Inflation Expectations and Choices of Households

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Introduction

- How do households form inflation expectations?

- Do their inflation expectations affect their choices?

Introduction

- We have a very unique dataset to address these two questions:

  - Longitudinal data for inflation expectations of households.

  - Inflation expectations and assets, liabilities and income in the same survey.

  - Matched with administrative data on income and wealth.

Introduction

- Results on inflation expectations:
  - ▸ Households have stable expectations at individual-specific levels.

- Results on financial decisions:
  - ▸ Households with higher inflation expectations have lower net worth (assets minus liabilities).

  - ▸ These households have both less assets and less liabilities.

  - ▸ Moreover, they hold less of all non-liquid assets (savings account, bonds, stocks, mutual funds, and housing).

Literature

- Inflation expectations and choices of households:

  - ▸ Papers on inflation expectations and "readiness to spend" in Michigan Survey of Consumers: Bachmann et al. (2015), D'Acunto et al. (2016)

  - ▸ Papers exploiting recent innovations in FRBNY Survey of Consumer Expectations: Armantier et al. (2015), Crump et al. (2015)

  - ▸ Paper on relationship between model-implied inflation expectations and financial decisions reported in Survey of Consumer Finances at cohort level: Malmendier and Nagel (2016)

Outline

- Inflation expectations of households
  - Model
  - Survey data
  - Results

- Financial decisions of households
  - Survey and administrative data
  - Results

Inflation Expectations: Model

1. Households believe inflation follows an AR(1) process
2. They pay attention to current inflation to forecast future inflation
3. They may believe that official inflation statistics are biased

Model

- Households' perceived law of motion for inflation:

$$\pi_t = (1-\rho)\,c + \rho\pi_{t-1} + u_t \tag{1}$$

$$u_t \sim iid\ N\left(0, \sigma_u^2\right)$$

- In every period each household receives a signal about current inflation. Household i believes that the signal is generated as follows:

$$s_{it} = \pi_t + \varepsilon_{it} \tag{2}$$

$$\varepsilon_{it} \sim iid\ N\left(\mu_i, \sigma_\varepsilon^2\right)$$

- The household uses the steady-state Kalman filter to compute the conditional expectation of future inflation.

Model

- Kalman filter:

$$E\left[\pi_t \mid F_{it}\right] = E\left[\pi_t \mid F_{i,t-1}\right] + K\left(s_{it} - \mu_i - E\left[\pi_t \mid F_{i,t-1}\right]\right)$$

and

$$E\left[\pi_{t+1} \mid F_{it}\right] = (1-\rho)\,c + \rho\,E\left[\pi_t \mid F_{it}\right]$$

yields

$$E\left[\pi_{t+1} \mid F_{it}\right] = (1-\rho)\,c - \rho K\mu_i + \rho\,(1-K)\,E\left[\pi_t \mid F_{i,t-1}\right] + \rho K s_{it}$$

- If the signal is indeed of the form π_t plus noise, one obtains

$$E\left[\pi_{t+1} \mid F_{it}\right] = \beta_i + \beta_1 E\left[\pi_t \mid F_{i,t-1}\right] + \beta_2 \pi_t + \nu_{it} \qquad (3)$$

with $\beta_1 + \beta_2 = \rho$ and $\beta_2/\beta_1 = K/(1-K)$

Model

- Individual forecasts:

$$\pi_{t+1|t,i} = \beta_i + \beta_1 \pi_{t|t-1,i} + \beta_2 \pi_t + \nu_{it} \qquad (4)$$

- Aggregation:

$$\bar{\pi}_{t+1|t} = \bar{\beta}_0 + \beta_1 \bar{\pi}_{t|t-1} + \beta_2 \pi_t + \bar{\nu}_t \qquad (5)$$

- Relative views:

$$\left(\pi_{t+1|t,i} - \bar{\pi}_{t+1|t}\right) = \left(\beta_i - \bar{\beta}_0\right) + \beta_1 \left(\pi_{t|t-1,i} - \bar{\pi}_{t|t-1}\right) + \left(\nu_{it} - \bar{\nu}_t\right) \quad (6)$$

Data

- The survey data is from the DNB Household Survey, conducted annually since 1993. The survey aims to be representative for the Dutch population. Households participate for several years.

