Salience and Asset Prices[†]

By Pedro Bordalo, Nicola Gennaioli, and Andrei Shleifer[*]

In Bordalo, Gennaioli, and Shleifer (2012a)—henceforth, BGS (2012a)—we described a new approach to choice under risk that we called salience theory. In comparisons of risky lotteries, we argued, individuals' attention is drawn to those payoffs which are most different or salient relative to the average. In making choices, individuals overweight these salient payoffs relative to their objective probabilities. A simple formalization of such salience-based probability weighting provides an intuitive account of a variety of puzzling evidence in decision theory, such as Allais paradoxes and preference reversals.

Salience theory naturally lends itself to the analysis of the demand for risky assets. After all, risky assets are lotteries evaluated in a context described by the alternative investments available in the market. An asset's salient payoff is naturally defined as one most different from the average market payoff in a given state of the world. We present a simple model of investor choice and market equilibrium in which salience influences the demand for risky assets. This model accounts for several time series and cross-sectional puzzles in finance in an intuitive way, based on its key implication that extreme payoffs receive disproportionate weight in the market valuation of assets.

We focus on four well known puzzles. First, salient thinking leads to a preference for assets characterized by the possibility of high, salient payoffs that are overweighted by investors. One type of such assets are those exhibiting positive skewness. Barberis (2013) summarizes considerable evidence that investors in fact overvalue such assets. Second, our theory helps explain the growth-value puzzle: growth stocks are overpriced in the market because they have large salient upsides, while value stocks are underpriced because they have salient downsides such as bankruptcy. Third, the model delivers a preference for safe assets over risky ones because, under the diminishing sensitivity property of salience introduced in BGS (2012a), investors focus on downside risks more than on equal-sized upside risks, leading to an undervaluation of risky assets. The model thus generates an equity premium (Mehra and Prescott 1985). Fourth, our theory predicts countercyclical variation in aggregate stock market returns. In bad times, the risky asset's downside relative to the safe asset is salient, and, hence, the risky asset is underpriced. Conversely, in good times its upside is salient, leading to overvaluation and low expected returns. The logic of time-varying expected returns is captured naturally in our model, because all we need is that investors focus on payoffs that are extreme relative to the safe asset.

Our model shares some predictions with approaches to asset pricing based on Prospect Theory (Kahneman and Tversky 1979), such as Barberis and Huang (2008) and Barberis, Huang, and Santos (2001). We compare the two approaches after presenting the model.

Bordalo: Royal Holloway, University of London, Economics Department, Egham Hill, Egham, TW20 0EX, UK (e-mail: pedro.bordalo@rhul.ac.uk); Gennaioli: Universita Bocconi, Department of Finance, Via Roentgen 1, Milan, Italy (e-mail: nicola.gennaioli@unibocconi.it); Shleifer: Harvard University, Economics Department, Littauer Center, 1805 Cambridge Street, Cambridge, MA 02138 USA (e-mail: shleifer@fas.harvard.edu). We are grateful to Nicholas Barberis, John Campbell, Robin Greenwood, Alp Simsek, Josh Schwartzstein, and Jeremy Stein for extremely helpful comments.

† To view additional materials, and author disclosure statement(s),visit the article page at http://dx.doi.org/10.1257/aer.103.3.623.

I. Asset Payoffs and Salience Weighting

There are two periods $t = 0, 1$ and a measure 1 of identical investors. Each investor has a linear utility function defined over consumption (c_0, c_1) in the two periods. Risk aversion plays no role in our analysis, and neither does time discounting. At $t = 0$, each investor receives an endowment w_0 of the consumption good, as well as one unit of each one of the $J > 1$ available assets $j = 1, \ldots, J$. At $t = 1$, there are S states

of nature $s = 1, \ldots, S$, each occurring with probability π_s, with $\sum_{s=1}^{S} \pi_s = 1$. Asset j pays dividend x_{js} in state $s \in S$ at $t = 1$.

Take a generic asset j. The salience of its payoff x_{js} depends on how x_{js} compares to the average market payoff $x_s = \sum_j x_{js}/J$ delivered by all the available assets in the same state s. Salience is thus defined within the "narrow frame" of objective asset payoffs and does not depend on investor-specific attributes such as own portfolio or wealth. Specifically, the salience function $\sigma(x_{js}, x_s)$ satisfies two properties: (i) ordering: if interval $[x, y]$ is contained in a larger interval $[x', y']$, then $\sigma(x, y) < \sigma(x', y')$; (ii) diminishing sensitivity: for all $x, y > 0$ and any $\epsilon > 0$, $\sigma(x, y) > \sigma(x + \epsilon, y + \epsilon)$. Following BGS (2012b), we balance these two properties by using a salience function that is symmetric and homogenous of degree zero: $\sigma(\alpha x, \alpha y) = \sigma(x, y)$ for any $\alpha > 0$, with $\sigma(0, 0) = 0$. This implies that salience is an increasing function of the percentage difference between x and y, consistent with Weber's law. An example of a salience function satisfying these properties is $\sigma(x, y) = |x - y|/(x + y)$, where $x, y > 0$.

