

# Smart(phone) Investing?

A within investor-time analysis of  
new technologies and trading behavior.

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  - ▶ Few exceptions related to the use robo-advisers: (e.g., [D'Acunto, Prahabala, and Rossi, \(2019\)](#) or [Loos et al., 2020](#))
- Empirical evidence comes from:
  - ▶ Comparisons of investor behavior **pre-** and **post-technology** adoption (vs. another group of non-adopters)
  - ▶ Potential **randomness** in the assignment of the new technology

# To what extent new technologies change investor behavior?

- Selection, both within- and across- investors, is a big issue
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- The policy implications are **starkly** different:
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- Extant literature doesn't clearly disentangle these alternatives
  - ▶ likely because of lack of data

# In this paper



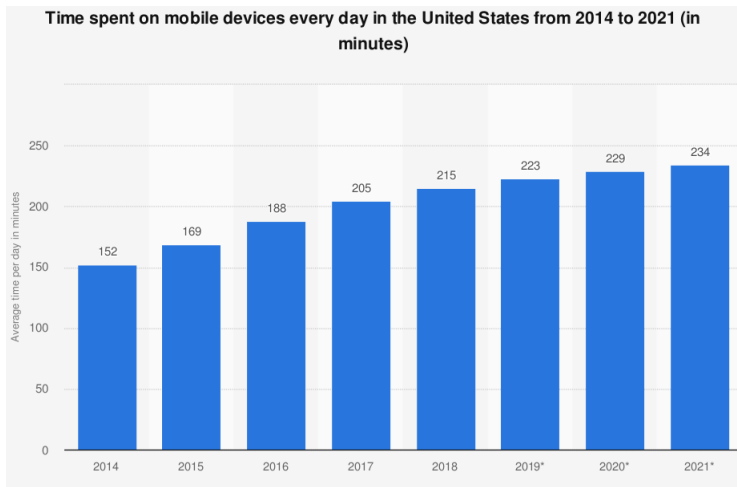
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# Smartphones are pervasive



There are over **300 million** smartphones in the US alone.  
In 2022, people spent **four hours and 29 minutes** on smartphones.

Source: Statista (2022)

# Do smartphone trading apps help investors?

The New York Times

## ***Robinhood Has Lured Young Traders, Sometimes With Devastating Results***

Its users buy and sell the riskiest financial products and do so more frequently than customers at other retail brokerage firms, but their inexperience can lead to staggering losses.



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  - ▶ Three types of behavior – risk taking, gambling preferences, and biases

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Shall we rely on smartphones as the **key** technology to democratize finance?

# Who trades using smartphones?

# Our data

We use micro-level data from **two large German retail banks**:

- **All transactions** that bank customers execute via the bank's platform
- Over **14 million** transactions by over **100k** customers
- This the **primary bank** for most customers in our sample.

# Who trades on smartphones? (I)

	<i>Phone Users</i>		<i>Non Users</i>		<i>Mean diff</i>
	Mean	Median	Mean	Median	<i>p-value</i>
Avg No of Trades per Month	10.01	3.00	5.32	2.00	0.00
Avg Value of Trades	4,477.11	1,895.00	3,812.90	1,000.00	0.00
Prob of Purchasing Risky Assets	0.68	1.00	0.58	1.00	0.00
Volatility of Assets Purchased (%)	22.01	17.78	16.52	13.13	0.00
Skewness of Assets Purchased	-5.61	-5.09	-9.02	-8.48	0.00
Prob of Purchasing Lottery type Assets	0.12	0.00	0.07	0.00	0.00
Underdiversification	0.65	0.59	0.47	0.00	0.00
Prob of Purchasing Past Winners	0.17	0.00	0.10	0.00	0.00
Prob of Purchasing Past Losers	0.09	0.00	0.06	0.00	0.00
Risk Categories of Assets Purchased	4.12	4.00	3.97	4.00	0.00
Prob of Purchasing a Warrant	0.43	0.19	0.24	0.00	0.00
Prob of Purchasing a Certificate	0.04	0.00	0.03	0.00	0.00
Sharpe Ratio	0.39	0.28	0.54	0.44	0.00
Market Adjusted Returns	-0.04	-0.03	-0.03	-0.024	0.00

Smartphone users have **higher trading activity**, are relatively **risk loving**, and **perform worse** than non-users.

