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R-SQUARED AND THE ECONOMY

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ABSTRACT

Many seemingly discordant results are reconciled if firm-specific return volatility is characterized as the intensity with which firm-specific events occur. A functionally efficient stock market allocates capital to its highest value uses, which often amounts to financing Schumpeterian creative destruction, wherein creative winner firms outpace destroyed losers, who can be last year's winners. This elevation in firm-specific fundamentals volatility elevates firm-specific return volatility in a sufficiently informationally efficient stock market. These linkages are interconnected feedback loops, rather than unidirectional chains of causality.

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1. Introduction

Asked to predict the market, JP Morgan famously snapped "Stock prices will fluctuate." Finance theory partitions those fluctuations into firm-specific fluctuations, affecting one (or a few) stocks, and market-wide fluctuation, affecting all (or most) stocks. This partition matters because firm-specific fluctuations cancel in a diversified portfolio, but market-wide fluctuations do not – and so are unavoidable risks. This simplifies finance research in two ways. First, asset pricing models can focus on unavoidable market-wide factors by assuming investors are diversified, leaving firm-specific fluctuations a residual afterthought. Second, corporate finance researchers can use event studies, which subtract out market-wide fluctuations, isolating firm-specific fluctuations associated with events that alter firms' fundamental values. Each subdiscipline's afterthought is the other's focus.

Roll (1988) observes that most fluctuations in US share prices are firm-specific. Morck, Yeung and Yu (2000) confirm this, but also find market-wide fluctuations far more important in eaarlier 20th century US data, and in emerging markets, especially where corruption is severe. Campbell et al. (2001) affirm rising firm-specific risk in US stocks from 1962 to 1997 and explore its econometric characteristics. Similar increases in firm-specific risk appear in other developed (Guo and Savickas 2008) and emerging economies (Li, Morck, Yang, and Yeung 2004).

A large literature exploring these findings can appear inconsistent, but actually coalesce into a coherent, if tentative, explanation if firm-specific return volatility is characterized as *firm-specific return event intensity*. Here, "event" connotes a firm-specific valuation change such as, if accompanied by a public announcement, an event study might investigate. In this sense, in

an efficient market, firm-specific return volatility necessarily measures the intensity of information events being capitalized into share prices (French and Roll 1986). A growing literature exploring these issues has implications about the role of stock markets in economic development.

First, firm-specific return event intensity correlates with financial development, and with market efficiency – particularly Tobin's (1984) *functional efficiency*, the stock market's reliability in allocating capital to its highest value uses. Institutional changes that plausibly make arbitrage less costly presage elevated firm-specific return event intensity. This reinforces Roll's (1988) argument that firm-specific risk reflects informed investors moving share prices - market efficiency in action.

Second, firm-specific return event intensity correlates with economic dynamism, over time and across countries. Intuitively, more intensive innovation corresponds to more (or more important) events raising the volatility of firm-specific fundamentals and returns (Chun et al 2008; 2011). Schumpeter's (1911) *creative destruction*, in particular, separates the firm-specific valuations of creative winner firms from those of laggard loser firms. Intensified creative destruction elevates what we call *firm-specific fundamentals event intensity*, and an informationally efficient stock market reflects this in elevated firm-specific return event intensity.

Laws, regulations, and other institutional features plausibly affect economic growth in ways associated with event intensity. Specifically, institutions that render financial markets

more functionally efficient also likely encourage creative destruction and thereby promote economic dynamism. However, various feedback effects make unidirectional causality unlikely.

2. R^2

The workhorse models of asset pricing theory explain any individual stock's return with changes in one or more economy-level common pricing factors. The simplest such framework, the Capital Asset Pricing Model (CAPM), represents the expected return of stock *j* as

[1] $$\tilde{r}_{j,t} = r_f + \beta_j\left(r_{m,t} - r_f\right)$$

where $r_{m,t}$ is the return on a fully diversified portfolio of assets and r_f is the risk-free return. The coefficient β_j relates the stock's return to the sole pricing factor, the equity risk premium $r_{m,t} - r_f$. Key parameters of [1] are often operationally approximated using *Market Model* regressions of the form

[2] $$r_{j,t} = \alpha_j + \beta_j r_{m,t} + e_{j,t}$$

where $e_{j,t}$ is the residual component of stock *j*'s return not explained by the equity risk premium and $\alpha_j = (1 - \beta_j)r_f$ and is non-stochastic.[1]

The non-stochastic nature of α_j and the orthogonality of regression [2]'s errors $e_{j,t}$ from its explanatory variable permits the variance decomposition

[1] The CAPM and Market Model are conceptually distinct. The former derives from a stylized model of investor behavior; the latter is a purely empirical proposition.

[3] $$variance\left[r_{j,t}\right] = \underbrace{variance\left[\beta_j r_{m,t}\right]}_{\substack{market\text{-}wide \\ variation}} + \underbrace{variance\left[e_{j,t}\right]}_{\substack{\text{firm-specific} \\ \text{variation}}}$$

where $variance\left[\beta_j r_{m,t}\right]$ is the *market-wide variation* in the stock's return and $variance\left[e_{j,t}\right]$ is the *firm-specific variation* in its return.

Roll (1988) notes that the regression R_j^2 of [2] is

[4] $$R_j^2 \equiv \frac{explained\ variation}{explained\ variation + residual\ variation} = \frac{market\text{-}wide\ variation}{firm\text{-}specific\ variation + market\text{-}wide\ variation},$$

and thus measures both the goodness of fit of the Market Model for stock *j*'s returns data and the fraction of the variation in stock *j*'s return related to market-wide fluctuations. In econometrics, a lower R_j^2 indicates a "worse" model, but here this rule-of-thumb fails. A lower R_j^2 merely means that more of the variation in stock *j*'s price is firm-specific – the stock's returns are less synchronous with the overall market. From a finance perspective, this is arguably "good", in that firm-specific variation is diversifiable. Obviously,

[5] $$1 - R_j^2 = \frac{firm\text{-}specific\ variation}{firm\text{-}specific\ variation + market\text{-}wide\ variation}$$

likewise measures the firm-specific fraction of the risk in stock j's returns, the stock's tendency to move asynchronously from the market. To stress that the Market Model R_j^2 is more than a statistical goodness of fit, we call R_j^2 stock *j*'s *synchronicity* and $1 - R_j^2$ its *asynchronicity*.

Greater *firm-specific return event intensity*, as defined in the introduction, corresponds to higher firm-specific variation in [4] and [5], and thus, all else equal, to less synchronous stock returns. As we elaborate below, all else is seldom equal.