The payoff x_{js} that asset j pays in state s is more salient than the payoff $x_{js'}$ it pays in state s' if and only if $\sigma(x_{js}, x_s) > \sigma(x_{js'}, x_{s'})$. Denote by r_{js} the salience ranking of x_{js}, which ranges from 1 (most salient) to S (least salient). In his valuation of asset j, the investor weights payoff x_{js} by $\omega_{js} = \delta^{r_{js}}/\sum_{s'} \pi_{s'} \delta^{r_{js'}}$. Here $\delta \in (0, 1]$ captures the degree to which the investor neglects nonsalient payoffs. If $\delta = 1$, the weight ω_{js} is equal to 1 for all s. This is the case of a rational investor. If instead $\delta < 1$, the investor overweights salient payoffs at the expense of the nonsalient ones.

If an investor trades an amount α_j of each asset j, his expected utility at $t = 0$ is

$$(1) \quad \left(w_0 - \sum_j \alpha_j \cdot p_j \right) +$$

$$\sum_s \pi_s \left(\sum_j (\alpha_j + 1) \cdot \omega_{js} \cdot x_{js} \right).$$

The first term in equation (1) is the first-period consumption, which equals the investor's wealth minus the expenditure on assets. The second term in equation (1) is the expected value of the salience-weighted portfolio return (where $\alpha_j + 1$ is the endowment of asset j plus any extra amount bought or sold by the investor).

As in the Lucas (1978) tree model, an equilibrium consists of: (i) optimal buying decisions α_j by all investors, which come from maximizing equation (1), and (ii) market equilibrium $\alpha_j = 0$, for all j. The first-order condition combined with market equilibrium yields the price of each asset j:

$$(2) \quad p_j = \mathbb{E}[\omega_{js} \cdot x_{js}] = \mathbb{E}[x_{js}] + \text{cov}[\omega_{js}, x_{js}].$$

The price of asset j is equal to the expected value of its future payoff x_{js} plus the covariance between payoffs and salience weights. If $\delta = 1$, there are no salience distortions, namely $\omega_{js} = 1$ for all x_{js}. In this case, $\text{cov}[\omega_{js}, x_{js}] = 0$, and the price of each asset j is its expected payoff $\mathbb{E}[x_{js}]$, the rational price. Since investors are risk neutral and do not discount the future, each risky asset yields a return equal to the interest rate of 1.

When $\delta < 1$, each asset j commands a risk premium equal to $-\text{cov}[\omega_{js}, x_{js}]$. When the lowest payoffs of an asset are the salient ones, namely $\text{cov}[\omega_{js}, x_{js}] < 0$, the investor focuses on downside risks and demands a positive risk premium. When the highest payoffs are the salient ones, namely $\text{cov}[\omega_{js}, x_{js}] > 0$, the investor focuses on the asset's upside potential, and the risk premium is negative.

Equation (2) has several implications. First, if the asset's payoffs are proportional to those on the market portfolio, its price is "rational." An asset is misvalued only to the extent that it delivers unusually salient payoffs in some states. Formally, when $x_{js} = \lambda \cdot x_s$, with $\lambda > 0$ for all states s, all states are equally salient, $\omega_{js} = 1$, and $\text{cov}[\omega_{js}, x_{js}] = 0$.

Second, although in equilibrium the investor holds the market portfolio, prices depend on each asset's idiosyncratic risk. To see this clearly, suppose that there is no aggregate risk, namely, $x_s = x$ in all states s. Any asset j then commands a risk premium due to idiosyncratic differences between its payoff x_{js} and the market payoff x. This phenomenon arises from a type of "narrow framing": salience is shaped by the payoffs of individual assets, not by the investor's portfolio. When thinking about buying an extra share of Facebook stock, investors focus on the billion users and potential extraordinary profits, and not on its impact on the payoff of the overall portfolio.

Third, an investor's willingness to pay for an asset is context dependent. Holding constant the payoff distribution of an asset j, the investor's willingness to pay for it depends on the payoff distribution of the market $(x_s)_{s \in S}$, and not (just) on the investor's own portfolio. Changes in background context affect the salience of an asset's payoffs and, thus, its price.

