One-Factor Asset Pricing[1]

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Abstract

We propose a single-factor asset pricing model based on an indicator function of aggregate consumption growth being less than its endogenous certainty equivalent. This certainty equivalent is derived from generalized disappointment aversion preferences, and it is located approximately one standard deviation below the conditional mean of consumption growth. Our single-factor model can sufficiently explain the cross-section of expected returns for various portfolio sorts as well as the premia of the five Fama and French (2015) factors. Overall, our results show strong empirical support for asymmetric preferences over gains and losses (first-order risk aversion), and question the effectiveness of the smooth utility framework (second-order risk aversion), which is traditionally used in consumption-based asset pricing.

Keywords: asset pricing, cross-section, expected returns, consumption, disappointment aversion, indicator, certainty equivalent, risk aversion

JEL classification: D51, D91, E21, G12

1. Introduction

Despite their universal importance, asset pricing models are usually characterized by a puzzling contradiction. On one hand, most of the empirical factor models that can successfully explain risk premia do not provide strong guidance with respect to the deep economic mechanism that drives expected returns. On the other hand, many models that are motivated by economic theory have limited empirical success.

For instance, according to the standard consumption-based framework (CCAPM) of Breeden (1979), expected returns across assets should be explained by their exposure to aggregate consumption risk. Specifically, Breeden shows that Merton's (1973) ICAPM pricing equation can be collapsed into a single-beta equation, where the expected excess return on any security is proportional to its covariance with aggregate consumption growth alone. Nevertheless, a number of studies have questioned the ability of consumption risk to explain equity premia and the cross-section of expected returns (e.g., Mehra and Prescott (1985), Liu et al. (2009)). Moreover, recent efforts to introduce alternative measures of consumption risk (e.g., Parker and Julliard (2005), Yogo (2006), Jagannathan and Wang (2007), Savov (2011)) have been undermined by the implausibly high degree of risk aversion that these models still imply for the representative agent.

To address the poor performance of single-factor models like the CAPM or the CCAPM, empirical asset pricing models tend to employ an increasing number of return-generated factors (see the recent contributions of Fama and French (2015) and Hou et al. (2015)). However, in most cases, these multi-factor models do not provide convincing arguments regarding the economic underpinnings of the proposed pricing factors, let alone data mining concerns (see Harvey et al. (2015)).

Motivated by the empirical shortcomings of the traditional consumption model and the upward trend in the number of pricing factors, we propose a single-factor, consumption-based model featuring disappointment aversion, but second-order risk-neutrality, to explain the cross-section of expected stock returns. The only pricing factor in our model is an indicator function of consumption growth being less than its certainty equivalent. This certainty equivalent is derived from generalized disappointment aversion preferences (Gul (1991), and Routledge and Zin (2010)), and it is located approximately one standard deviation below the conditional mean of consumption growth. Using this single-factor model, we show that *downside consumption risk alone*, as proxied by the disappointment indicator, can rationalize both the level and the cross-sectional dispersion of expected returns.

The starting point for our single-factor model is disappointment aversion, which was firstly introduced by Gul (1991) and subsequently generalized by Routledge and Zin (2010). Under this axiomatic framework, investor utility over stochastic consumption exhibits three features: (i) it is defined based on deviations from a reference point, (ii) it is steeper for losses than for gains, and (iii) the reference point for gains and losses is based on the certainty equivalent of consumption. These characteristics imply that disappointment aversion preferences are described by utility functions with a kink, exhibiting first-order risk aversion (Segal and Spivak, (1990)), in contrast to standard preferences specifications that employ smooth utility functions characterized by second-order risk aversion (e.g., CRRA or CARA). Moreover, in the disappointment aversion framework, the location of the kink is endogenously determined rather than being exogenously imposed in an ad hoc fashion, as it is the case with prospect theory specifications (see Barberis et al. (2001)).

Despite its theoretical tractability, the implementation of the disappointment model is quite challenging. Specifically, in the generalized disappointment model of Routledge and Zin (2010), preferences are non-separable across time, and hence the resulting SDF is a function of consumption growth as well as lifetime utility, which is unobservable. The presence of unobservable lifetime utility in the SDF impedes its empirical estimation.

To circumvent this problem, Delikouras (2016) assumes that consumption growth is predictable and homoscedastic, and derives explicit solutions for lifetime utility and the SDF in terms of observable consumption growth. These solutions imply that the corresponding pricing kernel is a function of two factors: (i) consumption growth; and (ii) an indicator of consumption growth being less than its certainty equivalent. Despite the explicit solutions proposed by Delikouras, his SDF is highly nonlinear. Therefore, estimation, identification, and hypothesis testing are quite challenging even for small cross-sections of portfolios, and almost infeasible at the stock level.

In contrast to Delikouras (2016), we propose a model where the representative investor is disappointment averse but *second-order risk-neutral*. In other words, her preferences are characterized by a piecewise linear function with a kink. As a result, our model is linear and consists of a single factor: the indicator of consumption growth being less than its certainty equivalent. The implication of our model is that risky assets yield premia as compensation for being exposed to *downside* *consumption risk only*; consumption growth risk per se is not priced. Due to the simple linear structure of the proposed model, we are able to test it using portfolio sorts with an arbitrarily large degree of granularity (e.g., 100 size/book-to-market portfolios) as well as individual stock returns.

For our main tests, we examine the fit of the proposed asset pricing model using annual and monthly returns of the size, value, reversal, profitability, and investment portfolios. These portfolios are the basis for the most frequently used asset pricing factors (e.g., HML, SMB, CMA, and RMW in Fama and French (1993, 2015)). The results are striking; the disappointment indicator can fit the cross-section of expected returns at least as accurately as the Fama-French three-factor model, and its performance is comparable to the Fama-French five-factor specification. For example, over the 1933-2012 annual sample, the cross-sectional R^2s for our single-factor model are: 90% for the size/book-to-market portfolios, 88% for the size/profitability portfolios, 74% for the size/investment portfolios, and 87% for the long-term reversal portfolios. The corresponding R^2s for the Fama-French three-factor model are 85%, 80%, 73%, and 93%, while for the five-factor specification, the R^2s are 82%, 88%, 81%, and 97%, respectively. *A fortiori*, our single-factor model can also explain the premia that the five Fama and French (2015) factors yield.

Our tests also provide insights on the plausibility of the preference parameters of consumption-based models. Specifically, the key parameter in the proposed model is the disappointment aversion coefficient, which measures the asymmetry in investor preferences over gains and losses. Our estimates of this coefficient are around 4 (2) at the portfolio (stock) level, implying that investors penalize losses during disappointment events 5 (3) times more than losses during normal times. These values are very close to the one employed by Ang et al. (2005) to explain the historical equity premium, and yield very realistic risk-taking behavior in Rabin (2000) games (see Ang et al. (2005)). Moreover, our estimates for the disappointment aversion coefficient remain fairly stable across subperiods, test assets and return frequencies. To the contrary, the standard CCAPM yields risk aversion coefficients higher than 60 at the annual frequency, and 240 at the monthly frequency, which render the representative investor implausibly risk averse over modest or large-stake gambles (see Rabin (2000)).

To verify the robustness of our findings, we conduct a series of additional tests. Specifically, we find that the proposed single-factor model can explain the cross-section of the 100 size/book-to-market portfolios as accurately as the Fama-French three- and five-factor models, while it also yields an extremely good fit for the 10 earnings-to-price portfolios. Moreover, we find that the goodness of fit of the disappointment model remains very stable when we recursively estimate the disappointment events using expanding time-windows. Interestingly, using the combined cross-section of the 85 size, value, profitability, investment, and long-term reversal portfolios, we find that our model yields a better fit than the three-factor Fama-French model, and its performance is almost identical to the five-factor specification. Finally, we show that the proposed model does not suffer from weak identification, and its empirical success is neither spuriously driven by the use of an indicator factor nor is particularly sensitive to the marginal characterization of some consumption growth observations as disappointing or not.

This study contributes to three strands of the asset pricing literature. First, we contribute to the literature on disappointment aversion, which has considerably grown following the works of Ang et al. (2005) and Routledge and Zin (2010).[1] Routledge and Zin (2010) and Bonomo et al. (2011) calibrate consumption-based models with disappointment aversion to explain the equity premium but do not provide results for the cross-section of expected returns. On the other hand, Ostrovnaya et al. (2006) and Faragó and Tédongap (2015) conduct cross-sectional tests based on disappointment aversion, but they substitute out consumption, and they propose multi-factor pricing models. In contrast, our single-factor model is expressed in terms of observable consumption growth, and we show that the disappointment consumption indicator is sufficient to explain the cross-section of expected returns.

Our work is also related to Delikouras (2016), who incorporates disappointment aversion in Epstein-Zin preferences, and uses a highly non-linear SDF to explain the cross-section of expected returns. Contrary to Delikouras, we introduce a linear SDF by assuming a disappointment averse but second-order risk-neutral representative investor. This is particularly important because the conclusion of Delikouras is that "disappointment aversion helps improve the cross-sectional fit of traditional consumption models". We take this argument a step further, showing that a reasonable degree of disappointment aversion actually suffices to explain the level and cross-sectional variation in equity premia, and that we can completely ignore the standard consumption growth factor, which arises from second-order risk aversion preferences.

[1] Choi et al. (2007) and Dahlquist et al. (2016) examine portfolio choices, whereas Gill and Prowse (2012) focus on effort provision. Dolmas (2014) combines disappointment aversion with rare disasters, while Schreindorfer (2014) uses disappointment aversion to price put options.

Moreover, in his empirical tests, Delikouras (2016) imposes the restriction that the disappointment threshold is exactly equal to the certainty equivalent of consumption growth as in Gul's (1991) original disappointment model. In contrast, our modeling framework adopts the more flexible approach of Routledge and Zin (2010), where the disappointment threshold is a *multiple* of the certainty equivalent. Our empirical focus is also different. Delikouras tests the disappointment aversion model across different asset classes (stocks, corporate bonds, commodity futures) using a single cross-section for equity returns with a few portfolios as test assets. To the contrary, the focus of our study is equity pricing. Hence, we use an extensive set of portfolios spanning the factors that are commonly used in the empirical asset pricing literature as well as individual stock returns.

Second, our results contribute to the consumption-based asset pricing literature. Specifically, we show that a non-linear transformation of the consumption growth process, which derives from generalized disappointment aversion preferences, can address the empirical shortcomings of the standard consumption model. In particular, while the CCAPM-implied estimates of the second-order risk aversion coefficient are implausibly high, undermining its validity, our estimates for the disappointment aversion parameter imply very reasonable risk-taking behavior. Finally, the good cross-sectional fit of the proposed single-factor model provides support for the theoretical argument in Breeden (1979) that premia should be proportional to covariances with a function of aggregate consumption, but we crucially show that it is downside consumption risk that is priced.

Third, this study contributes to the ongoing debate in the literature between mispricing arguments and risk-based asset pricing. Based on the poor empirical performance of the CAPM and CCAPM, a number of seminal studies have suggested that investor overreaction can fully explain the cross-section of portfolio returns.[2] To the contrary, we provide strong empirical support for a risk-based explanation of expected returns. Specifically, we show that the disappointment consumption indicator can sufficiently explain the size, value, profitability, investment, and reversal premia.

Collectively, our results question the effectiveness of the standard framework of smooth utility functions that is commonly used in consumption-based asset pricing. In contrast, we argue in favor of first-order risk aversion, and conclude that risk premia are, to a large extent, compensation for exposure to disappointment (i.e., downside) consumption risk.

[2]Shiller (1984), DeBondt and Thaler (1985, 1987), Lakonishok et al. (1994), etc.

2. The single-factor GDA-I SDF

In this section, we introduce our single-factor asset pricing model, termed GDA-I. Our starting point is the generalized disappointment aversion (GDA) intertemporal SDF of Routledge and Zin (2010):

$$M_{t+1}^{GDA} = \beta\Big(\frac{C_{t+1}}{C_t}\Big)^{\rho-1}\Big[\frac{V_{t+1}}{\mu_t\big(V_{t+1}\big)}\Big]^{\alpha-\rho}\Big[\frac{1+\theta\mathbf{1}\{V_{t+1}\ \leq\ \delta\mu_t\}}{1+\theta\delta^{\alpha}\mathbb{E}_t[\mathbf{1}\{V_{t+1}\ \leq\ \delta\mu_t\}]}\Big], \tag{1}$$

$$\text{with}\ \ \mu_t(V_{t+1}) = \mathbb{E}_t\Big[\frac{V_{t+1}^{\alpha}(1+\theta\mathbf{1}\{V_{t+1}\ \leq\ \delta\mu_t\})}{1+\theta\delta^{\alpha}\mathbb{E}_t[\mathbf{1}\{V_{t+1}\ \leq\ \delta\mu_t\}]}\Big]^{\frac{1}{\alpha}}. \tag{2}$$

This SDF adjusts expected values by taking into account investor preferences over the timing, risk, and disappointment of stochastic payoffs. $\mu_t(V_{t+1})$ is the GDA certainty equivalent for lifetime utility V_t, and $\mathbf{1}\{V_{t+1}\ \leq\ \delta\mu_t\}$ is the disappointment indicator. The parameter β is the rate of time preference, ρ determines the elasticity of intertemporal substitution (EIS $= 1/(1-\rho)$), and α is the second-order risk aversion parameter, which determines the piece-wise concavity of lifetime utility.

The disappointment aversion (DA) coefficient θ is the novel parameter in the GDA SDF. This parameter determines the asymmetry in investor preferences around the disappointment threshold. When θ is positive, a \$1 loss in consumption during disappointment periods hurts approximately $1+\theta$ times more than a \$1 loss in consumption during normal times.[3] For θ equal to zero, we obtain the standard Epstein-Zin (Epstein and Zin (1989)) framework. In the original framework of Gul (1991), disappointment events take place when lifetime utility falls bellow its certainty equivalent: $\mathbf{1}\{V_{t+1}\ \leq\ \mu_t\}$. In the GDA framework of Routlegde and Zin (2010), the threshold for disappointment is a multiple of the certainty equivalent, i.e., $\mathbf{1}\{V_{t+1}\ \leq\ \delta\mu_t\}$. Thus, in the GDA model, the threshold for disappointment is also determined by the positive GDA parameter δ.

According to the expression in equation (1), the GDA SDF of Routledge and Zin (2010) is a function of the observable consumption growth and the unobservable lifetime utility, because investor preferences are not separable across time. By assuming that consumption growth (Δc_t) is

[3] This behavior is consistent with a growing body of evidence documenting that disappointment risk is priced both at the individual and at the aggregate level because agents worry about losses more than they enjoy gains (see Epstein and Zin (1990, 2001), Choi et al. (2007), Routledge and Zin (2010), Gill and Prowse (2012)).

a homoscedastic AR(1) process with normal shocks,[4] Delikouras (2016) recasts the GDA SDF in terms of observable consumption growth as follows:

$$M_{t+1}^{GDA} = exp\Big[log\beta_M - \big(1-\rho+\frac{\rho-\alpha}{1-\kappa_{c,1}\phi_c}\big)\Delta c_{t+1} + \frac{(\rho-\alpha)\phi_c}{1-\kappa_{c,1}}\Delta c_t\Big]$$
$$\times \frac{1+\theta\mathbf{1}\{\Delta c_{t+1} \leq (1-\kappa_{c,1}\phi_c)log\delta + \mu_c(1-\phi_c) + \phi_c\Delta c_t + d_1\sqrt{1-\phi_c^2}\sigma_c\}}{1+\theta\delta^{\alpha}\mathbb{E}_t[\mathbf{1}\{\Delta c_{t+1} \leq (1-\kappa_{c,1}\phi_c)log\delta + \mu_c(1-\phi_c) + \phi_c\Delta c_t + d_1\sqrt{1-\phi_c^2}\sigma_c\}]}. \tag{3}$$

The parameters μ_c, σ_c^2, and ϕ_c are the unconditional mean, variance, and first-order autocorrelation for consumption growth, respectively. The constant β_M depends on the discount rate and the consumption growth moments, and $\kappa_{c,1} \in (0,1)$ is a log-linearization constant. The indicator $\mathbf{1}\{\}$ captures disappointment events in consumption growth, which take place when consumption growth is less than its certainty equivalent adjusted for the GDA parameter δ. This certainty equivalent depends on the consumption growth moments and the parameter d_1, which itself is an implicit function of consumption growth moments and risk preferences.

