICAL SUMMARY

The environment of extremely low interest rates during the last decade has stirred a debate about the distributional consequences of monetary policy. To understand the cyclical and structural drivers of inequality, and the distributional impact of monetary policy, most research has focused on income and wealth inequality, due to the availability of highly granular data and often from administrative sources. However, looking into consumption inequality is highly important from a welfare perspective, as variations in income and wealth over the business cycle will only matter if they translate into variations in consumption inequality.

In this paper, we address this shortcoming of the literature and focus on consumption inequality. Because consumption across the income distribution is usually measured through households' surveys, often scant or infrequent, we develop a methodology to address the low frequency issue of existing surveys. We apply this methodology to France, where the survey "Budget de Famille" is run every five year to provide a yearly measure of consumption by income quintiles. Our yearly data set thus allows us to study the evolution of consumption inequality over the long run in France, between 1989 and 2019.

Our methodology relies on matching and rescaling disaggregated consumption data from the household survey available at a five-year interval with the aggregate consumption from the national accounts. We then obtain an infrequent "distributional national accounts" data set. We then use an augmented Kalman filter, exploiting implicit linear constraints and available yearly income by quintiles as explanatory variables, to interpolate missing consumption observations. We first back-test this methodology for the United States, where the survey is run every year. We show that the Kalman filter largely improves on linear extrapolation methods, especially regarding cyclical variations, which is important when one seeks to analyze variations across the business cycle. Our methodology's contribution is twofolds: (i) we build consumption series by quintiles consistent across the household budget survey and national accounts, which provides harmonized estimates over time and across countries, and allows for meaningful comparison across these two dimensions; (ii) it is applicable to any country with infrequent household consumption survey data and can bridge this data gap.

Figure 1. Consumption by income quintiles as a proportion of total consumption in France
(survey data and survey matched with national accounts)



Note: Consumption from Budget de Famille survey matched with national accounts (full line), and consumption from survey data only (dotted line)

In the figure above, we contrast our consumption data by quintile (in shares of total consumption), obtained directly from the Budget de Famille survey, with the data obtained from matching the national accounts' 12 consumption categories with its survey equivalent. Matching these two data set is of particular importance as it yields noticeably different consumption shares, notably for the bottom and top quintiles.

Based on the constructed yearly dataset of consumption by income quintiles, we derive consumption inequality measures for both France and the United States (US). We find that consumption inequality is overall much lower than income inequality. Moreover, consumption inequality does not seem to mirror the evolution of income inequality. While consumption inequality has remained rather stable in the United States, income inequality has increased. France experienced over the whole period a modest rise in consumption inequality, but a more sizeable one in income. In France, consumption inequality steadily rose until the 2000s, followed by a slow decrease while income experienced higher variations, with steeper rises and falls over the same sub-periods. Finally, both consumption and income inequality are much lower in France than the US.

Finally, we compute consumption deflators and CPI indices across the income distribution. We depict small differences among the income quintiles, slightly larger in the US. This dispersion across quintiles slightly increases once we go to a thinner level of disaggregation, suggesting that the price heterogeneity probably lies within, and not between the broad consumption categories we have used.

Mesure et comparaison des inégalités de consommation entre la France et les US

RÉSUMÉ

Ce papier construit une base de données annuelle de consommation par quintiles de revenu pour la France depuis 1989 afin de comparer les inégalités de consommation avec les États-Unis. Tout d'abord, nous établissons une correspondance entre les données de consommation de l'enquête des ménages menée tous les cinq ans avec les comptes nationaux. Nous utilisons un filtre de Kalman qui tire parti des données annuelles des comptes nationaux pour interpoler les données manquantes de l'enquête. Nous validons cette technique en la testant sur des données américaines pseudo-manquantes, comparables à nos données françaises, mais où l'enquête, annuelle, permet de vérifier la performance de notre technique. Deuxièmement, nous construisons pour les US une base de données sur la consommation par quintile de revenu compatible avec la classification française des postes de consommation et comparons les tendances des inégalités de consommation entre les US et la France. Nous montrons que l'inégalité de consommation est globalement plus faible que l'inégalité de revenu, et les deux ne suivent pas forcément la même dynamique. L'inégalité de consommation est plus élevée aux US qu'en France. Enfin, nous construisons des déflateurs de consommation par quintiles. Nous constatons que la dispersion des pressions inflationnistes à travers la distribution des revenus est moins marquée en France qu'aux US, mais reste néanmoins faible dans les deux pays.

Mots-clés : inégalité, consommation, revenu, inflation

Codes JEL: D31, E21, E31

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1 Introduction

Inequality is a topic of major interest for policy makers as the world economy is currently facing a surge in economic inequality. According to the latest World Inequality Report[1], the COVID-19 crisis has exacerbated inequalities between the very rich and the rest of the population, raising awareness of these disparities. The environement of extremely low interest rates during the last decade has also favored an active debate on the effects of monetary policy on inequality (Auclert (2019), Lenza and Slacalek (2018), Hansen et al. (2020), Andersen et al. (2022)). In order to understand the structural and cyclical drivers of inequality, most research has focused on income and wealth inequality. This is also explained by the availability of highly granular income and wealth data, often from administrative sources. In this paper, we focus instead on consumption inequality, building a dataset that allows to study its evolution over the long-run.

From a welfare perspective, there are indeed several reasons to look beyond income inequality, and also investigate consumption inequality and the extent to which that matches income inequality. First, micro-founded models demonstrate that what matters for welfare comparisons is consumption (and leisure). Observed variations in income and wealth over the business cycle or as a consequence of macroeconomic policies will only matter if they translate into variations in consumption inequality. This is particularly relevant if variations in income and wealth move in opposite directions, and the ultimate welfare consequences of these offsetting movements are summarised by changes in consumption inequality. Second, the mapping between variations in income and wealth, and variations in consumption is not straightforward and may vary across income and wealth levels. Those with liquid wealth or pledgable assets, for example, can smooth their consumption in response to temporary income shocks in line with the life-cycle hypothesis of Modigliani and Brumberg (1954) and the permanent income hypothesis of Friedman (1957). For these households, the volatility of consumption will be lower than that of income or the market value of their wealth. On the contrary, hand-to-mouth households will have little financial wealth or ability to borrow to smooth consumption.

Nevertheless, research addressing consumption inequality is less extensive, mostly due to the relative paucity of data on consumption by income categories over long time periods allowing to disentangle the business cycle. Consumption by quintile is usually measured through households surveys, which are scant or infrequent in most countries. For the United States for example, which provide a wide array of data sources to study income inequality, surveys on households consumption are however scarce: only the Consumer Expenditure Survey (CEX) tracks consumption on a yearly basis. While it provides comprehensive and detailed information on household expenditure and its components, it lacks a longitudinal component. The Panel Study of Income Dynamics (PSID) is another data source but is only available bi-annually since 1997. For other countries, such as France, the frequency of these surveys is even lower and the data coverage is less consistent. The equivalent of the CEX, the survey "Budget de Famille" (BdF) is available roughly every 5 years, starting in 1972, with some evolution in data coverage[2]. As such, data availability makes the mapping

[1] See https://wid.world/news-article/world-inequality-report-2022/

[2] Before 1995, mostly monetary data was gathered. Since 2001, the quantity of products consumed is collected.

between income/wealth inequality and consumption inequality rather complex and pledges for the need to develop more high frequency datasets of consumption by income distribution on a comparable basis.

In this paper, we develop a methodology to address the low frequency issue of existing survey consumption data. We apply this methodology to France and provide a yearly measure of consumption by income quintiles in order to explore consumption inequality trends. We match disaggregated consumption data at a five-year interval from the BdF survey to aggregate consumption from the national accounts. We then interpolate missing observations by using the Kalman filter, exploiting a number of implicit linear constraints and available yearly information as regressors. We validate our methodology by exploiting the richer availability of annual consumption data by income level in the United States. We thus create a pseudo-dataset for the US that replicates the infrequent data in our French survey (every five years). We then run our Kalman filter over this pseudo-dataset and compare the interpolated values with the true data in order to show that the filter provides a good fit. Finally, we match consumption categories in the US survey in order to match the French classification and allow a comparison of consumption inequality between the two countries. Indeed, to legitimately compare trends in consumption inequality between France and the United States we need to make sure we use the same coverage of expenditure categories, and adjust them to get a common ground. As the US data is provided with a greater granularity and wider coverage (coverage between France and US are different across countries, e.g., contributions to retirement plans are treated as savings in France, but are included in total expenditures in the US), we trim the US data and distribute each component to match the consumption categories available for France.

Our methodology applicable to any country, has two benefits (i) it provides distributional national accounts data; (ii) it solves the issue of infrequent household consumption survey data. Indeed, the matching of survey data with national accounts is of particular interest as it allows for a consumption measure that is consistent across the two sources of data. We obtain distributional national accounts, thus we have harmonized estimates across time and countries, allowing for meaningful comparison along these two dimensions. Our methodology builds on Accardo et al. (2009) and Accardo et al. (2017) but their methodology is adapted to have consistent data sources since we build a longer time series using multiple survey waves. The methodology seeks to more precisely match each consumption category in the national accounts with the corresponding consumption in the surveys. For instance, in the 2003 exercise of Accardo et al. (2009), they use five different surveys[3] to get the equivalent of the consumption categories in the national accounts. In this paper, we only focus on the BdF survey, such that the data source can be matched in a consistent manner across years. Because the aggregated survey and the national accounts consumption series are equivalent once matched, the yearly consumption of the national accounts can be used in a linear constraint to impose structure on our Kalman filter to estimate consumption by quintiles. We also include as regressors yearly information on income by quintiles, coming from the Word Inequality database, to improve the filter's performance. We show that when including the constraint on yearly aggregate consumption from the national accounts, the

[3]Le dispositif des Statistiques sur les Ressources et les Conditions de Vie des ménages (SRCV - 2004), les enquêtes Revenus fiscaux (ERF - 2003), Budget de Famille (BdF - 2006), Logement (2002) et Santé (2003)

extrapolation performance of the Kalman filter technique improves over simple interpolation.

Based on these comparable datasets and using standard measures of inequality, we find that consumption inequality is much lower than income inequality, both in the United States and France. Moreover, consumption inequality does not seem to mirror the evolution of income inequality. While consumption inequality has remained rather stable in the United States (with some fluctuations around a stable trend), income inequality has had a starker increase. In France, consumption inequality experienced a prolonged rise from 1989 up until the late 2000s, before slowly receding. Income inequality has had steeper rises and falls over the same time periods, with larger variations. It has increased by more than consumption over our sample period. Finally, we find higher inequality in the United States than in France, with a bigger difference for income than consumption. Our results for both countries are in line with the findings of Chevalier et al. (2018) who use both CEX and BdF data at the 5-year frequency to document weaker inequality in France according to several indicators (Gini, variance of logarithm or even focusing on top or bottom distribution), lower levels as well as lower variations of consumption inequalities compared to income inequality.

Finally, we use our data on consumption expenditure by 12 categories of consumption items and by income level to build consumption deflators for France and the United States. This allows us to construct an annual series of real consumption by quintile. We do not observe sizeable differences between deflators among income quintiles, as measured by the broad categories of consumption. Larger differences appear however when going into a deeper disaggregagtion level, as we show for the US. This suggests that most of the heterogeneity probably lies within and not between the consumption categories. While using a national average of consumer expenditures to weight the categories has some appeal, it has limitations in representing the true cost of living.

Overall, we make three statistical and methodological contributions in this paper. First, we construct a consistent set of consumption expenditures by quintile at infrequent dates consistent with the national accounts' definitions, by extracting the relevant expenditure categories from household survey data and reweighting so that the total match the national aggregates. Second, we develop a Kalman filter technique to interpolate these infrequent data into annual series of consumption expenditure by quintile for France. Third, we create a dataset of consumption by quintile for the US that is consistent with the French nomenclature and estimate price indices by income quintiles.

We place our paper in the context of the existing literature in section 2, highlighting many of the issues we face in constructing our data. We describe our data sources in section 3 and our methodological contribution in section 4. Section 5 discusses our results, and section 6 concludes.

2 Literature review

Our paper first relates to the literature focusing on long-run inequality analyses. A large part of this literature has addressed income inequalities (Boiron (2016), Heathcote et al. (2010)) or wealth inequalities (Piketty and Zucman (2014)). While this kind of analysis on consumption inequality over the long-run already exists for the United States, none was performed for France. Chevalier et al. (2018) goes one step into this direction by comparing

consumption in 1995 and 2011 based on two waves of the French survey "Budget de Famille". Similarly does Accardo et al. (2009) for 2003 and Accardo et al. (2017) for 2011. Our paper fills in this gap in the literature, by constructing a more granular, yearly, consumption series by income quintiles for France from 1989 to 2019, based on survey measures consistent with the national accounts.

