

Inflation and Trading

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Introduction

- Inflation is key risk for financial-market participants
- Negative relation exists empirically b/w inflation and stock returns
(e.g., de Rubio Cruz et al., 2023; Fama, 1981; Fama and Schwert, 1977; Fang, Liu, and Roussanov, 2022)
- Many theories explain this relation that is at odds with intuition
(e.g., Bhamra et al., 2023; Campbell, Pflueger, and Viceira, 2020; Modigliani and Cohn, 1979)
- Evidence on how inflation affects investor beliefs and choices scant

This paper

- Study directly how investors respond to inflation
- Exogenous variation in beliefs about inflation and its return impact
 - ▶ Randomized information experiment with customers of German bank
 - ▶ Mix of info about inflation and returns during past inflation
- Analyze effects of information provision on beliefs and choices
 - ▶ Elicit return expectations, mental models, etc. in survey
 - ▶ Track investors' trading choices using bank data
- Preview of results:
 - ▶ Estimates of return impact of inflation heterogeneous and too high
 - ▶ Info \rightarrow return expectations \downarrow b/c beliefs about impact of inflation \downarrow
 - ▶ Info \rightarrow net purchases of stocks \downarrow in survey and bank data

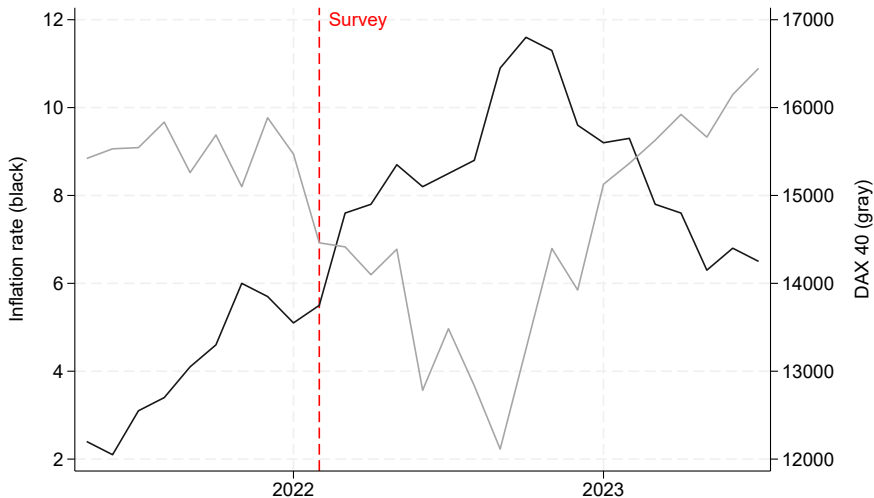
Plan for the talk

- Data and experimental design
- Prior beliefs about inflation and asset returns
- Treatment effects on return expectations
- Expectations and trading

Data

- Online survey experiment with customers of large German bank
- Invite all bank customers with brokerage account
- 2,843 completed responses, 18 min median response time
- Match survey responses to bank data
 - ▶ Set of demographics: age, zip code, marital status, etc.
 - ▶ Month-end portfolio holdings and each security transaction

Survey period



⇒ Inflation high and rising at time of and after intervention

Sample characteristics

<i>Statistics:</i>	Mean	SD	P25	P50	P75
Demographics and portfolio					
University completed (0/1)	0.66	0.47	0.00	1.00	1.00
Gross wealth (€ k)	345.09	302.76	87.50	375.00	750.00
Portfolio value (€ k)	139.61	265.61	7.38	35.96	130.74
Equity share (%)	0.84	0.22	0.76	0.94	1.00
Monthly trades (no.)	2.98	4.04	0.33	1.27	3.83
Monthly net buys (€)	628.01	5142.94	0.00	189.99	1061.07
Perceptions and expectations					
Inflation rate today (%)	4.99	1.62	4.00	5.00	5.00
Inflation rate today relative to 1yr ago (%)	3.12	1.97	2.00	3.00	4.00
Inflation as recent trading motive (0/1)	0.42	0.49	0.00	0.00	1.00
Inflation top financial-market risk (0/1)	0.26	0.44	0.00	0.00	1.00

