The Impact of Information Technology on the Equity Premium and Price Efficiency

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Overview and Motivation

- Research Question: Does the adoption of information technology by market participants affect systematic risk, hence the equity premium?

- Rapid improvements and cost reductions characterize communications technology but few studies examine their financial market implications.

- Information Technology: Number of NYSE ticker subscriptions.

- Tickers broadcast **firm-specific** public information regarding prices and volume.

- An increase in the number of tickers improves the dissemination of this information.

Main Findings

- Despite the upward trend in the number of tickers, variation over time is apparent, especially at the state level.

- Annual variation in NYSE ticker subscribers does not depend on stock returns, demographics, or economic activity.

- More tickers associated with a reduction in systematic risk, and a lower equity premium.

- More tickers is also associated with greater price efficiency.

- These conclusions hold after controlling for the impact of ticker subscriptions on liquidity.

Tickers

30000
25000
20000
15000
10000
5000
0

1926 1928 1930 1932 1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1985 1987
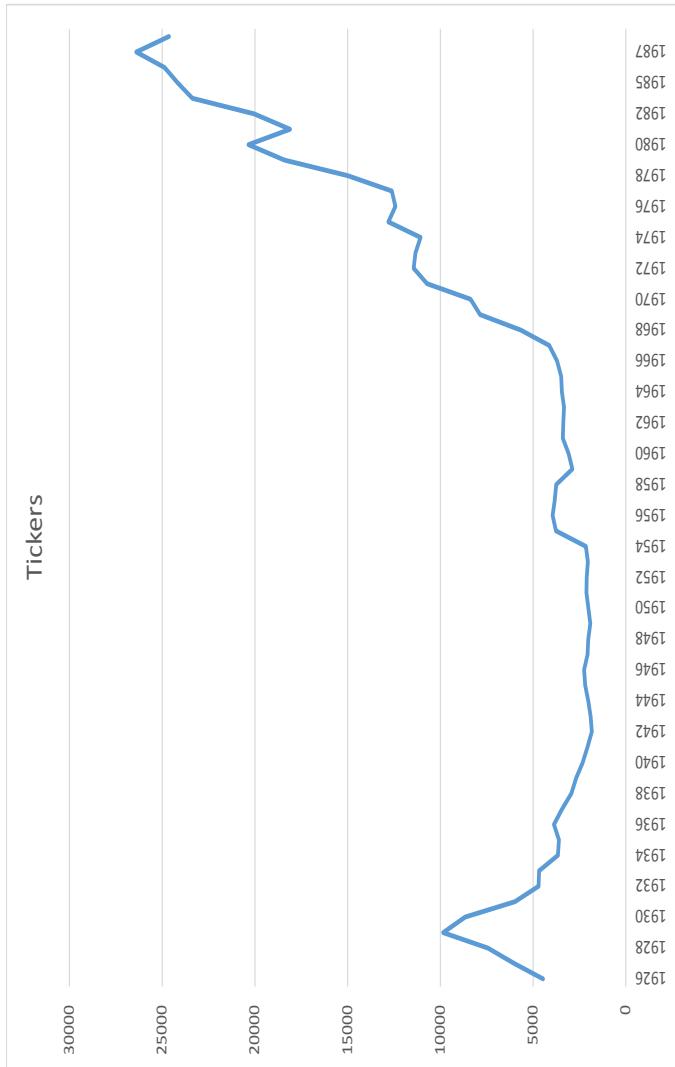
Why Tickers?

- Tickers are among the earliest adopters of new communication technology, and experienced several technological improvements (telegraph, phone, etc).

- Before 1988, ticker subscribers had a near monopoly on current financial market data.

- Media and analyst coverage often proxy for information dissemination, but both depend on firm size.

Literature Review

- Bogan (2008) finds internet trading increases stock market participation.

- Jain (2005) examines the transition from floor to electronic trading in a cross-sectional study involving 120 countries.

  – Result: Greater liquidity lowers the equity premium.

- Neither paper examines whether a systematic risk channel enables information technology to impact the equity premium.

- Pollet and Wilson (2010) study the impact of pairwise return correlation on the equity premium.

Ticker Data

- Number of NYSE ticker subscribers is available at the national and state level.

- Sample period is from 1926 until 1988.

- Bloomberg terminals and Internet trading were introduced in 1988.

