

The Reallocation of Information by Relative Value Arbitrage

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POVZETEK: Raziskava opisuje, kako relativno vrednostni arbitraziranci vplivajo na informativnost cijena. Dva rizikna vložilca s povezanih odnosov odplačevanja se trgujejo na razdeljenih trgih, while relativno vrednostni arbitraziranci npravijo obnovo informacij med cijenama. Ugotovljeno je, da relativno vrednostni arbitraziranci lahko povečajo informativnost cijena z informacijo, ki je vključena v povezane cene, vendar lahko tudi prenesejo šum iz ene cene v drugo. Raziskava karakterizira ravno stopnjo rizika, ki jo lahko prenese arbitraziranci, za maksimalizacijo informativnosti. Kalibracija z empirskimi ocenami informativnosti cijena suggestira, da čakajši nivo arbitraziranja lahko preteče informacijski kanal, čakajši nivo informativnosti cijena spadne.

METODA: Raziskava je izvedena v eno-odnosnem konkurenčnem ekonomskem okolju z eno besporednim in dva rizikna vložilca. Vloženci so specializirani po trgu: vloženci v vložilcu A trgujejo samo vložilcem A in besporednim vložilcem, vloženci v vložilcu B trgujejo samo vložilcem B in besporednim vložilcem. Konečna odplačanja so povezana, a cene so šumuječe. Povezana odplačanja vključujejo dve kanala: informacijski kanal, ki poveča informativnost, in šumski kanal, ki jo zmanjša.

KLJUČNE UGOTOVITVE:

- Relativno vrednostni arbitraziranci lahko povečajo, ampak tudi zmanjšajo informativnost cijena.
- Informacijski kanal poveča informativnost, zatiranjem šuma pa jo zmanjša.
- Stopnja informativnosti zavisi od stopnje rizika, ki jo lahko prenese arbitraziranci.
- Čakajši nivo rizika, ki ga lahko prenese arbitraziranci, za maksimalizacijo informativnosti je odvisen od stopnje šuma in nehedgeabilne komponente odplačevanja.

POMEN ZA TRGOVANJE: Raziskava je pomembna za razumevanje vpliva relativno vrednostnega arbitraziranja na informativnost cijena. Vključno z kalibracijo z empirskimi ocenami informativnosti cijena, suggirira, da čakajši nivo arbitraziranja lahko preteče informacijski kanal, če je stopnja šuma velika. Tako lahko arbitraziranci zmanjšajo informativnost cijena, če je rizik prenese.

The Reallocation of Information by Relative Value Arbitrage ^{*}

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September 7, 2026

Abstract

This paper studies how relative-value arbitrage affects price informativeness. Two risky assets with correlated payoffs are traded on segmented markets, while relative-value arbitrageurs observe only prices and trade across both markets. Relative-value arbitrage generates two opposing effects on informativeness. An information-aggregation channel increases informativeness by incorporating information contained in the related price, while a noise-contamination channel decreases informativeness by transmitting noise from one price into the other through price alignment. The paper characterizes the level of arbitrageurs' risk-bearing capacity that maximizes informativeness. A calibration based on empirical estimates of price informativeness suggests that, even for moderate levels of arbitrage activity, the noise-contamination channel can outweigh the information-aggregation channel.

Keywords: Price Informativeness, Relative Value Arbitrage, Limits to Arbitrage

JEL Codes: G12, G14, D82

^{*}I thank Fabrice Riva for helpful comments.

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1 Introduction

Many arbitrage strategies rely primarily on statistical relationships extracted from prices rather than on superior information about fundamentals. Yet a central idea in financial economics is that arbitrage improves price informativeness. Arbitrageurs who observe only prices cannot create information beyond what is already jointly embedded in the price system. They can, however, reallocate information across individual prices. When does this reallocation improve or reduce their informativeness?

This question matters even if the informativeness of the joint price system remains unchanged because economic decisions often rely on individual prices rather than on the full price system. For example, firms may use their own stock prices to guide investment decisions or incentivize management (Bond et al., 2012; Goldstein, 2023). This paper shows that relative-value arbitrageurs who observe only prices can improve, but also decrease, the informativeness of individual stock prices.

I consider a one-period competitive economy with one riskless asset and two risky assets. Investors are specialized across markets: investors in asset A trade only asset A and the riskless asset, while investors in asset B trade only asset B and the riskless asset. Terminal payoffs are correlated, and equilibrium prices are noisy. The possibility that arbitrage reduces price informativeness arises when arbitrage affects the two prices asymmetrically. Empirically, such asymmetries may arise when large valuations are traded against smaller ones, when benchmark portfolios are traded against individual stocks, when liquid ETFs or mutual funds are traded against illiquid underlying assets, or more generally when one leg of a pair trade is more price-sensitive than the other.

To characterize this possibility analytically, I first consider the limiting case of maximal asymmetry, in which asset B 's market is sufficiently large that its price is unaffected by arbitrage. Asset B can then be interpreted as a highly traded benchmark asset such as the S&P 500. The analytical benchmark focuses on how arbitrageurs who observe only prices and trade across both assets affect the informativeness of asset A 's price. I then study numerically what happens when asset B 's price becomes endogenous.¹

Noise and heterogeneous sensitivities to payoff signals among local investors generate relative-value opportunities across assets A and B . In equilibrium, arbitrage causes asset A 's price to reflect a combination of signals extracted from both prices. I measure

¹The case in which both assets have the same size is characterized analytically in Appendix B.

the strength of arbitrage through arbitrageurs' risk-bearing capacity. Greater arbitrage strength affects the informativeness of asset A 's price through two opposing channels: (1) an information-aggregation channel that increases informativeness, and (2) a noise-contamination channel that decreases informativeness.

Both channels arise from the correlation in terminal payoffs. When this correlation is zero, arbitrage has no effect on informativeness. Information aggregation results from incorporating into asset A 's price an additional signal about its payoff extracted from asset B 's price. Through this channel, relative-value arbitrage has social value by connecting fragmented pools of information. Noise contamination results from arbitrage aligning prices when payoffs are correlated, such that noise in asset B 's price contaminates asset A 's price. This alignment force emerges because correlated payoffs create opportunities to trade assets against each other while partially hedging risk, thereby improving return-to-risk ratios. A corner case of this alignment force arises when assets have identical payoffs, leading to the Law of One Price.

When arbitrage is initially absent, the information-aggregation channel dominates the noise-contamination channel, so that stronger arbitrage initially improves informativeness. The key result of the paper is to characterize the interior level at which the two forces cancel out, yielding the level of arbitrage strength that maximizes informativeness. The interior optimum is characterized by two properties of asset B : noise in its price and the non-hedgeable component of its payoff variance, that is, payoff movements in asset B uncorrelated with asset A 's payoff. Their relative importance determines whether an interior optimum exists.

If the non-hedgeable component is sufficiently large relative to noise, the interior solution does not exist, and the information-aggregation channel always dominates the noise-contamination channel, so that stronger arbitrage always improves informativeness. The intuition is that non-hedgeable payoff variance protects asset A from the alignment force through which noise contamination operates. Conversely, when the non-hedgeable component is sufficiently small relative to noise, the interior solution exists, and stronger arbitrage does not necessarily improve informativeness.

I calibrate the model using the informativeness estimates reported by Dávila and Parlato (2025) for U.S. firms. Both assets are assigned the same primitives, such that asymmetries in informativeness arise from arbitrage. Under this calibration, an interior

solution exists for all levels of payoff correlation between assets A and B , as the informativeness estimates reported by Dávila and Parlatore (2025) imply that prices contain substantial noise. Moreover, moderate to high levels of arbitrage often cause the noise-contamination channel to dominate to such an extent that informativeness falls below the level it would attain if arbitrage were absent.

A consequence of the model is that idiosyncratic payoff variation can protect asset A from the alignment force through which the noise-contamination channel operates, leading to higher levels of informativeness. Durnev et al. (2003), Chen et al. (2007), and Dávila and Parlatore (2025) find that higher idiosyncratic volatility is associated with greater price informativeness. Hou et al. (2013) express skepticism toward a naive association between idiosyncratic volatility and information. Dávila and Parlatore (2023) propose that investor learning from prices can lead to a positive correlation between volatility and informativeness. This paper points to a complementary mechanism whereby idiosyncratic volatility protects prices from the alignment force through which non-fundamental shocks are transmitted across assets.

Employing the same calibration, I numerically study the informativeness of both assets when asset B 's price is also endogenous. If assets A and B are perfectly symmetric and have the same size, arbitrage strength monotonically increases the informativeness of both prices. As asset B becomes larger, its informativeness continues to increase monotonically with arbitrage strength. Asset A 's informativeness, however, develops an interior solution. With the level of noise implied by the estimates reported in Dávila and Parlatore (2025), maximum informativeness of asset A can be reached for relatively moderate differences in size and arbitrage strength. As the size difference increases, the informativeness of asset B rises only slightly, whereas the informativeness of asset A initially increases with arbitrage strength but then declines sharply, eventually falling below its no-arbitrage level. These results are consistent with evidence that informativeness is positively related to firm size and liquidity in the cross-section and has increased among S&P 500 firms while declining outside the index (Bai et al., 2016; Dávila and Parlatore, 2025). The model proposes a mechanism for these patterns: small assets tend to be contaminated by noise originating from large assets, whereas large assets benefit from information aggregation from smaller assets. At the same time, their size protects them from the alignment forces through which the noise-contamination channel operates.

The model builds on the literature studying the aggregation of dispersed information initiated verbally by Hayek (1945), formalized mathematically by Grossman (1976), and extended by Hellwig (1980) and Diamond and Verrecchia (1981), who show the necessity of noise for prices to aggregate information. Admati (1985) is probably the closest paper to the present one. The paper extends noisy rational expectations equilibria to multi-asset markets and contains elements reminiscent of both the aggregation and noise-contamination channels studied here. For example, Section 4 shows that an increase in one asset’s price can lead investors to lower their expectation of its payoff because a related asset’s price remains unchanged. Section 5 shows that noise associated with a single asset can prevent other assets from becoming fully revealing. The present paper differs by explicitly studying the trade-off between information aggregation and noise contamination as relative-value arbitrage strengthens.

The social value of price informativeness comes from the feedback effect, whereby corporations use their own stock prices to learn about fundamentals or to incentivize management. For reviews of this literature, see Bond et al. (2012) and Goldstein (2023). For empirical evidence on the feedback effect, see Chen et al. (2007) and Edmans et al. (2012). In the present paper, greater informativeness may be assumed to improve the unconditional mean payoff of asset A by improving managerial decisions. I abstract from explicitly modeling how a decision maker observing the price subsequently affects fundamentals, which may create asymmetries in arbitrageurs’ positions (see Edmans et al. (2015)).

Other papers have found ambiguous effects of arbitrage on social welfare. Gromb and Vayanos (2002) show that while arbitrage improves investors’ welfare by providing liquidity, in some cases a reduction in arbitrageurs’ positions can be Pareto improving. Dugast and Foucault (2018) show that the growing use of rapidly produced, low-precision signals can crowd out slower fundamental analysis, reducing the long-run informativeness of stock prices.²

Relative-value arbitrage, where arbitrageurs rely primarily on prices, can take the form of simple pair trading between assets with related payoffs (see Gatev et al. (2006)), twin stocks (see Rosenthal and Young (1990); Froot and Dabora (1999)), or closed-end funds (see Lee et al. (1991); Cherkes (2012)). The dot-com era Negative Stub Values provide a

²See also Foucault et al. (2017).

local example in which stronger arbitrage may have reduced price informativeness: parent firms holding highly traded internet-related subsidiaries traded below the market value of their stake in the subsidiary (see Cornell and Liu (2001); Mitchell et al. (2002); Lamont and Thaler (2003)). Stronger relative-value arbitrage, by aligning parent prices with noisy subsidiary prices, may have reduced the informativeness of parent prices. More broadly, many beta-sorted portfolios and statistical arbitrage strategies can be interpreted as forms of relative-value trading that exploit statistical relationships extracted from prices and other public information, rather than new information about fundamentals not yet reflected in any price.

The rest of the paper proceeds as follows. Section 2 presents the model. Section 3 derives equilibrium prices and informativeness. Section 4 studies the relation between arbitrage and informativeness. Section 5 endogenizes asset B 's price. Section 6 concludes.

2 The Model

There are two periods, $t = 0, 1$. The market consists of one riskless asset and two risky assets, A and B .

