Project 2

Public Finance in Macroeconomics

Handed in by the **Heterogeneous Geeks**

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Project in the context of Prof. Ludwig's course:
Public Finance in Macroeconomics: Heterogenous Agent Models
at the Graduate School of Economics, Finance and Management

Problem 1: Summary statistics

Overall summary statistics per quarter

In the following we display summary statistics for several income and consumption measures per quarter. It can be seen that there are no large differences between the quarters.

Summary statistic: Q1

	(1)				
	count	mean	sd	min	max
grinc	67256	25143.1	22681.59	-87243	423388
netinc	67256	22951.4	20433.84	-150095	419146
food	67256	786.0634	576.6163	0	16297
ndcons1	67256	2462.707	1726.737	-3471	80621
ndcons2	67256	1837.486	1238.897	0	76066
ndconsserv	67256	3200.584	2011.449	-955	92337
totcons	67256	5264.832	4453.095	21	99117

Summary statistic: Q2

	(1)				
	count	mean	sd	min	max
grinc	69977	25463.11	23011.49	-103380	458989
netinc	69977	23243.73	20730.42	-149037	392936
food	69977	788.8158	555.1464	0	12553
ndcons1	69977	2356.858	1812.279	-7076	239060
ndcons2	69977	1859.186	1241.181	0	72106
ndconsserv	69977	3113.207	2130.612	-2502	273149
totcons	69977	5139.756	4362.793	6	209945

Summary statistic: Q3

	(1)				
	count	mean	sd	min	max
grinc	69120	25521.63	22901.41	-74324	493857
netinc	69120	23324.9	20708.01	-96769	488306
food	69120	821.0327	619.2579	0	27748
ndcons1	69120	2396.207	1688.581	-1479	87488
ndcons2	69120	1876.569	1307.911	0	85746
ndconsserv	69120	3181.598	1962.694	9	104964
totcons	69120	5340.207	4526.06	10	95017

Summary statistic: Q4					
	(1)				
	count	mean	sd	min	max
grinc	69832	25074.24	22810.13	-79767	490997
netinc	69832	22906.24	20568.11	-151223	485479
food	69832	801.4539	604.5863	0	20376
ndcons1	69832	2389.181	1719.842	-587	81867
ndcons2	69832	1838.99	1295.954	0	80393
ndconsserv	69832	3160.204	2019.21	0	94223
totcons	69832	5248.625	4517.338	23	112698

Means and Std. Dev. of Income and Consumption for every year

These tables can be compared to Mace's Table 1, where she also displayed means and standard deviations of income and consumption per quarter. There are some fluctuations between the years, but we can not depict (strong) trends.

Means and Std. Dev. of Income and Consumption per Quarter: 1986							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	22928.69	20870.65	760.0554	2441.876	1791.88	2981.48	5098.07
Q1: sd	19949.06	17919.71	541.0302	1717.273	1165.669	1843.647	4251.055
Q2: mean	23158.6	21098.72	776.7445	2343.511	1821.369	2917.572	4942.413
Q2: sd	19792.5	17989.47	561.4477	1581.072	1157.793	1732.475	4170.994
Q3: mean	23782.22	21648.72	809.8611	2415	1857.543	3005.142	5252.02
Q3: sd	20360.05	18431.12	599.9109	1676.038	1229.673	1818.714	4371.297
Q4: mean	23316.32	21244.39	785.83	2414.285	1826.325	2967.699	5183.977
Q4: sd	20231.56	18288.26	631.8824	1827.297	1324.605	1883.496	4672.035

Means and Std. Dev. of Income and Consumption per Quarter: 1987							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24703.96	22481.76	753.3457	2475.105	1802.057	3043.314	5214.511
Q1: sd	21167.65	19274.02	524.2484	1768.885	1126.387	1993.51	4560.501
Q2: mean	24575.25	22385.11	757.3883	2308.06	1803.536	2897.491	4893.032
Q2: sd	21333.2	19362.98	501.1873	1468.841	1113.911	1697.801	3951.9
Q3: mean	24732.74	22518.2	785.5384	2353.153	1813.237	3011.168	5208.587
Q3: sd	21297.46	19123.08	592.1846	1640.765	1204.211	1822.665	4448.497
Q4: mean	24276.66	22149.25	769.4199	2345.781	1782.96	2954.019	5056.564
Q4: sd	21491.23	19042.57	584.7579	1724.667	1286.097	1873.548	4243.51

Means and Std. Dev. of Income and Consumption per Quarter: 1988							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24759.28	22604.65	849.2856	2514.612	1870.996	3109.353	5210.896
Q1: sd	21364.95	19087.56	627.2075	1662.4	1152.631	1875.889	4143.386
Q2: mean	25199.38	23080.82	830.6603	2443.75	1905.772	3087.021	5211.907
Q2: sd	21680.61	19620.07	540.4691	1678.809	1279.852	1820.909	4496.818
Q3: mean	25322.76	23168.26	880.5835	2486.039	1924.128	3115.169	5395.279
Q3: sd	21539.88	19488.49	640.2726	1656.639	1228.69	1823.02	4427.774
Q4: mean	24729.7	22637.7	842.9052	2477.967	1882.379	3139.577	5286.163
Q4: sd	21307.85	19461.88	600.5489	1726.43	1258.28	1891.931	4443.387

Means and Std. Dev. of Income and Consumption per Quarter: 1989							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	25134.98	22984.72	831.3942	2557.194	1885.251	3220.424	5405.543
Q1: sd	21127.19	18669.21	601.7823	1765.814	1279.077	2047.868	4622.78
Q2: mean	25758.43	23422.14	842.5981	2460.583	1929.769	3149.738	5213.64
Q2: sd	21386.99	18881.59	596.5169	1715.295	1291.121	1951.337	4483.029
Q3: mean	26064.72	23638.46	887.8205	2492.387	1934.926	3200.323	5423.378
Q3: sd	21933.05	19309.78	681.0802	1739.644	1320.36	1986.518	4495.807
Q4: mean	25982.65	23544.33	868.1642	2518.272	1920.977	3214.608	5485.146
Q5: sd	22174.84	19532.65	635.1744	1708.873	1259.93	1992.146	4738.081

Means and Std. Dev. of Income and Consumption per Quarter: 1990							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	25803.6	23380.89	840.4301	2607.137	1927.758	3270.691	5479.21
Q1: sd	21404.81	18980.74	630.9163	1761.589	1251.608	2011.21	4324.508
Q2: mean	25716.01	23213.96	829.1843	2425.521	1900.098	3116.924	5221.865
Q2: sd	21212.75	18538.62	618.5536	1684.874	1290.96	1983.067	4400.979
Q3: mean	25438.94	23082.92	860.3252	2449.873	1896.263	3153.175	5296.789
Q3: sd	20849.49	18458.89	664.2596	1653.481	1208.798	1816.135	4180.959
Q4: mean	24803.68	22473.37	832.4756	2412.751	1838.265	3109.633	5173.744
Q4: sd	21000.14	18482.6	589.5517	1821.933	1388.868	2023.538	4392.326

Means and Std. Dev. of Income and Consumption per Quarter: 1991							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24975.32	22605.77	800.2889	2477.681	1820.023	3117.52	5222.492
Q1: sd	21097.76	18785.36	562.2103	1839.082	1223.371	1916.69	4488.512
Q2: mean	25315.45	22941.9	804.57	2350.949	1843.287	2991.598	5046.793
Q2: sd	21698.39	18822.3	565.6856	1552.695	1152.793	1660.356	4225.524
Q3: mean	25373.41	23069.93	823.4392	2415.168	1878.252	3100.509	5281.461
Q3: sd	20934.61	18983.86	658.9628	1904.36	1516.832	1872.023	4437.687
Q4: mean	24989.83	22498.55	811.2563	2414.514	1852.002	3087.545	5200.312
Q4: sd	21183.87	18838.84	579.7322	1688.031	1248.358	1892.839	4429.157

Means and Std. Dev. of Income and Consumption per Quarter: 1992							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	25375.38	22861.14	802.4549	2462.749	1838.735	3151.983	5292.708
Q1: sd	21501.97	19151.14	637.3413	1681.015	1198.108	1913.371	4552.254
Q2: mean	25200.62	22635.18	785.4282	2312.851	1822.749	3038.352	5047.498
Q2: sd	21427.69	18702.41	550.501	1578.78	1181.916	1871.003	4236.07
Q3: mean	24953.33	22567.81	831.8611	2378.08	1852.705	3124.879	5246.206
Q3: sd	21025.94	18768.16	604.1733	1653.93	1239.718	1884.181	4533.098
Q4: mean	24093.89	21861.97	802.9755	2337.094	1794.812	3072.031	5072.401
Q4: sd	20640.18	18289.29	599.9186	1620.976	1192.454	1879.829	4178.667

