Measuring and comparing consumption inequality in France and the United States

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*Views are my own and do not represent the position of the Banque de France or the Eurosystem.*
Consumption inequality

- Inequality is at the forefront of policy debates, especially following the Covid-19 crisis and the rise of inflation

Most research has focused on income and wealth inequality, partly because of highly granular data (from administrative sources), and of the scarcity of micro data on consumption.

But consumption is what matters in micro-founded models (e.g., Krueger et al. 2016) for measuring welfare.
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2. \textbf{Comparison with the US} by constructing a dataset compatible with the French nomenclature

3. We build a \textit{price index by quintile}

⇒ This paper is a first step within a broader agenda of evaluating the \textit{impact of monetary policy on inequality}
Methodological contribution

- Building a consumption series from the infrequent “Budget de Famille” survey (every 5 years) consistent with the national accounts

- Pairing each entry in BdF with the national account COICOP category, rescaling for consistent aggregates

- Estimates harmonized over time and across countries, they also allow to build price indices by quintile

- To fill missing years, discipline a Kalman filter with a regression component (income by quintile) and linear constraints, leveraging on the yearly national accounts data

- Sum of quintile consumption must equate national accounts aggregate

- We validate the technique by doing counterfactuals with the US data

- Outperforms linear interpolation
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Key take aways

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2. **Consumption inequality did not mirror income inequality** over our sample period
   - US: Rise in income inequality while consumption inequality did not increase
   - FR: Overall decrease of income inequality in France since 2000s, while consumption inequality rather increased

3. Higher inequality in the US than in France with different dynamics
   - Ratio Q5/Q1 for consumption is 1.5 times bigger, and 3.5 for income

4. No evidence of inflation inequality (with our level of disaggregation)
   - More visible with higher level of disaggregation (US)
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Related literature

1. Long-run inequality analyses
   - Most focus on income (Boiron 2016, Heathcote 2010) or wealth (Piketty and Zucman 2014)
   - Consumption inequality in France: Accardo et al. (2009, 2017), Chevalier et al. (2018) focus on few survey waves

2. Measurement issues in surveys, dissensus caused by difference in data sources or definitions:
   - Measurement errors (Aguiar and Bills (2015)), gap with national accounts (Garner et al. 2006)
   - Subset of consumption (Meyer and Sullivan 2017)
   - Our measure consistent with national accounts partly corrects for these measurement errors
Data
Survey Budget de Famille - France

- Cross-section of households (sample $S \approx 25000$, respondents $S \approx 15000$)
- Every 5 years since 1979 in its current format (but available since 1972), our sample starts in 1995
- Questionnaires for durables over a year, and two booklets about non-durables over 2 weeks
- Nomenclature of items in the BdF survey (around 900 items) following Eurostat norms (COICOP) since 2001
- Information about income (labor income, rents, etc)
Product nomenclature of French national accounts

<table>
<thead>
<tr>
<th>Category</th>
<th>COICOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>011</td>
</tr>
<tr>
<td>Non-alcoholic beverages</td>
<td>012</td>
</tr>
<tr>
<td>Alcoholic beverages</td>
<td>021</td>
</tr>
<tr>
<td>Tobacco</td>
<td>022</td>
</tr>
<tr>
<td>Clothing</td>
<td>031</td>
</tr>
<tr>
<td>Footwear</td>
<td>032</td>
</tr>
<tr>
<td>Actual rentals for housing</td>
<td>041</td>
</tr>
<tr>
<td>Imputed rents</td>
<td>042</td>
</tr>
<tr>
<td>Regular maintenance and repair of the dwelling</td>
<td>043</td>
</tr>
<tr>
<td>Other services related to the dwellings</td>
<td>044</td>
</tr>
<tr>
<td>Electricity, gas and other fuels</td>
<td>045</td>
</tr>
<tr>
<td>Furniture, furnishings and decorations, carpets and other floor coverings and repairs</td>
<td>051</td>
</tr>
<tr>
<td>Household textiles</td>
<td>052</td>
</tr>
<tr>
<td>Household appliances</td>
<td>053</td>
</tr>
<tr>
<td>Glassware, tableware and household utensils</td>
<td>054</td>
</tr>
<tr>
<td>Tools and equipment for house and garden</td>
<td>055</td>
</tr>
<tr>
<td>Goods and services for routine household maintenance</td>
<td>056</td>
</tr>
<tr>
<td>Medical products, appliances and equipment</td>
<td>061</td>
</tr>
<tr>
<td>Outpatient services</td>
<td>062</td>
</tr>
<tr>
<td>Hospital services</td>
<td>063</td>
</tr>
<tr>
<td>Purchase of vehicle</td>
<td>071</td>
</tr>
<tr>
<td>Sale of vehicle</td>
<td>071bis</td>
</tr>
<tr>
<td>Operation of personal transport equipment</td>
<td>072</td>
</tr>
<tr>
<td>Transport services</td>
<td>073</td>
</tr>
</tbody>
</table>
Product nomenclature of French national accounts

