Broadband Internet and the Stock Market Investments of Individual Investors

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汇报人：储刚

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Motivation

Does Internet use spur a "democratization of finance" ?

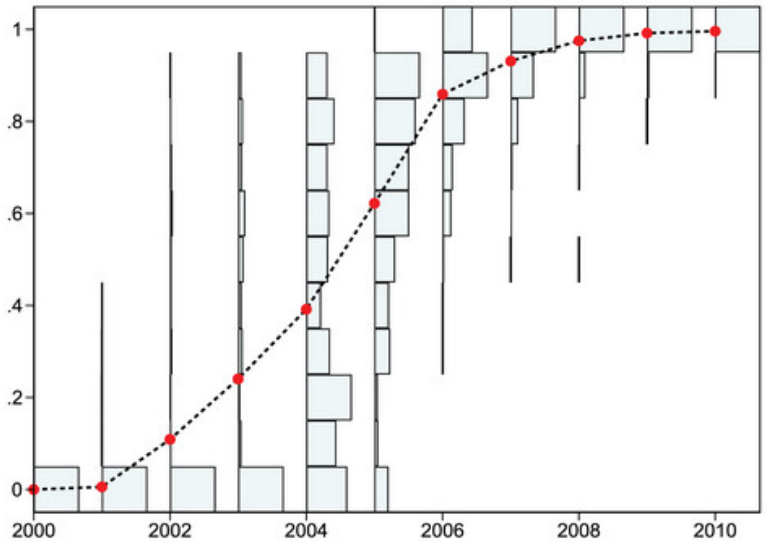
- Internet use amplifies behavioral biases (Barber and Odean, 2002; Choi, Laibson, and Metrick, 2002).
- Social media usage appears, at best, to have mixed effects on the quality of financial decisions (e.g., Allen et al., 2022; Barber et al., 2022; Hirshleifer, Peng, and Wang, 2023).

Limitations:

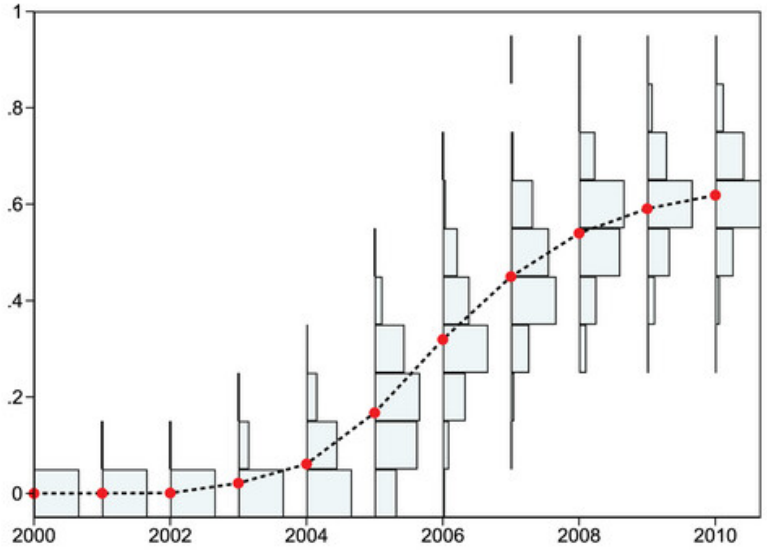
- Existing literature estimates the effects of internet use only within subgroups of investors.
- These studies mostly investigate the effect of Internet applications usage rather than Internet itself on individuals' financial decisions.

Motivation

- A program rolled out by the Norwegian government in the 2000s that aimed at ensuring broadband coverage at a reasonable price throughout the country, which provides a source of exogenous variation in internet use.
- This study focuses on the effects of the rollout of high-speed broadband internet on the stock market participation and portfolio choices of individual investors in Norway in the 2000s.