⇒ Sample: well-off, active, accurate perceptions, inflation matters

Experimental design

1. Pre-treatment section

- ▶ Inflation beliefs and trading motives
- ▶ Past unconditional and inflationary-period asset returns

2. Treatment section

- ▶ Control group receives no information
- ▶ T1: high current inflation and possibility of further rise
- ▶ T2: actual returns during past inflationary periods
- ▶ T3: T1 + T2 + explanations of past returns

3. Post-treatment section

- ▶ Beliefs about inflation and economy, mental models
 - ▶ Return expectations and hypothetical portfolio choice
- Track investors over time to investigate actual trading choices

T1: high current inflation and possibly further rise

- Inflation 3x higher than 10-year average + figure below
- Policymakers recently discussed possibility of further increase
- List of reasons for inflation surge

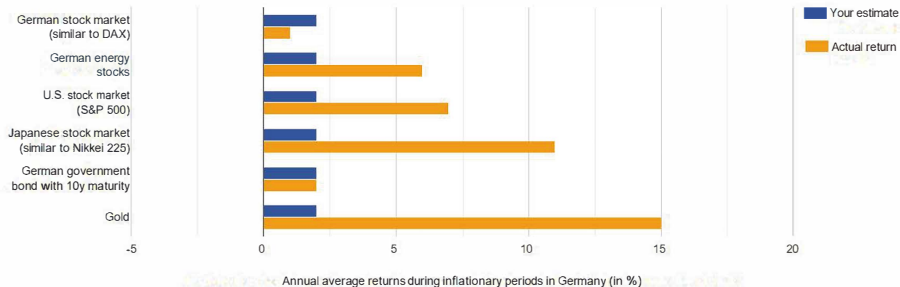
(Andre et al., 2022)



Source: Deutsche Bundesbank

T2: actual returns during past inflationary periods

- Initially display respondent's past-return estimates (blue bars)
- Click on button to display actual returns one-by-one (orange)
- One sentence contrasting both returns for each asset



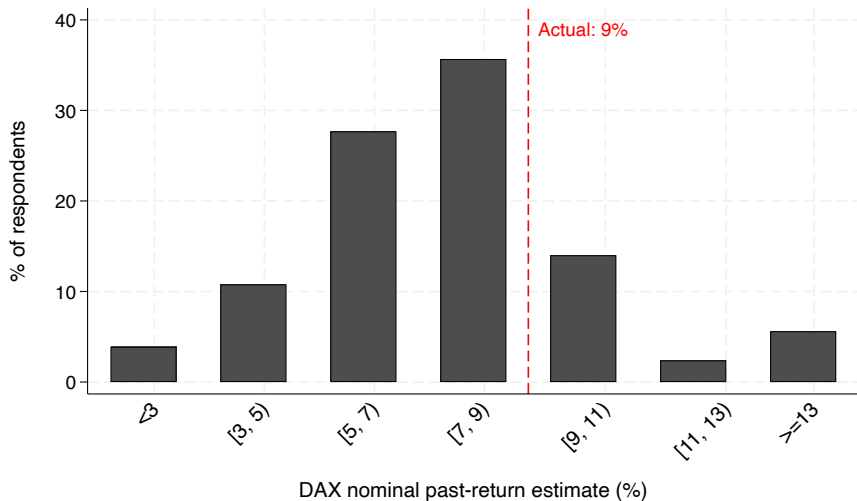
T3: T1 + T2 + explanations of past returns

- International diversification can protect against local inflation
- Commodities (such as energy) often drive inflation
- Gold perceived as a safe harbor during inflationary periods
- Calculations and explanations similar to existing work for US
(Neville et al., 2021)
- Giving context to returns might increase treatment effectiveness
(Andre et al., 2022; Goetzmann, Kim, and Shiller, 2022; Shiller, 2017)