Means and Std. Dev. of Income and Consumption per Quarter: 1993							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24571.03	22378.39	789.5066	2434.482	1810.718	3160.911	5122.149
Q1: sd	20904.8	18770.66	560.8535	1676.667	1148.956	1879.259	4179.187
Q2: mean	25142.99	22881.01	795.6595	2304.313	1828.915	3069.542	5006.52
Q2: sd	20802.24	18553.41	558.765	1469.99	1149.458	1732.495	4015.317
Q3: mean	24685.55	22486.27	812.4122	2327.11	1827.866	3129.052	5171.352
Q3: sd	20724.97	18612.37	570.0805	1561.343	1185.52	1729.743	4297.731
Q4: mean	24300.59	22046.3	806.663	2360.266	1813.603	3129.518	5185.775
Q4: sd	20568.08	18305	647.5273	1689.969	1232.334	1810	4313.164

Means and Std. Dev. of Income and Consumption per Quarter: 1994							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24782.1	22507.31	793.5588	2429.878	1824.422	3158.402	5200.715
Q1: sd	20931.42	18600.21	586.045	1661.089	1167.629	1837.309	4524.832
Q2: mean	24766.76	22416.28	791.5228	2357.135	1862.334	3086.785	5106.191
Q2: sd	20682.33	18139.65	559.1688	1559.797	1187.704	1743.129	4260.487
Q3: mean	25579.16	23210.33	826.7253	2417.129	1901.653	3184.718	5387.315
Q3: sd	21024.45	18731.05	597.4303	1642.469	1275.439	1876.199	4395.636
Q4: mean	25213.2	22942.41	817.3022	2404.35	1857.001	3196.552	5379.223
Q4: sd	20871.06	18580.81	638.2467	1665.769	1229.814	1873.869	4502.113

Means and Std. Dev. of Income and Consumption per Quarter: 1995							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24747.57	22599.85	771.1531	2413.067	1811.679	3167.844	5206.738
Q1: sd	20298.93	18403.14	571.6958	1674.362	1282.915	1867.239	4206.062
Q2: mean	25023.2	22795.86	788.8549	2301.223	1830.212	3036.425	4984.423
Q2: sd	20411.27	18381.42	575.4093	1446.312	1130.546	1721.824	3829.689
Q3: mean	24684.86	22507.44	822.7456	2348.907	1866.328	3170.994	5250.724
Q3: sd	19966.08	17928.54	609.7089	1511.661	1195.729	1825.44	4199.59
Q4: mean	24252.98	22063.13	792.8547	2338.166	1818.621	3133.908	5188.793
Q4: sd	20324.44	18268.5	589.6303	1567.667	1211.83	1824.173	4466.131

Means and Std. Dev. of Income and Consumption per Quarter: 1996							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24111.75	22080.47	787.3182	2445.454	1855.57	3191.436	5164.047
Q1: sd	24847.49	22807.04	646.1621	1686.524	1255.996	1954.455	4322.775
Q2: mean	24533.61	22538.11	763.7795	2320.194	1859.753	3138.992	5115.269
Q2: sd	23564.96	21742.27	513.8307	1648.895	1350.164	1979.574	4481.633
Q3: mean	25209.92	23088.63	800.0744	2353.003	1871.745	3200.991	5283.583
Q3: sd	23745.33	21653.69	638.6665	1682.415	1336.637	2101.881	4772.052
Q4: mean	24754.65	22580.25	776.4584	2312.611	1806.158	3112.374	5150.086
Q4: sd	23390.97	21031.74	613.2382	1579.422	1220.633	1971.22	4683.266

Means and Std. Dev. of Income and Consumption per Quarter: 1997							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	24971.12	22826.87	752.2901	2396.855	1808.71	3180.444	5158.025
Q1: sd	23183.53	20902.58	515.5727	1623.771	1190.73	2010.116	4196.288
Q2: mean	25391.52	23269.43	775.873	2322.327	1854.183	3147.475	5093.795
Q2: sd	24258.85	21966.09	547.1438	1516.73	1200.287	1931.449	4087.951
Q3: mean	25397.61	23336.85	803.0108	2355.372	1873.323	3241.551	5228.842
Q3: sd	23926.94	21692.57	568.4638	1529.345	1215.975	1971.292	4250.063
Q4: mean	25477.09	23401.82	790.6224	2363.345	1836.061	3278.551	5273.88
Q4: sd	24683.55	22563.73	631.9774	1629.681	1219.078	2149.682	4430.772

Means and Std. Dev. of Income and Consumption per Quarter: 1998							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	25277.11	23209.56	756.8901	2390.66	1808.698	3280.347	5162.431
Q1: sd	24692.52	22468.94	554.6807	1616.888	1222.899	2050.247	4245.867
Q2: mean	26126.04	23949.71	768.386	2322.424	1851.735	3249.881	5164.764
Q2: sd	26083.21	23571.35	565.3187	1516.332	1173.794	1975.732	4399.977
Q3: mean	26007.33	23888.17	793.4855	2379.487	1887.261	3321.756	5415.176
Q3: sd	24661.92	22170.25	596.4515	1615.994	1292.928	1993.377	4542.593
Q4: mean	25582.04	23550.94	767.9859	2357.934	1846.141	3290.945	5230.762
Q4: sd	24590.18	22156.98	561.7782	1612.069	1227.995	2212.564	4569.021

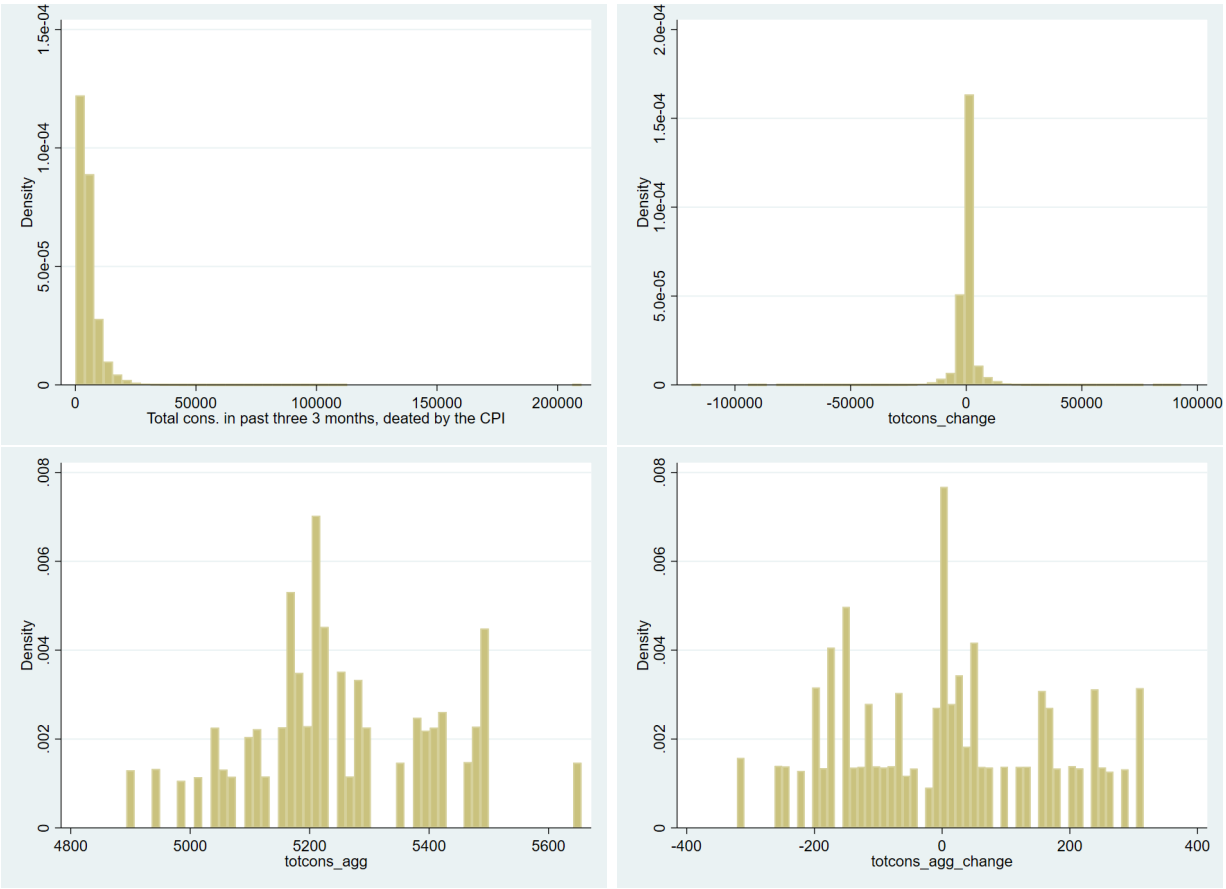
Means and Std. Dev. of Income and Consumption per Quarter: 1999							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	26319.47	24191.82	749.5738	2426.738	1849.003	3398.832	5383.542
Q1: sd	26543.77	23822.28	546.148	1638.348	1195.15	2118.345	4748.844
Q2: mean	27558.12	25464.93	757.3571	2391.167	1881.099	3355.025	5416.811
Q2: sd	28247.59	25886.98	512.1985	3449.101	1508.723	4057.798	5164.439
Q3: mean	27568.35	25411.96	796.8256	2405.541	1907.485	3377.465	5655.266
Q3: sd	28917.84	26547.33	667.6292	2019.582	1731.204	2508.424	5387.097
Q4: mean	27163.7	25071.98	789.1186	2407.219	1877.975	3365.568	5459.781
Q4: sd	28373.43	26036.68	594.001	2029.247	1683.668	2552.557	4858.13