- For years with missing ticker data, we create an enhanced sample using office-level NYSE subscriptions.

- Results are similar in both the original and enhanced samples.

Ticker Dynamics

- At both the national and state level, variation in the number of tickers does not depend on population, economic activity, or stock returns.

- Instead, change in trading volume and a time trend account for change in the number of stock tickers.

- State level variables are computed using the head-quarter location of firms (Kumar and Korniotis, 2013).

- Require a state to have at least 10 firms listed on the NYSE in a given year (relaxing this filter).

- Regression results using annual data at the national level are similar to panel regression results using state-year observations.

Ticker Variation Determinants

National-level determinants

	ΔTickers	ΔTickers	ΔTickers
ΔPopulation	0.8109	0.3818	-0.0699
	(0.48)	(0.20)	(-0.04)
ΔGDP	0.2075	0.1488	-0.0607
	(0.99)	(0.68)	(-0.29)
NYSE Return	0.0930	0.0952	0.0805
	(1.16)	(1.21)	(1.09)
ΔVolume	0.1335**	0.1271**	0.1253***
	(2.70)	(2.60)	(3.09)
Spread	–	–	-4.6520
			(-1.55)
Time–Trend	0.0047***	0.0056***	0.0054***
	(4.20)	(3.07)	(2.95)
Observations	41	41	41
R-squared	0.6366	0.6415	0.6540

Interpretation

- Investor attention (Andrei and Hasler, 2015) is predicted to be counter-cyclical. No evidence that tickers represent a proxy for attention.

- Higher trading volume leads to more ticker subscriptions, consistent with brokerages justifying demand for IT investment.

- Overall, as with many technologies, adoption is not significantly related to market performance or demographics.

- State-level co-movement in ticker subscribers much lower than co-movement in state-level returns and economic activity.

- Attempting to acquire data on the cost of ticker subscriptions over time and across states.

State–level determinants

	ΔTickers	ΔTickers	ΔTickers
ΔPopulation	0.6006	0.8512	1.0596
	(0.39)	(0.52)	(0.63)
ΔGSP	0.4831	0.3944	0.4448
	(1.08)	(0.85)	(0.92)
State Return	-0.0531	-0.0525	-0.0459
	(-0.58)	(-0.57)	(-0.49)
NYSE Return	0.0701	0.0564	0.0524
	(0.54)	(0.42)	(0.39)
ΔVolume	0.1109**	0.1130**	0.1065*
	(2.08)	(2.12)	(1.94)
Lag ΔVolume	–	0.0000	0.0000
		(0.73)	(0.39)
Spread	–	–	3.0265
			(0.99)
State Fixed Effects	Yes	Yes	Yes
Observations	350	350	350
R-squared	0.0787	0.0796	0.0814

Tickers and Liquidity

- An increase in the number of tickers stimulates trading but does not widen bid-ask spreads.

- These findings are consistent with tickers disseminating public not private firm-specific information.

- Control for liquidity by including volume and spreads in future regressions.

- Liquidity versus Systematic Risk are two channels through which tickers can impact the equity premium.

National Level

	ΔVolume	Spread
ΔTickers	1.0093***	-0.0057
	(3.07)	(-1.40)
Lag ΔVolume	-0.2477*	
	(-1.96)	
NYSE Return	0.5228***	-0.0093***
	(3.56)	(-3.30)
Time Trend	0.0008	0.0000
	(0.62)	(0.77)
Spread	-2.5544	
	(-0.46)	
Lag Spread		0.6720***
		(4.20)
ΔVolume		0.0034*
		(1.85)
R-squared	0.6309	0.5280

State Level

	ΔVolume	Spread
ΔTickers	0.0918**	-0.0003
	(2.02)	(-0.29)
Lag ΔVolume	-0.1395***	
	(-3.00)	
NYSE Return	0.3504***	-0.0021
	(4.30)	(-0.69)
State Return	1.6414**	-0.0540*
	(2.48)	(-1.82)
Spread	-1.0905	
	(-1.05)	
Lag Spread		0.3888***
		(3.61)
ΔVolume		-0.0009
		(-0.83)
State Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
R-squared	0.7005	0.5536

Systematic Risk

- Average pairwise return correlation and average R^2 from the market model both proxy for systematic risk.

- R^2 is available at the firm level for later Fama-MacBeth regressions.