- Beginning with the 2008 wave, the main quantitative question on inflation expectations is: "What is the most likely (consumer) prices increase over the next twelve months, do you think?"
  Possible answers are: 1%, 2%, 3%, ..., 10%.

- Respondents are then asked four questions regarding their subjective CDF.

- In 1993-2002, households were only asked for a point prediction.

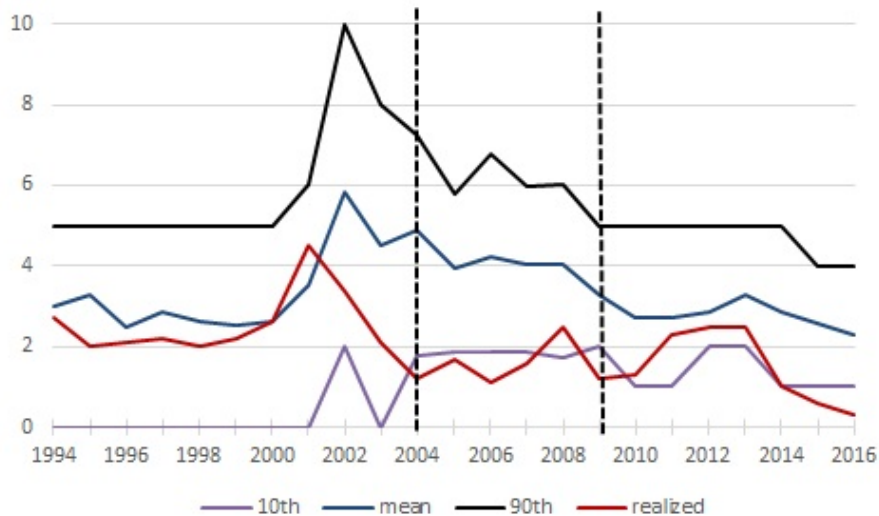- In 2003-2007, households were only asked for their subjective CDF.

Results

- Descriptive statistics: cross-section, time, and transition matrices

- Quantitative version of the model

Fact 1: Large cross-sectional heterogeneity

Mean = 3.283
Standard deviation = 1.756
N = 1,918
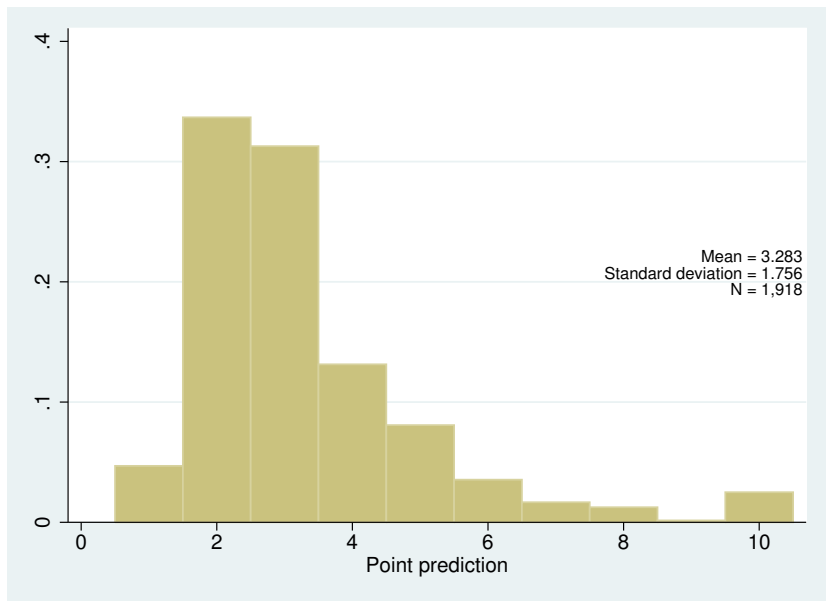
Fact 2: Cross-sectional mean moves to some extent with realized inflation

Fact 3: Households have fairly stable inflation expectations at individual-specific levels

1 to 2

	1% or less	2%	3%	4-5%	6% or more
1% or less	46.3	22.9	19.2	8.9	2.8
2%	17.4	41.7	29.6	8.1	3.2
3%	13.3	28.5	34.4	19.1	4.7
4-5%	11.6	16.6	25.1	36.2	10.6
6% or more	10.6	11.8	14.1	31.8	31.8
N = 3084					