2.1 Assets

The gross risk-free rate is equal to one. The two risky assets A and B are traded at $t = 0$, are in fixed supply, and have the following terminal payoffs at $t = 1$:

$$\theta_{A,1} = \theta_{A,0} + \eta_{A,0}, \quad \theta_{B,1} = \theta_{B,0} + \eta_{B,0},$$

where $\theta_{A,0}$ and $\theta_{B,0}$ are constants, and $\eta_{A,0}$ and $\eta_{B,0}$ are shocks realized at $t = 0$.

The payoff innovations are jointly normally distributed:

$$\eta_{A,0} \sim \mathcal{N}(0, \tau_{\eta,A}^{-1}), \quad \eta_{B,0} \sim \mathcal{N}(0, \tau_{\eta,B}^{-1}),$$

where $\tau_{\eta,A}$ and $\tau_{\eta,B}$ denote precisions.³ The covariance between $\eta_{A,0}$ and $\eta_{B,0}$ is

$$\text{Cov}(\eta_{A,0}, \eta_{B,0}) = \rho (\tau_{\eta,A} \tau_{\eta,B})^{-1/2},$$

³ $\tau_{\eta,A} = 1/\text{Var}(\eta_{A,0})$ and $\tau_{\eta,B} = 1/\text{Var}(\eta_{B,0})$.

where ρ denotes the correlation between $\eta_{A,0}$ and $\eta_{B,0}$.

2.2 A- and B-investors

Markets are segmented, with two non-overlapping continua of investors: the A -investors only invest in asset A and the riskless asset, and the B -investors only invest in asset B and the riskless asset. This assumption is justified by investors' specialization and creates a role for arbitrageurs who trade across markets.⁴

The A -investors have unit mass, $\mu_A = 1$, while the B -investors have much larger mass, $\mu_B \gg \mu_A$. The mechanism described in the model emerges from asymmetries between asset A and asset B .⁵ In the paper, I study the case where arbitrageurs have different price impact because asset B 's market contains many more investors than asset A 's market. Making this asymmetry strong simplifies exposition. Asset A can be thought of as a local firm, while asset B can be thought of as a heavily traded portfolio such as the S&P 500.

Each group of investors $k \in \{A, B\}$ has CARA preferences with risk-aversion parameter γ_k , and terminal wealth $W_{k,1}$. They solve

$$\max_{q_{k,0}^i} E \left[-e^{-\gamma_k W_{k,1}} \mid \mathcal{I}_{k,0} \right]$$

subject to

$$W_{k,1} = W_{k,0} + q_{k,0}^i (\theta_{k,1} - p_{k,0}),$$

where $W_{k,0}$ is initial wealth, $q_{k,0}^i$ is the number of shares held, and $p_{k,0}$ is the price.

Their information set $\mathcal{I}_{k,0}$ contains $\theta_{k,0}$, a private signal about $\eta_{k,0}$, and heterogeneous priors $\bar{\eta}_{0,k}^i$. The private signal is

$$s_{k,0}^i = \eta_{k,0} + \varepsilon_{sk,0}^i,$$

⁴See Gromb and Vayanos (2002) for a similar segmentation assumption, and Merton (1987) for an example where investors specialize in a limited number of firms.

⁵Appendix B shows that, in the perfectly symmetric case, arbitrage monotonically improves informativeness. Once symmetry is broken, however, for example through asymmetric price impact or different noise variances, this monotonicity result no longer holds.

where $\varepsilon_{sk,0}^i \sim N(0, \tau_{s,k}^{-1})$. Heterogeneous priors satisfy

$$\bar{\eta}_{k,0}^i = n_{k,0} + \varepsilon_{nk,0}^i,$$

where $n_{0,k} \sim N(0, \tau_{n,k}^{-1})$ and $\varepsilon_{nk,0}^i \sim N(0, \tau_{\pi,k}^{-1})$. The terms $\varepsilon_{sk,0}^i$ and $\varepsilon_{nk,0}^i$ represent idiosyncratic noise. All idiosyncratic terms are mutually orthogonal across investors i and assets k , and are orthogonal to fundamentals.

The term $n_{0,k}$ is common across investors. It represents aggregate sentiment and acts as noise, preventing prices from being perfectly revealing about payoffs. The choice of modeling noise through aggregate priors is not critical for the results derived in this model. An analogous framework could instead be written with supply shocks. In that interpretation, aggregate sentiment can be viewed as supply-driven variation in discount rates that is not separately identifiable from fundamentals.

From CARA-normality, the demand for each group of investors $k \in \{A, B\}$ is

$$q_{k,0}^i = S_k(\theta_{k,0} + \kappa_k s_{k,0}^i + (1 - \kappa_k)\bar{\eta}_{k,0}^i - p_{k,0}), \quad (1)$$

where

$$\kappa_k = \frac{\tau_{s,k}}{\tau_{s,k} + \tau_{\pi,k}} \quad (2)$$

is the Kalman gain, that is, the weight investors put on their private signal, and

$$S_k = \frac{\tau_{s,k} + \tau_{\pi,k}}{\gamma_k} \quad (3)$$

is the price sensitivity of investors in market k . Higher precision of private signals or heterogeneous priors increases price sensitivity, while higher risk aversion decreases it.

2.3 Arbitrageurs

There is a continuum of arbitrageurs who can invest in both asset A and asset B , as well as in the riskless asset. They do not receive private signals about fundamentals and instead engage in statistical arbitrage based on price information alone.

Arbitrageurs have unit mass, $\mu_{\text{arb}} = 1$, and are small relative to the mass of B -investors, $\mu_B \gg \mu_{\text{arb}}$. Taking the example where asset B represents the S&P 500, this

assumption reflects the idea that relative-value arbitrageurs represent only a small fraction of investors in a central market.

They have CARA preferences with risk-aversion parameter ξ , and terminal wealth $W_{\text{arb},1}$. They solve

$$\max_{q_{\text{arb},0}^i} E \left[-e^{-\xi W_{\text{arb},1}} \mid \mathcal{I}_{\text{arb},0} \right]$$

subject to

$$W_{\text{arb},1} = W_{\text{arb},0} + (q_{\text{arb},0}^i)'(\theta_1 - p_0),$$

where

$$q_{\text{arb},0}^i = \begin{pmatrix} q_{A,\text{arb},0}^i \\ q_{B,\text{arb},0}^i \end{pmatrix}, \quad \theta_1 = \begin{pmatrix} \theta_{A,1} \\ \theta_{B,1} \end{pmatrix}, \quad p_0 = \begin{pmatrix} p_{A,0} \\ p_{B,0} \end{pmatrix}.$$

Their information set $\mathcal{I}_{\text{arb},0}$ contains the unconditional mean payoff vector (θ_0), prices (p_0), and the aggregate position of the arbitrage sector. Arbitrageurs are also assumed to know the price sensitivities of other investors and the joint distribution of payoffs and equilibrium prices. The inclusion of the aggregate position of the arbitrage sector in the information set is justified by the identical information and preferences of arbitrageurs, which, by symmetry, allow them to deduce the position of the sector as a whole.

From CARA-normality, arbitrageurs demand is

$$q_{\text{arb},0}^i = \xi^{-1} \Sigma_{\eta|x}^{-1} (\theta_0 + E[\eta_0 \mid \mathcal{I}_{\text{arb},0}] - p_0), \quad (4)$$

where

$$\theta_1 = \theta_0 + \eta_0 = \begin{pmatrix} \theta_{A,0} \\ \theta_{B,0} \end{pmatrix} + \begin{pmatrix} \eta_{A,0} \\ \eta_{B,0} \end{pmatrix}$$

and $\Sigma_{\eta|x}^{-1}$ is the posterior precision matrix of the unobservable payoff innovations.

3 Equilibrium

3.1 Equilibrium Prices

Assets A and B are in fixed per-capita supply Q_A and Q_B , respectively. Since the mass of A -investors is normalized to one, total supply of asset A is equal to Q_A . By contrast, the mass of B -investors is μ_B , such that total supply of asset B is equal to $\mu_B Q_B$. Thus,

the supply of asset B scales proportionally with the size of its market.

Market clearing for asset A yields

$$\begin{aligned} Q_A &= \int_0^1 q_{A,0}^i di + \int_0^1 q_{A,\text{arb},0}^i di \\ &= S_A x_{A,0} - S_A p_{A,0} + \int_0^1 q_{A,\text{arb},0}^i di \end{aligned}$$

where, by the law of large numbers, the idiosyncratic components average out in the cross-section of investors, such that

$$x_{A,0} = \kappa_A \eta_{A,0} + (1 - \kappa_A) n_{A,0}. \quad (5)$$

Solving for the equilibrium price gives

$$p_{A,0} = -\frac{Q_A}{S_A} + x_{A,0} + \frac{1}{S_A} \int_0^1 q_{A,\text{arb},0}^i di. \quad (6)$$

Market clearing for asset B yields

$$\begin{aligned} \mu_B Q_B &= \int_0^{\mu_B} q_{B,0}^i di + \int_0^1 q_{B,\text{arb},0}^i di \\ &= \mu_B S_B x_{B,0} - \mu_B S_B p_{B,0} + \int_0^1 q_{B,\text{arb},0}^i di \end{aligned}$$

where, by the law of large numbers, the idiosyncratic components average out in the cross-section of B -investors, such that

$$x_{B,0} = \kappa_B \eta_{B,0} + (1 - \kappa_B) n_{B,0}. \quad (7)$$

Solving for the equilibrium price gives

$$p_{B,0} = -\frac{Q_B}{S_B} + x_{B,0} + \frac{1}{\mu_B S_B} \int_0^1 q_{B,\text{arb},0}^i di.$$

Taking the limit as $\mu_B \rightarrow \infty$, arbitrageurs have vanishing price impact on asset B , and

$$p_{B,0} = -\frac{Q_B}{S_B} + x_{B,0}. \quad (8)$$

Arbitrageurs know the aggregate position of the arbitrage sector and the price sensi-

tivities of other investors, allowing them to infer $x_{A,0}$ and $x_{B,0}$. These variables constitute a sufficient statistic for the vector of payoff innovations η_0 . Arbitrage demand in equation (4) can be rewritten:

$$q_{\text{arb}}^i = \xi^{-1} \left(\Sigma_{\eta|x}^{-1} E[\eta_0 | x_0] - \Sigma_{\eta|x}^{-1} (p_0 - \theta_0) \right). \quad (9)$$

The vector of informational components extracted from prices is

$$x_0 = K\eta_0 + N_0.$$

where

$$x_0 = \begin{pmatrix} x_{A,0} \\ x_{B,0} \end{pmatrix}, \quad K = \begin{pmatrix} \kappa_A & 0 \\ 0 & \kappa_B \end{pmatrix}, \quad \eta_0 = \begin{pmatrix} \eta_{A,0} \\ \eta_{B,0} \end{pmatrix}, \quad N_0 = \begin{pmatrix} (1 - \kappa_A)n_{A,0} \\ (1 - \kappa_B)n_{B,0} \end{pmatrix}$$

with $N_0 \sim \mathcal{N}(0, R)$.

Using Bayes' rule, the posterior distribution of η_0 conditional on x_0 satisfies

$$p(\eta_0 | x_0) \propto p(x_0 | \eta_0) p(\eta_0).$$

Under normality, matching quadratic and linear terms yields

$$\Sigma_{\eta|x}^{-1} = \Sigma_{\eta}^{-1} + K' R^{-1} K, \quad \Sigma_{\eta|x}^{-1} E[\eta_0 | x_0] = K' R^{-1} x_0.$$

The A -component of arbitrage demand is

$$\begin{aligned} q_{\text{arb},A}^i = \xi^{-1} & \left(\frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} x_{A,0} \right. \\ & + \left[\frac{\tau_{\eta,A}}{1 - \rho^2} + \frac{\kappa_A^2}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right] (\theta_{A,0} - p_{A,0}) \\ & \left. - \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2} (\theta_{B,0} - p_{B,0}) \right). \end{aligned} \quad (10)$$

A full derivation is provided in Appendix A.

