Corporate Innovation and its Effects on Equity Returns*

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Abstract

This paper provides a rational explanation for the performance of price momentum strategies, based on the concept of corporate innovation. We define corporate innovation as the proportion of a firm's gross profit margin not explained by the capital and labor it utilizes. We show that an aggregate measure of corporate innovation is priced in the cross-section of equity returns. Corporate innovation-based portfolio strategies exhibit very similar characteristics and performance to those of price momentum strategies. The returns on corporate innovation-based strategies can explain a substantial proportion of the time-series variation in price momentum strategies. Finally, our economic story about the performance of price momentum, based on the concept of corporate innovation, is also consistent with long horizon return reversals and the performance of long-horizon contrarian strategies.

Keywords: Corporate innovation, price momentum, risk.

JEL classification: G12, G14.

How easily can a firm replicate the success of another? Can a firm match the profitability of a successful firm by simply putting in place the same amount of capital and labor as that of the firm it tries to mimic?

Most economists and strategists will agree that matching a firm's amount of labor and capital is far from sufficient for matching its success in the market place, as measured by its market share and profits. Several other factors play a pivotal role in a firm's success including, but not limited to, the quality of its management, its commitment to innovation, marketing efforts, and brand name. Such factors can substantially differentiate two firms with otherwise identical amounts of capital and labor in place, and lead to very different levels of profitability. For simplicity, we will refer to such productivity factors as corporate innovation.

The purpose of this paper is to examine the effects that corporate innovation has on equity returns. In doing that, we also provide a rational explanation for the performance of price momentum strategies.

We measure corporate innovation as the component of a firm's Gross Profit Margin (GPM) not explained by the amount of capital and labor it has in place. We show that an aggregate measure of corporate innovation is priced in the cross-section of equity returns, when it appears in a pricing model together with the market factor. The economic justification for such a specification can be found with reference to Merton's (1973) Intertemporal Capital Asset Pricing Model (ICAPM). Note that corporate innovation is the product of the human capital employed in a firm. People who possess high levels of human capital receive a high return on it when their firm's corporate innovation is high, and low return when corporate innovation is low. Since human capital cannot be sold but only leased, economic agents wish to hedge their human capital risk by selling stocks of companies whose returns are

positively correlated with the aggregate level of corporate innovation. The result would be that the prices of these stocks will be driven down and their expected returns up. This hypothesis is confirmed in our asset pricing tests which show that our measure of aggregate corporate innovation (*ACI*) receives positive and statistically significant risk premium.

In addition, our asset pricing tests reveal that the priced information in the momentum factor, often used in asset pricing tests, is similar in nature to that of *ACI*. Indeed, when the momentum factor coexists in the pricing kernel together with *ACI*, it no longer receives a positive and statistically significant risk premium, unlike what has been previously shown in the literature. The implication of this result is that the risk premium attached to the momentum factor may be a premium for hedging human capital risk.

The link between *CI* and price momentum portfolios is further explored by examining the relation between the returns of portfolios formed on the basis of *CI* and past returns. We show that portfolios formed on the basis of *CI* and portfolios formed on the basis of past returns share several important characteristics. Portfolios constructed on the basis of *CI* exhibit monotonicity with respect to this variable by construction. However, the construction of momentum portfolios does not involve any information related to *CI*. Nevertheless, momentum portfolios exhibit the same kind of monotonicity across deciles as that found in the *CI* portfolios. Winners are the firms with the highest average *CI* among momentum deciles, whereas losers are the firms with the lowest average *CI*. This finding reveals that *CI* is an important variable for the performance of momentum strategies.

Further tests reveal that price momentum strategies deliver zero returns when they are run using exclusively stocks of low *CI* firms. In contrast, when they are run using only stocks of high *CI* firms, they are very profitable, and more so than when the winners and losers are chosen from the whole

sample. In other words, the performance of momentum strategies is conditional on the stocks held being of high *CI* firms.

Regression analysis reveals that the returns of *CI*-based strategies can explain a substantial proportion of the time-series variation in the returns of popular momentum strategies. The adjusted R-squares obtained vary between 23% and 28%. This is a large improvement over the typical 0% adjusted R-squares previously reported in the literature from regressions of momentum returns on economically motivated variables.

One of the major challenges in explaining price momentum is that the economic explanation proposed should also be consistent with the fact that price momentum is a medium-term phenomenon, and that returns exhibit reversals in 3-5 year horizons, giving rise to contrarian strategies. Our results in Section 4 show that *CI* can explain both the momentum and contrarian strategy returns. Whereas losers are the firms with the lowest average *CI* and winners the firms with the highest average *CI* at the time of portfolio formation, five years down the road, losers outperform winners and they exhibit higher average *CI* than the winners at that time. In other words, the switch from return continuation to reversal has to do with the evolution over time of *CI* at a firm level. Corporate innovation is not publicly known at each point in time, but it can be inferred. As information about it is slowly revealed to the market, the prices of stocks adjust to reflect it. This process induces a return continuation. Losers cannot remain losers forever or they will be punished with extinction. They have to find a way to innovate and deliver higher returns to capital. Similarly, it is hard for winners to remain winners for prolonged periods of time. Good ideas are eventually imitated by competitors, and human capital cannot be expected to be equally creative per unit of time. Over time, winners may lose their competitive edge, at least temporarily.

The rest of the paper is organized as follows. Section 1 details the approach we use to measure corporate innovation. Section 2 describes the data and provides summary statistics. Section 3 contains the main body of our results. It contains asset pricing tests, as well as results based on portfolio sortings that reveal the level of relation between corporate innovation and momentum. In addition, it provides evidence from regression analysis. Section 4 contains results on the relation between *CI*, momentum, and contrarian strategies. We conclude with a summary of our results in Section 5.

1. Measuring a Firm's Level of Corporate Innovation

As mentioned earlier, we measure corporate innovation as the proportion of a firm's Gross Profit Margin (GPM) not explained by the level of capital and labor it utilizes. We define GPM as the difference between a firm's sales and the cost of the goods it sells. The idea is that we can set up another firm in the same line of business as a successful firm, by investing the same amount of capital in the same technology as the successful firm, and hire the same amount of labor. This, however, will not guarantee that this "copy-cat" firm will be as successful as the original firm. Part of the original firm's success is exactly due to its originality, which may be attributed to factors such as its ability to come up with innovative new products, the possession of patents and know-how, the quality of its management, the quality of labor it can attract, and its marketing and advertising strategies, among other things.

Although we do not aim to provide here a theoretical justification for our measure of corporate innovation, our formulation can be understood by reference to a standard Cobb-Douglas production function. In particular, assume that a firm's output is given by

$$Y_t = A_t K_t^{\alpha_1} L_t^{\alpha_2} \qquad (1)$$

where Y_t denotes the firm's output at time t, K_t is the firm's capital stock used for the production of Y_t L_t is the labor input in the production process, and A_t is the total factor productivity at time t, which is often interpreted in the literature as capturing technology shocks. The exponents α_1 and α_2 denote the shares of capital and labor respectively. In a competitive labor market, and assuming for simplicity absence of intermediate goods in the production function, the gross profit margin of the firm is defined as follows:

$$GPM_t = Y_t - L_t MP_L \tag{2}$$

where *GPM* denotes the gross profit margin, and MP_L the marginal product of labor. Note that MP_L is given by

$$MP_L = a_2 A_t K_t^{a_1} L_t^{a_2 - 1} \tag{3}$$

Therefore,

$$\begin{aligned} &GPM_t = A_t K_t^{a_1} L_t^{a_2} - a_2 A_t K_t^{a_1} L_t^{a_2} \Rightarrow \\ &GPM_t = (A_t - a_2 A_t) K_t^{a_1} L_t^{a_2} \end{aligned} \tag{4}$$

Equation (4) says that a firm's gross profit margin at time *t* is a function of the firm's capital and labor at time *t*, as well as the term $(A_t - a_2 A_t)$, which we call Corporate Innovation (CI).

Our next task is to estimate the CI term at time *t* for all US firms. To do that, we can use the following regression equation:

$$\Delta^i gpm_{lt} = \beta_0 + \beta_1 \Delta^i k_{lt} + \beta_2 \Delta^i l_{lt} + \varepsilon_{lt}, \qquad i = 1, 2, 3, 4 \quad l=1,\ldots,N \tag{5}$$

where $\Delta^i gpm_{lt} = \log\left(GPM_{lt} \big/ GPM_{lt-i} \right)$ is the change in the l^{th} firm's log GPM from quarter $t-i$ to quarter t, $\Delta^i k_{lt} = \log\left(K_{lt} \big/ K_{lt-i} \right)$ is the change in the log capital stock from quarter $t-i$ to quarter t

for firm l, and $\Delta^i l_{lt} = \log\left(L_{lt} \middle/ L_{lt-i} \right)$ is the change for firm l in the log labor employed from quarter $t-i$ to quarter t. Note that i denotes the horizon over which the growth in the variables of interest is computed.

Corporate innovation is then given by:

$$CI_{lt}^{i} = \Delta^i gpm_{lt} - \left(\hat{\beta}_1 \Delta^i k_{lt} + \hat{\beta}_2 \Delta^i l_{lt} \right) \qquad (6)$$

where $\hat{\beta}_1$ and $\hat{\beta}_2$ are the OLS estimates of β_1 and β_2 respectively.