## Who trades on smartphones? (II)

	<i>Phone Users</i>		<i>Non Users</i>		<i>Mean diff</i>
	Mean	Median	Mean	Median	<i>p-value</i>
Income Bin [20k,60k)	0.60	1.00	0.60	1.00	0.88
Income Bin [60k,100k)	0.32	0.00	0.32	0.00	0.67
Income Bin [ $\geq$ 100k]	0.09	0.00	0.08	0.00	0.34
Wealth Bin [20k,60k)	0.75	1.00	0.80	1.00	0.00
Wealth Bin [60k,100k)	0.09	0.00	0.08	0.00	0.13
Wealth Bin [ $\geq$ 100k]	0.17	0.00	0.12	0.00	0.00
Years since Member	8.71	9.32	9.82	9.32	0.00
Age	44.85	45.00	52.61	52.00	0.00
Female	0.05	0.00	0.18	0.00	0.00

Smartphone users are relatively **inexperienced**, **younger** and more likely to be **males**.

# Empirical challenges and main specification

Comparisons of smartphone trades versus other trades suffer from **selection**:

- Smartphone traders are different from non-smartphone traders.
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Exploit within **individual-by-time** variation to identify the effect of the use of smartphones:

$$y_{i,j,t} = \beta \times \textit{Smartphone}_{i,j,t} + \delta_{i,t} + \epsilon_{i,j,t}$$



Do smartphones change trading activity?

# Smartphones and trading

	Volatility
	(1)
Smartphone	7.352*** (22.55)
Individual x Month FE	Yes
Observations	8,529,126
$R^2$	0.565

Relative to the unconditional mean, assets purchased using smartphones are:

33.4% more volatile

# Smartphones and trading

	Volatility	Skewness	Lottery-Type Assets
	(1)	(2)	(3)
Smartphone	7.352*** (22.55)	10.548*** (10.08)	0.054*** (12.34)
Individual x Month FE	Yes	Yes	Yes
Observations	8,529,126	8,527,701	8,527,701
$R^2$	0.565	0.347	0.381

Relative to the unconditional mean, assets purchased using smartphones are:

33.4% more volatile,

46.7% more likely to be lottery-type

# Smartphones and trading

	Volatility	Skewness	Lottery-Type Assets	Under-Divers.	Past Winners	Past Losers
	(1)	(2)	(3)	(4)	(5)	(6)
Smartphone	7.352*** (22.55)	10.548*** (10.08)	0.054*** (12.34)	0.406*** (18.45)	0.087*** (14.19)	0.066*** (14.58)
Individual x Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,529,126	8,527,701	8,527,701	8,452,120	8,418,764	8,418,764
$R^2$	0.565	0.347	0.381	0.408	0.393	0.411

Relative to the unconditional mean, assets purchased using smartphones are:

33.4% more volatile,

46.7% more likely to be lottery-type, and

51.2% more likely to be past winners

Do investors substitute across platforms?

# Smartphones and spillover effects

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Diff-in-diff using the **staggered** introduction of the app in **iOS** vs. **Android**:

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	Volatility	Skewness	Lottery-Type Assets	Under-Divers.	Past Winners	Past Losers
	(1)	(2)	(3)	(4)	(5)	(6)
Smartphone Launch	0.094 (0.47)	3.978*** (5.01)	-0.003 (-0.63)	0.003 (0.36)	-0.002 (-0.32)	0.003 (0.53)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	248,031	248,324	154,865	154,865	149,743	149,743
R <sup>2</sup>	0.496	0.090	0.287	0.506	0.314	0.294

This evidence contradicts substitution effects



Do features of the app drive smartphone effects?

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- Customers can use the app to check balances on savings and checking accounts, make transfers, and for trading.
- There are **no nudges** or **push notifications**.
- There are **no** elements of **gamification** associated with trades.