2 to 3

	1% or less	2%	3%	4-5%	6% or more
1% or less	49.5	23.6	10.6	13.5	2.9
2%	22.4	41.0	23.5	10.8	2.2
3%	17.8	29.2	33.3	16.7	3.0
4-5%	12.2	19.1	26.6	33.5	8.5
6% or more	9.6	11.0	20.5	31.5	27.4
N = 3084					

3 to 4

	1% or less	2%	3%	4-5%	6% or more
1% or less	51.3	21.7	15.4	9.6	2.1
2%	21.3	47.2	21.6	8.2	1.8
3%	13.1	30.0	36.3	17.7	3.0
4-5%	14.0	17.2	27.4	32.3	9.1
6% or more	9.1	14.5	18.2	25.5	32.7
N = 3084					

1 to 4

	1% or less	2%	3%	4-5%	6% or more
1% or less	43.7	25.8	14.6	13.1	2.8
2%	24.4	40.7	22.8	10.6	1.6
3%	17.6	32.4	30.9	14.8	4.3
4-5%	17.6	21.1	29.1	24.6	7.5
6% or more	12.0	19.3	22.9	26.5	19.3
N = 3084					

Fact 3: Households have fairly stable inflation expectations at individual-specific levels

1 to 2

	1% or less	2%	3%	4-5%	6% or more
1% or less	46.3	22.9	19.2	8.9	2.8
2%	17.4	41.7	29.6	8.1	3.2
3%	13.3	28.5	34.4	19.1	4.7
4-5%	11.6	16.6	25.1	36.2	10.6
6% or more	10.6	11.8	14.1	31.8	31.8

Calibration and simulation

- Calibration:

  1. We use the time series for the cross-sectional mean of inflation expectations and the time series for inflation to estimate

  $$\bar{\pi}_{t+1|t} = \bar{\beta}_0 + \beta_1 \bar{\pi}_{t|t-1} + \beta_2 \pi_t + \bar{v}_t$$

  This yields estimates of $\bar{\beta}_0, \beta_1, \beta_2$ and $\sigma_{\bar{v}}^2$.

  2. We use the same time series for inflation to estimate the actual law of motion for inflation.

  3. We assume that: (i) β_i has a log-normal distribution, and (ii) the variance of $v_{it} - \bar{v}_t$ equals twice the variance of $\bar{v}_t$. We set the parameters of the log-normal distribution to match the cross-sectional variance of inflation expectations in 2012.

- We simulate data for individual inflation expectations from

$$\pi_{t+1|t,i} = \beta_i + \beta_1 \pi_{t|t-1,i} + \beta_2 \pi_t + v_{it}$$

and the actual law of motion for inflation.

Results

- The simple model matches the data reasonably well.

- Recall that the simple model allows for three deviations from the theoretical benchmark of full-information, rational expectations:

  - Households may believe official inflation statistics are biased (or there is some other model feature that creates individual-specific intercepts).

  - Households may believe inflation is more persistent than it actually is.

  - Households may pay limited attention to current inflation to forecast future inflation.

Financial Decisions of Households: Data

- Data source 1: Survey data on assets, liabilities, and income

- Data source 2: Administrative data on income and wealth

Summary Statistics

DHS Survey	Nonzero	Mean	St. Dev.	Min	Max
Expected inflation		3.167	4.244	-15.540	100
Checking account	0.829	1,622	5,437	-263,830	177,376
Savings account	0.755	12,412	37,403	0	2,353,074
Mutual funds	0.176	4,170	22,389	0	868,425
Bonds	0.036	908	10,179	0	501,015
Stocks	0.111	2,902	24,155	0	1,104,528
Financial wealth	0.851	22,015	60,533	-252,091	2,353,821
House value	0.583	94,306	109,136	0	3,417,924
Assets	0.916	137,556	166,049	0	3,721,935
Liabilities	0.584	39,626	72,219	0	3,031,418
Net worth	0.921	97,930	152,987	-2,863,506	3,655,346