The computation of CI_t used here is very similar to that of Solow (1957) residuals.[3] In fact, equation (4) reveals that CI_t shows up as a modified Solow residual. In particular, CI_{lt} is the Solow residual A_t of firm l shrunk by the factor $a_2 A_t$. It can be understood as the return on capital of that particular firm at time t.

For the purpose of our empirical analysis, we compute CI_{lt} over the horizons of past 1, 2, 3 and 4 quarters. To prevent look-ahead bias, we use only information that is available to the investor at time t. We obtain a time-series of CI_t's by performing rolling regressions. The CI_l at time t is computed using the parameters estimated from a regression run with data up to time t. Similarly, CI_{lt+1} is obtained by re-estimating the parameters after adding one new observation to the rolling regression window and dropping the first one.

The reader may observe that some of the production factors captured by our definition of CI can simply be intangible assets such as Research and Development (R&D) expenditure, or

[3] Some assumptions of the original Solow (1957) derivation do not hold in our application. In particular, Solow (1957) assumes that the productivity growth is not directly affected by any exogenous shifts in the firm's demand function or in the prices of its factors of production. As noted in Hall (1990), when there is a correlation between an exogenous variable and the Solow residual, the assumptions of perfect competition and constant returns to scale no longer hold. Our estimation of corporate innovation is simply *in the spirit* of Solow residuals.

licensing and patterns. Such factors have been considered in previous papers.[4] However, CI_t is much more general than any particular intangible asset category considered in previous research. As mentioned above, it can be viewed as the return on capital for a particular firm, and factors such as R&D or patterns simply contribute positively or negatively to this rate of return. In addition, the focus of the current paper is different. Whereas most previous work focuses on how accounting practices treat intangible assets, our paper focuses on the effect that non-capital and non-labor production factors have on a firm's profitability and its expected returns. In this context, we also provide new insights into the performance of price momentum strategies.

A study that considers the effects of intangible assets on equity returns is that of Chan, Lakonishok, and Sougiannis (2001). They examine whether stock prices fully reflect R&D expenditure. They find that the average historical returns of firms that do R&D are the same as those of firms that do not. As it is apparent from the previous discussion, the focus and results of our paper differ substantially from those of Chan, Lakonishok and Sougiannis (2001).

2. Data

The inputs needed to compute a firm's *CI* are obtained from COMPUSTAT.

As mentioned earlier, we define a firm's gross profit margin as the difference between a firm's sales (COMPUSTAT industrial quarterly data item 2) minus its cost of goods sold (COMPUSTAT industrial quarterly data item 30).

A firm's labor is proxied by the number of its employees (COMPUSTAT industrial annual data item 29).[5] Furthermore, the capital stock of a firm is measured using the series "Property, Plant and

[4] See for instance, the studies of Hall (1993), Barth and Clinch (1998), and Lev, Nissim, and Thomas (2002), among others.

[5] We prefer the data item 29 over the series "labor and related expenses" (Compustat industrial annual data item 42) because the latter is only sparsely collected for most of the firms in Compustat.

Equipment – Total (Net)" (COMPUSTAT industrial annual data item 8 before 1976, and COMPUSTAT industrial quarterly data item 42 after 1976).

We convert data available at an annual frequency to quarterly observations by simply assigning for the quarters of the year the annual observation of that year. As a robustness check, we also experimented with simple splicing techniques to transform annual data into quarterly. The results of the paper remain qualitatively the same, and for that reason we do not report them here.

We use the fiscal year end month data (FYR) variable in the COMPUSTAT industrial annual file to arrange the annual data into the appropriate calendar period. To make sure that there is no look-ahead bias in our analysis, an observation is used about 3 months after it is published. For instance, in the case of an annual observation with YEARA (fiscal year) equal to 1966 and FYR (fiscal year end month of data) equal to 3, the observation is first used as an end-of-quarter observation for the second quarter of 1966. By the same token, we lag quarterly series by one quarter. In this manner, we ensure that the information used to compute CI_{lt} is known to the investors at the time of the computation of CI_{lt}.

The capital, labor, and output data are transformed into one-, two-, three-, and four-quarter growth rates, giving us a total of four different growth rates data sets. We do that in order to be able to measure CI_t over different horizons. To compute the CI_t for the current quarter, we require a firm to have at least 7 years of prior data, or a total of 28 consecutive quarterly observations for the GPM, labor, and capital stock series. Table 1 reports the number of firms included in each of the four data sets, as well as the mean and standard deviation of the corporate innovation measure each year.

Our analysis covers the period from the first quarter of 1967 to the last quarter of 2001, which represents the period for which data for all variables are available. Since we require a minimum of 28 consecutive observations to compute the CI_t, the first $CI's$ are computed for the first quarter of 1975.

However, only a small number of firms is available for that year, making the portfolio results for 1975 relatively unreliable. For that reason, we present results on portfolio returns starting January 1976.

Monthly stock prices, book-to-market (BM), and market capitalization (ME) information is obtained from the Center for Research in Security Prices (CRSP) database. It includes firms listed on the NYSE, AMEX, and NASDAQ stock exchanges. We restrict our analysis to stocks with codes equal to 10 or 11. This ensures that we work exclusively with returns on common stocks. In other words, closed-end funds, trusts, shares of Beneficial Interest, American Depository Receipts, Real Estate Investment Trusts, etc, are excluded from our analysis. Firm size is defined as the number of shares outstanding times the monthly price. A firm's BM is defined as the COMPUSTAT industrial quarterly data item 59 divided by the firm size.

Data for the 25 Fama-French (1993) portfolios, as well as for the market factor, T-bill rate, the size factor SMB, the BM factors HML, and the momentum factor UMD are obtained from Kenneth French's website.[6]

3. Empirical Results

This section contains the main body of our results. It shows that an aggregate measure of CI is priced in the cross-section of equity returns. It also shows that corporate innovation can at least partly explain the performance of price momentum strategies.

3.1. The Pricing of Corporate Innovation in Equity Returns

[6] We would like to thank Kenneth French for making the data publicly available. The website URL is http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

We start our analysis by examining whether corporate innovation represents a risk factor in equity returns. For the purpose of the asset pricing tests, we aggregate the GPM, capital stock, and labor across all firms in our sample. We then compute the growth rates of these variables over the past quarter, and construct an aggregate CI factor, which we will denote by *ACI*. The variable *ACI* is used as a factor in our asset pricing tests. As test assets we use the familiar Fama-French (1993) 25 book-to-market and size-sorted portfolios obtained from Ken French's website.

Our asset pricing tests are performed using the Generalized Methods of Moments (GMM). Since *ACI* is a generated factor, and to avoid problems related to errors-in-variables, we stack the moment conditions for the estimation of *ACI* on top of those of the asset pricing model in question, and estimate them all simultaneously in one large GMM system. This method is proposed in Cochrane (2001) in connection with correcting for errors-in-variables problems inherent in the Fama-MacBeth procedure.

In the absence of a theoretical asset pricing model that gives rise to *ACI* as a risk factor, we need to examine whether it is priced within a reasonable empirical specification. We choose to add *ACI* to the Capital Asset Pricing Model (CAPM) specification, generating therefore a two-factor model.

An economic justification for this empirical specification can be obtained with reference to Merton's (1973) Intertemporal CAPM (ICAPM). Note that corporate innovation is the result of human capital. People with high levels of human capital get good return on it when their firm's corporate innovation is high. Therefore, the return on human capital is positively correlated with the corporate innovation of the company where it is employed. Since people cannot sell their human capital, but only lease it, they hedge it by selling stocks of companies whose returns are positively correlated with the aggregate corporate innovation *ACI*. This activity drives down the prices of stocks with positive *CI* and

increases their expected return. The end result is that firms that are positively correlated with *ACI* receive a positive risk premium in the cross-section of equity returns.

The findings in Table 2 confirm the above reasoning. Indeed, *ACI* carries a positive and statistically significant risk premium in the cross-section of the 25 Fama-French portfolios. This premium can be understood as a hedging premium for hedging one's human capital risk.

Apart from examining the pricing of *ACI* in this section, we also test an additional hypothesis, the results of which are important for interpreting the rest of the findings in this paper.

The performance of price momentum strategies and the ability of the momentum factor to explain part of the cross-section of equity returns has been one of the most puzzling anomalies in the asset pricing literature in the recent years. Grinblatt, Titman and Wermers (1995) and Carhart (1997) show that a momentum factor can explain part of the abnormal returns generated by mutual funds. Fama and French (1996) discuss the properties of their three factor model, and its inability to explain momentum. They suggest that a fourth, momentum-related factor may need to be added to their empirical specification. Recently, there have been some risk-based explanations for the performance of the Fama-French (1993) model.[7] These explanations relate the Fama-French factors to macroeconomic variables and the business cycle. In the remainder of this section we examine whether the momentum factor shares any priced information with *ACI*, thereby testing a particular risk-based hypothesis for the pricing of momentum.

