READING TEA LEAVES: BENEFITS AND COSTS OF LEARNING ABOUT FUTURE DEMAND SHOCKS

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Introduction

This paper studies how learning about future demand shocks affects investor behavior and market outcomes. Under the noisy rational expectations equilibrium (NREE) framework, I show that with extra access to information about future demand shocks, investors learn less about current dividend and demand shocks, and allocate more precision to signals about future demand shocks via the front-running channel and a new *future uncertainty channel*.

The front-running channel suggests that if investors learn that the future demand is high (low), they would buy (sell) assets today so that they can sell (buy) in the future, while the future uncertainty channel works on two levels: on the aggregate level, market-wise dividend information acquisition decreases, which makes dividends riskier and leads to higher risk premia; on the individual level, information acquisition on future demand shocks decreases the conditional variance of future excess payoffs. Thus the investor's *ex ante* utility improves.

I also show that price volatility increases due to more heterogeneous private information, and that learning about future demand shocks makes price more informative in the future but less informative in the present.

Contribution

This paper contributes to the NREE literature:

	Current	Future
Fundamental Shocks	Verrecchia (1982) Van Nieuwerburgh and Veldkamp (2010) Goldstein and Yang (2015, 2019)	Cai (2017)
Demand Shocks	Medrano and Vives (2004) Ganguli and Yang (2009)	This paper

The macroeconomic literature usually treats news shock as signals about future fundamentals, (e.g., Jaimovich and Rebelo, 2009). This paper complements it by highlighting the importance of learning about future demand shocks. The front-running channel also echos with the general idea in Beaudry and Portier (2014).

This paper also contributes to the literature on high frequency traders (HFT). Empirical evidence has shown that HFTs predict order flows (Hirschey, 2018) or price changes (Harris and Saad, 2014), which can be mapped into acquiring a signal for future demand shocks in this paper. This paper finds that with access to information about future demand shocks, investors are better off, which is consistent with Jovanovic and Menkveld (2017) who empirically find a moderately positive welfare effect.

Model

Standard CARA-normal competitive market noisy rational expectations equilibrium (NREE) model with:

Asset:

- A risk-free asset with return r.
- A single tradable risky asset with time-t payoff $\alpha p_{t+1} + \tilde{d}_t$, where $\tilde{d}_t = \mu + g d_{t-1} + \tilde{y}_t$.
- Demand shocks $\tilde{x}_t$ are modeled as shocks to asset supply $\bar{x}$. $\alpha = 0$, static model; $\alpha = 1$, dynamic.

Three private signals:

- Signal about current fundamental shock: $\tilde{\eta}^y_{it} = \tilde{\boldsymbol{y}}_{\boldsymbol{t}} + \tilde{\epsilon}^y_{it}$.
- Signal about current demand shock: $\tilde{\eta}^x_{it} = \tilde{\boldsymbol{x}}_{\boldsymbol{t}} + \tilde{\epsilon}^x_{it}$.
- **Signal about future demand shock**: $\tilde{\xi}^x_{it} = \tilde{\boldsymbol{x}}_{\boldsymbol{t+1}} + \tilde{\nu}^x_{it}$.

OLG investors:

- live for two periods and maximize terminal wealth;
- choose *signal precision* $\tau_{\epsilon yt}$, $\tau_{\epsilon xt}$ and $\tau_{\nu xt}$ subject to linear information capacity constraint $\gamma_{\epsilon y}\tau_{\epsilon yt} + \gamma_{\epsilon x}\tau_{\epsilon xt} + \gamma_{\nu x}\tau_{\nu xt} = K$ (or a convex constraint);
- make portfolio choices q_{it} and q_{it+1} subject to budget constraint $\tilde{W}_{it+1} = r^2 W_0 + r q_{it}\left(\tilde{d}_t + \alpha p_{t+1} - p_t r\right) + q_{it+1}\left(\tilde{d}_{t+1} + \alpha p_{t+2} - p_{t+1} r\right)$.

Equilibrium price:

- Guess and verify: $p_t r = A_t + B d_{t-1} + C_t \tilde{y}_t + D_t \tilde{x}_t$.