The implication that idiosyncratic risk affects security valuations is consistent with a good deal of empirical evidence (Barberis 2013, Boyer, Mitton, and Vorkink 2010). The intuition is straightforward and plausible: investors think about individual assets, focus on their upsides and downsides, and value them according to what draws their attention. The next question is exactly what this implies for cross-sectional patterns of asset pricing.

II. Taste for Skewness and the Growth-Value Puzzle

Suppose that there are three states of nature, $s = 1, 2, 3$, and that the market has no aggregate risk, so that its payoff is $x_s = x$ in all states. Asset j delivers a high payoff, $x_{j1} = x + G$, in state 1, the market payoff $x_{j2} = x$ in state 2, and a low payoff $x_{j3} = x - L$ in state 3. For simplicity, assume that $\pi_1 G = \pi_3 L$. The expected payoff of the asset, and, thus, its rational price, is then equal to $p_j = x$.

For our investor, the salience of x_{js} depends on how this payoff compares to the market payoff x. The upside is more salient than the downside when $\sigma(x + G, x) > \sigma(x - L, x)$. From homogeneity of degree zero of the salience function σ, this holds if and only if $(x + G)(x - L) > x^2$, or

$$(3) \qquad G > \frac{L}{1 - L/x}.$$

The upside of asset j is likely to be salient if j features a large gain G (with a low probability) and a small loss L (with a high probability) relative to its average payoff x. Keeping x fixed, condition (3) holds provided G is sufficiently higher than L. As the level of all payoffs x rises, diminishing sensitivity becomes weaker and the salience of payoffs is determined by the ordering property. In the limit, if $G > L$ the investor focuses on the asset's upside.

The salience ranking pins down the payoff weights ω_{j1}, ω_{j2}, ω_{j3}. Given these weights, and

under the assumption that $\pi_1 G = \pi_3 L$, the price of the asset is given by

$$(4) \qquad p_j = x + \pi_1 G \cdot [\omega_{j1} - \omega_{j3}].$$

Whether salient thinking causes the asset to be over- or underpriced relative to its rational value x depends on whether condition (3) holds. When (3) holds, the high payoff $x + G$ is salient, $\omega_{j1} > \omega_{j3}$, and the asset is overpriced: investors overweight the opportunity of obtaining the high payoff $x + G$. When condition (3) is violated, the asset's low payoff $x - L$ is salient. Now $\omega_{j3} > \omega_{j1}$ and the asset is underpriced. Investors overweight the risk of obtaining the low payoff $x - L$.

This mechanism provides insight into the well-known empirical finding (Fama and French 1992; Lakonishok, Shleifer, and Vishny 1994) that value stocks—those with low stock market prices relative to measures of "fundamentals" such as assets or earnings—earn higher average returns than growth stocks—those with high market prices relative to measures of fundamentals. In our model, asset j fits the description of a "value stock" if it delivers a small upside G with high probability π_1 and a big downside L, such as bankruptcy, with a low probability π_3 (recall that $\pi_1 G = \pi_3 L$). In this case, condition (3) does not hold. As a consequence, the investor magnifies the downside risk of the value stock, $\omega_{j3} > \omega_{j1}$, so that by equation (4) the asset is underpriced. Alternatively, asset j is a "growth stock" if it yields a big upside G with a low probability π_1 and a small downside L with a high probability π_3. In this case, if condition (3) holds, the investor thinks of the growth stock as an opportunity to obtain a large windfall, partly neglecting the fact that the growth stock has a sizable objective probability of a low payoff. From equation (4) such an asset is overpriced. In sum, in our model growth stocks are overvalued because, in contrast to value stocks, they have the possibility of delivering a very high payoff (becoming the next Google). In focusing on the role of payoffs (as opposed to probabilities), condition (3) differs from (in fact is stronger than) positive skewness.

This implication of the model is consistent with the empirical evidence we already mentioned, but it goes further. Fama and French (1992) conjecture that value stocks earn higher average returns because they are disproportionately exposed to a separate risk factor, which they call distress risk. Subsequent research, however,

failed to find evidence that value stocks are particularly risky. Campbell, Hilscher, and Szilagyi (2008) find that stocks of companies vulnerable to the risk of bankruptcy if anything earn lower average returns, contrary to the Fama-French view that "value" reflects bankruptcy risk. In our model, value stocks are not fundamentally riskier, but the possibility of their bankruptcy is salient to investors, causing undervaluation. In contrast, growth stocks may themselves have a high risk of bankruptcy, but it is their greater upside that attracts investors' attention, causing overvaluation. The model thus puts together the Fama-French intuition that investors fear bankruptcy of value stocks with the observation that this possibility is salient and, thus, exaggerated.