Plan for the talk

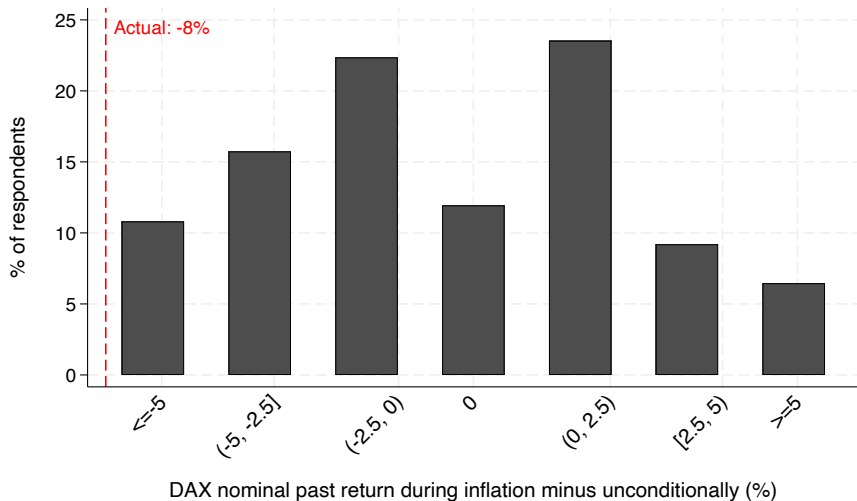
- Data and experimental design
- **Prior beliefs about inflation and asset returns**
- Treatment effects on return expectations
- Expectations and trading

Perceived unconditional historical stock-market returns



⇒ High awareness of average past stock returns

Perceived historical stock-return impact of inflation

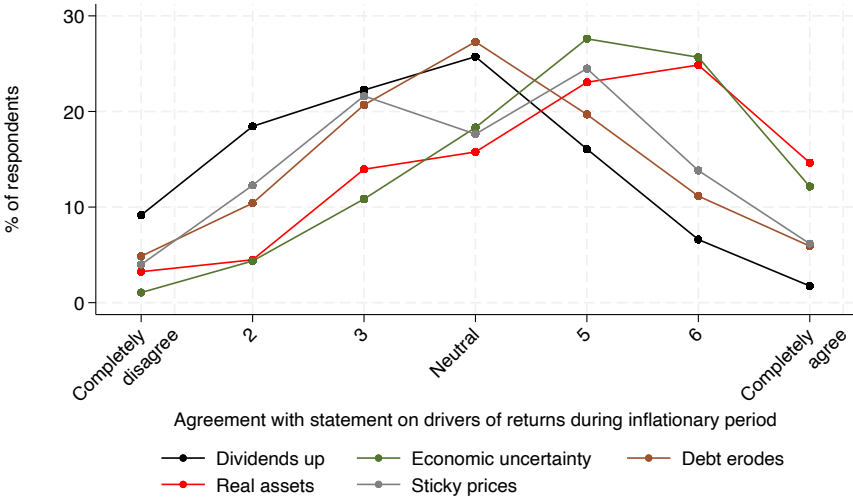


⇒ Disagreement and overoptimism about stock return-inflation relation

Mental models behind return impact of inflation

- Elicit agreement with theories on stock return-inflation relation
- Real assets protect against money erosion
(e.g., Fang, Liu, and Roussanov, 2022)
- Fisher channel: inflation erodes nominal debt
(e.g., Doepke and Schneider, 2006; Fisher, 1933; Schnorpfel, Weber, and Hackethal, 2023)
- Money illusion: constant nominal CF discounted w/ higher rate
(e.g., Cohen, Polk, and Vuolteenaho, 2005; Modigliani and Cohn, 1979)
- Inflation precedes economic uncertainty
(e.g., Boons et al., 2020; Campbell, Pflueger, and Viceira, 2020; Fama, 1981)
- Firms have limited ability to raise prices
(e.g., Bhamra et al., 2023; Gorodnichenko and Weber, 2016; Weber, 2015)

Mental models behind return impact of inflation



⇒ Large heterogeneity in reasoning behind stock return-inflation relation

Plan for the talk

- Data and experimental design
- Prior beliefs about inflation and asset returns
- **Treatment effects on return expectations**
- Expectations and trading

Equation to estimate treatment effects on return beliefs

$$\hat{y}_i = \alpha + \sum_{k=1}^3 \beta_k I(x_i = x^k) + \theta \mathbf{X}_i + \epsilon_i,$$

with

- \hat{y}_i = post-treatment 12-month return expectation of respondent i
- $I(x_i = x^k)$ = indicator that respondent i receives treatment k
- \mathbf{X}_i denotes set of controls from survey and bank data:
 - ▶ Age, risk tolerance, inflation and return perceptions, wealth and debt
 - ▶ Dummies for gender, marital status, education, financial literacy, financial advice, trading activity, timing of survey participation