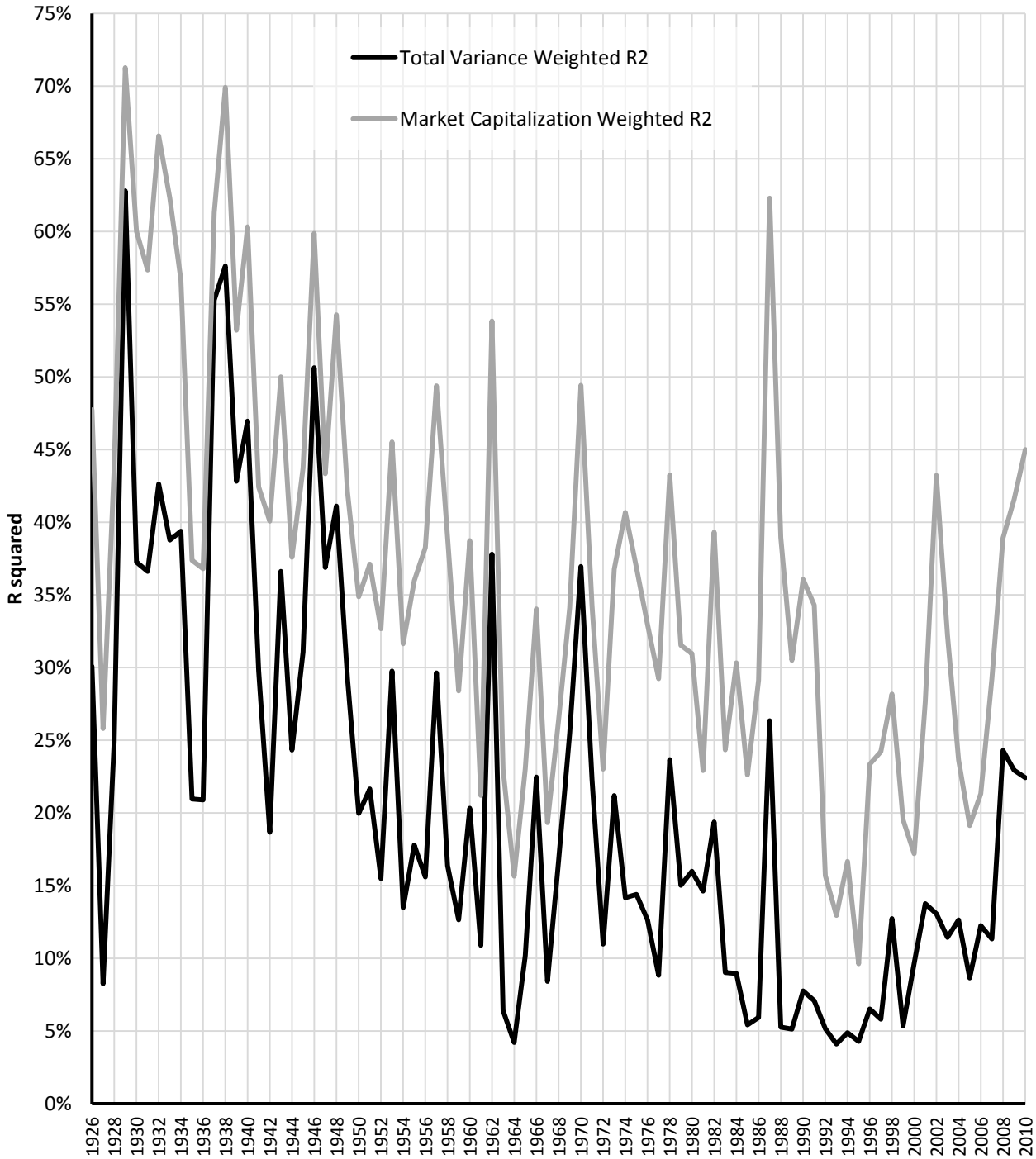
2.1 R^2 over time in the US

Panel A of Figure 1 graphs the annual mean R^2 s of [2] for US stocks from 1926 through 2010. For each stock in each year, weekly returns are regressed on the CRSP value-weighted market return. To mitigate data errors, weekly returns are winsorized at 99.9% and weeks with missing or zero trading volume are removed. Also, firms with fewer than 30 valid weekly returns in a year are dropped. The mean R^2 each year is then calculated as in [3] – first replicating Morck et al. (2000) and weighting firms by total returns variation, then weighting by beginning-of-year market capitalization.

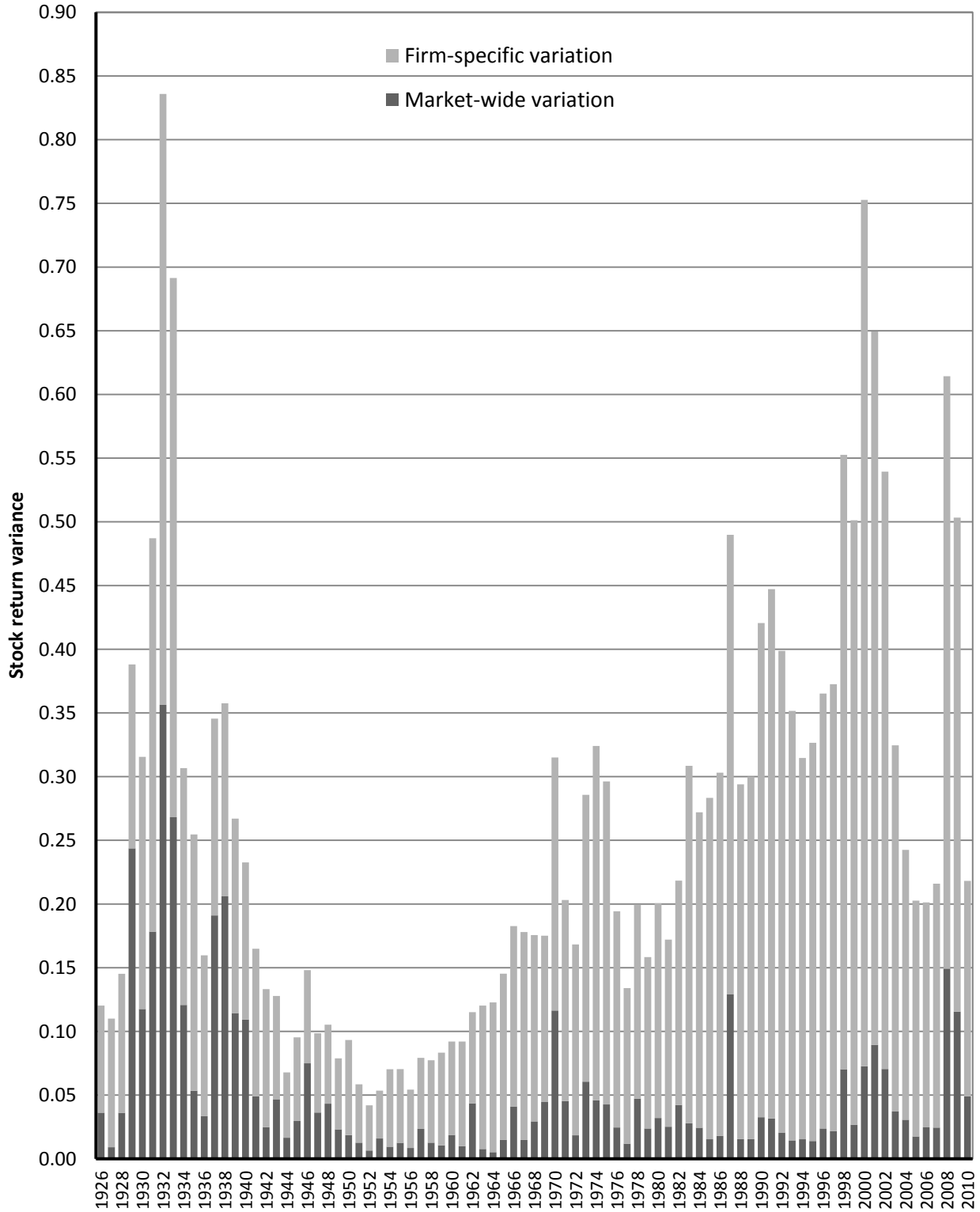
Both mean R^2s fall steadily through the mid-1990s, replicating Morck et al. (2000); but then rise again after 2000, and by 2008 regain levels that, except amid the Crash of 1987, were unseen since the 1970s. Weighting by beginning-of-year market capitalization produces higher R^2s throughout, consistent with larger firms' greater importance in the index. Alternative approaches – not winsorizing, dropping extreme observations, or using the methodology of Cambell et al. (2001) – all generate broadly similar patterns.

Figure 1. US Stock Comovement, 1926 – 2010

Panel A. R-squared is the mean of the R^2s of Market Model regressions of each US stock's weekly (Weds.-to-Weds.) total return of the CRSP value-weighted market return. Means are weighted by either total return variation or market capitalization.



Panel B. Market-wide variation is the mean across all US stocks of the sum-of-squared variation explained by the Market Model. Firm-specific variation is the corresponding residual variation.