Analytical Results: Static Model

To see how the novel future uncertainty channel works more clearly, I study the static model and set $\alpha = 0$ to shut down the front-running channel.
Under the assumption of equal information acquisition costs, in period t, $\mathcal{G}_{t-1}$-investors (a) optimally choose not to learn about future demand shocks, that is $\hat{\tau}_{\nu xit} = 0$; and (b) only learn about current dividend innovation regardless of the realization of signal about $\tilde{x}_t$ they received in the previous period, that is $\hat{\tau}_{\epsilon yit} = \frac{K}{\gamma_{\epsilon y}}$ and $\hat{\tau}_{\epsilon xit} = 0$. $\mathcal{G}_t$-investors optimally choose to only learn about future demand shocks, that is $\tau_{\epsilon yt} = \tau_{\epsilon xt} = 0$ and $\tau_{\nu xt} = \frac{K}{\gamma_{\nu x}}$.
The following theorems summarize the main results on price informativeness, price volatility and *ex ante* utility in the static model.

THEOREM 1 (Price informativeness): *Price informativeness decreases with access to information about future demand shocks.*

THEOREM 2 (Price volatility): *The price volatility $\mathbb{V}ar(p_t)$ changes with information processing capacity K. Given that $\frac{\partial|\zeta_t|}{\partial K} > 0$:*

(a) if $\tau_x \geq \bar{\Omega}_x$, then $\frac{\partial \mathbb{V}ar(p_t)}{\partial K} \geq 0$;
(b) if $\underline{\Omega}_x < \tau_x < \bar{\Omega}_x$, then

$$\frac{\partial \mathbb{V}ar(p_t)}{\partial K}\begin{cases} \geq 0, & \text{if } \zeta_t \leq \underline{\zeta}_t \text{ or } \bar{\zeta}_t \leq \zeta_t < 0, \\ < 0, & \text{if } \underline{\zeta}_t < \zeta_t < \bar{\zeta}_t; \end{cases}$$

(c) If $0 < \tau_x \leq \underline{\Omega}_x$, then

$$\frac{\partial \mathbb{V}ar(p_t)}{\partial K}\begin{cases} \geq 0, & \text{if } \zeta_t \leq \underline{\zeta}_t, \\ < 0, & \text{if } \underline{\zeta}_t < \zeta_t < 0; \end{cases}$$

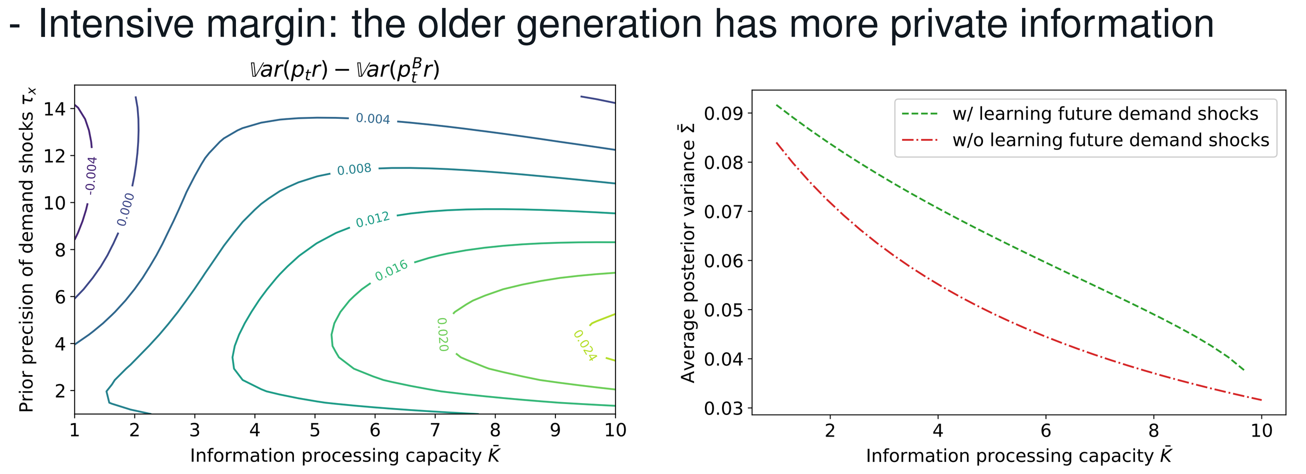
THEOREM 3: *With access to information about future demand shocks, the ex ante utility for the young generation is improved, while the ex ante utility of the old generation is improved when K, τ_x and $\gamma_{\epsilon x} = \gamma_{\nu x}$ are smaller than some boundaries.*

Numerical Results: Dynamic Model

The results of the static model can be extended to the dynamic model, as is confirmed by the following numerical exercises. The following results compare the dynamic model with the case where learning about the future is not possible.