The GDA SDF of Delikouras (2016) in equation (3) indicates that risky assets should compensate investors for two sources of systematic risk. The first source is consumption risk, and it is captured by the consumption growth rate. The second source of risk is disappointment consumption risk, and it is captured by the disappointment indicator.

The key innovation of our study is to assume that the representative investor is *second-order risk-neutral* with time-separable preferences, i.e., $\alpha = \rho = 1$ in equation (3). In other words, we assume that the utility function of the representative investor is piece-wise linear with a kink, the location of which is endogenously determined. Given these preferences assumptions, we introduce a linear SDF that depends only on the disappointment indicator. Specifically, the proposed GDA-I SDF *for excess returns* reads up to a multiplicative scalar term as:

$$M_t^{GDA-I} = 1 + \theta\mathbf{1}\big\{\Delta c_t \leq \mu_c(1-\phi_c) + \phi_c\Delta c_{t-1} + d_2\sqrt{1-\phi_c^2}\sigma_c\big\}, \text{ with } d_2 = d_1 + \frac{(1-\kappa_{c,1}\phi_c)log\delta}{\sqrt{1-\phi_c^2}\sigma_c}. \tag{4}$$

Based on Delikouras (2016), when $\alpha = \rho = 1$, the parameter d_1 above is the solution to the

[4] $\Delta c_{t+1} = \mu_c(1-\phi_c) + \phi_c\Delta c_t + \sqrt{1-\phi_c^2}\sigma_c\epsilon_{c,t+1}$, where $\epsilon_{c,t+1}$ are i.i.d. N(0,1) shocks.

following fixed-point problem:

$$d_1 = \frac{1}{2(1-\kappa_{c,1}\phi_c)}\sqrt{1-\phi_c^2}\sigma_c + \frac{log\Big(\frac{1+\theta N\left(d_1+\frac{(1-\phi_c\kappa_{c,1})log\delta}{\sqrt{1-\phi_c^2}\sigma_c}-\frac{1}{1-\kappa_{c,1}\phi_c}\sqrt{1-\phi_c^2}\sigma_c\right)}{1-\theta(\delta-1)\mathbf{1}\{\delta>1\}+\theta\delta N\left(d_1+\frac{(1-\phi_c\kappa_{c,1})log\delta}{\sqrt{1-\phi_c^2}\sigma_c}\right)}\Big)}{\frac{1}{1-\kappa_{c,1}\phi_c}\sqrt{1-\phi_c^2}\sigma_c}. \tag{5}$$

Since the disappointment threshold coefficient d_2 depends on θ through d_1 as well as on the GDA parameter δ, which is a free parameter, in our estimation approach we treat d_2 as a free parameter.

The proposed GDA-I SDF in equation (4) consists of a single pricing factor: the indicator of consumption growth being less than its certainty equivalent. This indicator is scaled by the DA parameter θ, which captures the price of disappointment risk. Contrary to the standard CCAPM and the GDA SDFs in equations (1) and (3), consumption growth per se is not priced in our model due to the second-order risk neutrality assumption. Finally, the threshold for disappointment in equation (4) is the GDA-I certainty equivalent of consumption growth, $\mu_t^{GDA-I}(\Delta c_{t+1})$, which is given by:

$$\mu_t^{GDA-I}(\Delta c_{t+1}) = \mu_c(1-\phi_c) + \phi_c\Delta c_t + d_2\sqrt{1-\phi_c^2}\sigma_c. \tag{6}$$

Essentially, the GDA-I SDF in equation (4) follows a bi-modal distribution, exhibiting a switching-type behavior even though the consumption growth process does not (see Epstein and Zin (2001) for a related discussion). Testing the goodness of fit of this parsimonious single-factor SDF, we essentially test whether disappointment consumption risk alone suffices to price the cross-section of expected stock returns. This is a much more challenging task relative to the GDA SDFs of Routledge and Zin (2010) and Delikouras (2016), because our preferences assumptions forego the flexibility that unrestricted second-order risk aversion and EIS parameters would allow.

2.1 Alternative asset pricing models

In addition to the GDA-I model, we estimate the following set of asset pricing models for comparison:

$$M_t^{CCAPM} = -\widetilde{\alpha}\Delta c_t \tag{7}$$

$$M_t^{CAPM} = -b_m R_{m,t}^x \tag{8}$$

$$M_t^{FF3} = -b_m R_{m,t}^x - b_{smb} R_{smb,t} - b_{hml} R_{hml,t} \tag{9}$$

$$M_t^{FF5} = -b_m R_{m,t}^x - b_{smb} R_{smb,t} - b_{hml} R_{hml,t} - b_{rmw} R_{rmw,t} - b_{cma} R_{cma,t} \tag{10}$$

$$M_t^{NBER} = -\lambda \mathbf{1}\{\text{more than 4 NBER recession months in year } t\} \tag{11}$$

The discount factor in equation (7) is the linearized CCAPM with CRRA preferences, where $\widetilde{\alpha}$ is the second-order risk aversion parameter and captures the price of consumption risk. The CCAPM represents the traditional view in consumption-based asset pricing, according to which investors are second-order risk averse but disappointment risk-neutral. The SDF M_t^{CAPM} corresponds to the standard CAPM, whereas M_t^{FF3} and M_t^{FF5} correspond to the Fama and French (1993, 2015) three- and five-factor models, respectively. Finally, M_t^{NBER} is the NBER discount factor, which is based on an indicator function for recessions. This indicator takes the value 1 when there are more than 4 NBER recession months in year t and 0 otherwise.[5] The parameter λ in equation (11) captures the price of NBER recession risk. We use the NBER model to show that disappointment events do not simply capture NBER recessions, but they rather have distinct asset pricing implications.

3. Data and estimation methodology

3.1 Data

The aim of our empirical analysis is to examine whether the GDA-I model can explain well established stylized facts in the cross-section of equity returns. To this end, we consider the following equally-weighted portfolio cross-sections:

1. **25 and 100 portfolios sorted on size/book-to-market (size/bm).** These portfolios capture the value and size premia, which are reflected in the HML and SMB factors of the

[5] Because NBER recessions are defined on a monthly basis, we create an annual NBER indicator by considering a 4-month cutoff for the number of NBER recession months in a year. We have considered alternative cutoffs for the NBER indicator. The 4-month cutoff yields the best cross-sectional fit. Based on this cutoff, the NBER recession years are 1937, 1938, 1945, 1949, 1953, 1954, 1960, 1970, 1974, 1980, 1981, 1982, 1990, 2001, 2008, and 2009.

Fama and French (1993) three-factor model.

2. **25 portfolios sorted on size/operating profitability (size/op).** These portfolios capture the profitability premia, which are reflected in the RMW factor of the Fama and French (2015) five-factor model.

3. **25 portfolios sorted on size/investment (size/inv).** These portfolios capture the investment premia, which are reflected in the CMA factor of the Fama and French (2015) five-factor model.

4. **10 portfolios sorted on long-term reversal (ltr).** These portfolios capture the long-term reversal premium documented in Jegadeesh and Titman (1993).

5. **10 portfolios sorted on earnings-to-price (e/p).** These portfolios have been used by Fama and French (1993) in cross-sectional tests of their three-factor model.

We use the above sets of portfolios for two reasons. First, these sets of portfolios constitute the basis for a number of return-generated factors that are commonly used in the empirical asset pricing literature, such as the HML, SMB, CMA, and RMW factors in Fama and French (1993, 2015). Second, as shown in Harvey et al. (2015) and Hou et al. (2015), the above portfolios are also the basis for a wide range of well-established patterns in the cross-section of equity returns. Details on the construction of these portfolios can be found on Kenneth French's website, while their summary statistics are shown in Table 1. We use both annual and monthly portfolio returns. Both samples run from 1933 to 2012, with the exception of the profitability and investment portfolios that begin in 1964, and the earnings-to-price portfolios that begin in 1953.

The GDA-I framework is a consumption-based model. To construct the per-capita aggregate consumption series, we use personal consumption expenditures (PCE) and PCE price index data from the BEA. Monthly consumption data are available since 1959. Aggregate consumption is defined as services plus non-durables. Each component of aggregate consumption is deflated by its corresponding PCE price index (base year is 2009). Population data are from the U.S. Census Bureau and recession dates are from the NBER. In matching consumption growth with asset returns, we follow the "beginning-of-period" convention as in Campbell (2003) and Yogo (2006), because beginning-of-period consumption growth is better aligned with asset returns.

A note should be made on not including momentum portfolios in our test assets. Any consumption-based model would require that past winner stocks should perform poorly relative to past losers during low consumption (high marginal utility) periods to justify the much higher premia that the former yield as compensation for risk. Nevertheless, during the recent crisis period, which was marked by the most negative consumption growth rate in our sample and it is clearly classified as a disappointment event by our GDA-I model, past winner stocks considerably outperformed past losers. Given this empirical fact, we remain sceptical about the ability of any consumption-based asset pricing model, including GDA-I, to explain momentum premia.

3.2 Estimation methodology

We test the competing asset pricing models (7)-(11) using first-stage GMM (Hansen and Singleton (1982)) with an identity weighting matrix for the following system of Euler equations:

$$\mathbb{E}[(R_{i,t} - R_{1y,t})(1 - \mathbb{E}[M_t] + M_t)] = 0, \quad \text{for} \quad i = 1, .., n, \tag{12}$$

where $R_{1y,t}$ is the one-year interest rate and n is the number of test assets. We augment the SDF by the constant $1 - \mathbb{E}[M_t]$ to rule out a zero solution for risk prices since we are testing linear models on excess returns. Using the definition of covariance, we obtain the following equivalent expression for expected portfolio premia:

$$\mathbb{E}[R_{i,t} - R_{1y,t}] = -\mathbf{Cov}(R_{i,t} - R_{1y,t}, M_t) \tag{13}$$

Based on the above, this GMM setup is equivalent to running a cross-sectional regression of portfolio premia on covariances imposing a zero intercept. However, the critical advantage of the GMM specification is that it automatically corrects standard errors for the fact that covariances of excess returns with the SDF need also be estimated.

To test the performance of the GDA-I model in equation (4), we need to identify the set of disappointment consumption events, and hence we need to specify the values for the mean (μ_c), variance (σ_c^2), and autocorrelation (ϕ_c) of consumption growth. To this end, for the GDA-I model alone, we minimize the following augmented GMM system that fits the empirical consumption growth moments jointly with the unconditional Euler equations for excess portfolio returns:

$$\begin{bmatrix} \mathbb{E}[\Delta c_t] - \mu_c \\ \mathbb{E}[\Delta c_t^2] - \mu_c^2 - \sigma_c^2 \\ \mathbb{E}[\Delta c_t \Delta c_{t-1}] - \mu_c^2 - \phi_c \sigma_c^2 \\ \mathbb{E}\big[(R_{i,t} - R_{1y,t})(1 - \mathbb{E}[M_t^{GDA-I}] + M_t^{GDA-I})\big] \end{bmatrix}. \tag{14}$$

In minimizing the above GMM system, we use a diagonal weighting matrix in which the first three diagonal elements are very large numbers (10^8), and the remaining diagonal elements are 1. There are two reasons for overweighting the moment conditions for consumption growth. First, these moment conditions have a different scale from the ones for portfolio returns. For example, the annual return for the *size1/bm5* portfolio (= 27%) is much larger than the sample autocovariance of the annual consumption growth (= 0.005%). Therefore, these consumption growth moments need to be weighted accordingly. Second, by overweighting the consumption growth moments, we are not allowing the estimation to fit risk premia at the expense of errors in the consumption growth process (e.g., inflating the variability or the persistence of consumption growth).[6]

We assess the overall model fit using the χ^2-test (Hansen (1982)), the cross-sectional R^2, and the cross-sectional root mean square error ($RMSE$). The magnitude of the $RMSE$ for each cross-section should be compared with the corresponding average portfolio returns reported in Table 1. Finally, it should be noted that the critique in Lewellen et al. (2010) regarding the mechanical fit of asset pricing models due to the factor structure of certain cross-sections of portfolios is less relevant for the GDA-I SDF because it is a single-factor model.

4. Results

4.1 Estimation results for annual portfolio returns

For the first set of tests, we estimate the various asset pricing models using annual returns for the 25 *size/bm*, 25 *size/op*, 25 *size/inv*, and 10 *ltr* portfolios, in turn. The corresponding results are

[6]For the 1933-2012 sample period, the estimates for the annual consumption growth mean, variance, and autocovariance yielded by the augmented GMM system for the GDA-I model in equation (14) are 2.170%, 0.024%, and 0.005%, respectively. For the 1964 - 2012 sample period, the corresponding estimates are 1.945%, 0.016%, and 0.010%, respectively. These values do not differ across portfolios within each sample period due to the choice of the GMM weighting matrix, which assigns very large weights to the GMM conditions for consumption growth moments.

reported in Table 2.

4.1.1 Model fit

The results in Table 2 show that the GDA-I model achieves a very good fit in absolute terms, with R^2 being as high as 90% in the cross-section of the 25 *size/bm* portfolios. The goodness of fit is also high across the 25 *size/op*, 25 *size/inv*, and 10 *ltr* portfolios (R^2s = 88%, 74%, and 87%, respectively). Additionally, the GDA-I model is able to fit sample portfolio premia, yielding low $RMSE$s. This success is particularly striking for the 25 *size/bm* and the 25 *size/op* portfolios, given the substantial cross-sectional dispersion in the sample premia of these portfolios.

The empirical success of the GDA-I model is illustrated in Figure 1, which plots sample portfolio premia versus fitted expected excess returns for all models. These scatterplots show that the GDA-I model can successfully align fitted with sample premia across all portfolio sorts. Finally, on the basis of the χ^2-test of overidentifying restrictions, the GDA-I model cannot be formally rejected in the sets of examined portfolios.

The goodness of fit of the GDA-I model is even more striking when assessed relatively to the alternative, commonly used asset pricing models. The GDA-I model outperforms the CCAPM in terms of goodness of fit. This outperformance is most pronounced among the 25 *size/inv* portfolios, where the CCAPM performs very poorly. This is also evident from Panel C of Figure 1. It should be also mentioned that the CCAPM is formally rejected by the χ^2-test in all but one of the portfolio sets considered. Equally importantly, the GDA-I model outperforms the CAPM, which yields much lower R^2s and much higher $RMSE$s across the board. Interestingly, the CAPM not only fails badly to price the 25 *size/inv* and the 25 *size/op* portfolios, but also yields twice as high $RMSE$ as the GDA-I model for the 25 *size/bm* portfolios. Moreover, the CAPM is rejected by the χ^2-test for all sets of portfolios considered.

A challenging benchmark for the GDA-I model is the Fama-French three-factor model. Despite the fact that our model utilizes a single macroeconomic indicator variable, its goodness of fit is very similar to that of the Fama-French model. In fact, in the cross-section of the 25 *size/bm* portfolios, from which the HML and SMB factors are constructed, the GDA-I model yields a higher R^2 and a lower $RMSE$ relative to this model. The same is true for the 25 *size/inv* and the 25 *size/op* portfolios. On the other hand, the three-factor model outperforms the GDA-I model in the cross-section of the 10 *ltr* portfolios, where it achieves an almost perfect fit. The overall relative parity in terms of goodness of fit among these two models is illustrated in Figure 1. Finally, it should be mentioned that the Fama-French model is rejected by the χ^2-test for all sets of portfolios considered.

The GDA-I model also compares very well with respect to the Fama-French five-factor model. The corresponding estimation results in Table 2 show that the five-factor model outperforms the GDA-I model across the 25 *size/inv* portfolios, but it underperforms our model across the 25 *size/bm* portfolios. Both models achieve an equally good fit across the 25 *size/op* portfolios.