- Along with equity premium, the average of these metrics is value-weighted using market capitalizations at the beginning of each year.

- In contrast, consistent with the anomalies literature, the average return autocorrelation used to examine return predictability is equal-weighted.

National-level systematic risk

	Correlation	R-squared	Correlation	R-squared
ΔTickers	-0.2427***	-0.5201***	-0.1984*	-0.4494**
	(-3.06)	(-4.13)	(-1.71)	(-2.49)
ΔVolume			-0.0260	-0.0016
			(-0.47)	(-0.02)
Spread			1.2860	7.2395**
			(0.58)	(2.45)
Constant	0.2045***	0.3559***	0.1838***	0.2358***
	(17.25)	(21.81)	(4.65)	(4.44)
R-squared	0.1664	0.3136	0.1756	0.3703

State-level systematic risk

	Correlation	R-squared	Correlation	R-squared
ΔTickers	-0.0816***	-0.1732***	-0.0496***	-0.1221***
	(-4.34)	(-4.78)	(-2.83)	(-3.63)
ΔVolume			-0.0456***	-0.0678***
			(-4.79)	(-4.38)
Spread			1.1528**	2.4289***
			(2.41)	(3.12)
State Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.1510	0.3519	0.1879	0.3849

- Correlation in fundamentals reflected in return correlation but is not expected to vary with the number of tickers.

Interpretation

- Recall that tickers improve liquidity by increasing trading volume.

- After accounting for liquidity, an increase in the number of tickers lowers systematic risk.

- Next analysis determines whether this reduction affects the equity premium.

Systematic Risk Channel

- Two-stage procedure that first isolates the impact of tickers on pairwise return correlation:

$$\text{Correlation}_t = \gamma_0 + \gamma_1 \Delta \text{NT}_t + \epsilon_t$$

- Utilize the fitted values denoted $\hat{FC} = \hat{\gamma}_0 + \hat{\gamma}_1 \Delta \text{NT}$ from the first stage to examine the impact of tickers on the equity premium through the systematic risk channel:

$$\text{Equity Premium}_t = \alpha_0 + \alpha_1 \hat{\text{FC}}_t + \alpha_2 \Delta \text{Volume}_t$$
$$+ \alpha_3 \text{Spread}_t + \epsilon_t$$

National-level equity premium

	Equity Premium	Equity Premium	Equity Premium
ΔTickers	-0.4830**	-0.4773**	
	(-2.09)	(-2.06)	
ΔVolume	-0.0011	0.0012	-0.0011
	(-0.01)	(0.01)	(-0.01)
Spread	-20.1190***	-20.1200***	-20.1190***
	(-3.08)	(-3.06)	(-3.08)
Correlation		0.1080	
		(0.30)	
Fitted Correlation			2.4338**
			(2.09)
Time Trend	0.0050**	0.0053*	0.0050**
	(2.40)	(2.00)	(2.40)
Constant	0.2166*	0.1861	-0.2307
	(2.01)	(1.27)	(-0.99)
R-squared	0.2748	0.2760	0.2748

State-level equity premium

	Equity Premium	Equity Premium	Equity Premium
ΔTickers	-0.1516***	-0.1569***	
	(-2.92)	(-2.99)	
ΔVolume	0.0618**	0.0574**	0.0618**
	(2.14)	(1.96)	(2.14)
Spread	-4.8616***	-4.8553***	-4.8616***
	(-2.85)	(-2.86)	(-2.85)
Correlation		-0.0931	
		(-1.23)	
Fitted Correlation			3.0548***
			(2.92)
State Fixed Effects	Yes	Yes	Yes
R-squared	0.0581	0.0592	0.0581

Economic Significance

- Standard deviation of ΔTickers is higher at the state level than the national level.

- This standard deviation induces an 20% change in pairwise correlation.

- This standard deviation implies a 3% change in equity premium.

Return Predictability

- Eyster, Rabin, and Vayanos (2013): Stock prices are too sensitive to public information because investors fail to fully extract the private information in prices.

- As a result, public information leads to return predictability (Tetlock, 2011).

- Proxies for return predictability include daily return autocorrelation and variance ratio tests using weekly returns.