Panel B links the late 20th century R2 decline to escalating firm-specific variation, more than declining market-wide variation, though the latter is also detectable in what macroeconomists dub the Great Moderation (Taylor 2000; Blanchard and Simon 2001). Again, this pattern reverses, at least temporarily, in the early 21st century. Explanations of why firm-specific and systematic risk change over time must account for this complete pattern, not just the trends in the late 20th century.

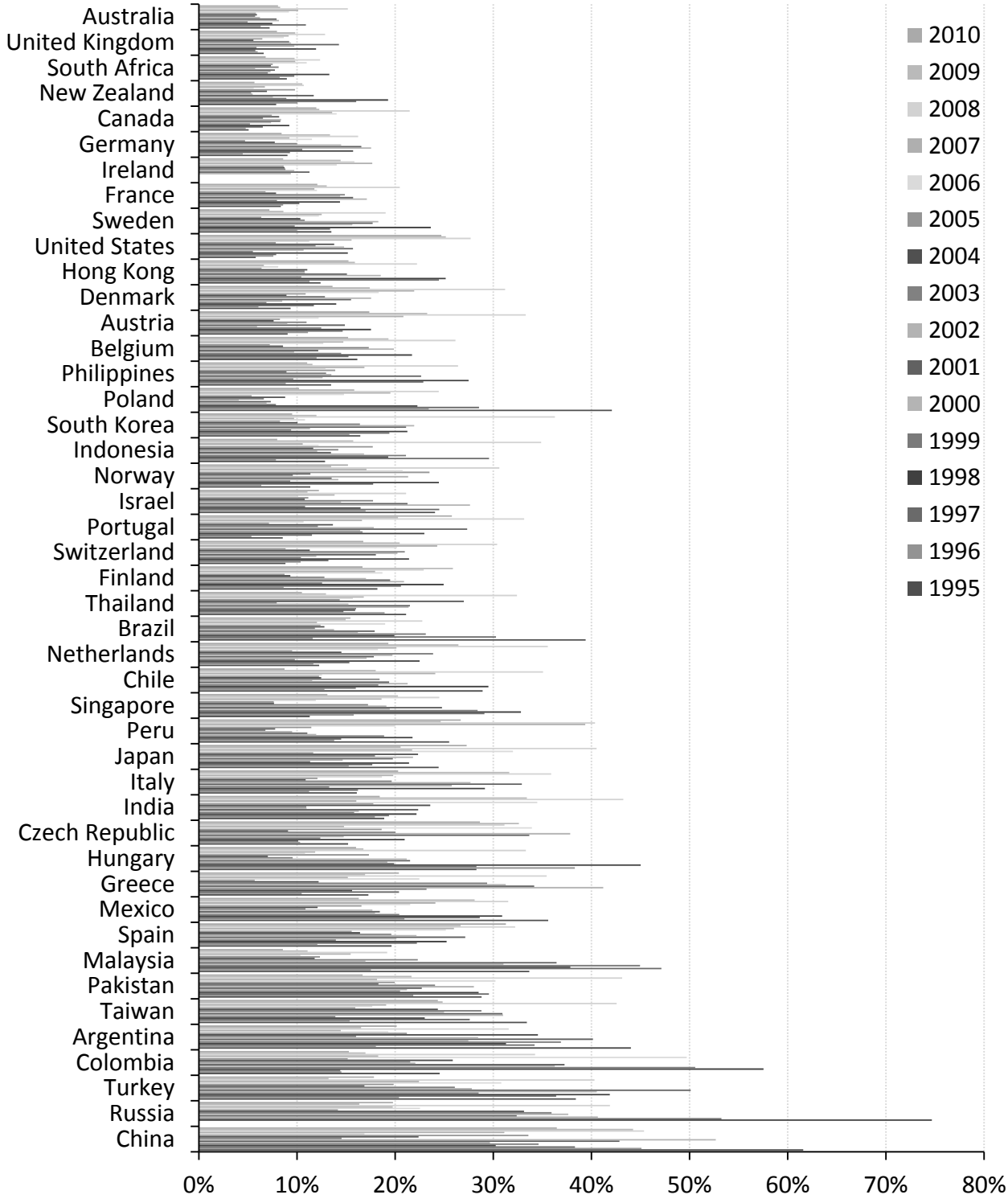
2.2 R^2 across countries

Panel A of Figure 2 ranks countries by the grand means of their mean R^2s for 1995 through 2010. The lesser synchronicity of higher income countries' stocks evident in Panel A is confirmed in Panel B, which graphs each country's grand mean firm-level R^2s against its mean log of per capita GDP, averaged over the same 1995 to 2010 period. Both panels show the pattern Morck et al. (2000) observe in the 1990s persisting. Even their reported major anomaly persists: Japanese stocks' remain oddly synchronous given the country's high per capita GDP.

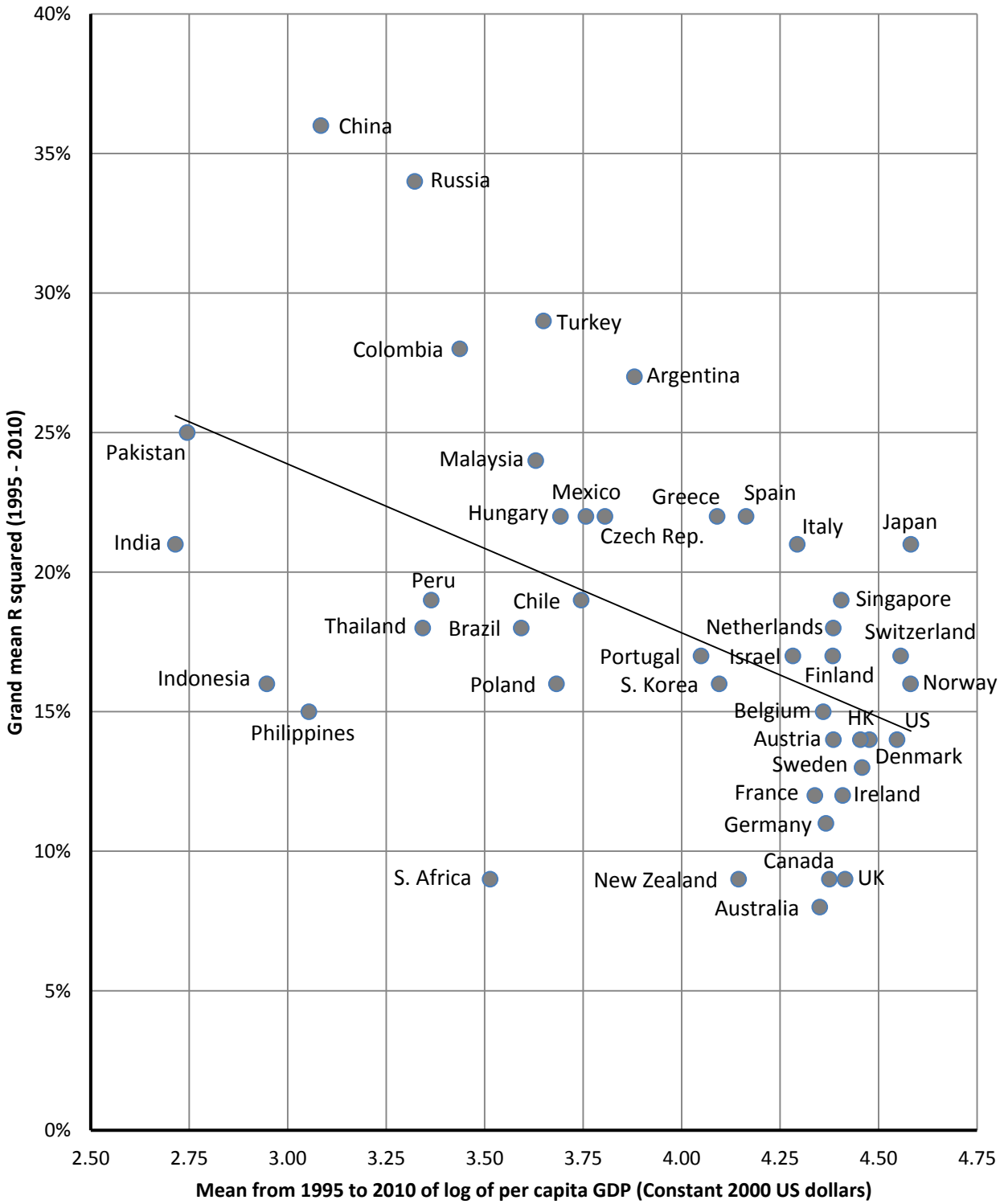
One major difference between Morck et al. (2000) and Figure 3 is that American stocks, the most idiosyncratic in the 1990s, became more synchronous over time, leaving its stocks only the tenth most asynchronous in the figure. Another is that Polish stocks, among the most synchronous in the word in the 1990s, become quite idiosyncratic over time. Yet another is South African stocks' marked asynchronicity, given its relatively low *per capita* income.