To show that the empirical success of the GDA-I model does not derive from naively mimicking recession periods, we also compare it with the NBER model. In fact, we find that a simple NBER recession indicator cannot price at all the *size/inv* and *size/op* portfolios, since it yields very high $RMSE$s and very low R^2s. The very poor performance of the NBER model can be visualized by the scatterplots in the fourth column of Figure 1. These results imply that NBER recessions are not particularly important for explaining portfolio premia.

Overall, the performance of the GDA-I model indicates that investors are sensitive to disappointment consumption years and require a higher premium for holding assets that perform badly during these years. In fact, the results in Table 2 suggest that downside consumption risk, as measured by disappointment events in consumption growth, can explain both the level and the cross-sectional variation in portfolio premia. Hence, we argue that to a large extent, *size*, *bm*, *op*, *inv*, and *ltr* premia are compensation for exposure to downside consumption risk.

Contrary to a number of previous studies that propose mispricing as an explanation for equity premia, our results support a risk-based rationalization for the cross-section of stock returns. Specifically, the successful performance of the GDA-I model in the *size/bm* cross-section challenges the conclusions in Lakonishok et al. (1994), who suggest that book-to-market effects are a result of investor overreaction to past firm performance. Lakonishok et al. (1994) and DeBondt and Thaler (1985) propose an overreaction explanation for the long-term reversal premium as well. Yet, the reported results for the *ltr* portfolios in Table 2 indicate that disappointment risk can explain the long-term reversal puzzle too.

4.1.2 Prices of risk and disappointment threshold coefficient

In addition to model fit, Table 2 reports the estimated prices of risk across the various models and portfolio sorts considered. For the GDA-I and CCAPM specifications, the prices of risk have a structural interpretation and can be directly mapped into preference parameters. Specifically, the price of risk for the GDA-I model is the DA coefficient θ from equation (4), while the price of risk for the CCAPM is the second-order risk aversion parameter $\widetilde{\alpha}$ from equation (7). Hence, we can also assess the plausibility of these two models by examining their implied preference parameters.

Regarding the CCAPM, the estimated risk aversion coefficients reported in Table 2 range from 57 for the *size/bm* portfolios to 91 for the *size/inv* portfolios. These magnitudes are consistent with the ones reported in Mehra and Prescott (1985), Cochrane (2001), and Savov (2011), and reflect the equity premium puzzle. In other words, the CCAPM requires extremely large risk aversion parameters to match equity premia. Echoing Rabin (2000), accepting such a high degree of concavity in the representative investor's utility function is equivalent to accepting that this investor would paradoxically reject even extremely favorable larger-stake gambles, rendering her implausibly risk averse.

On the other hand, the estimated DA coefficients reported in Table 2 range from 3.4 for the *size/inv* portfolios to 4.3 for the *ltr* portfolios and they remain fairly stable across the examined cross-sections. This range of values for the DA coefficient is very close to the value required by Ang et al. (2005) to explain the historical equity premium, and implies a very reasonable risk-taking behavior in Rabin games (see Ang et al. (2005)). It should be also noted that the estimated factor coefficients reported in Table 2 reveal an important limitation of the Fama-French models. These multi-factor models achieve relatively low RMSEs in each set of test assets at the expense of strikingly different factor coefficients across these cross-sections, hindering their interpretation in a theoretically consistent fashion.

Finally, Table 2 also reports estimates for the coefficient d_2 in each cross-section. According to equation (6), the parameter d_2 characterizes the threshold for disappointment in terms of standard deviations away from the conditional mean of consumption growth. For example, we find that for the *size/bm* (*ltr*) portfolios in the full sample period, disappointment events in consumption occur when realized consumption growth is 0.77 (0.75) standard deviations below its conditional mean.

The threshold is somewhat higher for the *size/inv* and *size/op* portfolios in the post-1964 period, but the corresponding estimates for d_2 are not directly comparable since the consumption growth moments are also different in this subperiod (see footnote 6).

According to equation (4), the coefficient d_2 is a function of consumption growth moments, the GDA parameter δ, and the coefficient d_1, which itself is an implicit function of preferences and consumption growth dynamics (see equation (5)). Back-of-the-envelope calculations based on the full-sample estimates of the consumption growth moments reported in footnote 6, and the estimates for the DA coefficient θ and threshold coefficient d_2 reported in Table 2, yield a GDA parameter δ of 0.998.[7] This value is consistent with the range of values advocated by recent studies employing GDA preferences. For instance, in the calibration exercise of Routledge and Zin, δ ranges from 0.9692 to 1.0431, while Bonomo et al. (2011) and Faragó and Tédongap (2015) use δ values of 0.989 and 0.998, respectively.

5. Robustness tests

In this section, we conduct a series of robustness checks. Specifically, we (i) recursively estimate the GDA-I model using expanding time-windows, (ii) employ monthly instead of annual returns, (iii) compare the competing models using jointly the 85 size, value, profitability, investment, and long-term reversal portfolios in the post-1964 period, and (iv) use alternative sets of portfolios.

5.1 Recursive estimation approach

The benchmark results presented in the previous section were based on the full sample estimation of the GDA-I model. In this section, we alternatively follow a recursive estimation approach. In particular, we recursively estimate the GMM system specified in equation (14), starting from an initial window of 30 years. As a result, starting in 1963 (1994 for the profitability and investment portfolios), we recursively estimate μ_c, σ_c, ϕ_c, θ, and d_2, obtaining a new set of disappointment events and the corresponding model fit based on the available filtration up to year t. This recursive estimation approach essentially examines the stability of the benchmark results for different sample

[7] For these calculations, we need to specify a value for the parameter $\kappa_{c,1}$ in equation (5). This parameter is a log-linearization constant for the price-dividend ratio of the consumption claim. Following Bansal and Yaron (2004), we set $\kappa_{c,1}$ equal to 0.997. Our results are not sensitive to this assumption.

periods, using "real-time" information.

The results from this recursive estimation approach are reported in Table 3. In particular, we report the time-series averages of the recursively estimated θ and d_2 coefficients, and the goodness of fit statistics. Overall, these results are in line with the full-sample estimates reported in Table 2. The average θ coefficient takes values between 3 and 4.6 across the various sets of portfolios, confirming its subsample stability, even when quite short sample periods are considered. Equally importantly, the average values for the disappointment threshold coefficient d_2 are also close to their corresponding full sample estimates.

Moreover, the average R^2s of the model are quite high and $RMSE$s are quite low, taking into account that these average values also reflect the initial short sample periods, which omit a considerable number of subsequent disappointment events. In fact, with the exception of the 25 *size/inv* portfolios, the R^2 of the GDA-I model is never lower than 66%, whereas its maximum level surpasses the full sample estimates reported in Table 2.

Overall, these results point to the conclusion that by estimating the GDA-I model using information available in real time, an econometrician would have found this model performing very well already in much earlier periods. This finding also addresses the potential concern that the success of the GDA-I model may be solely driven by the disappointment events that occurred during the recent crisis period.

5.2 Monthly returns

In the benchmark analysis, the sample frequency is annual and disappointment events last for a year. However, discrete time models provide no guideline as to how often investors should evaluate their wealth and adjust their consumption. If an optimal consumption rebalancing frequency exists, then it will undoubtedly affect the empirical performance of consumption-based asset pricing models. To address this concern, this section examines the performance of the GDA-I model at the monthly frequency.

We define monthly disappointment events as follows: if year t is a disappointment year, then all months in year t are disappointment months; if year t is not a disappointment year, then none of the months in year t are disappointment months. Arguably, this measure of monthly disappointment events is rather coarse, and hence the reported results in this section can be viewed as the most conservative estimates of the empirical fit of the GDA-I model at the monthly frequency.

5.2.1 Model fit

Table 4 reports the GMM results for the examined asset pricing models and sets of portfolios at the monthly frequency. Overall, these results are consistent with the ones reported in Table 2 for the annual frequency. Specifically, the fit of the single-factor GDA-I model is superior to the one of the CAPM, CCAPM, and NBER models across all sets of portfolios. In fact, the CAPM and CCAPM perform very poorly at the monthly frequency.

Moreover, the goodness of fit for the GDA-I model is comparable to the fit for the Fama-French three- and five-factor models. Interestingly, the GDA-I model yields the lowest $RMSE$ and the highest R^2 for the 25 *size/bm* portfolios across all models, including the five-factor Fama-French specification, while it also outperforms the Fama-French three-factor model across the 25 *size/op* portfolios. It should be noted that the flexibility of the Fama-French multi-factor models to fit each cross-section comes again at the expense of yielding strikingly different estimates for the factor coefficients across these sets of portfolios.

The goodness of fit for the various models is illustrated by the scatterplots of sample average versus model-implied portfolio premia in Figure 2. These scatterplots show that the GDA-I model can align fitted with sample premia as accurately as the Fama-French three-factor model across all portfolio sorts. On the other hand, the CCAPM cannot price any of these sets of portfolios at the monthly frequency.

5.2.2 Prices of risk

In addition to model fit, Table 4 also reports the corresponding estimated prices of risk. At the monthly frequency, the estimates for the DA coefficient θ range from 3.1 to 3.9. These estimates are very similar to the θ estimates derived from the annual sample, which are reported in Table 2. In contrast, the second-order risk aversion coefficients implied by the CCAPM in the monthly sample are very different from the ones derived from annual returns. In particular, the risk aversion estimates reported in Table 4 range from 226 to 283, and they are up to four times larger than the corresponding annual estimates. These results confirm that the equity premium puzzle becomes even more pronounced if one employs monthly returns, since the representative investor's implied utility function becomes extraordinarily concave. In sum, the prices of risk reported in Table 4 indicate that, unlike the second-order risk aversion parameter, the DA parameter exhibits the desirable property of being stable across frequencies.

5.3 Joint cross-section of portfolios

In this section, we alternatively estimate the augmented GMM system from equation (14) using the joint set of 85 *size/bm*, *size/inv*, *size/op*, and *ltr* portfolios for the post-1964 period. As a result, we estimate a unique set of disappointment events (equivalently, θ and d_2 coefficients) from this joint cross-section. In this way, we address the potential concern that the goodness of fit of the GDA-I model in our benchmark results may be driven by identifying a different set of disappointment events to fit each cross section separately. For comparison, we also use this joint cross-section to assess the performance of the competing asset pricing models.

The results from this exercise are reported in Table 5 for the annual (Panel A) and monthly (Panel B) sample, respectively. We find that the estimates for the θ and d_2 parameters from the joint cross-section are very similar to the ones reported in Table 2 and Table 4 for the 25 *size/inv* and 25 *size/op* portfolios during the post-1964 period. This finding confirms the stability of these parameter estimates across alternative cross sections, and indicates that the implied price of disappointment risk is very close to the one derived from the full sample period. To the contrary, the second-order risk aversion coefficient implied by the CCAPM is higher in the post-1964 period, undermining further the validity of this model, especially at the monthly frequency.

Equally importantly, our single-factor GDA-I model yields a comparable fit to the Fama-French five-factor specification, while outperforming the rest of the models. These results convincingly show that a common set of disappointment events can sufficiently explain the joint cross-section of expected returns both at the annual and at the monthly frequency. In contrast, the fit of the Fama-French multi-factor models deteriorates in the joint cross-section due to the instability in their factor coefficient estimates when fitting each set of portfolios separately.[8]

[8] In unreported tests, we alternatively estimate the coefficients of the various asset pricing models using the cross-section of *ltr* portfolios, and then examine their goodness of fit in the joint cross-section of the 85 portfolios. In these "out-of-sample" tests, the R^2 of the GDA-I model is 79%, whereas the corresponding R^2 of the Fama-French five-factor model is negative.

5.4 Additional tests for size- and value-related cross-sections

The cross-section of size and value portfolios is the most commonly used laboratory for empirical tests of asset pricing models.[9] To this end, we present here additional results using alternative sets of portfolios that are constructed from size and value sorts.[10]

5.4.1 100 size/bm portfolios

In this section, we utilize the set of 100 *size/bm* portfolios. This is arguably the most challenging size and value cross-section to fit due to its high degree of granularity. Results are reported in Table 6. Panel A reports results for annual portfolio returns, while Panel B reports results for monthly portfolio returns.[11]

According to the results in Panel A of Table 6, the GDA-I model yields the highest R^2 and the lowest $RMSE$ across all examined models (R^2 = 77%, $RMSE = 2.1$). Its goodness of fit is similar to the one for the Fama-French three-factor model, but superior to the one of the CAPM, CCAPM, Fama-French five-factor, and the NBER models. We also find that the DA coefficient estimate is very similar to the one reported for the 25 *size/bm* portfolios in Table 2, indicating that the price of disappointment risk is not affected by the degree of granularity of the *size/bm* portfolios. Moreover, the estimated risk aversion coefficient derived from the CCAPM remains too high, whereas the SMB and HML factor coefficient estimates are substantially different between the three- and the five-factor Fama-French model specifications.

Similar are the results obtained from monthly portfolio returns. Specifically, the GDA-I model can explain 59% of the cross-sectional variation in the 100 *size/bm* portfolio premia with an $RMSE$ of 0.185, whereas the R^2 for the Fama-French three-factor model is 62% with an $RMSE$ of 0.179. Consistent with the results from annual portfolio returns, the estimated DA coefficient in the monthly sample is 3.6, while the second-order risk aversion parameter implied by the CCAPM is implausibly large (estimate = 245).

The results reported in Table 6 are illustrated by the scatterplots in Figure 3, which show sample

[9] Jagannathan and Wang (1996), Lettau and Ludvigson (2001), Yogo (2006), Malloy et al. (2009), Bansal et al. (2014).

[10] In untabulated results, we also find that the GDA-I model can explain the cross-section of 10 short-term reversal portfolios with an R^2 of 82% (67%) in the annual (monthly) sample.

[11] It should be noted that in the case of few missing return observations for the 100 portfolios, we replace them with the corresponding unconditional average portfolio return to maintain a balanced panel.

average versus fitted premia for the 100 *size/bm* portfolios. In fact, the GDA-I model yields a very good cross-sectional fit, which is comparable to the one of the Fama-French three-factor model. On the other hand, the CCAPM and the NBER model yield a poor fit, especially at the monthly frequency. Taken together, the results in this section show that the monthly and annual premia of the 100 *size/bm* portfolios can be sufficiently explained using a single pricing factor, namely the indicator of consumption growth being less than its certainty equivalent.

5.4.2 10 earnings/price portfolios

Fama and French (1993) use portfolios sorted on earnings/price (*e/p*) ratios to test their three-factor model. For robustness, we also test the GDA-I model using the cross-section of 10 *e/p* portfolios for the 1953 - 2012 period, both at the annual and at the monthly frequency. According to the annual results reported in Panel A of Table 7, the price of disappointment risk in the *e/p* cross-section (estimate = 4.1) is similar to the estimates reported in Table 2. This finding further supports the consistency of the DA coefficient estimates across test portfolios.

In contrast, the estimate of the second-order risk aversion coefficient is very large (estimate = 98.8), suggesting that the implied equity premium puzzle for the *e/p* portfolios is even more pronounced than for the *size/bm* cross-section. Finally, in terms of model fit, the single-factor GDA-I model can very well explain the cross-section of *e/p* portfolios at the annual frequency (R^2 = 92%, $RMSE$ = 0.86). In relative terms, the GDA-I model yields a better fit than the CCAPM, CAPM and NBER models, but it does not outperform the Fama-French three- and five-factor models, which achieve an almost perfect fit; however, the latter model yields puzzlingly negative factor coefficient estimates.

In the case of monthly returns, the results reported in Panel B of Table 7 show that the GDA-I model yields a much lower $RMSE$ than the CCAPM, CAPM, and NBER models. The CCAPM actually performs very poorly and implies a risk aversion coefficient of 286. The Fama-French three- and five-factor models still yield the best fit, but their factor coefficient estimates are dramatically different relative to the annual sample. To the contrary, the DA coefficient estimate is very similar to the one derived from annual portfolio returns. Overall, the results for the monthly *e/p* portfolios confirm that the GDA-I model outperforms the traditional CCAPM both in terms of model fit and in terms of plausibility of risk prices.