For the United States, similar studies rely on the Consumer Expenditure Survey (CEX), assessing the relationship between trends in income inequality and consumption inequality. Most of these studies reach the conclusion that income inequality has risen sharply over the past five decades (Meyer and Sullivan (2017), Amin-Smith and Attanasio (2020)). Consumption studies, on the contrary, arrive at a dissensus. Early papers such as Attanasio and Davis (1996), Slesnick (2001) or Krueger and Perri (2006) provide evidence that consumption inequality has only modestly increased over recent decades in the United States, despite the rise in income inequality. Attanasio and Davis (1996) show that consumers were able to smooth short-run shocks to income but were less able to do so in the longer run, when consumption and income inequality become strongly correlated, due to the returns on education. Subsequent work tends to overturn these findings, showing consumption inequality to mirror, or even exceed, the rise in income inequality (Attanasio et al. (2007), Attanasio et al. (2012), Aguiar and Bils (2015)).

Such lack of consensus can stem from different data sources or measurement errors, which can impact the conclusions of within-country analysis, and also hinder cross-country analysis. Indeed, Meyer and Sullivan (2017) highlight the importance of data consistency, as they argue that these different results are explained by the different data sources, the definitions of consumption (total versus non-durables) as well as measurement error in consumption and income. They suggest consumption inequality tends to be smaller than income inequality[4]. Aguiar and Bils (2015) document some of the most common measurement errors in consumer surveys, such as more severe underreporting of consumption by richer households or a more severe underreporting of consumer spending for some goods. Poorer households, who receive transfers, also tend to underreport income (Slesnick (2001)) and underreporting has increased over time (Meyer and Sullivan (2017)). Finally, an increasing gap between CEX consumption expenditures and those reported by national income and product accounts (NIPA) has also been documented by Garner et al. (2006) and Parker and Ziebarth (2009).

As such, our paper contributes to the literature that dwelves more deeply into data measurement issues. Some previous studies drop outliers (bottom and top 5%, as in Aguiar and Bils (2015)), while others focus on subsets of consumption, in order to address measurement issues in consumer surveys. Meyer and Sullivan (2017) construct an improved measure of consumption based on the well-measured components reported in survey data, like food at home, housing and vehicles. Their results show that consumption inequality rose considerably less than income inequality over the past five decades, with some distinct periods. Aguiar and Bils (2015) construct an alternative inequality indicator relying on differences in luxury and necessity expenditures between high- and low-income households. Similarly, Andersen et al. (2022) use information on car purchases to proxy consumption of durables at different positions in the income distribution, while more recent studies even use propri-

[4]Other important papers in this line of literature include Amin-Smith and Attanasio (2020), Meyer and Sullivan (2008) and Krueger and Perri (2006).

etary datasets based on card transactions to measure consumption expenditures (Cardoso et al. (2022)). Most of these studies conclude that consumption inequality rises more than previously believed, and tracks income inequality more closely, especially in the 2000s (see also Attanasio et al. (2007) and Attanasio et al. (2012)).

Our method, by constructing a consumption series from surveys consistent with the national accounts, corrects for some of these measurement errors. We leverage the consistency between survey and national accounts data to impose structure to a Kalman filter, both from a linear constraint on yearly consumption from the national accounts, and using yearly income by quintiles as regressors. This allows us to obtain yearly consumption data improved compared to a simple linear extrapolation. Such measure of "distributional national accounts" allow for a consistent comparison of inequality developments with the United States and over time.

3 Data

3.1 France

For France, we use the survey "Budget de Famille" (BdF) for information about consumption and income on one hand, as well as consumption data from the national accounts on the other hand, to make aggregates consistent with the national accounts and allow for coherent comparison over time.

The Budget de Famille survey covers a cross-section of approximately 10000 households. It is collected generally every five to six years since 1972. We extract the waves 1989, 1995, 2001, 2006, 2011 and 2017. This survey aims at reconstituting households' accounts by gathering information about revenues and expenditures. Household members complete questionnaires for their durable expenditures over the year and two booklets for their non durable consumptions during two weeks[5]. Information is collected over twelve months to limit seasonal effects affecting spending such as heating or particular food purchases. Since 1995, income analysis was added to the questionnaire. In 1995, the product nomenclature also changed and was adapted to Eurostat norms (Classification of Individual Consumption by Purpose or COICOP).

As aforementioned, we want to build a consumption measure from the survey that is realigned with the national accounts. For that purpose, we follow the 12 consumption categories of the COICOP to build our measure of consumption for each household, and rescale both consumption and gross disposable income entries so as to match the national accounts aggregates. The methodology heavily relies on the methodology developed in Accardo et al. (2009) and Accardo et al. (2017), except that in order to build a longer sample, and for consistency across time, we only use as data source the Budget de Famille. The methodology consists in pairing each consumption entry of a household in the survey (from which we get information about the type of consumption from the BdF nomenclature) with its national account category, i.e., with regards to the 12 COICOP consumption brackets (see annex 4). Thus each consumption entry in the survey is assigned a consumption category of the COICOP (e.g., food, clothing, housing...), correcting as much as possible for differ-

[5]The time window is the same as the Diary Survey of th U.S. CEX.

ences in concepts and coverage[6]. This methodology is of particular interest as matching the consumption categories across survey and national accounts allows us to leverage the yearly national account data to fill the gaps in the consumption series.

As for income, we proceed similarly. We focus on a measure of gross disposable income consistent with that of the national accounts, measured by the French National Institute of Statistics and Economic Studies (INSEE henceforth). INSEE defines gross disposable income in its national accounts as income available to households for consumption or investment, after redistribution operations. It includes all income from employment (wages, employers' legal contributions, mixed income of self-employed persons), income from property (interest, dividents, life insurance income, etc.), and income from estate (including rental income charged to households owning the housing they occupy). Cash social benefits received by households are mainly added and social contributions and taxes paid are deducted.

We summarize the methodology to pair the consumption categories, which proceeds in several steps:

1. Identification in the consumption entry of the survey (from the BdF nomenclature), the component from the 12 COICOP categories the closest to the national accounts. In our consumption data, there is no imputed expense like healthcare or education, only direct expenses. Contributions to retirement plans are treated as savings[7]. Moreover, for consistency of the methodology across survey years, the matching or pairing makes uses only of information on consumption from Budget de Famille, and no other sources that could improve the matching such as social security spendings.

2. Computation of total for each consumption categories identified above, across households.

3. Amounts are then adapted to the total amount from the national accounts by comparing the aggregate consumption for each of the 12 categories with that of the national accounts. We adjust individual observations proportionnally to conform to the national accounts amount.

4. We proceed similarly for income. Once these amounts coincide, we can classify each household by income quintile and obtain total consumption per quintile.

Figure 1a graphs the available data on both income and consumption quintiles shares as a proportion of their respective total (after pairing and rescaling), where the markers represent the data points from the 1989, 1995, 2001, 2006, 2011 and 2017 waves available from the BdF survey. The solid lines between each markers show what would be implied by simple linear interpolation. Figure 1b plots for each quintile the ratio of consumption over disposable income. Not surprisingly, the ratio of consumption over after-tax income is inversely related with the quintiles (figure 1b). Moreover, lower quintiles tend to have a higher consumption share in total consumption than of income over total income (1a). This

[6]We present in the appendix some examples of differences in concepts and coverage in table i in the appendix.

[7]They are therefore excluded from the US total expenditure data, as it is not consumption but savings.

suggests that there may be more income inequality than consumption inequality, which will be the focus of section 5.

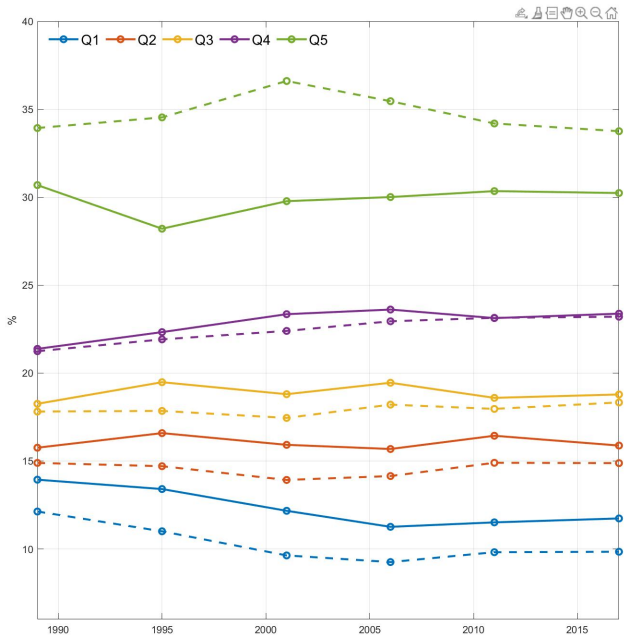
Why is pairing important, aside from allowing us to leverage yearly data in a Kalman filter ? In figure 2, we contrast our consumption data by quintile (in shares of total consumption), obtained directly from the BdF survey, with the data obtained from matching the national accounts' 12 consumption categories with its survey equivalent. Matching these two data set is of particular importance as it yields noticeably different consumption shares. Without this readjustment, amounts differ quite a lot, thereby not only changing quantitatively our measure of inequality but also its evolution. Indeed, based on these modified survey responses, we can observe that without this matching, we would underestimate the consumption of the top 3 quintiles, and over estimate that of the bottom quintiles, thereby under-estimating inequality. Given the readjustment is also different across quintiles and years (as quintiles consume goods from the different categories in different proportions, which also evolve over time, it leads to a different rescaling in aggregate for each quintile), we would also have a biased estimate of the evolution of consumption inequality.

Table 5 in the appendix provides further statistics and compares the differences between total consumption in the survey only and the survey data matched with national accounts. The differential between aggregate survey consumption and national accounts aggregate is sizable, with a 37% difference in 2017. We also observe an increasing gap between the consumer expenditure survey and national accounts, without this rescaling. This is in line with the findings of Garner et al. (2006) for the United States. These differences arise from divergences in scope between the BdF and national accounts (Chevalier et al. (2018) cover these differences in details, and we illustrate these differences in the appendix table 3). For instance, BdF only accounts for rents paid by renters, while national accounts consider owners imputed rents. Other explanations include an under-reporting or no-reporting of some expenditures or revenues, as well as differences in coverage. BdF only collects expenditures and revenues of residents (excluding collectivities). Moreover, it covers expenditures abroad of residents but not expenditures by non-resident in France, unlike the national accounts. Adjusting individual observations proportionnally to conform to national accounts, while not solving the reporting issues, does bring us a consistent database to leverage the national accounts. Moreover, if reporting problems are uniform across income levels, inequality measures based on ratios such as Q5/Q1 should not be biased.

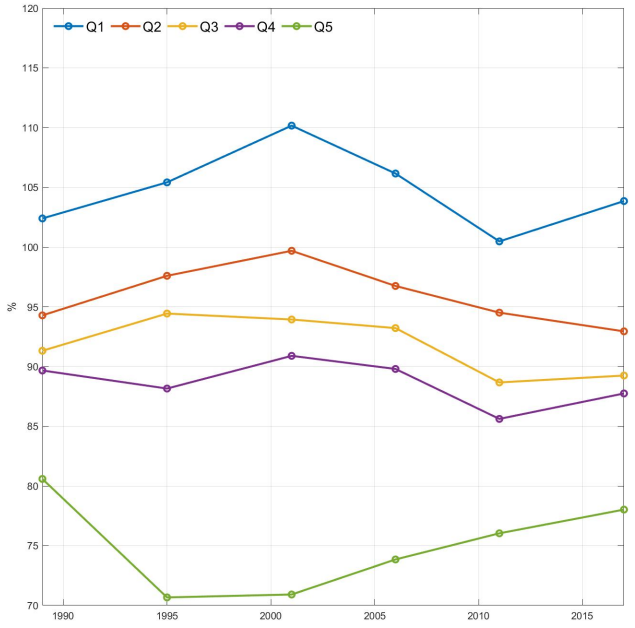
3.2 United States

For the United States, we use the consumer expenditures survey (CEX) available at a yearly frequency, spanning years 1984 to 2019. This is a nationwide household survey run by the Census Bureau for the U.S. Bureau of Labor Statistics (BLS) on a sample of up to 14 000 households per year. It comprises two separate surveys, the quarterly Interview Survey for major and/or recurring items and the Diary Survey for more minor or frequently purchased items. It provides data on income, expenditures and demographic characteristics of consumers in the United States.