Treatment effects on 12-month return expectations

$$\hat{y}_i = \alpha + \sum_{k=1}^3 \beta_k I(x_i = x^k) + \theta \mathbf{X}_i + \epsilon_i$$

<i>Dependent variable:</i>	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	0.092 (0.181)	0.243 (0.189)	0.051 (0.203)	-0.163 (0.166)	-0.087 (0.103)	-0.026 (0.170)
T2: past returns	-0.684*** (0.184)	0.505*** (0.189)	-0.035 (0.205)	1.066*** (0.200)	0.123 (0.102)	1.909*** (0.214)
T3: 1+2+reason	-1.049*** (0.185)	0.429** (0.180)	-0.114 (0.205)	1.490*** (0.194)	0.164 (0.109)	2.354*** (0.219)
Observations	2,568	2,572	2,499	2,578	2,644	2,525
R-squared	0.14	0.10	0.16	0.18	0.16	0.22
Controls	Y	Y	Y	Y	Y	Y
Avg. Y control group	5.0	4.6	5.9	4.1	1.4	4.0

- Inflation treatment has no effect on return expectations
- Info on low German stock returns reduces expectations
- Info on high returns of other assets has large effects

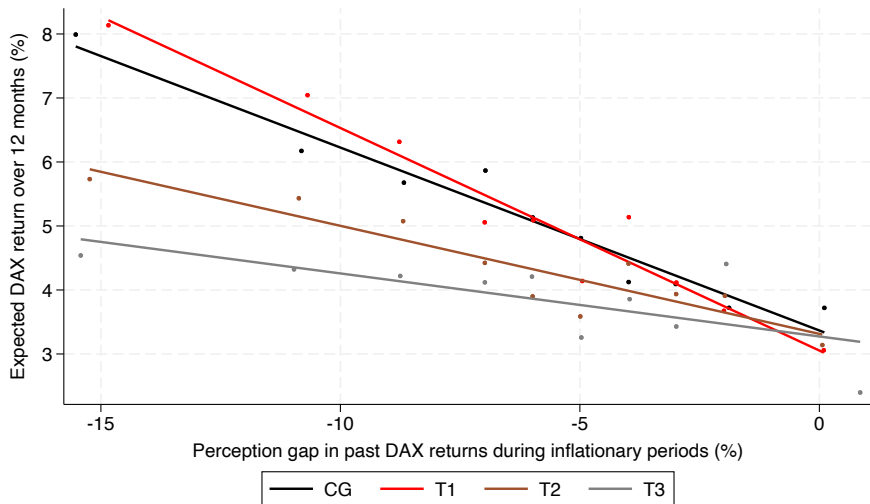
Treatment effects on return beliefs by perception gaps

- Learning might be stronger when priors deviate more from signals
- Focus on degree of updating as function of news in signal:

$$\hat{y}_i = \sum_{k=1}^3 \beta_k I(x_i = x^k) (x^{ret} - \hat{x}_{i,prior}^{ret}) + \mu_k I(x_i = x^k) + \delta_k (x^{ret} - \hat{x}_{i,prior}^{ret}) + \theta \mathbf{X}_i + \epsilon_i$$

- $(x^{ret} - \hat{x}_{i,prior}^{ret}) =$ gap b/w realized return and prior estimate
- μ_k measures treat effects that are independent of priors
- δ_k captures posteriors across respondents w/ different priors

Treatment effects on return beliefs by perception gaps



⇒ Return info (T2/T3) weakens association b/w prior and posterior

Inflation beliefs and return expectations

- Inflation info (T1/T3) \rightarrow 12m inflation expectations \uparrow by 0.5 pp
▶ Table
 - Info does not tighten relation b/w priors and return expectations
▶ Table
 - Return-info effect similar when paired w/ higher inflation f/cast (T3)
▶ Table
- \Rightarrow When inflation high, small inflation f/cast shifts w/ limited effects
(Andrade, Gautier, and Mengus, 2023; Pfäuti, 2024)