Panel B of Table 2 reports the results from GMM tests that include in the pricing kernel the market factor and the momentum factor UMD, obtained from Ken French's website. These results confirm previous findings that UMD carries a positive and statistically significant risk premium. Panel C presents results from a model that includes in the pricing kernel the market factor, UMD, and *ACI*.

[7] See for instance, Liew and Vassalou (2000), Lettau and Ludvingson (2001), Vassalou (2003), Li, Vassalou, and Xing (2003), and Vassalou and Xing (2003).

Note that while *ACI* continues to be priced as in Panel A, the risk premium attached to UMD ceases to be statistically significant. This implies that *ACI* and UMD share common priced information. In other words, the premium attached to UMD appears to be a hedging premium for human capital risk.

In the following sections, we explore further the relation between corporate innovation and price momentum by examining the performance and characteristics of portfolios formed on the basis of these two variables.

3.2. Corporate Innovation and Subsequent Equity Returns

To understand better the relation between corporate innovation and price momentum, we construct portfolios using the methodology detailed in Jagadeesh and Titman (1993). To render our comparison more informative, we focus on the 6-month, 6-month momentum strategy which is the most popular in the literature. This momentum strategy involves sorting stocks on the basis of their returns over the past 6 months and creating 10 portfolios. It then goes long on the decile that contains the best performing stocks over the past 6 months (winners) and short on the decile with the worst performing stocks over the past 6 months (losers). The zero initial investment portfolio is held for a period of 6 months.

We construct a CI-based strategy that matches the formation and holding period horizons of the above-mentioned momentum strategies. In particular, once we have obtained a time series of *CI*'s for each firm in our sample, we construct portfolios in the following manner. In the beginning of each quarter, we rank firms on the basis of their current quarter *CI,* computed using growth rates in GPM, capital and labor over the past two quarters. We then form ten portfolios. Decile 1 (P1) contains the firms with the lowest (negative) *CI*'s, whereas decile 10 (P10) contains the firms with the highest *CI*'s. Every month of that quarter, we go long on P10 and short on P1 (P10-P1). The holding period for the

portfolios is 6 months. The portfolios are equally-weighted, and their performance is reported in Table 3, together with that of the 6-month, 6-month momentum strategy.

The comparison of the performances of the *CI* and momentum strategies reveals the following results. First, the returns from the two alternative zero-investment strategies are quite similar. The return on the zero-investment portfolio of the *CI* strategy is equal to 0.73% per month, or 8.76% per year. This is a bit higher than the corresponding momentum strategy return, which is equal to 0.64% per month.

More importantly, the two alternative strategies have common characteristics with respect to the corporate innovations of the stocks they trade. By construction, the deciles sorted on the basis of *CI* exhibit monotonicity with respect to this variable. Note, however, that the procedure used to construct the price momentum strategy does not involve the use of any information about the *CI* 's of the firms involved. Nevertheless, the price momentum portfolios exhibit the same type of monotonicity with respect to *CI* as the portfolios sorted on the basis of corporate innovation. In particular, the "losers" are typically firms with negative *CI* 's, whereas the "winners" are the firms with the highest average *CI* among momentum portfolios. In addition, there is some degree of similarity across the *CI* and price momentum deciles with respect to their average size and BM characteristics. More specifically, high *CI* stocks, as well as winners, tend to be larger, low BM firms, whereas low *CI* stocks and losers are somewhat smaller, higher BM firms. The spread, however, in terms of size and BM across the *CI* portfolios is smaller than that across the momentum portfolios, further suggesting that the firms comprising the deciles of the two strategies are not identical. Finally, both strategies are market beta neutral, as indicated by the beta of the zero-investment portfolios.

Table 3 also reports the firm-specific volatilities of all deciles of the *CI* and price momentum strategies. Average firm-specific volatility for each portfolio is computed following the method

proposed in Campbell, Lettau, Malkiel, and Xu (2001). In particular, we decompose a firm's return into the return of its industry and an innovation. For this decomposition, we use the same 49 industry classification as in Campbell et al (2001). We then sum the squares of the firm-specific innovations. For each industry represented in each of the portfolios of the two strategies, we compute the weighted average of the firm-specific volatilities. We then average over industries represented within each portfolio of the two strategies to obtain a measure of average firm-specific volatility for the portfolio. The numbers reported are annualized volatilities in percentage terms.

A comparison of the average firm-specific volatilities by decile for the two strategies reveals that they exhibit a similar pattern. Specifically, the firm-specific volatilities across deciles of each strategy form an asymmetric U-shape. Firms with negative CI 's , as well as losers, have the highest firm-specific volatilities. As the level of CI increases to around zero, the average firm-specific volatility of the portfolio decreases. The same is true as we move from the losers portfolio to portfolio 6. As average CI becomes positive and increases across the CI portfolios, so does the average firm-specific volatility. This is also the case across the momentum deciles.

Note that the average firm-specific volatility for the highest CI portfolio and for the winners is nevertheless smaller than that of the negative CI and losers portfolios respectively. This means that firms with the highest levels of CI are riskier than firms with close to zero CI . However, firms with the most negative average CI , as well as past losers, are the riskiest among all stocks.

It is obvious why firms with negative CI 's are the riskiest. They are the firms that use their production factors inefficiently. They provide a GPM that is much lower than what is justified given the capital and labor they employ. Investors sell such firms, pushing their prices lower, and rendering them "losers".

Firms that have the highest levels of *CI* 's are also risky, albeit less than those with the most negative *CI* 's. These are firms that deliver much higher GPM than what one would expect given the capital and labor they use. Their success is due to production factors that are not easily quantifiable and measurable. They are less risky than the firms with the most negative *CI* 's because they have positive innovation to help them boost their profitability. They are however more risky than firms with zero *CI* 's, because so much of their profitability is due to corporate innovation which is a somewhat elusive production factor, and one that can be relatively easily lost, as we will see in Section 3.3. Stocks with the highest level of *CI* are "winners", so long as they can keep up the corporate innovation. Note that winners have also higher levels of firm-specific volatility than firms that had delivered less high returns in the past six months.

Table 3 also reports the average GPM growth per decile of the two strategies. As expected, the *CI* deciles exhibit monotonicity with respect to GPM growth with P10 providing the highest GPM growth and P1 the lowest. The same is true for the momentum deciles, even though their construction does not involve any information related to GPM. In particular, "winners" is the decile with the highest average GPM growth, whereas losers is the one with the lowest. We also report the average coefficients on capital and labor growth, as well as the constant from the OLS regressions used in the computation of the CI variable. No specific pattern for the capital and labor coefficients is found across the deciles of the two strategies, implying that winners and high CI firms are not distinct from the others in terms of their growth in capital and labor. In other words, their capital and labor growth rates are not the sources of their success.

The CI strategy presented here may constitute an at least partial explanation for the returns of the momentum strategy. It is partial to the extent that the stocks involved in the two strategies are not identical, although the characteristics of the strategies are very similar. It may also be a complete

explanation. Note that the average firm-specific volatilities for P1 and P10 in the case of the momentum strategy are higher than those for the CI strategy. Also, the return on the zero-investment CI portfolio is slightly higher than that of the zero-investment momentum portfolio. It is possible that the momentum strategy is a noisy proxy of the CI strategy, and that this is the reason why its returns are lower and the firm-specific volatilities higher. Distinguishing between these two hypotheses is beyond the scope of the current study, as it would involve a comprehensive empirical test of alternative risk-based and behavioral explanations proposed previously in the literature.[8]

However, to gain a better understanding of the extent to which corporate innovation and past returns proxy for each other, we perform the following tests. We sort stocks first into ten portfolios according to their current *CI* computed using growth rates over the past two quarters. We then sort stocks within each *CI* decile into ten portfolios according to their past returns. This procedure gives rise to 100 portfolios. We then examine whether the difference in returns between winners and losers within each *CI* portfolio is positive and statistically significant.

The results are reported in Table 4. Within the first 6 *CI* portfolios with the lowest corporate innovation, the difference in returns between winners and losers is not economically and statistically significant. However, within the remaining four CI portfolios with the highest CI, the difference in returns between winners and losers is positive, statistically significant, and larger than that obtained using the whole sample, as can be seen by comparing the returns with those reported in Table 3.

[8] See for instance, Barberis, Shleifer, and Vishny (1998), Daniel, Hirshleifer, and Subrahmanyam (1998), Hong, Lim and Stein (1998), and Hong and Stein (1998) for potential behavioral explanations, Conrad and Kaul (1998) and Grundy and Martin (2001) for work on risk-based explanations, and Moskowitz and Grinblatt (1999) for an analysis based on the importance of industries for momentum portfolios that can be consistent with both behavioral and risk-based explanations. Chordia and Shivakumar (2002) provide evidence that suggests a link between the returns on momentum portfolios and the business cycle.

These results imply that there is a nonlinear relation between corporate innovation and past returns. For the segment of the market that contains the 60% of stocks with the lowest levels of *CI*, the relation between *CI* and past returns is linear. This means that when stocks are sorted on the basis of *CI*, the spread in returns between winners and losers is close to zero. On the other hand, for the remaining 40% of the market, this is not the case. The implication is that for momentum strategies to be profitable, the level of corporate innovation has to be high. Put differently, corporate innovation is a necessary condition for momentum profits to exist.