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
Accommodation 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
Consumer Expenditure Surveys - United States

- Available at yearly frequency, from 1984 to 2019
- Sample of 14,000 per year
- Based on two surveys: the quarterly Interview Survey for major and/or recurring items and the Diary Survey for more minor or frequently purchased items
- Provides data on income, expenditures and demographic characteristics of consumers
Constructing survey consumption consistent with NA

Building on Accardo et al. (2009, 2017):

1. **Identification in the consumption entry** of the survey, the corresponding COICOP category in the national accounts
   - Each household’s consumption is distributed among the 12 categories
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4. We proceed **similarly for income**
   - Ranking households by income to get consumption by quintiles
Consumption: survey vs national accounts

<table>
<thead>
<tr>
<th>Consumption (in billions)</th>
<th>Matched with National Accounts</th>
<th>Original Survey</th>
<th>Difference without matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>1178,80</td>
<td>732,85</td>
<td>37.8%</td>
</tr>
<tr>
<td>1</td>
<td>137,89</td>
<td>97,19</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>187,02</td>
<td>121,18</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>222,46</td>
<td>138,93</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>275,13</td>
<td>164,49</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>356,31</td>
<td>211,07</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>1079,14</td>
<td>710,38</td>
<td>34.1%</td>
</tr>
<tr>
<td>1</td>
<td>125,49</td>
<td>92,93</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>177,52</td>
<td>121,66</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>200,02</td>
<td>132,43</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>250,11</td>
<td>159,61</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>326,00</td>
<td>203,75</td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>964,48</td>
<td>729,71</td>
<td>24.3%</td>
</tr>
<tr>
<td>1</td>
<td>109,34</td>
<td>94,02</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>152,06</td>
<td>118,96</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>187,27</td>
<td>138,88</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>227,39</td>
<td>166,09</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>288,43</td>
<td>211,75</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>799,70</td>
<td>617,05</td>
<td>22.8%</td>
</tr>
<tr>
<td>1</td>
<td>98,61</td>
<td>81,59</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>127,37</td>
<td>100,25</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>150,25</td>
<td>116,96</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>187,09</td>
<td>141,57</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>236,38</td>
<td>176,69</td>
<td></td>
</tr>
</tbody>
</table>

- Like with CEX (Garner et al. 2006), increasing gap between survey and national account without pairing and rescaling
Consumption: survey vs national accounts

Without this matching: under estimate the consumption of the top 3 quintiles, and over estimate that of the bottom quintiles → under-estimating inequality

Different readjustment across quintiles and years → a biased estimate of the evolution of consumption inequality

Note: Consumption in BdF survey matched with national accounts (full line), and consumption from BdF survey only (dotted line)
Bridging missing years - Kalman filter
Kalman filter

- Multivariate Kalman filter with a linear constraint and a regression component

- State equation:

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

where \( u_t \sim N(0, Q) \)
Kalman filter

- **Measurement equation:**

\[
\begin{bmatrix}
C_{1,t} \\
C_{2,t} \\
C_{3,t} \\
C_{4,t} \\
C_{5,t} \\
C_{total_t}
\end{bmatrix} = \begin{bmatrix}
A_{1,1} & 0 & 0 & 0 & 0 & 0 \\
0 & A_{2,2} & 0 & 0 & 0 & 0 \\
0 & 0 & A_{3,3} & 0 & 0 & 0 \\
0 & 0 & 0 & A_{4,4} & 0 & 0 \\
0 & 0 & 0 & 0 & A_{5,5} & 0 \\
A_{1,1} & A_{2,2} & A_{3,3} & A_{4,4} & A_{5,5}
\end{bmatrix} \begin{bmatrix}
X_{1,t} \\
X_{2,t} \\
X_{3,t} \\
X_{4,t} \\
X_{5,t}
\end{bmatrix} + \begin{bmatrix}
\beta_{1,1} \\
\beta_{2,2} \\
\beta_{3,3} \\
\beta_{4,4} \\
\beta_{5,5}
\end{bmatrix} \begin{bmatrix}
l_{1,t} \\
l_{2,t} \\
l_{3,t} \\
l_{4,t} \\
l_{5,t}
\end{bmatrix} + \begin{bmatrix}
B_{1,1} & 0 & 0 & 0 & 0 & 0 \\
0 & B_{2,2} & 0 & 0 & 0 & 0 \\
0 & 0 & B_{3,3} & 0 & 0 & 0 \\
0 & 0 & 0 & B_{4,4} & 0 & 0 \\
B_{1,1} & B_{2,2} & B_{3,3} & B_{4,4} & B_{5,5}
\end{bmatrix} \nu_t,
\]

where \( \nu_t \sim N(0, H) \)

- **Linear equality constraint on national accounts**
- **Income by quintile as regression component**
Kalman filter

▶ Measurement equation:

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

where \( \nu_t \sim N(0, H) \)

▶ Linear equality constraint on national accounts

▶ Income by quintile as regression component
Kalman filter

★ Measurement equation:

\[
\begin{bmatrix}
C_{1,t} \\
C_{2,t} \\
C_{3,t} \\
C_{4,t} \\
C_{5,t} \\
\text{C}_{\text{total},t}
\end{bmatrix}
= \begin{bmatrix}
A_{1,1} & 0 & 0 & 0 & 0 \\
0 & A_{2,2} & 0 & 0 & 0 \\
0 & 0 & A_{3,3} & 0 & 0 \\
0 & 0 & 0 & A_{4,4} & 0 \\
0 & 0 & 0 & 0 & A_{5,5}
\end{bmatrix}
\begin{bmatrix}
X_{1,t} \\
X_{2,t} \\
X_{3,t} \\
X_{4,t} \\
X_{5,t}
\end{bmatrix}
+ \begin{bmatrix}
\beta_{1,1} & 0 & 0 & 0 & 0 \\
0 & \beta_{2,2} & 0 & 0 & 0 \\
0 & 0 & \beta_{3,3} & 0 & 0 \\
0 & 0 & 0 & \beta_{4,4} & 0 \\
0 & 0 & 0 & 0 & \beta_{5,5}
\end{bmatrix}
\begin{bmatrix}
l_{1,t} \\
l_{2,t} \\
l_{3,t} \\
l_{4,t} \\
l_{5,t}
\end{bmatrix}
+ \begin{bmatrix}
B_{1,1} & 0 & 0 & 0 & 0 \\
0 & B_{2,2} & 0 & 0 & 0 \\
0 & 0 & B_{3,3} & 0 & 0 \\
0 & 0 & 0 & B_{4,4} & 0 \\
0 & 0 & 0 & 0 & B_{5,5}
\end{bmatrix}
\nu_t,
\]

where \( \nu_t \sim N(0, H) \)

★ Linear equality constraint on national accounts

★ Income by quintile as regression component
Estimating missing years

Once the model parameters are estimated → we can estimate the latent variables

The KF operates to find optimal estimates of $X_t \sim N(a_t, P_t)$

The KF computes the conditional mean $a_t$ and variance $P_t$ of the distribution of $X_t$ conditional on observations up to time $t$

When data is available, the KF estimates $X_{t+1}$ using the estimates of the current state and the current observation $Y_t$ by estimating

$$a_{t+1} = Da_t + K_t(Y_t - AX_t)$$
$$P_{t+1} = DP_tD' + Q.$$

where $K_t$ is the Kalman gain

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

$$a_{t+1} = Da_t$$
$$P_{t+1} = DP_tD' + Q$$
Estimating missing years

- Then we use the measurement equation to predict $Y_t$

\[ \hat{y} = AX_t \]
How to assess our technique?