Figure 2. Less Synchronous Stock Returns in Higher Income Economies

Panel A. Mean stock-level market model R^2, by year from 1995 to 2010 for each country, estimated using weekly (Weds.-to-Weds.) DataStream total returns and country total return indexes. Countries are sorted by their mean R^2 over all years.



Panel B. Country means of the stock-level Market Model R^2s from Panel A plotted against log of per capita GDP (constant 2000 US dollars). Both are means for 1995 to 2010.



3. Market Efficiency and Capital Allocation

Higher firm-specific stock return volatility can signify more *firm-specific stock return event intensity.* All else equal, this would indicate more nuanced stock price movements more accurately reflecting similar underlying firm-specific fundamentals events. All else is seldom equal, but Durnev et al. (2003) nonetheless explore this possibility and find that future earnings changes better explain the current stock price returns of firms in US industries where stock returns are also less synchronous. Because the power of future earnings changes to explain current stock returns is a widely accepted measure of stock market informativeness in the accounting literature (Collins et al. 1994 and Basu 1997), they conclude that elevated firm-specific return event intensity reflects more informationally efficient stock pricing.

Further development of this line of reasoning requires an exploration of the determinants of market efficiency. Fama (1970) describes the stock market as more informationally efficient if share prices adjust faster and more completely to new information. Informational efficiency can reflect private arbitrageurs gathering new information, reassessing firms' fundamental values, and trading to profit from those reassessments (Grossman 1976); or more meaningful public announcements (Fama et al. 1969); or more energetic insider trading (Manne 1966). Each can push stock prices towards fundamental values, all else equal, raising informational efficiency where informed arbitrage is less costly, disclosure fuller and timelier, or insider trades more informative.

3.1 Private information-based arbitrage

French and Roll (1986) and Roll (1988) argues that firm-specific fluctuations reflect more than just public news announcements, and credit private arbitrage for much stock price fluctuation. That is, they attribute firm-specific return volatility to *firm-specific stock return event intensity*. Consistent with this, Berry and Howe (1994) detect no relationship between the incidence of public news and firm-specific stock returns. Although recent work (Boudoukh et al. 2013) contests this conclusion, we consider it for the moment.

If private arbitrageurs are an important force pushing prices towards fundamental values, arbitrageurs' costs of business affect the informational efficiency of the stock market (Grossman and Stiglitz 1980). This linkage suggests that higher firm-specific variation in higher income countries and later 20^{th} century decades might reflect arbitrageurs' falling costs or rising trading revenues.

In a dynamic model with discrete fixed costs of information gathering and processing, Veldkamp (2006) formalizes this. Competition biases information suppliers towards producing information useful for estimating the fundamental values of many firms because this has more buyers than information about one stock. Higher fixed costs of information production extenuate this, leading to even less production of information about individual firms. Thus, where arbitrage fixed costs are higher, more investors trade *en masse* on the same information about the same subset of stocks, rendering returns more synchronous.

The economics of the information production industry reconciles several seemingly discordant findings. Stocks followed by more analysts commove more in the US (Piotroski and

Roulstone 2004) and elsewhere (Chan and Hameed 2006); and changes in their fundamentals also correlate more closely with changes in the fundamentals of more other firms (Hameed, Morck, and Yeung 2005). All these findings are consistent with Veldcamp (2006); as is evidence that analysts' forecasts contain mainly industry and economy-level information (Schutte and Unlu 2009; Crawfordet al. 2012).[2] Presumably, firm-specific information enters stock prices via other channels.

Stocks move more independently after emerging markets lower inward foreign portfolio investment bariers (Li, Morck, Yang, and Yeung 2004), receive increased equity investment inflows from the US (Bae, Bailey, and Mao 2006), announce stock market liberalizations (Bae, Bailey, and Mao 2006), or allow cross-listings or closed-end country funds into the US, UK, (Bae, Bailey, and Mao 2006) or Hong Kong (Gul, Kim, and Qiu 2010). These findings also fit the pattern if foreign arbitrageurs raise the intensity and sophistication of informed trading.

More binding short sale restrictions correlate positively with stock return synchronicity (Bris, Goetzmann, and Zhu 2007). Arbitrageurs with information that a stock is overvalued profit from short-selling – borrowing an overpriced stock, selling it, and repurchasing and returning it after the price falls. Some countries ban short selling, presumably reducing the value of roughly half of all non-public information. Bris et al. distinguish a *downside* R^2, measuring stock return co-movement when the market return is negative, from an *upside* R^2, measuring stock return co-movement when the market return is non-negative. They find short-

[2] The latter add that analysts beginning to follow stocks other analysts already follow generate firm-specific information

sales restrictions correlating most strongly with their *downside* R^2. Chang, Cheng, Pinegar, and Yu (2012) replicate this using firm-level data in Hong Kong.

Who the informed arbitrageurs are is less clear. Malkiel and Xu (2002) find higher firm-specific return volatility in stocks whose institutional ownership is larger, and argue that this reflects noise trading by institutions. Chung, Fung, Shilling, and Simmons-Mosley (2011) advance an alternative explanation more consistent with the noise trading literature (DeLong et al. 1990): larger institutional investors' economies of scale better cover the fixed costs of information (Veldcamp 2006). Supporting this, they find firm-specific variation positively correlated with the stakes of hedge funds, a genre of institutional investor thought to specialize in informed arbitrage (Chun et al. 2011). Piotroski and Roulstone (2004) revisit institutional investors in general and report higher return synchronicity in stocks with less institutional trading. Ferreira and Laux (2007) find institutional stakes positively correlated with firm-specific variation around mergers for firms unprotected from takeovers (Gompers et al. 2003).

These findings coalesce into Veldcamp's (2006) theory of fixed costs of information limiting informed arbitrage. Hedge funds may act as firm-specific information generators, as may other institutional investors in at least some circumstances. Analysts appear to generate information the market interprets as more broadly relevant. The roles of other classes of potential private arbitrageurs remain unclear. Institutional environments (restrictions on foreign investors, short sales, etc.) or economic conditions (recessions, etc.) that increase the net effect of fixed information costs correlate with less independent stock returns.