Plan for the talk

- Data and experimental design
- Prior beliefs about inflation and asset returns
- Treatment effects on return expectations
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Treatment effects on hypothetical trading

$$\hat{y}_i = \alpha + \sum_{k=1}^3 \beta_k I(x_i = x^k) + \theta \mathbf{X}_i + \epsilon_i$$

Dependent variable:	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	-73.6 (120.5)	42.8 (61.8)	-50.5 (121.0)	-58.4 (41.3)	-25.8 (41.2)	-3.7 (83.5)
T2: past returns	-830.6*** (123.7)	155.3** (63.7)	-231.1* (124.8)	383.4*** (55.9)	30.7 (40.3)	397.3*** (94.9)
T3: 1+2+reason	-1288.1*** (120.8)	372.0*** (65.8)	-125.8 (123.0)	522.3*** (57.8)	21.2 (40.1)	456.8*** (91.1)
Observations	2,597	2,594	2,529	2,599	2,648	2,549
R-squared	0.11	0.06	0.16	0.09	0.04	0.09
Controls	Y	Y	Y	Y	Y	Y
Avg. Y control group	3,444.3	771.8	2,963.2	488.0	264.9	1,024.4

- Inflation treatment has no effect on hypothetical trading
- Return info alters allocations in expected direction (except US)
- T3 effects larger; in particular, 1/3 less invest in German market

Treatment effects on actual trading

$$\hat{y}_i = \alpha + \sum_{k=1}^3 \beta_k I(x_i = x^k) + \theta \mathbf{X}_i + \epsilon_i$$

DV:	Number German equities				German equities in EUR			
	Gross buys		Net buys		Gross buys		Net buys	
Trades:								
Post:	2m	4m	2m	4m	2m	4m	2m	4m
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T1	-0.05 (0.05)	-0.04 (0.04)	-0.03 (0.05)	-0.01 (0.04)	-24.55 (292.96)	-89.58 (201.89)	37.19 (275.04)	46.06 (211.29)
T2	-0.02 (0.05)	-0.01 (0.04)	0.00 (0.05)	0.01 (0.04)	-261.13 (296.61)	-209.77 (212.80)	-103.66 (272.08)	-150.14 (210.64)
T3	-0.15*** (0.05)	-0.09** (0.04)	-0.13*** (0.05)	-0.07* (0.04)	-693.94*** (265.69)	-388.77* (203.70)	-229.40 (251.07)	-91.79 (200.70)
N	1,994	1,994	1,994	1,994	1,994	1,994	1,994	1,994
Y	0.55	0.49	0.34	0.31	1,823.67	1,415.51	550.27	428.34

- Hypothetical trading translates into actual trading
- Effect operates primarily through adjustments in gross buys
(e.g., Calvet, Campbell, and Sodini, 2009)

Changes in return expectations and actual trading

- Study return expectations as link b/w info provision and trading
- Estimate following model:

$$a_i = \delta + \kappa \hat{y}_i + \theta \mathbf{X}_i + \epsilon_i$$

- Instrument for return expectation, \hat{y}_i , using T3 indicator
- Info does not affect set of expectations about economic conditions

▶ Table

Changes in return expectations and actual trading

$$a_i = \delta + \kappa \hat{y}_i + \theta \mathbf{X}_i + \epsilon_i$$

<i>DV:</i>	Number German equities				German equities in EUR			
	Gross buys		Net buys		Gross buys		Net buys	
<i>Trades:</i>	2m	4m	2m	4m	2m	4m	2m	4m
<i>Post-treat:</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
12m DAX	0.12*** (0.04)	0.07** (0.03)	0.11** (0.04)	0.06* (0.03)	536.22** (234.14)	287.46* (169.85)	165.20 (204.38)	55.92 (162.34)
N	1,001	1,001	1,001	1,001	1,001	1,001	1,001	1,001
F-stat	29.71	29.71	29.71	29.71	29.71	29.71	29.71	29.71
Y	0.55	0.49	0.34	0.31	1,823.67	1,415.51	550.27	428.34

