MPC Heterogeneity in Europe: Sources and Policy Implications

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Motivation

- Big Theme: Heterogeneity matters for economic policy
- Little Theme: What are the implications of heterogeneity in MPC for monetary policy?

What do we do

- Build a life-cycle model with portfolio choice, participation costs, credit constraints and bequest motives.
- Take into account rich heterogeneity in income, education, wealth accumulation and portfolio allocation.
- Estimate the model using data from the HFCS for France, Germany, Italy and Spain.
- Characterize the distribution of MPC across households.
- Evaluate the effect of monetary policy on consumption through its effects on income and asset prices.

Some data facts

- Education is a key determinant of household's financial behaviour.
- Between and within country heterogeneity.

Table: Household Facts by Education across Countries

	Germany		**Spain**		**France**		**Italy**	
edu	low	high	low	high	low	high	low	high
part. direct	6.4	19.9	6.5	21.3	11.6	24.7	3.8	10.5
share	18.9	19.2	26.8	26.9	22.7	23.1	28.0	20.5
part. indirect	9.5	31.5	7.0	22.5	13.0	28.2	4.7	12.8
share	12.8	12.1	28.2	28.4	23.2	23.6	30.5	24.0
part. indirect max	45.4	66.7	23.2	47.0	39.2	56.0	19.5	36.0
share	50.0	44.7	50.8	45.1	50.0	44.5	47.3	37.6
WI	0.350	0.749	0.180	0.399	0.303	0.552	0.287	0.519
WI(h)	1.038	3.133	8.039	7.650	4.113	4.794	5.563	6.064
avg. age	52.5	53.0	54.4	47.0	54.8	43.7	56.7	51.0
sample size	2085	1480	3988	2209	10833	4173	7013	938

This table displays the participation rate in stocks (defined in three different ways, row 1: direct, row 3: stocks plus mutual funds invested mainly in stocks and row 5: stocks, mutual funds invested mainly in stocks plus private pension plans), the share of stocks over total liquid assets (for participants), the median wealth income ratio, with and without housing (h) for households in each country by educational attainment, low (no college) and high (college). The moments come from the HFCS.

The model - Main features

- **Households maximize expected lifetime utility**
  - Choice variables: consumption (C), bond holdings (B), stock holdings (S), asset market participation and stock adjustment.
- **Idiosyncratic shocks to income and risky financial assets**
  - Exogenous income process: deterministic (growth) and stochastic components (persistent and transitory shock).
  - Risky asset return stochastic (R^s), bond return fixed (R^b).
- **Liquidity constraints, financial frictions, bequest motive**
  - Participation and re-balancing costs.
  - Borrowing limit.
  - Bequest motive.
- **Consumption floor** $\underline{c}$ coming from government transfer.
- Ingredients produce precautionary savings and a distribution of MPCs.