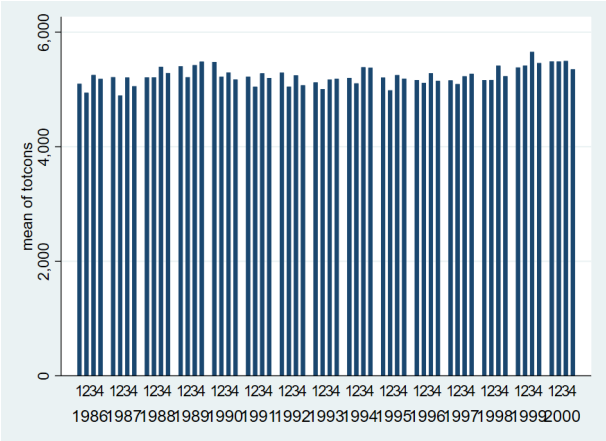
Means and Std. Dev. of Income and Consumption per Quarter: 2000							
	grinc	netinc	food	ndcons1	ndcons2	ndconsserv	totcons
Q1: mean	27037.14	25045.13	767.2417	2462.09	1851.007	3429.086	5490.222
Q1: sd	27117.16	24854.23	550.0558	1985.224	1558.669	2465.768	4968.221
Q2: mean	27559.08	25521.79	783.6921	2378.779	1890.158	3325.094	5487.897
Q2: sd	27188.37	24964.24	558.542	1646.359	1292.736	2030.788	4686.515
Q3: mean	27248.07	25354.76	802.4585	2374.29	1864.772	3333.618	5496.493
Q3: sd	27069.02	24933.42	580.0577	1661.217	1217.803	2055.361	4678.143
Q4: mean	26520.02	24713.21	783.3201	2368.349	1831.737	3314.711	5351.18
Q4: sd	26410.95	24358.75	563.317	1696.248	1233.987	2087.961	4637.982

Histograms and bar plots

We visualised variables of consumption and income by histograms. The histograms on the left display the absolute value and the absolute value of the aggregate measure once for the whole sample. The histograms on the right display the change and the aggregate change of the measure. The bar plots on the left display the mean of the measure per quarter per year. The bar plots on the right display the mean of the change of the measure per quarter per year. All in all, the plots underline what we've already seen in the summary statistics provided above: There are some fluctuations within and between years, but otherwise consumption is remarkably stable. It can be seen that there is a small positive trend in gross as well as net average income.

Total consumption

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4,000
6,000
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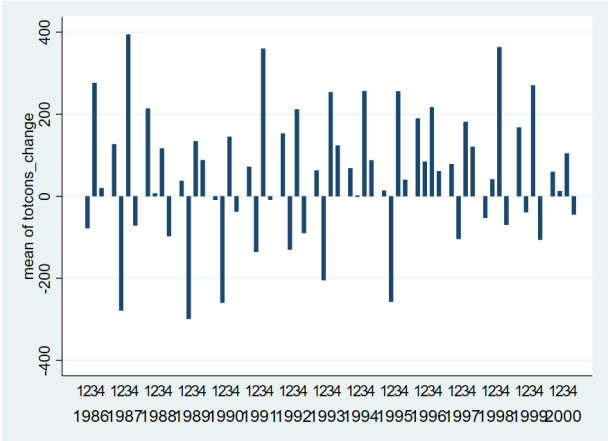
mean of totcons_change
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-200
0
200
400
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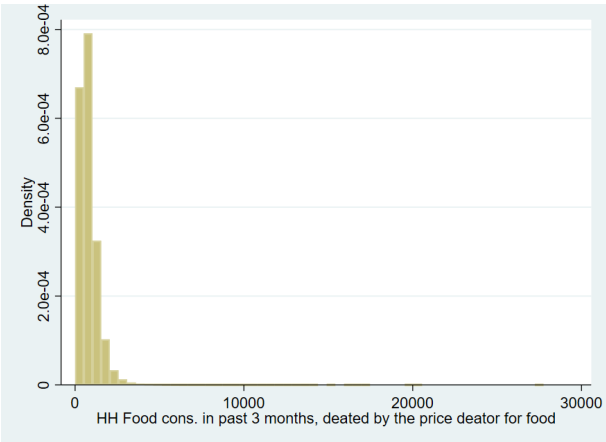
Food


Density
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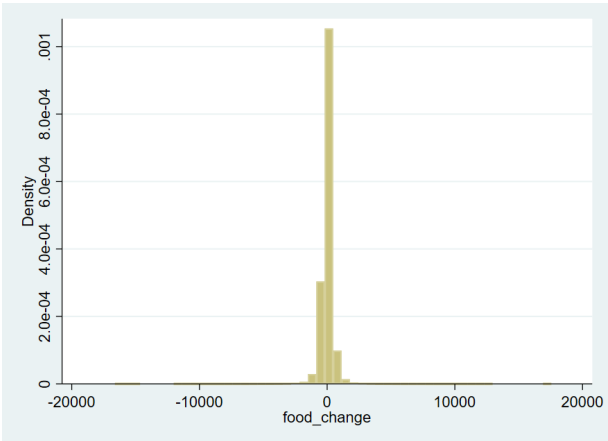
4.0e-04
6.0e-04
8.0e-04
0
10000
20000
30000
HH Food cons. in past 3 months, deated by the price deator for food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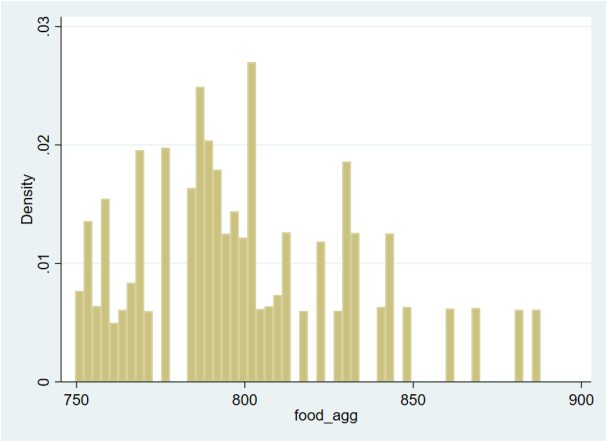
20000
food_change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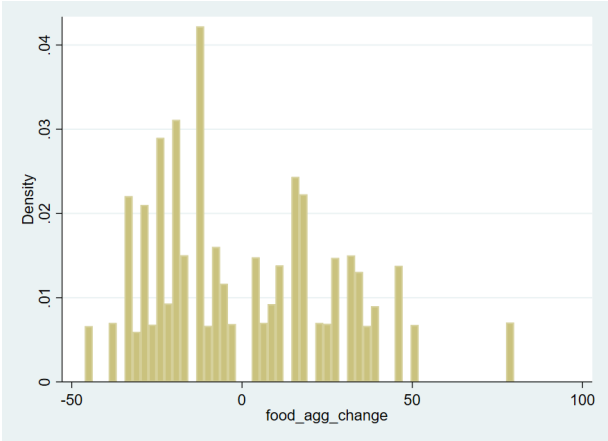
800
850
900
food_agg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.02
.03
.04
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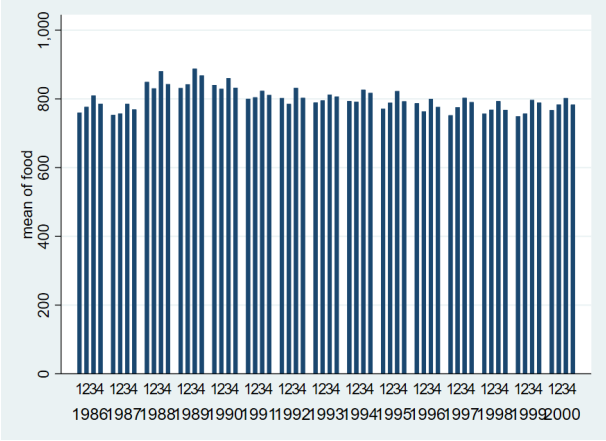
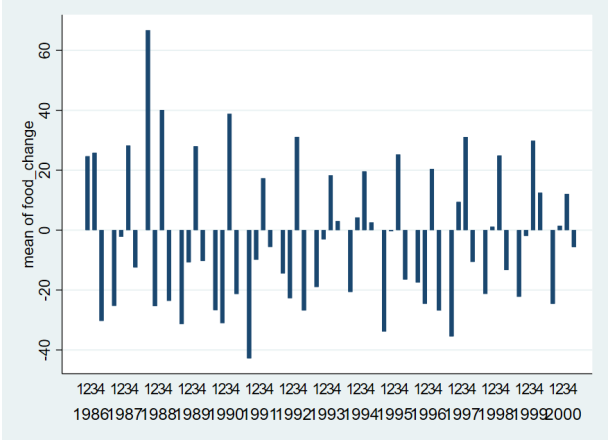
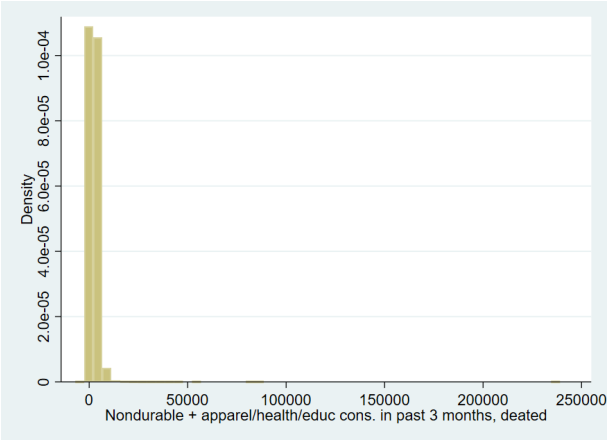
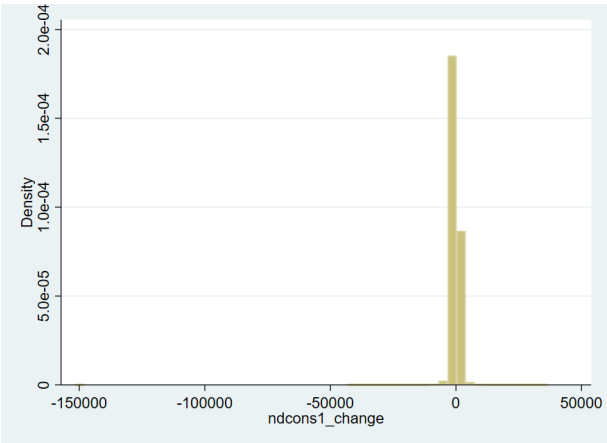
0
50
100
food_agg_change