Table 5 reports results from a reverse double sort. Stocks are now first sorted on past returns and then on *CI*. Similarly to Table 4, stocks are grouped into 10 portfolios according to their past returns. Subsequently, each of the ten portfolios is subdivided into ten new portfolios according to the *CI* of the stocks it contains. The results of Table 5 show that the spread in returns between high and low *CI* stocks is always positive and statistically significant, independently of the level of past returns of the stocks. Put differently, the returns of the *CI* strategy are not contingent on the past returns of the stocks, whereas the returns of the momentum strategy are crucially dependent on the level of corporate innovation that the stocks exhibit.

The results of Tables 3 to 5 reveal the existence of a strong link between corporate innovation and return continuation. Return continuation is prominent and the momentum strategy is profitable only for the high CI firms.

The reason return continuation is present only for the high CI firms has to do, in our opinion, with the very nature of corporate innovation. As mentioned earlier, CI is the results of human capital. The level of CI in a firm is not publicly known, but it can be inferred over time. As information about positive CI is slowly revealed in the market, this information gets incorporated in the prices, inducing in the process a return continuation. When there is no CI in the firm, there is no information of that

nature to be revealed, and therefore no resulted return continuation. On the other hand, when CI is negative, information gets revealed faster and the effects of bad news are often easier to evaluate. Consider as an example a biotech company working on a new cancer drug. News about the progress they make on their research is periodically released in the market and the price of its stock changes to reflect any positive developments. If, however, the drug they develop does not get FDA approval, or their tests prove it to be ineffective, this information will have an immediate negative impact on the price of the stock. Whereas there may be return continuation while information about positive *CI* is revealed in the market, there will be none when news about a negative *CI* is made public.

The results of Tables 3 to 5 reveal that corporate innovation and return continuation are intimately related and that a rational explanation can be provided for the performance of the momentum strategy.

3.3. The Performance of CI Strategies Over Different Formation and Holding Periods

Since there is a plethora of price momentum strategies documented in the literature (see, Jagadeesh and Titman (1993, 2001), and Rowenhorst (1998)), it is important to examine if strategies based on *CI* can be similarly profitable when the formation and holding periods vary beyond one quarter. To conserve space, we will only present results based on CI strategies, and not those on price momentum strategies. For stylized facts on the performance of price momentum strategies, we refer the reader to the cited momentum studies.

Table 6 reports the returns of portfolios formed on the basis of past one-quarter *CI* 's, but held for a period of 3, 6, 9, or 12 months. The return of the zero-investment portfolio, P10-P1, decreases as the holding period increases, indicating that the *CI* characteristics of stocks change substantially over time. Indeed, the turnover of portfolios reported in Panel E confirms this indication. Turnover is

defined as the proportion of firms in a portfolio that leaves the portfolio each quarter. It is evidently very high for all deciles. High levels of turnover have also been reported in the literature for price momentum portfolios (see for instance, Jagadeesh and Titman (1993, 2001)).

Tables 7, 8, and 9 report the returns of the *CI* strategies when the portfolios are formed on the basis of *CI* 's computed using growth rates in GPM, capital, and labor over the past two, three, and four quarters. The following conclusion emerges from those tables. As formation period increases, the profitability of the zero-investment CI strategy increases, whereas as the holding period increases, its profitability decreases. The result is that the most profitable *CI* strategy is the one formed on the basis of the past 4 quarters of *CI* and held for 3 months. Its average return is equal to 13.7% per annum.

As the period over which we compute the growth in GPM, capital and labor increases, the turnover of the decile portfolios decreases. This implies that when *CI* is computed over longer periods of time, the stocks are ranked on the basis of their relative *CI* measured over longer period of time, which is likely to exhibit a higher level of stability over time. In contrast, when stocks are ranked on the basis of *CI* over the past quarter, the relative ranking takes into account small changes in *CI* , which may be highly transient, or simply due to estimation noise.

The general message that emerges from this section is that strategies based on *CI*, constructed along the lines of price momentum strategies, are at least as profitable as the price momentum strategies examined in the literature.

3.4. Further Comparisons of CI and Price Momentum Strategies

This section provides further evidence on the relation between the momentum and CI strategies, by reporting the correlation matrix of various CI and price momentum strategies, as well as results based on regression analysis.

Table 10a reports the correlation matrix of the various *CI* strategies reported in the previous section, and their corresponding momentum strategies. The correlations are relatively high, ranging from 0.31 to 0.55, with an average correlation of 0.47. Table 10b reports the correlation matrix for the various CI strategies presented earlier. The correlations are again relatively high, and vary between 0.16 and 0.95. It seems that the main element that leads to low correlations between two different *CI* strategies is a large difference in the holding periods of the long and short portfolios.

Table 11, Panel A provides results from regressions of the returns on zero-investment price momentum strategies (winners minus losers) on the returns of zero-investment *CI* strategies. The adjusted R-squares vary between 23% and 28%, suggesting that the *CI* strategies can explain a substantial proportion of the returns of the price momentum strategies. These adjusted R-squares are much larger than those previously reported in the literature from regressions of momentum portfolios on economic variables. For a recent examination of the ability of other economic variables to explain momentum, see Griffin, Li, and Martin (2003). The average adjusted R-square from analogous regressions reported in that study is around zero. Contrary to previous findings, the results of Table 11 show that an economic variable can indeed explain a substantial portion of the time series variation in momentum returns.

Panel B of Table 11 reports results of predictive regressions, where the returns of zero-investment momentum strategies are predicted by past month's returns of zero-investment *CI* strategies. The adjusted R-squares vary now between zero and 3%, implying that *CI* strategies have a very limited ability to predict the returns of momentum strategies one month ahead. This implies that *CI* and momentum strategies share a strong contemporaneous relation, rather than a lagged one.

4. Corporate Innovation, Momentum, and Contrarian Strategies

Some of the skepticism in the literature about the idea that a rational explanation for the price momentum may exist, stems from the fact that price continuation is a medium-horizon phenomenon. In horizons longer than 12 months, and most notably in horizons of 3 to 5 years, losers tend to outperform winners, which is the opposite to what we observe in momentum. This observation, attributed to Bondt and Thaler (1985) gave rise to the contrarian strategies. As the term implies, contrarian strategies aim to buy securities that performed poorly in the past and short securities that did well. The holding period for such strategies is typically 3 to 5 years.

In this section, we examine whether our explanation about price momentum is also consistent with the performance of long horizon contrarian strategies. Put differently, if price continuation and medium-term momentum is due to corporate innovation, can corporate innovation also explain the long-horizon reversals and the performance of the resulting contrarian strategies?

To examine this hypothesis, we rank stocks on the basis of their past 5-year returns and form 10 portfolios.[9] We go long on the past winners and short on the past losers, as we would do in a momentum strategy. We then hold this zero-investment portfolio for 5 years. If a reversal is present in the return continuation of stocks over long horizons, the return of the zero-investment portfolio should be negative.

Table 12 shows that this is indeed the case and confirms previous findings that a contrarian strategy may be profitable in long horizons, although the return difference in our results is not highly statistically significant.

[9] We choose for our experiment the 5-year horizon because contrarian strategies over this period are considered the most popular and profitable. In tests not presented here, we verify that our results remain unchanged when the formation and holding period horizons vary between 3 and 5 years.

Table 12 also reports the evolution over time of the average CI for the ten portfolios, measured using growth rates in GPM, capital and labor over the past 4 quarters. We chose to compute *CI's* over the past four quarters since the results of Section 3.3 show that *CI's* are more stable over time at this horizon. Consistent with the results of Table 3, we observe monotonicity with respect to current CI across the portfolios. The losers have the lowest level of current CI and the winners the highest. However, as we track the evolution of CI over time for these 10 portfolios, the above monotonicity gets distorted. By the end of the holding period (year 5), the losers have a higher average level of CI than the winners. According to our analysis, this is consistent with the fact that in that horizon, the losers outperform the winners.

What is the reason that losers end up in the long run with higher average levels of CI than the winners? In our view, the reason is again related to the nature of corporate innovation. Losers cannot continue to be losers for long periods of time or they will go bankrupt. They need to innovate in order to continue to exist. By the same token, while there may be some persistence in corporate innovation, top levels of *CI* may not be sustainable over very long periods of time. Successful ideas are often imitated by competitors, leading innovators to lose their competitive edge, unless they can continue to produce and implement innovative ideas of the same caliber. This may not be always possible, since the human capital that produces the corporate innovation is unlikely to be equally creative across units of time. These effects may lead past winners to become somewhat less successful in the future, and past losers to improve their relative position in the marketplace.

The results of Table 12 do not constitute a complete explanation of the reversals observed in equity returns. Such an analysis is beyond the scope of this study which focuses on the relation between corporate innovation and price momentum. They do suggest however that one can provide a

rational economic story, along the lines explored here, which is consistent both with the performance of the momentum and the contrarian strategies.

5. Conclusions

This paper provides a rational explanation for the performance of the popular price momentum strategies.

We measure a firm's corporate innovation as the proportion of its gross profit margin not explained by the capital and labor it has in place. Our measure of corporate innovation corresponds to a "shrunk" firm-level Solow residual. In the business cycle literature, Solow residuals are interpreted as capturing broadly defined technology shocks.