- Is the constraint enough to discipline the Kalman filter? Are series consistent?
- Why not just use linear interpolation?
- CEX data for the US offer us a counterfactual
- We simulate infrequent series as for France, with a 5-year gap
- Estimate the Kalman filter to impute missing years
Validating with US data

- Based on counterfactual US data, the Kalman filter outperforms linear interpolation
- Better match of cyclical variations, and lower RMSE
Validating with US data

- Closer match for upper quintiles (partly due to higher weight in total consumption)
Getting yearly consumption by income quintiles for France

- Higher cyclicality of upper quintiles consumption, similar to the US
Comparison with national accounts

![Graph comparing consumption national accounts and total imputed consumption over time](image)

- **Consumption national accounts**
- **Total imputed consumption**
Inequality statistics
Consumption did not mirror income inequality (US)

- Consumption inequality lower than income inequality
- Over the long period we study, cyclical variations of consumption inequality around a rather stable trend
- Income inequality has increased from the late 80’s to the beginning of the 2010’s before recently receding
Consumption did not mirror income inequality (FR)

- Consumption inequality lower than income inequality
- As in Chevalier (2018), C&I inequality did not track each other, especially so during GFC when they went in opposite directions
- Overall both on decreasing trends even if consumption inequality increased in the earliest part of the sample (and income did not)
Higher inequality in the US

Table 1: France

<table>
<thead>
<tr>
<th>Year</th>
<th>Income</th>
<th></th>
<th>Consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gini</td>
<td>Q5/Q1</td>
<td>Gini</td>
<td>Q5/Q1</td>
</tr>
<tr>
<td>1995</td>
<td>0.217</td>
<td>3.14</td>
<td>0.14</td>
<td>2.1</td>
</tr>
<tr>
<td>2001</td>
<td>0.25</td>
<td>3.80</td>
<td>0.17</td>
<td>2.39</td>
</tr>
<tr>
<td>2017</td>
<td>0.225</td>
<td>3.42</td>
<td>0.178</td>
<td>2.58</td>
</tr>
</tbody>
</table>

Table 2: United States

<table>
<thead>
<tr>
<th>Year</th>
<th>Income</th>
<th></th>
<th>Consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gini</td>
<td>Q5/Q1</td>
<td>Gini</td>
<td>Q5/Q1</td>
</tr>
<tr>
<td>1995</td>
<td>0.409</td>
<td>12.88</td>
<td>0.241</td>
<td>3.64</td>
</tr>
<tr>
<td>2017</td>
<td>0.404</td>
<td>12.53</td>
<td>0.249</td>
<td>3.77</td>
</tr>
</tbody>
</table>

- Results hold regardless of the measure of income we use for France (WID vs BdF)
- Difference of the ratio Q5/Q1 for consumption is 1.5 times bigger in the US compared to FR, and 3.6 for income
Deflator across income quintiles (United States)

- No striking difference, unless we go into higher level of disaggregation
Deflator across income quintiles (France)
Real consumption inequality (United States)
Real consumption inequality (France)
Building price indices (FR)
Building price indices (FR)
Concluding remarks

- Addressed shortcomings of infrequent micro data on consumption
- Analysing inequality through consumption provides a different perspective than through income
- **Consumption inequality** is much lower than income inequality
- **Consumption inequality did not mirror income inequality**
  - US: rise in income inequality over past decades but consumption inequality rather stable
  - FR: decrease of income inequality over the long run, whereas consumption inequality has only started to decrease during the last decade
- Both inequalities are higher in the US than in France
- **No difference in inflation experiences** across income quintiles
Next steps

- Data
  - Higher level of disaggregation (around 60 functions) for France
  - Extend time series
  - Bring in wealth to study how fluctuations in income and wealth transmit to consumption

- Analysis of the impact of monetary policy
- Rationalize data with a model
Thank you!
Dynamics in the US vs France
Deflator across income quintiles (United States)
Consumption structure Q1 vs Q5 (US)
Consumption structure Q1 vs Q5 (FR)
Price index measure

Computation of the IPC (INSEE)

\[ IPC = \sum_{i=1}^{12} \rho_i \text{pond}_i IPC_i \]

where \( \text{pond}_i \) are CPI weights, and \( \rho_i \) is ratio of Q1 share of i’s consumption in Q1 total consumption, over share of all households.