The survey provides us with total average expenditure by income distribution, as well as some more detailed expenditure categories such as food at home, rent,... To construct our consumption measure, we dig into the structure of consumption to obtain consumption cate-



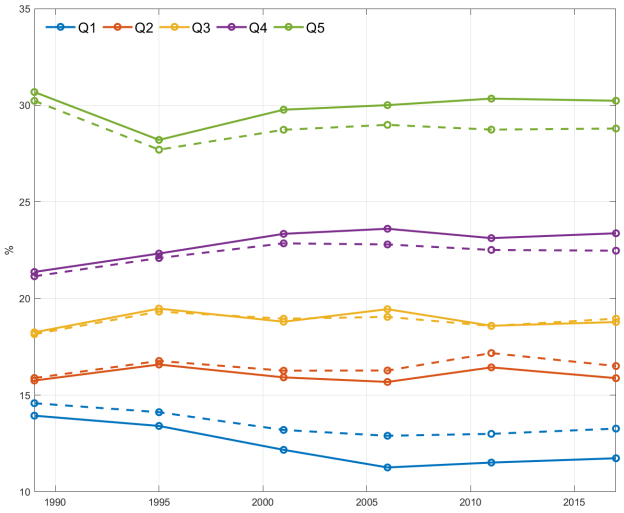
(a) Shares of quintiles' consumption as a proportion of total consumption (full line) and shares of quintiles' gross disposable income as a proportion of total income (dashed line)



Note: Income before tax

(b) Ratio of consumption over gross disposable income by quintiles

Figure 1: Consumption and income shares by quintile in France



Note: Consumption in BdF survey matched with national accounts (full line), and consumption from BdF survey only (dotted line)

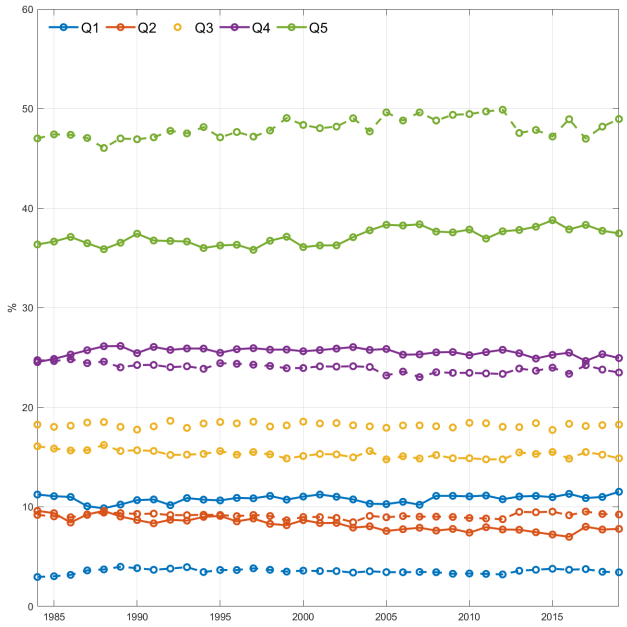
Figure 2: Consumption of quintiles as a proportion of total consumption (survey data and survey matched with national accounts)

gories by income quintile matching those in the French data. Table 6 shows the matching of the different consumption categories from the CEX survey with the corresponding COICOP broad categories so as to have a comparable consumption structure for the United States and France. We thus matched 35 expenditure categories from the CEX survey into the 12 COICOP categories used for French data. While not perfect, the matching is straightforward for most consumption items, as seen in Table 6. In our consumption measure, we exclude the pensions and Social Security contributions, which correspond to savings, as well as property taxes. The survey also provides both before- and after-tax income, as well as eight categories of income, such as wages, unemployment benefits or dividends.

Figure 3a presents the evolution of income and consumption shares for the five quintiles from 1984 to 2019, as obtained from the CEX survey data. These shares are rather stable during this 36-year period. Shares in consumption seem slightly more scattered than for France, a potential indication of stronger inequality in the United States: the bottom quintile counts for around 10% of total consumption whereas the top quintile counts for 35%. Unsurprisingly, income shares are even more dispersed than for consumption: only 4% for the bottom quintile and close to 50% for the top quintile. They also do not show signs of convergence. Figure 3b illustrates the evolution of the ratio of consumption over income for the five quintiles. The remarkably high ratio for Q1 stands out, stemming from the well-documented problem of underreporting of income by the lowest quintile. Such issue does not arise with our French data as we rescale to match aggregate amounts from the national accounts[8].

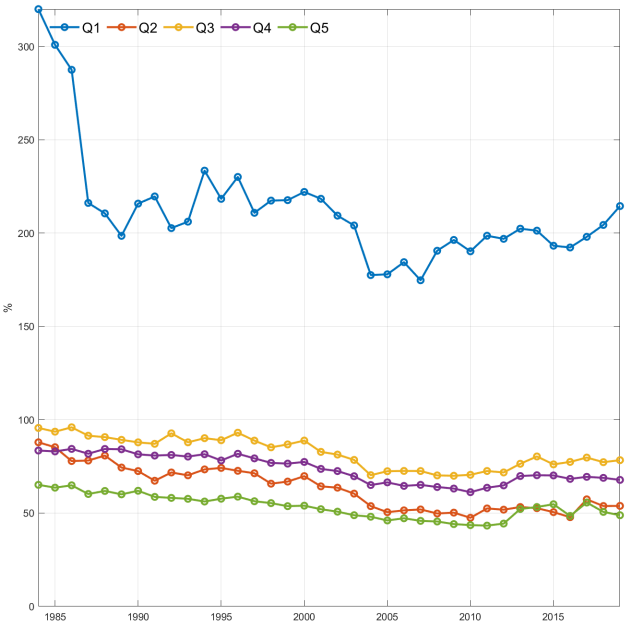
Several studies argue that survey and national account data on consumption have expe-

[8]Moreover, the big decrease occuring for Q1 in the ratio of consumption over income in the earliest part of our sample points most likely poinnts to some abnomality in the early years when the survey was instaured.



Note: Consumption excl. Property Tax and Pension contributions

(a) Shares of quintiles consumption over total consumption (full line) and shares of quintiles gross disposable income over total income (dashed lined)



(b) Ratio of consumption over after-tax income by quintiles

Figure 3: Consumption and income shares by quintile in the United States

rienced widened discrepancy for the US, similar assessment as we made afore for the case of France. For the US, Passero et al. (2014) have shown that consumer spending data in the CEX has become increasingly detached from the Personal Consumption Expenditure (PCE) data, input in the national income and product accounts data. The ratio of total expenditures in the CEX compared to the PCE data has declined from 70% in 1992 to 58% in 2010, similar magnitude as observed for France. On one hand, this is true that they track different concepts and cover different entities, as for France. National accounts cover the value of goods purchased by the country's residents and non-profit organizations on behalf of households, including what they are purchasing when traveling or working abroad. For the case of the US, to list a few discrepancies between the two sources, the PCE includes institutionalized individuals (e.g., in prison, hospitals, students, and individuals in the military) while the CEX does not. The PCE concept includes imputed rents on owner-occupied housing, while the CEX aggregates typically exclude them.

As emphasized previously, we proceed to a matching between the consumption categories in the national accounts and the survey data to get "equivalent" or comparable series for France correcting in parts this discrepancy through rescaling, before building a consumption measure from the US survey comparable to that of France, which we present in the following section. With consistent data across the two countries, we can now use the US data to generate infrequent observations, and test the validity of our method with the actual data, before applying our methodology to French data.

4 Bridging missing years in surveys: a Kalman filter approach

After matching the BdF data with the national accounts data, we are still left with an infrequent dataset which gives us an incomplete picture of the evolution of consumption inequality. Different techniques could be used to extrapolate the missing data, such as linear extrapolation. We show in this section that a better approximation can be reached with a Kalman filter that leverages yearly information from the national accounts (yearly aggregate consumption to impose a linear equality constraint), and yearly incomes as regressors to impute the "missing" data. We first outline our technique and then validate it using US data.

Bridge models are commonly used to deal with mixed frequency data[9]. Indeed, state-space models, and among those, Kalman filters, are a natural representation for handling mixed frequency data and non-synchronicity of data releases, because they jointly describe the dynamics of the variable to be explained and of the latent or indicator variable. The latent variable can then be used to estimate missing observations of the observed variable.

Kalman filters operate on state space models of the form:

$$Y_t = AX_t + B\nu_t, \tag{1}$$

[9]Among these alternatives, mixed data sampling (MIDAS) and factor models are commonly used. For instance, central banks use such models to nowcast GDP and for short-term nowcasting (e.g., Clements and Galvão (2008)). Foroni and Marcellino (2013) provide a survey of recent work and empirical applications in the literature.

where $\nu_t \sim N(0, \Sigma)$ and

$$X_t = DX_{t-1} + Eu_t, \tag{2}$$

where $u_t \sim N(0, Q)$.

Equation (1) is the measurement equation, while (2) is the state equation. Y_t is the observed series, which in our case is the consumption data with 5-year gaps between the surveys, and aggregate consumption from the annual national accounts. X_t represents the state variables of the system and contains two different elements. One component is a vector of latent variables. The second component are potential explanatory variables, which add a regression component to our technique. Our explanatory variables will be a vector of annual income by quintile. The precise specification of our Kalman filter is in the next subsection.

Once the parameters of the model are estimated, the Kalman filter (KF) can be used to find optimal estimates of the latent X_t, including for dates for which there are no observable survey date. We use two-sided filtered estimates to obtain X_t. Then, we can use the observation equation to produce estimates of the observables for all dates:

$$\hat{y}_t = AX_t. \tag{3}$$

How do we obtain the latent variables? Since $X_t \sim N(a_t, P_t)$, the Kalman filter computes the conditional mean and variance of the distribution of X_t conditional on observations up to time t. For that purpose, we write the likelihood function and proceed with a maximum likelihood estimation. The estimation procedure is as follows: first, the Kalman filter estimates X_{t+1} using the estimates of the current state and the current observation Y_t. It estimates X_{t+1} by estimating

$$a_{t+1} = Da_t + K_t(Y_t - AX_t) \tag{4}$$

$$P_{t+1} = DP_t(D - K_tX_t)' + Q, \tag{5}$$

where K_t is the Kalman gain. When there is an observation missing, the Kalman filter can still use the transition equation and compute

$$a_{t+1} = Da_t \tag{6}$$

$$P_{t+1} = DP_tD' + Q, \tag{7}$$

meaning it does the best guess using the transition equation. Once the Kalman filter has run, we have an estimate of the states and can back out the estimates of the observables.

4.1 Multivariate Kalman filter with aggregate constraint and a regression component

Therefore, the Kalman filter can be used to estimate our series of interest and fill the gap in these infrequent surveys using our estimates of the latent variable. However, without any

additional yearly information, the best a researcher could do to fill these "gaps" would be to estimate a univariate Kalman filter. This would give only marginal improvements over linear interpolation. To obtain better estimates, we exploit two additional data sources:

- First, we have annual data on aggregate consumption from the national accounts. By construction, this is the sum of consumption across the quintiles. This gives us an annual adding up constraint on the latent variable. The matching of the survey data with the national accounts concept is essential for this to work.
- Second, we have income by quintile, from other sources, such as from the World Inequality Database. We include these as regressors to estimate more precisely the coefficient in the latent system.

Equations 9 and 10 outline the state space system we are estimating. We implement the adding up constraint in the final row of the loading matrix on X_t in the observation equation (9). We also impose the assumption that the latent variable associated with each quintile does not affect consumption for any other quintiles (the zeros off the main diagonal). Note that this constraint also applies to the error terms in equation (9). In effect, we impose the equality constraint that

$$C_{1,t} + C_{2,t} + C_{3,t} + C_{4,t} + C_{5,t} = Ctotal_t, \tag{8}$$

where $Ctotal_t$ stands for total consumption.