We show that corporate innovation is priced in the cross-section of equity returns. We also show that portfolios sorted on the basis of corporate innovation have very similar properties to those sorted on past returns. In particular, "winners", the portfolio with the highest past returns in the price momentum strategy, are firms with the highest levels of corporate innovation. Similarly, "losers", the portfolio with the lowest past returns, are firms with the lowest (negative) levels of corporate innovation.

Further experiments reveal the existence of a strong relation between corporate innovation and return continuation. For momentum strategies to be profitable, the level of *CI* of the firms involved needs to be high. Momentum strategies performed using low *CI* stocks deliver zero average returns.

Regression analysis reveals that a substantial proportion of the time-variation in the returns of momentum strategies can be explained by the returns of *CI*-based strategies. This is the first evidence that an economically motivated variable can explain a significant proportion of the momentum returns.

Finally, we provide evidence that an explanation of momentum based on corporate innovation is consistent with the performance and characteristics of long-horizon contrarian strategies. In particular, just as losers outperform winners in horizons of 3 to 5 years, the *CI* of the two groups of stocks evolves in the same direction. Losers have lower *CI* than winners at the time of portfolio formation. However, at the end of the holding period, when losers outperform winners, the average *CI* of losers is also higher than that of winners.

The analysis of this study shows that there is a rational explanation for the performance of price momentum strategies, which is intimately related to the level of innovation produced by the firms held in those portfolio strategies. Since corporate innovation is the product of human capital employed by the firms, the risk premium attached to corporate innovation, estimated as part of our asset pricing tests, can be understood as a hedging premium for human capital risk. Furthermore, since the level of *CI* in a firm is not publicly known at each point in time, gradual revelation of information about it induces prices to adjust slowly, producing a return continuation similar to the one captured by the price momentum strategies.

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TABLE 1: Description of data

We report the number of firms available for the period during which we construct portfolios based on firms' corporate innovation (CI). A firm's CI is measured over four different horizons, depending on the period over which growth rates for gross profit margin (GPM), labor and capital are measured. As a result, four different datasets are created. One-quarter CI reports the firms available every year when CI is computed using the growth rates in GPM, labor and capital over the previous one quarter. Similarly, four-quarter CI reports the firms available every year when CI is computed using the growth rates in GPM, labor and capital over the previous four quarters. We also report the mean CI for each year and its standard deviation. To compute the CI of a firm at time t, the firm must have a minimum of 28 consecutive quarterly observations, including the current quarter, for GPM, capital and labor data.

year	One-Quarter CI			Two-Quarter CI			Three-Quarter CI			Four-Quarter CI		
	Number of Firms	mean	std	Number of Firms	mean	std	Number of Firms	mean	std	Number of Firms	mean	std
1976	104	-0.0101	0.0192	99	0.0465	0.0270	95	0.0572	0.0294	38	0.0571	0.0421
1977	153	0.0658	0.0403	144	0.0557	0.0196	142	0.0874	0.0225	109	0.1171	0.0281
1978	197	0.0671	0.0154	187	0.0805	0.0374	183	0.1598	0.0380	167	0.1532	0.0373
1979	240	0.0392	0.0128	231	0.0924	0.0139	227	0.1465	0.0173	207	0.1869	0.0165
1980	276	0.0524	0.0209	269	0.0894	0.0256	265	0.1309	0.0165	242	0.1276	0.0168
1981	325	0.0614	0.0178	305	0.0492	0.0192	296	0.0639	0.0278	277	0.1011	0.0296
1982	631	-0.0302	0.0135	546	-0.0118	0.0149	495	-0.0327	0.0176	321	0.0323	0.0201
1983	1005	-0.0071	0.0121	970	0.0196	0.0158	921	0.0534	0.0153	629	0.0082	0.0172
1984	1094	0.0589	0.0111	1082	0.0525	0.0111	1067	0.1345	0.0128	939	0.1375	0.0163
1985	1051	0.0148	0.0097	1037	0.0150	0.0106	1026	0.0469	0.0138	982	0.0716	0.0105
1986	1000	0.0352	0.0103	989	0.0465	0.0116	978	0.0654	0.0119	954	0.0579	0.0113
1987	917	0.0323	0.0128	901	0.0526	0.0117	895	0.0749	0.0127	885	0.0583	0.0101
1988	1238	-0.0108	0.0110	1138	0.0520	0.0125	1058	0.0463	0.0114	829	0.0728	0.0109
1989	1304	0.0105	0.0100	1271	0.0271	0.0104	1249	0.0402	0.0110	1187	0.0602	0.0115
1990	1339	0.0254	0.0105	1312	0.0200	0.0114	1286	0.0290	0.0115	1224	0.0288	0.0108
1991	1380	0.0137	0.0123	1348	0.0157	0.0123	1320	0.0281	0.0108	1283	0.0217	0.0097
1992	1449	0.0109	0.0090	1411	0.0290	0.0103	1386	0.0672	0.0112	1323	0.0458	0.0107
1993	1591	0.0115	0.0091	1539	0.0399	0.0103	1481	0.0659	0.0109	1403	0.0636	0.0104
1994	1725	0.0316	0.0084	1677	0.0554	0.0092	1638	0.0760	0.0088	1559	0.0655	0.0087
1995	1826	0.0423	0.0078	1763	0.0799	0.0090	1738	0.1144	0.0087	1670	0.0974	0.0080
1996	1860	0.0227	0.0078	1825	0.0408	0.0083	1791	0.0669	0.0086	1728	0.0571	0.0082
1997	1858	0.0380	0.0082	1826	0.0456	0.0084	1791	0.0759	0.0085	1748	0.0646	0.0079
1998	1842	0.0137	0.0080	1797	0.0448	0.0088	1769	0.0791	0.0087	1709	0.0631	0.0078
1999	1826	-0.0017	0.0082	1782	-0.0107	0.0089	1753	0.0293	0.0091	1696	0.0040	0.0090
2000	1764	0.0097	0.0082	1721	0.0282	0.0090	1695	0.0696	0.0093	1644	0.0654	0.0094
2001	1755	-0.0023	0.0080	1716	-0.0030	0.0094	1680	0.0334	0.0099	1624	0.0306	0.0095

TABLE 2: Asset pricing tests on the Fama-French 25 portfolios using Corporate Innovation and Momentum as factors: 1970Q1 – 2001Q4

Panel A: Market Factor and Momentun (UMD) factor model				
	Constant	Market	UMD	
Coefficient	0.9169	-1.9081	-3.6769	
t-value	16.8854	-1.8581	-2.2380	
Premium		0.0196	0.0222	
t-value		2.3899	2.5218	
	Over-identification Test	P-Wald(b)		
	25.1872			
p-value	0.3407	0.0000		
Panel B: Market Factor and Aggregate Corporate Innovation (ACI) factor model				
	Constant	Market	ACI	
Coefficient	1.2341	-3.7224	-8.6366	
t-value	18.7217	-3.9510	-2.7843	
Premium		0.0243	0.0134	
t-value		3.2472	2.4009	
	Over-identification Test	P-Wald(b)		Wald(UMD)
	23.8654			2.6668
p-value	0.4113	0.0000		0.1025
Panel C: ;Market Factor, Aggregate Corporate Innovation (CI) + Momentum (UMD) factor model				
	Constant	Market	ACI	UMD
Coefficient	1.3474	-4.0012	-9.8423	-2.4365
One Step t-value	13.9764	-3.7236	-2.8814	-1.6415
Premium		0.0229	0.0146	0.0072
One Step t-value		3.0798	2.4940	1.0191
	Over-identification Test	P-Wald(b)		
	23.5373			
p-value	0.3719	0.0000		

Note: The data for the test assets, the market factor, the risk-free rate, and UMD are obtained from Ken French's website. The corporate innovation factor ACI is the aggregate of the firm-level corporate innovation series, estimated following the methodology of Section 1. The Wald(UMD) test examines the ability of UMD to explain the test assets when it is added to the pricing kernel of the model in Panel B.

Table 3: Returns on Corporate Innovation-based and Momentum Strategies.

This table is split into two parts. Panel A reports results for a simple corporate innovation (CI) strategy, where the CI of a firm is measured using growth rates in the input and output variables over the past two quarters. The holding period for the portfolios is 6 months. Panel B reports results on the popular 6-month/ 6-month price momentum strategy. In the case of the CI strategy, stocks are ranked on the basis of their current CI, measured using growth rates over the past two quarters, and ten portfolios are formed. In the case of the price momentum strategy, stocks are ranked on the basis of their past 6 month returns. In the case of the CI strategy, Portfolio P1 contains stocks with the lowest CI's, whereas in the case of the momentum strategy, it contains stocks with the lowest past 6 month returns. Similarly, portfolio P10 contains the stocks with the highest CI's in the case of the CI strategy, and the stocks with the highest prior 6 month returns in the case of the momentum strategy. In both strategies, portfolios are held for a period of six months. The period for which returns are computed is from January 1976 to December 2001. Portfolio characteristics such as CI, size, and BM are averages of the characteristics of the portfolios each time they are rebalanced (i.e., at formation dates). Size denotes the average market capitalization of the portfolio, and it is measured in millions of dollars. Beta is the market beta of the portfolio returns, computed over the whole time period. T-values for the mean returns appear in parentheses. The column labeled Volatility denotes the firm-specific average volatility of each portfolio. Firm-specific volatilities are computed following the methodology outlined in Campbell, Lettau, Malkiel, and Xu (2001). They are reported annualized and in percentage terms. GPM growth is the average 2-quarter growth of the GPM of each stock in the portfolio. Constant, Capital and Labor denote the average coefficient estimates from the regressions ran to compute the CI's of the firms in each portfolio.