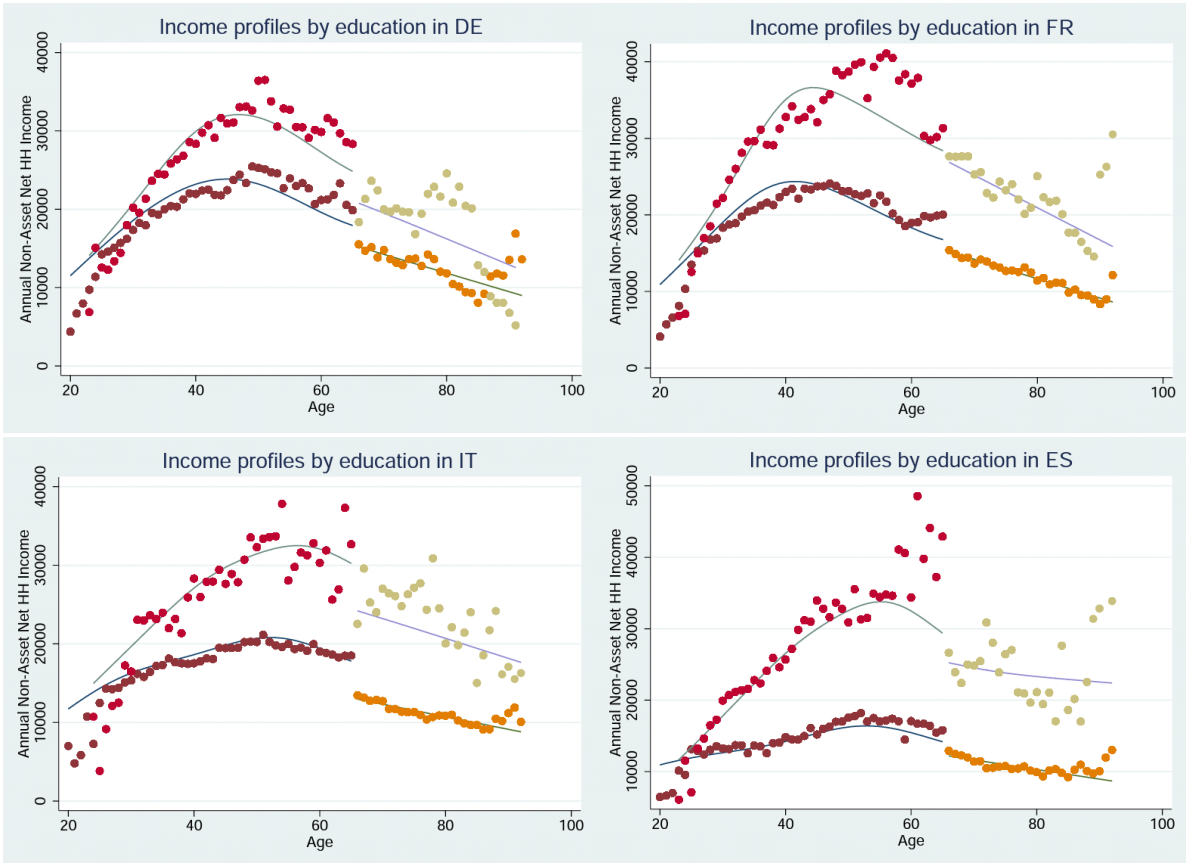
The model - Income processes

- **Deterministic income profile**
  - Estimated from ECHP, 1994-2001. Labor income net of taxes and transfers
  - $log(Y_{i,t}) = const + polynomial_{(age)} + HHComp + TimeEff$
- **Persistent and transitory income shocks**

$$\tilde{y}_{i,t} = z_{i,t} + \epsilon_{i,t}$$
$$z_{i,t} = \rho z_{i,t-1} + \eta_{i,t} \quad (1)$$

- **Linear fit for retirement period**

The model - Income profiles



Source: European Community Household Panel 1994–2001

The model - Income processes

Stochastic Processes by education and country

	Germany			France		
	ρ	σ_η^2	σ_ϵ^2	ρ	σ_η^2	σ_ϵ^2
No college	0.895***	0.022***	0.016***	0.971***	0.031***	0.006*
	(0.005)	(0.001)	(0.001)	(0.014)	(0.006)	(0.003)
College	0.937***	0.020***	0.011***	0.941***	0.023***	0.018***
	(0.008)	(0.001)	(0.001)	(0.007)	(0.003)	(0.002)

	Italy			Spain		
	ρ	σ_η^2	σ_ϵ^2	ρ	σ_η^2	σ_ϵ^2
No college	0.944***	0.072***	0.020***	0.951***	0.092***	0.016***
	(0.005)	(0.003)	(0.002)	(0.007)	(0.004)	(0.002)
College	0.921***	0.029***	0.022***	0.986***	0.058***	0.004**
	(0.016)	(0.01)	(0.006)	(0.007)	(0.004)	(0.002)

The model - Asset returns

- Real return on bonds is set at 2% for all countries
- Mean and standard deviations for real stock returns taken from historical data by country

Table: Stock Return Processes

	mean return	standard deviation
Germany	0.085	0.310
Spain	0.078	0.245
France	0.092	0.291
Italy	0.046	0.290

Note: Real stock returns, 1930-2012

The model: Participants

$$v_t(\Omega) = \max\{v_t^a(\Omega), v_t^n(\Omega), v_t^x(\Omega)\} \qquad \Omega = (y, A^b, A^s) \tag{2}$$

Adjust:

$$v_t^a(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b, A^{s\prime} \geq 0} \left\{ (1-\beta)c^{1-1/\theta} + \beta \left[(1-\nu_{t+1}) \left(E_t v_{t+1}(\Omega')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} + \nu_{t+1} \left(E_t B(A')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \right]^{1-1/\theta} \right\}^{\frac{1}{1-1/\theta}} ($$

$s.t.$

$$c = y + TR + \textstyle\sum_{i=b,s} R^i A^i - \sum_{i=b,s} A^{i\prime} - F \quad ($$

$$A' = R^b A^{b\prime} + R^{s\prime} A^{s\prime} \quad ($$

$$TR = \max\{0, \underline{c} - (y + \textstyle\sum_{i=b,s} R^i A^i)\}. \quad ($$