Because arbitrageurs have unit mass and symmetric information and preferences, individual and aggregate arbitrage demand coincide. Substituting arbitrage demand from

equation (10) and the equilibrium price of asset B from equation (8) into equation (6), and solving for the price of asset A , yields

$$p_{A,0} = \theta_{A,0} - \phi_A + \frac{x_{A,0} + \lambda_A \left[\frac{\kappa_A}{(1-\kappa_A)^2 \tau_{n,A}^{-1}} x_{A,0} + \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1-\rho^2} x_{B,0} \right]}{1 + \lambda_A \left[\frac{\tau_{\eta,A}}{1-\rho^2} + \frac{\kappa_A^2}{(1-\kappa_A)^2 \tau_{n,A}^{-1}} \right]}. \quad (11)$$

where

$$\phi_A = \frac{\frac{Q_A}{S_A} + \lambda_A \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1-\rho^2} \frac{Q_B}{S_B}}{1 + \lambda_A \left[\frac{\tau_{\eta,A}}{1-\rho^2} + \frac{\kappa_A^2}{(1-\kappa_A)^2 \tau_{n,A}^{-1}} \right]} \quad (12)$$

where

$$\lambda_A = \frac{\xi^{-1}}{S_A} \quad (13)$$

represents the strength of arbitrage, or more technically, the relative risk-bearing capacity of arbitrageurs. S_A is the price sensitivity of A -investors. As defined in equation (3), it is equal to the sum of the precision of private signals and heterogeneous priors divided by investors' risk-aversion parameter. The greater S_A , the smaller λ_A , and the lower the effect of arbitrage trading on the price of asset A . Conversely, the greater arbitrageurs' risk-bearing capacity, the greater λ_A , and the stronger the effect of arbitrage trading on the price of asset A . When $\lambda_A \rightarrow \infty$, the relative strength of arbitrage is infinite. This case corresponds to a frictionless environment in which arbitrageurs can perfectly diversify and face no constraints. The main object of the paper is to understand how λ_A influences the informativeness of the price of asset A .

The equilibrium price of asset A is composed of the observable payoff component $\theta_{A,0}$, an equilibrium discount ϕ_A , and a weighted combination of informational components extracted from prices about payoff innovations. The dependence of the price of asset A on the informational component of asset B is governed by the correlation coefficient ρ . When $\rho > 0$, two forces emerge as arbitrage strength, λ_A , increases: one force tends to increase the informativeness of $p_{A,0}$, while the other can reduce it.

The first force is information aggregation: using an additional signal from asset B allows arbitrageurs to improve the informativeness of asset A 's price. The second force is price alignment: exploiting inconsistencies in prices between both assets can lead noise from asset B 's price to contaminate the price of asset A . The next subsection defines

the equilibrium informativeness of the joint price system and of asset A 's price. The following section then studies how arbitrage strength λ_A and the correlation parameter ρ affect this informativeness.

The equilibrium discount ϕ_A is also a weighted combination of the discount that asset A would have in autarky and the discount implied by arbitrageurs' valuation. When $\lambda_A \rightarrow \infty$, isolating the arbitrage component yields

$$\lim_{\lambda_A \rightarrow \infty} \phi_A = \frac{\frac{\rho(\tau_{\eta,A}\tau_{\eta,B})^{1/2}}{1-\rho^2} \frac{Q_B}{S_B}}{\frac{\tau_{\eta,A}}{1-\rho^2} + \frac{\kappa_A^2}{(1-\kappa_A)^2 \tau_{n,A}^{-1}}}.$$

The derivative of this limit with respect to ρ is positive whenever $Q_B > 0$. In the example where asset B represents the S&P 500, this implies that, when arbitrage is very strong, assets whose payoffs are more correlated with this central and highly traded asset carry a larger equilibrium discount.

3.2 Equilibrium Informativeness

I define the joint informativeness of the price system as

$$I_p = \text{Cov}(\eta_0, p_0)' \text{Var}(p_0)^{-1} \text{Cov}(\eta_0, p_0).$$

The intuition for this informativeness measure is discussed below in the scalar case of asset A .

Proposition 1. *Relative-value arbitrage reallocates information across prices but does not change the informativeness of the joint price system.*

Proof. The equilibrium price vector is an affine transformation of the vector of informational components:

$$p_0 = c + Hx_0,$$

where c is constant and H is a nonsingular matrix determined by equilibrium. Since affine constants do not affect covariance matrices,

$$\text{Cov}(\eta_0, p_0) = \text{Cov}(\eta_0, x_0)H', \quad \text{Var}(p_0) = H \text{Var}(x_0)H'.$$

Therefore,

$$\begin{aligned} I_p &= \text{Cov}(\eta_0, x_0) H' (H \text{Var}(x_0) H')^{-1} H \text{Cov}(x_0, \eta_0) \\ &= \text{Cov}(\eta_0, x_0) \text{Var}(x_0)^{-1} \text{Cov}(x_0, \eta_0) \end{aligned}$$

Thus, the informativeness of the joint price system is invariant to the equilibrium transformation induced by arbitrage. Relative-value arbitrage changes how information is allocated across individual prices, but it does not create or destroy information at the level of the joint system. $\square$

For relative-value arbitrage to have social value, one must assume that the price system contains information unavailable to corporate decision makers, and that these decision makers rely primarily on the price of their own firm.⁶ If they are instead able to extract information from the full price system, then relative-value arbitrage is redundant, as it does not increase the total amount of information available to decision makers and therefore does not improve the real allocation of capital. Because asset B is assumed to be sufficiently large for arbitrage to have no impact on its price, its informativeness is exogenous, and relative-value arbitrage affects real outcomes only through changes in the informativeness of asset A 's price. To allow arbitrage to affect real outcomes, suppose that $\theta_{A,0}$ depends on the informativeness of asset A 's price. In that case, allocating information across prices can affect firms' investment decisions, and therefore expected payoffs across states of the economy.⁷

The informativeness of the price of asset A is defined as

$$\mathcal{I}_{p_A} = \frac{\text{Cov}(\eta_{A,0}, p_{A,0})^2}{\text{Var}(p_{A,0})}. \quad (14)$$

This informativeness measure corresponds to the R^2 of the simple regression of payoff innovations on prices, or equivalently of prices on payoff innovations, up to a scaling factor equal to the variance of payoff innovations, which is unaffected by arbitrage. The measure is written in this form rather than directly as an R^2 only to simplify the algebra.

⁶See Bond et al. (2012) for a review of how information embedded in stock prices can affect the allocation of capital.

⁷"[I]nvestment is an option on information, and firm value embeds the value of this option" (Bai et al., 2016). See also Goldstein et al. (2013), where the capital provider's expected surplus is maximized when price informativeness is highest.

Since informativeness is scale invariant, we can compute it using

$$\mathcal{I}_{p_A} = \frac{\text{Cov}(\eta_{A,0}, y_{A,0})^2}{\text{Var}(y_{A,0})}. \quad (15)$$

where

$$y_{A,0} = x_{A,0} + \lambda_A \left[\frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} x_{A,0} + \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2} x_{B,0} \right]. \quad (16)$$

The term $x_{A,0}$ corresponds to the informational component generated by the A -investors. The component multiplied by the arbitrageurs' relative strength parameter λ_A captures the linear combination of price signals $x_{A,0}$ and $x_{B,0}$ toward which arbitrage pulls the price of asset A as arbitrage becomes increasingly strong. When arbitrage is initially weak, an increase in arbitrage improves price informativeness by aggregating an additional independent signal from asset B . However, beyond some point, stronger arbitrage need not further improve the informativeness of asset A . This is studied in the next section. A full derivation of informativeness in terms of primitives is provided in Appendix A.3.

4 Arbitrage and Informativeness

4.1 Optimal Arbitrage for Informativeness

I first study the effect of a marginal increase in arbitrage when arbitrage is absent. Starting from the informativeness measure defined in equation (15), I evaluate its derivative with respect to λ_A at $\lambda_A = 0$. To simplify the analysis, I study $\log(\mathcal{I}_{p_A})$, which by monotonicity preserves the sign of the derivative:

$$\left. \frac{\partial \log(\mathcal{I}_{p_A})}{\partial \lambda_A} \right|_{\lambda_A=0} = \frac{2\kappa_B \rho^2 (1 - \kappa_A)^2 \tau_{n,A}^{-1}}{(1 - \rho^2) \kappa_A \tau_{\eta,A}^{-1} [\kappa_A^2 \tau_{\eta,A}^{-1} + (1 - \kappa_A)^2 \tau_{n,A}^{-1}]} > 0. \quad (17)$$

Thus, informativeness initially increases with arbitrage intensity.

Proposition 2. *When arbitrage is absent and $\rho \neq 0$, introducing a marginal amount of arbitrage always increases the informativeness of asset A 's price.*

From equation (17), we see that arbitrage can improve informativeness only when $\rho \neq 0$. This isolates the channel through which relative-value arbitrage improves the

informativeness of asset A : it aggregates independent information contained in the price of asset B . When $\rho = 0$, the price of asset B contains no information about asset A 's payoff innovation, and relative-value arbitrage has no effect on the informativeness of asset A 's price.

Corollary 1. *Arbitrageurs who observe only the price of asset A cannot improve the informativeness of asset A 's price.*

This corollary follows from Proposition 1 applied to the case where the price system contains only one price. The case $\rho = 0$ in equation (17) provides an equivalent intuition: when asset B 's payoff is uncorrelated with asset A 's payoff, observing the price of asset B is informationally equivalent to not observing it at all. If arbitrageurs observe only the price of asset A , equilibrium trading cannot introduce new information about η_A beyond what is already embedded in p_A .⁸ Thus, arbitrageurs observing only prices can improve informativeness only by aggregating information contained in other prices with correlated payoffs.

I next compute the arbitrage strength that maximizes informativeness. The first-order condition with respect to λ_A , the relative risk-bearing capacity of arbitrageurs, yields

$$\lambda_A^* = \frac{\kappa_B(1 - \kappa_A)^2 \tau_{n,A}^{-1} \tau_{\eta,B}^{-1} (1 - \rho^2)}{\kappa_A(1 - \kappa_B) [(1 - \kappa_B) \tau_{n,B}^{-1} - \kappa_B \tau_{\eta,B}^{-1} (1 - \rho^2)]}. \quad (18)$$

Stronger arbitrage always improves informativeness when there is no positive interior solution for the optimal arbitrage intensity, that is, when $\lambda_A^* \leq 0$. This condition is characterized in the following proposition.

Proposition 3. *Relative-value arbitrage monotonically improves informativeness whenever the variance of noise in asset B is sufficiently small relative to the residual independent component of payoff variation:*

$$\tau_{n,B}^{-1} < \frac{\kappa_B}{1 - \kappa_B} \tau_{\eta,B}^{-1} (1 - \rho^2).$$

The intuition is as follows. Stronger arbitrage pulls the information content of asset A 's price toward a linear combination of price signals $x_{A,0}$ and $x_{B,0}$ appearing between

⁸Arbitrage will only reduce volatility without affecting informativeness.

brackets in equation (16). Two forces affect the informativeness of this linear combination: (1) information aggregation, which, as discussed above, increases informativeness by aggregating an additional signal, and (2) noise contamination, which decreases informativeness. The noise-contamination effect is driven both by the amount of noise present in asset B and by how strongly arbitrage pulls the price of asset A toward the price of asset B . The component of asset B 's payoff variation that is independent of asset A 's payoff ($\tau_{\eta,B}^{-1}(1 - \rho^2)$) acts as a countervailing force that limits how strongly arbitrage pulls the price of asset A toward the price of asset B . When the variance of noise in asset B ($\tau_{\eta,B}^{-1}$) is sufficiently small relative to this countervailing force, the information-aggregation effect always dominates the noise-contamination effect, and stronger arbitrage always increases informativeness of the price of asset A . However, when the amount of noise present in asset B 's price is sufficiently large, and the payoffs of assets A and B are sufficiently correlated, stronger arbitrage can eventually deteriorate the informativeness of asset A 's price.⁹

From the numerator of the optimal relative risk-bearing capacity in equation (18), we see that a larger noise variance in the price signal of asset A ($(1 - \kappa_A)^2 \tau_{\eta,A}^{-1}$) makes stronger arbitrage more beneficial. Intuitively, when asset A 's own price signal is noisy, incorporating information extracted from asset B 's price becomes more valuable. As a result, a higher level of arbitrage is required before the noise-contamination channel outweighs the information-aggregation channel. The presence of $\tau_{\eta,B}^{-1}(1 - \rho^2)$ in the numerator can be understood as a risk-scaling factor: when the payoffs of both assets are less correlated, arbitrageurs' relative risk-bearing capacity must mechanically increase to maintain the same level of equilibrium informativeness. Finally, all terms are multiplied by the scaling factor $\frac{\kappa_B}{\kappa_A(1 - \kappa_B)}$. When κ_B is large, investors in asset B place more weight on payoff signals, strengthening the benefits of stronger arbitrage through the information-aggregation channel. Conversely, when κ_A is large, investors in asset A place more weight on payoff signals, making stronger arbitrage more likely to deteriorate an already informative price through the noise-contamination channel.