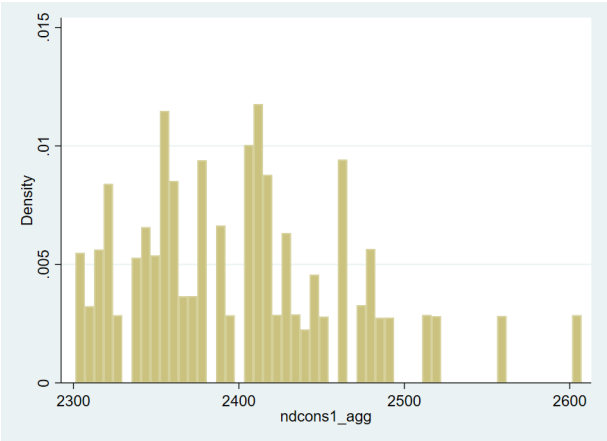

mean of food
0
200
400
600
800
1,000
1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000

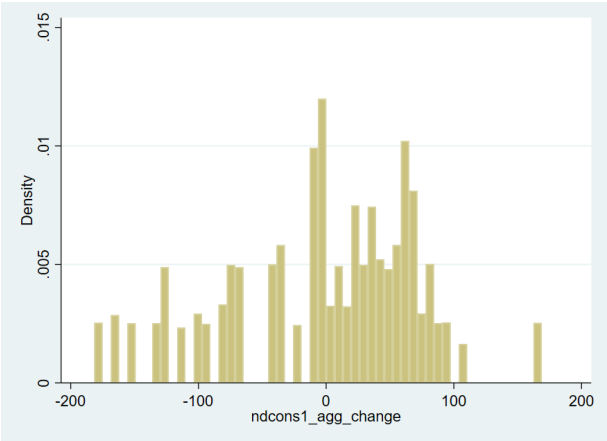

mean of food_change
-40
-20
0
20
40
60
1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234 1234
1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000

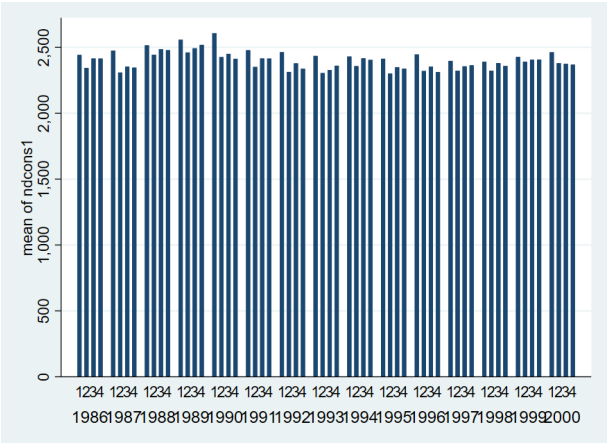
Nondurable consumption expenditures

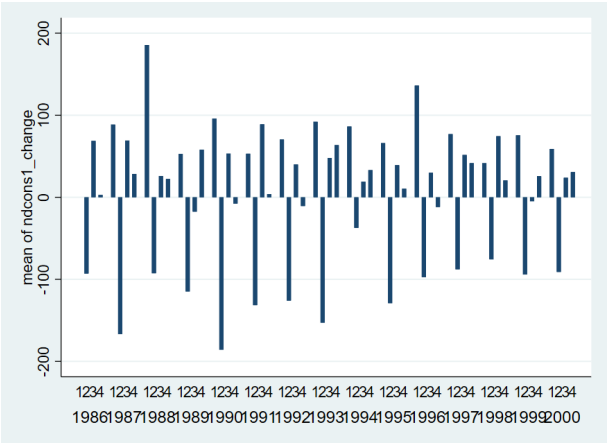






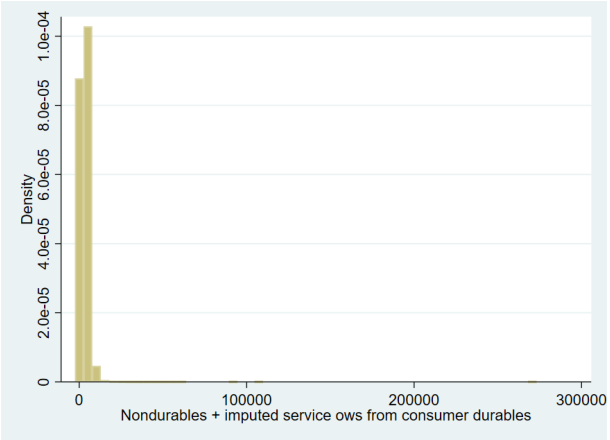


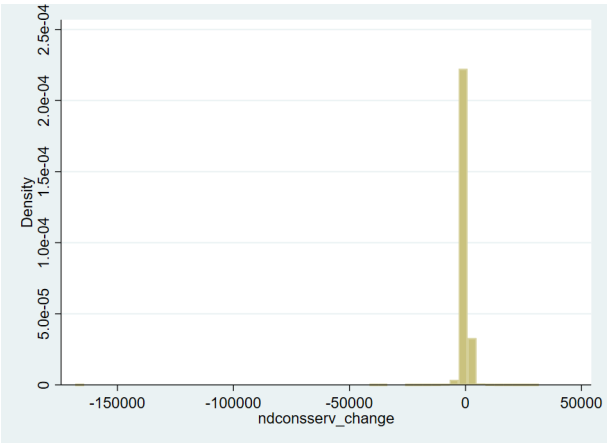


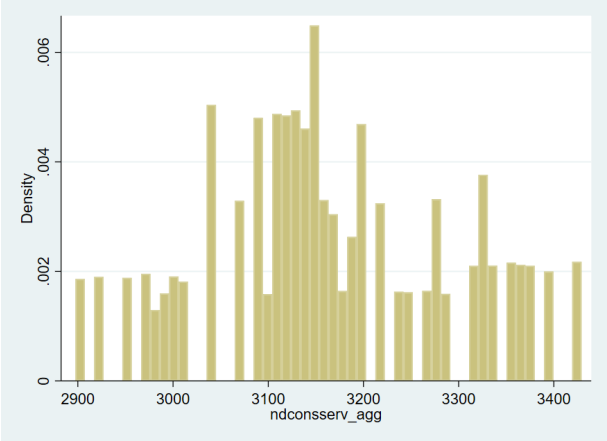


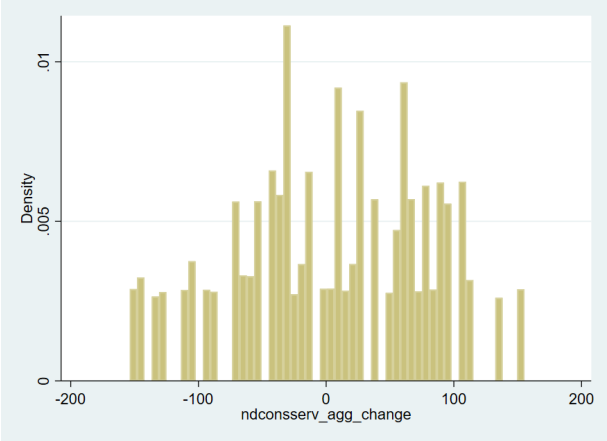
Strictly nondurable consumption expenditures