No Adjust:

$$v_t^n(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b} \left\{ (1-\beta)c^{1-1/\theta} + \beta \left[(1-\nu_{t+1}) \left(E_t v_{t+1}(\Omega')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} + \nu_{t+1} \left(E_t B(A')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \right]^{1-1/\theta} \right\}^{\frac{1}{1-1/\theta}}$$

$s.t.$

$$c = y + TR + R^b A^b - A^{b\prime}$$

$$A^{s\prime} = R^s A^s$$

$$A' = R^b A^{b\prime} + R^{s\prime} A^{s\prime}$$

$$TR = \max\{0, \underline{c} - (y + \textstyle\sum_{i=b,s} R^i A^i)\}$$

The model: Non: Participants

$$w_t(\Omega) = \max\{w_t^n(\Omega), w_t^p(\Omega)\} \tag{7}$$

for all Ω.
No Entry

$$w_t^n(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b} \left\{ (1-\beta)c^{1-1/\theta} + \beta \left[(1-\nu_{t+1}) \left(E_t w_{t+1}(\Omega')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} + \nu_{t+1} \left(E_t B(A')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \right]^{1-1/\theta} \right\}^{\frac{1}{1-1/\theta}} \tag{8}$$

$$c = y + TR + R^b A^b - A^{b\prime}$$
$$A' = R^b A^{b'}$$
$$TR = \max\{0, \underline{c} - (y + R^b A^b)\}$$

Entry

$$w_t^p(\Omega) = \max_{A^{b\prime} \geq \underline{A}^b, A^{s\prime} \geq 0} \left\{ (1-\beta)c^{1-1/\theta} + \beta \left[(1-\nu_{t+1}) \left(E_t v_{t+1}(\Omega')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} + \nu_{t+1} \left(E_t B(A')^{1-\gamma} \right)^{\frac{1}{1-\gamma}} \right]^{1-1/\theta} \right\}^{\frac{1}{1-1/\theta}} (9$$

$$c = y + TR + R^b A^b - A^{b\prime} - A^{s\prime} - \Gamma$$
$$A' = R^b A^{b'} + R^{s'} A^{s'}$$
$$TR = \max\{0, \underline{c} - (y + R^b A^b)\}.$$

The model - Solution and estimation

- **Finite dynamic optimization problem solved by backward induction**
  - Discretized shocks, initial distribution of assets...
  - Value function iteration
- **Simulated method of moments estimation**
  - $$\Lambda = min_{\Theta}(M^s(\Theta) - M^d)W(M^s(\Theta) - M^d)'. \quad (10)$$
  - Match regression coefficient of participation rate, stock share, (liquid) wealth-to-income ratio
  - Explain moments by age and education (plus home equity controls)
- **Estimate MPC**
  - For each single household
  - Matching the liquid wealth distribution
  - In response to a transitory income shock and a stock return shock

Results

Parameter Estimates

Table: Parameter Estimates

	β_0	β_1	γ	Γ	F	L	ϕ	$\underline{c}$	θ	$\underline{A}^b$	Λ
Germany	0.800	0.857	14.920	0.002	0.011	0.032	0.680	0.219	0.445	-0.123	1111.42
	(0.009)	(0.008)	(0.245)	(0.001)	(0.014)	(0.010)	(0.522)	(0.052)	(0.029)	(0.045)	
Spain	0.794	0.865	12.535	0.013	0.006	0.099	0.699	0.312	0.294	-0.062	806.04
	(0.008)	(0.021)	(0.378)	(0.004)	(0.002)	(0.044)	(1.467)	(0.035)	(0.091)	(0.638)	
France	0.792	0.864	18.522	0.008	0.016	0.027	1.55	0.150	0.401	-0.130	7617.63
	(0.006)	(0.005)	(0.023)	(0.003)	(0.004)	(0.004)	(0.155)	(0.020)	(0.009)	(0.040)	
Italy	0.808	0.881	13.947	0.008	0.0003	0.042	1.558	0.336	0.317	-0.069	2702.26
	(0.031)	(0.022)	(3.273)	(0.011)	(0.001)	(0.013)	(2.033)	(0.001)	(0.001)	(0.237)	

This table reports parameter estimates and the corresponding standard errors. The last column is model fit from (10).