More generally, this example shows that the extent to which certain asset payoffs "stand out" relative to the market may cause—through salience—distortions in the perception of asset specific risks and, thus, in asset prices, for instance helping to explain why right-skewed assets tend to be overvalued. Barberis (2013) reviews a large body of evidence, from individual stocks to IPOs, pointing to an overpricing of right-skewed assets in markets.

Since salience depends on the market context, our model also predicts that the overpricing of growth stocks should vary with market conditions. Holding constant the prospects of an individual right-skewed asset, improvements in market conditions should reduce its overpricing relative to other assets in the market.

III. Time-Varying Risk Premia

To analyze the implications of our model for time-varying risk premia, suppose there are only two assets in the market ($J = 2$): a risk free asset F with constant payoff f, and a risky asset that delivers a high payoff, $x_{j1} = x + G$, in state 1 that occurs with probability π, and a lower payoff $x_{j2} = x$ in state 2 that occurs with probability $1 - \pi$. The sure payoff lies between the highest and lowest risky payoff, namely, $x < f < x + G$.

The average market payoff is then equal to $x_1 = (x + G + f)/2$ in state 1 and $x_2 = (x + f)/2$ in state 2, so that the market displays aggregate risk. In this context, we can think of "good times" as x being high, potentially close to f. Bad times are defined as low x. The variance of the risky asset's payoffs does

not depend on the times, i.e., does not depend on x. We also consider what happens if good times are defined by π being large.

The safe asset is priced at f, so it provides a return equal to the interest rate of 1. In a rational world, the risky asset is priced at $p = x + \pi G$. Since the investor is risk neutral, the price changes one for one with x, and the asset again yields a return of 1.

With salient thinking, the investor perceives the risky asset's downside to be salient when

$$(5) \qquad \frac{x + G}{(x + G + f)/2} < \frac{(x + f)/2}{x},$$

and its upside as salient otherwise. Condition (5) says that the downside is salient when the risky asset's loss relative to the safe asset is proportionally larger than its gain. Given a salience ranking, the price of the risky asset is then given by

$$(6) \qquad p = x + \omega_1 \pi G.$$

By comparing p with the fundamental price $x + \pi G$, we see that the risky asset is underpriced (the risk premium is positive) when its downside is salient, because in this case $\omega_1 = \delta/(\pi\delta + [1 - \pi]) < 1$. In contrast, the risky asset is overpriced (the risk premium is negative) when its upside is salient, because in this case $\omega_1 = 1/(\pi + [1 - \pi]\delta) > 1$.

Equation (6) implies that the risk premium $(1 - \omega_1)\pi G$ is countercyclical: it decreases in the average payoff x. This is because salience switches as market conditions change. When the fundamentals x of the risky asset deteriorate, its upside $x + G$ gets closer to the safe payoff f. This makes the downside of the risky asset salient, triggering a positive risk premium. When instead the fundamentals x of the risky asset improve, its downside x gets closer to the safe payoff f. In this case, the risky asset's upside becomes salient, and the risk premium turns negative.

The role of market movements in affecting, through salience, the risks that investors attend to can help shed new light on the observed countercyclical variation in risk premia (Campbell and Shiller 1988). When fundamentals are good, investors focus on the upside of future payoffs and overvalue the market. When fundamentals are poor, investors focus on the downside of future payoffs and undervalue the market.

Equation (6) also implies that investors overreact to news about salient payoffs and underreact to news about nonsalient payoffs. Suppose that the risky asset's upside is salient so that the risk premium is negative, $\omega_1 > 1$. Then an increase in the risky asset's upside G causes a disproportionate increase in its price, and, thus, a reduction in the risk premium. Similarly, if the probability of the asset's salient upside is small, $\pi < \sqrt{\delta}/(1 + \sqrt{\delta})$, the investor overreacts to news about π, and good news (increase in π) leads to a further reduction in the risk premium.

This example is readily extended to include many risky assets. Since most risky assets are not sufficiently right skewed relative to the market, their downsides are salient, by the diminishing sensitivity property of salience. This leads to an overall undervaluation of the market, an equity premium (Mehra and Prescott 1985).[1] Still, since the available right-skewed stocks are more likely to be overvalued in good times, the model generates, in the aggregate, a countercyclical (positive) risk premium.