To calibrate the model, I use the relative informativeness measure proposed by Dávila

⁹Interior solutions also exist when the price of asset B is endogenous. In the symmetric case where assets A and B have the same size and the same investor price sensitivity ($S_B = S_A$), arbitrage monotonically improves informativeness. Some asymmetry, such as differences in size ($\mu_B > \mu_A$) or investor price sensitivity ($S_B > S_A$), is therefore necessary for an interior solution to emerge. See Appendix B.

and Parlatore (2025):

$$R_{p_A}^2 = \tau_{\eta,A} \mathcal{I}_{p_A} = \frac{\text{Cov}(\eta_{A,0}, p_{A,0})^2}{\text{Var}(p_{A,0}) \text{Var}(\eta_{A,0})}. \quad (19)$$

This measure is the informativeness measure defined in Equation (14) scaled by the precision of the payoff of asset A , or, equivalently, the squared correlation between $p_{A,0}$ and $\eta_{A,0}$. For U.S. firms, Dávila and Parlatore (2025) estimate a mean relative informativeness of 2.61% and a median of 2.34%. They show that relative informativeness corresponds to the weight a Bayesian observer would place on an unbiased signal extracted from prices when learning about future payoffs. Thus, a relative informativeness of 2.61% implies that a Bayesian observer would place only 2.61% weight on the information extracted from prices and 97.39% weight on prior beliefs. In the benchmark calibration with $\kappa_A = 0.5$ and $\lambda_A = 0$, a one-dollar increase in the price of asset A corresponds to a two-dollar increase in the unbiased signal extracted from the price. Consequently, a Bayesian observer would increase expected payoff by $2 \times 0.0261 = \$0.0522$, indicating that prices are highly noisy.

Figure 1 plots the relative informativeness of asset A 's price on the vertical axis as a function of arbitrage strength λ_A on the horizontal axis for four different levels of payoff correlation. I calibrate the model such that the relative informativeness of asset B matches the mean estimate of 2.61% reported by Dávila and Parlatore (2025). Assuming an asset- B investor Kalman gain on the private signal of $\kappa_B = 0.5$, matching this level of relative informativeness requires payoff variance to be small relative to noise variance. Specifically, I set $\tau_{\eta,B}^{-1} = 1$ and $\tau_{n,B}^{-1} = 37$. To isolate the effect of arbitrage on relative informativeness, I assign the same primitives to asset A . Consequently, when arbitrage is absent ($\lambda_A = 0$), both assets have the same level of relative informativeness.

Consistent with Proposition 2, we can see that when arbitrage is absent ($\lambda_A = 0$), introducing a marginal amount of arbitrage increases relative informativeness of asset A . From Proposition 3, $\kappa_B = 0.5$, $\tau_{\eta,B}^{-1} = 1$, and $\tau_{n,B}^{-1} = 37$ imply that there is no value of ρ for which no interior solution exists. As shown in Figure 1, all curves attain an optimal level of relative informativeness for arbitrage strengths ranging from 0.5 to 1.5. When arbitrageurs have roughly twice the risk-bearing capacity of A -investors, relative informativeness returns to the level observed in the absence of arbitrage. As arbitrage strength increases further, the relative informativeness of asset A falls below its no-

arbitrage level. Thus, the amount of noise required to match the empirical estimates of Dávila and Parlato (2025) implies that the noise-contamination channel can dominate the information-aggregation channel even for moderate levels of arbitrage strength.

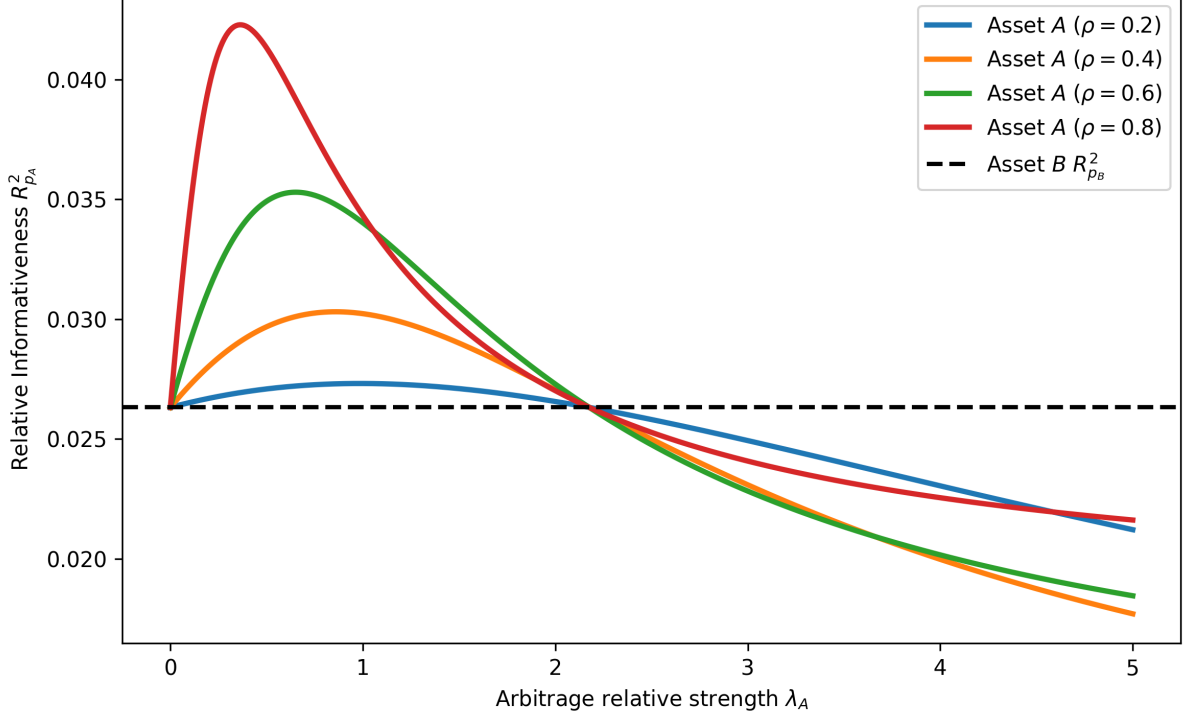


Figure 1: Equilibrium relative informativeness of asset A 's price as a function of arbitrage strength λ_A . Relative informativeness is defined as $R_{p_A}^2 = \tau_{\eta,A} \mathcal{I}_{p_A} = \frac{\text{Cov}(\eta_{A,0}, p_{A,0})^2}{\text{Var}(p_{A,0}) \text{Var}(\eta_{A,0})}$. The calibration matches the mean relative informativeness reported by Dávila and Parlato (2025). The parameters are $\kappa_A = \kappa_B = 0.5$, $\tau_{\eta,A}^{-1} = \tau_{\eta,B}^{-1} = 1$, and $\tau_{n,A}^{-1} = \tau_{n,B}^{-1} = 37$. The figure reports results for payoff correlations $\rho \in \{0.2, 0.4, 0.6, 0.8\}$, spanning a range from moderate to high fundamental comovement.

4.2 Optimal Payoff Comovement for Informativeness

The payoff correlation between assets A and B has two contradictory effects. First, when $\rho = 0$, relative-value arbitrage has no effect on the informativeness of prices. When $\rho > 0$, some amount of relative-value arbitrage increases informativeness through the information-aggregation channel. However, a greater ρ also strengthens the noise-contamination channel, increasing the parameter space in which stronger arbitrage deteriorates informativeness.

Unlike the analysis of arbitrage strength in the previous subsection, studying the effect of ρ through closed-form comparative statics does not lead to a particularly transparent characterization. Although interior solutions can be derived analytically, the resulting

expressions are cumbersome and provide little additional intuition. I therefore study the relationship between payoff comovement and informativeness numerically.

Figure 2 plots, on the vertical axis, the relative informativeness of asset A 's price as defined in (19) as a function of payoff correlation ρ on the horizontal axis, for four different levels of relative arbitrage risk-bearing capacity λ_A . When arbitrageurs' relative risk-bearing capacity is smaller than that of asset- A investors, correlation with asset B always improves relative informativeness. For $\lambda_A = 0.5$, where arbitrageurs have half the risk-bearing capacity of asset- A investors, the optimum is reached at a correlation of approximately $\rho = 0.8$. As arbitrageurs' relative risk-bearing capacity increases, the correlation that maximizes relative informativeness decreases, as illustrated by the curves for $\lambda_A = 1$ and $\lambda_A = 2$. For $\lambda_A = 3$, correlation with asset B reduces the relative informativeness of asset A 's price. In this case, the noise-contamination channel dominates the information-aggregation channel.

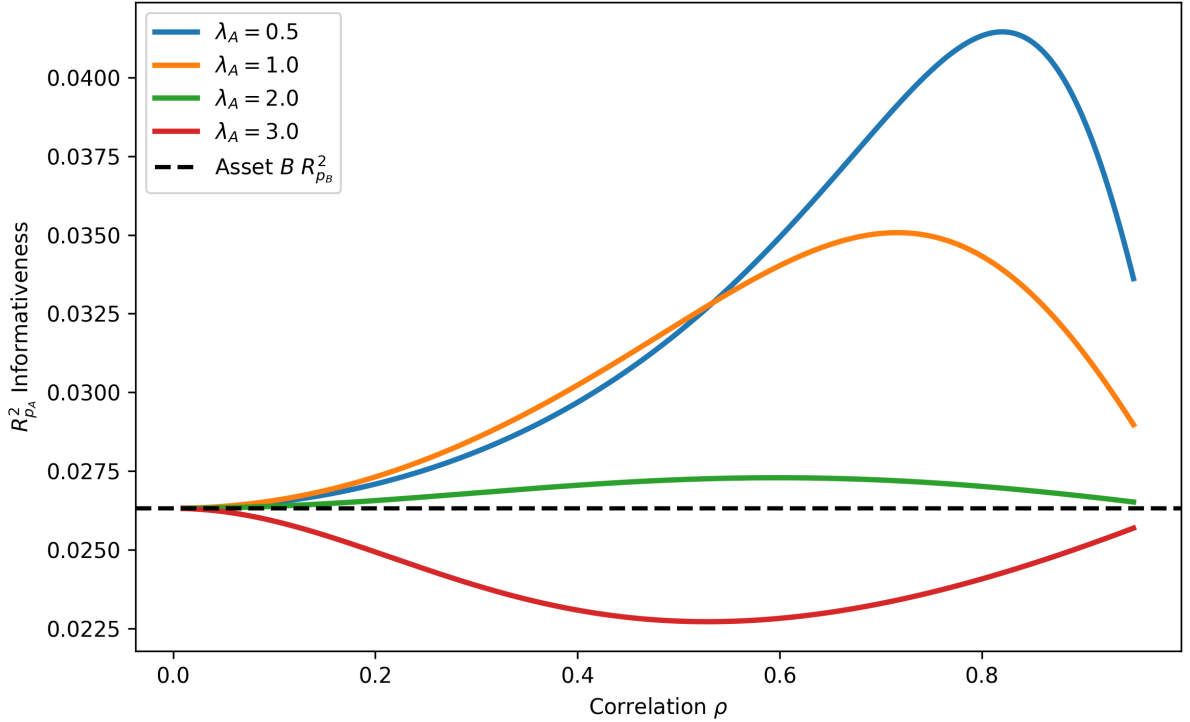


Figure 2: Relative informativeness of asset A 's price as a function of payoff correlation ρ for different levels of arbitrageurs' relative risk-bearing capacity. The parameters are $\kappa_A = \kappa_B = 0.5$, $\tau_{\eta,A}^{-1} = \tau_{\eta,B}^{-1} = 1$, and $\tau_{n,A}^{-1} = \tau_{n,B}^{-1} = 37$. With this calibration, asset B , and asset A when $\lambda_A = 0$, match the mean relative informativeness estimated by Dávila and Parlato (2025).

Let us assume that asset B is a central benchmark asset such as the S&P 500. Most

assets' payoff correlations with such an asset are likely to lie between 0 and 0.5. From Figure 2, this is a region in which greater payoff correlation reduces informativeness for sufficiently strong levels of arbitrage. Thus, idiosyncratic payoff variation will tend to be positively related to informativeness. Durnev et al. (2003) find that firms with greater idiosyncratic return variation tend to be more informative about future earnings. Other papers also document a positive relationship between idiosyncratic variation and informativeness, such as Chen et al. (2007) and, more recently, Dávila and Parlato (2025), although the latter finds only a modest effect.¹⁰ One interpretation of these findings is that idiosyncratic variation protects prices from the noise-contamination channel. In the model, a larger idiosyncratic component limits the extent to which arbitrage pulls an asset's price toward correlated assets and their associated noise.¹¹

5 Endogenous Asset B

When asset B 's price is endogenous, that is, when the size of its market is finite ($\mu_B < \infty$), its informativeness is also affected by arbitrageurs' trading. In the symmetric case ($\mu_A = \mu_B$), neither asset admits an interior solution, and stronger arbitrage always increases informativeness. This result is demonstrated in Appendix B. More generally, whenever $\mu_B > \mu_A$, asset B also has no interior solution. For the larger asset, the information-aggregation channel always dominates the noise-contamination channel, so stronger arbitrage unambiguously increases its informativeness. However, because it is the larger asset, arbitrage also affects its price less. In the limit as $\mu_B \rightarrow \infty$, the price of asset B becomes exogenous to arbitrageurs' trading activity.