- Discount factors lower than conventional value (0.95). HH with low education have even lower β than highly educated HH
- High risk aversion coefficients (US around 4)
- High stock participation costs (highest in Spain, lowest in Germany) estimates are in terms of mean income
- Importance of bequests stronger in some countries

Table: Data and Model Moments

	con.	*age*	age^2	*college* (∗*age*)	*college* ∗age^2	con.	*age*	age^2	*college* (∗*age*)	*college* ∗age^2
			Germany: Data					Germany: Model		
Part.	0.250	0.018	-0.00026	0.159		0.276	0.0157	-0.00014	0.164	
Share	0.004	0.023	-0.00024	-0.060		0.025	0.0235	-0.00023	-0.062	
W/I	0.542	-0.008	0.00022	0.037	-0.00036	1.143	-0.0326	0.00031	-0.041	0.000929
			Spain: Data					Spain: Model		
Part.	-0.716	0.035	-0.00034	0.161		-0.157	0.0295	-0.00022	0.178	
Share	-0.116	0.026	-0.00025	-0.049		-0.115	0.0264	-0.00025	-0.049	
W/I	-1.675	0.065	-0.00036	0.013	0.00012	-0.266	0.0396	-0.00027	-0.056	0.001248
			France: Data					France: Model		
Part.	-0.090	0.015	-0.00013	0.148		-0.020	0.0235	-0.00016	0.161	
Share	0.056	0.013	-0.00007	-0.017		0.052	0.0102	-0.00009	-0.017	
W/I	1.344	-0.050	0.0007	-0.004	0.0003	2.753	-0.1060	0.00124	-0.092	0.002534
			Italy: Data					Italy: Model		
Part.	-0.117	0.014	-0.00017	0.089		-0.002	0.0336	-0.00029	-0.002	
Share	0.225	0.015	-0.00016	-0.082		0.098	0.0112	-0.00013	-0.086	
W/I	-0.062	0.023	-0.00018	-0.023	0.00042	1.491	-0.0313	0.00048	-0.073	0.00167

This table reports data and model moments. For the wealth-income ratio regression, the regressors include a constant, age, age-squared, college*age, college*age-squared. For all regressions, controls included home equity and homeownership status.

Other Properties of Solution

- 8-10% of low education HHs hit consumption floor in Italy and Spain.
- borrowing constraints rarely bind
- local identification through derivative of moments wrt parameters
- Hand to Mouth Households are present due to portfolio adjustment costs

MPCs by country

- Average MPC from income between 0.25-.040, average MPC from stock returns between 0.2-0.3
- Moderate cross-country heterogeneity

Average MPCs by country in response to

	1% income shock	1% return shock
Germany	0.383	0.284
Spain	0.332	0.211
France	0.304	0.197
Italy	0.243	0.255

MPC Distributions from Income and Return Shocks

Figure: A 1% income shock

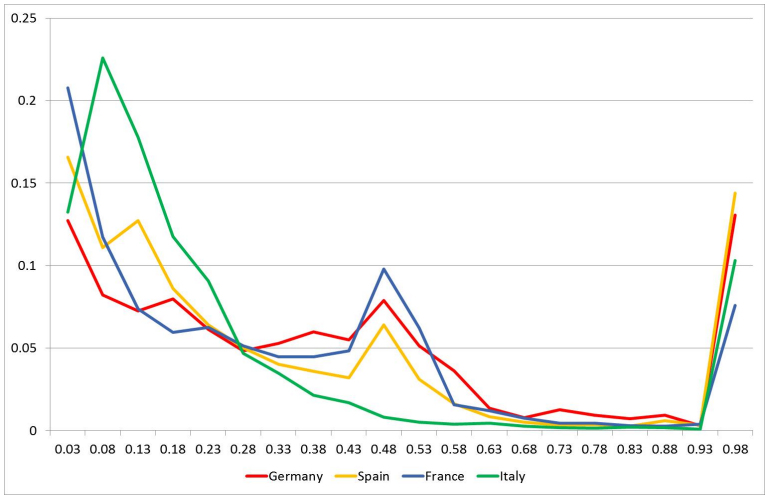
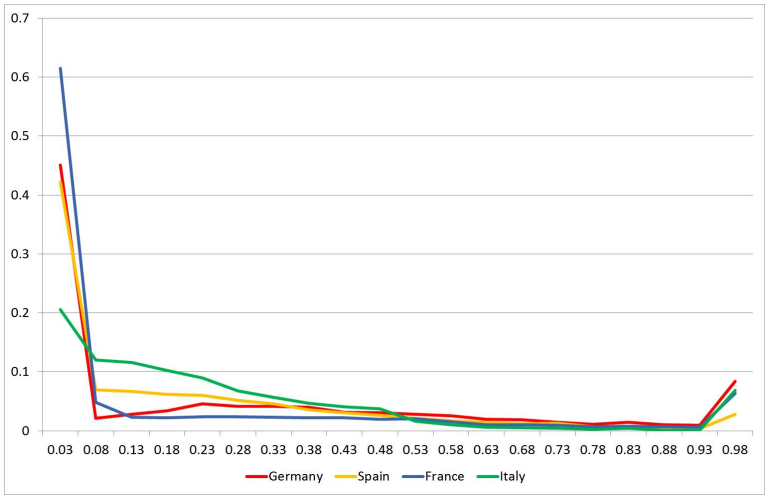