⇒ Significant passthrough from subjective return expectations to trading

Conclusion

- Study investors' return beliefs and trading in context of inflation
- In inflationary regime, behavior appears inelastic to infl. expectations
- Heterogeneity and overoptimism about return impact of inflation
- Shifting return beliefs alters expectations and trading
- Results informative for household finance, asset pricing, and macro
 - ▶ HF: investors care about inflation but are unaware of hedging
 - ▶ AP: shed light on which subjective models guide investor behavior
 - ▶ Macro: implications of HH inflation expectations for investments

Appendix

Treatment effects on inflation expectations

$$\hat{y}_i = \alpha + \sum_{k=1}^3 \beta_k I(x_i = x^k) + \theta \mathbf{X}_i + \epsilon_i$$

<i>Dependent variable:</i>	1yr forecast		Revision 1yr forecast		5yr forecast	
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	0.395*** (0.101)	0.493*** (0.089)	0.532*** (0.094)	0.546*** (0.092)	0.294*** (0.096)	0.350*** (0.087)
T2: past returns	-0.189* (0.105)	-0.093 (0.087)	-0.198** (0.088)	-0.178** (0.086)	-0.140 (0.101)	-0.066 (0.091)
T3: 1+2+reason	0.417*** (0.109)	0.478*** (0.093)	0.331*** (0.101)	0.412*** (0.098)	0.202** (0.097)	0.299*** (0.091)
Controls	N	Y	N	Y	N	Y
Avg. Y control group	5.0	5.0	0.4	0.3	3.7	3.7
Observations	2,747	2,660	2,704	2,631	2,751	2,663
R-squared	0.02	0.27	0.02	0.09	0.01	0.18

Shift in inflation f /cast \times prior beliefs about return impact

<i>Dependent variable:</i>	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
T1: inflation	-0.035 (0.185)	0.338* (0.191)	0.195 (0.203)	-0.092 (0.167)	-0.098 (0.113)	-0.093 (0.183)
Return Δ when inflation	0.208*** (0.045)	0.284*** (0.045)	0.171*** (0.052)	0.154*** (0.047)	0.069* (0.041)	0.173*** (0.047)
T1 \times return Δ	-0.026 (0.061)	-0.028 (0.072)	0.102 (0.077)	0.071 (0.073)	0.001 (0.065)	0.071 (0.071)
Controls	N	Y	N	Y	N	Y
Observations	1,402	1,387	1,343	1,389	1,424	1,340
R-squared	0.19	0.20	0.24	0.22	0.21	0.24

Shift in inflation f/cast x shift in beliefs about returns

<i>Dependent variable:</i>	DAX	DE energy	S&P 500	Nikkei 225	Bunds 10y	Gold
	(1)	(2)	(3)	(4)	(5)	(6)
Inflation-forecast revision	-0.038 (0.089)	-0.074 (0.086)	0.004 (0.097)	-0.001 (0.110)	0.065 (0.061)	-0.002 (0.131)
Controls	N	Y	N	Y	N	Y
Observations	538	542	530	544	557	529
R-squared	0.15	0.13	0.14	0.18	0.12	0.14

Treatment effects on other expectations

$$\hat{y}_i = \alpha + \sum_{k=1}^3 \beta_k I(x_i = x^k) + \theta \mathbf{X}_i + \epsilon_i$$

DV:	Own salary		Own portfolio		Unemployment		Economic growth	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T1	0.003 (0.040)	-0.005 (0.040)	-0.034 (0.047)	-0.074 (0.046)	-0.049 (0.045)	-0.067 (0.045)	0.006 (0.051)	-0.021 (0.050)
T2	-0.014 (0.042)	-0.003 (0.041)	0.118** (0.048)	0.077 (0.047)	0.020 (0.049)	-0.028 (0.049)	0.056 (0.054)	0.017 (0.053)
T3	0.004 (0.041)	0.017 (0.040)	0.039 (0.048)	-0.012 (0.047)	-0.042 (0.048)	-0.078 (0.049)	-0.081 (0.053)	-0.129** (0.053)
Controls	N	Y	N	Y	N	Y	N	Y
Avg. Y	3.3	3.3	3.5	3.5	2.9	2.9	3.1	3.1
N	2,792	2,690	2,792	2,690	2,792	2,690	2,792	2,690
R2	0.00	0.09	0.00	0.09	0.00	0.04	0.00	0.06