Making asset B endogenous substantially complicates the analytical expressions. I therefore study the model numerically and simulate how the relative informativeness of assets A and B evolves with their relative size μ_B/μ_A and arbitrage strength λ under the assumption that investors in assets A and B have the same price sensitivity ($S_A = S_B$). Table 1 reports the relative informativeness of both assets for different values of μ_B/μ_A and λ . The calibration matches the mean relative informativeness reported by Dávila

¹⁰Relatedly, Dávila and Parlato (2023) find that stocks with high idiosyncratic volatility tend to exhibit higher comovement scores, a measure designed to identify whether volatility is more likely to reflect informativeness rather than noise.

¹¹The interpretation of idiosyncratic return variation as a measure of informativeness has also been challenged. See, for example, Hou et al. (2013).

Table 1: Relative informativeness of assets A and B for different levels of arbitrage strength and asset-size asymmetry. The table reports relative informativeness measured as R_p^2 (in percent). The parameter μ_B/μ_A denotes the relative size of asset B . When $\mu_B/\mu_A = 1$, both assets are symmetric. As μ_B/μ_A increases, the price of asset B becomes progressively less affected by arbitrage, converging toward the pinned- B benchmark. The calibration matches the mean relative informativeness reported by Dávila and Parlato (2025). The parameters are $\kappa_A = \kappa_B = 0.5$, $\tau_{\eta,A}^{-1} = \tau_{\eta,B}^{-1} = 1$, and $\tau_{n,A}^{-1} = \tau_{n,B}^{-1} = 37$. The payoff correlation is set to $\rho = 0.20$.

μ_B/μ_A	Asset	λ_A									
		0	0.5	1	2	3	5	8	10	50	100
1	A	2.63	2.69	2.71	2.72	2.73	2.73	2.73	2.73	2.73	2.73
	B	2.63	2.69	2.71	2.72	2.73	2.73	2.73	2.73	2.73	2.73
10	A	2.63	2.71	2.73	2.70	2.62	2.48	2.35	2.30	2.46	2.61
	B	2.63	2.64	2.64	2.65	2.65	2.65	2.66	2.66	2.68	2.70
50	A	2.63	2.71	2.73	2.67	2.53	2.22	1.88	1.73	1.42	1.71
	B	2.63	2.63	2.63	2.64	2.64	2.64	2.64	2.64	2.65	2.65
100	A	2.63	2.71	2.73	2.66	2.51	2.18	1.79	1.62	1.09	1.24
	B	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.64	2.64
500	A	2.63	2.71	2.73	2.66	2.50	2.13	1.71	1.52	0.80	0.75
	B	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63
1000	A	2.63	2.71	2.73	2.66	2.50	2.13	1.70	1.51	0.76	0.68
	B	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63

and Parlato (2025). The parameters are $\kappa_A = \kappa_B = 0.5$, $\tau_{\eta,A}^{-1} = \tau_{\eta,B}^{-1} = 1$, and $\tau_{n,A}^{-1} = \tau_{n,B}^{-1} = 37$. The payoff correlation is set to $\rho = 0.20$ to be representative. For higher payoff correlations, the pattern shown in Table 1 becomes stronger.

When $\mu_B/\mu_A = 1$, the relative informativeness of both assets A and B increases monotonically with arbitrage strength λ , consistent with the result derived in Appendix B for the symmetric case. It is only as μ_B/μ_A increases that the noise-contamination channel generates an interior solution for asset A , while the gains in relative informativeness for asset B become progressively smaller. When λ becomes very large, relative informativeness converges to the case in which arbitrageurs are effectively risk-neutral and set both prices entirely based on their price signals, leading to informativeness levels that are higher than in the absence of arbitrage. At the same time, Table 1 shows that moderate to high levels of arbitrage can substantially reduce the informativeness of asset A , often pushing it below its no-arbitrage level.

One of the stable findings in the literature on price informativeness (Bai et al., 2016; Dávila and Parlato, 2025) is that measures of size and liquidity are positively related

to informativeness. Large and liquid firms tend to be more informative about future payoffs than small and illiquid firms. The model offers a potential mechanism for this pattern. For small and illiquid firms, the noise-contamination channel is more likely to dominate the information-aggregation channel. When a large and liquid asset experiences a non-fundamental demand shock, arbitrage can transmit part of this shock to smaller and less liquid assets, contaminating their prices. By contrast, smaller assets can still provide information about the payoffs of larger assets, while the larger assets' size protects them from these alignment forces. As a result, the noise-contamination channel never dominates the information-aggregation channel for sufficiently large and liquid assets.

6 Conclusion

This paper studies how relative-value arbitrage affects price informativeness when arbitrageurs observe only prices. While arbitrageurs cannot create information beyond what is already jointly embedded in the price system, they can reallocate information across individual prices. Relative-value arbitrage therefore has two opposing effects on informativeness. By aggregating information contained in related assets' prices, arbitrage can improve informativeness. At the same time, by aligning prices, arbitrage can also transmit noise across assets and reduce informativeness.

The paper shows that whether stronger arbitrage improves or deteriorates informativeness depends on the relative importance of these two forces. When related assets contain relatively little noise or sufficiently large independent payoff variation, the information-aggregation channel dominates and stronger arbitrage improves informativeness. Conversely, when highly traded benchmark assets are subject to substantial noise pressure, stronger arbitrage can contaminate the informativeness of related assets' prices.

At the level of the joint price system, relative-value arbitrage does not create information. Its social value instead comes from reallocating information across individual prices when economic agents rely primarily on their own stock price to make decisions. More broadly, the paper suggests that arbitrage based primarily on statistical relationships extracted from prices may differ fundamentally from arbitrage based on new information about fundamentals. While the latter introduces new information into prices, the former primarily redistributes information and noise already embedded in the price system.

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A Proofs

A.1 Arbitrageurs' Investment Positions

Arbitrageurs choose positions

$$q_{\text{arb}}^i = \xi^{-1} \Sigma_{\eta|x}^{-1} (\theta_0 + E[\eta_0 | x_0] - p_0) \quad (20)$$

$$= \xi^{-1} \left(\Sigma_{\eta|x}^{-1} E[\eta_0 | x_0] - \Sigma_{\eta|x}^{-1} (p_0 - \theta_0) \right). \quad (21)$$

We compute the products $\Sigma_{\eta|x}^{-1} E[\eta_0 | x_0]$ and $\Sigma_{\eta|x}^{-1} (p_0 - \theta_0)$. The signal vector satisfies

$$x_0 = K\eta_0 + N_0, \quad (22)$$

where

$$x_0 = \begin{pmatrix} x_{A,0} \\ x_{B,0} \end{pmatrix}, \quad K = \begin{pmatrix} \kappa_A & 0 \\ 0 & \kappa_B \end{pmatrix}, \quad \eta_0 = \begin{pmatrix} \eta_{A,0} \\ \eta_{B,0} \end{pmatrix}, \quad N_0 = \begin{pmatrix} (1 - \kappa_A)n_{A,0} \\ (1 - \kappa_B)n_{B,0} \end{pmatrix}$$

with $N_0 \sim \mathcal{N}(0, R)$.

The noise covariance matrix is

$$R = \begin{pmatrix} (1 - \kappa_A)^2 \tau_{n,A}^{-1} & 0 \\ 0 & (1 - \kappa_B)^2 \tau_{n,B}^{-1} \end{pmatrix}. \quad (23)$$

The posterior distribution of η_0 given x_0 satisfies

$$p(\eta_0 | x_0) \propto p(x_0 | \eta_0) p(\eta_0). \quad (24)$$

Under normality, the posterior density is

$$p(\eta_0 \mid x_0) \propto \exp \left(-\frac{1}{2} (x_0 - K\eta_0)' R^{-1} (x_0 - K\eta_0) - \frac{1}{2} \eta_0' \Sigma_\eta^{-1} \eta_0 \right) \quad (25)$$

$$\propto \exp \left(-\frac{1}{2} (\eta_0' (\Sigma_\eta^{-1} + K' R^{-1} K) \eta_0 - 2\eta_0' K' R^{-1} x_0) \right). \quad (26)$$

Matching quadratic and linear terms yields

$$\Sigma_{\eta|x}^{-1} = \Sigma_\eta^{-1} + K' R^{-1} K, \quad \Sigma_{\eta|x}^{-1} E[\eta_0 \mid x_0] = K' R^{-1} x_0. \quad (27)$$

We can write

$$\Sigma_{\eta|x}^{-1} E[\eta_0 \mid x_0] = K' R^{-1} x_0 \quad (28)$$

$$= \begin{pmatrix} \frac{\kappa_A x_{A,0}}{(1-\kappa_A)^2 \tau_{n,A}^{-1}} \\ \frac{\kappa_B x_{B,0}}{(1-\kappa_B)^2 \tau_{n,B}^{-1}} \end{pmatrix}, \quad (29)$$

$$\Sigma_{\eta|x}^{-1} (p_0 - \theta_0) = (\Sigma_\eta^{-1} + K' R^{-1} K) (p_0 - \theta_0) \quad (30)$$

$$= \begin{pmatrix} \frac{\tau_{\eta,B}^{-1}}{D} + \frac{\kappa_A^2}{(1-\kappa_A)^2 \tau_{n,A}^{-1}} & -\frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{-1/2}}{D} \\ -\frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{-1/2}}{D} & \frac{\tau_{\eta,A}^{-1}}{D} + \frac{\kappa_B^2}{(1-\kappa_B)^2 \tau_{n,B}^{-1}} \end{pmatrix} \begin{pmatrix} p_{A,0} - \theta_{A,0} \\ p_{B,0} - \theta_{B,0} \end{pmatrix} \quad (31)$$

where

$$D = \det(\Sigma_\eta) = \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} (1 - \rho^2). \quad (32)$$

Using the first row, the A -component of arbitrage demand is

$$\begin{aligned} q_{\text{arb},A}^i = & \xi^{-1} \left(\frac{\kappa_A}{(1-\kappa_A)^2 \tau_{n,A}^{-1}} x_{A,0} \right. \\ & + \left[\frac{\tau_{\eta,A}}{1-\rho^2} + \frac{\kappa_A^2}{(1-\kappa_A)^2 \tau_{n,A}^{-1}} \right] (\theta_{A,0} - p_{A,0}) \\ & \left. - \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1-\rho^2} (\theta_{B,0} - p_{B,0}) \right). \end{aligned} \quad (33)$$

The arbitrageurs' demand for asset B is obtained symmetrically.