Figure: A 1% return shock



- Larger MPCs coming from income shocks.
- Group of liquidity constrained households.

MPCs by country and wealth distribution

MPC regressions by country

	const.	age	age2	income	edu	WYratio	Total financial wealth 5-50%	50-70%	70-90%	90-95%	95-100%
MPCs in response to a 1% increase in transitory income											
Germany	0.186	0.017	-0.00020	-0.043	-0.0045	0.000	0.059	-0.069	-0.146	-0.152	
Spain	0.271	0.006	-0.00007	-0.017	0.0053	0.000	-0.051	-0.079	-0.113	-0.114	
France	0.231	0.017	-0.00021	-0.048	0.0090	0.021	-0.171	-0.198	-0.207	-0.212	
Italy	0.272	0.007	-0.00007	-0.034	0.0184	0.044	-0.101	-0.117	-0.131	-0.135	
MPCs in response to a 1% increase in stock returns											
Germany	0.255	0.024	-0.00029	-0.040	-0.0109	-0.106	-0.200	-0.250	-0.359	-0.376	
Spain	0.159	0.015	-0.00017	-0.013	0.0166	-0.091	-0.148	-0.191	-0.245	-0.258	
France	0.142	0.011	-0.00014	-0.011	-0.0068	0.000	-0.127	-0.173	-0.197	-0.195	
Italy	0.376	0.006	-0.00005	-0.034	-0.0147	0.000	-0.163	-0.201	-0.242	-0.257	

- Non-linearity of MPC along the wealth distribution.
- Same response for bottom half of the distribution, smaller afterwards.

MPCs by country

Table: MPC Distribution: Income Shock

Country	Ed	1%						10%					
		All Households:by income			Participants:by income			All Households:by income			Participants:by income		
		low	middle	high	low	middle	high	low	middle	high	low	middle	high
Germany	low	0.438	0.262	0.233	0.331	0.289	0.232	0.399	0.251	0.201	0.270	0.245	0.200
	high	0.311	0.191	0.142	0.258	0.187	0.142	0.295	0.186	0.139	0.237	0.182	0.139
Spain	low	0.647	0.213	0.139	0.272	0.174	0.142	0.658	0.178	0.139	0.203	0.158	0.138
	high	0.282	0.154	0.136	0.198	0.154	0.138	0.247	0.156	0.137	0.191	0.155	0.139
France	low	0.382	0.198	0.149	0.295	0.196	0.155	0.306	0.192	0.147	0.234	0.189	0.153
	high	0.235	0.132	0.086	0.150	0.130	0.145	0.206	0.128	0.100	0.138	0.126	0.164
Italy	low	0.675	0.137	0.115	0.453	0.136	0.115	0.653	0.136	0.113	0.400	0.134	0.113
	high	0.259	0.128	0.117	0.178	0.118	0.119	0.214	0.125	0.117	0.163	0.117	0.119

Table: MPC of Stock Market Participants

	1%		10%	
	Adjustors	Non-adustors	Adjustors	Non-adustors
Germany	0.125	0.211	0.124	0.212
Spain	0.142	0.174	0.137	0.151
France	0.102	0.156	0.169	0.140
Italy	0.153	0.297	0.142	0.161

This table reports the mean MPC of stock market participants. Adjustors are the participants who engaged in portfolio re-balancing.