Panel A. Broadband coverage rates



Panel B. Broadband user rates

Research Question

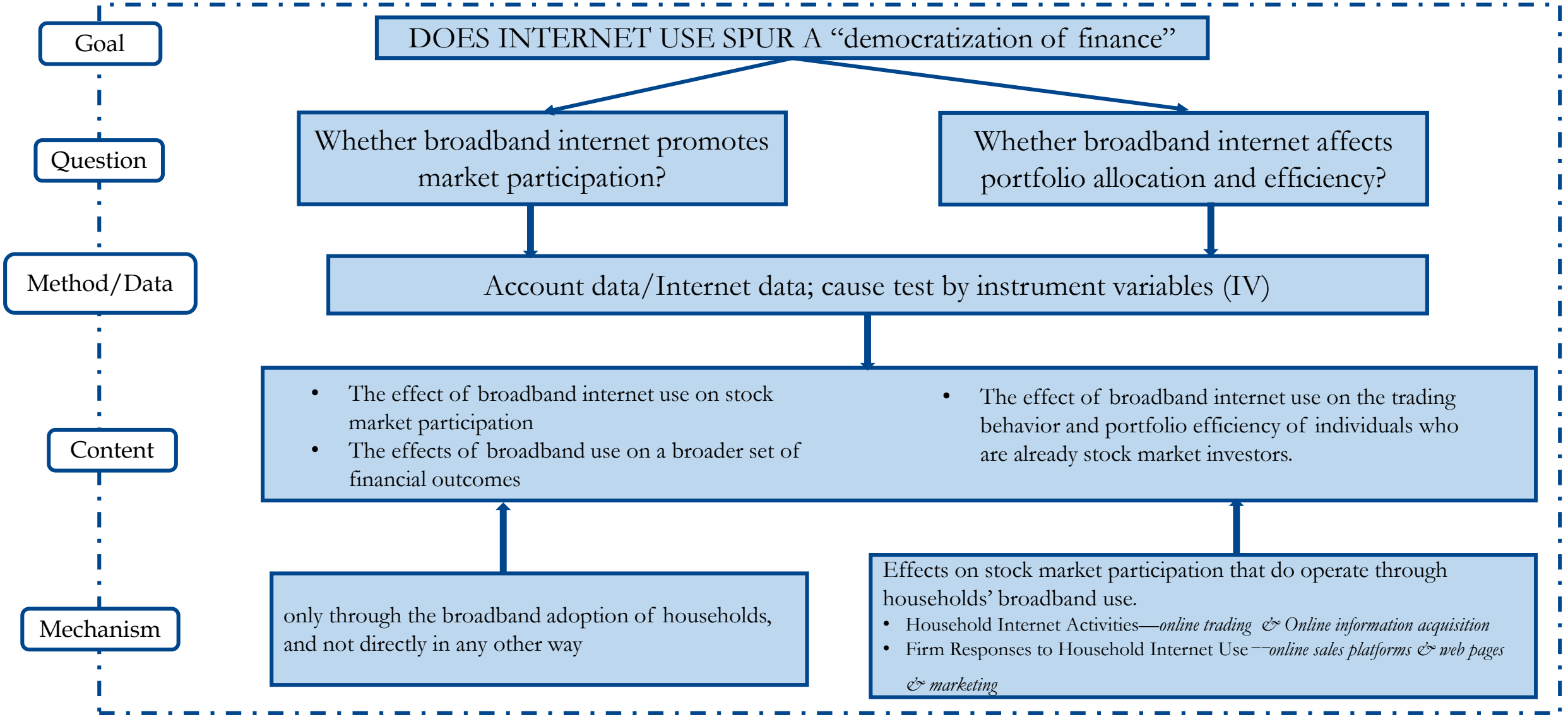
Q1: Whether high-speed broadband internet promotes the stock market participation of individual investors.

- Faster internet would reduce the cost of these activities and thus increase stock market participation rates.
- Faster internet also reduces the cost of leisure-related activities, such as social networking or watching movies, which could crowd out individuals' focus on personal finance.

Q2: Whether broadband internet affects the portfolio allocation and portfolio efficiency of individuals?

- Access to broadband internet reduces the cost of acquiring information about individual companies, which may increase investors' belief that they can beat the market by being well informed and thus lead to increased trading activity and possibly decreased diversification.
- Broadband provide easier access to information about sound portfolio allocation principles and thus lead to improved choices.

Structure


Goal
DOES INTERNET USE SPUR A "democratization of finance"
Question
Whether broadband internet promotes market participation?
Whether broadband internet affects portfolio allocation and efficiency?
Method/Data
Account data/Internet data; cause test by instrument variables (IV)
Content
The effect of broadband internet use on stock market participation
The effects of broadband use on a broader set of financial outcomes
The effect of broadband internet use on the trading behavior and portfolio efficiency of individuals who are already stock market investors.
Mechanism
only through the broadband adoption of households, and not directly in any other way
Effects on stock market participation that do operate through households' broadband use.
Household Internet Activities—online trading & Online information acquisition
Firm Responses to Household Internet Use—online sales platforms & web pages & marketing

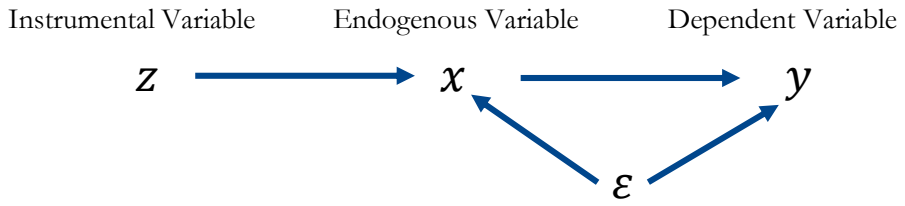
Contribution

- **Contributes to a literature on how internet use affects the portfolio choices of individual investors by providing evidence that stock market participation improves portfolio efficiency of individual investors.**
  - ✓ Excessive stock trading among adopters of online trading platforms (Barber and Odean, 2002).
  - ✓ Herding and speculation among users of Twitter, Stocktwits, and Reddit's "wallstreet- bets" stock forum (Allen et al., 2022)