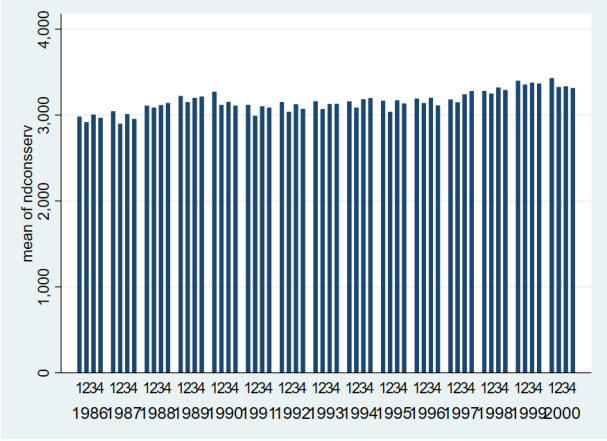
Nondurables plus imputed service flows from consumer durables

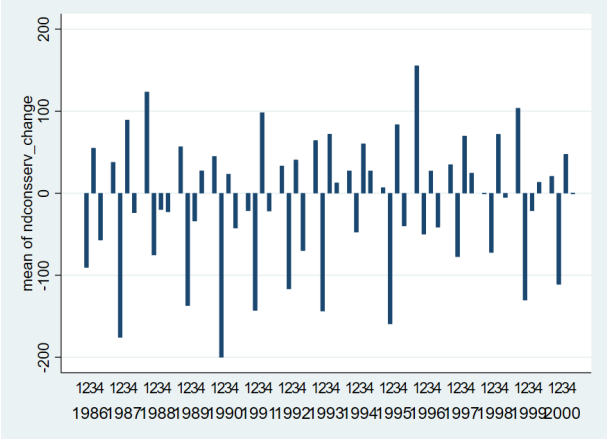




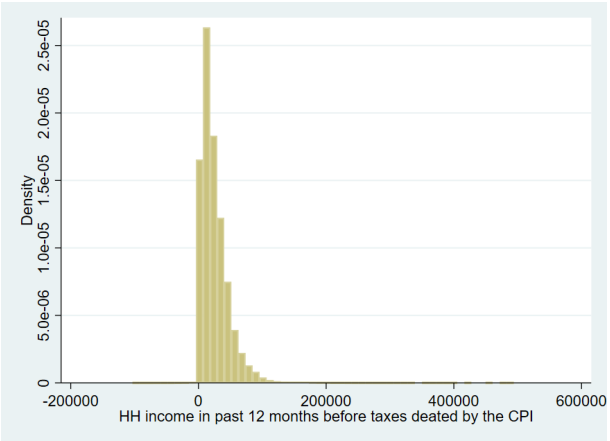


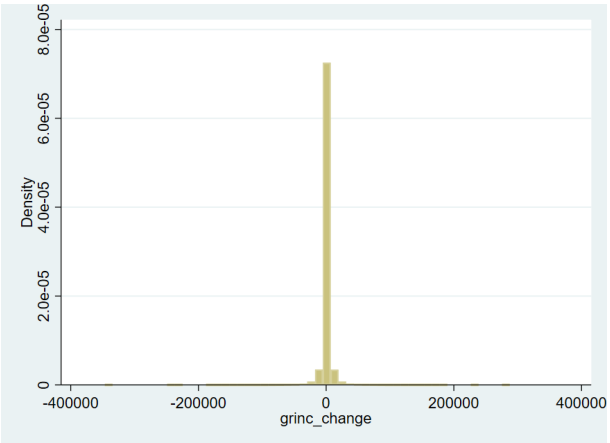


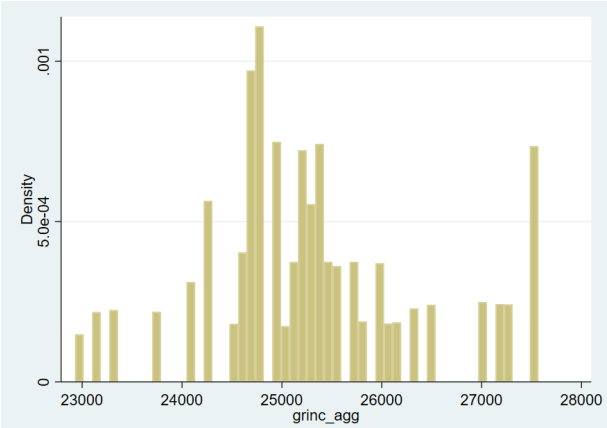


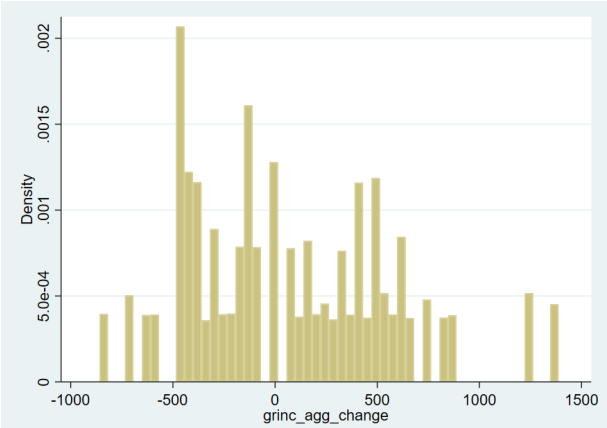


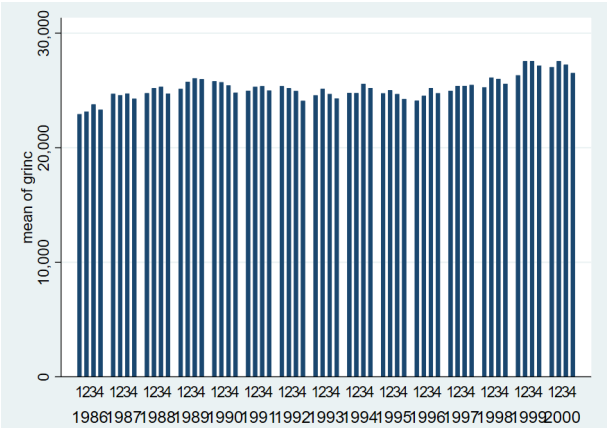
Household income before taxes

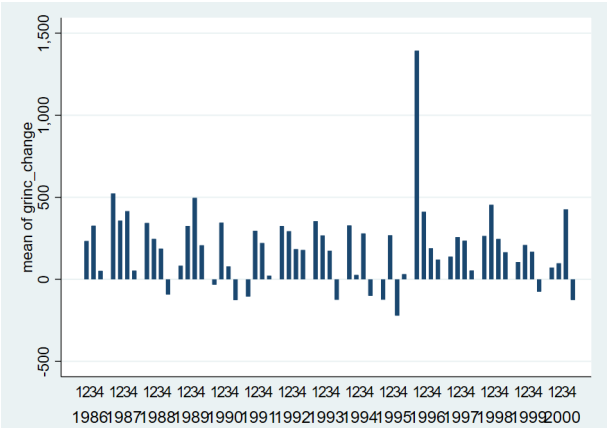




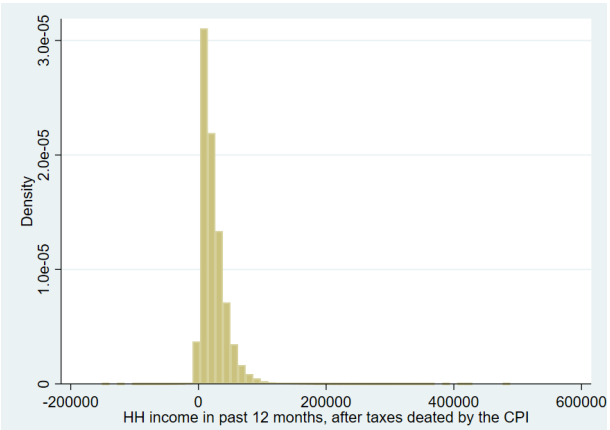


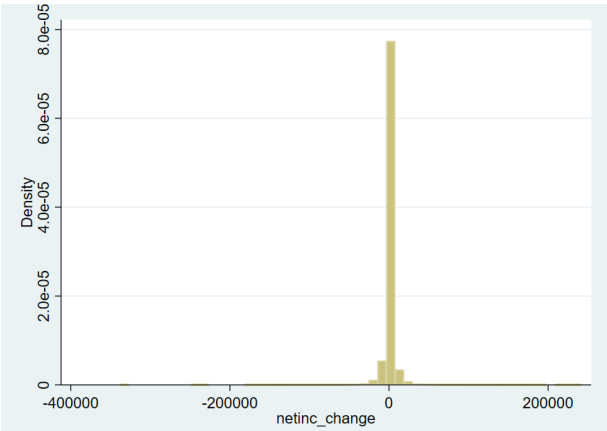


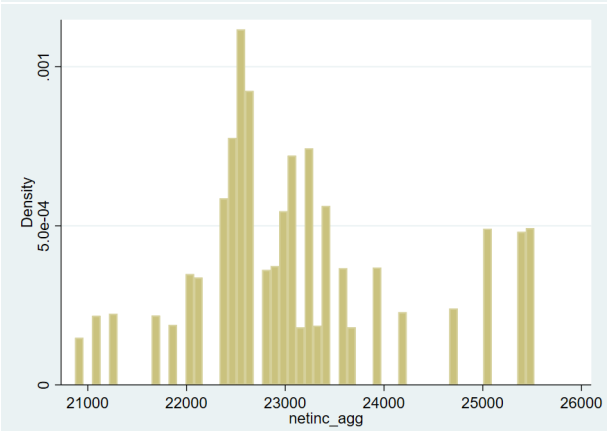


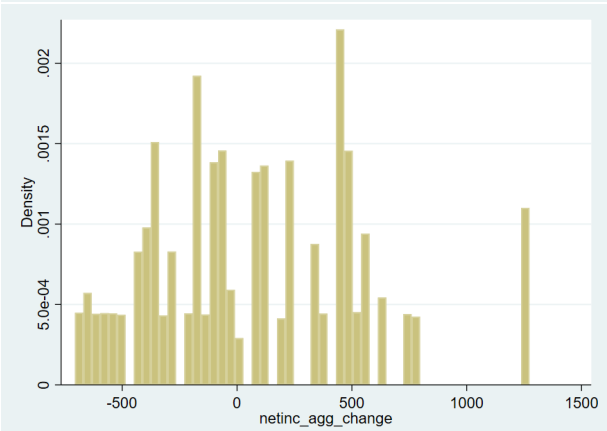