Table: MPC Distribution: Return Shocks

Country		1% Income			10% Income		
	Ed	low	middle	high	low	middle	high
Germany	low	0.307	0.246	0.202	0.311	0.250	0.202
	high	0.274	0.175	0.139	0.278	0.175	0.139
Spain	low	0.224	0.146	0.139	0.227	0.148	0.139
	high	0.182	0.145	0.131	0.185	0.145	0.133
France	low	0.196	0.183	0.160	0.205	0.185	0.162
	high	0.138	0.116	0.156	0.140	0.117	0.158
Italy	low	0.328	0.144	0.112	0.344	0.144	0.112
	high	0.156	0.117	0.111	0.159	0.118	0.113

- conditional on participation
- MPC falls with permanent income level

Hand to Mouth Households

- liquid assets less than half income flow
- Data
  - poor have negative illiquid assets
  - rich have positive illiquid assets
- Simulated Data from Est. Model
  - both types exist in simulated
  - low income HtM consumers generally have higher MPCs

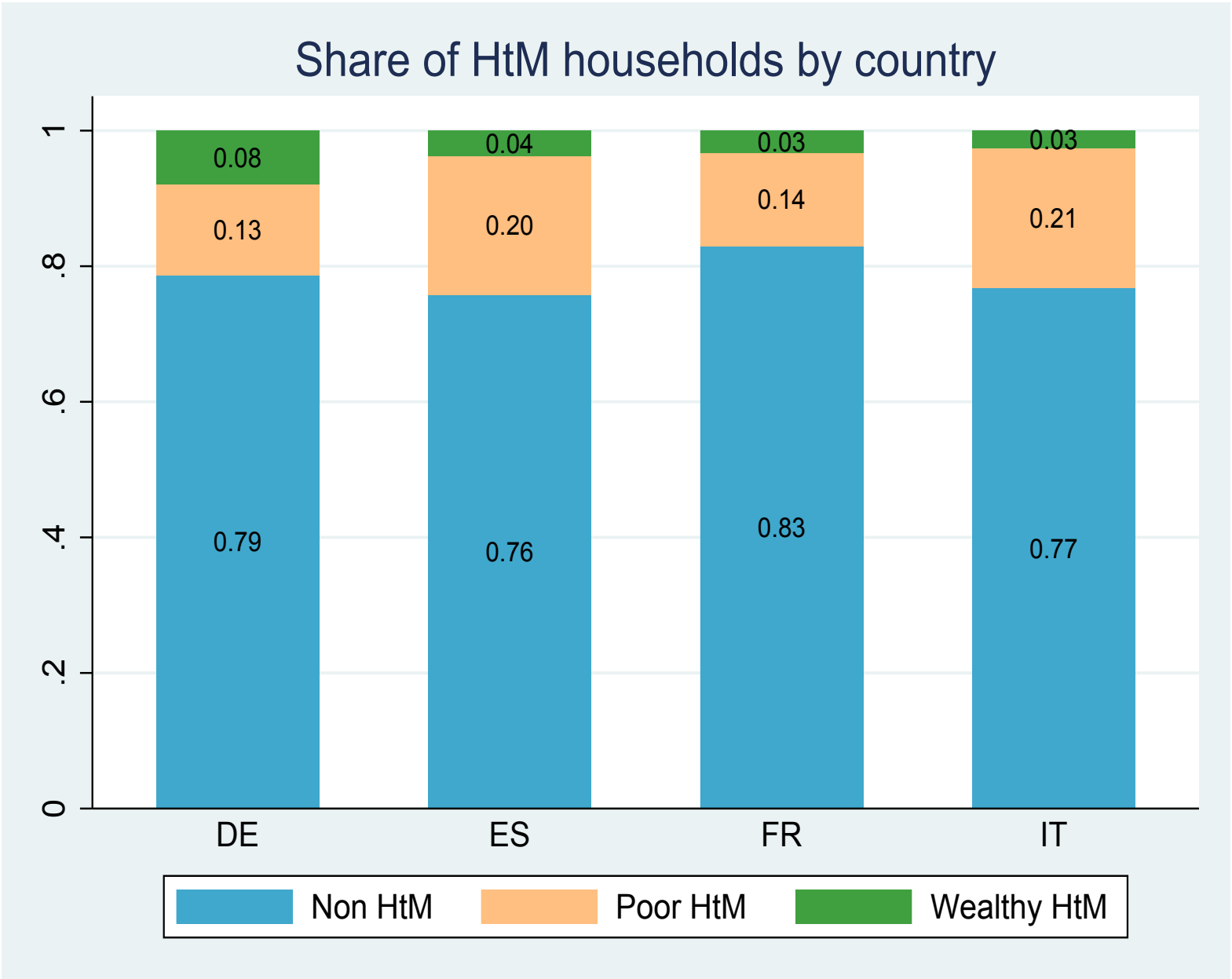


Figure: HtM Households

Table: Hand-to-Mouth Consumers: Income Shock

Country	Ed/Inc		Fraction of HtM'ers				Mean MPC of HtM'ers		
			low	middle	high	total	low	middle	high
Germany	all	low	0.082	0.065	0.013	0.249	0.564	0.357	0.484
		high	0.060	0.027	0.001		0.512	0.323	0.281
	part.	low	0.017	0.037	0.008	0.106	0.434	0.107	0.443
		high	0.021	0.022	0.001		0.491	0.298	0.281
	non-part.	low	0.065	0.028	0.005	0.143	0.597	0.686	0.546
		high	0.039	0.005	0.000		0.524	0.438	0.277
Spain	all	low	0.091	0.036	0.003	0.169	0.795	0.338	0.266
		high	0.031	0.009	0.000		0.516	0.278	0.216
	part.	low	0.008	0.023	0.002	0.053	0.606	0.319	0.274
		high	0.013	0.008	0.000		0.335	0.289	0.196
	non-part.	low	0.083	0.013	0.000	0.116	0.812	0.370	0.218
		high	0.018	0.001	0.000		0.645	0.197	0.570
France	all	low	0.055	0.007	0.000	0.098	0.588	0.328	0.361
		high	0.033	0.003	0.000		0.544	0.321	0.140
	part.	low	0.006	0.005	0.000	0.017	0.511	0.335	0.351