We exploit the availability of post-tax income by quintile[10] through the second term in equation (9). Again we make the assumption that the net income of each quintile does not affect the consumption of any other quintile.

$$\begin{bmatrix} C_{1,t} \\ C_{2,t} \\ C_{3,t} \\ C_{4,t} \\ C_{5,t} \\ Ctotal_t \end{bmatrix} = \begin{bmatrix} A_{1,1} & 0 & 0 & 0 & 0 \\ 0 & A_{2,2} & 0 & 0 & 0 \\ 0 & 0 & A_{3,3} & 0 & 0 \\ 0 & 0 & 0 & A_{4,4} & 0 \\ 0 & 0 & 0 & 0 & A_{5,5} \\ A_{1,1} & A_{2,2} & A_{3,3} & A_{4,4} & A_{5,5} \end{bmatrix} \begin{bmatrix} X_{1,t} \\ X_{2,t} \\ X_{3,t} \\ X_{4,t} \\ X_{5,t} \end{bmatrix} + \begin{bmatrix} \beta_{1,1} & 0 & 0 & 0 & 0 \\ 0 & \beta_{2,2} & 0 & 0 & 0 \\ 0 & 0 & \beta_{3,3} & 0 & 0 \\ 0 & 0 & 0 & \beta_{4,4} & 0 \\ 0 & 0 & 0 & 0 & \beta_{5,5} \\ \beta_{1,1} & \beta_{1,2} & \beta_{1,3} & \beta_{1,4} & \beta_{5,5} \end{bmatrix} \begin{bmatrix} I_{1,t} \\ I_{2,t} \\ I_{3,t} \\ I_{4,t} \\ I_{5,t} \end{bmatrix} + \begin{bmatrix} B_{1,1} & 0 & 0 & 0 & 0 \\ 0 & B_{2,2} & 0 & 0 & 0 \\ 0 & 0 & B_{3,3} & 0 & 0 \\ 0 & 0 & 0 & B_{4,4} & 0 \\ 0 & 0 & 0 & 0 & B_{5,5} \\ B_{1,1} & B_{2,2} & B_{3,3} & B_{4,4} & B_{5,5} \end{bmatrix} \nu_t, \tag{9}$$

[10] For the US, we can directly use after-tax income for the survey, for France we need to use data from the World Inequality database.

$$\begin{bmatrix} X_{1,t} \\ X_{2,t} \\ X_{3,t} \\ X_{4,t} \\ X_{5,t} \end{bmatrix} = \begin{bmatrix} D_{1,1} & 0 & 0 & 0 & 0 \\ 0 & D_{2,2} & 0 & 0 & 0 \\ 0 & 0 & D_{3,3} & 0 & 0 \\ 0 & 0 & 0 & D_{4,4} & 0 \\ 0 & 0 & 0 & 0 & D_{5,5} \end{bmatrix} \begin{bmatrix} X_{1,t-1} \\ X_{2,t-1} \\ X_{3,t-1} \\ X_{4,t-1} \\ X_{5,t-1} \end{bmatrix} + \begin{bmatrix} E_{1,1} & 0 & 0 & 0 & 0 \\ 0 & E_{2,2} & 0 & 0 & 0 \\ 0 & 0 & E_{3,3} & 0 & 0 \\ 0 & 0 & 0 & E_{4,4} & 0 \\ 0 & 0 & 0 & 0 & E_{5,5} \end{bmatrix} u_t, \tag{10}$$

Note that in the estimation, we impose the following non-negativity constraints on the parameters A, B, D, E:

$$A, B, D, E \geq 0. \tag{11}$$

4.2 Validating the technique with US data

As described in section 3.2, we have annual consumption and post-tax income data by quintile for the US. The availability of this yearly data allows us to use it as a benchmark with which to confront our estimates based on the Kalman filter described in the previous section.

We simulate an infrequent dataset by removing data points to create a survey of frequency comparable to the French one (i.e., 5-year frequency). We use the annual aggregate consumption data as the variable for the equality constraint, rather than total consumption from the national accounts, as the proportional rescaling of individual observations to match national accounts is not done in the CEX like in BdF. The test of our technique will be how closely we can recover the true data. If we obtain a close match, then we have some comfort that we can generate a good estimate for French consumption. Our results are reported in Figures 4 and 5.

The Kalman filter outperforms linear interpolation. Figure 4 compares the true data (in dot-dash blue), our imputed series (in red) and linear interpolation between data points (in yellow) for the fourth quintile. This shows a fairly good fit. Indeed, our technique can capture quite well the cyclicality in quintile consumption expenditure. This is especially important if we want to study for instance how monetary policy affects inequality through the smoothing of the business cycles. Not only does it track better the cyclical variations of consumption, but it yields overall a lower sum of squared errors (see table 1) compared to linear interpolation.

Upper quintiles' consumption is more acurately estimated. Figure 5 reports the results for all 5 quintiles. These graphs illustrate that the technique gives much more accurate estimates for the top three quintiles in terms of cyclicality, compared to linear interpolation. This is reflected in the lower root mean squared errors of the Kalman filter for the top three quintiles. There is however a difference in fit among these 3 quintiles. This difference in fit among the top three quintiles could reflect several factors. The consumption data is more volatile for the fifth quintile (with an average absolute annual change of 2023$ per consumer unit for the fifth quintile, more than thrice that of the first quintile), as is the reported post-tax income (average absolute annual change of 5435$ per consumer unit). This can explain the relatively higher RMSE compared to the other quintiles, while we still do a better job at matching the cyclicality compared to a linear interpolation.

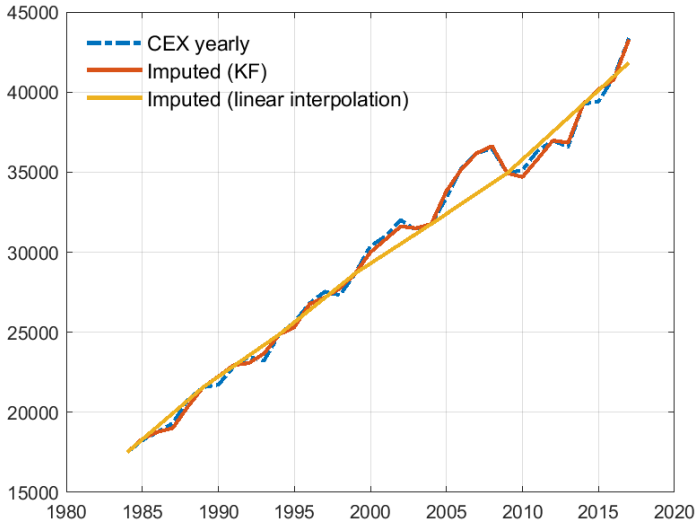


Figure 4: Imputed Q4 consumption with linear interpolation vs Kalman filter (in dollars)

Table 1: RMSE (in thousands of dollars)

Quintile	**Kalman Filter**	**Linear Interpolation**
Q1	0.5987	0.6551
Q2	1.1473	0.8693
Q3	0.5230	0.9585
Q4	0.4311	1.2521
Q5	1.6027	2.1435

Why is it harder to match consumption for the first quintile? Contrarily to the other four quintiles, the first quintile has consumption that is twice as much volatile as income (686$ absolute annual change on average compared to 358$) for income, while the reverse holds for the other quintiles, see table 7 in the appendix). Moreover, the relationship between post-tax income and consumption is less close for the bottom quintile (see table 8 in the appendix, based on the estimated coefficients in the Kalman filter with infrequent data). Indeed, when we run the Kalman filter without the income regression component, and compare the estimation with and without income, we see that having income in the Kalman filter does not improve the fit significantly (see appendix figure 15).

Overall, we conclude that our technique can provide better estimates of annual consumption by quintiles than linear interpolation. We now turn to estimation of the French data, following the same methodology based on the multivariate Kalman filter with a regression component.

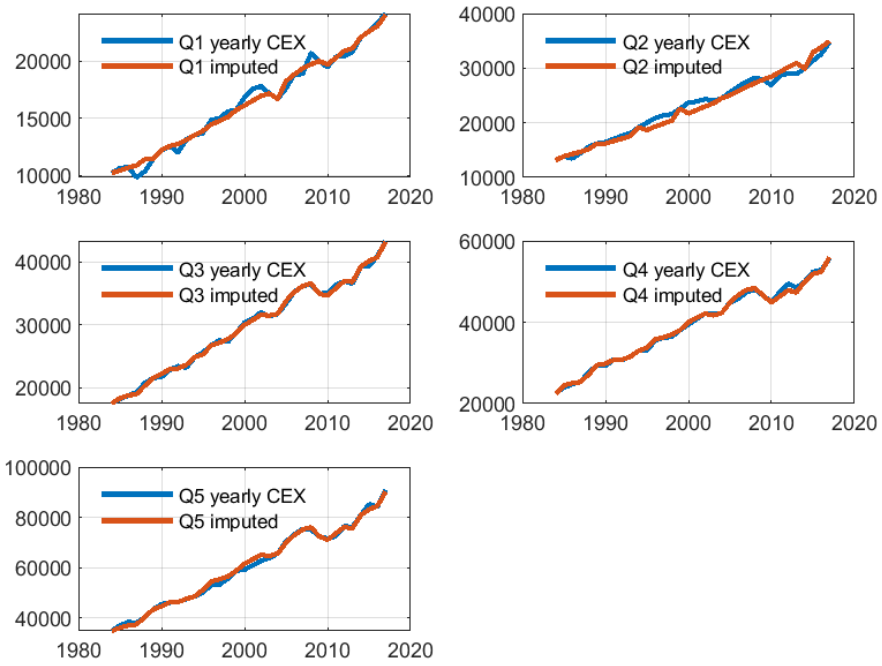


Figure 5: Yearly consumption(CEX) and imputed series for each quintiles (US, in dollars)

4.3 Towards yearly French consumption survey data

We obtain similarly as before the series for average consumption by quintiles, presented in figure 6. Before dwelving into inequality statistics, a simple observation of the patterns of average nominal consumption over time highlights notably different consumption behaviour for top and bottom quintiles. First, there is a noticeable difference in consumption growth between 1989 and 2019, but the gaps between quintile groups vary quite a bit through time. Second, as observed as well in the US data, there seems to be more cyclical variation in estimated consumption for higher income groups than lower income groups.

The first observation points to time-varying inequality, which will be the focus of the next section. As for the second point, although it is a feature of the annual data in the US that we documented above, it is difficult to determine which part stems from "accurate" consumption behavior of these quintiles, or stemming from our technique[11] giving more weight to these quintiles consumption so as to match the national accounts aggregate and its fluctuations. Indeed, mathematically, since the consumption of the top two cohorts make up 50% of total consumption, and given that total consumption is cyclical, we can expect comparable cyclicality in the top cohorts. Therefore, what is less clear is why the estimated consumption of lower income quintiles are so stable. One potential explanation is that a higher fraction of their spending is dedicated to housing and food which is hardly substitutable,

[11]Note that we use a two-sided Kalman filter therefore these cannot be entirely attributed to the filtering method.

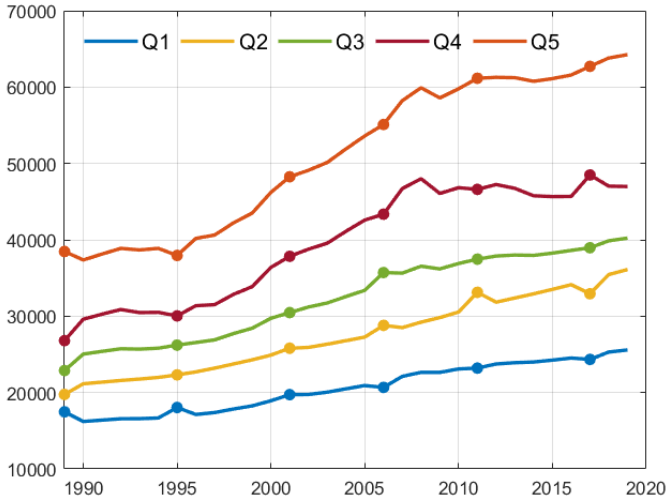


Figure 6: Average consumption by quintiles for France (in euros)

while upper quintiles do spend a higher fraction on travels and entertainments, which are substitutable (see charts 10a and 10b). For the upper quintiles, savings, which are equivalently more volatile, serve as a buffer. For instance, in the latest INSEE survey on income, the Covid measures have been an important benefit that sustained consumption in 2020[12].

As a test of fit of our analysis, we compare the evolution of total consumption in the survey (as obtained by summing up all five quintiles' consumption, which we estimated to get at a yearly frequency) with consumption from the national accounts. We see from figure 7 that the two track each other quite consistently. Having established that our methodology yields a satisfactory yearly database, we now turn to the subject of our focus: the trends in consumption inequality over the past decades.