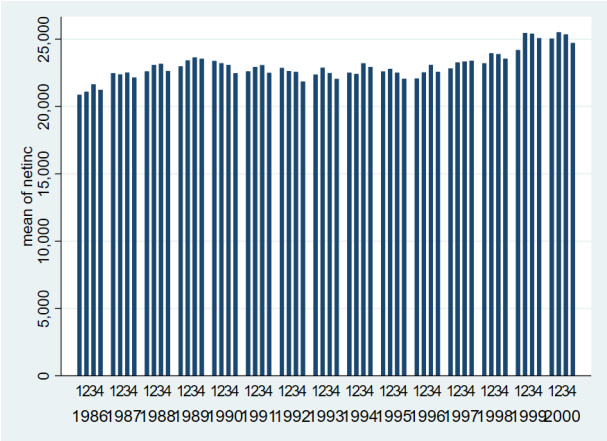
Household income after taxes

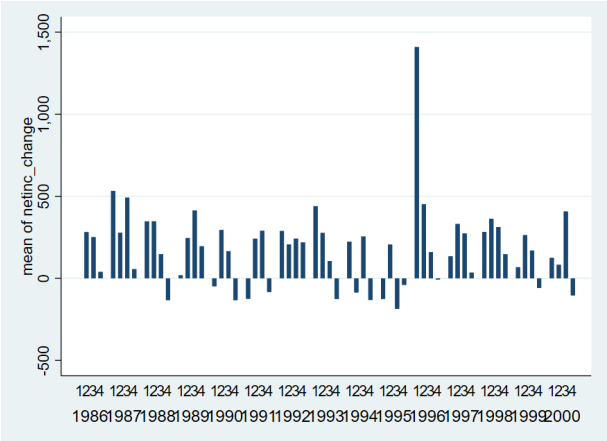






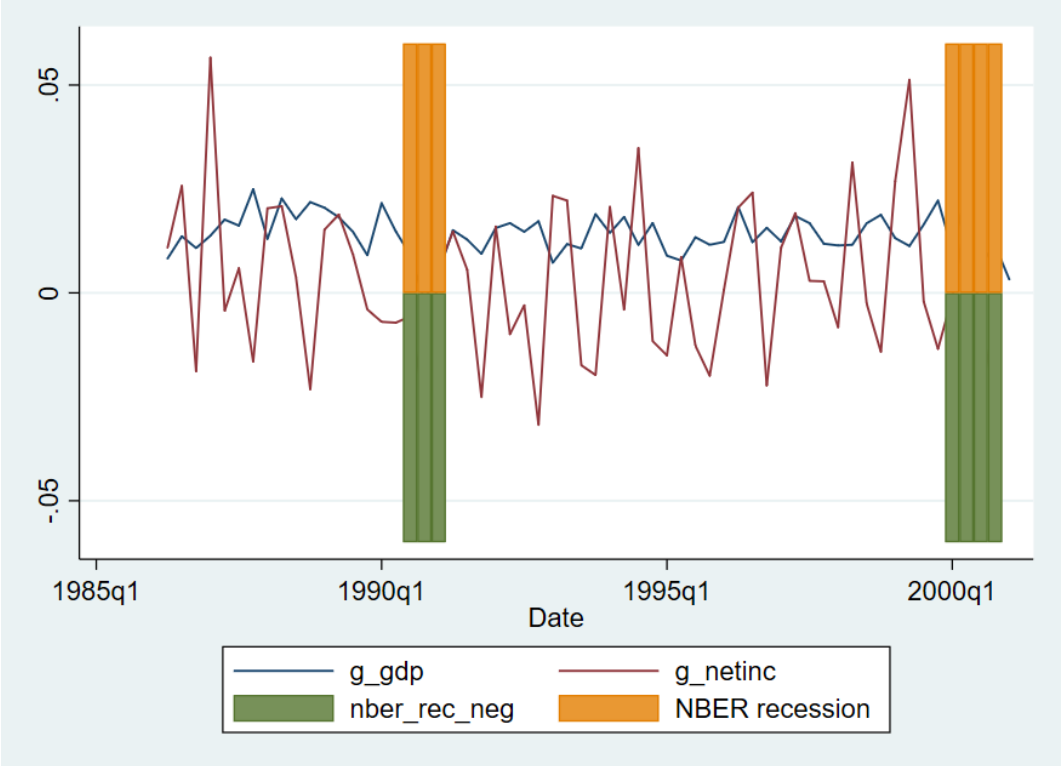


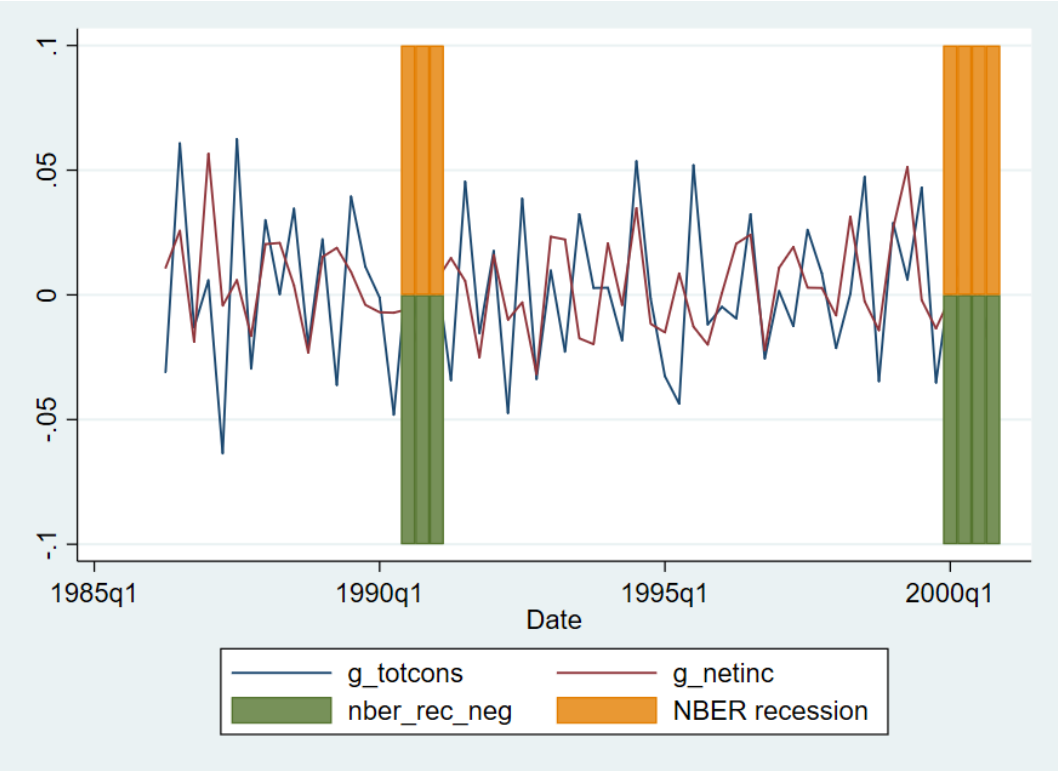




GDP, recessions, income and consumption

To detect business cycle effects we plotted (i) total income changes in comparison with GDP changes and NBER recessions in the given time span as well as (ii) consumption changes in comparison with GDP changes and NBER recessions in the given time span. We can see fluctuations during recessions, yet, they are not considerably different in magnitute from other occuring fluctuations.