		high	0.005	0.001	0.000		0.333	0.200	0.123
	non-part.	low	0.050	0.002	0.000	0.081	0.597	0.307	0.413
		high	0.028	0.002	0.000		0.585	0.400	0.159
Italy	all	low	0.090	0.011	0.000	0.128	0.802	0.190	0.229
		high	0.024	0.003	0.000		0.665	0.273	0.202
	part.	low	0.046	0.010	0.000	0.065	0.729	0.175	0.228
		high	0.007	0.002	0.000		0.493	0.204	0.148
	non-part.	low	0.043	0.001	0.000	0.063	0.881	0.445	0.265
		high	0.017	0.002	0.000		0.730	0.339	0.253

Table: Hand-to-Mouth Consumers: Return Shock

Country		Fraction of HtM'ers				Mean MPC of HtM'ers		
	Ed/Inc	low	middle	high	total	low	middle	high
Germany	low	0.022	0.049	0.010	0.140	0.449	0.308	0.175
	high	0.028	0.030	0.001		0.348	0.334	0.259
Spain	low	0.009	0.027	0.003	0.064	0.523	0.147	0.138
	high	0.016	0.009	0.000		0.248	0.252	0.194
France	low	0.007	0.006	0.000	0.022	0.225	0.132	0.120
	high	0.007	0.001	0.000		0.185	0.156	0.148
Italy	low	0.051	0.011	0.000	0.071	0.284	0.150	0.165
	high	0.007	0.002	0.000		0.321	0.261	0.151

This table reports the mean MPC of stock market participants who are hand-to-mouth consumers in response to a return shock that is 1% of the stock value.

Monetary Policy Implications

- Impact of monetary policy shocks on consumption through income and asset returns.
- Use elasticities of income and asset returns to monetary policy shocks from the literature and our estimates of MPCs
- 100 basis point cut in target rate

$$\frac{dC}{dMP} = \int_s \frac{dc(Y, R^s, R^b, \Omega)}{dY} \frac{dY}{dMP} dG(\Omega) + \int_s \frac{dc(Y, R^s, R^b, \Omega)}{dR^s} \frac{dR^s}{dMP} dG(\Omega) \tag{11}$$

Aggregate Response

Table: Aggregate Consumption Response to Monetary Policy (in %)

Country	Income Shocks	Return shocks	Total Response
Germany	0.070	0.075	0.113
Spain	0.171	0.214	0.293
France	0.092	0.770	0.525
Italy	0.072	0.216	0.215