6. Disappointment events and high marginal utility states

6.1 Disappointment events and their characteristics

A successful consumption-based asset pricing model needs to accurately map "bad economic times" to states of high marginal utility for the representative investor. To this end, we examine how some key economic and financial variables behave during the disappointment consumption years extracted from the cross-section of the 25 *size/bm* portfolios (see Table 2). In particular, these disappointment years occurred in 1937, 1946, 1948, 1956, 1973, 1979-80, 1990, 1999, 2007-08, and 2011-12, and they are illustrated in Figure 4.[12] Table 8 reports the average values of these variables in the full sample period as well as during disappointment years. Moreover, to highlight that the identified disappointment events do not simply capture recession periods, we also report the average values of these variables during NBER recession years.

With respect to stock market performance, we find that during disappointment consumption years the market premium is negative, the size premium is highly negative, and the value premium is quite low relative to its full sample average. These effects are much less pronounced when we split the sample on the basis of NBER recession years, indicating that the stock market leads recessions and the disappointment indicator is successful in capturing this behavior. Moreover, the daily standard deviation of S&P 500 returns also tends to be higher during disappointment years.

Disappointment years are associated with a lower average term spread, supporting the argument that the disappointment indicator can be considered as a recession leading indicator. Verifying that disappointment years are "bad times" indeed, real consumption growth is almost zero, and the corresponding earnings growth rate is almost a third of its full sample average. Interestingly, net equity expansion is also very low during disappointment years, indicating that corporations anticipate the economic slowdown. Finally, confirming that consumption is abnormally low during these years, *cay* takes a negative average value and consumer confidence is dramatically reduced. On the other hand, we do not find disappointment years to be associated with a particularly negative market sentiment level, once this is orthogonalized with respect to macroeconomic conditions.

Furthermore, we find that disappointment consumption years are also associated with a high and

[12]The set of disappointment consumption years extracted from the cross-section of the 100 *size/bm* portfolios is the same, with the addition of 2006.

increasing inflation rate. Additionally, supporting the argument that the disappointment indicator anticipates rather than coincides with recessions, we find that these years are followed by, but do not coincide with, a higher and increasing unemployment rate.

6.2 Expected returns according to the GDA-I model

To explain the superior performance of the GDA-I model relative to the traditional CCAPM framework, we consider the expression for risk premia in equation (13). The poor performance of the CCAPM, especially at the monthly frequency, is due to the inability of the aggregate consumption growth process to align asset returns with marginal utility. In contrast, GDA-I is a non-linear transformation of the consumption growth process, for which periods of low returns are aligned with periods of high marginal utility (disappointment events).

More specifically, the GDA-I SDF in equation (4) implies that asset premia should be linearly related to their expected losses during disappointment events. In particular, substituting (4) into (13), we get:

$$\begin{aligned}\mathbb{E}[R_{i,t} - R_{f,t}] &= \frac{\theta}{1 - \theta\mathbb{E}[\mathbf{1}_t]}\mathbb{E}[\mathbf{1}_t(R_{i,t} - R_{f,t})] \\ &= -\frac{\theta\mathbb{E}[\mathbf{1}_t]}{1 - \theta\mathbb{E}[\mathbf{1}_t]}\mathbb{E}[(R_{i,t} - R_{f,t})|\mathbf{1}_t = 1],\end{aligned}$$

where $\mathbf{1}_t$ is the disappointment indicator. By correctly identifying disappointment events, the GDA-I model is able to align the full sample premia of risky assets with the average losses they incur during these events. To this end, Delikouras (2016) shows that the location of the reference point for gains and losses, i.e., the certainty equivalent of consumption growth, is crucial for this successful alignment.

Confirming these arguments, Figure 5 plots the full sample annual premia of the 25 *size/bm* portfolios versus their full sample disappointment betas. These betas are estimated from a model where the only regressor is the disappointment indicator (GDA-I) extracted from the cross-section of the 25 *size/bm* portfolios. In fact, Figure 5 shows that portfolio premia are almost perfectly aligned with their disappointment betas ($R^2 = 90.1\%$). In other words, the more sensitive portfolio returns are to the occurrence of a disappointment event (i.e., the greater the losses during this period), the higher the premium that this portfolio yields.

6.3 The GDA-I model and the Fama-French (2015) five-factor premia

The results reported in Section 4 show that the proposed GDA-I model can fit the premia of the size, value, profitability, and investment cross-sections as accurately as the multi-factor Fama-French models. This striking finding implies that the GDA-I SDF is a single-factor, consumption-based equivalent representation of the Fama-French multi-factor SDFs. If this holds true, then the GDA-I model should be also able to explain the premia that the five Fama and French (2015) factors yield.

To examine the validity of this conjecture, Figure 6 plots the full sample premia of the market, SMB, HML, RMW, and CMA factors versus their disappointment betas. Again, these betas are estimated from a model where the only regressor is the disappointment indicator (GDA-I) extracted from the cross-section of the 25 *size/bm* portfolios. In line with our conjecture, we find that the factor premia are well-aligned with their GDA-I betas ($R^2 = 76\%$). Moreover, the slope of the linear relationship between the factor premia and their GDA-I betas implies a DA coefficient of 4.19, which is very close to the corresponding estimates from the portfolio cross-sections (see Table 2). These results point to the conclusion that the premia that the Fama and French (2015) factors yield reflect compensation for exposure to disappointment consumption risk.

7. Identification, sensitivity analysis, and placebo tests

7.1 Identification tests for GDA-I betas

Burnside (2011) and Bryzgalova (2015) convincingly show that if asset returns are weakly correlated with the candidate pricing factor, then the corresponding risk premium may be weakly identified, leading to spurious inference. To address the potential concern that the proposed GDA-I model may suffer from weak identification, we conduct a series of Wald tests regarding the joint significance and the cross-sectional dispersion of the GDA-I betas.

To this end, we jointly estimate GDA-I betas utilizing a system of seemingly unrelated regressions (SUR) of the 25 *size/bm* portfolios as well the market portfolio returns on the GDA-I factor. The point estimates of GDA-I betas for these 25 portfolios are illustrated in Figure 5. First, we test the null hypothesis that these 25 GDA-I betas are jointly equal to zero ($H_0 : \widehat{\beta}_i^{GDA-I} = 0,\ \forall i$). Second, we test whether the 25 GDA-I betas are jointly equal to the GDA-I beta of the market portfolio ($H_0: \widehat{\beta}_i^{GDA-I} = \widehat{\beta}_m^{GDA-I},\ \forall i$). Third, we test whether the 25 GDA-I betas are jointly equal to their average estimate ($H_0: \widehat{\beta}_i^{GDA-I} = \overline{\widehat{\beta}}^{GDA-I},\ \forall i$). Finally, we test whether the GDA-I beta of the *small/value* portfolio, which yields the highest premium (see Table 1), is equal to that of the *big/growth* portfolio, which yields the lowest premium ($H_0: \widehat{\beta}_{S1B5}^{GDA-I} = \widehat{\beta}_{S5B1}^{GDA-I}$).

The Wald statistics reported in Table 9 indicate that we can reject each of these four null hypotheses at any conventional significance level. These results alleviate the potential concern that the GDA-I model may be weakly identified, since the 25 *size/bm* portfolio betas with respect to the GDA-I factor are both individually and jointly significant, and they exhibit significant cross-sectional dispersion in the statistical sense too. Hence, we conclude that the 25 *size/bm* portfolio returns significantly covary with the GDA-I SDF, and that these covariances exhibit a significant cross-sectional dispersion, reflecting the dispersion across portfolio premia.

7.2 Sensitivity analysis with respect to the disappointment threshold coefficient

In this section, we examine how sensitive is the explanatory ability of the GDA-I model with respect to the disappointment threshold coefficient d_2, which determines the GDA certainty equivalent for consumption growth (see equation (6)). To this end, we arbitrarily set this coefficient equal to $d_2 \pm$ std.error(d_2), based on the estimates of d_2 (= -0.770) and std.error(d_2) (=0.256) for the 25 *size/bm* portfolios from Panel A of Table 2. Each of these two alternative values for d_2 yields a different certainty equivalent, and hence a different set of disappointment consumption events.

Using each of these two modified GDA-I factors, we re-estimate the corresponding betas for the 25 *size/bm* portfolios, and re-examine their explanatory ability with respect to the annual portfolio premia. Panel A of Figure 7 contains the scatterplot of these portfolio premia versus their GDA-I betas, where the modified GDA-I factor has been determined using a disappointment threshold coefficient equal to $d_2 +$ std.error(d_2) (= -0.513). In this case, we get 21 disappointment consumption years in the 1933-2012 sample period, and the cross-sectional R^2 of the modified GDA-I factor betas with respect to the 25 *size/bm* portfolio premia is 82.2%. Moreover, the price of disappointment risk is equal to 0.577, implying a DA parameter of 2.942.

Panel B of Figure 7 contains the scatterplot of the 25 *size/bm* portfolio premia versus their GDA-I betas, where the modified GDA-I factor has been determined using a disappointment threshold coefficient equal to $d_2 -$ std.error(d_2) (= -1.026). In this case, we get only 7 disappointment consumption years. For this set of disappointment events, the cross-sectional R^2 of the modified GDA-I factor betas with respect to the portfolio premia is 79%, the price of disappointment risk is 0.389, and the implied DA parameter is 4.808.

This sensitivity analysis leads to some interesting conclusions. First, the explanatory power of the GDA-I factor remains quite high for a wide range of values of the disappointment threshold coefficient. Therefore, its successful empirical performance in our benchmark results is not particularly sensitive to the characterization as disappointing or not of those consumption growth observations that lie marginally around the GDA certainty equivalent (see Figure 4). Second, an alternative way to interpret these results is that the set of the 7 lowest consumption growth years (1937, 1946, 1973, 1979, 1990, and 2007-2008), which coincide with the disappointment events derived when the threshold coefficient is set equal to -1.026, goes a long way in explaining the cross-sectional dispersion in portfolio premia. Finally, the price of disappointment risk and the implied DA parameter derived from each of these two alternative sets of disappointment consumption events remain relatively stable around the benchmark estimates reported in Table 2.

7.3 Placebo indicators

Last but not least, we address the potential concern that the high explanatory power of the GDA-I model may be spuriously driven by the fact that the proposed factor is an indicator function. In particular, we examine whether a randomly generated (placebo) indicator could also yield a similarly high explanatory power, and hence whether our benchmark results are driven by "luck". To this end, we generate 1,000,000 time series, each consisted of 80 observations drawn from a Bernoulli distribution, containing exactly 67 zeros and 13 ones, and hence characterized by the same mean and variance as the GDA-I factor extracted from the cross-section of the 25 *size/bm* portfolios. Subsequently, we estimate the betas of the 25 *size/bm* portfolios with respect to each of these placebo indicators, and run a cross-sectional regression (without intercept) of the annual portfolio premia on the corresponding placebo indicator betas.

Figure 8 shows the histogram of the cross-sectional R^2s yielded by the placebo indicators, whereas the red vertical line indicates the R^2 (=90.1%) of the actual GDA-I factor. It is evident that the placebo indicators have a dismally low explanatory power with respect to the 25 *size/bm* portfolio premia. In fact, only 15 out of the 1,000,000 placebo indicators (=0.0015%) yield a cross-sectional R^2 that is equal to or greater than the one of the GDA-I factor. Hence, we can confidently reject at any conventional significance level the null hypothesis that the explanatory power of the proposed factor is driven by "luck".

8. Disappointing-minus-Elating factor

To gain additional insight on the economic significance of the GDA-I model, we construct a zero-cost *Disappointing-minus-Elating* (DME) factor utilizing the 100 *size/bm* portfolios. Using an initial window of 20 years (240 months), we recursively compute the covariances of these portfolio returns with respect to the GDA-I extracted from the cross-section of the 25 *size/bm* portfolios, sort these 100 portfolios in ascending order according to the absolute value of their covariances, assign them to deciles, and compute their post-ranking equally-weighted returns.[13] The *High-minus-Low* spread between the extreme deciles yields the DME factor return. Results are shown in Table 10 for both annual and monthly samples.

The premia and Sharpe ratios of the GDA-I covariance-sorted deciles clearly increase as we move from low (in absolute value) covariance portfolios to high covariance portfolios. Furthermore, the average DME factor premium in the annual sample is as high as 7.92% p.a. (Sharpe ratio = 0.46) and strongly significant (t-statistic = 3.60). Similar results hold for the monthly sample (DME premium = 0.43% per month, t-statistic = 3.12, Sharpe ratio = 0.12).

To gauge the relation between the DME factor and the Fama-French factors, we estimate the three-factor model for the DME factor returns and report the corresponding alpha and factor loadings in Panel B of Table 10. We find that the DME factor has strongly significant loadings on both SMB and HML factors at both frequencies. As a result, its three-factor alpha becomes economically insignificant, confirming that the DME factor premium predominantly reflects size and value premia and vice versa.

[13] Results are quantitatively very similar when we instead compute portfolio covariances with respect to the GDA-I factor extracted from the cross-section of the *100 size/bm* portfolios.

9. Stock-level analysis

In this section, we examine whether the GDA-I factor is priced in the cross-section of individual stock returns. To this end, we utilize all NYSE, AMEX, and NASDAQ common stocks (share codes 10 and 11) available at CRSP database during the period 1933 - 2012. The only filters we impose is that the stock price in December of the previous year is greater than \$5, and that a stock should have at least 20 years (240 months) of valid return observations so as to estimate reliable factor betas. As a result, our sample consists of 2,724 (2,732) unique permnos at the annual (monthly) frequency.

Given the very large cross-section of stocks and the unbalanced nature of this panel, we cannot estimate the GDA-I model using the benchmark GMM approach. Thus, we employ the Fama and MacBeth (1973) two-pass regression approach. In the first pass, we run full-sample time series regressions of individual stock excess returns on the GDA-I extracted from the cross-section of the 25 *size/bm* portfolios to estimate the corresponding GDA-I betas.[14] In the second pass, each year (month) we run a cross-sectional regression of stock excess returns on their full sample GDA-I betas to estimate the price of disappointment risk, which is given by the time-series average of these cross-sectional slope coefficients. Consistent with the functional form of the GDA-I SDF in equation (4), we impose no intercept in the cross-sectional regression. For comparison, we follow the same approach to fit the CCAPM, CAPM, Fama-French three-factor, and NBER models. Apart from standard t-statistics for these Fama-MacBeth estimates, we also compute their t-statistics with Shanken-adjusted standard errors to address the potential EIV bias arising from the fact that the factor betas are pre-estimated.

Results are reported in Table 11 for annual (Panel A) and monthly (Panel B) stock returns. In both cases, the price of disappointment risk is highly significant, even when we account for the fact that GDA-I betas are pre-estimated. The Fama-MacBeth estimate of 0.306 (0.307) for annual (monthly) stock returns implies a DA coefficient of 2.22 (2.26), which is lower but of the same order of magnitude as the coefficients estimated using portfolios as test assets. Moreover, these implied DA coefficients, are even closer to the ones reported in experimental studies. Overall, these

[14]Results are quantitatively very similar when we instead estimate stock betas with respect to the GDA-I extracted from the cross-section of the *100 size/bm* portfolios.

results show that the GDA-I factor is priced in the cross-section of stock returns, implying a very reasonable degree of disappointment aversion for the representative investor.

With respect to the other models, our conclusions are similar to the ones derived using portfolios as test assets. Regarding the CCAPM, even though consumption growth betas are significant in the cross-section of stock returns, and their explanatory power is comparable to the one of the GDA-I betas, the implied risk aversion coefficient is again implausibly high (46 for annual returns, and 192 for monthly returns). Moreover, Fama-French betas appear to yield the best explanatory power for stock premia, but this good fit comes at the expense of insignificant prices of risk for the SMB and HML factors. Even worse, the estimated price of risk for the HML factor turns negative for monthly stock returns, undermining the ability of the Fama-French model to explain the cross-section of stock premia in a theoretically consistent fashion.