Problem 2:

General explanation on how we deal with the data:
Since from the Mace paper only the second and the fifth interview contain useful income information and we always work with differences, we will focus on those individuals whose income is observed twice (in second and fifth interview).

Interviews take place 9 months apart from one another (we confirmed that for all individuals). However, consumption always refers to consumption in the 3 previous months, while income refers to the income in the last 12 months. In order to handle this frequency imbalance for consumption and income data, we are regressing changes in 3-month-long consumption on changes in annual income (in both cases, the reported changes are calculated with information that is collected 9 months apart). Since 3 month-changes is 1/4 of yearly changes, in order to interpret the magnitude of the effect of income changes, we have to divide the coefficient on income by 4.

Our solution to this problem consists of 2 subsections:

- In the first subsection, we test for the perfect risk sharing hypothesis, namely, individual consumption depends only on aggregate spending/ consumption. In order to test this hypothesis, we employed the specification from Mace, 1991 which is given as follows:

$$\Delta C_t^J = \beta_1 \Delta C_t^a + \beta_2 \Delta y_t^J + u_t^J \tag{1}$$

where ΔC_t^J is the change in individual j's consumption, ΔC_t^a is the change of aggregate income, Δy_t^J is the change in individual j's income. This specification applies to households with

exponential utility.

- In the second subsection, we test whether individual log consumption growth depends only on aggregate log consumption growth. In order to test this hypothesis, we employed the specification from Mace, 1991 which is given as follows:

$$\Delta logC_t^J = \beta_1 \Delta logC_t^a + \beta_2 \Delta logy_t^J + v_t^J \tag{2}$$

where $\Delta logC_t^J$ is the log growth of individual j's consumption, $\Delta logC_t^a$ is the log growth of aggregate consumption, $\Delta logy_t^J$ is the log growth of individual j's income. This specification applies to households with power utility.

$\Delta logC_t^a$ are computed as in Mace, 1991:

$$\Delta logC_t^a = \frac{1}{J} \sum_{J}^{J=1} \Delta logC_t^J \tag{3}$$

.

That is, the average across households of log-differences of consumption.

Following this, we will re-estimate her results (as well as we possibly can, as we don't observe employment status) using CEX dataset for both specifications. In both cases, we introduce some additional controls to extend the model and review alternative economic interpretations.

Hypothesis 1: Individual Consumption depends only on Aggregate Spending

From equation (1), the predictions of risk sharing model are $\beta_1 = 1$ & $\beta_2 = 0$, we would expect the coefficient on diff_netinc to be 0 and coefficients on different types of consumption(avg-food-change, avg-ndcons1-change, avg-ndcons2-change,avg-ndconsserv-change) to be 1.

Please note: In all coming specification we will always look at the same type of consumption (i.e. food, non-durables including education, non-durables excluding education, etc.) on the individual and aggregate levels (the exact definitions of the consumption variables are given in Problem 1).

Mace's specification

In table 1, we can see that the coefficient of diff_netinc is close to 0, on the other hand, coefficients on the 4 different types of consumption change as well as on total consumption change are close to 1. All of these coefficients are statistically significant at 1% level. This suggests that our result using Mace's exponential utility specification is in line with what is predicted by the risk sharing hypothesis. Across the variables that our dataset has in common with Mace's (total consumption, non-durables,

Table 1: Explaining changes in consumption

	(1)	(2)	(3)	(4)	(5)
avg-totcons-change	1.000***				
	(0.0628)				
diff_netinc	0.0215***	0.00116***	0.00463***	0.00345***	0.00474***
	(0.00137)	(0.000195)	(0.000498)	(0.000339)	(0.000526)
avg-food-change		1.005***			
		(0.0570)			
avg-ndcons1-change			0.998***		
			(0.0534)		
avg-ndcons2-change				1.000***	
				(0.0639)	
avg-ndconsserv-change					0.999***
					(0.0568)
constant	-12.35	-0.645	-2.549	-1.969	-2.701
	(24.92)	(2.764)	(7.347)	(6.008)	(7.435)
N	44772	44772	44772	44772	44772

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

food), we find the coefficients on those variables from our regression and hers are roughly the same. However, using F test, Mace only found the coefficients significant when she regressed individual's Non-durables consumption change on average Non-durables consumption change. This may be due to the fact that she tested the hypothesis on coefficients using joint F tests, whereas we tested using t-tests and also that our dataset was different from hers. In the next section we introduce additional controls to verify if not some other explanatory variable was driving the observed results.

Our additional controls

In table 2 , some additional variables are introduced into the model: dummy variables for 4 quarters, age and household size (hhzsize). The reason why we include dummy variables for 4 quarters is to control for the seasonality of consumption, i.e. aggregate consumption as well as individual level's consumption vary significantly across quarters. We have seem this takes place in the data in Problem 1. Adding quarterly dummy variables should eliminate any omitted variable bias that may occur in the previous model. Secondly, age is particularly relevant because, theoretically speaking, older household should have more chances to self-insure by accumulating wealth, since we don't have any wealth data in our dataset, age is a good proxy. (One could also think of adding squared age). Last but not least, different demographic groups have different consumption elasticity as well as different access to insurance. A larger household size means there is a higher likelihood of people of 2 or more demographic groups living in the same house, for example, a couple with two children are far less likely to reduce consumption due to income shock than household of couples with no children or singles .

From table 2, we can see that the coefficients of interest are still roughly the same and significant. By adding additional controls to the model, which serves as robustness check, our result still support

Table 2: Explaining change in consumption - net

	(1)	(2)	(3)	(4)	(5)
avg-totcons-change	0.996***				
	(0.0679)				
netinc-change	0.0214***	0.00116***	0.00456***	0.00339***	0.00482***
	(0.00137)	(0.000195)	(0.000499)	(0.000339)	(0.000526)
age	3.029*	0.186	-0.591	-0.682*	0.360
	(1.194)	(0.170)	(0.434)	(0.295)	(0.458)
hhsize	48.43***	1.231	16.36***	15.00***	-20.32***
	(13.33)	(1.899)	(4.852)	(3.299)	(5.117)
1.quarter	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
2.quarter	-8.535	-0.368	-1.240	-0.823	-3.310
	(59.52)	(8.210)	(22.56)	(13.66)	(23.67)
3.quarter	-7.273	-0.407	-1.313	-0.912	-2.234
	(56.02)	(7.953)	(22.09)	(13.81)	(22.24)
4.quarter	12.75	0.646	3.128	2.434	1.534
	(55.25)	(7.834)	(23.26)	(13.47)	(23.45)
year	-0.00331	0.00111	-0.0132	-0.0129	0.0109
	(0.729)	(0.105)	(0.266)	(0.180)	(0.280)
avg-food-change		1.002***			
		(0.0644)			
avg-ndcons1-change			1.000***		
			(0.0641)		
avg-ndcons2-change				0.999***	
				(0.0644)	
avg-logndconsserv-change					0.996***
					(0.0659)
constant	-290.9**	-13.35	-15.28	-6.402	32.94
	(111.0)	(15.41)	(40.26)	(26.85)	(41.74)
N	44772	44772	44772	44772	44772

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

the perfect risk sharing hypothesis.

Our additional controls plus controlling for gross income changes instead of net income changes

Since net income changes may be correlated with household size (due to tax law, households with more children are taxed less and and result in a higher net income), which leads to the problem of multicollinearity, we used gross income as another proxy for income, which is free of correlation with household size, to deal with this problem. From table 3, we can see that coefficients of interest are still valid for perfect risk sharing hypothesis and statistically significant.

Table 3: Explaining change in consumption - gross

	(1)	(2)	(3)	(4)	(5)
avg-totcons-change	0.991***				
	(0.0679)				
grossinc-change	0.0255***	0.00112***	0.00443***	0.00385***	0.00488***
	(0.00137)	(0.000196)	(0.000500)	(0.000340)	(0.000527)
age	3.158**	0.190	-0.576	-0.664*	0.378
	(1.192)	(0.170)	(0.434)	(0.295)	(0.458)
hhsize	47.49***	1.238	16.39***	14.89***	-20.33***
	(13.32)	(1.899)	(4.852)	(3.298)	(5.117)
1.quarter	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
2.quarter	-12.65	-0.435	-1.742	-1.178	-3.867
	(59.45)	(8.210)	(22.56)	(13.66)	(23.67)
3.quarter	-7.073	-0.296	-1.250	-0.713	-2.072
	(55.95)	(7.953)	(22.10)	(13.80)	(22.24)
4.quarter	14.31	0.643	2.578	2.723	1.209
	(55.19)	(7.834)	(23.27)	(13.47)	(23.45)
year	-0.0308	-0.000336	-0.0173	-0.0170	0.00629
	(0.728)	(0.105)	(0.266)	(0.180)	(0.280)
avg-food-change		1.001***			
		(0.0644)			
avg-ndcons1-change			0.998***		
			(0.0641)		
avg-ndcons2-change				0.996***	
				(0.0644)	
avg-logndconsserv-change					0.994***
					(0.0659)
constant	-293.7**	-13.45	-15.42	-6.911	32.51
	(110.9)	(15.41)	(40.27)	(26.84)	(41.74)
N	44772	44772	44772	44772	44772