- **Contributes to a literature in household finance by analyzing the effects of an exogenous reduction in the fixed costs of equity market participation due to faster internet access.**
  - ✓ personal wealth (Brunnermeier and Nagel, 2008; Calvet, Campbell, and Sodini, 2009; Briggs et al., 2021)
  - ✓ educational attainment (Cole, Paulson, and Shastry, 2014)
  - ✓ computer ownership (Bogan, 2008)
  - ✓ financial literacy (Lusardi and Mitchell, 2014; Lusardi, Michaud, and Mitchell, 2017)

- **Speaks to ongoing policy debates on the government expansion or funding of broadband infrastructure.**

Research Design



IV 3 assumption:

- Relevance assumption
- Exclusion restriction
- Exogeneity assumption

The reduced form of our IV model:

$$y_{kt} = \delta z_{kt-1} + \mu_k + \chi_t + \varepsilon_{kt}, \qquad (1)$$

Stock market participation rate (or other outcome)

Broadband coverage rate

Municipality fixed effects

Year fixed effects

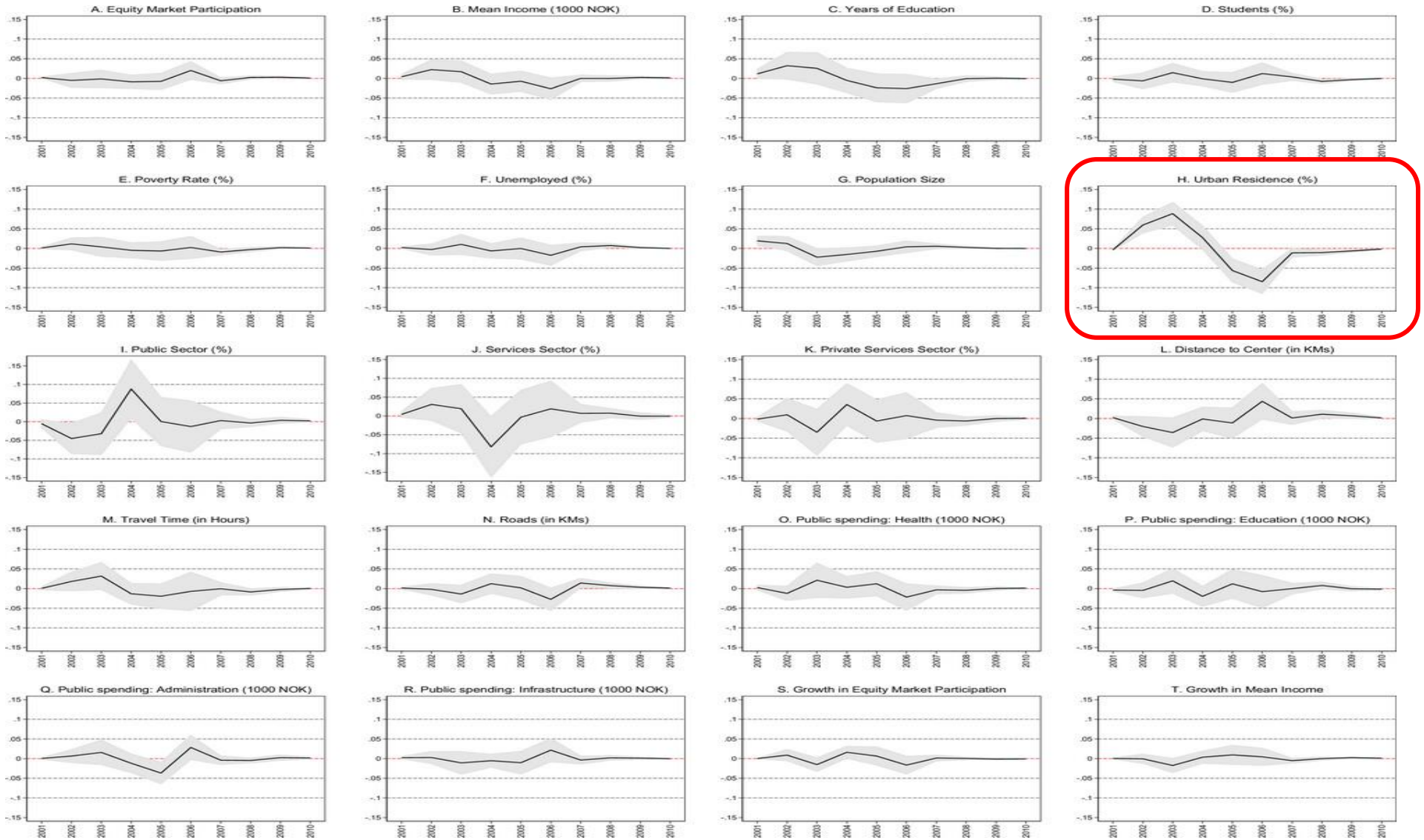
Exogeneity assumption:

Identifying: In the absence of broadband coverage expansions, municipalities with early and late expansions would, on average, have followed the same trend in outcomes.