10. Conclusion

Kocherlacota (1996) argues that to improve the performance of consumption-based models (at least) one of the following three assumptions needs to be relaxed: (i) CRRA preferences, (ii) market completeness, (iii) transaction costs. In this paper, we relax the CRRA assumption and propose a single-factor asset pricing model based on an indicator function of aggregate consumption growth being less than its certainty equivalent. This certainty equivalent is derived from generalized disappointment aversion preferences, and it is located approximately one standard deviation below the expected consumption growth.

Our single-factor model can sufficiently explain the cross-section of expected returns for the size, value, profitability, investment, and long-term reversal portfolios. In terms of relative performance, the proposed model outperforms traditional asset pricing models (CCAPM, CAPM). Moreover, the fit of our model is at least as good as the fit of the Fama and French (1993) three-factor model, and its performance is comparable to the one of the five-factor specification (Fama and French (2015)). In fact, our single-factor model can also explain the premia that the five Fama and French (2015) factors yield. Finally, the estimated prices of disappointment risk are more plausible and more stable across test portfolios and frequencies relative to the risk aversion coefficient estimates derived from the CCAPM.

Collectively, our results indicate that equity risk premia are, to a large extent, compensation for exposure to disappointment (i.e., downside) consumption risk, and challenge the overreaction hypothesis suggested by a number of previous studies. Our findings also indicate that disappointment aversion plays a crucial role in understanding the cross-section of expected returns from a consumption-based perspective, and question the effectiveness of the second-order risk aversion framework that is commonly used in asset pricing.

References

Ang, A., G. Bekaert, and J. Liu, 2005, "Why Stocks May Disappoint," *Journal of Financial Economics*, 76(3), 471–508.

Baker, M., and J. Wurgler, 2006, "Investor Sentiment and the Cross-section of Stock Returns," *Journal of Finance*, 61(4), 1645–1680.

Bansal, R., D. Kiku, I. Shaliastovich, and A. Yaron, 2014, "Volatility, the Macroeconomy, and Asset Prices," *Journal of Finance*, 69(6), 2471–2511.

Bansal, R., and A. Yaron, 2004, "Risks for the Long-Run: A Potential Resolution of Asset Pricing Puzzles," *Journal of Finance*, 59(4), 1481–1509.

Barberis, N., M. Huang, and T. Santos, 2001, "Prospect Theory and Asset Prices," *Quarterly Journal in Economics*, 116(1), 1–53.

Bonomo, M., R. Garcia, N. Meddahi, and R. Tédongap, 2011, "Generalized Disappointment Aversion, Long-Run Volatility Risk, and Asset Prices," *Review of Financial Studies*, 24(1), 82–122.

Breeden, D. T., 1979, "An Intertemporal Asset Pricing Model with Stochastic Consumption and Investment Opportunities," *Journal of Financial Economics*, 7(3), 265–296.

Bryzgalova, S., 2015, "Spurious Factors in Linear Asset Pricing Models," *Working paper.*

Burnside, C., 2011, "The Cross-Section of Foreign Currency Risk Premia and Consumption Growth Risk: Comment," *American Economic Review*, 101(7), 3456–3476.

Campbell, J., 2003, "Consumption-Based Asset Pricing," in *Handbook of the Economics of Finance.* Elsevier, Amsterdam, vol. 1B, pp. 801–885.

Choi, S., R. Fisman, D. Gale, and S. Kariv, 2007, "Consistency and Heterogeneity of Individual Behavior Under Uncertainty," *American Economic Review*, 97(5), 1921–1938.

Cochrane, J., 2001, *Asset pricing.* Princeton University Press, Princeton, NJ.

Dahlquist, M., A. Faragó, and R. Tédongap, 2016, "Asymmetries and Portfolio Choice," *Review of Financial Studies*, Forthcoming.

DeBondt, W. F., and R. Thaler, 1985, “Does the Stock Market Overreact?,” *Journal of Finance*, 40(3), 793–805.

———, 1987, “Further Evidence on Investor Overreaction and Stock Market Seasonality,” *Journal of Finance*, 42(3), 557–582.

Delikouras, S., 2016, “Where’s the Kink? Disappointment Events in Consumption Growth and Equilibrium Asset Prices,” *Review of Financial Studies*, Forthcoming.

Dolmas, J., 2014, “Disastrous Disappointments: Asset-Pricing with Disaster Risk and Disappointment Aversion,” *Working paper*.

Epstein, L. G., and S. E. Zin, 1989, “Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns,” *Econometrica*, 57(4), 937–969.

———, 1990, “First-Order Risk Aversion and the Equity Premium Puzzle,” *Journal of Monetary Economics*, 26(3), 387–407.

———, 2001, “The Independence Axiom and Asset Returns,” *Journal of Empirical Finance*, 8(5), 537–572.

Fama, E. F., and K. R. French, 1993, “Common Risk Factors in the Returns on Stocks and Bonds,” *Journal of Financial Economics*, 33(1), 3–56.

———, 2015, “A Five-Factor Asset Pricing Model,” *Journal of Financial Economics*, 116(1), 1–22.

Fama, E. F., and J. D. MacBeth, 1973, “Risk, Return, and Equilibrium: Empirical Tests,” *Journal of Political Economy*, 81(3), 607–636.

Faragó, A., and R. Tédongap, 2015, “Downside Risks and the Cross-Section of Asset Returns,” *Working paper*.

Gill, D., and V. Prowse, 2012, “A Structural Analysis of Disappointment Aversion in a Real Effort Competition,” *American Economic Review*, 102(1), 469–503.

Gul, F., 1991, “A Theory of Disappointment Aversion,” *Econometrica*, 59(3), 667–686.

Hansen, L. P., 1982, "Large Sample Properties of Generalized Method of Moments Estimators," *Econometrica*, 50(4), 1029–1054.

Hansen, L. P., and K. J. Singleton, 1982, "Generalized Instrumental Variables Estimation of Non-Linear Rational Expectations Models," *Econometrica*, 50(5), 1269–1286.

Harvey, C. R., Y. Liu, and H. Zhu, 2015, "... and the Cross-Section of Expected Returns," *Review of Financial Studies*, 29(1), 5–68.

Hou, K., C. Xue, and L. Zhang, 2015, "A Comparison of New Factor Models," *Working paper*.

Jagannathan, R., and Y. Wang, 2007, "Lazy Investors, Discretionary Consumption, and the Cross-Section of Stock Returns," *Journal of Finance*, 62(4), 1623–1661.

Jagannathan, R., and Z. Wang, 1996, "The Conditional CAPM and the Cross-Section of Expected Returns," *Journal of Finance*, 51(1), 3–53.

Jegadeesh, N., and S. Titman, 1993, "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency," *Journal of Finance*, 48(1), 65–91.

Kocherlacota, N., 1996, "The Equity Premium: It's Still a Puzzle," *Journal of Economic Literature*, 34(1), 42–71.

Lakonishok, J., A. Shleifer, and R. W. Vishny, 1994, "Contrarian investment, extrapolation and risk," *Journal of Finance*, 49(5), 1541–1578.

Lettau, M., and S. Ludvigson, 2001, "Resurrecting the (C)CAPM: A cross-sectional test when risk premia are time–varying," *Journal of Political Economy*, 109(6), 1238–1287.

Lewellen, J., S. Nagel, and J. Shanken, 2010, "A Skeptical Appraisal of Asset Pricing Tests," *Journal of Financial Economics*, 96(2), 175–194.

Liu, L. X., T. M. Whited, and L. Zhang, 2009, "Investment-Based Expected Stock Returns," *Journal of Political Economy*, 117(6), 1105–1139.

Malloy, C. J., T. J. Moskowitz, and A. Vissing-Jrgensen, 2009, "Long-run Stockholder Consumption Risk and Asset Returns," *Journal of Finance*, 64(6), 2427–2479.

Mehra, R., and E. C. Prescott, 1985, "The Equity Premium: a Puzzle," *Journal of Monetary Economics*, 15(2), 145–161.

Merton, R. C., 1973, "An Intertemporal Capital Asset Pricing Model," *Econometrica*, 41(5), 867–887.

Ostrovnaya, A., B. R. Routledge, and S. E. Zin, 2006, "Endogenous Countercyclical Risk Aversion and the Cross-Section," *Working paper*.

Parker, J. A., and C. Julliard, 2005, "Consumption Risk and the Cross-Section of Expected Returns," *Journal of Political Economy*, 113(1), 185–222.

Rabin, M., 2000, "Risk Aversion and Expected-Utility Theory: a Calibration Theorem," *Econometrica*, 68(5), 1281–1292.

Routledge, B., and S. Zin, 2010, "Generalized Disappointment Aversion and Asset Prices," *Journal of Finance*, 65(4), 1303–1332.

Savov, A., 2011, "Asset Pricing with Garbage," *Journal of Finance*, 76(1), 177–201.

Schreindorfer, D., 2014, "Tails, Fears, and Equilibrium Option Prices," *Working paper*.

Segal, U., and A. Spivak, 1990, "First Order Versus Second Order Risk Aversion," *Journal of Economic Theory*, 51(1), 111–125.

Shanken, J., 1992, "On the Estimation of Beta-Pricing Models," *Review of Financial Studies*, 5(1), 1–33.

Shiller, R. J., 1984, "Stock prices and social dynamics," *Brookings Papers on Economic Activity*, 12, 457–498.

Welch, I., and A. Goyal, 2008, "A comprehensive look at the empirical performance of equity premium prediction," *Review of Financial Studies*, 21(4), 1455–1508.

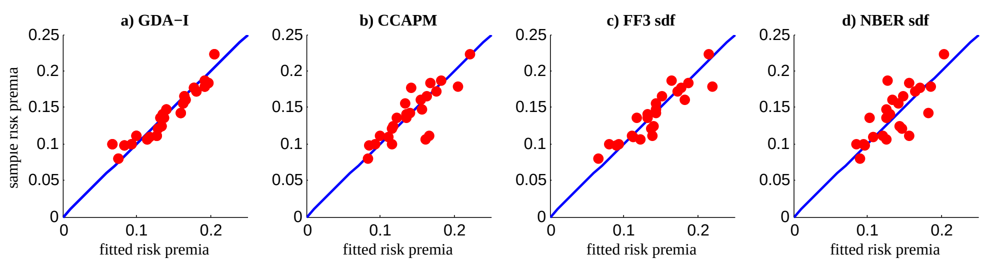
Yogo, M., 2006, "A Consumption-Based Explanation of Expected Stock Returns," *Journal of Finance*, 61(2), 539–580.

Figures

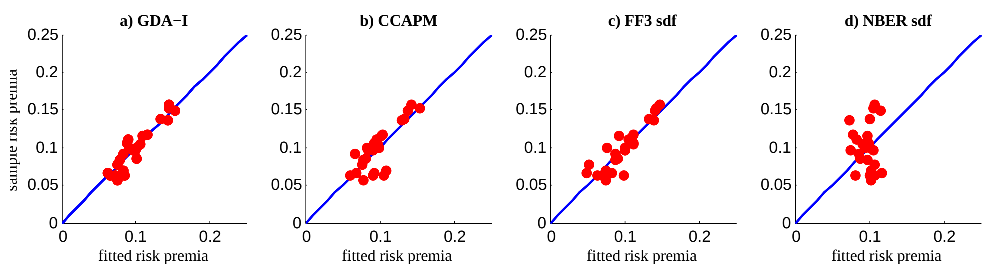
Figure 1 Sample and fitted risk premia for size/bm, size/op, size/inv, and ltr portfolios: annual returns

Figure 1 shows sample and fitted annual risk premia returns for the 25 size/book-to-market portfolios (Panel A), the 25 size/operating profitability portfolios (Panel B), the 25 size/investment portfolios (Panel C), and the 10 long-term reversal portfolios (Panel D). All portfolios are equally weighted. Fitted risk premia are estimated according to the expression in equation (13) for the *GDA-I*, *CCAPM*, *FF*3, and *NBER* discount factors. Estimation results are shown in Table 2. The sample period is from 1933 to 2012, with the exception of the operating profitability and investment portfolios that start in 1964.

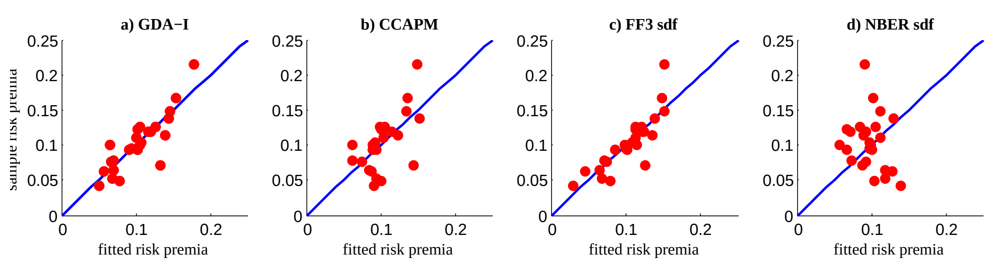
Panel A: 25 size/bm portfolios



Panel B: 25 size/op portfolios



Panel C: 25 size/inv portfolios



Panel D: 10 ltr portfolios

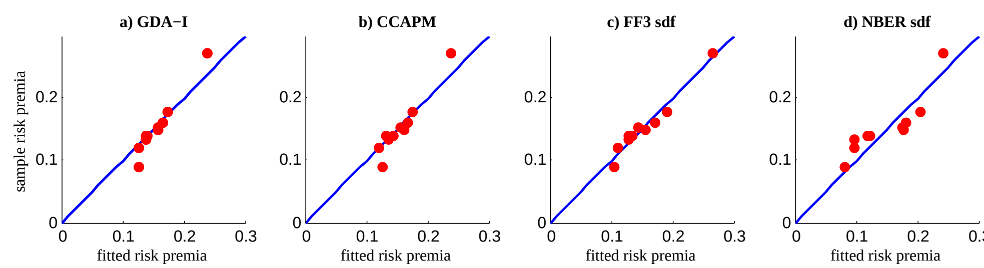


Figure 2 Sample and fitted risk premia for size/bm, size/op, size/inv, and ltr portfolios: monthly returns

Figure 2 shows sample and fitted monthly risk premia for the 25 size/book-to-market portfolios (Panel A), the 25 size/operating profitability portfolios (Panel B), the 25 size/investment portfolios (Panel C), and the 10 long-term reversal portfolios (Panel D). All portfolios are equally weighted. Fitted risk premia are estimated according to the expression in equation (13) for the *GDA-I*, *CCAPM*, *FF*3, and *NBER* discount factors. Estimation results are shown in Table 4. The sample period is from 1933 to 2012. The sample for the *CCAPM* starts in 1959, and the sample period for the operating profitability and the investment portfolios is from 1964 to 2012.