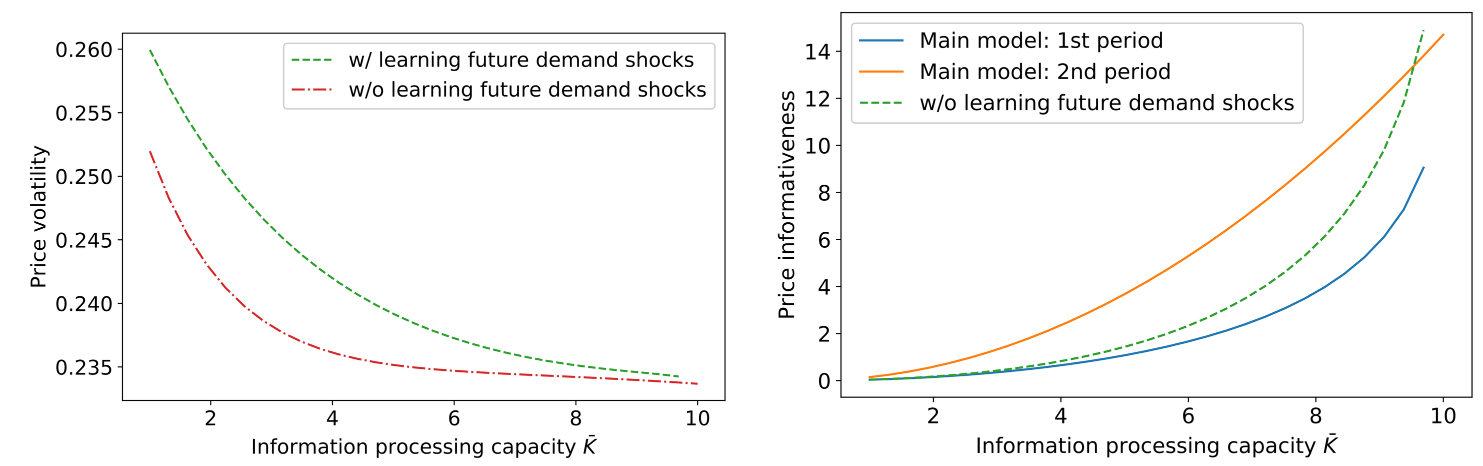
Result 1: Heterogeneous private information increases price volatility.

- Extensive margin: two co-existing generations become different
- Intensive margin: the older generation has more private information



Result 2: Less fundamental information acquisition leads to higher risk Premium

- Less fundamental information acquisition $\Longrightarrow$ average posterior variance of fundamental shocks, $\bar{\Sigma}$, is **larger** $\Longrightarrow$ higher risk premium.