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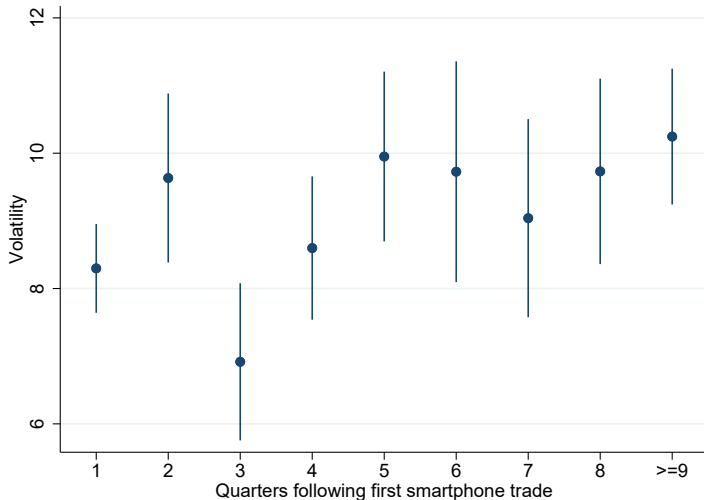
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Does **screen size** matter?

- **Similar results for iPads and iPhones**

Is there a learning curve to using new technology?

## Are smartphone effects short-lived?



Effects are stable over **all outcomes** for at least **10 quarters** after the smartphone app adoption.

Does selection of assets and times drive our results?

# Smartphones effects and asset class selection

## Smartphones effects and asset class selection

	Volatility	Skewness	Lottery-Type Assets	Past Winners	Past Losers
	(1)	(2)	(3)	(4)	(5)
Smartphone	2.176*** (13.30)	2.449*** (5.65)	0.024*** (7.12)	0.011*** (3.08)	0.022*** (7.26)
Ind x Month FE	Yes	Yes	Yes	Yes	Yes
Asset Class x Year FE	Yes	Yes	Yes	Yes	Yes
Observations	8,500,780	8,499,363	8,499,363	8,400,232	8,400,232
$R^2$	0.672	0.379	0.401	0.432	0.434

Magnitudes are **attenuated**, but **still** economically significant.

# Smartphones effects and timing of trading



## Smartphones effects and timing of trading

	Volatility	Skewness	Lottery-Type Assets	Under- Divers.	Past Winners	Past Losers
	(1)	(2)	(3)	(4)	(5)	(6)
Smartphone	2.516*** (10.10)	4.717*** (5.91)	0.021*** (3.62)	0.113*** (7.05)	0.024*** (4.05)	0.020*** (3.90)
Ind x Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Trade Hour x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,335,955	4,335,054	4,335,054	4,261,470	4,264,904	4,264,904
$R^2$	0.691	0.453	0.474	0.476	0.484	0.515

New estimates range from 27.6% to 44.8% of previous ones, but [still](#) economically significant.

## Mechanism: Summary so far

- Results less likely to be driven by features of the app like screen size or prominence of information display (e.g., daily winners and losers)
- Less likely to be driven by ubiquitous access to information
- Choice of asset classes and timing of trades play a role but do not *fully* explain our findings
- Learning curve not likely to drive our results

Do smartphones promote more intuitive thinking?

# Intuitive vs. deliberative thinking

Deliberative thinking (System-2) is costly, and triggered only if System-1 faces sufficient uncertainty/conflict in its automatic intuition (Stanovich, 2018)

Illut and Valchev, 2022 formally model this framework in economic decision making

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- We are in a positive mood such as on sunny days (Bassi et al (2013))  
Stronger effects for days with more sunshine hours