3.2 Public Information Announcements

Boudoukh et al. (2013), using advanced text analysis software (Feldman et al. 2011), find a larger fraction of firm-specific stock price movements corresponding to identifiable public news announcements than did Roll (1988). Their methodology combines machine learning with word (Tetlock 2007; Loughran and McDonald 2011) and phrase-level text analysis rules to gauge the tone and relevance to specific companies of some 1.9 million news articles from 2000 to 2009. This lets them link public news with stock returns far more reliably, and use this information to explain when stocks move idiosyncratically as opposed to with the market. Their median estimated stock-level return R^2 is 16% on dates their algorithm designates "news days", down from 28% on "no news days". This linkage suggests that the public release of news, a very straightforward indicator of events happening, indeed correlates with stock return asynchronicity

News services are one source of public information; financial disclosure is another. Morck et al. (2000) report no correlation between firm-specific return volatility and a measure of national disclosure standards comprehensiveness. However, comprehensive standards are unimportant if the numbers are uninformative; and measures of disclosure *quality* do correlate with lower synchronicity (Lau, Ng, and Zhang 2012).[3] Moreover, firm-specific return volatility rises after countries adopt International Financial Reporting Standards (IFRS), especially for countries with worse institutional environments, where IFRS likely most improves disclosure quality (Bissessur and Hodgson 2012; Kim and Shi 2012). Also consistent with this reasoning,

[3] Their risk premium volatility, by construction, measures synchronicity.

Durnev, Fox, Morck, and Yeung (2003) find a 1980 increase in US disclosure requirements raising firm-specific return variation, but only for firms most affected by the change. Once again, this ties firm-specific return volatility to firm-specific event intensity.

Jin and Myers (2006) model insiders' appropriating firm-specific, but not market-wide, abnormal profits as an explanation of low firm-specific stock return variation in countries where *de facto* disclosure standards are low. Consistent with this, they report economy-level measures of firm-level disclosure quality positively correlated with firm-specific return variation, as well as other evidence supporting their model. These findings suggest that differences in the strength of public investors' property rights over the wealth their firms generate might help explain cross-country differences in stock return synchronicity. Also supporting Jin and Myers' model, Hutton, Marcus and Tehranian (2009) find firm-specific return variation negatively correlated with accruals management, which they interpret as measuring management's preference for opacity, in US firms. Moreover, this relationship vanishes with the passage of the Sarbanes-Oxley Act, which limits earnings manipulation. The negative correlation between stock return synchronicity and shareholder rights (Morck et al 2000) is also consistent with Jin and Myers' model.

Corporate disclosure is always partly voluntary. Managers might disclose the bare minimum consistent with a legalistic reading of the regulations, or take pains to be transparent. The stocks of US firms with better voluntary disclosure ratings move more independently (Haggard, Martin, and Pereira 2008); as do those of Chinese firms with a Big Four auditor (Gul, Kim, and Qiu 2010). Ferreira and Laux (2007) find firm-specific return variation correlating

positively with corporate governance quality, which they interpret as reflecting investors' power to demand transparency. A similar interpretation explains higher firm-specific return variation in Chinese stocks with more dispersed ownership, more foreign ownership, and less state control (Gul, Kim, and Qiu (2010). These studies permit a reinterpretation of the Li et al. (2004), Bae et al. (2006) and Gul et al. (2010) findings of increased asynchronicity after foreign investors enter: more sophisticated investors might demand more disclosure, as well as intensify informed arbitrage.

Transparency especially matters to firms needing public equity (Myers and Majluf 1984), and securities regulations typically require unusually detailed disclosure prior to equity issues. Dasgupta, Gan, and Gao (2010) report elevated firm-specific return variation prior to seasoned equity issues (SEOs) and cross-listings, which often precede SEOs, and depressed firm-specific return variation subsequent to these events.

These studies link less synchronous stock returns to higher disclosure quality, and to better voluntary disclosure especially. Such findings qualify, but need not contradict, arguments linking informed arbitrage to firm-specific stock return variation. For example, better disclosure might reduce the fixed costs of information generation, which might replace rare large corrections with frequent small ones, more readily observable in any given time window. But regardless of whether events are discovered by private investors or disclosed publicly, firm-specific return volatility is interpretable as firm-specific return event intensity and reflects firm-specific fundamentals event intensity.

3.3 Insider Trading

Informed arbitrage and public disclosure are not the only ways private information can enter share prices. Manne (1966) argues for unrestricted insider trading because insiders, having the most information about their firm, are best able to engage in informed arbitrage should its stock become mispriced. However, unrestricted insider trading might also worsen information asymmetry problems (Bhattacharya and Nicodano 2001), deterring outsider arbitrageurs from paying for information (Fishman and Hagerty 1992) and leaving its stock less accurately priced.

Firm-specific return variation correlates with the intensity of insider trading in US firm-level data (Piotroski and Roulstone 2004); but correlates with the strength of restrictions on insider trading across countries (Durnev and Nain 2007). These seemingly discordant results are reconciled by recalling that US insider trading restrictions do not ban insider trading, but require insiders to refrain from trading until material inside information is made public, and to disclosure their trades. The incidence of disclosed firm-specific events might thus correlate with subsequent insider trades in countries with US-style insider trading rules, but not where insiders freely trade on undisclosed private information.

Consistent with this reconciliation, Khwaja and Mian (2005) report that Pakistani insiders' "pump and dump" trading correlates with elevated stock return synchronicity, perhaps because such practices deter informed arbitrage by outsiders. Fernandes and Ferreira (2009) find a country's first enforcement of its insider trading law elevating firm-specific variation in developed, but not emerging economies, consistent with insider trading restrictions encouraging fuller disclosure in developed economies, but not where institutions are

chronically unreliable. Bhattacharya, Daouk, and Kehr (2000) argue that, regardless of sporadic enforcement actions, firm-specific information in many low-income economies seeps slowly into stock prices via insider trading well before any public disclosure.

4. Functional Efficiency

The previous section proposes that firm-specific stock return volatility is higher where informed arbitrage is less costly, disclosure fuller, and insider trading regulations more conducive to transparency, all else equal. The findings present a *prima fascia* case for elevated firms-specific return volatility, all else equal, reflecting fuller and prompter information capitalization into stock prices. That is, elevated firm-specific return volatility can reflect elevated firm-specific return event intensity.

As conceded above, all else is seldom equal, and the assumption that fundamentals events unfold similarly across firms and over time is excessively strong. Once heterogeneity across firms, or over time for a given firm, is conceded, an instrumental view of informational efficiency comes into focus. Informational efficiency is a means to an end, not necessarily an end *per se*.

The social purpose of financial markets is arguably to allocate the economy's savings to their highest value uses (Schumpeter 1911). Tobin (1984) defines the stock market as *functionally efficient* if stock price changes push the economy towards a microeconomically efficient allocation of capital, and notes that functional and informational efficiency need not

coincide. Indeed, Grossman and Stiglitz (1980) and Black (1985) argue they cannot if information is costly. Thus, tests of how closely share prices obey a martingale (Griffin, Kelly and Nardari 2013) need not gauge functional efficiency. For example, a casino stock market, with stock prices set by roulette wheels, might be totally free of momentum effects, mean reversion, or other such deviations from a martingale, yet generate share prices utterly unrelated to firm fundamentals and utterly useless in allocating capital to its highest value uses.

Such considerations shift our focus from informational efficiency to functional efficiency: Do stock prices that move about more asynchronously better direct capital to its highest value uses? To explore this, Wurgler (2000) gauges the functional efficiency of a country's financial system by the correlation of capital spending with value added across industries. If a country's capital spending concentrates in its higher value-added industries, capital flows to where it creates more new wealth and Wurgler's measure is near +1. If capital is sprinkled randomly across sectors, without regard to where its return is higher, the measure is near zero. If capital perversely flows disproportionately to where its value-added is lowest, the measure drops to minus one .

Wurgler finds more functional efficiency in the financial systems of economies with higher mean incomes, larger financial sectors, and stronger shareholder rights. Most relevant here, Figure 3 plots Wurgler's (2000) finding that more asynchronous stock returns correlate with more functionally efficient capital allocation.

Figure 3. Functional Efficiency and R^2

Higher levels of Wurgler's (20000) measure of functional efficiency indicate a greater concentration of capital spending in industries with higher value-added. R-squared is from Morck et al. (2000). Both variables use mid 1990s data.