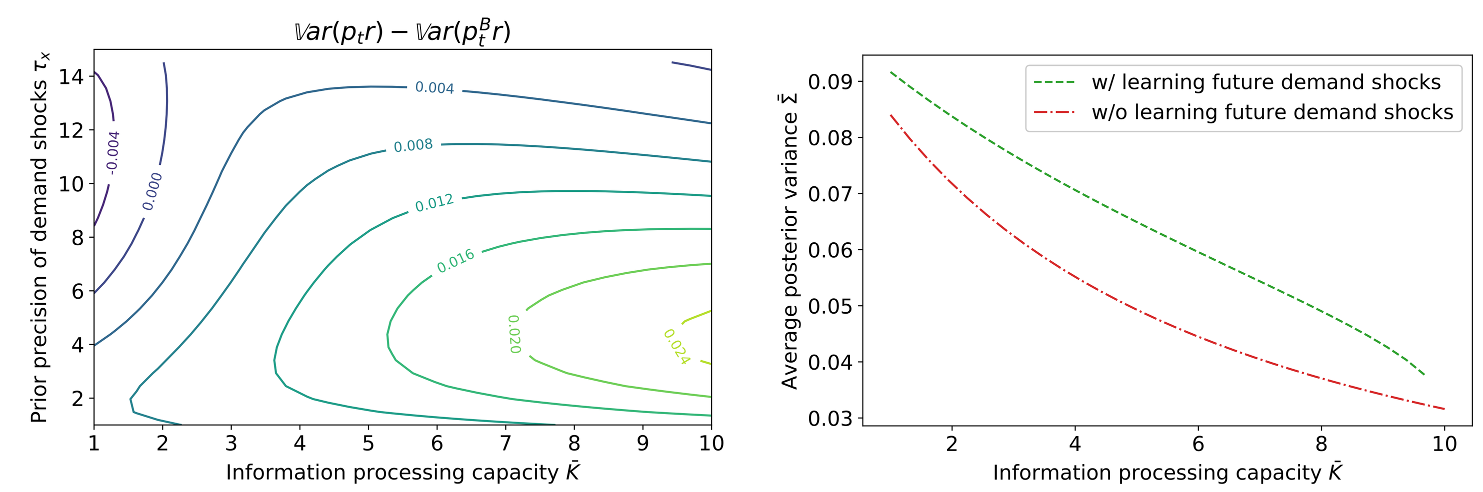


Result 3: Price informativeness decreases in the first period and increases in the second period.

- In the second period, price is more informative for the investor because she has required a signal about second-period demand shocks in her first period. Although the price contains less fundamental information, her ability to extract other investors' private information out of the equilibrium price is higher, and the latter effect dominates.
- While in the first period, her ability to extract information from price is not changed. Since price contains less fundamental information, it is less informative for her.

Result 4: The *ex ante* utility improves through the future uncertainty channel.

- Aggregate level: higher risk premium
- Individual level: taking less risk in the second period



Empirical Application

This model can be applied to a broad range of real-world scenarios where investors are able to learn about future demand shocks. I discuss the BGI transaction here.

BlackRock, Inc. acquired Barclays Global Investors (BGI), including iShares in 2009. BlackRock struck the deal to "broaden the firm's investment capability with passive and quantitative investment strategies, particularly exchange-traded funds." Observing the news of the completion of the BGI transaction on Dec 1, sophisticated investors expect the iShares AUM to expand in the following years. For the component stocks of iShares ETFs, these are future demand shocks that are not related to their firm fundamentals.

In 2009, around 25% of iShares' net assets were concentrated on iShares Core S&P 500 ETF. I then look at the share prices of S&P 500 component firms and non-S&P firms around the BGI announcement. Adding year fixed effect and controlling for the total asset size, GDP growth, risk measures, book-to-market ratio and past returns, the share prices of the S&P component firms increase 5 percentage points in in the 2 years following the BGI transaction compared with non-S&P firms, of which around 50% can be explained by the front-running channel and 20% by the future uncertainty channel.

References

Beaudry, Paul, and Franck Portier, 2014, News-driven business cycles: Insights and challenges, *Journal of Economic Literature* 52, 993–1074.
Cai, Zhifeng, 2017, *Essays on macroeconomics and finance*, Ph.D. thesis, University of Minnesota.
Ganguli, Jayant Vivek, and Liyan Yang, 2009, Complementarities, multiplicity, and supply information, *Journal of the European Economic Association* 7, 90–115.
Goldstein, Itay, and Liyan Yang, 2015, Information diversity and complementarities in trading and information acquisition, *The Journal of Finance* 70, 1723–1765.
Goldstein, Itay, and Liyan Yang, 2019, Good disclosure, bad disclosure, *Journal of Financial Economics* 131, 118–138.
Harris, Jeffrey H, and Mohsen Saad, 2014, The sound of silence, *Financial Review* 49, 203–230.
Hirschey, Nicholas, 2018, Do high-frequency traders anticipate buying and selling pressure?, Technical report, Available at SSRN 2238516.
Jaimovich, Nir, and Sergio Rebelo, 2009, Can news about the future drive the business cycle?, *American Economic Review* 99, 1097–1118.
Jovanovic, Boyan, and Albert J Menkveld, 2017, Dispersion and skewness of bid prices, Technical report, Available at SSRN 2463066.
Medrano, Luis Angel, and Xavier Vives, 2004, Regulating insider trading when investment matters, *Review of Finance* 8, 199–277.