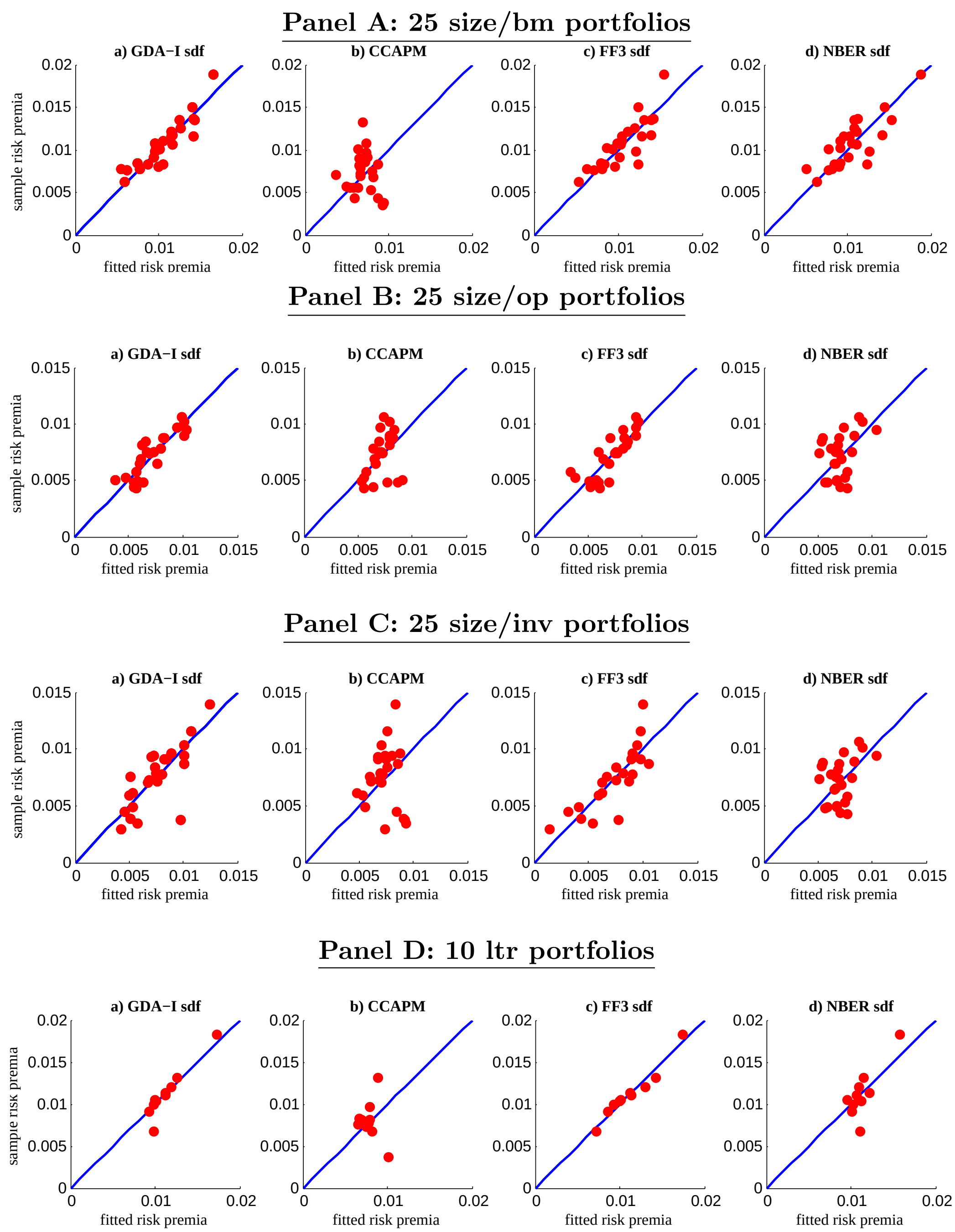
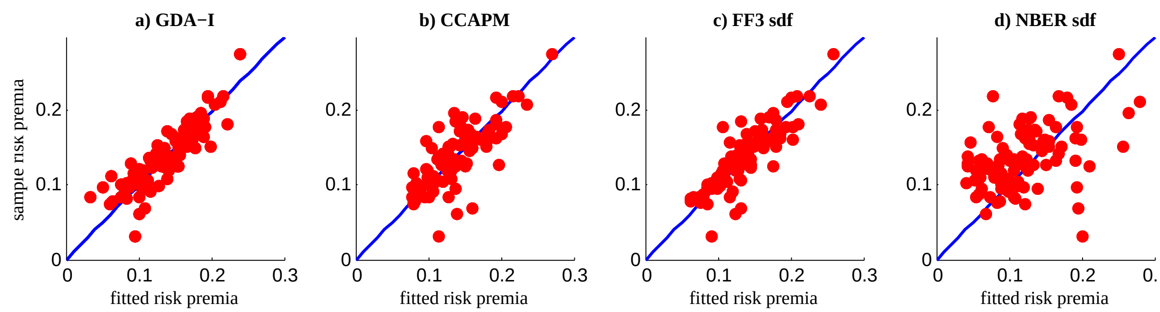


Figure 3 Sample and fitted risk premia for 100 size/bm portfolios

Figure 3 shows sample and fitted risk premia for the 100 size/book-to-market portfolios. Panel A shows results for annual returns while Panel B shows results for monthly returns. Fitted risk premia are estimated according to the expression in equation (13) for the $GDA\text{-}I$, $CCAPM$, $FF3$, and $NBER$ discount factors. Estimation results are shown in Table 6. The sample period is from 1933 to 2012, with the exception of the monthly sample for the $CCAPM$ that starts in 1959.

Panel A: annual returns



Panel B: monthly returns

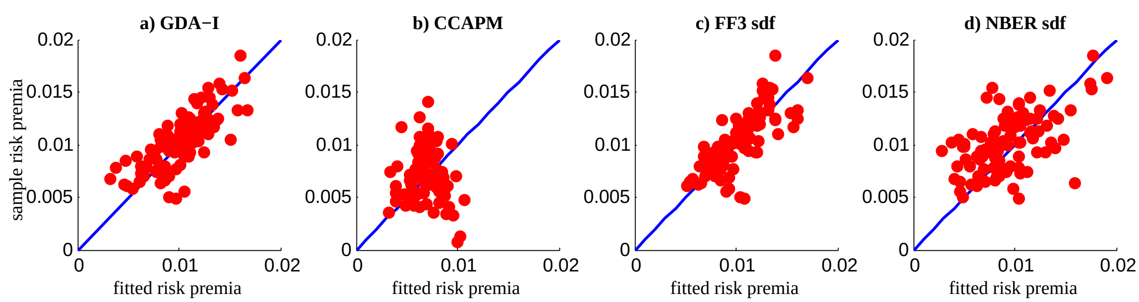


Figure 4 Consumption growth, disappointment events, and NBER recessions

Figure 4 shows annual disappointment events in consumption growth for the GDA-I discount factor of equation (4). Disappointment events are determined using the estimation results for the 25 size/book-to-market portfolios reported in Table 2. The solid line denotes consumption growth, and the dashed line is the time-varying GDA certainty equivalent of consumption growth given by equation (6). Disappointment events are highlighted by ellipses, and shaded areas are NBER recessions. The sample period is 1933 - 2012.

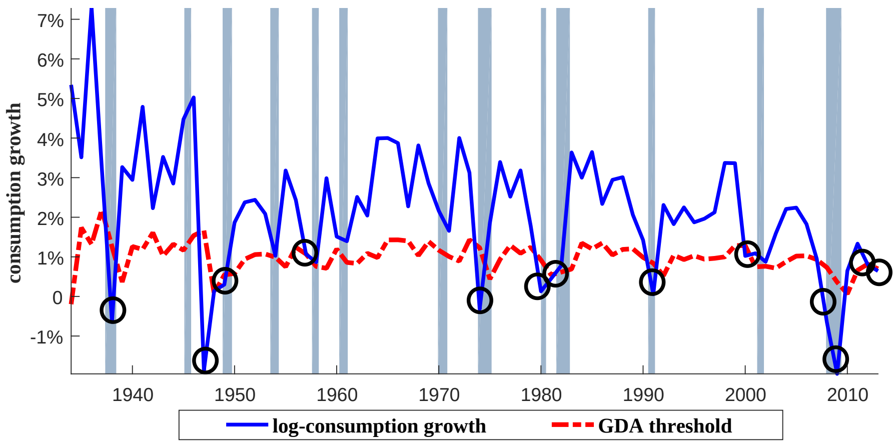


Figure 5 Premia vs. betas for the 25 size/bm portfolios

Figure 5 plots sample annual premia versus time-series betas estimated with respect to the GDA-I factor for the set of the 25 size/book-to-market portfolios. The GDA-I factor is determined using the estimation results for the 25 size/book-to-market portfolios reported in Table 2. R^2 is computed from the cross-sectional regression of portfolio premia on GDA-I factor betas without intercept. The sample period is 1933 - 2012.

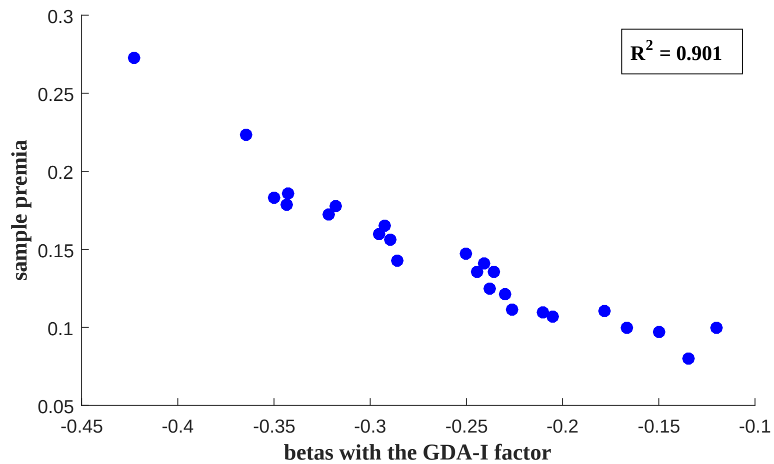


Figure 6 Premia vs. betas for the five Fama-French factors

Figure 6 plots sample annual premia versus time-series betas estimated with respect to the GDA-I factor for the five Fama and French (Fama and French (2015)) factors. The GDA-I factor is determined using the estimation results for the 25 size/book-to-market portfolios reported in Table 2. R^2 is computed from the cross-sectional regression of factor premia on GDA-I factor betas without intercept. The sample period for the excess market, SMB, and HML factors is 1933 - 2012, whereas the sample period for the RMW and CMA factors is 1964-2012.

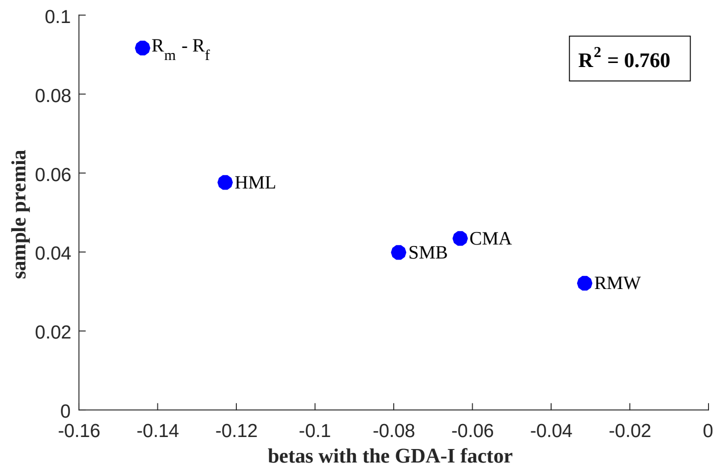
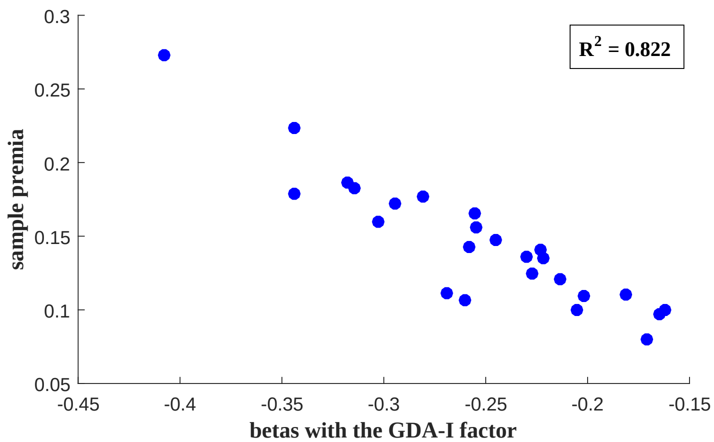


Figure 7 Sensitivity analysis for the disappointment threshold coefficient

Figure 7 plots sample annual premia versus time-series betas estimated with respect to a modified GDA-I factor for the set of 25 size/book-to-market portfolios. In Panel A, the modified GDA-I factor is defined relative to the certainty equivalent for consumption growth given by equation (6), and computed using a disappointment threshold coefficient equal to $d_2 + \text{std.error}(d_2)$ (= -0.513). In Panel B, the corresponding modified GDA-I factor is defined using a disappointment threshold coefficient equal to $d_2 - \text{std.error}(d_2)$ (= -1.026). The estimates of d_2 (= -0.770) and std.error(d_2) (= 0.256) are taken from Panel A of Table 2. R^2 is computed from the cross-sectional regression of portfolio premia on GDA-I factor betas without intercept. The sample period is 1933 - 2012.

Panel A: disappointment threshold coefficient: $d_2 + \textbf{std.error}(d_2)$



Panel B: disappointment threshold coefficient: $d_2 - \textbf{std.error}(d_2)$

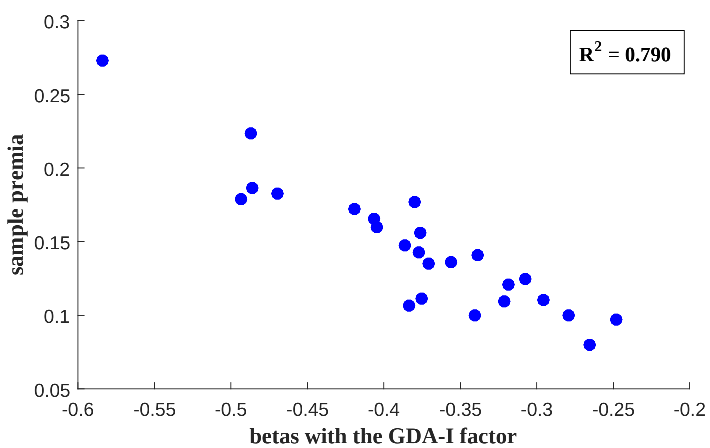
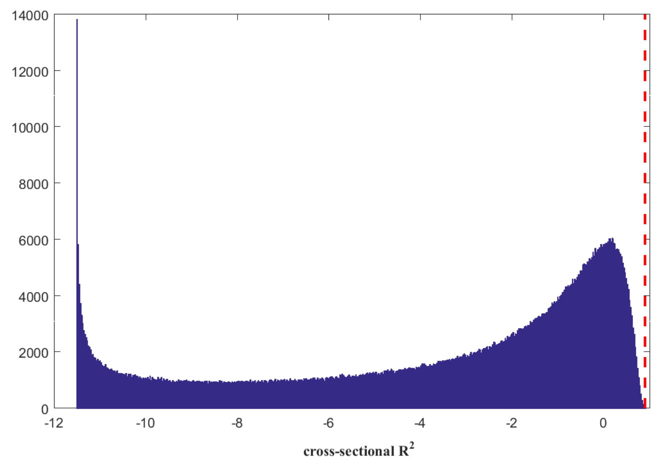


Figure 8 Explanatory power of placebo indicators

Figure 8 shows the histogram of cross-sectional R^2s yielded by a no-intercept regression of the annual premia of the 25 *size/bm* portfolios on their betas estimated with respect to a placebo indicator. Each of the 1,000,000 placebo indicators that we generate is consisted of 80 observations drawn from a Bernoulli distribution, containing exactly 67 zeros and 13 ones, and thus is characterized by the same mean and variance as the GDA-I factor extracted from the cross-section of the 25 *size/bm* portfolios. The vertical dashed line indicates the corresponding cross-sectional R^2 yielded by the actual GDA-I factor (R^2=0.901).



Tables

Table 1 Summary statistics

Table 1 shows summary statistics for the annual and monthly excess returns of all portfolios used in this study. Portfolio returns are from Kenneth French's website. Panel A shows summary statistics for annual excess returns, and Panel B shows summary statistics for monthly excess returns. We consider the following portfolio sorts: the 25 size/book-to-market portfolios (*size/bm*), the 25 size/operating profitability portfolios (*size/op*), the 25 size/investment portfolios (*size/inv*), the 10 long-term reversal portfolios (*ltr*), and the 10 earnings/price portfolios (*e/p*). The sample period is from 1933 to 2012. The sample for the operating profitability and investment portfolios starts in 1964, and the sample for earnings/price portfolios starts in 1953.