Panel A: Current Two-Quarter Corporate Innovation/6 Month Returns

	Returns	CI	ln(Size)	BM	Beta	Volatility	GPM Growth	constant	Capital	Labor
P 1 (Low CI)	0.0110	-0.6141	6.8325	1.1550	0.9183	13.8338	-0.5967	0.0158	0.2905	0.2977
	(3.76)									
P 2	0.0129	-0.1856	7.2493	1.0255	0.8918	11.7680	-0.1708	0.0402	0.1681	0.1945
	(4.93)									
P 3	0.0127	-0.0818	7.4550	1.0055	0.9006	10.9185	-0.0710	0.0457	0.1169	0.1314
	(4.92)									
P 4	0.0133	-0.0215	7.5816	0.9243	0.8841	9.8020	-0.0123	0.0469	0.1362	0.1288
	(5.26)									
P 5	0.0154	0.0219	7.6998	0.8834	0.8804	9.0536	0.0266	0.0513	0.1128	0.0719
	(6.15)									
P 6	0.0157	0.0604	7.7238	0.8917	0.9302	9.5002	0.0643	0.0533	0.1250	0.0665
	(6.01)									
P 7	0.0165	0.1031	7.7551	0.8499	0.9157	9.4133	0.1014	0.0593	0.0344	0.0830
	(6.43)									
P 8	0.0177	0.1619	7.6678	0.8745	0.9930	10.1960	0.1543	0.0648	-0.0037	0.0624
	(6.42)									
P 9	0.0177	0.2612	7.3799	0.9003	1.0075	11.1909	0.2449	0.0705	-0.0546	-0.0055
	(6.20)									
P 10 (High CI)	0.0180	0.6540	7.0083	0.9931	0.9541	11.9160	0.6156	0.0876	-0.3471	-0.1265
	(6.37)									
P 10 – 1 (High CI-Low CI)	0.0070				0.0409					
	(5.68)									

Table3 cont'd

Panel B: 6-Month/6 Month Momentum

	Returns	CI	ln(Size)	BM	Beta	Volatility	GPM Growth	constant	Capital	Labor
P 1 (Losers)	0.0130	-0.0675	6.4198	1.3602	1.0920	17.9227	-0.0815	0.0499	0.1238	0.0550
	(3.31)									
P 2	0.0133	-0.0001	7.0681	1.1114	0.9420	11.3761	-0.0045	0.0530	0.0488	0.0705
	(4.59)									
P 3	0.0141	0.0174	7.3254	1.0336	0.8720	9.9151	0.0149	0.0510	0.0327	0.1176
	(5.47)									
P 4	0.0136	0.0254	7.4949	0.9649	0.8452	8.9149	0.0215	0.0514	0.0224	0.1270
	(5.55)									
P 5	0.0148	0.0398	7.5754	0.9324	0.8266	8.3982	0.0395	0.0523	0.0123	0.1163
	(6.24)									
P 6	0.0154	0.0486	7.6414	0.9089	0.8388	8.2985	0.0494	0.0519	0.0424	0.0886
	(6.49)									
P 7	0.0149	0.0529	7.7288	0.8991	0.8661	8.1940	0.0541	0.0525	0.0510	0.1176
	(6.17)									
P 8	0.0158	0.0607	7.7881	0.8311	0.8897	8.5832	0.0633	0.0541	0.0841	0.1115
	(6.37)									
P 9	0.0166	0.0742	7.7611	0.7865	0.9504	9.5022	0.0788	0.0574	0.0688	0.0688
	(6.22)									
P 10 (Winners)	0.0197	0.1189	7.3137	0.6821	1.1527	13.3605	0.1296	0.0627	0.0823	0.0209
	(5.71)									
P 10 – 1 (Winners-Losers)	0.0067				0.0657					
	(2.31)									

Table 4: Returns of Portfolios Sorted First on Current two-quarter Corporate Innovation and then on Past 6-month Returns.
The holding period is 6 months. Returns are from May 1977 to December 2001, as before May 1977 there are not enough stocks in our sample to ensure that none of the 100 portfolios will be empty at any point in time.

Current Two-Quarter Corporate Innovation	6 Month Past Returns										
	Loser	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**Winner**	**Winner - Loser**
Low CI	0.0127	0.0076	0.0079	0.0106	0.0100	0.0112	0.0104	0.0104	0.0102	0.0121	-0.0006
	(1.92)	(1.69)	(2.25)	(3.35)	(3.48)	(3.93)	(4.06)	(4.17)	(3.67)	(3.33)	(-0.10)
P 2	0.0151	0.0115	0.0120	0.0099	0.0113	0.0117	0.0104	0.0132	0.0121	0.0167	0.0016
	(3.16)	(3.32)	(4.11)	(3.62)	(4.28)	(4.53)	(4.06)	(5.30)	(4.13)	(4.76)	(0.41)
P 3	0.0122	0.0110	0.0107	0.0105	0.0128	0.0129	0.0130	0.0119	0.0122	0.0162	0.0040
	(2.86)	(3.45)	(3.75)	(4.01)	(4.98)	(5.08)	(5.13)	(4.61)	(4.49)	(4.60)	(1.13)
P 4	0.0140	0.0134	0.0135	0.0134	0.0134	0.0127	0.0132	0.0133	0.0126	0.0138	-0.0002
	(3.27)	(4.38)	(5.04)	(4.98)	(5.24)	(4.99)	(5.06)	(5.33)	(4.54)	(4.23)	(-0.06)
P 5	0.0158	0.0152	0.0147	0.0144	0.0157	0.0153	0.0146	0.0149	0.0137	0.0165	0.0007
	(4.16)	(5.42)	(5.64)	(5.60)	(6.20)	(5.97)	(5.68)	(5.70)	(4.95)	(5.04)	(0.23)
P 6	0.0150	0.0163	0.0158	0.0146	0.0146	0.0164	0.0157	0.0144	0.0172	0.0155	0.0004
	(3.58)	(5.38)	(5.47)	(5.73)	(5.64)	(6.28)	(6.02)	(5.31)	(6.05)	(4.57)	(0.13)
P 7	0.0108	0.0139	0.0140	0.0139	0.0172	0.0163	0.0169	0.0174	0.0165	0.0216	0.0108
	(2.71)	(4.74)	(5.07)	(5.34)	(6.66)	(6.18)	(6.43)	(6.78)	(5.84)	(6.17)	(3.31)
P 8	0.0148	0.0154	0.0164	0.0164	0.0180	0.0180	0.0179	0.0181	0.0190	0.0223	0.0075
	(3.78)	(4.64)	(5.49)	(5.89)	(6.58)	(6.60)	(6.58)	(6.22)	(6.07)	(5.59)	(2.28)
P 9	0.0125	0.0150	0.0158	0.0169	0.0158	0.0158	0.0173	0.0177	0.0206	0.0213	0.0089
	(3.10)	(4.53)	(5.50)	(6.06)	(5.97)	(5.75)	(6.14)	(5.87)	(6.13)	(4.92)	(2.33)
High CI	0.0150	0.0157	0.0174	0.0155	0.0149	0.0169	0.0167	0.0177	0.0183	0.0257	0.0107
	(3.28)	(4.59)	(5.91)	(5.49)	(5.61)	(5.81)	(5.70)	(5.88)	(5.13)	(5.69)	(2.43)
High - Low	0.0023	0.0081	0.0094	0.0049	0.0049	0.0058	0.0063	0.0073	0.0081	0.0135	
	(0.53)	(3.05)	(4.29)	(2.67)	(2.77)	(3.11)	(3.51)	(4.33)	(3.93)	(4.89)	

Table 5: Returns of Portfolios Sorted First on Past 6-month Returns and then on Current two-quarter Corporate Innovation.
The holding period is 6 months. Returns are from May 1977 to December 2001, as before May 1977 there are not enough stocks in our sample to ensure that none of the 100 portfolios will be empty at any point in time.