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Controlling for aggregate changes income (instead of aggregate changes in consumption)

Idea here: Hypothesis 1 argues that individual consumption changes co-move one-to-one with the economy's average expenditure changes (and not with individual income changes). Besides proxying for changes in aggregate spending by changes in aggregate consumption (as we did before), we can proxy for it using changes in aggregate income. We do that below, controlling for changes in net/ gross individual income in table 4

Table 4: Explaining change in consumption - net

	(1)	(2)	(3)	(4)	(5)
avg-netinc-change	-0.00414	-0.00654*	-0.000709	-0.00187	-0.00364
	(0.0223)	(0.00318)	(0.00811)	(0.00552)	(0.00856)
netinc-change	0.0215***	0.00116***	0.00458***	0.00340***	0.00484***
	(0.00138)	(0.000196)	(0.000501)	(0.000341)	(0.000528)
age	3.259**	0.211	-0.508	-0.647*	0.463
	(1.196)	(0.171)	(0.436)	(0.296)	(0.459)
hhsize	47.82***	1.302	16.62***	15.35***	-20.64***
	(13.36)	(1.904)	(4.865)	(3.308)	(5.130)
1.quarter	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
2.quarter	-333.8***	-34.45***	-161.2***	-4.796	-161.3***
	(56.05)	(7.988)	(20.41)	(13.87)	(21.52)
3.quarter	-107.0	12.82	-139.5***	18.17	-95.86***
	(56.22)	(8.013)	(20.47)	(13.92)	(21.59)
4.quarter	-137.0*	15.58	-188.4***	15.25	-162.6***
	(55.93)	(7.971)	(20.36)	(13.84)	(21.47)
year	-0.0538	-0.267*	0.195	-0.0173	0.265
	(0.730)	(0.104)	(0.266)	(0.181)	(0.280)
constant	99.82	10.01	125.9**	41.93	116.6**
	(108.7)	(15.49)	(39.58)	(26.91)	(41.74)
N	44772	44772	44772	44772	44772

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Analyze findings. Maybe add some conclusive paragraph on why we couldn't show that the perfect risk sharing hypothesis is wrong (we should have been able to do so, according to Prof. Ludwig..!)

Hypothesis 2: Individual Consumption Growth depends only on Aggregate Consumption Growth

The difference between the second and first hypothesis is the choice of preference functions(exponential vs power utility) underlying the implication we are testing. From Mace, 1991, following the specification of power utility and her derivation, there is a positive and linear relationship between the growth rates of individual consumption and the growth rate of aggregate consumption. From equa-

tion (3), our prediction is that $\beta_1 = 1$ & $\beta_2 = 0$, which means we would expect the coefficient on log.averagetotcons.change to be 1, and the coefficient on log.netinc.change to be 0.

Mace's specification

In table 5, we can clearly see that aggregate consumption's growth rate co-moves one to one with individual consumption's growth rate (the same holds for different types of consumption: Food, Non-durables including education, Non-durables excluding education, etc.). However, growth rate of income correlates with individual consumption's growth rate to a higher extent. To give an example, taking the case of total consumption, increases in the household's yearly net income of 100% increase 3-monthly consumption by 8.5% This effect may be relatively small, but it is economically and statistically significant.

Overall, the perfect risk sharing hypothesis still holds to a certain extent. In comparison to Mace's result, our result is in line with what she did and what the perfect risk sharing hypothesis predicted. More importantly this time, it doesn't matter if F-test or t-test was conducted, we and Mace both reached the same level of significance for coefficients on the aforementioned variables that our dataset and Mace's have in common. This suggests that perfect risk sharing hypothesis also holds for individuals with power utility.

Table 5: Explaining change in consumption growth

	(1)	(2)	(3)	(4)	(5)
avg-logtotcons-change	0.996***				
	(0.0531)				
lognetinc-change	0.0851***	0.0500***	0.0459***	0.0419***	0.0296***
	(0.00360)	(0.00391)	(0.00293)	(0.00291)	(0.00240)
avg-logfood-change		1.018***			
		(0.0496)			
avg-logndcons1-change			1.002***		
			(0.0416)		
avg-logndcons2-change				0.996***	
				(0.0562)	
avg-logndconsserv-change					0.998***
					(0.0448)
constant	-0.00266	-0.00124	-0.00154	-0.00108	-0.000969
	(0.00312)	(0.00248)	(0.00196)	(0.00239)	(0.00151)
N	44448	44376	44443	44447	44448

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Our additional controls

Following the same idea for including controls when regressing using exponential preference specification, Table 6 still support the risk sharing hypothesis for a different class of preference

Table 6: Explaining change in consumption growth

	(1)	(2)	(3)	(4)	(5)
avg-logtotcons-change	0.989***				
	(0.0600)				
lognetinc-change	0.0856***	0.0501***	0.0456***	0.0415***	0.0300***
	(0.00360)	(0.00391)	(0.00294)	(0.00292)	(0.00240)
age	0.000846***	0.000504***	-0.0000997	-0.000390***	0.0000351
	(0.000140)	(0.000152)	(0.000114)	(0.000113)	(0.0000930)
hhsize	0.00412**	0.00520**	0.00475***	0.00386**	-0.00842***
	(0.00156)	(0.00169)	(0.00127)	(0.00126)	(0.00104)
1.quarter	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
2.quarter	-0.00305	-0.00217	-0.00143	-0.00188	-0.00209
	(0.00717)	(0.00732)	(0.00583)	(0.00524)	(0.00487)
3.quarter	-0.00200	-0.000668	-0.000849	-0.000940	-0.00126
	(0.00671)	(0.00709)	(0.00588)	(0.00530)	(0.00458)
4.quarter	0.00231	0.00117	0.00205	0.00128	-0.0000257
	(0.00691)	(0.00695)	(0.00662)	(0.00516)	(0.00506)
year	0.00000873	-0.00000570	-0.00000720	-0.00000802	0.00000384
	(0.0000853)	(0.0000940)	(0.0000695)	(0.0000690)	(0.0000568)
avg-logfood-change		1.007***			
		(0.0556)			
avg-logndcons1-change			1.010***		
			(0.0532)		
avg-logndcons2-change				1.002***	
				(0.0571)	
avg-logndconsserv-change					0.990***
					(0.0546)
constant	-0.0559***	-0.0395**	-0.00861	0.00919	0.0201*
	(0.0133)	(0.0137)	(0.0107)	(0.0103)	(0.00860)
N	44448	44376	44443	44447	44448

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Our additional controls (plus controlling for gross income changes instead of net income changes)

Same idea from section 1.3 is employed in this section. Here, we regress individual HH's consumption growth rates (in its different specifications) in the past 9 months (time between the surveys) on the growth rate of aggregate consumption of that type, the growth rate of the HH's income and HH characteristics such as (age, HH size) and seasonal variation.
Table 7

Table 7: Explaining change in consumption growth

	(1)	(2)	(3)	(4)	(5)
avg-logtotcons-change	0.987***				
	(0.0599)				
loggrossinc-change	0.0873***	0.0502***	0.0455***	0.0419***	0.0318***
	(0.00354)	(0.00384)	(0.00289)	(0.00287)	(0.00236)
age	0.000854***	0.000503***	-0.0000981	-0.000398***	0.0000406
	(0.000140)	(0.000151)	(0.000114)	(0.000113)	(0.0000929)
hhsize	0.00431**	0.00527**	0.00485***	0.00396**	-0.00828***
	(0.00156)	(0.00169)	(0.00127)	(0.00126)	(0.00104)
1.quarter	0	0	0	0	0
	(.)	(.)	(.)	(.)	(.)
2.quarter	-0.00305	-0.00141	-0.00122	-0.00151	-0.00168
	(0.00716)	(0.00731)	(0.00582)	(0.00524)	(0.00486)
3.quarter	-0.00139	-0.000182	-0.000393	-0.000358	-0.000664
	(0.00670)	(0.00708)	(0.00587)	(0.00529)	(0.00457)
4.quarter	0.00200	0.00176	0.00185	0.00139	0.000483
	(0.00691)	(0.00694)	(0.00661)	(0.00515)	(0.00506)
year	0.0000120	-0.00000465	-0.00000321	-0.00000587	0.00000525
	(0.0000853)	(0.0000939)	(0.0000694)	(0.0000690)	(0.0000567)
avg-logfood-change		1.004***			
		(0.0555)			
avg-logndcons1-change			1.005***		
			(0.0532)		
avg-logndcons2-change				1.000***	
				(0.0570)	
avg-logndconsserv-change					0.997***
					(0.0545)
constant	-0.0571***	-0.0405**	-0.00922	0.00880	0.0189*
	(0.0133)	(0.0137)	(0.0107)	(0.0103)	(0.00859)
N	44646	44573	44641	44645	44646

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

References

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