Inflation Expectations and Assets, Liabilities, and Net worth

Survey	Assets		Liabilities		Net Worth	
Inflation expectations	-1.168***	-1.437***	-0.326***	-0.254*	-0.842***	-1.183***
	(0.219)	(0.439)	(0.073)	(0.131)	(0.193)	(0.393)
Financial literacy (std.)		13.566***		3.572***		9.994***
		(3.157)		(1.113)		(2.899)
Regional unemployment	-8.127***	-11.123**	-1.617*	-2.481	-6.510***	-8.642*
	(2.043)	(5.203)	(0.865)	(1.831)	(1.927)	(4.838)
Age	5.266***	7.589***	0.604	-0.170	4.662***	7.759***
	(0.950)	(1.812)	(0.394)	(0.697)	(0.899)	(1.625)
Age squared	-0.036***	-0.060***	-0.012***	-0.008	-0.025**	-0.051***
	(0.010)	(0.018)	(0.004)	(0.006)	(0.010)	(0.017)
ihs(household income)	3.493***	2.914***	1.285***	1.150***	2.208***	1.764***
	(0.322)	(0.667)	(0.137)	(0.258)	(0.304)	(0.603)
Adjusted R^2	0.189	0.207	0.113	0.141	0.152	0.193
Mean dep. variable	137.556	155.688	39.626	40.576	97.930	115.113
Fraction nonzero	0.916	0.942	0.584	0.603	0.921	0.946
N households	6921	1069	6921	1069	6921	1069
N observations	26492	8465	26492	8465	26492	8465

Inflation Expectations and Assets, Liabilities, and Net worth

Admin	Pooled DHS and CCO			DHS		
	Assets	Liabilities	Net Worth	Assets	Liabilities	Net Worth
Inflation expectations	-2.721***	-0.888***	-1.833***	-7.167***	-2.444***	-4.723***
	(0.425)	(0.129)	(0.362)	(1.617)	(0.771)	(1.413)
Regional unemployment	-15.340**	-1.405	-13.935**	-0.026	0.032	-0.058
	(7.170)	(1.218)	(6.797)	(8.355)	(2.762)	(7.635)
Age	9.636***	1.217***	8.420***	5.212***	-1.031	6.243***
	(0.875)	(0.303)	(0.812)	(1.985)	(0.694)	(1.909)
Age squared	-0.063***	-0.020***	-0.043***	-0.028	-0.004	-0.024
	(0.011)	(0.003)	(0.011)	(0.020)	(0.006)	(0.020)
ihs(household income)	13.345**	2.885*	10.460**	16.162**	6.761***	9.401*
	(5.227)	(1.533)	(4.644)	(7.159)	(2.482)	(5.101)
DHS sample	-38.178***	-12.103***	-26.076***			
	(6.197)	(2.007)	(5.708)			
Adjusted R^2	0.019	0.132	0.015	0.152	0.207	0.158
Mean dependent variable	193.859	73.842	120.016	169.872	65.008	104.865
Fraction non-zero	0.991	0.689	0.995	0.993	0.671	0.995
N households	18698	18698	18698	2134	2134	2134
N observations	24534	24534	24534	7969	7969	7969

Inflation Expectations and Asset Ownership

Survey	Checking	Savings	Funds	Bonds	Stocks	House
Inflation expectations	-0.0006	-0.0013*	-0.0023***	-0.0005*	-0.0013***	-0.0053***
	(0.0007)	(0.0007)	(0.0005)	(0.0002)	(0.0004)	(0.0008)
Regional unemployment	0.0004	-0.0006	-0.0056	-0.0007	-0.0064	0.0081
	(0.0042)	(0.0049)	(0.0053)	(0.0026)	(0.0044)	(0.0064)
Age/10	-0.0008	-0.0247	0.0626***	-0.0177	0.0141	0.1562***
	(0.0164)	(0.0187)	(0.0209)	(0.0116)	(0.0186)	(0.0266)
Age/10 squared	-0.0008	-0.0007	-0.0056***	0.0029**	-0.0005	-0.0148***
	(0.0015)	(0.0018)	(0.0021)	(0.0013)	(0.0019)	(0.0027)
ihs(household income)	0.0163***	0.0196***	0.0066***	0.0011***	0.0028***	0.0014*
	(0.0007)	(0.0008)	(0.0007)	(0.0003)	(0.0006)	(0.0008)
ihs(net worth)	0.0227***	0.0204***	0.0090***	0.0021***	0.0062***	0.0180***
	(0.0008)	(0.0008)	(0.0005)	(0.0002)	(0.0004)	(0.0008)
Adjusted R^2	0.187	0.173	0.076	0.028	0.059	0.259
Mean dependent variable	0.765	0.755	0.176	0.036	0.111	0.712
N households	6921	6921	6921	6921	6921	6901
N observations	26492	26492	26492	26492	26492	26466