6 Month Past Returns	Current Two-Quarter Corporate Innovation										
	Low CI	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**High CI**	**High - Low**
Loser	0.0084	0.0117	0.0143	0.0113	0.0147	0.0158	0.0128	0.0137	0.0139	0.0154	0.0070
	(1.47)	(2.29)	(3.21)	(2.63)	(3.56)	(3.61)	(3.12)	(3.33)	(3.46)	(3.45)	(1.82)
P 2	0.0073	0.0128	0.0110	0.0118	0.0130	0.0147	0.0152	0.0137	0.0137	0.0152	0.0079
	(2.28)	(3.85)	(3.70)	(3.86)	(4.08)	(4.74)	(4.83)	(4.28)	(4.19)	(4.61)	(4.03)
P 3	0.0102	0.0108	0.0101	0.0118	0.0139	0.0147	0.0147	0.0165	0.0152	0.0165	0.0063
	(3.38)	(3.95)	(3.78)	(4.41)	(5.20)	(5.37)	(5.18)	(5.63)	(5.01)	(5.61)	(3.54)
P 4	0.0091	0.0104	0.0112	0.0119	0.0147	0.0147	0.0134	0.0146	0.0165	0.0152	0.0061
	(3.27)	(4.03)	(4.33)	(4.67)	(5.73)	(5.55)	(5.08)	(5.47)	(5.67)	(5.45)	(3.80)
P 5	0.0130	0.0120	0.0129	0.0130	0.0141	0.0153	0.0153	0.0160	0.0181	0.0149	0.0019
	(5.00)	(4.71)	(5.01)	(5.13)	(5.54)	(5.98)	(5.83)	(6.02)	(6.59)	(5.59)	(1.35)
P 6	0.0106	0.0124	0.0141	0.0139	0.0154	0.0151	0.0166	0.0167	0.0166	0.0160	0.0054
	(4.07)	(5.07)	(5.66)	(5.52)	(5.93)	(5.89)	(6.41)	(6.40)	(6.22)	(6.03)	(3.93)
P 7	0.0099	0.0129	0.0130	0.0135	0.0139	0.0154	0.0167	0.0159	0.0158	0.0155	0.0056
	(3.87)	(5.02)	(5.30)	(5.26)	(5.48)	(6.10)	(6.33)	(6.05)	(5.79)	(5.71)	(4.20)
P 8	0.0093	0.0137	0.0125	0.0149	0.0156	0.0157	0.0179	0.0173	0.0173	0.0170	0.0077
	(3.56)	(5.33)	(4.77)	(5.51)	(5.81)	(5.88)	(6.55)	(6.41)	(6.21)	(5.88)	(4.92)
P 9	0.0145	0.0123	0.0142	0.0150	0.0150	0.0172	0.0198	0.0193	0.0190	0.0177	0.0032
	(4.47)	(4.28)	(4.99)	(5.20)	(5.42)	(5.77)	(7.02)	(6.30)	(6.04)	(5.90)	(1.59)
Winner	0.0146	0.0149	0.0159	0.0176	0.0191	0.0208	0.0212	0.0218	0.0232	0.0242	0.0096
	(3.57)	(4.03)	(4.33)	(4.94)	(5.50)	(5.46)	(5.45)	(5.50)	(5.49)	(5.71)	(3.58)
Winner - Loser	0.0062	0.0032	0.0016	0.0064	0.0045	0.0051	0.0084	0.0082	0.0093	0.0088	
	(1.26)	(0.72)	(0.42)	(1.76)	(1.35)	(1.35)	(2.55)	(2.46)	(2.59)	(2.13)	

Table 6: Portfolios formed on the basis of CI measured over the past 1 quarter

Corporate innovation (CI) is measured using growth rates for the input and output variables over the past 1 quarter. Returns span the period from January 1976 to December 2001. Portfolio P1 denotes the portfolio that contains the stocks with the lowest current CI, while portfolio P10 contains the stocks with the highest current CI. The row labeled "beta" refers to the market beta of the portfolio computed using the whole time-series of the portfolio. Portfolio characteristics such as CI, size, and BM are computed at the portfolio formation date. T-values for the mean returns appear in parentheses. The turnover of each portfolio refers to the proportion of firms that exits the portfolio from one quarter to another. Size denotes the average market capitalization of the portfolio, and it is measured in millions of dollars.

	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	P 10 - 1
3 Month Holding Period											
Returns	0.0111	0.0135	0.0145	0.0146	0.0150	0.0171	0.0166	0.0160	0.0190	0.0178	0.0067
	(3.71)	(5.04)	(5.31)	(5.50)	(5.77)	(6.33)	(6.13)	(5.81)	(6.94)	(6.43)	(4.71)
Beta	0.93	0.90	0.95	0.93	0.91	0.95	0.96	0.96	0.96	0.92	-0.01
6 Month Holding Period											
Returns	0.0111	0.0142	0.0143	0.0143	0.0148	0.0165	0.0167	0.0162	0.0180	0.0171	0.0061
	(3.84)	(5.37)	(5.40)	(5.53)	(5.82)	(6.24)	(6.34)	(5.89)	(6.55)	(6.25)	(5.86)
Beta	0.93	0.90	0.92	0.91	0.89	0.94	0.94	0.98	0.97	0.91	-0.01
9 Month Holding Period											
Returns	0.0117	0.0142	0.0144	0.0142	0.0148	0.0164	0.0163	0.0160	0.0170	0.0169	0.0052
	(4.16)	(5.45)	(5.53)	(5.53)	(5.96)	(6.30)	(6.21)	(5.83)	(6.17)	(6.23)	(6.27)
Beta	0.91	0.89	0.91	0.91	0.88	0.92	0.94	0.98	0.98	0.91	0.00
12 Month Holding Period											
Returns	0.0125	0.0146	0.0149	0.0143	0.0148	0.0161	0.0158	0.0154	0.0162	0.0163	0.0038
	(4.57)	(5.68)	(5.74)	(5.66)	(5.97)	(6.29)	(6.05)	(5.67)	(5.91)	(6.09)	(5.71)
Beta	0.90	0.88	0.90	0.90	0.88	0.91	0.94	0.98	0.97	0.90	0.01
Portfolio Characteristics											
Turnover	0.8650	0.9216	0.9072	0.8891	0.8421	0.8569	0.8730	0.9098	0.9068	0.8737	
CI	-0.5404	-0.1707	-0.0792	-0.0289	0.0062	0.0373	0.0718	0.1186	0.2017	0.5437	
ln(Size)	6.9126	7.2416	7.4534	7.6661	7.6688	7.7373	7.6764	7.6198	7.4131	6.9809	
BM	1.0858	0.9518	0.9252	0.8806	0.8724	0.8338	0.8289	0.8448	0.8855	0.9731	

Table 7: Portfolios formed on the basis of CI measured over the past 2 quarters

Corporate innovation (CI) is measured using growth rates for the input and output variables over the past 2 quarters. Returns span the period from January 1976 to December 2001. Portfolio P1 denotes the portfolio that contains the stocks with the lowest current CI, while portfolio P10 contains the stocks with the highest current CI. The row labeled "beta" refers to the market beta of the portfolio computed using the whole time-series of the portfolio. Portfolio characteristics such as CI, size, and BM are computed at the portfolio formation date. T-values for the mean returns appear in parentheses. The turnover of each portfolio refers to the proportion of firms that exits the portfolio from one quarter to another. Size denotes the average market capitalization of the portfolio, and it is measured in millions of dollars.

	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	P 10 - 1
3 Month Holding Period											
Returns	0.0104	0.0128	0.0130	0.0130	0.0150	0.0165	0.0171	0.0178	0.0187	0.0191	0.0087
	(3.48)	(4.68)	(4.88)	(4.91)	(5.92)	(6.25)	(6.62)	(6.43)	(6.43)	(6.61)	(5.66)
Beta	0.92	0.91	0.92	0.92	0.88	0.93	0.91	0.97	1.01	0.96	0.04
6 Month Holding Period											
Returns	0.0110	0.0129	0.0127	0.0133	0.0154	0.0157	0.0165	0.0177	0.0177	0.0180	0.0070
	(3.76)	(4.93)	(4.92)	(5.26)	(6.15)	(6.01)	(6.43)	(6.42)	(6.20)	(6.37)	(5.68)
Beta	0.91	0.89	0.91	0.89	0.88	0.93	0.91	0.99	1.01	0.96	0.06
9 Month Holding Period											
Returns	0.0117	0.0137	0.0134	0.0140	0.0154	0.0153	0.0165	0.0175	0.0167	0.0169	0.0053
	(4.14)	(5.32)	(5.25)	(5.55)	(6.24)	(5.92)	(6.50)	(6.42)	(5.90)	(5.97)	(5.08)
Beta	0.90	0.88	0.89	0.88	0.88	0.92	0.91	0.99	1.00	0.97	0.07
12 Month Holding Period											
Returns	0.0127	0.0141	0.0137	0.0144	0.0155	0.0151	0.0160	0.0169	0.0160	0.0159	0.0033
	(4.57)	(5.58)	(5.40)	(5.74)	(6.32)	(5.93)	(6.31)	(6.21)	(5.65)	(5.68)	(3.51)
Beta	0.89	0.87	0.89	0.88	0.87	0.90	0.91	0.98	1.00	0.96	0.07
Portfolio Characteristics											
Turnover	0.7116	0.8267	0.8602	0.8492	0.8457	0.8448	0.8508	0.8580	0.8262	0.7204	
CI	-0.6173	-0.1857	-0.0819	-0.0215	0.0218	0.0601	0.1024	0.1608	0.2593	0.6558	
ln(Size)	6.8291	7.2547	7.4779	7.6011	7.7002	7.7387	7.7648	7.6927	7.4153	7.0293	
BM	1.1037	0.9833	0.9479	0.8927	0.8761	0.8410	0.8300	0.8358	0.8465	0.9595	

Table 8: Portfolios formed on the basis of CI measured over the past 3 quarters

Corporate innovation (CI) is measured using growth rates for the input and output variables over the past 3 quarters. Returns span the period from January 1976 to December 2001. Portfolio P1 denotes the portfolio that contains the stocks with the lowest current CI, while portfolio P10 contains the stocks with the highest current CI. The row labeled "beta" refers to the market beta of the portfolio computed using the whole time-series of the portfolio. Portfolio characteristics such as CI, size, and BM are computed at the portfolio formation date. T-values for the mean returns appear in parentheses. The turnover of each portfolio refers to the proportion of firms that exits the portfolio from one quarter to another. Size denotes the average market capitalization of the portfolio, and it is measured in millions of dollars.