A.2 Proof of the Equilibrium Price of Asset A

The market clearing condition for asset A at time $t = 0$ is

$$\begin{aligned}
Q_A = & S_A(\theta_{A,0} + x_{A,0} - p_{A,0}) \\
& + \xi^{-1} \left(\frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} x_{A,0} \right. \\
& + \left[\frac{\tau_{\eta,A}}{1 - \rho^2} + \frac{\kappa_A^2}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right] (\theta_{A,0} - p_{A,0}) \\
& \left. - \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2} (\theta_{B,0} - p_{B,0}) \right). \tag{34}
\end{aligned}$$

We assume that the market for asset B is very large ($\mu_B \rightarrow \infty$), such that arbitrage has a vanishing impact on its price. Thus, the price of asset B is pinned solely by the B -investors and is given by

$$p_{B,0} = \theta_{B,0} - \frac{Q_B}{S_B} + x_{B,0}. \tag{35}$$

Let

$$\lambda_A = \frac{\xi^{-1}}{S_A}.$$

Solving for $p_{A,0}$ gives

$$p_{A,0} = \theta_{A,0} - \phi_A + \frac{x_{A,0} + \lambda_A \left[\frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} x_{A,0} + \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2} x_{B,0} \right]}{1 + \lambda_A \left[\frac{\tau_{\eta,A}}{1 - \rho^2} + \frac{\kappa_A^2}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right]}. \tag{36}$$

where

$$\phi_A = \frac{\frac{Q_A}{S_A} + \lambda_A \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2} \frac{Q_B}{S_B}}{1 + \lambda_A \left[\frac{\tau_{\eta,A}}{1 - \rho^2} + \frac{\kappa_A^2}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right]}. \tag{37}$$

$$\lim_{\rho \rightarrow 1} p_{A,0} = \theta_{A,0} - \phi_A + \left(\frac{\tau_{\eta,B}}{\tau_{\eta,A}} \right)^{1/2} x_{B,0}. \tag{38}$$

A.3 Proof of Equilibrium Informativeness

The informativeness of asset B is not affected by arbitrage. The informativeness of asset A is defined as

$$\mathcal{I}_{p_A} = \text{Var}(\mathbb{E}[\eta_{A,0} \mid p_{A,0}]) = \frac{\text{Cov}(\eta_{A,0}, p_{A,0})^2}{\text{Var}(p_{A,0})} = \frac{\text{Cov}(\eta_{A,0}, y_{A,0})^2}{\text{Var}(y_{A,0})}. \quad (39)$$

where $p_{A,0}$ is affine in $y_{A,0}$ and

$$y_{A,0} = x_{A,0} + \lambda_A \left[\frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} x_{A,0} + \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2} x_{B,0} \right] \quad (40)$$

$$= (1 + \lambda_A a) x_{A,0} + \lambda_A b x_{B,0}, \quad (41)$$

with

$$a = \frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}}, \quad b = \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2}.$$

We compute $\text{Cov}(\eta_{A,0}, y_{A,0})$ and $\text{Var}(y_{A,0})$. First,

$$\begin{aligned} \text{Cov}(\eta_{A,0}, y_{A,0}) &= (1 + \lambda_A a) \text{Cov}(\eta_{A,0}, x_{A,0}) + \lambda_A b \text{Cov}(\eta_{A,0}, x_{B,0}) \\ &= \text{Cov}(\eta_{A,0}, x_{A,0}) + \lambda_A (a \text{Cov}(\eta_{A,0}, x_{A,0}) + b \text{Cov}(\eta_{A,0}, x_{B,0})). \end{aligned} \quad (42)$$

Similarly,

$$\begin{aligned} \text{Var}(y_{A,0}) &= (1 + \lambda_A a)^2 \text{Var}(x_{A,0}) + (\lambda_A b)^2 \text{Var}(x_{B,0}) \\ &\quad + 2(1 + \lambda_A a) \lambda_A b \text{Cov}(x_{A,0}, x_{B,0}) \end{aligned} \quad (43)$$

$$\begin{aligned} &= \text{Var}(x_{A,0}) + 2\lambda_A (a \text{Var}(x_{A,0}) + b \text{Cov}(x_{A,0}, x_{B,0})) \\ &\quad + \lambda_A^2 (a^2 \text{Var}(x_{A,0}) + b^2 \text{Var}(x_{B,0}) + 2ab \text{Cov}(x_{A,0}, x_{B,0})). \end{aligned} \quad (44)$$

Then

$$\mathcal{I}_{p_A} = \frac{[(1 + \lambda_A a) \text{Cov}(\eta_{A,0}, x_{A,0}) + \lambda_A b \text{Cov}(\eta_{A,0}, x_{B,0})]^2}{(1 + \lambda_A a)^2 \text{Var}(x_{A,0}) + \lambda_A^2 b^2 \text{Var}(x_{B,0}) + 2(1 + \lambda_A a) \lambda_A b \text{Cov}(x_{A,0}, x_{B,0})}. \quad (45)$$

Using

$$\text{Cov}(\eta_{A,0}, x_{A,0}) = \kappa_A \tau_{\eta,A}^{-1},$$

$$\text{Cov}(\eta_{A,0}, x_{B,0}) = \kappa_B \rho (\tau_{\eta,A} \tau_{\eta,B})^{-1/2},$$

$$\text{Var}(x_{A,0}) = \kappa_A^2 \tau_{\eta,A}^{-1} + (1 - \kappa_A)^2 \tau_{n,A}^{-1},$$

$$\text{Var}(x_{B,0}) = \kappa_B^2 \tau_{\eta,B}^{-1} + (1 - \kappa_B)^2 \tau_{n,B}^{-1},$$

and

$$\text{Cov}(x_{A,0}, x_{B,0}) = \kappa_A \kappa_B \rho (\tau_{\eta,A} \tau_{\eta,B})^{-1/2},$$

we obtain the following expression:

$$\mathcal{I}_{p_A} = \frac{\left[\left(1 + \lambda_A \frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right) \kappa_A \tau_{\eta,A}^{-1} + \lambda_A \frac{\kappa_B \rho^2}{1 - \rho^2} \right]^2}{\left\{ \begin{aligned} & \left(1 + \lambda_A \frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right)^2 [\kappa_A^2 \tau_{\eta,A}^{-1} + (1 - \kappa_A)^2 \tau_{n,A}^{-1}] \\ & + \lambda_A^2 \frac{\rho^2 \tau_{\eta,A} \tau_{\eta,B}}{(1 - \rho^2)^2} [\kappa_B^2 \tau_{\eta,B}^{-1} + (1 - \kappa_B)^2 \tau_{n,B}^{-1}] \\ & + 2 \left(1 + \lambda_A \frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right) \lambda_A \frac{\kappa_A \kappa_B \rho^2}{1 - \rho^2} \end{aligned} \right\}}. \quad (46)$$

Special Cases First, set the correlation between the payoffs of assets A and B to zero:

$$\begin{aligned} \mathcal{I}_{p_A} \big|_{\rho=0} &= \frac{\left[\left(1 + \lambda_A \frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right) \kappa_A \tau_{\eta,A}^{-1} \right]^2}{\left(1 + \lambda_A \frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}} \right)^2 [\kappa_A^2 \tau_{\eta,A}^{-1} + (1 - \kappa_A)^2 \tau_{n,A}^{-1}]} \\ &= \frac{\kappa_A^2 \tau_{\eta,A}^{-2}}{\kappa_A^2 \tau_{\eta,A}^{-1} + (1 - \kappa_A)^2 \tau_{n,A}^{-1}}. \end{aligned} \quad (47)$$

When $\rho = 0$, informativeness does not depend on arbitrage.

Next, consider the limit as the correlation approaches one. Since the expression is not defined at $\rho = 1$, we study the limit $\rho \rightarrow 1$. For any $\lambda_A > 0$, the dominant terms in the numerator and denominator are those of order $(1 - \rho^2)^{-2}$. Taking the limit yields

$$\lim_{\rho \rightarrow 1} \mathcal{I}_{p_A} = \frac{\kappa_B^2 \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1}}{[\kappa_B^2 \tau_{\eta,B}^{-1} + (1 - \kappa_B)^2 \tau_{n,B}^{-1}]}. \quad (48)$$

A.4 Proof of Optimal Risk-Bearing

Starting from the log of equation (45), and computing the first-order condition with respect to λ_A , we obtain:

$$\begin{aligned} \frac{\partial \log(\mathcal{I}_{p_A})}{\partial \lambda_A} = & 2 \frac{a \operatorname{Cov}(\eta_{A,0}, x_{A,0}) + b \operatorname{Cov}(\eta_{A,0}, x_{B,0})}{(1 + \lambda_A a) \operatorname{Cov}(\eta_{A,0}, x_{A,0}) + \lambda_A b \operatorname{Cov}(\eta_{A,0}, x_{B,0})} \\ & - \frac{2a(1 + \lambda_A a) \operatorname{Var}(x_{A,0}) + 2\lambda_A b^2 \operatorname{Var}(x_{B,0}) + 2b(1 + 2\lambda_A a) \operatorname{Cov}(x_{A,0}, x_{B,0})}{(1 + \lambda_A a)^2 \operatorname{Var}(x_{A,0}) + \lambda_A^2 b^2 \operatorname{Var}(x_{B,0}) + 2(1 + \lambda_A a)\lambda_A b \operatorname{Cov}(x_{A,0}, x_{B,0})} = 0. \end{aligned} \quad (49)$$

Solving this first-order condition for λ_A yields:

$$\lambda_A^* = \frac{b \left[\operatorname{Cov}(\eta_{A,0}, x_{A,0}) \operatorname{Cov}(x_{A,0}, x_{B,0}) - \operatorname{Cov}(\eta_{A,0}, x_{B,0}) \operatorname{Var}(x_{A,0}) \right]}{\left\{ \begin{aligned} & ab \left[\operatorname{Cov}(\eta_{A,0}, x_{B,0}) \operatorname{Var}(x_{A,0}) - \operatorname{Cov}(\eta_{A,0}, x_{A,0}) \operatorname{Cov}(x_{A,0}, x_{B,0}) \right] \\ & + b^2 \left[\operatorname{Cov}(\eta_{A,0}, x_{B,0}) \operatorname{Cov}(x_{A,0}, x_{B,0}) - \operatorname{Cov}(\eta_{A,0}, x_{A,0}) \operatorname{Var}(x_{B,0}) \right] \end{aligned} \right\}}. \quad (50)$$

Substituting the expressions for the moments derived above, we obtain the fully primitive expression:

$$\lambda_A^* = \frac{\kappa_B(1 - \kappa_A)^2 \tau_{n,A}^{-1} \tau_{\eta,B}^{-1} (1 - \rho^2)}{\kappa_A(1 - \kappa_B) \left[(1 - \kappa_B) \tau_{n,B}^{-1} - \kappa_B \tau_{\eta,B}^{-1} (1 - \rho^2) \right]}. \quad (51)$$

This solution is interior and positive when

$$(1 - \kappa_B) \tau_{n,B}^{-1} > \kappa_B \tau_{\eta,B}^{-1} (1 - \rho^2). \quad (52)$$

Let us prove that λ_A^* is a maximum. Starting from (49), and setting $\lambda_A = 0$, we get

$$\left. \frac{\partial \log(\mathcal{I}_{p_A})}{\partial \lambda_A} \right|_{\lambda_A=0} = \frac{2\kappa_B \rho^2 (1 - \kappa_A)^2 \tau_{n,A}^{-1}}{(1 - \rho^2) \kappa_A \tau_{\eta,A}^{-1} \left[\kappa_A^2 \tau_{\eta,A}^{-1} + (1 - \kappa_A)^2 \tau_{n,A}^{-1} \right]} > 0. \quad (53)$$

When (52) holds, $\lambda_A^* > 0$ and the first-order condition has a unique positive solution. Since the expression above shows that $\mathcal{I}_{p_A}$ is initially increasing in λ_A , this stationary point is a maximum.

A.5 Proof of Optimal Correlation

Starting from equation (45), the informativeness of asset A is

$$\mathcal{I}_{p_A}(\rho) = \frac{[(1 + \lambda_A a) \text{Cov}(\eta_{A,0}, x_{A,0}) + \lambda_A b \text{Cov}(\eta_{A,0}, x_{B,0})]^2}{(1 + \lambda_A a)^2 \text{Var}(x_{A,0}) + \lambda_A^2 b^2 \text{Var}(x_{B,0}) + 2(1 + \lambda_A a) \lambda_A b \text{Cov}(x_{A,0}, x_{B,0})}, \quad (54)$$

with

$$a = \frac{\kappa_A}{(1 - \kappa_A)^2 \tau_{n,A}^{-1}}, \quad b = \frac{\rho(\tau_{\eta,A} \tau_{\eta,B})^{1/2}}{1 - \rho^2},$$

and

$$\text{Cov}(\eta_{A,0}, x_{B,0}) = \kappa_B \rho(\tau_{\eta,A} \tau_{\eta,B})^{-1/2}, \quad \text{Cov}(x_{A,0}, x_{B,0}) = \kappa_A \kappa_B \rho(\tau_{\eta,A} \tau_{\eta,B})^{-1/2}.$$

As b and both covariance terms contain ρ , it follows that $\mathcal{I}_{p_A}(\rho)$ depends on ρ only through ρ^2 . Therefore, maximizing informativeness with respect to ρ is equivalent to maximizing it with respect to ρ^2 .