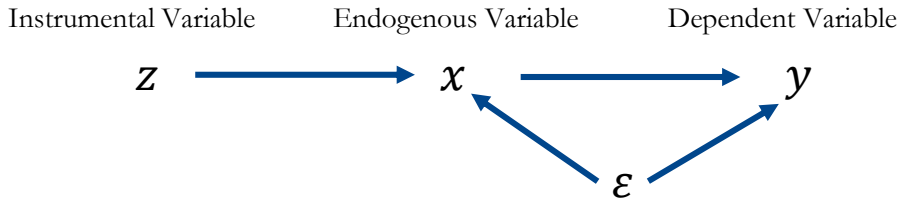
Assessing:

$$\Delta z_{kt} = \alpha + [m_{k,2000}]'\beta + \kappa_{kt}, \qquad (2)$$

Research Design



Research Design



IV 3 assumption:

- Relevance assumption
- Exclusion restriction
- Exogeneity assumption

IV model:

$$i_{kt} = \phi z_{kt-1} + \gamma_k + \theta_t + \nu_{kt}, \quad (3)$$

$$y_{kt} = \omega i_{kt} + \alpha_k + \tau_t + \epsilon_{kt}, \quad (4)$$

Exclusion restriction:

Identifying: lagged broadband coverage affects stock market participation only through its impact on current household broadband use, and not directly in any other way.

Assessing: Discussed latter

Sample and Data

Transaction-Level Data (1993-2010)

- Data on all common stock trades made on the OSE : NCSD
- Daily ticker prices and other company information: OSE
- 50% fund customer relationship: OSE

Internet Data (2000-2010)

- Broadband *coverage data:* Norwegian Ministry of Government Administration
- Broadband *subscriptions data:* Telenor (2000-2001); The quarterly Internet Survey per- formed by Statistics Norway (2002-2010)

Other Data

- The sociodemographic data (1993-2010): Administrative registers provided by Statistics Norway
- Educational attainment data: Norwegian educational establishments
- Income and wealth data: Tax records and other registers.
- Firm-level data (2001-2010): Yearly accounting statements submitted by all incorporated firms to the tax authorities

Q1. Market Participation

Effect of broadband internet use on stock market participation

- Broadband internet use leads to increased stock market participation driven by an increase in the share of the population investing in equity funds
- There is no effect of internet use on the share of the population holding common stocks

Broadband adoption rate--Market participation rate

Broadband coverage rate--Market participation rate

Broadband coverage rate-- Broadband adoption rate

	Panel A: Main Results			Panel B: Robustness		
	Holds Any	*Holds Stocks*	*Holds Funds*	*Holds Any*	*Holds Any*	*Holds Funds*
IV estimate	0.0698***	−0.0062	0.0764***	0.0486***	0.0287***	0.0248**
	(0.0169)	(0.0075)	(0.0173)	(0.0152)	(0.0105)	(0.0099)
Reduced form	0.0078***	−0.0007	0.0085***	0.0057***	0.0034**	0.0028**
	(0.0018)	(0.0008)	(0.0018)	(0.0018)	(0.0013)	(0.0011)
First stage	0.1116***	0.1116***	0.1116***	0.1168***	0.1185***	0.1116***
	(0.0079)	(0.0079)	(0.0079)	(0.0077)	(0.0077)	(0.0079)
Controls	No	No	No	Yes	Yes	No
Muni. trends	No	No	No	No	Yes	No
DNB data	No	No	No	No	No	Yes
N	4,220	4,220	4,220	4,220	4,220	4,220
Prereform mean	0.1313	0.0865	0.0633	0.1313	0.1313	0.0893

Q1. Market Participation

Effect Heterogeneity ——*age, sex, and educational attainment & wealth and income*

- The introduction of broadband internet appears to have a positive impact on stock market participation rates across socioeconomic groups.
- A relatively stronger impact for younger, less-educated, lower-income, lower- wealth individuals, who have the lowest stock market participation rates (and likely the lowest financial literacy)

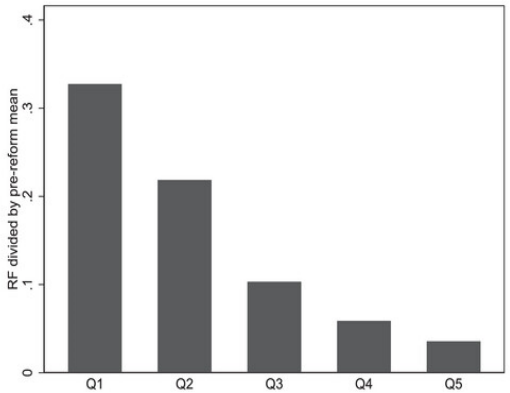
Broadband spurs a democratization of finance.