5 Inequalities in France and in the United States

We present two standard measures of inequality for France and the United States - the Gini coefficient and the ratio of the fifth quintile to the first quintile (Q5/Q1). Three key messages emerge from our analysis: (i) consumption inequality is much lower than income inequality and did not mirror income inequality, (ii) inequality is higher in the United States than France, and (iii) in real terms, there is only slightly more inequality in real consumption than nominal consumption, explained by a very small difference in consumption deflators across the income distribution.

5.1 Does consumption inequality track income inequality?

We compute consumption and after-tax income inequality measures for both countries and compare their evolution. Figures 8a, 8b, 9, and table 2 summarize our main findings.

[12]See for instance the October 2022 report available at https://www.insee.fr/fr/statistiques/6542073.

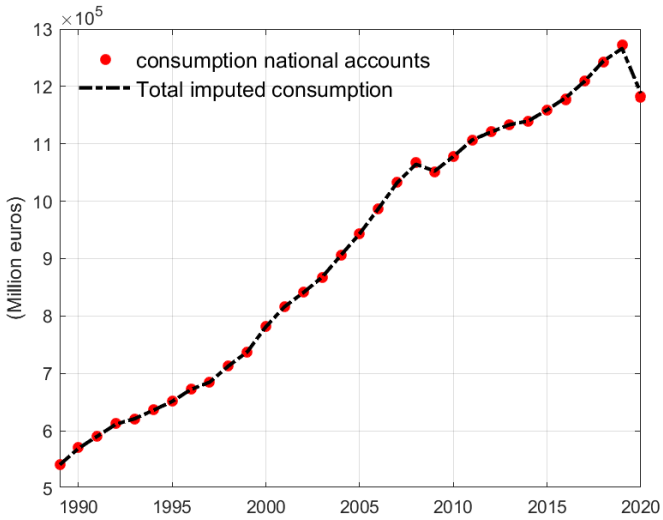


Figure 7: Total consumption in the national accounts and from the BdF survey

Focusing on the Gini index[13], figures 8a and 8b show that consumption inequality is significantly lower than income inequality for both countries. Moreover, its evolution does not mimic the evolution of income inequality. This is more pronounced in the United States (figure 8a), where over the long period we have under scrutiny, consumption inequality has experienced several cyclical variations around a rather stable trend, whereas income inequality has mostly increased. Indeed, while broadly stable over our long sample, on shorter periods of time, consumption inequality has increased sizeably in the US, such as in the begining of the 2000's, before receding. The difference in behavior is especially noticeable during the financial crisis when they went in opposite directions for the US. We recall that we use survey data, which explains the dips in income inequality at the begining and the end of the period for the US. We note that our results on income slightly differ from Bozio et al. (2020) and Piketty et al. (2022). They show that income inquality has continued to increase in the US after 2010. This difference can be explained by the fact that they use fiscal administrative data (and also different inequality indicators). A version of figure 8a based on income data from these authors, disseminated through the World Inequality Database (WID), is presented in figures 16b in the appendix and shows a persistent increase in income inequality in the US, in accordance with the aforementioned studies.

In France, consumption inequality has increased in the earlier period of our sample before slowly receding since the mid to late 2000s (based on both measures of inequality, see figures 8b and 9). When looking over the entire sample from 1989 to 2019, consumption inequality seems to have increased but only slightly. Income inequality, based on our survey measure of disposable income, has had a larger increase between our endpoints. Income inequality experienced a prolonged and steep increase in the earlier part of our sample followed by

[13]Note that our Gini measure most likely estimates inequality with a downward bias as it is based on our quintiles. We are developing an alternative Gini index as in Belz (2019) who generates a distribution from quantiles data to estimate a Lorenz curve.

a relatively steep decrease since the early 2000s, more pronounced than for consumption. Hence, overall, as in Chevalier et al. (2018), consumption inequality did not track income inequality. Similarly as for the US, we present similar statistics based on gross-disposable income data from the World Inequality database. A slightly different picture emerges, in which disposable income inequality followed a more consistent and steeper downward trend, with some cyclical variations (figure 16a in the appendix). Part of the explanation is again the difference in data sources, as Bozio et al. (2020) use administrative data. Morever, lower inequality statistics in the earlier part of our survey sample could stem from a change in income measurement pre- and post-1995. Comparing trends across data sources between 2001 and 2017, we both observe a downward trend in income inequality, consistent across data sources.

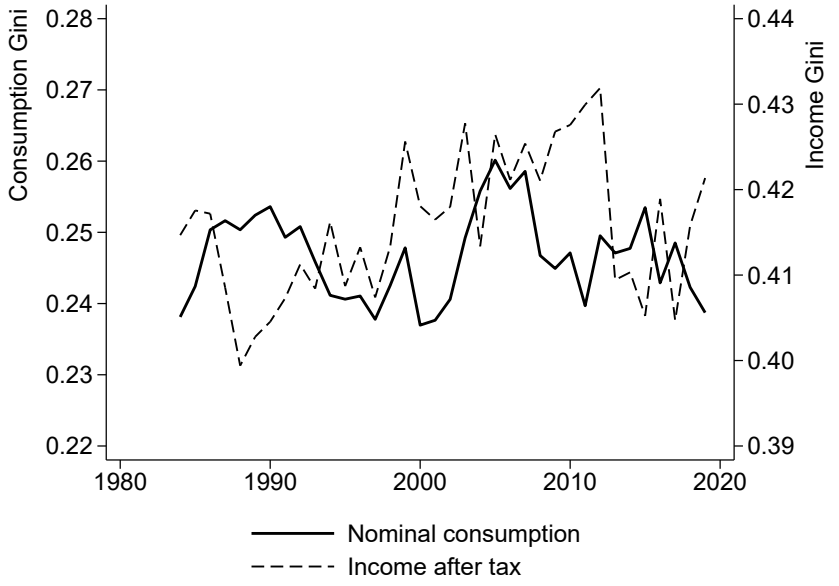
We summarize and compare the evolution of inequality over the long-run in table 2 (based on our survey data for both variables) and across our two measures. Between our first available BdF survey wave and the last one, we observe that over the past 30 years, consumption inequality in France seems to have increased by slightly less than income inequality and remains substantially lower (see table 2). As for the United States, consumption inequality, as measured by the ratio Q5/Q1 consumption, is about the same while it increased for income.

Second, both consumption and income inequality are substantially higher in the US than in France. The US after-tax income Gini is slighly above 0.40, whereas the French one is closer to 0.2-0.25. The US consumption Gini hovers around 0.25, whereas the French one is around 0.17-0.18. This is rather intuitive, as the French system is known to have a strong redistributive policy reducing inequalities in income and therefore consumption. Furthermore, we observe a bigger difference in income inequality than for consumption inequality across these two countries. The ratio of Q5/Q1 consumption is respectively 1.5 bigger in the US than in France, and 3.7 for income. This is in line with Bozio et al. (2020) and Piketty et al. (2022) who have also documented higher income inequality in the US compared to France.

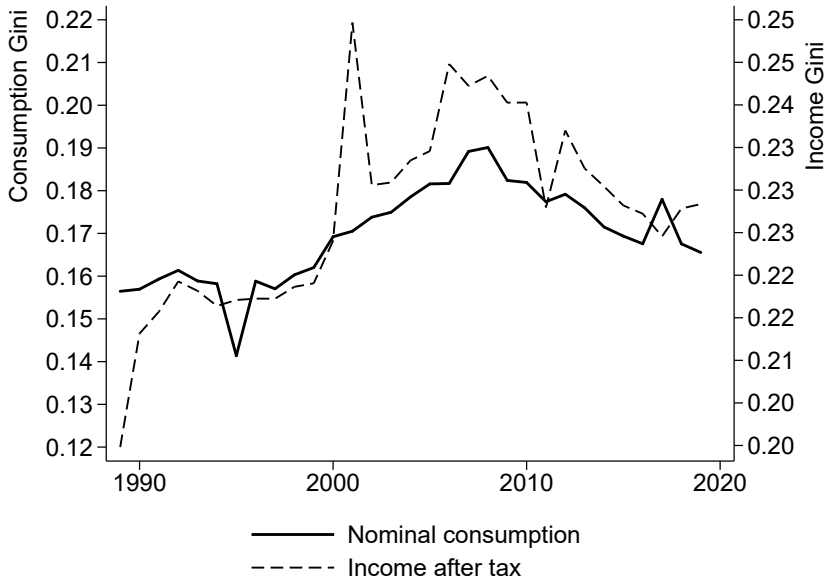
In dynamics, the two countries present different developments as well. If consumption inequality seems to have decreased in France since the late 2000's after a somewhat continous rise starting in 1989 or early 1990s (figure 8b), this trend is less obvious for the US ((figure 8a). Over that same time period, consumption inequality has had more sizeable fluctuations in the US and the inequality statistics in 2017 is still higher than in 2011. A notable difference between the two countries is the dynamics in the build up of the Great Financial Crisis. In the late 2000s, consumption inequality decreased in the United States, despite the rise in income inequality, peaking around 2010. On the contrary, in France, both have been following a downward trend in that same time period. When consumption inequality does not increase as much as income inequality, this might reflect surging indebtedness and financial risk.

Overall, our results are in line with the findings of Aguiar and Bils (2015) and Krueger and Perri (2006) for the United States, who used a demand system to correct for measurement errors in the CEX[14]. As in Chevalier et al. (2018), we observe, for both countries, some stability in consumption inequality, compared to its income equivalent.

[14]Similar studies include Lise and Seitz (2011), Attanasio and Pistaferri (2016) and Heathcote et al. (2009))



(a) United States



(b) France

Figure 8: Consumption vs after-tax income inequality

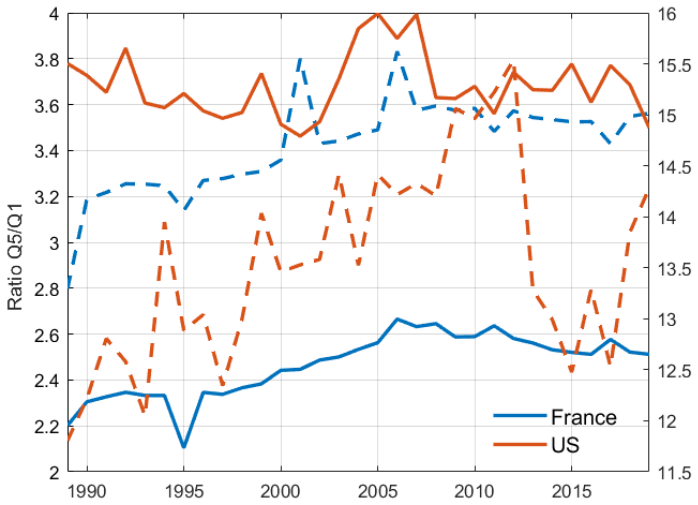


Figure 9: Ratio of Q5/Q1 consumption in France and the United States (full line, left axis) and income (dotted line, left axis for FR, right axis for the US).

Table 2: Evolution of consumption and income inequality

Year	**Income**		**Consumption**	
	Gini	Q5/Q1	Gini	Q5/Q1
1989	0.2	2.70	0.16	2.2
2001	0.25	3.80	0.17	2.39
2017	0.225	3.43	0.178	2.58

(a) France

Year	**Income**		**Consumption**	
	Gini	Q5/Q1	Gini	Q5/Q1
1989	0.409	11.81	0.241	3.78
2017	0.404	12.53	0.249	3.77

(b) United States

5.2 Inflation inequality

We are also interested in real consumption dynamics and thus the price pressures faced by households from different income quintiles. From a monetary policy perspective, central banks target average inflation across the income distribution. However, a common price index may suffer from an aggregation bias. In fact, according to the position in the income distribution, households may actually face significantly different price pressures, as their consumption basket is potentially different. Jaravel (2021) showed that inflation rates decline with household income in the United States.

In a recent speech, Lael Brainard[15] emphasized that indeed, lower-income household spend 77% of their income on necessities compared to 31% for higher-income households (in France, a large portion of income is dedicated to housing and other necessities as well, see figure 10a). Typical inflation indices give weights to products in the basket according to consumption across the economy. In the United States for example, housing and utilities represent on average 20% of total consumption for the top quintile, whereas it counts for 30% of total consumption for the bottom quintile. Also, inside housing, high income households will actually spend a higher proportion on owned houses, whereas poorer households will spend much more on rented houses. Based on the consumer survey in the United States, rents represent on average 17% of consumption for the bottom quintile and only 3% for the top quintile. Moreover, even within the same categories, consumption patterns may differ.