Taking logs and differentiating,

$$\begin{aligned} \frac{\partial \log \mathcal{I}_{p_A}(\rho^2)}{\partial \rho^2} &= 2 \frac{\partial}{\partial \rho^2} \log [(1 + \lambda_A a) \text{Cov}(\eta_{A,0}, x_{A,0}) + \lambda_A b \text{Cov}(\eta_{A,0}, x_{B,0})] \\ &\quad - \frac{\partial}{\partial \rho^2} \log [(1 + \lambda_A a)^2 \text{Var}(x_{A,0}) + \lambda_A^2 b^2 \text{Var}(x_{B,0}) + 2(1 + \lambda_A a) \lambda_A b \text{Cov}(x_{A,0}, x_{B,0})] \end{aligned} \quad (55)$$

Solving yields

$$\rho^{2*} = \frac{N}{D}, \quad (56)$$

where

$$\begin{aligned} N &= \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A^2 \kappa_B^2 \lambda_A^2 - 2 \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A^2 \kappa_B \lambda_A^2 \\ &\quad + \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A \kappa_B^2 (1 - \kappa_A)^2 \tau_{n,A}^{-1} \lambda_A \\ &\quad - 4 \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A \kappa_B (1 - \kappa_A)^2 \tau_{n,A}^{-1} \lambda_A \\ &\quad - 2 \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_B (1 - \kappa_A)^4 (\tau_{n,A}^{-1})^2 \\ &\quad + \tau_{\eta,A}^{-1} \kappa_A^2 (1 - \kappa_B)^2 \tau_{n,B}^{-1} \lambda_A^2 \\ &\quad + \tau_{\eta,A}^{-1} \kappa_A (1 - \kappa_A)^2 (1 - \kappa_B)^2 \tau_{n,A}^{-1} \tau_{n,B}^{-1} \lambda_A. \end{aligned} \quad (57)$$

and

$$\begin{aligned}
D = & \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A^2 \kappa_B^2 \lambda_A^2 - 2 \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A^2 \kappa_B \lambda_A^2 \\
& + \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A \kappa_B^2 (1 - \kappa_A)^2 \tau_{n,A}^{-1} \lambda_A \\
& - 4 \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_A \kappa_B (1 - \kappa_A)^2 \tau_{n,A}^{-1} \lambda_A \\
& - 2 \tau_{\eta,A}^{-1} \tau_{\eta,B}^{-1} \kappa_B (1 - \kappa_A)^4 (\tau_{n,A}^{-1})^2 \\
& - \tau_{\eta,A}^{-1} \kappa_A^2 (1 - \kappa_B)^2 \tau_{n,B}^{-1} \lambda_A^2 \\
& - \tau_{\eta,A}^{-1} \kappa_A (1 - \kappa_A)^2 (1 - \kappa_B)^2 \tau_{n,A}^{-1} \tau_{n,B}^{-1} \lambda_A \\
& + \tau_{\eta,B}^{-1} \kappa_B^3 (1 - \kappa_A)^2 \tau_{n,A}^{-1} \lambda_A^2 \\
& + \kappa_B (1 - \kappa_A)^2 (1 - \kappa_B)^2 \tau_{n,A}^{-1} \tau_{n,B}^{-1} \lambda_A^2.
\end{aligned} \tag{58}$$

An interior solution requires

$$0 < \frac{N}{D} < 1. \tag{59}$$

Let us prove that ρ^{2*} is a maximum. Starting from (55), and setting $\rho = 0$, we obtain

$$\left. \frac{\partial \log(\mathcal{I}_{p_A})}{\partial \rho^2} \right|_{\rho=0} = \frac{2\lambda_A \kappa_B}{(1 + \lambda_A a) \kappa_A \tau_{\eta,A}^{-1}} - \frac{\lambda_A^2 (\tau_{\eta,A} \tau_{\eta,B})^{-1} \text{Var}(x_{B,0}) + 2(1 + \lambda_A a) \lambda_A \kappa_A \kappa_B \tau_{\eta,A}^{-1}}{(1 + \lambda_A a)^2 \text{Var}(x_{A,0})}. \tag{60}$$

The sign of this derivative is ambiguous. Increasing payoff correlation improves the informativeness of asset B 's price about the payoff of asset A , but also strengthens the transmission of noise from asset B 's price into the price of asset A .

However, for sufficiently small λ_A , the first term dominates the second-order noise-transmission effect, implying

$$\left. \frac{\partial \log(\mathcal{I}_{p_A})}{\partial \rho^2} \right|_{\rho=0} > 0. \tag{61}$$

the first-order condition admits an interior solution $\rho^{2*} \in (0, 1)$. Whenever the derivative at $\rho = 0$ is positive, this stationary point corresponds a maximum.

B Endogenous Price for Asset B

B.1 Equilibrium Prices

Using the expression for arbitrage demand,

$$q_{\text{arb},0} = \xi^{-1} \Sigma_{\eta|x}^{-1} (E[\eta_0 | x_0] - (p_0 - \theta_0)),$$

and the identity

$$\Sigma_{\eta|x}^{-1} E[\eta_0 | x_0] = K' R^{-1} x_0,$$

we can write arbitrage demand as

$$q_{\text{arb},0} = \xi^{-1} \left[K' R^{-1} x_0 - \Sigma_{\eta|x}^{-1} (p_0 - \theta_0) \right]. \quad (62)$$

Market clearing for each asset is

$$Q = S(\theta_0 + x_0 - p_0) + q_{\text{arb},0}, \quad (63)$$

where

$$S = \begin{pmatrix} S_A & 0 \\ 0 & S_B \end{pmatrix}.$$

Substituting arbitrage demand gives

$$Q = S(\theta_0 + x_0 - p_0) + \xi^{-1} \left[K' R^{-1} x_0 - \Sigma_{\eta|x}^{-1} (p_0 - \theta_0) \right]. \quad (64)$$

Premultiplying by S^{-1} , we obtain

$$S^{-1}Q = \theta_0 + x_0 - p_0 + S^{-1}\xi^{-1} \left[K' R^{-1} x_0 - \Sigma_{\eta|x}^{-1} (p_0 - \theta_0) \right]. \quad (65)$$

Rearranging terms,

$$\left[I + S^{-1}\xi^{-1}\Sigma_{\eta|x}^{-1} \right] (p_0 - \theta_0) = \left[I + S^{-1}\xi^{-1}K'R^{-1} \right] x_0 - S^{-1}Q. \quad (66)$$

Since

$$S^{-1}\xi^{-1} = \begin{pmatrix} \xi^{-1}/S_A & 0 \\ 0 & \xi^{-1}/S_B \end{pmatrix} = \begin{pmatrix} \lambda & 0 \\ 0 & s\lambda \end{pmatrix}, \quad \lambda = \frac{\xi^{-1}}{S_A}, \quad s = \frac{S_A}{S_B},$$

we get

$$\left[I + \begin{pmatrix} \lambda & 0 \\ 0 & s\lambda \end{pmatrix} \Sigma_{\eta|x}^{-1} \right] (p_0 - \theta_0) = \left[I + \begin{pmatrix} \lambda & 0 \\ 0 & s\lambda \end{pmatrix} K'R^{-1} \right] x_0 - S^{-1}Q. \quad (67)$$

The last term, $S^{-1}Q$, is independent of x_0 . Since informativeness depends only on the covariance between prices and payoff innovations, this constant term can be omitted. Thus, for the informativeness analysis, the relevant equilibrium system is

$$\left[I + \begin{pmatrix} \lambda & 0 \\ 0 & s\lambda \end{pmatrix} \Sigma_{\eta|x}^{-1} \right] (p_0 - \theta_0) = \left[I + \begin{pmatrix} \lambda & 0 \\ 0 & s\lambda \end{pmatrix} K'R^{-1} \right] x_0. \quad (68)$$

Define

$$M(\lambda, s) = I + \begin{pmatrix} \lambda & 0 \\ 0 & s\lambda \end{pmatrix} \Sigma_{\eta|x}^{-1}, \quad B(\lambda, s) = I + \begin{pmatrix} \lambda & 0 \\ 0 & s\lambda \end{pmatrix} K'R^{-1}.$$

Then equilibrium prices satisfy

$$p_0 - \theta_0 = M(\lambda, s)^{-1} B(\lambda, s) x_0.$$

Since the system is linear in x_0 , the price of asset A can be written as

$$p_{A,0} = \alpha(\lambda, s) x_{A,0} + \beta(\lambda, s) x_{B,0},$$

up to a multiplicative constant that does not affect informativeness. The coefficients $\alpha(\lambda, s)$ and $\beta(\lambda, s)$ correspond to the first row of the matrix $M(\lambda, s)^{-1} B(\lambda, s)$.

B.2 Symmetric Case

I now specialize to the case where primitives are symmetric and the only asymmetry comes from price sensitivity:

$$\kappa_A = \kappa_B = \kappa, \quad \tau_{\eta,A} = \tau_{\eta,B} = \tau_{\eta}, \quad \tau_{n,A} = \tau_{n,B} = \tau_n,$$

while

$$S_A \leq S_B, \quad s = \frac{S_A}{S_B} \in [0, 1].$$

Let $\sigma^2 = \tau_{\eta}^{-1}$.

In this case, solving the system yields

$$p_{A,0} = \frac{\alpha(\lambda, s)x_{A,0} + \beta(\lambda, s)x_{B,0}}{\Delta(\lambda, s)},$$

where $\Delta(\lambda, s)$ is a scalar that does not affect informativeness, and

$$\alpha(\lambda, s) = (\kappa\lambda + (1 - \kappa)^2\tau_n^{-1}) \left[\sigma^2(1 - \rho^2)(\kappa^2 s\lambda + (1 - \kappa)^2\tau_n^{-1}) + (1 - \kappa)^2\tau_n^{-1}s\lambda \right], \quad (69)$$

$$\beta(\lambda, s) = (1 - \kappa)^2\tau_n^{-1}\rho\lambda(\kappa s\lambda + (1 - \kappa)^2\tau_n^{-1}). \quad (70)$$

The coefficient $\alpha(\lambda, s)$ captures the direct loading of the price of asset A on its own signal $x_{A,0}$, while $\beta(\lambda, s)$ captures the cross-loading on the signal $x_{B,0}$, which arises from arbitrage activity.

B.3 Equal Price Sensitivity: $s = 1$

Consider the case where primitives are symmetric and price sensitivities are equal:

$$\kappa_A = \kappa_B = \kappa, \quad \tau_{\eta,A} = \tau_{\eta,B} = \tau_{\eta}, \quad \tau_{n,A} = \tau_{n,B} = \tau_n, \quad S_A = S_B.$$

Let

$$\sigma^2 = \tau_{\eta}^{-1}, \quad \lambda = \frac{\xi^{-1}}{S_A}.$$

From the equilibrium system, the price of asset A can be written as

$$p_{A,0} = \alpha(\lambda)x_{A,0} + \beta(\lambda)x_{B,0},$$

up to a multiplicative constant that does not affect informativeness, where

$$\alpha(\lambda) = (\kappa\lambda + (1 - \kappa)^2\tau_n^{-1}) \left[\sigma^2(1 - \rho^2)(\kappa^2\lambda + (1 - \kappa)^2\tau_n^{-1}) + (1 - \kappa)^2\tau_n^{-1}\lambda \right], \quad (71)$$

$$\beta(\lambda) = (1 - \kappa)^2\tau_n^{-1}\rho\lambda(\kappa\lambda + (1 - \kappa)^2\tau_n^{-1}). \quad (72)$$

Define

$$y_{A,0} = \alpha(\lambda)x_{A,0} + \beta(\lambda)x_{B,0}.$$

Using

$$\text{Cov}(\eta_{A,0}, x_{A,0}) = \kappa\sigma^2, \quad \text{Cov}(\eta_{A,0}, x_{B,0}) = \kappa\rho\sigma^2,$$

$$\text{Var}(x_{A,0}) = \text{Var}(x_{B,0}) = \kappa^2\sigma^2 + (1 - \kappa)^2\tau_n^{-1}, \quad \text{Cov}(x_{A,0}, x_{B,0}) = \kappa^2\rho\sigma^2,$$

the informativeness of asset A is

$$\mathcal{I}_{p_A}(\lambda) = \frac{\kappa^2\sigma^4 [\alpha(\lambda) + \rho\beta(\lambda)]^2}{(\kappa^2\sigma^2 + (1 - \kappa)^2\tau_n^{-1}) [\alpha(\lambda)^2 + \beta(\lambda)^2] + 2\kappa^2\rho\sigma^2\alpha(\lambda)\beta(\lambda)}.$$

Differentiating with respect to λ , one obtains

$$\frac{\partial \mathcal{I}_{p_A}(\lambda)}{\partial \lambda} > 0 \quad \text{for all finite } \lambda \text{ when } \rho > 0,$$

and

$$\lim_{\lambda \rightarrow \infty} \frac{\partial \mathcal{I}_{p_A}(\lambda)}{\partial \lambda} = 0.$$

Thus, when price sensitivities are equal, increasing arbitrage intensity monotonically improves the informativeness of asset A . By symmetry, the same holds for asset B . There is no finite interior solution. When $\rho = 0$, informativeness does not depend on arbitrage intensity.