Panel A: Annual Returns

	25 size/bm		*25 size/op*		*25 size/inv*		10 *ltr*		*10 e/p*	
	size1/bm5	size5/bm1	size1/op1	size5/op5	size1/inv1	size5/inv5	ltr1	ltr 10	ep1	ep10
average (×100)	27.29	7.99	14.87	7.67	21.53	4.15	27.13	9.02	8.08	18.34
st. dev. (×100)	48.64	19.91	41.13	19.42	44.19	23.95	52.78	26.90	28.76	29.48

Panel B: Monthly Returns

	25 size/bm		*25 size/op*		*25 size/inv*		10 *ltr*		*10 e/p*	
	size1/bm5	size5/bm1	size1/op1	size5/op5	size1/inv1	size5/inv5	ltr1	ltr 10	ep1	ep10
average (×100)	1.88	0.63	0.94	0.57	1.38	0.28	1.83	0.67	0.56	1.27
st. dev. (×100)	9.53	5.30	7.68	481	7.74	6.02	10.43	6.57	6.43	5.63

Table 2 GMM results for annual portfolio returns

Table 2 shows GMM results for different portfolio sorts and asset pricing models at the annual frequency. For this set of tests, we estimate consumption growth moments, the DA coefficient θ, and the disappointment threshold d_2 for the *GDA-I* model from equation (4) using the augmented GMM system from equation (14). Table 2 does not report estimation results for the consumption growth moments. For our test assets, we consider four equally-weighted portfolio sorts: the 25 size/book-to-market portfolios (Panel A), the 25 size/operating profitability portfolios (Panel B), the 25 size/investment portfolios (Panel C), and the 10 long-term reversal portfolios (Panel D). *GDA-I* is the disappointment aversion discount factor from equation (4), and *CCAPM* is the consumption-based discount factor from equation (7). *CAPM* is the market model from (8). $FF3$ and $FF5$ are the Fama-French three- and five-factor models in equations (9) and (10), respectively. *NBER sdf* is the recession-based discount factor from equation (11). *GDA ind* is the disappointment indicator, d_2 is the threshold for disappointment from equation (4), *CONS* is aggregate consumption growth, *MKT* is the market excess return, *SMB* is the size factor, *HML* is the value factor, *RMW* is the profitability factor, *CMA* is the investment factor, and *NBER* is the NBER recession indicator. t-statistics are shown in parentheses. χ^2, dof, and p are the first-stage χ^2-test (Hansen (1982)), degrees of freedom, and p-value that all moment conditions are jointly zero. R^2 and $RMSE$ are the cross-sectional R-square and root mean square error ($\times 100$), respectively. The sample period is 1933-2012. The sample for the five-factor Fama-French model, the operating profitability, and the investment portfolios start in 1964.

PANEL A: 25 SIZE/BM

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	4.126					
	(4.207)					
d_2	-0.770					
	(-3.006)					
CONS		57.331				
		(3.499)				
MKT			2.935	2.043	3.191	
			(4.781)	(2.375)	(2.218)	
SMB				0.335	1.912	
				(0.309)	(1.242)	
HML				3.026	−0.473	
				(3.079)	(−0.153)	
RMW					0.967	
					(0.308)	
CMA					9.321	
					(2.080)	
NBER ind						9.157
						(1.053)
χ^2	28.795	87.580	97.940	62.460	42.570	5.543
dof	23	24	24	22	20	24
p	0.187	0	0	0	0.002	1.000
$RMSE$	1.345	2.107	2.973	1.648	1.563	2.358
R^2	0.901	0.758	0.519	0.852	0.821	0.697

PANEL C: 25 SIZE/INV

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	3.448					
	(2.477)					
d_2	-0.584					
	(-0.031)					
CONS		91.068				
		(1.701)				
MKT			2.889	2.841	3.713	
			(2.785)	(2.010)	(2.512)	
SMB				1.242	2.992	
				(0.921)	(1.707)	
HML				6.946	−4.664	
				(4.281)	(−0.760)	
RMW					4.686	
					(1.138)	
CMA					14.868	
					(1.811)	
NBER ind						4.642
						(1.188)
χ^2	31.137	49.241	131.615	64.842	57.750	15.146
dof	23	24	24	22	20	24
p	0.119	0.001	0	0	0	0.916
$RMSE$	1.952	3.028	3.967	2.020	1.696	4.770
R^2	0.743	0.383	-0.057	0.725	0.806	-0.529

PANEL B: 25 SIZE/OP

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	3.809					
	(1.710)					
d_2	-0.480					
	(-2.004)					
CONS		88.188				
		(1.672)				
MKT			2.793	2.430	2.546	
			(2.698)	(1.797)	(2.051)	
SMB				1.452	2.037	
				(1.258)	(2.024)	
HML				5.156	0.805	
				(1.839)	(0.267)	
RMW					3.523	
					(1.824)	
CMA					2.142	
					(0.596)	
NBER ind						4.527
						(1.183)
χ^2	15.506	30.481	69.366	51.500	36.759	15.714
dof	23	24	24	22	20	24
p	0.875	0.169	0	0	0.012	0.898
$RMSE$	1.031	1.728	2.674	1.338	1.016	3.247
R^2	0.879	0.660	0.187	0.796	0.882	−0.197

PANEL D: 10 LTR

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	4.327					
	(2.912)					
d_2	-0.752					
	(-4.682)					
CONS		62.493				
		(3.352)				
MKT			3.189	1.042	1.558	
			(4.875)	(0.695)	(0.418)	
SMB				2.205	10.133	
				(0.830)	(1.844)	
HML				3.067	−14.952	
				(1.330)	(−1.052)	
RMW					12.369	
					(1.121)	
CMA					31.899	
					(1.248)	
NBER ind						9.797
						(1.054)
χ^2	13.411	24.233	37.292	25.435	2.763	2.943
dof	8	9	9	7	5	9
p	0.098	0.003	0	0	0.736	0.966
$RMSE$	1.640	1.658	2.213	0.954	0.708	2.450
R^2	0.868	0.865	0.759	0.932	0.967	0.705

Table 3 GMM results for annual portfolio returns: recursive estimation of disappointment events

Table 3 shows GMM results for the *GDA-I* model across different portfolio sorts at the annual frequency. For these tests, disappointment events are estimated every year based on the available information up to time t with an initial period of 30 years. Specifically, every year, we estimate consumption growth moments, the DA coefficient θ, and the disappointment threshold d_2 for the *GDA-I* model from equation (4) using the augmented GMM system from equation (14). Table 3 does not report estimation results for the consumption growth moments. We consider four equally-weighted portfolio sorts: the 25 size/book-to-market portfolios, the 25 size/operating profitability portfolios, the 25 size/investment portfolios, and the 10 long-term reversal portfolios. Table 3 shows time-series averages of the recursive GMM estimates. The sample sample starts in 1933, with the exception of the operating profitability and investment portfolios that start in 1964. χ^2, dof, and p are the first-stage χ^2-test, degrees of freedom, and p-value that all moment conditions are jointly zero. R^2 and $RMSE$ are the cross-sectional R-square and root mean square error ($\times 100$), respectively. The numbers in brackets denote the minimum and maximum values for the corresponding time-series of R^2s.

Time-series means of the recursive GMM estimates

	25 size/bm	**25 size/op**	**25 size/inv**	**10 ltr**
θ	4.187	4.484	4.559	2.961
d_2	-0.839	-0.921	-0.854	-0.432
$\boldsymbol{\chi^2}$	27.177	24.059	25.971	10.917
$\boldsymbol{dof}$	23	23	23	8
$\boldsymbol{p}$	0.377	0.658	0.582	0.248
$\boldsymbol{RMSE}$	1.951	1.495	2.244	1.705
$\boldsymbol{R^2}$	0.848	0.773	0.670	0.878
	[0.72, 0.90]	[0.66, 0.89]	[0.35, 0.79]	[0.79, 0.94]

Table 4 GMM results for monthly portfolio returns

Table 4 shows GMM results for different portfolio sorts and asset pricing models at the monthly frequency. In the monthly sample, the only free parameter in the *GDA-I* model is the DA coefficient θ, since monthly disappointment events are based on annual disappointment events. Specifically, based on the results from Table 2, if year t is a disappointment year, then we assume that all months in year t are disappointment months. For these tests, we consider four equally-weighted portfolio sorts: the 25 size/book-to-market portfolios (Panel A), the 25 size/operating profitability portfolios (Panel B), the 25 size/investment portfolios (Panel C), and the 10 long-term reversal portfolios (Panel D). *GDA-I* is the disappointment aversion discount factor from equation (4), and $CCAPM$ is the consumption-based discount factor from equation (7). $CAPM$ is the market model from (8). $FF3$ and $FF5$ are the Fama-French three- and five-factor models in equations (9) and (10), respectively. $NBER$ *sdf* is the recession-based discount factor from equation (11). *GDA ind* is the disappointment indicator, *CONS* is aggregate consumption growth, MKT is the market excess return, *SMB* is the size factor, *HML* is the value factor, RMW is the profitability factor, *CMA* is the investment factor, and *NBER* is the NBER recession indicator. t-statistics are shown in parentheses. χ^2, dof, and p are the first-stage χ^2-test, degrees of freedom, and p-value that all moment conditions are jointly zero. R^2 and $RMSE$ are the cross-sectional R-square and root mean square error ($\times 100$), respectively. The sample period is 1933-2012. The sample for the five-factor Fama-French model, the operating profitability, and the investment portfolios start in 1964, and the sample for the $CCAPM$ starts in 1959.

PANEL A: 25 SIZE/BM

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	3.673					
	(3.293)					
CONS		248.151				
		(2.464)				
MKT			3.579	2.342	3.625	
			(4.974)	(2.847)	(2.245)	
SMB				0.517	6.724	
				(0.434)	(3.638)	
HML				4.905	2.138	
				(4.521)	(0.367)	
RMW					9.490	
					(1.837)	
CMA					10.265	
					(0.891)	
NBER ind						7.786
						(1.374)
χ^2	41.296	70.582	121.875	94.856	94.631	9.662
dof	24	24	24	22	20	24
p	0.015	0	0	0	0	0.995
$RMSE$	0.119	0.283	0.249	0.156	0.142	0.174
R^2	0.818	−0.496	0.178	0.677	0.673	0.601

PANEL C: 25 SIZE/INV

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	3.076					
	(2.147)					
CONS		232.939				
		(2.452)				
MKT			3.195	3.755	3.284	
			(3.003)	(2.865)	(1.979)	
SMB				3.596	1.473	
				(1.978)	(0.653)	
HML				14.136	19.445	
				(6.943)	(2.387)	
RMW					−7.160	
					(−0.999)	
CMA					−6.898	
					(−0.664)	
NBER ind						5.484
						(1.026)
χ^2	74.268	146.370	226.658	133.842	125.073	41.850
dof	24	24	24	22	20	24
p	0	0	0	0	0	0.013
$RMSE$	0.167	0.292	0.314	0.146	0.145	0.333
R^2	0.594	−0.230	−0.425	0.689	0.694	−0.604

PANEL B: 25 SIZE/OP

	DA sdf	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	3.514					
	(1.746)					
CONS		226.207				
		(2.403)				
MKT			3.086	3.697	2.958	
			(2.916)	(2.692)	(1.927)	
SMB				3.265	4.226	
				(1.869)	(2.466)	
HML				13.753	10.704	
				(4.199)	(1.756)	
RMW					4.335	
					(1.677)	
CMA					−3.329	
					(−0.330)	
NBER ind						5.432
						(1.008)
χ^2	16.535	27.161	58.037	37.576	32.066	7.492
dof	24	24	24	22	20	24
p	0.867	0.297	0	0.020	0.042	0.999
$RMSE$	0.094	0.174	0.208	0.106	0.079	0.180
R^2	0.744	0.126	−0.243	0.675	0.817	0.069

PANEL D: 10 LTR

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	3.854					
	(3.393)					
CONS		283.175				
		(2.592)				
MKT			3.916	2.602	−2.977	
			(5.267)	(2.225)	(−0.445)	
SMB				−0.277	−0.399	
				(−0.166)	(−0.010)	
HML				6.869	57.460	
				(3.211)	(0.998)	
RMW					−22.229	
					(−0.324)	
CMA					−70.971	
					(−0.834)	
NBER ind						8.265
						(1.369)
χ^2	15.084	39.204	52.822	17.187	4.934	4.153
dof	9	9	9	7	5	9
p	0.088	0	0	0	0.423	0.901
$RMSE$	0.108	0.264	0.209	0.016	0.059	0.182
R^2	0.856	−0.394	0.468	0.945	0.942	0.597

Table 5 GMM results for the joint cross-section of portfolios

Table 5 shows GMM results for the various asset pricing models at the annual and monthly frequencies during the 1964-2012 period using the joint cross-section of portfolio returns. For the annual sample in Panel A, we estimate consumption growth moments, the DA coefficient θ, and the disappointment threshold d_2 using the augmented GMM system from equation (14). Table 5 does not report estimation results for the consumption growth moments. In the monthly sample of Panel B, the only free parameter in the GDA-I model is the DA parameter θ, since monthly disappointment events are based on annual disappointment events. Specifically, based on the results from Panel A, if year t is a disappointment year, then we assume that all months in year t are disappointment months. For these tests, we *jointly* consider four equally-weighted portfolio sorts: the 25 size/book-to-market portfolios, the 25 size/operating profitability portfolios, the 25 size/investment portfolios, and the 10 long-term reversal portfolios. *GDA-I* is the disappointment aversion discount factor from equation (4), and $CCAPM$ is the consumption-based discount factor from equation (7). $CAPM$ is the market model from (8). $FF3$ and $FF5$ are the Fama-French three- and five-factor models in equations (9) and (10), respectively. $NBER$ *sdf* is the recession-based discount factor from equation (11). *GDA ind* is the disappointment indicator, *CONS* is aggregate consumption growth, MKT is the market excess return, *SMB* is the size factor, *HML* is the value factor, RMW is the profitability factor, *CMA* is the investment factor, and *NBER* is the NBER recession indicator. t-statistics are shown in parentheses. χ^2, dof, and p are the first-stage χ^2-test, degrees of freedom, and p-value that all moment conditions are jointly zero. R^2 and $RMSE$ are the cross-sectional R-square and root mean square error ($\times 100$), respectively. Panel A does not show results for the t-statistics and χ^2-test due to the limited time-series observations relative to the number of portfolios.