- Consistent with Boehmer and Kelly (2009), absolute value of both metrics are used.

| Daily EW Return Autocorrelation |
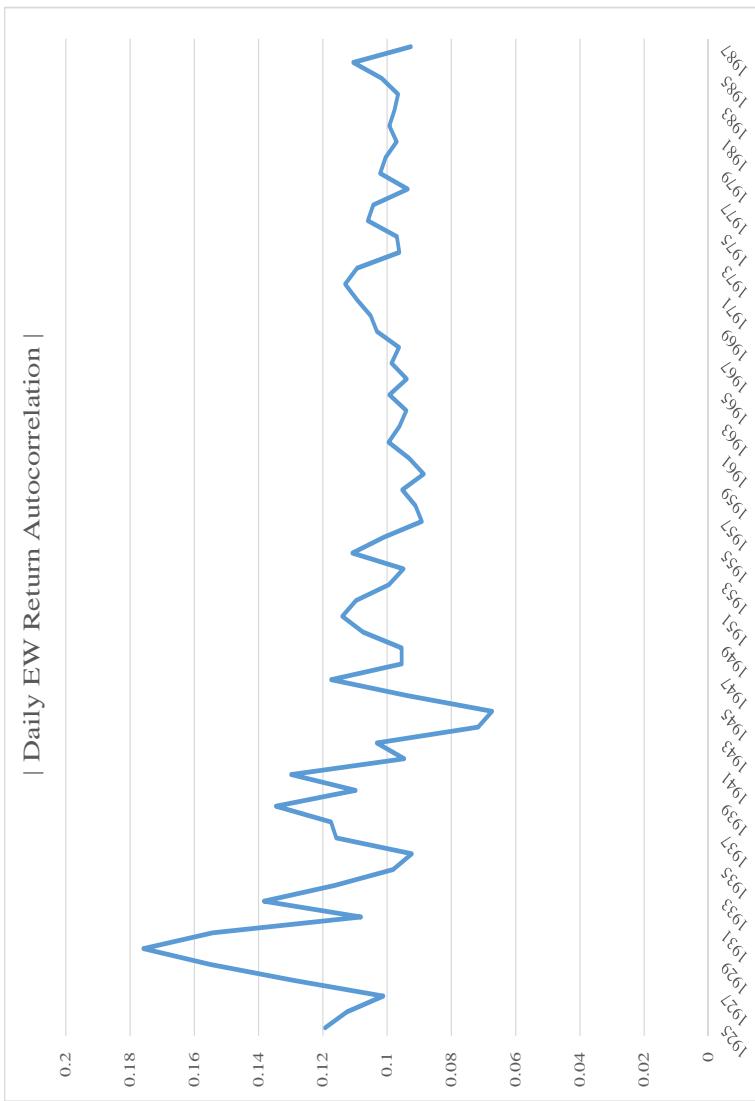
National-level return predictability

	|Autocorrelation|
Δ Tickers	-0.0494*
	(-1.97)
Δ Volume	-0.0112
	(-1.07)
NYSE Return	-0.0120
	(-0.61)
Spread	1.0368**
	(2.43)
Constant	0.0930***
	(11.71)
R-squared	0.4219

Interpretation

- After accounting for liquidity, increase in the number of tickers is associated with less return predictability.

- Finding does not support the predictions of Eyster, Rabin, and Vayanos (2013).

- Instead, our result is consistent with an increase in the number of tickers improving price efficiency.

State-level return predictability

	|Autocorrelation|	|VRT(1,4) − 1|
∆Tickers	-0.0175***	-0.0323**
	(-3.15)	(-2.13)
∆Volume	-0.0079**	-0.0226**
	(-2.57)	(-2.16)
State Return	-0.0053	0.0231
	(-0.75)	(0.68)
NYSE Return	-0.0264***	-0.0087
	(-2.91)	(-0.26)
Spread	0.2209	1.2801***
	(1.60)	(2.69)
State Fixed Effects	Yes	Yes
R-squared	0.2534	0.0943

Conclusion

- The adoption of information technology by market participants has implications for firms and investors.

- Information technology that disseminate firm-specific public affects systematic risk as well as liquidity.

- Adoption of this technology lowers systematic risk, and the equity premium as a consequence.

- Adoption of this technology also enhances price efficiency.

Current Work

- Sub sample analysis (pre–1963 versus post–1963) reveals stronger results in the early subperiod.

- Relaxing the 10 firms per state filter.

- More important, estimating Fama-MacBeth regressions using firm-level R^2, return, volume, and spread as well as state-level number of tickers.