Durnev et al. (2004) replicate Wurgler's finding using industry-level US data. Gauging the marginal value of capital by Tobin's marginal Q ratio (one plus the estimated NPV of the firm's marginal capital project over its setup cost, adjusted for taxes), they find higher firm-specific return event intensity in US industries where marginal Q is nearer one, and thus capital allocation more functionally efficient. Allocating capital to its highest value uses should ultimately enhance overall total factor productivity. Consistent with this, Durnev et al. (2004a) report higher TFP growth in countries whose stock markets exhibit higher firm-specific return event intensity.

These findings motivate further theoretical and empirical reflection on the functional efficiency of financial markets, its determinants, and its relationship to informational efficiency, often misconstrued as a normative goal. Most importantly, functional efficiency mandates considering firm fundamentals, how these change, and how the stock market's faithfulness in reflecting fundamental values matters to the real economy.

5. Fundamentals

The previous section take firm-specific and market-wide fundamental volatilities as given, and considers how differences in the way stock prices approximate fundamentals might generate the time series and cross sectional patterns observed in firm-specific and market-wide return volatilities. Morck et al. (2000) find that stocks exhibit higher proportions of firm-specific volatility in countries with higher incomes and fewer corruption problems, but control for firm-

specific fundamentals variation with a potentially problematic measure of earnings volatility. Better fundamentals variation measures better explain the relative importance of firm-specific versus market-wide return volatility in cross-section (Pastor and Veronesi 2003) and panel (Wei and Zhang 2006; Chun et al. 2008; Irvine and Pontiff 2009) data. These findings necessitate considering why firm-specific fundamentals volatility – that is, *firm-specific fundamentals event intensity* – might vary across firms, industries, countries and time.

5.1 An excess of explanations

Irvine and Pontiff (2009) link elevated firm-specific volatility in fundamentals and returns to increased competition, arguing that smaller momentary leads or missteps induce more protracted gains and losses in the more competitive latter 20th century US economy. Supported by larger increases in fundamentals volatility in deregulated industries, this explanation also accommodates declining fundamentals returns. Gasper and Massa (2006) similarly argue that market power lets firms smooth firm-specific earnings fluctuations to lower information uncertainty for investors, explaining their finding that firms with larger market shares have lower firm-specific fundamentals and stock return volatilities.

Pastor and Veronesi (2003) find higher firm-specific earnings volatility in younger firms; and Fama and French (2004) report a rising incidence of small and newly listed firms, which have lower and more positively skewed earnings, in the late 20th century. Both suggest that newer firms have more volatile fundamentals and may be harder for investors to value. Brown and Kapadia (2007) link the time trend in idiosyncratic return volatility to IPOs; and report

persistently higher idiosyncratic volatility in later cohorts of IPOs. They conclude that the findings of Fama and French reflect riskier firms listing, not smaller firms being riskier. Fink, Fink, Grullon, and Weston (2010) find a steady drop in firm age at IPO – from about 40 years in the early 1960s to less than 5 years by 2000 – and that controls for firm age explain the time trend in US idiosyncratic return volatility.

Several studies relate elevated firm-specific return volatility to better corporate governance. Recall that Ferreira and Laux (2007) find elevated firm-specific return volatility in firms with higher corporate governance scores, and Gul, Kim, and Qiu (2010) report higher firm-specific return volatility in Chinese stocks with more disperse ownership, more foreign ownership, and less state control. If better governed firms are more apt to pursue promising, but risky, innovative investments (John, Litov and Yeung 2008), these findings might reflect higher firm-specific fundamentals volatility, as well as greater transparency. Also supporting a governance effect, Cheng (2011) finds lower firm-specific fundamentals and stock return variability in firms with larger boards, a widely accepted proxy for poor governance (Yermak 1996; Hermalin and Weisbach 2003; Adams et al. 2010). Malkiel and Xu's (2002) linking institutional investor stakes to elevated firm-specific return volatility can be reinterpreted as institutional investors holding managers to higher governance standards (Shleifer and Vishny 1986). A similar reinterpretation might recast fuller disclosure (Jin and Myers 2006; Haggard, Martin, and Pereira 2008; Dasgupta, Gan, and Gao 2010) and cross-listing into a regulatory regime enforcing stronger shareholder rights (Fernandes and Ferreira 2008) as improving corporate governance. Adams, Almeida, and Ferreira (2005) find elevated stock return

volatility in firms controlled by founders, and argue that these, like firms with small boards, undertake riskier value-creating investments because they are better governed.

Cross-country differences in corporate governance might also matter. Listed corporations in more corruption-prone economies are more apt to belong to business groups, and thus have equity cross-holdings, shared directors, and/or a common controlling shareholder (La Porta et al. 1999). Firms in business group exhibit lower firm-specific return volatility in Japan (Hamao, Mei, and Xu 2007) and elsewhere (Khana and Thomas 2009). One possible explanation of this result is that group firms co-insure (Hoshi, Kashyap and Scharfstein 1991) against adverse firm-specific shocks: temporarily successful group member firms prop up temporarily unsuccessful related firms.

Japan, which grants bankers substantial corporate governance influence, is an outlier in Figure 2 – a high income economy where firm-specific return volatility is persistently low (Morck and Yeung 2003) and dropping through the 1990s (Hamao, Mei, and Xu 2007). Banker governance influence correlates with Japanese firms pursuing low-risk strategies (Morck, Nakamura and Shivdasani 2000), and firm-specific return volatility is significantly higher in Japanese family-controlled firms (Nguyen 2011).

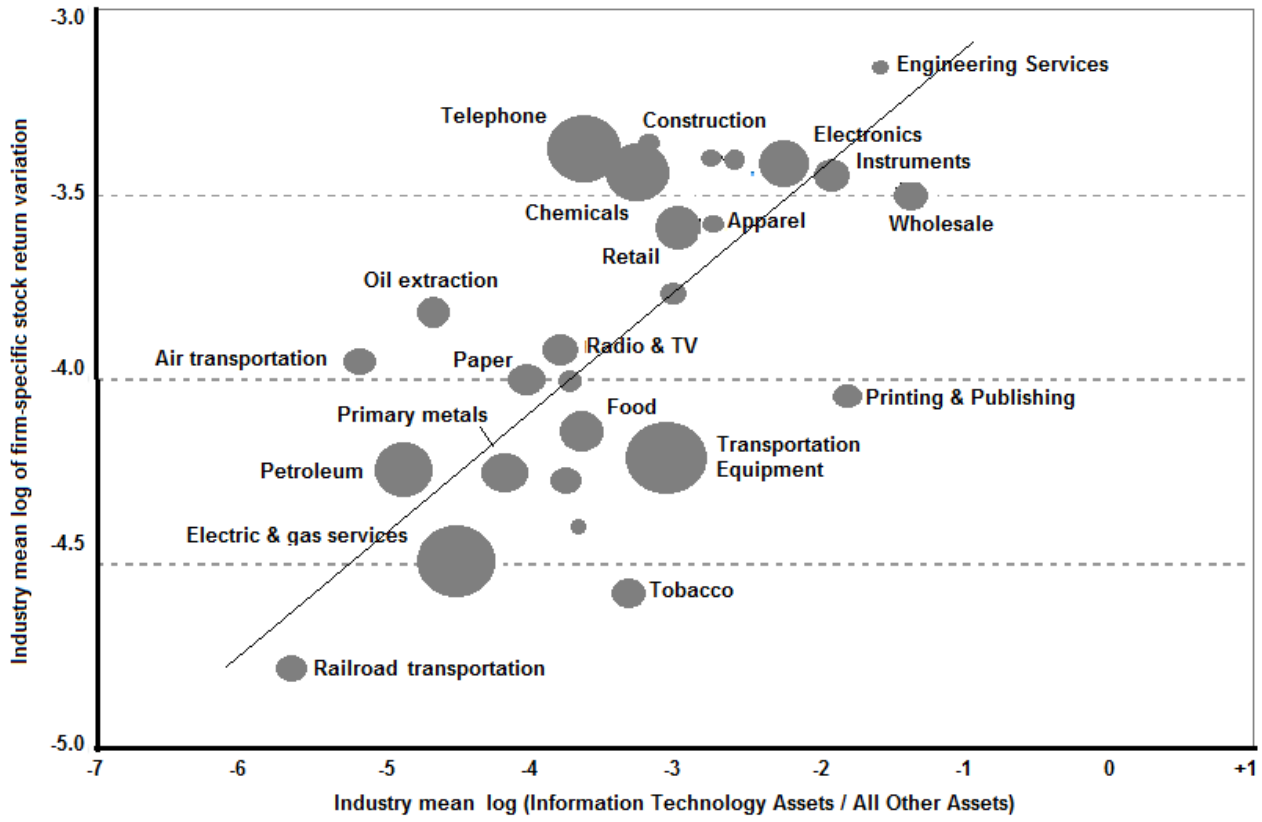
5.2 Creative destruction and firm-specific event intensity