Panel A: IV, RF, FS Using Survey Data

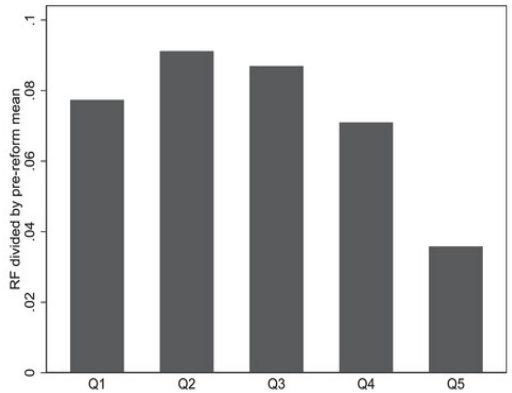
	Age Bins:			Gender:		Education:		
	16–34	35–54	>54	Male	Female	Low	Medium	High
IV estimate	0.0597***	0.0630**	0.0581**	0.0610***	0.0267**	0.0169**	0.0807**	0.0643
	(0.0215)	(0.0287)	(0.0276)	(0.0224)	(0.0110)	(0.0075)	(0.0382)	(0.0627)
Reduced form	0.0134***	0.0130***	0.0122***	0.0125***	0.0061***	0.0056**	0.0124***	0.0062
	(0.0037)	(0.0048)	(0.0032)	(0.0031)	(0.0021)	(0.0024)	(0.0037)	(0.0041)
First stage	0.2247***	0.2063***	0.2101***	0.2046***	0.2282***	0.3300***	0.1542***	0.0957
	(0.0589)	(0.0606)	(0.0776)	(0.0509)	(0.0574)	(0.0699)	(0.0579)	(0.0714)
N	1,731	1,926	1,209	2,144	1,987	1,491	1,975	1,421
Prereform mean	0.1005	0.1858	0.1706	0.1544	0.0905	0.0561	0.1853	0.2377

Panel B: RF Using Full Data

	Age Bins:			Gender:		Education:		
	16–34	35–54	>54	Male	Female	Low	Medium	High
Reduced form	0.0116***	0.0144***	0.0041**	0.0091***	0.0064***	0.0061***	0.0122***	0.0060**
	(0.0030)	(0.0033)	(0.0019)	(0.0021)	(0.0016)	(0.0015)	(0.0028)	(0.0026)
N	4,220	4,220	4,220	4,220	4,220	4,220	4,220	4,220
Prereform mean	0.1005	0.1858	0.1706	0.1544	0.0905	0.0561	0.1853	0.2377



Panel A. Effects by wealth



Panel B. Effects by income

Q2. Portfolio allocation

Effects for Existing Investors

- Broadband coverage should lead to an increase for existing investors in the portfolio share of funds.
- Increased access to broadband internet leads to improved outcomes for existing investors.

	Panel A: Trading Activity				
	Funds		Stocks		
	Buy	Sell	Buy	Sell	Stock Share
Reduced form	0.0371***	−0.0042	0.0045	0.0011	−0.0308***
	(0.0082)	(0.0053)	(0.0040)	(0.0033)	(0.0089)
N	4,220	4,220	4,220	4,220	4,220
Prereform mean	0.2298	0.0777	0.1377	0.0848	0.4781

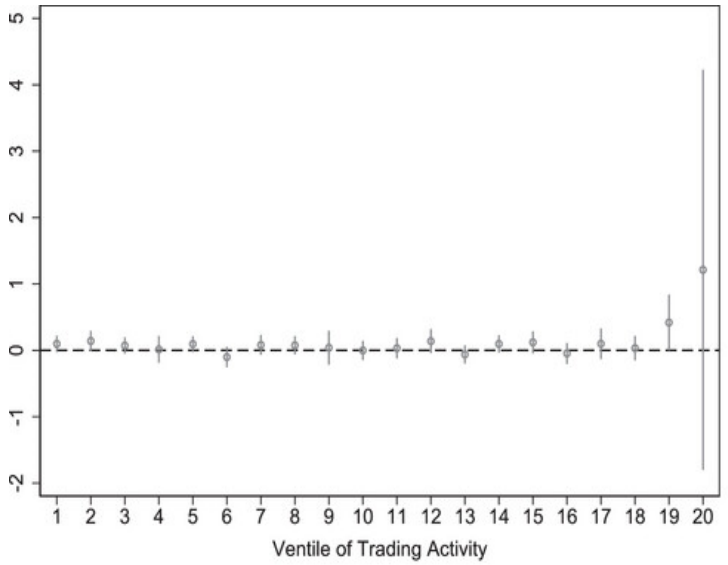
	Panel B: Portfolio Efficiency					
	RLoss	RWeight	*SD*	RSRL	SRatio	IdioShare
Reduced form	−0.0034***	−0.0187***	−0.0419	−0.0057***	0.0025***	−0.0031**
	(0.0008)	(0.0038)	(0.0284)	(0.0021)	(0.0009)	(0.0015)
N	4,220	4,220	4,220	4,220	4,220	4,220
Prereform mean	0.0376	0.3230	0.3373	0.6604	0.1488	0.8637