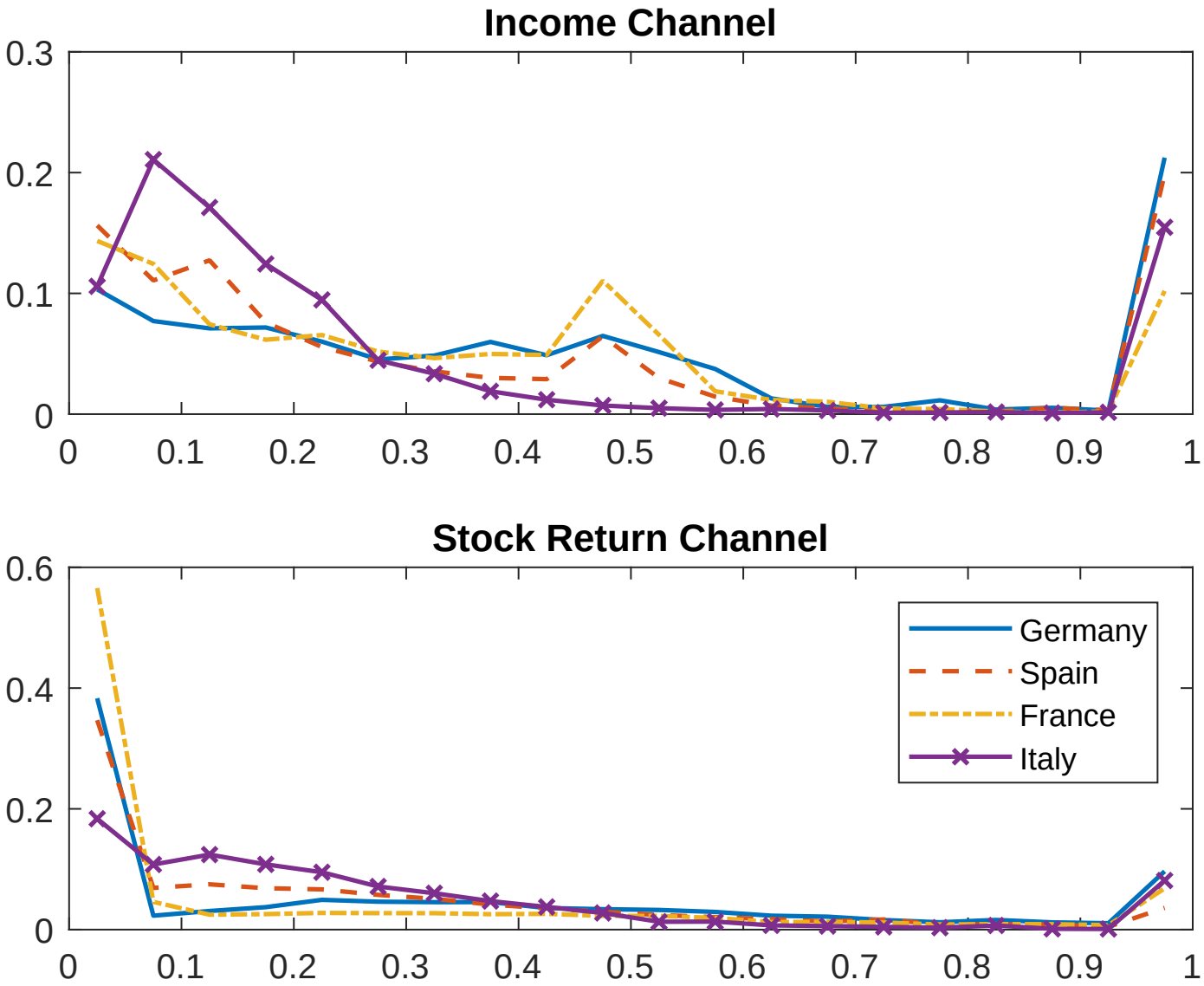


Figure: Distribution of MPC from Policy Induced Income and Return Shocks

Monetary Policy Effect on Income

Country	Effect on Income
Germany	0.164
Spain	0.497
France	0.208
Italy	0.291

Distribution Consequences

Country	EdInc	Monetary Policy Response: All Households			Monetary Policy Response: Participants			Participation Rate		
		low	middle	high	low	middle	high	low	middle	high
Germany	low	0.134	0.103	0.112	0.116	0.107	0.119	0.358	0.754	0.863
	high	0.107	0.106	0.132	0.109	0.114	0.136	0.587	0.899	0.964
Spain	low	0.472	0.207	0.217	0.243	0.193	0.217	0.245	0.871	0.993
	high	0.258	0.246	0.603	0.220	0.246	0.603	0.691	0.984	1.000
France	low	0.192	0.159	0.187	0.190	0.171	0.196	0.259	0.806	0.942
	high	0.232	0.596	3.206	0.240	0.599	3.206	0.637	0.983	0.999
Italy	low	0.411	0.111	0.119	0.291	0.111	0.119	0.648	0.997	1.000
	high	0.176	0.229	1.041	0.140	0.228	1.041	0.774	0.940	0.996

Conclusion

- Life-cycle model with portfolio choice, participation costs, credit constraints and bequest motives implies significant differences in deep parameters' estimates within and across countries.
- Characterize the distribution of MPC across households and countries.
- Monetary policy effects on consumption through income and asset prices are household specific.