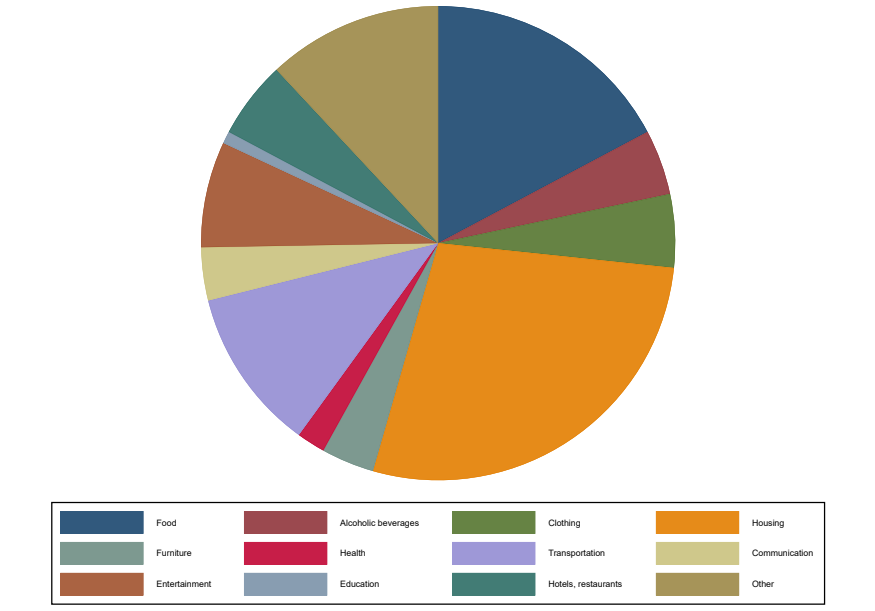
5.2.1 Price indices by quintiles

Therefore, we construct consumption deflators by income quintile to account for these differences in spending patterns that may generate different price deflators. The aim is to provide estimates of real consumption across the income distribution. We bear in mind that we only have the 12 broad consumption categories according to the COICOP classification[16]. This classification is standard for the French statistical system, but less detailed than what is used by INSEE which uses the 86 groupings to get its price index. In accordance with our French data, we thus choose to trim the US data, which is more detailed and is structured under a different classification, so as to match the French nomenclature. The shares of these consumption categories for the first and the fifth quintiles are presented in Figures 10a and 10b, which we discussed previously. Based on the shares of these consumption items in the total consumption expenditure of the corresponding quintile, as well as the average price change of the consumption item, we are able to compute consumption deflators for each of the five income quintiles[17]. They are presented in figure 12a for France and figure 12b for the United States.

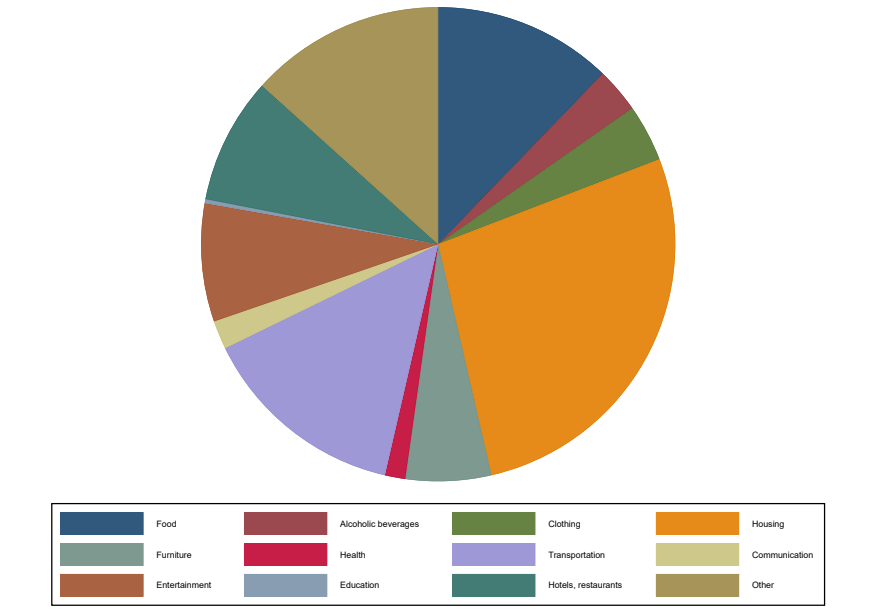
[15] Speech on variation in the inflation experiences of households at the Spring 2022 Institute Research Conference

[16] At least for France, for the US we could go into a more detailed decomposition of consumption, but we chose to be consistent among the two countries.

[17] We follow the methdology of national statistical institutes of using the weights in consumption categories at t to compute the price index of t+1.

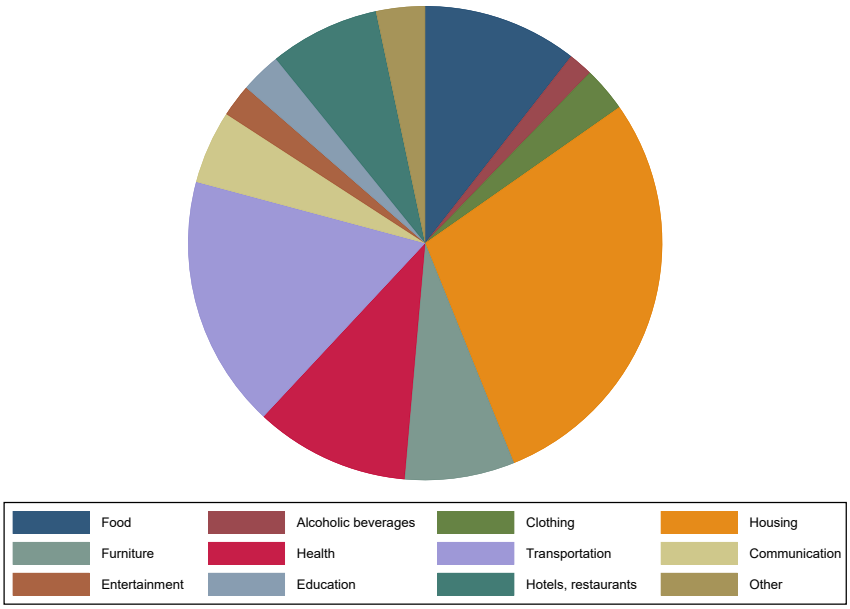


(a) First quintile - France

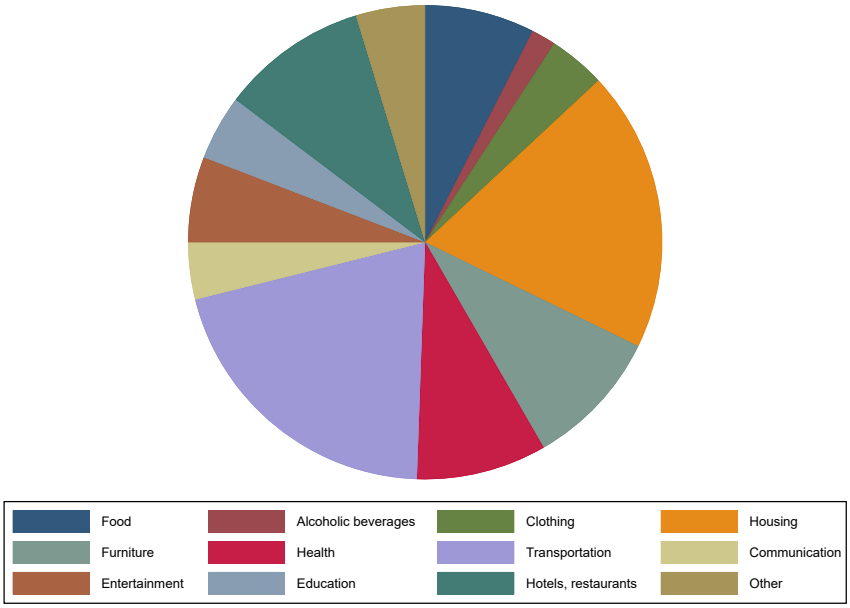


(b) Fifth quintile - France

Figure 10: Consumption by categories for the highest and lowest quintiles (last survey wave)



(a) First quintile - US



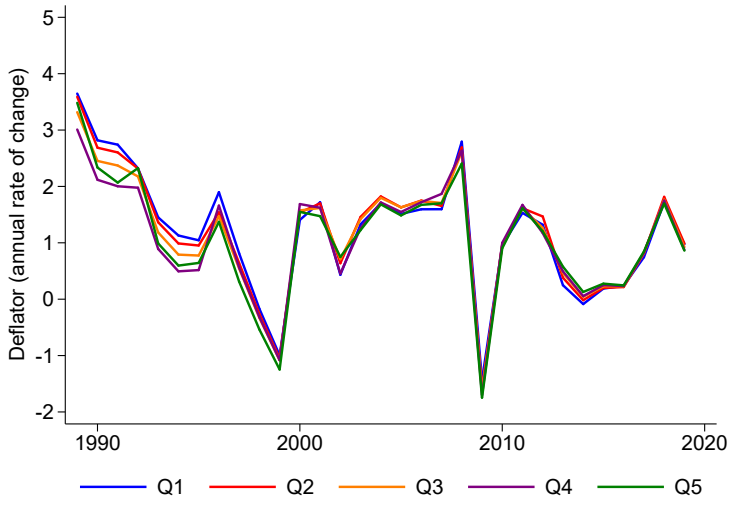
(b) Fifth quintile - US

Figure 11: Consumption by categories for the highest and lowest quintiles (last survey wave)

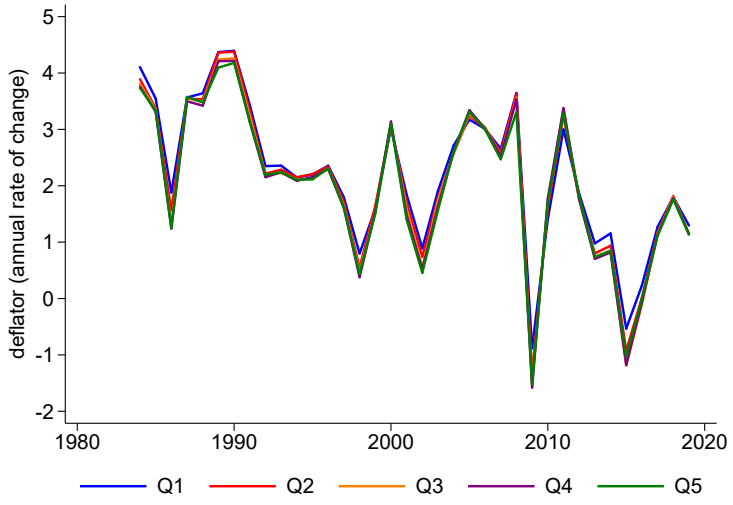
Overall, we see that there is not much difference in price deflators. For the US, we confirm that the top of the income distribution systematically experiences less price increases than the bottom of the distribution (an average of -0.18% per year between quintile 5 and quintile 1 between 2001 and 2019). The differences are small, though. For France, differences arise from time to time. The maximum inter-quintile absolute difference is around half of a percentage point in 1991. There is still a systematic difference in price deflators through time (an average of -0.14% per year between quintile 5 and quintile 1 between 1989 and 2019, hence quite small), with bigger differences in the late 1990s and after 2011. Our results seem in line with the recent literature on inflation inequality. Using Spanish data, Cardoso et al. (2022) find that the dispersion in individual inflation rates across the population is not large enough to generate significant losses or gains in terms of consumption. They do find, however, that individual inflation has a more meaningful impact across the age and not the income distribution, with older individuals suffering the most by the consequences of inflation.

These small differences could be explained by an aggregation bias. Figures 10a and 11a show that consumption patterns using the 12 broad consumption categories according to the COICOP classification are fairly similar across income groups (US housing is an outlier). Therefore, differences in price pressures across income groups should not be very important. For this reason, Jaravel (2021) argues that in order to observe significantly different price pressures, one needs to go into the more detailed structure of the consumption basket. Even within income quintiles, there remains heterogeneity in the consumption baskets, and consumption could depend as well on geographical location. We check this intuition on the US sample, where we do have more detailed structure of the consumption basket. Without going into the microdata, we rely on series aggregated by the BLS by income quintile and can thus compute price indices based on 35 categories of consumption for each quintile (see figure 13). This seems to confirm the fact that the more detailed the consumption basket, the higher the revealed difference in the price indices. For example, based on the 12 COICOP categories, consumer prices have increased 13% for the bottom quintile during the last ten years (2009 to 2019) and 12% for the top quintile. However, when considering a more detailed basket, differences appear slighly larger: prices have increased 18% for the first quintile in the decade up to 2019 versus 15% for the last quintile.