Q2. Portfolio allocation

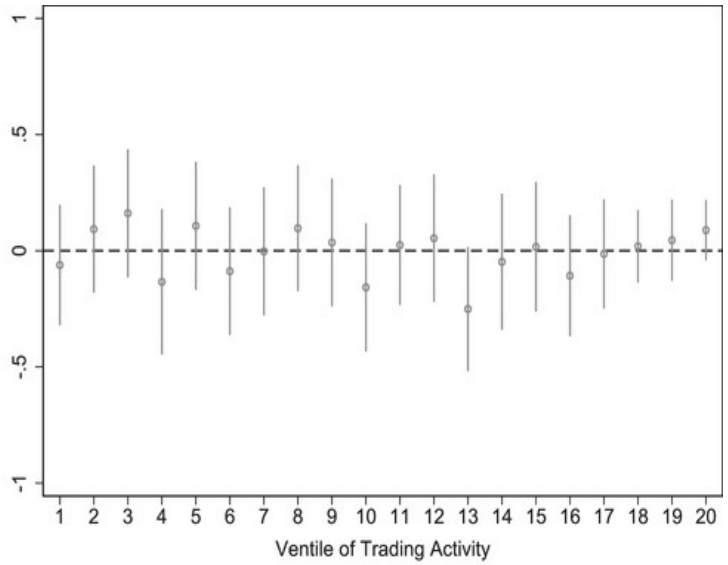
Effects for Existing Investors

- Average existing investor does not increase his stock trading activity following increased access to broadband, it could be that the most active ones do (Barber and Odean, 2002; Choi et al., 2002)

There may be an increase in stock trading activity among the most active existing investors.



Panel A. Avg. #stock trades



Panel B. Log(Avg. #stock trades)

Mechanisms

Threats to the Exclusion Restriction

Whether the increased broadband coverage affects stock market participation only through the broadband adoption of households, and not directly in any other way?

- The estimated effect of broadband coverage on stock market participation results from broadband adoption at the firm level rather than at the household level.

Broadband coverage → Increased productivity and wages of of the firms' workers → Increase stock market participation

	Log(Income)	Log(Debt)	Log(Deposits)
Reduced Form	0.0010	0.0053	-0.0111
	(0.0052)	(0.0117)	(0.0126)
N	4220	4220	4220
Pre-reform mean	12.4367	12.4167	12.1150

Mechanisms

Threats to the Exclusion Restriction

Whether the increased broadband coverage affects stock market participation only through the broadband adoption of households, and not directly in any other way?

- Through a combination of firm- and household- level broadband adoption

Broadband coverage → Skilled workers to work from home / Creating more time for leisure activities → Increase stock market participation

This mechanism is likely to be more prevalent for high- than low-skill workers.

There is an equally strong for individuals with low education

Mechanisms

Threats to the Exclusion Restriction

Whether the increased broadband coverage affects stock market participation only through the broadband adoption of households, and not directly in any other way?

- Through local real estate prices

Broadband coverage → High local real estate prices
Loosening of household budget constraints → Increase stock market participation

	Panel A. Wealth			Panel B. Return-on-wealth		
	Log(Gross)	Log(RealEst)	Log(Fin)	GrossR	RealEstR	FinR
IV Estimate	0.0447	-0.0103	0.1365	0.0508***	0.0080	0.0533***
	(0.0520)	(0.0522)	(0.0890)	(0.0093)	(0.0111)	(0.0115)
Reduced Form	0.0050	-0.0012	0.0152	0.0057***	0.0009	0.0059***
	(0.0059)	(0.0058)	(0.0101)	(0.0010)	(0.0012)	(0.0012)
First Stage	0.1116***	0.1116***	0.1116***	0.1116***	0.1116***	0.1116***
	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)
N	4220	4220	4220	4220	4220	4220
Pre-reform mean	13.8430	13.3967	12.5568	0.1132	0.1526	0.0808

Mechanisms

Threats to the Exclusion Restriction

Whether the increased broadband coverage affects stock market participation only through the broadband adoption of households, and not directly in any other way?

- Through lagged household broadband use

Lagged broadband coverage → Lagged household broadband use → Increase stock market participation

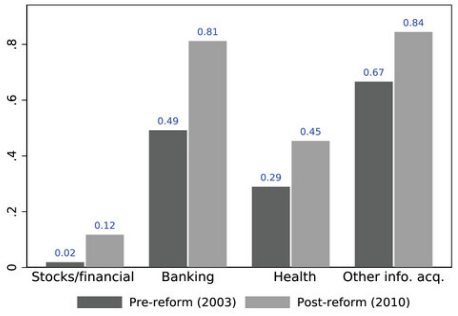
	Holds	Holds	Holds	Holds	Holds
IV (Instrument: z_{t-1}, z_{t-2})					0.0523**
					(0.0266)
IV (Instrument: z_{t-1})	0.0698***	0.0895***	0.0899***	0.0529**	
	(0.0169)	(0.0261)	(0.0227)	(0.0232)	
RF (Instrument: z_{t-1})	0.0078***	0.0072***	0.0074***	0.0043**	
	(0.0018)	(0.0019)	(0.0017)	(0.0018)	
FS (Instrument: z_{t-1})	0.1116***	0.0809***	0.0819***	0.0812***	
	(0.0079)	(0.0081)	(0.0073)	(0.0075)	
Controls for z_{t+2}	No	Yes	No	Yes	Yes
Controls for z_{t+1}	No	Yes	No	Yes	Yes
Controls for z_{t-2}	No	No	Yes	Yes	No
Controls for z_{t-3}	No	No	Yes	Yes	Yes
Controls for i_{t-1}	No	No	No	No	Yes
N	4220	3376	4220	3376	3376