Chun et al (2008, 2011) find that firms in US industries that invest more intensively in information technology (IT) have less synchronous fundamentals and returns, as well as higher

productivity growth. Figure 4 summarizes their findings. Endogenous growth theory (Jovanovic and Rouseau 2005) links IT to a broad wave of creative destruction (Schumpeter 1911) across the US economy in the late 20th century: the creative firms that most successfully applied IT in their sectors profited hugely, leaving unsuccessful innovators and non-innovative incumbents partially or completely destroyed. Chun et al. argue that elevated firm-specific return and fundamentals volatilities reflect this wave of IT driven creative destruction magnifying the gap between winners and losers. Consistent with this, Chun et al. (2013) find this effect fading in the early 21st century as IT investment plateaus across sectors and the IT boom appeared to have run its course.

Figure 4. Investment in Innovation and Firm-specific Event Intensity

The stocks of firms in US industries with histories of heavier investment in Information technology-related capital assets exhibit higher firms-specific return volatility in the 1990s century. Circle sizes reflect relative industry total assets.



Source: Chun et al. (2008, p. 117)

Consistent with this explanation, Irvine and Pontiff (2009) link elevated firm-specific volatility in fundamental and returns to increased competition associated with deregulation. Extensive US deregulation in the 1980s exposed creaking, formerly politically sheltered monopolies (Stigler 1971) to pressure from more innovative entrants.

A wave of creative destruction also meshes with the firm age effect reported above (Pastor and Veronesi 2003; Fama and French 2004; Brown and Kapadia 2007; Fink et al. 2010). A wave of newly listed firms is consistent with a wave of creative destruction because the top executives of established firms, whose human capital relates to existing technologies, often block disruptive innovation (Bower & Christensen 1995) and because new firms offer creative entrepreneurs surer ownership of their ideas (Schumpeter 1911). Finally, Chun et al. (2013) argue that low returns in listed firms can accompany a wave of creative destruction that increases the overall productivity of the economy if the owners of creative firms capture much of the return to innovation prior to their IPOs.

Also consistent with innovation elevating firm-specific volatility, Kothari, Laguerre, and Leone (2002) find R&D investments positively related to subsequent earnings volatility. Osinga, Leeflang, Srinivasan, and Wieringa (2011) find advertising spending correlated to elevated firm-specific return volatility in pharmaceutical firms, which could reflect either advertising campaigns either having winner-take-all characteristics akin to R&D races or echoing innovative success. Bartram, Brown, and Stulz (2012) report higher idiosyncratic return volatility in US firms than in comparable foreign firms, and link the difference to R&D and patents. Brown and

Kimbrough (2011) link intangible investments to earnings variability, and find R&D especially correlated with earnings variability in industries where patents are better protected.

Building on the real option models of Galai and Masulis (1976) and Myers (1977), Cao, Simin, and Zhao (2008) argue that levered firms' managers, to maximize existing shareholders' wealth, favor investments that elevate their firm's idiosyncratic risk. Cao et al find firm-specific return volatility positively correlated with Tobin's average Q, which they interpret as a proxy for growth options. They further find that controlling for growth options removes, or even reverses, the idiosyncratic volatility trend in Campbell et al (2001), and renders insignificant other explanatory variables, including profitability (Pastor and Veronesi 2003; Wei and Zhang 2006) and firm age and size (Pastor and Veronesi 2003; Fama and French 2004; Fink et al 2010). Zhang (2010) analogously links firm-specific return volatility to market-to-book ratios and earnings volatility in industry-level data for the US and nine other high-income countries. Bekaert, Hodrick, and Zhang (2012) likewise link firm-specific volatility to market-to-book ratios, business cycles variables, and systematic volatility in G7 country data. To the extent that growth options arise from new technologies, and that Tobin's average Q ratios and market-to-book ratios approximates Tobin's marginal Q ratio (a theoretically motivated measure of growth options), these findings also support elevated firm-specific volatility reflecting technological progress.

5.3 The Importance of functional efficiency to creative destruction

Perhaps most importantly, this explanation links firm-specific return volatility to both market efficiency and fundamentals volatility. King and Levine (1993) present empirical evidence supporting Schumpeter's (1911) argument that an efficient financial system, especially a functionally efficient stock market, is essential to fast-paced creative destruction. This is because creative potential entrepreneurs often lack adequate personal or family wealth, and must raise risk-tolerant capital from others to develop their innovations.

Creative undertakings are uniquely ill-suited for bank loans because they promise huge upside potential but entail substantial downside risk. Because banks receive fixed interest, bankers are unimpressed by upside potential, however huge, but deeply concerned about downside risk. Creative innovators typically have scant collateral, which bankers value highly. Even ultimately successful innovators may not generate substantial revenues for many years, yet bank loans typically require prompt commencement of regular payments of interest and principal.

Schumpeter (1911) argues that creative entrepreneurs therefore need economically efficient financial markets in which to raise capital.[4] Stock markets are especially helpful (Atje and Jovanavlc 1993; Levine and Zervos 1998) because shareholders balance downside risk against upside potential, demand no collateral, and accept that dividends may not begin for many years. Even venture capital firms, financial institutions that provide capital to innovators,

[4] Schumpeter was unimpressed with high finance, viewing highly leveraged banks his era's financial engineering as diversions from the financial system's social purpose (Leathers and Raines 2004).

typically do so with the expectation of recouping their investment plus a profit when the innovators' firms go public (Gompers and Lerner 2001), and thus also rely on stock markets. Once listed, these firms can grow further by issuing more equity; and only much later rely mainly retained earnings and debt.

Costly regulations with scant real positive impact on corporate governance render outside equity capital from either an IPO or a seasoned equity offering (SEO) more costly. The period from 1975 through 2000 saw a series of sweeping financial liberalizations in the US and elsewhere that, at first at least, dismantled a broad range of arguably inefficient regulation. While events after 2000 lead many to conclude that deregulation grew excessive, it seems plausible that increasing competition among market makers and brokers (Geisst 2012) and an expanding venture-capital-fund-to-IPO cycle (Gompers and Lerner 2001) improved the informational and functional efficiency of the US financial system. Similar liberalizations may have had like effects in other countries (Bekaert, Harvey and Lundblad 2005; Henry 2007).

This linkage between functional efficiency and creative destruction can also play out across countries. In countries where corporate governance standards are lower, public equity capital is dearer (La Porta et al. 1998; Rajan and Zinglaes 1998) and new listings rarer (La Porta et al. 1998); so entrepreneurs, intent on founding new firms with public equity capital, find tough going. In such countries, wealthy business families often control vast business groups (Rajan and Zingales 2003; Morck et al. 2004), whose member firms' assets are what creative destruction would destroy (Morck and Yeung 2003). Thus, less firm-specific variation amid business groups (Khanna and Thomas 2009) might reflect sluggish innovation.