Inflation Expectations and Asset Ownership

Admin	Pooled DHS and CCO				DHS			
	Savings	Bonds	Stocks	House	Savings	Bonds	Stocks	House
Inflation expectations	0.0002	-0.0007***	-0.0031***	-0.0041***	-0.0010	-0.0047**	-0.0285***	-0.0187***
	(0.0001)	(0.0002)	(0.0005)	(0.0006)	(0.0011)	(0.0020)	(0.0048)	(0.0053)
Regional unemployment	0.0004	-0.0014	0.0008	0.0019	0.0023	-0.0082	-0.0113	0.0191
	(0.0011)	(0.0027)	(0.0061)	(0.0055)	(0.0030)	(0.0080)	(0.0179)	(0.0161)
Age/10	-0.0000	0.0033	0.1097***	0.1783***	-0.0050	-0.0120	0.1588***	0.0962**
	(0.0044)	(0.0089)	(0.0179)	(0.0187)	(0.0097)	(0.0244)	(0.0496)	(0.0486)
Age/10 squared	0.0001	0.0005	-0.0088***	-0.0175***	0.0003	0.0025	-0.0126***	-0.0098**
	(0.0004)	(0.0010)	(0.0018)	(0.0018)	(0.0008)	(0.0026)	(0.0048)	(0.0046)
ihs(household income)	0.0020***	0.0064***	0.0162***	0.0198***	0.0029	0.0085***	0.0398***	0.0355**
	(0.0007)	(0.0010)	(0.0034)	(0.0035)	(0.0018)	(0.0027)	(0.0109)	(0.0141)
ihs(net worth)	0.0014***	0.0023***	0.0075***	0.0038***	0.0020***	0.0028***	0.0083***	0.0033***
	(0.0001)	(0.0001)	(0.0005)	(0.0004)	(0.0003)	(0.0004)	(0.0013)	(0.0010)
DHS sample	0.0036*	0.0122**	0.0571***	-0.0231**				
	(0.0019)	(0.0057)	(0.0117)	(0.0110)				
Adjusted R^2	0.024	0.037	0.085	0.184	0.028	0.048	0.097	0.201
Mean dependent variable	0.990	0.047	0.282	0.751	0.988	0.059	0.349	0.739
N households	18698	18698	18698	18698	2134	2134	2134	2134
N observations	24534	24534	24534	24534	7969	7969	7969	7969

Inflation Expectations and Asset Values

Survey	Checking	Savings	Funds	Bonds	Stocks	Financial	Housing
Inflation expectations	-5.3	-71.5*	-77.4***	-16.3**	-86.8***	-257.3***	-439.5***
	(4.5)	(38.8)	(21.8)	(8.1)	(21.9)	(61.0)	(146.5)
Regional unemployment	-88.4*	-36.4	-182.4	-19.9	-488.5	-815.7	-4782.8***
	(45.3)	(448.3)	(303.3)	(129.7)	(329.6)	(820.5)	(1222.4)
Couple	138.1	2949.7**	-1719.2*	-385.1	-2652.1**	-1668.6	21888.3***
	(134.8)	(1147.3)	(1032.4)	(393.0)	(1326.9)	(2861.8)	(3478.7)
Age	9.3	106.7	-17.7	-84.5	-330.5**	-316.6	1211.7**
	(19.3)	(211.3)	(135.9)	(63.2)	(143.6)	(343.2)	(568.7)
Age squared	0.0	-0.2	1.0	1.3**	4.1***	6.3*	-8.7
	(0.2)	(2.3)	(1.5)	(0.7)	(1.6)	(3.7)	(6.0)
ihs(household income)	32.6***	337.4**	116.1***	35.7**	21.3	543.0***	1439.7***
	(7.3)	(140.5)	(36.4)	(14.7)	(43.5)	(160.7)	(179.4)
ihs(net worth)	94.3***	853.4***	322.4***	72.5***	225.4***	1568.0***	4929.3***
	(4.7)	(57.1)	(30.5)	(12.0)	(26.2)	(84.0)	(174.5)
Adjusted R^2	0.046	0.054	0.033	0.011	0.033	0.079	0.298
Mean dependent variable	1823	12412	4170	908	2902	22216	94306
Fraction non-zero	0.765	0.755	0.176	0.036	0.111	0.837	0.583
N households	6921	6921	6921	6921	6921	6921	6921
N observations	26492	26492	26492	26492	26492	26492	26492