Mechanisms

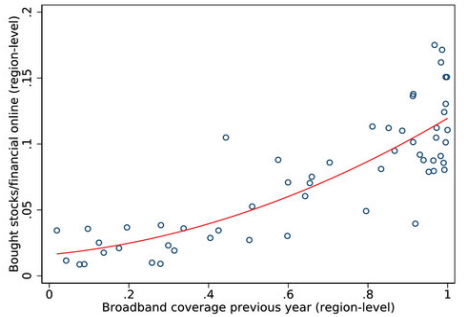
Household Internet Activities

Each year, more than 1,000 respondents give detailed information about whether or not they have access to the internet and how they use it.

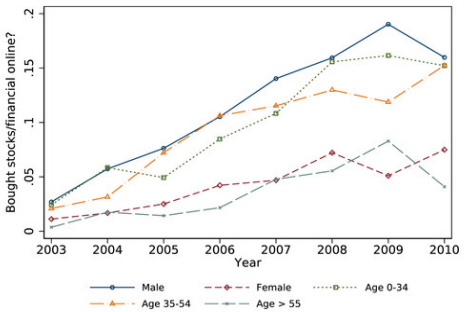
- ***Online trading--***whether respondents have used the internet to purchase stocks and/or financial services.
- ***Online information acquisition—***Why would access to faster internet lead to increased stock market participation and other beneficial outcomes?



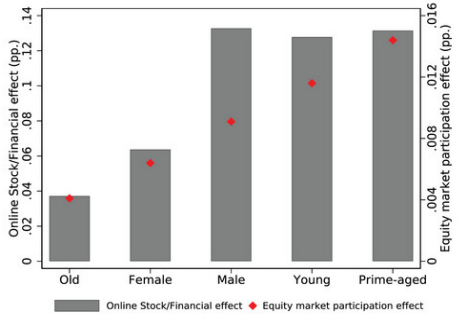
Panel A. Internet activities



Panel B. Online stock/financial over coverage



Panel C. Online stock/financial over time



Panel D. Effects in survey and register data

	Check facts	Read news
IV Estimate	0.3352	0.5065**
	(0.2523)	(0.2477)
Reduced Form	0.0674	0.1018**
	(0.0509)	(0.0478)
First stage	0.2010***	0.2010***
	(0.0440)	(0.0440)
N	2785	2785
Pre-reform mean	0.3192	0.3604

Mechanisms

Firm Response to Household Internet Use

Firms to ramp up their online presence and marketing in response and thus further reduce the costs for households of online information acquisition and learning.

- A survey about 3000 firms each year that give detailed information about whether they have access to internet and how the firm uses the internet.

  Firms increase their online presence—by adding online sales platforms and web pages—from before to after the broadband reform.

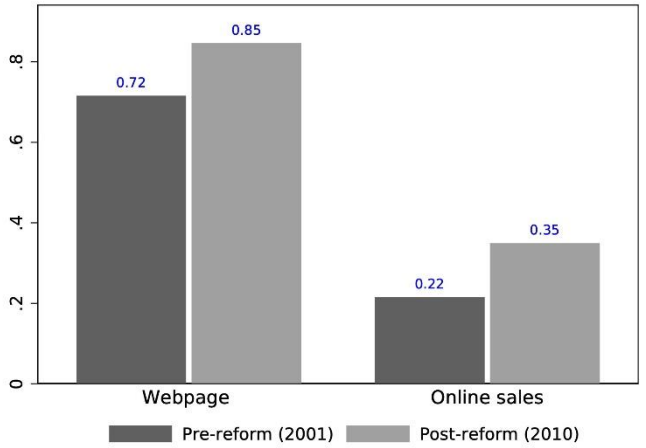
- Detailed tax returns data for the population of Norwegian firms allow us to measure firms' marketing-related costs.

  Firms ramping up their marketing in response to increased broadband use by households.

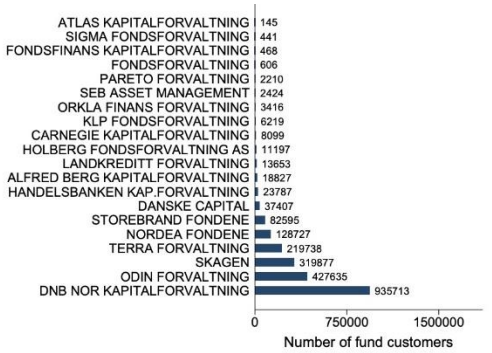
Financial institutions increasingly pushed their fund products in response to increased internet use by their customers.