IV. Conclusion

We conclude by comparing our paper to the work based on Prospect Theory. Barberis and Huang (2008) study the implications of probability weighting for the cross-section of stock returns. They show that overweighting small probabilities associated with extreme events leads to the pricing of idiosyncratic skewness. In our model, extreme payoffs are overweighted not because they have small probabilities but because they are salient relative to the market payoff. This has two implications. First, in our model the relevant notion of positive skewness is not defined in isolation, but relative to alternative investments. Second, in our model investors overreact to changes in the probability of salient payoffs, even if these payoffs have sizeable probabilities.

These features allow us to naturally account for time-varying risk premia. It is harder for Prospect Theory's standard probability weighting function to do so, unless it is assumed that during booms individual assets become more positively skewed. In a recession, when the objective probability of left-tail payoffs increases, standard probability weighting would imply that the low payoff will be less overweighted than before. Similarly, when the objective probability of right-tail payoffs decreases, the high payoff will be more overweighted than before. This suggests that risk aversion should increase in good times and decrease in bad times, which appears counterfactual.

To address these problems, models using Prospect Theory rely on its other features to explain the evidence, particularly loss aversion and time-varying reference points. Benartzi and Thaler (2000) show that loss-averse investors require a large premium to hold equity. Barberis, Huang, and Santos (2001) extend this argument to a dynamic setting, in which recent gains or losses are only slowly incorporated into an investor's reference point, leading to shifts in his risk aversion, so that in good times the investor expects, and receives, a lower premium. In contrast, our model predicts that the equity premium is driven not by preferences but by the salience of market payoffs: in good times the investor *perceives* the risky assets to be better than they really are. As a consequence, investors' expectations of payoffs are themselves cyclical.

In sum, our model can account for the basic cross-sectional and time-series puzzles in asset pricing using one simple idea that an investor focuses on salient payoffs of an asset, which are those that stand out from the average (market portfolio that includes the riskless asset). As a consequence, assets with large upsides are overpriced. Assets with large downsides are underpriced. The model yields several new implications and can be extended to concave utility and to more dynamic environments. We leave this to future work.

REFERENCES

Barberis, Nicholas. 2013 "Thirty Years of Prospect Theory in Economics: A Review and Assessment." *Journal of Economic Perspectives* 27 (1): 173–96.

Barberis, Nicholas, Ming Huang, and Tano Santos. 2001. "Prospect Theory and Asset Prices." *Quarterly Journal of Economics* 116 (1): 1–53.

Barberis, Nicholas, and Ming Huang. 2008. "Stocks as Lotteries: The Implications of

[1] Because the price of the market portfolio equals the sum of the prices of the individual assets composing it, the market is undervalued, namely, there is an equity premium, if and only if the assets are on average undervalued. From equation (2) this holds when $\sum_j \mathrm{cov}_s[\omega_{js}, x_{js}] < 0$.

Probability Weighting for Security Prices." *American Economic Review* 98 (5): 2066–100.

Benartzi, Shlomo, and Richard H. Thaler. 2000. *Myopic Loss Aversion and the Equity Premium Puzzle*. New York: Cambridge University Press.

Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer. 2012a. "Salience Theory of Choice under Risk." *Quarterly Journal of Economics* 127 (3):1243–85.

Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer. 2012b. "Salience and Consumer Choice." National Bureau of Economic Research Working Paper 17947.

Boyer, Brian, Todd Mitton, and Keith Vorkink. 2010. "Expected Idiosyncratic Skewness." *Review of Financial Studies* 23 (1):169–202.

Campbell, John Y., Jens Hilscher, and Jan Szilagyi. 2008. "In Search of Distress Risk." *Journal of Finance* 63 (6):2899–939.

Campbell, John Y., and Robert Shiller. 1988. "The Dividend-Price Ratio and Expectations of Future Dividends and Discount Factors," *Review of Financial Studies*, 1 (3): 195–228.

Fama, Eugene F., and Kenneth R. French. 1992. "The Cross-Section of Expected Stock Returns." *Journal of Finance* 47 (2):427–65.

Kahneman, Daniel, and Amos Tversky. 1979. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica* 47 (2):263–91.

Lakonishok, Josef, Andrei Shleifer, and Robert W. Vishny. 1994. "Contrarian Investment, Extrapolation, and Risk." *Journal of Finance* 49 (5):1541–78.

Lucas, Robert E., Jr. 1978. "Asset Prices in an Exchange Economy." *Econometrica* 46 (6): 1429–45.

Mehra, Rajnish, and Edward C. Prescott. 1985. "The Equity Premium: A Puzzle." *Journal of Monetary Economics* 15 (2): 145–61.