B.4 Pinned- B Limit: $s = 0$

When the market for asset B is infinitely elastic, arbitrage has no price impact on B . In this case,

$$\alpha(\lambda) = (1 - \kappa)^2\tau_n^{-1}\sigma^2(1 - \rho^2)(\kappa\lambda + (1 - \kappa)^2\tau_n^{-1}), \quad \beta(\lambda) = (1 - \kappa)^4\tau_n^{-2}\rho\lambda.$$

The informativeness is obtained from

$$y_{A,0} = \alpha(\lambda)x_{A,0} + \beta(\lambda)x_{B,0},$$

using the same covariance structure as above.

The first-order condition

$$\frac{\partial \mathcal{I}_{p_A}(\lambda)}{\partial \lambda} = 0$$

yields

$$\lambda^* = \frac{(1 - \kappa)^2 \tau_n^{-1} \tau_\eta^{-1} (1 - \rho^2)}{(1 - \kappa) [(1 - \kappa) \tau_n^{-1} - \kappa \tau_\eta^{-1} (1 - \rho^2)]}.$$

This solution is positive when

$$(1 - \kappa) \tau_n^{-1} > \kappa \tau_\eta^{-1} (1 - \rho^2).$$

When this condition holds, arbitrage first increases informativeness by incorporating information from asset B , but for sufficiently large λ , the transmission of noise dominates and informativeness decreases. Hence there is a finite interior optimum. This optimum is, however, in general only a local maximum, as for sufficiently large λ arbitrage affects both prices more symmetrically, which can restore informativeness and prevent the interior point from being a global maximum.

B.5 Persistence of the Interior Solution for Finite S_B

Let

$$F(\lambda, s) \equiv \frac{\partial \mathcal{I}_{p_A}(\lambda, s)}{\partial \lambda}. \quad (73)$$

The function $\mathcal{I}_{p_A}(\lambda, s)$ is continuous in (λ, s) whenever its denominator is non-zero. Therefore, $F(\lambda, s)$ is also continuous whenever the denominator of $\mathcal{I}_{p_A}(\lambda, s)$ is non-zero.

Persistence from the pinned- B case. Suppose the pinned- B condition holds:

$$(1 - \kappa) \tau_n^{-1} > \kappa \tau_\eta^{-1} (1 - \rho^2). \quad (74)$$

Then $F(\lambda, 0)$ changes sign. It is positive for small λ , and negative for larger λ . By continuity, this sign change persists for all $s > 0$ sufficiently close to zero. Hence there

exists a finite $\lambda^*(s) > 0$ such that

$$F(\lambda^*(s), s) = 0. \quad (75)$$

Thus, an interior local maximum exists for finite S_B , provided S_B is sufficiently large relative to S_A .

A sufficient condition for general $s < 1$. I now derive a sufficient condition under which the derivative becomes negative for some positive λ . This gives a sufficient condition for an interior local maximum.

Define

$$\nu = (1 - \kappa)^2 \tau_n^{-1}, \quad v = \tau_\eta^{-1}, \quad d = 1 - \rho^2. \quad (76)$$

From the symmetric-price system,

$$y_{A,0} = \alpha(\lambda, s)x_{A,0} + \beta(\lambda, s)x_{B,0}, \quad (77)$$

with

$$\alpha(\lambda, s) = (\kappa\lambda + \nu) [vd(\kappa^2 s\lambda + \nu) + \nu s\lambda], \quad (78)$$

and

$$\beta(\lambda, s) = \nu\rho\lambda(\kappa s\lambda + \nu). \quad (79)$$

The key difference between the cases $s = 1$ and $s = 0$ is the term

$$\nu s\lambda. \quad (80)$$

When $s = 1$, this term is fully present in $\alpha(\lambda, s)$. When $s = 0$, it disappears. This term captures the reciprocal adjustment of the benchmark price. When both prices are equally elastic, arbitrage moves both prices symmetrically. When B is pinned, this reciprocal adjustment disappears, and the price of asset A is pulled toward the benchmark signal $x_{B,0}$ without a corresponding adjustment of $p_{B,0}$ toward $x_{A,0}$.

The informativeness of asset A is

$$\mathcal{I}_{p_A}(\lambda, s) = \frac{\text{Cov}(\eta_{A,0}, y_{A,0})^2}{\text{Var}(y_{A,0})}. \quad (81)$$

Using

$$\text{Cov}(\eta_{A,0}, x_{A,0}) = \kappa\tau_\eta^{-1}, \quad \text{Cov}(\eta_{A,0}, x_{B,0}) = \kappa\rho\tau_\eta^{-1}, \quad (82)$$

$$\text{Var}(x_{A,0}) = \text{Var}(x_{B,0}) = \kappa^2\tau_\eta^{-1} + (1 - \kappa)^2\tau_n^{-1}, \quad (83)$$

and

$$\text{Cov}(x_{A,0}, x_{B,0}) = \kappa^2\rho\tau_\eta^{-1}, \quad (84)$$

we obtain

$$\text{Cov}(\eta_{A,0}, y_{A,0}) = \kappa\tau_\eta^{-1} [\alpha(\lambda, s) + \rho\beta(\lambda, s)], \quad (85)$$

and

$$\begin{aligned} \text{Var}(y_{A,0}) &= [\kappa^2\tau_\eta^{-1} + (1 - \kappa)^2\tau_n^{-1}] [\alpha(\lambda, s)^2 + \beta(\lambda, s)^2] \\ &\quad + 2\kappa^2\rho\tau_\eta^{-1}\alpha(\lambda, s)\beta(\lambda, s). \end{aligned} \quad (86)$$

Therefore,

$$\mathcal{I}_{p_A}(\lambda, s) = \frac{\kappa^2\tau_\eta^{-2} [\alpha(\lambda, s) + \rho\beta(\lambda, s)]^2}{[\kappa^2\tau_\eta^{-1} + (1 - \kappa)^2\tau_n^{-1}] [\alpha(\lambda, s)^2 + \beta(\lambda, s)^2] + 2\kappa^2\rho\tau_\eta^{-1}\alpha(\lambda, s)\beta(\lambda, s)}. \quad (87)$$

Taking logs gives

$$\log \mathcal{I}_{p_A}(\lambda, s) = \log(\kappa^2\tau_\eta^{-2}) + 2 \log [\alpha(\lambda, s) + \rho\beta(\lambda, s)] - \log (\text{Var}(y_{A,0})). \quad (88)$$

Differentiating with respect to λ ,

$$\frac{\partial \log \mathcal{I}_{p_A}(\lambda, s)}{\partial \lambda} = 2 \frac{\alpha_\lambda(\lambda, s) + \rho\beta_\lambda(\lambda, s)}{\alpha(\lambda, s) + \rho\beta(\lambda, s)} - \frac{\partial_\lambda \text{Var}(y_{A,0})}{\text{Var}(y_{A,0})}. \quad (89)$$

After multiplying by the strictly positive denominator, the sign of the derivative is the sign of a cubic polynomial:

$$P_s(\lambda) = A_3\lambda^3 + A_2\lambda^2 + A_1\lambda + A_0. \quad (90)$$

The coefficients are

$$\begin{aligned} A_3 &= \kappa s \left[\kappa\tau_\eta^{-1}(1 - \rho^2)(2s + 1) \right. \\ &\quad \left. - (1 - s) \left((1 - \kappa)^2\tau_n^{-1} + \kappa^2\tau_\eta^{-1}(1 - \rho^2) \right) \right]^2, \end{aligned} \quad (91)$$

$$\begin{aligned}
A_2 &= 3\kappa s \tau_\eta^{-1} (1 - \rho^2) (1 - \kappa)^2 \tau_n^{-1} \\
&\times \left[\kappa \tau_\eta^{-1} (1 - \rho^2) \right. \\
&\quad \left. - (1 - s) \left((1 - \kappa)^2 \tau_n^{-1} + \kappa^2 \tau_\eta^{-1} (1 - \rho^2) \right) \right],
\end{aligned} \tag{92}$$

$$\begin{aligned}
A_1 &= \tau_\eta^{-1} (1 - \rho^2) (1 - \kappa)^4 (\tau_n^{-1})^2 \\
&\times \left[\kappa \tau_\eta^{-1} (1 - \rho^2) (2s + 1) \right. \\
&\quad \left. - (1 - s) \left((1 - \kappa)^2 \tau_n^{-1} + \kappa^2 \tau_\eta^{-1} (1 - \rho^2) \right) \right],
\end{aligned} \tag{93}$$

and

$$A_0 = (1 - \rho^2)^2 (1 - \kappa)^6 (\tau_n^{-1})^3 (\tau_\eta^{-1})^2. \tag{94}$$

Since

$$A_0 > 0, \tag{95}$$

we have

$$P_s(0) > 0. \tag{96}$$

Therefore, arbitrage initially increases informativeness.

A sufficient condition for the derivative to become negative at some positive λ is that there exists $\lambda > 0$ such that

$$P_s(\lambda) < 0. \tag{97}$$

Substituting the coefficients yields the primitive condition

$$\begin{aligned}
&\kappa s \left[\kappa \tau_\eta^{-1} (1 - \rho^2) (2s + 1) \right. \\
&\quad \left. - (1 - s) \left((1 - \kappa)^2 \tau_n^{-1} + \kappa^2 \tau_\eta^{-1} (1 - \rho^2) \right) \right]^2 \lambda^3 \\
&+ 3\kappa s \tau_\eta^{-1} (1 - \rho^2) (1 - \kappa)^2 \tau_n^{-1} \\
&\quad \times \left[\kappa \tau_\eta^{-1} (1 - \rho^2) \right. \\
&\quad \left. - (1 - s) \left((1 - \kappa)^2 \tau_n^{-1} + \kappa^2 \tau_\eta^{-1} (1 - \rho^2) \right) \right] \lambda^2 \\
&+ \tau_\eta^{-1} (1 - \rho^2) (1 - \kappa)^4 (\tau_n^{-1})^2 \\
&\quad \times \left[\kappa \tau_\eta^{-1} (1 - \rho^2) (2s + 1) \right. \\
&\quad \left. - (1 - s) \left((1 - \kappa)^2 \tau_n^{-1} + \kappa^2 \tau_\eta^{-1} (1 - \rho^2) \right) \right] \lambda \\
&+ (1 - \rho^2)^2 (1 - \kappa)^6 (\tau_n^{-1})^3 (\tau_\eta^{-1})^2 < 0.
\end{aligned} \tag{98}$$

Since $P_s(0) > 0$, condition (98) implies that the derivative becomes negative for some positive λ . By continuity, $F(\lambda, s)$ must therefore cross zero from above. Hence,

$$F(\lambda, s) = \frac{\partial \mathcal{I}_{p_A}(\lambda, s)}{\partial \lambda} \quad (99)$$

changes sign from positive to negative, and $\mathcal{I}_{p_A}(\lambda, s)$ admits an interior local maximum.

This condition cannot hold when $s = 1$. In that case, the reciprocal-adjustment term

$$(1 - \kappa)^2 \tau_n^{-1} s \lambda \quad (100)$$

is fully present in $\alpha(\lambda, s)$, and arbitrage affects both prices symmetrically. Informativeness therefore increases monotonically with λ .

When $s < 1$, however, the reciprocal adjustment becomes weaker. As $s \rightarrow 0$, the benchmark price becomes increasingly pinned, and arbitrage pulls the price of asset A toward the benchmark signal $x_{B,0}$ without a corresponding adjustment of $p_{B,0}$ toward $x_{A,0}$. This asymmetry allows excessive arbitrage to reduce informativeness. Moreover, the condition becomes easier to satisfy when benchmark noise τ_n^{-1} increases. A noisier benchmark transmits more noise to the less elastic asset, strengthening the negative effect of excessive arbitrage.

The condition in (98) can hold for economically reasonable primitives. For example, when

$$\kappa = 0.5, \quad \rho = 0.8, \quad \tau_\eta^{-1} = 1, \quad \tau_n^{-1} = 1, \quad s = 0.1,$$

the derivative polynomial becomes negative for intermediate values of λ , implying the existence of an interior local maximum. The mechanism becomes stronger when benchmark noise increases. For instance, keeping all other parameters unchanged but setting

$$\tau_n^{-1} = 5,$$

the derivative becomes negative for smaller values of λ . These examples illustrate that the interior solution is not a knife-edge phenomenon. It arises for plausible levels of payoff correlation and benchmark noise whenever the benchmark market is sufficiently more elastic than the local market.

Role of noise asymmetry. The mechanism is strengthened when the more elastic asset is also more exposed to noise. In that case, arbitrage transmits a larger amount of noise from the benchmark price to the less elastic asset. This amplifies the negative effect of excessive arbitrage and makes condition (98) easier to satisfy.