Inflation Expectations and Asset Values

Admin	Pooled DHS and CCO					DHS				
	Savings	Bonds	Stocks	Financial	Housing	Savings	Bonds	Stocks	Financial	Housing
Inflation expectations	-366.2***	-31.6**	-144.3***	-542.1***	-1059.5***	-1042.6***	55.1	-829.8**	-1816.8***	-3751.7***
	(62.3)	(14.8)	(47.0)	(95.7)	(106.7)	(371.3)	(153.6)	(388.7)	(690.7)	(1099.3)
Regional unemployment	713.4	27.7	149.7	890.8	-6120.4***	834.6	-239.1	757.9	1353.8	-4118.9
	(1231.4)	(359.5)	(848.8)	(1916.2)	(1209.3)	(3197.9)	(695.0)	(2022.8)	(4785.8)	(3523.7)
Age	82.9	62.1	174.2	319.0	3567.4***	-615.9	13.0	-164.8	-768.7	1645.9
	(342.3)	(85.3)	(246.5)	(520.1)	(381.4)	(983.3)	(193.5)	(531.0)	(1397.3)	(1007.9)
Age squared	1.8	-0.5	0.6	2.0	-30.0***	8.3	0.4	5.0	13.8	-10.3
	(3.7)	(0.9)	(2.6)	(5.6)	(3.9)	(10.3)	(2.1)	(5.6)	(14.8)	(10.0)
ihs(household income)	3558.9***	659.3***	-785.0	3433.3	5633.6***	5506.4***	389.1**	2402.8***	8298.4***	10126.9***
	(906.6)	(163.2)	(1653.8)	(2279.4)	(1043.9)	(1583.9)	(190.2)	(801.1)	(2381.8)	(3497.4)
ihs(net worth)	1792.9***	170.9***	753.8***	2717.6***	1967.1***	1458.9***	105.8***	596.9***	2161.9***	1574.6***
	(61.2)	(31.9)	(68.7)	(129.2)	(87.6)	(90.3)	(32.3)	(76.8)	(156.4)	(206.5)
dhs	-5745.7***	-591.8	-2468.3*	-8806.0***	-8975.2***					
	(1571.4)	(574.6)	(1407.2)	(2782.2)	(2255.1)					
Adjusted R^2	0.049	0.005	0.020	0.042	0.205	0.078	0.011	0.051	0.090	0.217
Mean dependent variable	31580	2238	11437	45255	116069	27806	1694	10139	39636	116933
Fraction non-zero	0.990	0.047	0.282	0.991	0.743	0.988	0.059	0.349	0.990	0.736
N households	18698	18698	18698	18698	18698	2134	2134	2134	2134	2134
N observations	24534	24534	24534	24534	24534	7969	7969	7969	7969	7969

Conclusions

- Results on inflation expectations:
  - Households have stable expectations at individual-specific levels.

- Results on financial decisions:
  - Households with higher inflation expectations have lower net worth.

  - These households hold both less assets and less liabilities.

  - Moreover, they hold less of all non-liquid assets (savings account, bonds, stocks, mutual funds, and housing).

Conclusions

- That households with high inflation expectations spend more is consistent with theoretical predictions in the literature on the zero lower bound (e.g. Wiederholt, 2015).

- That households with high inflation expectations are less leveraged and invest less in stocks/housing is more difficult to formalize.

  - Bernanke (2007): "More fundamentally, experience suggests that high and persistent inflation undermines public confidence in the economy and in the management of economic policy generally, with potentially adverse effects on risk-taking, investment, and other productive activities that are sensitive to the public's assessments of the prospects for future economic stability."

  - Rational inattention