Even Japan fits. Japan's prolonged economic slowdown after 1990 is attributed to stalled innovation (Morck and Yeung 2003). Risk-averse bank-influenced firms (Morck et al. 2001) predominate in sheltered backwater sectors, while many family firms are actually run by first generation entrepreneurs, whom business families adopt as legal sons and heirs (Mehotra et al. 2013). Perhaps higher returns comovement for bank-linked than family firms (Nguyen 2011) reflects more innovation in the latter.

6. Noise traders and Systematic Risk

Noise in financial markets is doubtless important in understanding event intensity; however, a consensus as to how it does so remains elusive. Thus far, our focus is firm-specific events, and some firm-specific return volatility may well be "occasional frenzy unrelated to concrete information" (Roll 1988, 566), and Malkiel and Xu (2002) pursue this interpretation. We feel the weight of evidence now suggests that much, perhaps most, firm specific volatility reflects information capitalization, but concede that the issue is far from closed.

Market-wide stock market volatility can likewise reflect macroeconomic events (Bernanke and Kuttner 2005; Rigobon and Sack 2008) or noise (Keynes 1936; Kindleberger 1978; Devenow and Welch 1996). Market-wide noise, because it cannot be diversified away, is potentially economically important to the real economy, and thus to functional efficiency, than firm-specific noise.

Thus, DeLong et al. (1990) presume noise trading to be synchronous – driving the whole market (or at least a broad section of it) to unrealistic heights or depths. Their irrationally

overoptimistic noise traders inflate all equity investments above fundamental values, letting firms issue overvalued shares or, equivalently, lowering their costs of public equity capital. Their irrationally pessimistic noise traders can likewise depress the all equity investments, deterring firms from issuing public equity.

Noise traders can affect the economics of the informed arbitrage business in (at least) two ways. First, Black (1985) argues that noise traders' irrational optimism or pessimism can push stock price away from fundamental values, thereby making informed risk arbitrage more profitable. Second, DeLong et al. (1990) argue that noise traders can "create their own space" in the stock market because their shifting optimism and pessimism affect all stock prices synchronously. This elevates systematic risk, which raises the cost of capital for everyone, including informed arbitrageurs. If higher capital costs drive enough informed arbitrageurs out of business, stock markets are left to noise traders, and informational efficiency is compromised.

These two effects conflict when noise traders are irrationally optimistic. Irrationally exuberant share prices cheapen equity capital, which theoretically cuts costs for both informed arbitrageurs and creative innovators. But heightened systematic risk makes equity dearer, raising costs of capital for both. Which effect dominates is unclear *a priori*, though historical evidence suggests that noise trader optimism often correlates with cheap equity capital (Keynes 1936; Kindleberger 1978; Shiller 2000; Reinhart and Rogoff 2011). If noise trader optimism does cut costs of capital, Schumpeter's (1911) thesis that creative entrepreneurs lacking substantial private wealth require efficient stock markets can be extended. Perhaps

optimistic noise traders, by lowering new entrepreneurial firms' costs equity, accelerate creative destruction, thereby elevating firm-specific event intensity. Alternatively, a cost of capital biased down by noise traders might cause substantial capital misallocation and hobble long-term growth.

When noise traders are pessimistic, in contrast, the Black (1985) and DeLong et al. (1990) effects align. Irrationally dejected share prices and amplified systematic risk inflict a double whammy on the cost of capital, starving both informed arbitrageurs and creative entrepreneurs of capital. The latter attenuates the intensity of firm-specific fundamentals events, and the former renders stock prices less faithful reflections of such events. Pessimistic noise traders might thus make capital dearer to new entrepreneurial firms, retarding creative destruction, and to informed arbitrageurs, retarding information capitalization. Either effect could then decrease firm-specific event intensity. But working in the other direction, arbitraging undervalued stocks entails taking long positions, a less costly arbitrage strategy than shorting overvalued stocks in an irrationally exuberant stock market.

Much of the evidence above can be cast as consistent with noise traders affecting asset prices. The elevated systematic risk and depressed firm-specific risk evident in very low-income countries' stocks (Morck et al 2000; Jin and Myers 2006) is consistent with noise traders predominating, though more erratic government policy might also be to blame (Taylor 2000; Blanchard and Simon 2001). The heightened correlation across asset prices in bear markets (Ribeiro and Veronesi 2002; Brockman, Liebenberg and Shcutte 2010), especially evident in low-income countries (Brockman, Liebenberg and Shcutte 2010), also dovetails with pessimistic

noise traders both pushing equity prices down and thereby elevating both leverage and systematic risk, though other explanations associated with fixed information costs (Veldcamp 2006) may also be important.

How the limits to arbitrage (Shleifer and Vishny 1997) affect return event intensity is obviously a complicated business, and a full review is beyond the scope of this article. However, the evidence above of connections to functional efficiency gives the problem very general interest. Further theoretical and empirical research exploring these connections would be useful.

7. Conclusions

In a perfectly informationally efficient financial market, firm-specific return volatility reflects the intensity of underlying firm-specific events (French and Roll 1986). We call this *firm-specific fundamentals event intensity*. If informational efficiency is imperfect, firm-specific return volatility reflects the capitalization into stock prices of some, but perhaps not all, previously private information about firm-specific fundamentals events. We call this *firm-specific stock return event intensity*.

A stream of empirical work links firm-specific return event intensity to plausible indicators of the extent of informed arbitrage: easier short-selling, hedge fund interest, openness to foreign investors, investor rights, and the like. Another line of work suggests a link to public announcements – news items and public disclosure documents. Both lines of work

are credible and suggest higher return event intensity when stock prices echo firm-specific fundamentals events more faithfully. A range of empirical and theoretical arguments can be reconciled to this thesis, including many that *a priori* seem discordant.

One important cause of events that alter firm-specific fundamental values is creative destruction, in which creative winner firms' valuations rise and loser firms' valuations are destroyed, at least partially. Higher firm-specific fundamentals event intensity can reflect more vigorous technological progress, as in the late 20th century IT boom in the US, or in more innovative US industries, or in higher-income economies more generally.

Causality here is likely neither unidirectional nor straightforward. First, creative destruction feeds back upon itself. More intensive creative destruction shortens the profitable product life of an innovation. If this encourages successful entrepreneurs to move on to new innovations faster, fast creative destruction can encourage yet more creative destruction. But if the faster evaporation of an innovation's profits deters further innovation, a negative feedback results instead. How fundamentals event intensity feeds back upon itself is thus ambiguous.

A larger feedback loop connects firm-specific fundamentals event intensity, firm-specific return event intensity, functional efficiency, and creative destruction. More and larger firm-specific fundamentals events increase the value of having information the market does not yet have, and thus increases appropriately informed arbitrageurs' profits. But more firm-specific fundamentals volatility also elevates the risk arbitrageurs incur taking large undiversified positions in stocks they deem mispriced (Shleifer and Vishny 1997). How this risk-return

tradeoff affects the intensity of informed arbitrage is ambiguous. If the tradeoff is such that intensified creative destruction, by elevating firm-specific fundamentals event intensity, encourages informed arbitrage, the stock market might become more informationally and functionally efficient. Capital could then flow more reliably to more promising entrepreneurs, further accelerating creative destruction. But if the elevated firm-specific fundamentals event intensity instead discourages arbitrage, the stock market might become less informationally and functionally efficient; and capital would flow less reliably to promising entrepreneurs, retarding creative destruction. Because noise trader herding can also affect the cost of capital to informed arbitrageurs and potentially creative entrepreneurs alike, yet another set of feedback effects arise.

Institutions, especially those that encourage or discourage private information generation, informed arbitrage, innovation, and financial development more generally may be important because they affect which of these many possible feedback effects dominate. Additional empirical and theoretical work to elaborate, qualify, or refute these hypotheses is welcome.

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