PANEL A: Annual Returns

	GDA-I	**CCAPM**	**CAPM**	**FF3**	**FF5**	**NBER sdf**
GDA ind	3.506					
d_2	-0.532					
CONS		91.646				
MKT			2.915	2.377	3.306	
SMB				1.550	2.513	
HML				5.100	-1.593	
RMW					2.929	
CMA					10.831	
NBER ind						4.739
$RMSE$	1.588	2.387	3.542	1.834	1.598	4.015
R^2	0.806	0.563	0.039	0.742	0.804	−0.379

PANEL B: Monthly Returns

	GDA-I	**CCAPM**	**CAPM**	**FF3**	**FF5**	**NBER sdf**
GDA ind	3.159					
	(2.135)					
CONS		234.556				
		(2.453)				
MKT			3.233	2.990	4.746	
			(3.021)	(2.443)	(3.693)	
SMB				3.790	5.399	
				(2.279)	(3.207)	
HML				10.133	−1.385	
				(6.157)	(−0.503)	
RMW					6.745	
					(2.421)	
CMA					18.942	
					(4.821)	
NBER ind						5.509
						(1.027)
χ^2	151.995	246.359	376.476	346.425	302.160	134.894
dof	84	84	84	82	80	84
p	0	0	0	0	0	0
$RMSE$	0.131	0.262	0.280	0.145	0.129	0.294
R^2	0.695	−0.232	−0.382	0.630	0.706	−0.516

Table 6 GMM results for the 100 size/book-to-market portfolios

Table 6 shows GMM results for different asset pricing models in the cross-section of 100 size/book-to-market portfolios. The sample period is from 1933 to 2012. The sample for the five-factor Fama-French model starts in 1964, and the monthly sample for the *CCAPM* starts in 1959. For the annual sample in Panel A, we estimate consumption growth moments, the DA coefficient θ, and the disappointment threshold d_2 using the augmented GMM system from equation (14). Table 6 does not report estimation results for the consumption growth moments. For the monthly sample in Panel B, the only free parameter in the *GDA-I* model is the DA coefficient θ, since monthly disappointment events are based on annual disappointment events. Specifically, based on the results from Panel A, if year t is a disappointment year, then we assume that all months in year t are disappointment months. *GDA-I* is the disappointment aversion discount factor from equation (4), and *CCAPM* is the consumption-based discount factor from equation (7). *CAPM* is the market model from (8). *FF*3 and *FF*5 are the Fama-French three- and five-factor models in equations (9) and (10), respectively. *NBER sdf* is the recession-based discount factor from equation (11). *GDA ind* is the disappointment indicator and d_2 is the threshold for disappointment from equation (4). *CONS* is aggregate consumption growth, *MKT* is the market excess return, *SMB* is the size factor, *HML* is the value factor, *RMW* is the profitability factor, *CMA* is the investment factor, and *NBER* is the NBER recession indicator. t-statistics are shown in parentheses. χ^2, dof, and p are the first-stage χ^2-test, degrees of freedom, and p-value that all moment conditions are jointly zero. R^2 and $RMSE$ are the cross-sectional R-square and root mean square error ($\times 100$), respectively. Panel A does not show results for the t-statistics and χ^2-test due to the limited time-series observations relative to the number of portfolios.

PANEL A: Annual Returns

	GDA-I	**CCAPM**	**CAPM**	**FF3**	**FF5**	**NBER sdf**
GDA ind	4.031					
d_2	-0.749					
CONS		58.273				
MKT			2.978	1.996	2.778	
SMB				0.641	1.991	
HML				2.689	0.953	
RMW					1.651	
CMA					5.618	
NBER ind						8.161
$\boldsymbol{RMSE}$	2.100	2.731	3.204	2.176	2.155	5.955
$\boldsymbol{R^2}$	0.769	0.609	0.463	0.752	0.668	−0.854

PANEL B: Monthly Returns

	GDA-I	**CCAPM**	**CAPM**	**FF3**	**FF5**	**NBER sdf**
GDA ind	3.578					
	(3.292)					
CONS		244.522				
		(2.448)				
MKT			3.573	2.433	3.923	
			(4.944)	(2.996)	(2.883)	
SMB				0.591	5.834	
				(0.524)	(3.443)	
HML				4.467	0.677	
				(4.093)	(0.193)	
RMW					8.254	
					(1.913)	
CMA					12.638	
					(1.972)	
NBER ind						7.418
						(1.410)
$\boldsymbol{\chi^2}$	125.087	133.184	183.886	66.507	206.415	64.796
$\boldsymbol{dof}$	99	99	99	97	95	99
$\boldsymbol{p}$	0.039	0.012	0	0	0	0.996
$\boldsymbol{RMSE}$	0.185	0.291	0.258	0.179	0.169	0.339
$\boldsymbol{R^2}$	0.590	−0.501	0.209	0.620	0.562	−0.360

Table 7 GMM results for the 10 earnings-to-price portfolios

Table 7 shows GMM results for different asset pricing models in the cross-section 10 earnings-to-price portfolios. The sample period is from 1953 to 2012. The sample for the five-factor Fama-French model starts in 1964. For the annual sample in Panel A, we estimate consumption growth moments, the DA coefficient θ, and the disappointment threshold d_2 using the augmented GMM system from equation (14). Table 7 does not report estimation results for the consumption growth moments. For the monthly sample of Panel B, the only free parameter in the *GDA-I* model is the DA coefficient θ, since monthly disappointment events are based on annual disappointment events. Specifically, based on the results from Panel A, if year t is a disappointment year, then we assume that all months in year t are disappointment months. *GDA-I* is the disappointment aversion discount factor from equation (4), and *CCAPM* is the consumption-based discount factor from equation (7). *CAPM* is the market model from (8). *FF*3 and *FF*5 are the Fama-French three- and five-factor models in equations (9) and (10), respectively. *NBER sdf* is the recession-based discount factor from equation (11). *GDA ind* is the disappointment indicator and d_2 is the threshold for disappointment from equation (4). *CONS* is aggregate consumption growth, *MKT* is the market excess return, *SMB* is the size factor, *HML* is the value factor, *RMW* is the profitability factor, *CMA* is the investment factor, and *NBER* is the NBER recession indicator. t-statistics are shown in parentheses. χ^2, *dof*, and p are the first-stage χ^2-test, degrees of freedom, and p-value that all moment conditions are jointly zero. R^2 and *RMSE* are the cross-sectional R-square and root mean square error ($\times$100), respectively.

PANEL A: Annual Returns

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	4.132					
	(1.089)					
d_2	-0.606					
	(-1.387)					
CONS		98.838				
		(2.395)				
MKT			3.417	0.864	−0.093	
			(3.567)	(0.420)	(−0.010)	
SMB				3.699	−16.396	
				(1.212)	(−1.089)	
HML				6.367	−12.738	
				(3.626)	(−0.831)	
RMW					14.353	
					(0.690)	
CMA					−1.074	
					(−0.035)	
NBER ind						8.103
						(0.965)
χ^2	7.593	14.150	23.528	3.868	1.256	2.042
dof	8	9	9	9	5	9
p	0.474	0.117	0.005	0.794	0.939	0.990
RMSE	0.858	1.153	3.085	0.342	0.648	4.020
R^2	0.918	0.853	-0.051	0.987	0.950	-0.785

PANEL B: Monthly Returns

	GDA-I	CCAPM	CAPM	FF3	FF5	NBER sdf
GDA ind	3.848					
	(2.558)					
CONS		285.694				
		(2.632)				
MKT			4.373	3.457	−1.661	
			(4.070)	(1.679)	(−0.223)	
SMB				5.500	9.955	
				(1.373)	(0.645)	
HML				15.306	23.813	
				(7.556)	(2.386)	
RMW					13.200	
					(0.595)	
CMA					−33.324	
					(−1.148)	
NBER ind						10.275
						(0.826)
χ^2	8.815	31.177	76.364	5.584	3.579	3.095
dof	9	9	9	7	5	9
p	0.454	0	0	0.589	0.611	0.960
RMSE	0.061	0.277	0.269	0.023	0.023	0.332
R^2	0.896	−0.961	−0.764	0.987	0.984	−1.683

Table 8 Key economic variables during disappointment and recession years

Table 8 shows averages for key economic and financial variables during disappointment and recession years as well as over the full sample period, 1933-2012. *Cay* is available since 1945, *unemployment rate* is available since 1947, *consumer confidence* is available since 1961, and *sentiment* is available since 1965. The set of disappointment years is determined using the estimation results for the 25 size/book-to-market portfolios reported in Table 2. Factor returns are taken from Kenneth French's website. The economic and financial variables are computed using the updated dataset of Welch and Goyal (2008), with the exception of the unemployment rate, which is taken from the Bureau of Labor Statistics, and the real per capita consumption growth rate, which is sourced from BEA. *Consumer confidence* is the University of Michigan survey of consumer confidence, and *sentiment* is the Baker and Wurgler (2006) index of investor sentiment orthogonalized with respect to a set of macroeconomic conditions.

	Full Sample	Disappointment Years	Non-Disappointment Years	NBER Recession Years	Non-Recession Years
Market Premium	9.16%	-3.05%	11.52%	1.93%	10.96%
SMB Premium	2.12%	-5.68%	3.63%	0.95%	2.41%
HML Premium	9.02%	4.23%	9.95%	8.02%	9.28%
S&P 500 Daily St. Dev.	15.43%	19.22%	14.70%	19.26%	14.48%
Default spread	1.12%	1.33%	1.08%	1.55%	1.01%
Term spread	1.62%	0.99%	1.74%	1.83%	1.57%
Real Consumption growth	2.21%	-0.07%	2.65%	1.47%	2.39%
Earnings growth	11.23%	3.20%	12.78%	4.65%	12.87%
Net Equity Expansion	1.52%	0.77%	1.66%	1.48%	1.53%
cay	0.00%	-0.16%	0.03%	-0.08%	0.02%
Inflation Rate	3.68%	6.03%	3.23%	3.47%	3.74%
Change in inflation	0.15%	1.75%	-0.16%	-1.13%	0.47%
Unemployment	5.77%	5.72%	5.78%	6.16%	5.67%
Change in unemployment	0.06%	-0.04%	0.09%	1.25%	-0.23%
Unemployment, t+1	5.77%	6.22%	5.68%	7.28%	5.43%
Change in unemployment, t+1	0.06%	0.97%	-0.10%	1.12%	-0.20%
Consumer confidence	86.31	76.44	88.38	71.52	89.41
% Change in consumer confidence	0.16%	-7.49%	1.80%	-8.80%	2.08%
Sentiment (orthogonalized)	0.012	-0.028	0.019	0.364	-0.074

Table 9 Identification tests for GDA-I betas

Table 9 presents the results from four Wald tests regarding the joint significance and the cross-sectional dispersion of the GDA-I factor betas. We estimate a system of seemingly unrelated regressions (SUR) of the 25 *size/bm* portfolios as well as the market portfolio returns on the GDA-I factor. The GDA-I factor is determined using the estimation results for the 25 size/book-to-market portfolios reported in Table 2. Based on these estimates, we conduct the following Wald tests: i) we test whether the 25 portfolio betas are jointly equal to zero ($H_0 : \widehat{\beta}_i^{GDA-I} = 0,\ \forall i$); ii) we test whether the 25 portfolio betas are jointly equal to the market portfolio beta ($H_0 : \widehat{\beta}_i^{GDA-I} = \widehat{\beta}_m^{GDA-I},\ \forall i$); iii) we test whether the 25 portfolio betas are jointly equal to their average estimate ($H_0 : \widehat{\beta}_i^{GDA-I} = \overline{\widehat{\beta}}^{GDA-I},\ \forall i$); and iv) we test whether the beta of the *small/value* portfolio is equal to that of the *big/growth* portfolio ($H_0 : \widehat{\beta}_{S1B5}^{GDA-I} = \widehat{\beta}_{S5B1}^{GDA-I}$). $Wald$ and p denote the $Wald$ statistic and the corresponding p-value, respectively. The sample period is 1933-2012.

	Null Hypothesis			
	$\widehat{\beta}_i^{GDA-I} = 0,\ \forall i$	$\widehat{\beta}_i^{GDA-I} = \widehat{\beta}_m^{GDA-I},\ \forall i$	$\widehat{\beta}_i^{GDA-I} = \overline{\widehat{\beta}}^{GDA-I},\ \forall i$	$\widehat{\beta}_{S1B5}^{GDA-I} = \widehat{\beta}_{S5B1}^{GDA-I}$
$\boldsymbol{Wald}$	71.68	63.32	68.97	6.24
$\boldsymbol{p}$	0.000	0.000	0.000	0.002

Table 10 Portfolios sorted on the covariance with the disappointment indicator

Panel A of Table 10 shows the unconditional risk premia and Sharpe ratios for decile portfolios constructed on the basis of covariances with respect to the disappointment indicator ($GDA\text{-}I$), which is determined using the estimation results for the 25 size/book-to-market portfolios reported in Table 2. Starting from an initial time-window of 20 years (240 months), we recursively estimate the covariances of the *100 size/bm* portfolio returns with respect to GDA-I, sort these portfolios into deciles according to their covariances, and compute their post-ranking equally-weighted returns. The *High-minus-Low* spread between the extreme deciles yields the *Disappointing-minus-Elating* (DME) factor return. Table 10 also reports the time-series averages of the covariances between each decile portfolio and the $GDA\text{-}I$ factor. Panel B of Table 10 reports the Fama-French three-factor regression results for the DME factor. α_{FF3} is the Fama-French alpha of the DME factor, while β_m, β_{smb}, and β_{hml} are the market, SMB, and HML betas of the DME factor respectively. t-statistics, which are shown in parentheses, are adjusted for autocorrelation and heteroscedasticity using the Newey-West correction with four lags. R^2 is the time-series R-square. The sample period is 1933 - 2012.

PANEL A: Portfolios sorted on disappointment covariances

Rank	**Annual Returns**			**Monthly Returns**		
	−Covariance with the GDA-I	**Premia**	**Sharpe**	**−Covariance with the GDA-I**	**Premia**	**Sharpe**
High	5.88	15.77	0.55	0.49	1.03	0.17
9	5.01	12.64	0.46	0.41	0.77	0.13
8	4.65	13.39	0.51	0.38	0.92	0.16
7	4.31	12.03	0.48	0.35	0.89	0.16
6	4.01	10.74	0.45	0.33	0.84	0.15
5	3.70	10.06	0.43	0.30	0.69	0.13
4	3.38	9.48	0.44	0.27	0.73	0.14
3	3.09	8.61	0.40	0.25	0.71	0.15
2	2.65	8.05	0.40	0.22	0.62	0.13
Low	1.90	7.85	0.38	0.15	0.60	0.13
High-minus-Low (DME)	3.98	7.92	0.46	0.33	0.43	0.12
		(3.60)			(3.12)	

PANEL B: High-minus-Low (DME) on FF3 factors

	Annual	Monthly
α_{FF3}	1.75	0.03
	(2.13)	(0.39)
β_m	0.02	-0.03
	(0.35)	(-0.97)
β_{smb}	1.06	1.01
	(8.95)	(12.58)
β_{hml}	0.58	0.59
	(11.72)	(9.55)
R^2	0.85	0.68

Table 11 Fama-MacBeth results for individual stock returns

Table 11 shows Fama-MacBeth estimation results for individual stock returns using the linear discount factor specifications from equations (4)-(11). Panel A shows annual results, while Panel B shows monthly results. *GDA-I* is the disappointment aversion discount factor from equation (4), and *CCAPM* is the consumption-based discount factor from equation (7). *CAPM* is the market model from (8), *FF3* is the Fama-French three factor model from (9), and *NBER sdf* is the recession-based discount factor from equation (11). *GDA ind* is the disappointment indicator, *CONS* is aggregate consumption growth, *MKT* is the market excess return, *SMB* is the size factor, *HML* is the value factor, and *NBER* is the NBER recession indicator. The GDA-I factor is determined using the estimation results for the 25 size/book-to-market portfolios reported in Table 2. t-statistics are shown in parentheses, and Shanken (1992) t-statistics are shown in brackets. θ and $\widetilde{\alpha}$ are the DA and risk aversion parameters implied by the estimates in Table 11. The sample period is from 1933 to 2012. The monthly sample for *CCAPM* starts in 1959.

PANEL A: Annual returns						**PANEL B: Monthly returns**					
	GDA-I	**CCAPM**	**CAPM**	**FF3**	**NBER sdf**		**GDA-I**	**CCAPM**	**CAPM**	**FF3**	**NBER sdf**
GDA ind	0.306					GDA ind	0.307				
	(3.84)						(5.04)				
	[3.14]						[3.91]				
implied θ	2.22					implied θ	2.26				
CONS		0.012				CONS		0.002			
		(4.38)						(3.91)			
		[3.87]						[3.31]			
implied $\widetilde{\alpha}$		45.53				implied $\widetilde{\alpha}$		192			
MKT			0.116	0.109		MKT			0.009	0.010	
			(4.82)	(4.92)					(5.38)	(5.93)	
			[4.67]	[4.90]					[5.37]	[5.92]	
SMB				0.046		SMB				0.002	
				(2.56)						(1.58)	
				[2.47]						[1.57]	
HML				0.008		HML				-0.001	
				(0.42)						(-0.72)	
				[0.40]						[-0.72]	
NBER ind					0.367	NBER ind					0.321
					(3.77)						(4.29)
					[2.93]						[3.22]
R^2	0.171	0.222	0.265	0.343	0.089	R^2	0.120	0.131	0.211	0.239	0.077