Mechanisms

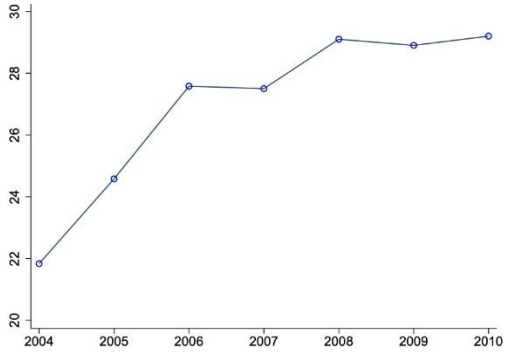
Firm Response to Household Internet Use



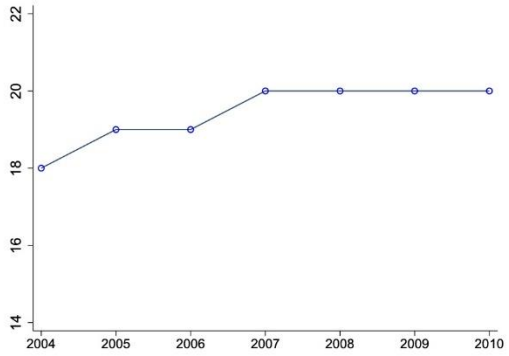
	Marketing cost share		
	(1)	(2)	(3)
Reduced form	0.0013***	0.0012***	0.0008*
	(0.0004)	(0.0004)	(0.0004)
Firm weights	Yes	Yes	
Balanced firm panel		Yes	
Municipality weights			Yes
N	656667	108905	4218
Pre-reform mean	0.0132	0.0126	0.0097



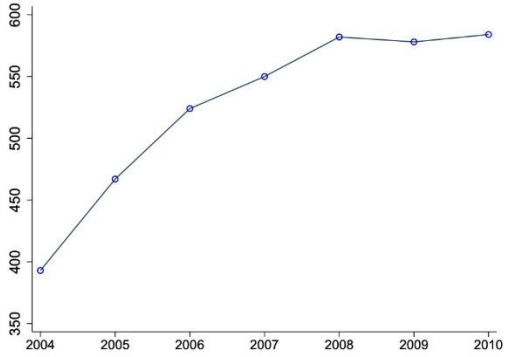
Panel A. #Fund customers in 2010



Panel B. Mean #fund products per provider



Panel C. Total #unique fund providers



Panel D. Total #fund products across all providers

Additional Analyses

Broader Financial Outcomes

The introduction of broadband internet ease access to information and improve individuals' financial skills, whether it affects aspects of financial decision making other than equity market participation.

- Bonds and bond funds as well as in unlisted stocks (direct investment decision)
- Life insurance or private pension plans (indirect investment decision)
- Investor wealth

Broadband use appears to positively impact portfolio allocation and outcomes for individual investors.

	Bond funds	Bonds	Unlisted stocks
IV Estimate	0.0217***	0.0185***	0.0140**
	(0.0048)	(0.0064)	(0.0071)
Reduced Form	0.0024***	0.0021***	0.0016*
	(0.0005)	(0.0007)	(0.0008)
First Stage	0.1116***	0.1116***	0.1116***
	(0.0079)	(0.0079)	(0.0079)
N	4220	4220	4220
Pre-reform mean	0.0271	0.0101	0.0312

	LifeIns	PrivPens	IntRate
IV Estimate	-0.0006	-0.0035	-0.0042**
	(0.0128)	(0.0038)	(0.0016)
Reduced Form	-0.0001	-0.0004	-0.0005**
	(0.0014)	(0.0004)	(0.0002)
First Stage	0.1116***	0.1116***	0.1116***
	(0.0079)	(0.0079)	(0.0079)
N	4220	4220	4220
Pre-reform mean	0.1830	0.0299	0.0721

	Panel A. Wealth			Panel B. Return-on-wealth		
	Log(Gross)	Log(RealEst)	Log(Fin)	GrossR	RealEstR	FinR
IV Estimate	0.0447	-0.0103	0.1365	0.0508***	0.0080	0.0533***
	(0.0520)	(0.0522)	(0.0890)	(0.0093)	(0.0111)	(0.0115)
Reduced Form	0.0050	-0.0012	0.0152	0.0057***	0.0009	0.0059***
	(0.0059)	(0.0058)	(0.0101)	(0.0010)	(0.0012)	(0.0012)
First Stage	0.1116***	0.1116***	0.1116***	0.1116***	0.1116***	0.1116***
	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)	(0.0079)
N	4220	4220	4220	4220	4220	4220
Pre-reform mean	13.8430	13.3967	12.5568	0.1132	0.1526	0.0808

Conclusion

- The introduction of broadband internet seems to spur a democratization of finance, with households making investment decisions that are more in line with the advice from portfolio theory.

- High-speed internet lead to increased participation rates and improved portfolio efficiency by reducing the fixed costs to enter financial markets.
  - ✓ Becoming aware of stock market opportunities
  - ✓ Acquiring financial competence

Further Discussion

- **This paper = Classic questions + Unique data + Appropriate methods/design**

- **Future research**
  - The effect of mobile Internet use on individuals' financial decisions
  - The effect of ChatGPT use on use on individuals' financial decisions

Thank you!

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