In the construction of our consumption deflators, we use the weights of the consumption items as they appear in the surveys. However, we are also interested in comparing with the official inflation figures, based on the consumer price index. In order to do that and to be able to compute CPI by income quintile, we project the relative differences among the income quintiles observed in the survey to the weights of the CPI basket. More precisely, for each consumption item and each quintile we can compute its share in total consumption by quintile relative to the total population of the survey. Those relative shares indicate how close or how far away is the respective income quintile from the general pattern of consumption observed in the total population. Finally, we can apply those relative shares to the weights of the official CPI basket. This allows us to compute CPI indexes by income quintiles for both France and the US. They are shown in figures 17a and 17b in appendix. As for the deflators, the CPI indexes do not show a meaningful differences among the income quintiles.



(a) France



(b) United States

Figure 12: Consumption deflators by quintile based on the 12 COICOP categories

Figure 13: Consumption deflators by quintile based on 35 consumption categories from the CEX - US

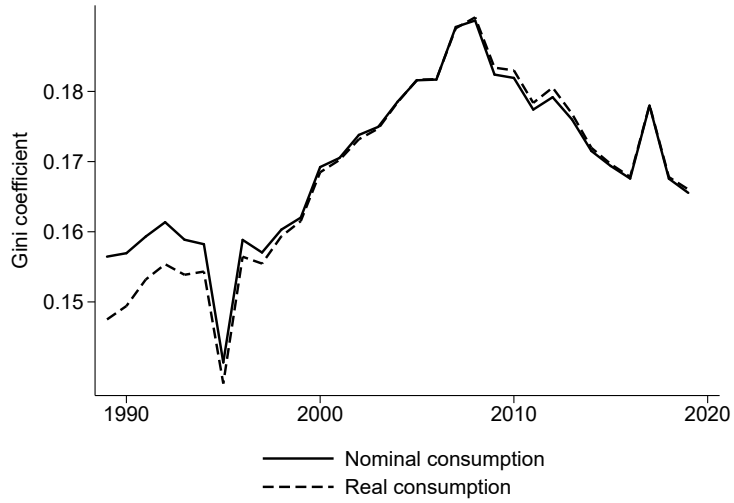
5.2.2 Real consumption inequality

Finally, we focus our attention on real consumption series by income quintile. Gini coefficients based on real consumption are systematically higher than those based on nominal consumption (see figures 14a and 14b). This difference is more obvious for the US, as the shares of the 12 COICOP consumption categories are materially different between the quintiles, leading to more variability in the associated prices indexes, especially cumulated throughout the years. The difference between nominal and real consumption Gini is much lower for France, except between 2005 and 2012, as the quintiles do not experience materially different price indices over our sample.

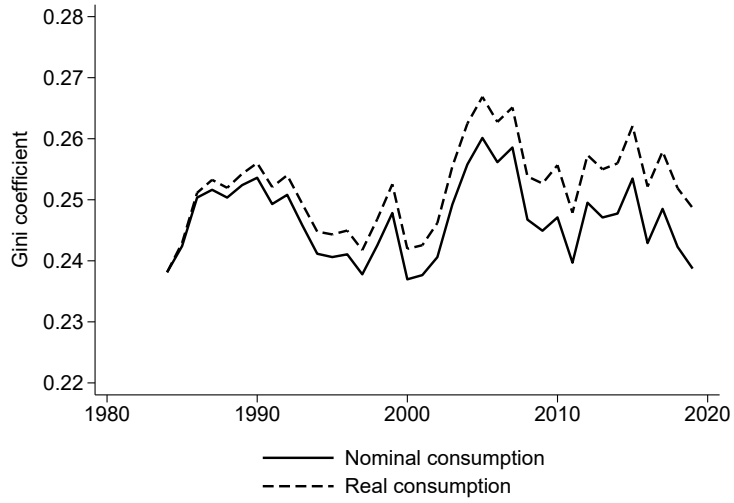
6 Conclusion

Due to household heterogeneity and rising inequality impacting the transmission of monetary policy, inequality is increasingly being taken into account by policy makers when designing economic policies. The distributional consequences of monetary policy have come to the center stage as unconventional monetary policy measures have been generalized in the last decade. Does monetary policy systematically benefit the same categories of households ? To answer this question, the literature has mainly focused on income and wealth inequality (for instance, Kaplan et al. (2018) or Bonifacio et al. (2021)) and only indirectly deducing the impact of monetary policy on consumption inequality, with the exception of Coibion et al. (2017). Studies directly performing and empirical evaluation of the impact of monetary policy (conventional and unconventional) on consumption inequalities are rare, mainly due to the lack of disaggregated consumption data by income distribution and infrequent consumer surveys.

In this paper, we addressed this shortcoming of the literature and developed a methodology to solve the measurement issue of consumption by income quintiles. We show that the



(a) Gini coefficient in France



(b) Gini coefficient in the United States

Figure 14: Comparison of Gini coefficients in France and the United States

Kalman filter methods largely improves on linear extrapolation methods. In particular, when matching consumption from surveys to that of the national accounts, it allows researchers to discipline the Kalman filter in the "missing years", on top of adding yearly income as a regressor. Our analysis shows that when one wants to consider cyclical variations in these variables, linear extrapolation will fall short of capturing those.

Our analysis confirms that looking at consumption inequality provides a different picture than income inequality. Consumption inequality remains overall much lower than income inequality. Also, its dynamics does not seem to mirror the dynamics of income inequality. While income inequality has been rising in the past decades in the United States, it only partially transmitted to consumption inequality, which appears rather stable. In France, on the other hand, income inequality seems to have risen sharply up until the 2000s before a steep decrease, whereas consumption inequality's rise has been more nuanced, followed by a tardier decrease.

Finally, we seeked to investigate how inflation may potentially affect household differently across the income distribution, due to their different consumption baskets. We build consumption deflators by quintile for both France and the US. In the US, prices pressures are indeed higher at the bottom of the income distribution and lower at the top. The picture is more mixed for France. While there is some dispersion across quintiles between 1989 and 1995, with bottom quintiles experiencing higher price pressures than the top, this difference becomes quite small over the rest of the sample. Such small dispersion is probably due to the level of disaggregation that does not capture enough the discrepancies of consumption baskets across quintiles, but as well as government schemes to protect lower income households.

The present methodological article is meant as a first step in the evaluation of the distributional impact of monetary policy. It provides yearly data that will be used to evaluate the effect of monetary policy shocks on consumption inequality. We leave for future research as well the development of a model calibrated with our data so as to rationalize our findings and explain the different dynamics across countries and variables.

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7 Appendix - the methodology of distributional national accounts

The methodology of distributional national accounts (DNA), which we rely on in this paper, is part of a larger exercise that was set up by the OECD, and was performed on household income by Garbinti et al. (2018) in order to measure solely income inequality. The guiding principle is that the information on a specific component of household's income, consumption and savings in the national accounts framework should be drawn from the best microdata available. Indeed, the first DNA for France (Accardo et al. (2009)) used several surveys, namely the SRCV (the SILC survey for France) for the distribution of income and of inter-households transfers, the ERFS (data from administrative sources linked to the Labor Force Survey) for the distribution of property income and of taxes, Enquête Logement (Housing Survey) for the distribution of housing subsidies, Budget de Famille (the French Household Budget Survey) for the distribution of consumption expenses for most of the items in the Coicop nomenclature, Enquête Santé (the Health survey) for the distribution of expenses on health, and some other minor sources.

Such a strategy is probably optimal when working on DNA for a specific year, but less appropriate for DNA spanning over long periods, and particularly decades, which is the focus of our study. The main reason for that is that in most countries, and France in particular, the sources available and the methodology used to draw on them in order to derive the DNA hardly stay unchanged for more than a few years. The greater the number of sources the DNA rely on, the higher the risk that one (or more) of them has changed, possibly significantly, over time. To which extent the changes in the methodology impact the results is in general rather difficult to assess. Moreover, it also complicates considerably the interpretation of the data's patterns. There is thus a trade-off between the number of sources (the broader the sources, the more precise the distributional information available for the DNA for a specific year) and the comparability of DNA across years (more sources usually means more methodological breaks, making the evolution of results "noisier").

As one of the primary aims of this paper is to describe the evolutions of consumption across income quintile over a period of 30 years or more, we give priority to methodological stability over precision of the distibutional aspects. One-source based DNA are also simpler to elaborate than their multi-sources counterparts. In contrast to the methodology followed in the published French DNA studies (Accardo et al. (2009), Accardo et al. (2017)), which by and large comply with the OECD EG DNA Guidelines, we chose to compute the DNA for 1989, 1995, 2001, 2006, 2011, 2017 using only the French HBS. The results in this study for the years 2011 to 2017 may thus differ, in general only marginally, from those already published in the afformentioned studies.

7.1 DNA: an example of construction of consumption and income by category

To illustrate how the DNA approach works in practice, we take the example of consumption expenses on food and (non alcoholic) beverages (C01 in the COICOP nomenclature), and present below the main steps we use to derive this consumption item by income quintile for the year 2017.

According to the national accounts data, the total food and beverages expenses amounted

to 160.2 billion euros in 2017.

The Budget de famille survey in 2017 has a sample of size H = 12 081 households (excluding households living abroad) for a total of 28.6 million households living in France. For each household h, $h = 1, \ldots, H$, let $C01_h$ note the value of its expense on this item (as obtained from summing the expenses listed by each households or provided on their supermarket tickets, expenses that correspond to categories 011 and 012 in table 4).

According to the survey, the extrapolated total of these expenses is:

$$C01 = \sum_{h=1}^{H} w_h C01_h, \tag{12}$$

where w_h is the sampling weight of household h, determined by INSEE. The total was 121.7 billions of euros, that is a 76% coverage of the total national accounts aggregate for this consumption item.

There is 24 % discrepancy, which is explained mainly by restrictions in the survey frame and by under-reporting of consumption by the households in the survey. In the context of the study, we suppose that the missing part is distributed across the households like the observed part. Though it may seems a strong assumption, it can be verified that its impact is quite limited. We therefore rescale the food and beverages consumption from the survey to the total in the national accounts. The rescaled consumption, denoted $C'01_h$ is:

$$C'01_h = \alpha_{01} C01_h, \tag{13}$$

where $\alpha_{01} = 160.2/121.7$ is the scaling factor. The survey now matches exactly the national accounts aggregate for this specific item.

This operation is replicated to all the twelve consumption items of the COCICOP, $C'02, \ldots C'12$. We can therefore compute the total consumption of household h :

$$C'_h = C'01_h + \ldots + C'12_h. \tag{14}$$

Aggregating the C'_h over all the households gives the amount of consumption (COICOP 01 to 12) as found in the national accounts (1,154 billion euros in 2017).

On the income side, these steps are replicated for each component of the gross domestic income (wages, mixed income, property income, benefits,...). In the end, we obtain Y_h, the gross domestic income of each household h and his savings:

$$S_h = Y_h – C'_h.$$

7.2 Classifying consumption by income quintiles

The previous section explained, how, from the 32 elements of the COICOP tables, one could reconstruct consumption for each of the 12 categories, and gross income and for each household h. Having income for each household h, we can then compute income quintiles. All households in the survey $h \in (1, H)$ are thus ranked by income quintile. For each of the 12 consumption COICOP category, we can subsequently obtain 5 means for each quintile.

7.3 Differences in concepts and coverage of BdF and national accounts

Table 3 summarize the main differences in concepts between the survey and national accounts. Corrections linked to differences in coverage were also made. The main difference stems primarily from the fact that BdF covers expenditures made by French households abroad, but do not account for expenditures in France by foreign tourists. Inversely, the national accounts record all expenses made on the French territory. It is possible to implement a territorial correction on national accounts expenditures so as to get consumption net of foreign tourists' expenditures and accounting for French households' spendings abroad. The difficulty in implementing such correction is that the variable "territorial balance" which corresponds to the difference between purchases abroad of residents and purchases in France of non-residents is not available by COICOP category. d'Albis and Badji (2017) circumvent this problem by ventilating the territorial balance among consumer items more likely to be concerned by touristic spendings (hotels, restaurants, leisure activities and transports) using the repartition key as in the tourism satellite account.