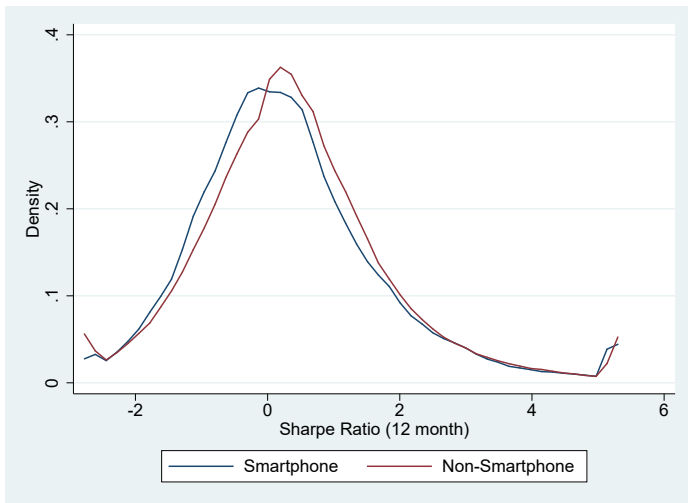
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Stronger smartphone effects during after hours (5pm-10pm)
- We are in a positive mood such as on sunny days ([Bassi et al \(2013\)](#))  
Stronger effects for days with more sunshine hours
- We observe “usual” states ([Ilut and Valchev \(2022\)](#))  
Stronger effects for days with lower market-wide implied volatility  
Stronger effects for days with no unscheduled announcements

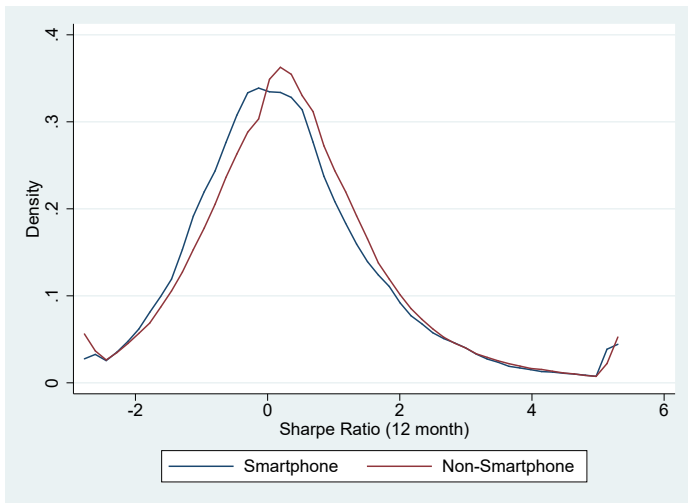
What are the implications of smartphone effects?

# Implications for performance



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**Lower returns** and higher volatility drive worst Sharpe ratios.

# Strong effects also for experienced investors

## Strong effects also for experienced investors

	Volatility (1)	Skewness (2)	Lottery Assets (3)	Under- Divers. (4)	Past Winners (5)	Past Losers (6)	Sharpe Ratio (7)
Smartphone	4.203*** (7.90)	6.710*** (5.39)	0.033*** (4.62)	0.320*** (8.94)	0.050*** (6.27)	0.038*** (6.07)	-0.067*** (-2.53)
Ind x Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,934,702	3,934,235	3,934,235	3,934,235	3,898,641	3,898,641	3,853,966
R <sup>2</sup>	0.686	0.411	0.441	0.510	0.465	0.471	0.504

	Volatility (1)	Skewness (2)	Lottery Assets (3)	Under- Divers. (4)	Past Winners (5)	Past Losers (6)	Sharpe Ratio (7)
Smartphone	3.413*** (14.33)	5.234*** (6.21)	0.027*** (5.73)	0.269*** (9.58)	0.041*** (7.18)	0.033*** (6.76)	-0.056*** (-3.54)
Ind x Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,193,525	4,192,631	4,192,631	4,192,631	4,123,537	4,123,537	4,047,198
R <sup>2</sup>	0.703	0.429	0.460	0.532	0.479	0.499	0.523

Strong smartphone effects also for investors with **more than seven years** of experience.

To conclude...

## To sum-up

- Comparing trades within the same individual and month, we find that investors when using smartphones are more likely to purchase:
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- Selection of what and when to trade matters.
- Smartphones seem to promote more intuitive/ system-1 thinking.
- Our results caution against the indiscriminate use of smartphones to democratize finance and increase access to financial markets.