Table 3: Difference in concepts between BdF and National Accounts

COICOIP	**BdF**	**National Accounts**
01 Food products	no self-consumption	with self-consumption
02 Alcoholic beverages and tobacco	no self-consumption	with self-consumption
04 Housing	imputed rents not included for owners	inputed rents included
06 Health	remaining expenses of households	remaining expenses of households and reimbursements by private and mutual insurance
07 Transports	all purchases including to a private individual households actual expenditures	intermediary's margin of merchant households actual expenditures and charged expenses of insurers
09 Culture and hobbies	entire package price	tour operators' margin other expenses are in restauration, transports and housing
12 Other goods and services	premium paid by households services directly mesured and paid by households	premium net of received compensation SIFIM and other financial services

7.4 COICOP categories - harmonization between France and the United States

Table 4: Product nomenclature of French National Accounts

	COICOP category
Food	011
Non-alcoholic beverages	012
Alcoholic beverages	021
Tobacco	022
Clothing	031
footwear	032
Actual rentals for housing	041
Imputed rents	042
Regular maintenance and repair of the dwelling	043
Other services related to the dwellings	044
Electricity, gas and other fuels	045
Furniture, furnishings and decorations, carpets and other floor coverings and repairs	051
Household textiles	052
Household appliances	053
Glassware, tableware and household utensils	054
Tools and equipment for house and garden	055
Goods and services for routine household maintenance	056
Medical products, appliances and equipment	061
Outpatient services	062
Hosptical services	063
Purchase of vehicle	071
Sale of vehicle	071bis
Operation of personal transport equipment	072
Transport services	073
Communications	081
Audio-visual, photographic and information processing equipment	091
Other major durables for recreation and culture	092
Other recreational items and equipment, gardens and pets	093
Recreational and cultural services	094
Newspapers, books and stationery	095
Package holidays	096
Education	10
Catering services	111
Accomodation services	112
Personal care	121
Personal effects n.e.c	123
Social protection	124
Insurance	125
Financial services n.e.c	126
Other services	127

Table 5: Household final consumption in national accounts and Budget de Famille survey

Consumption (in billions)	**Matched with National Accounts**	**Original Survey**	**Difference**
2017	1209.0	761.7	37%
1	141.85	101.06	
2	191.96	125.72	
3	227.06	144.40	
4	282.60	171.19	
5	365.51	219.34	
2011	1106.8	695.8	37.1%
1	127.39	90.42	
2	181.90	119.50	
3	205.74	129.26	
4	255.93	156.63	
5	335.83	199.95	
2006	987.1	698.9	29.2%
1	111.12	90.14	
2	154.79	113.74	
3	191.96	133.13	
4	233.04	159.33	
5	296.18	202.59	
2001	816.5	553.7	32.2%
1	99.35	73.07	
2	129.97	90.06	
3	153.48	104.95	
4	190.61	126.54	
5	243.06	159.08	
1995	651.18	641.48	1.5%
1	87.29	90.55	
2	107.99	107.57	
3	126.84	123.94	
4	145.39	141.73	
5	183.67	177.69	
1989	540.81	565.26	4.5%
1	75.37	82.42	
2	85.21	89.79	
3	98.70	102.62	
4	115.59	119.56	
5	165.94	170.87	

Table 6: Household consumption categories in the United States. Matching of CEX categories with the COICOP classification

	COICOP	**CEX survey categories**
1	Food	Food at home
2	Alcoholic beverages and tobacco	Alcoholic beverages
		Tobacco products and smoking supplies
3	Clothing	Apparel and services
4	Housing	Owned dwellings less Property tax
		Rented dwellings
		Electricity
		Natural gas
		Fuel oil and other fuels
		Water and other public services
5	Furniture	Household furnishings and equipment
		Housekeeping supplies
		Household operations
6	Health	Health insurance
		Medical services
		Drugs: Prescription and nonprescription
		Medical supplies
7	Transportation	Vehicle purchases: Cars and trucks, new
		Vehicle purchases: Cars and trucks, used
		Other vehicle purchases
		Gasoline, other fuels, and motor oil
		Vehicle insurance
		Vehicle maintenance and repairs
		Vehicle renting, leasing, licence, other charges
		Public and other transportation
8	Information and communication	Telephone services
		Audio and visual equipment and services
9	Recreation, sport and culture	Entertainment less Audio and visual equipment and services
		Reading
10	Education	Education
11	Restaurants and accomodation	Food away from home
		Other lodging
12	Other goods and services	Personal care products and services
		Life and other personal insurance
		Miscellaneous expenditures

8 Appendix - summary statistics and complementary figures

Table 7: Absolute average annual change (in dollars, United States)

	Q1	Q2	Q3	Q4	Q5
Income	358,6	797,828571	1344,77143	2121,28571	5435,42857
Consumption	686,714286	780,171429	984,857143	1292,68571	2023,42857

Note: the sample spans 1984-2019. Income is after-tax income.

Table 8: Relationship between income and consumption (United States)

	Coef.	Std. Err.	t-stat
C5 - I5	0.95112	0.00038	2512.46627
C1 - I1	0.25313	0.00003	9036.71500

Note: Regression coefficients from a regression based on the pseudo 5-year frequency data. The sample spans 1984-2019. Income is after-tax income.

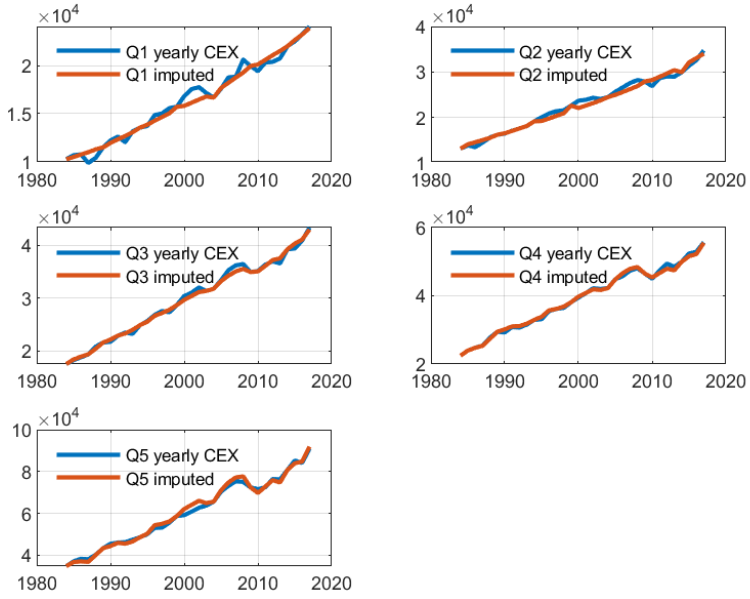
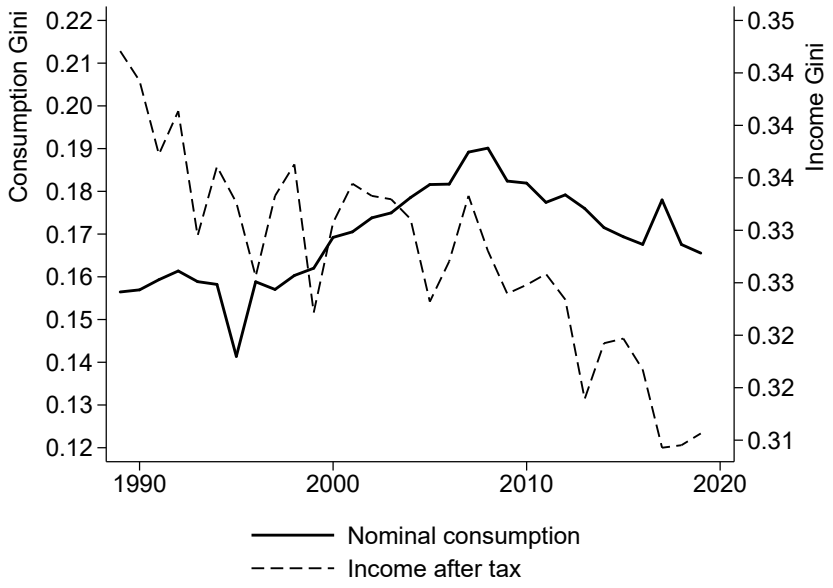
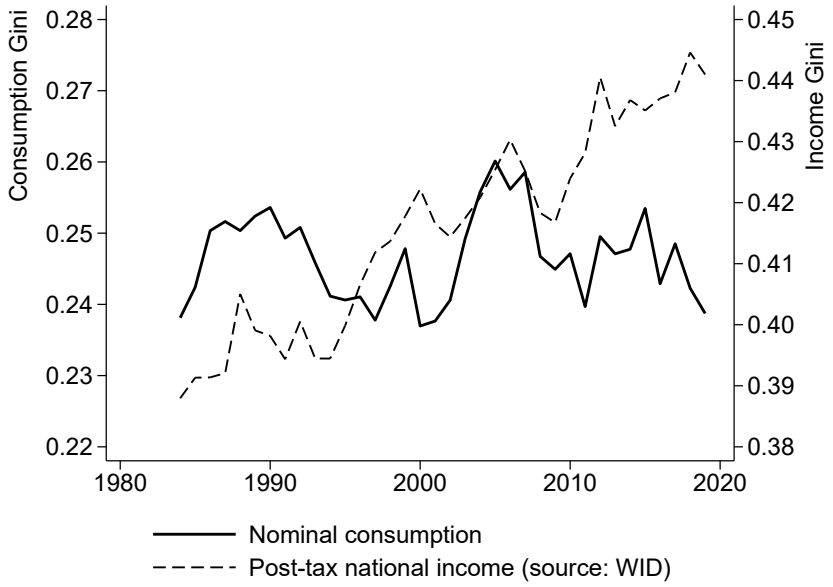


Figure 15: Kalman filter without income (United States)

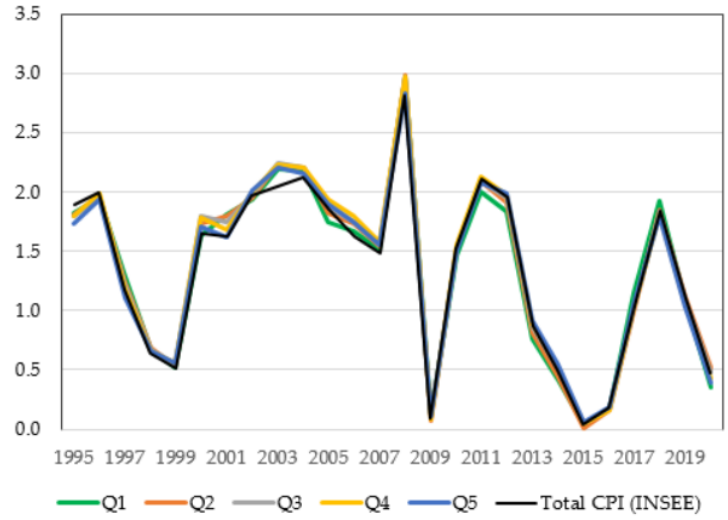


(a) France

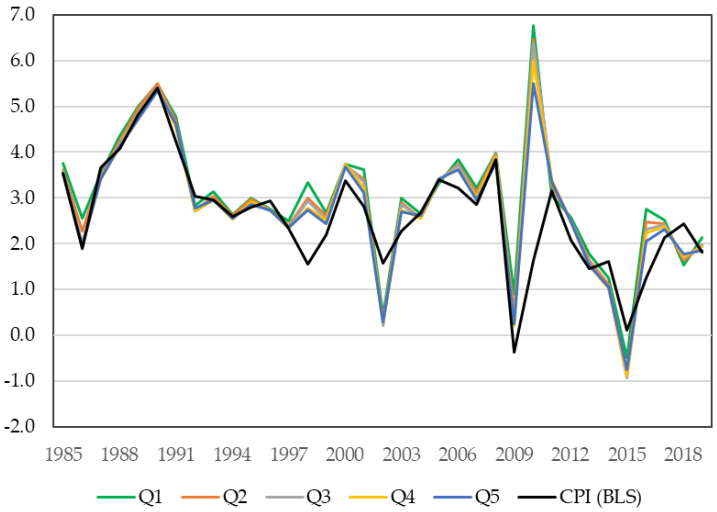


(b) United States

Figure 16: Consumption (from household budet survey) vs after tax income inequality (from the WID)



(a) France



(b) United States

Note: The computed CPIs by income quintile for the US are sometimes significantly different from the official CPI because of the imperfect matching of broad category price indexes with the COICOP classification. This is particularly visible during the Great Financial Crisis. We are currently working on improving this matching.

Figure 17: CPI indexes by income quintiles