	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	P 10 - 1
3 Month Holding Period											
Returns	0.0097	0.0107	0.0131	0.0126	0.0154	0.0166	0.0183	0.0179	0.0196	0.0204	0.0107
	(3.27)	(3.97)	(5.01)	(4.96)	(6.07)	(6.32)	(6.67)	(6.55)	(6.69)	(6.99)	(6.64)
Beta	0.92	0.91	0.89	0.86	0.88	0.91	0.96	0.96	1.02	0.98	0.07
6 Month Holding Period											
Returns	0.0112	0.0120	0.0142	0.0133	0.0155	0.0159	0.0170	0.0173	0.0181	0.0185	0.0073
	(3.87)	(4.59)	(5.51)	(5.27)	(6.20)	(6.29)	(6.36)	(6.40)	(6.31)	(6.32)	(5.25)
Beta	0.90	0.90	0.89	0.86	0.88	0.90	0.95	0.96	1.01	1.00	0.10
9 Month Holding Period											
Returns	0.0117	0.0130	0.0148	0.0142	0.0157	0.0152	0.0166	0.0164	0.0170	0.0168	0.0051
	(4.14)	(5.11)	(5.79)	(5.69)	(6.31)	(6.09)	(6.32)	(6.10)	(5.96)	(5.75)	(3.99)
Beta	0.89	0.88	0.88	0.86	0.88	0.89	0.94	0.96	1.01	1.00	0.12
12 Month Holding Period											
Returns	0.0128	0.0134	0.0151	0.0145	0.0154	0.0149	0.0160	0.0160	0.0166	0.0156	0.0028
	(4.58)	(5.33)	(5.97)	(5.91)	(6.24)	(5.99)	(6.17)	(6.00)	(5.85)	(5.42)	(2.47)
Beta	0.88	0.86	0.88	0.85	0.87	0.88	0.93	0.96	1.00	0.99	0.11
Portfolio Characteristics											
Turnover	0.6983	0.8318	0.8534	0.8551	0.8479	0.8386	0.8433	0.8578	0.8321	0.7093	
CI	-0.6062	-0.1878	-0.0800	-0.0146	0.0345	0.0779	0.1248	0.1885	0.2916	0.6727	
ln(Size)	6.8619	7.3120	7.5591	7.5400	7.6865	7.7517	7.7069	7.6852	7.4780	7.2089	
BM	1.1282	1.0102	0.9475	0.9050	0.8851	0.8542	0.8477	0.8235	0.8386	0.9112	

Table 9: Portfolios formed on the basis of CI measured over the past 4 quarters

Corporate innovation (CI) is measured using growth rates for the input and output variables over the past 4 quarters. Returns span the period from January 1976 to December 2001. Portfolio P1 denotes the portfolio that contains the stocks with the lowest current CI, while portfolio P10 contains the stocks with the highest current CI. The row labeled "beta" refers to the market beta of the portfolio computed using the whole time-series of the portfolio. Portfolio characteristics such as CI, size, and BM are computed at the portfolio formation date. T-values for the mean returns appear in parentheses. The turnover of each portfolio refers to the proportion of firms that exits the portfolio from one quarter to another. Size denotes the average market capitalization of the portfolio, and it is measured in millions of dollars.

	P 1	P 2	P 3	P 4	P 5	P 6	P 7	P 8	P 9	P 10	P 10 - 1
3 Month Holding Period											
Returns	0.0099	0.0121	0.0138	0.0138	0.0140	0.0161	0.0166	0.0174	0.0193	0.0213	0.0114
	(3.15)	(4.47)	(5.51)	(5.56)	(5.68)	(6.25)	(6.39)	(6.49)	(6.53)	(6.29)	(6.19)
Beta	0.92	0.90	0.84	0.85	0.86	0.89	0.91	0.93	1.03	1.12	0.20
6 Month Holding Period											
Returns	0.0114	0.0131	0.0141	0.0143	0.0146	0.0159	0.0163	0.0161	0.0178	0.0189	0.0074
	(3.71)	(5.03)	(5.70)	(5.83)	(6.00)	(6.34)	(6.36)	(6.07)	(6.06)	(5.63)	(4.10)
Beta	0.91	0.87	0.84	0.84	0.86	0.88	0.90	0.94	1.03	1.11	0.21
9 Month Holding Period											
Returns	0.0119	0.0140	0.0144	0.0147	0.0145	0.0156	0.0157	0.0158	0.0171	0.0172	0.0053
	(3.97)	(5.36)	(5.91)	(6.13)	(6.05)	(6.31)	(6.15)	(5.99)	(5.93)	(5.19)	(3.17)
Beta	0.91	0.87	0.83	0.83	0.84	0.86	0.90	0.94	1.03	1.11	0.20
12 Month Holding Period											
Returns	0.0131	0.0143	0.0146	0.0148	0.0145	0.0154	0.0151	0.0155	0.0164	0.0162	0.0031
	(4.42)	(5.56)	(6.07)	(6.24)	(6.11)	(6.26)	(6.00)	(5.95)	(5.74)	(4.95)	(2.01)
Beta	0.90	0.87	0.83	0.83	0.84	0.86	0.90	0.93	1.02	1.10	0.20
Portfolio Characteristics											
Turnover	0.5314	0.7459	0.7906	0.8055	0.8121	0.8204	0.7951	0.7745	0.7253	0.5164	
CI	-0.5153	-0.1283	-0.0378	0.0162	0.0564	0.0929	0.1328	0.1841	0.2690	0.6050	
ln(Size)	6.9801	7.2714	7.4749	7.6301	7.7009	7.6672	7.7455	7.6472	7.6666	7.2424	
BM	1.1827	1.0228	0.9617	0.9175	0.8766	0.8482	0.8198	0.8399	0.8328	0.8762	

Table 10a: Correlation coefficients between CI and price momentum zero-investment strategies

This table presents correlation coefficients between various zero-investment corporate innovation (CI) and price momentum strategies. The strategies are labeled based on the formation and holding periods. The letter "Q" stands for quarter, whereas the letter "M" stands for month. For instance, the label 1Q/3M indicates that the portfolio was formed based on the CI over the past one quarter, and held for 3 months. Similarly 3M/9M denotes the momentum zero-investment portfolio formed on the basis of past 3 month returns, and held for 9 months.

CORPORATE INNOVATION ZERO-INVESTMENT PORTFOLIOS	PRICE MOMENTUM ZERO-INVESTMENT PORTFOLIOS															
	3M/3M	3M/6M	3M/9M	3M/12M	6M/3M	6M/6M	6M/9M	6M/12M	9M/3M	9M/6M	9M/9M	9M/12M	12M/3M	12M/6M	12M/9M	12M/12M
1Q/3M	0.40	0.44	0.43	0.39	0.42	0.43	0.40	0.35	0.42	0.39	0.35	0.31	0.36	0.34	0.29	0.26
1Q/6M	0.47	0.51	0.50	0.46	0.49	0.50	0.47	0.42	0.50	0.47	0.43	0.38	0.44	0.41	0.36	0.32
1Q/9M	0.48	0.50	0.52	0.48	0.49	0.50	0.48	0.44	0.51	0.48	0.44	0.38	0.45	0.42	0.36	0.32
1Q/12M	0.47	0.50	0.51	0.50	0.48	0.50	0.49	0.47	0.49	0.47	0.44	0.40	0.45	0.44	0.40	0.36
2Q/3M	0.44	0.48	0.49	0.48	0.48	0.49	0.49	0.46	0.50	0.49	0.47	0.43	0.48	0.48	0.44	0.41
2Q/6M	0.46	0.48	0.53	0.52	0.49	0.52	0.53	0.49	0.54	0.53	0.51	0.45	0.54	0.51	0.47	0.42
2Q/9M	0.45	0.46	0.51	0.51	0.47	0.50	0.52	0.50	0.52	0.52	0.50	0.45	0.52	0.51	0.47	0.43
2Q/12M	0.44	0.46	0.50	0.52	0.47	0.51	0.53	0.52	0.52	0.53	0.52	0.48	0.53	0.53	0.50	0.46
3Q/3M	0.41	0.43	0.50	0.49	0.44	0.49	0.50	0.47	0.50	0.50	0.47	0.42	0.48	0.46	0.43	0.39
3Q/6M	0.43	0.45	0.51	0.53	0.46	0.51	0.54	0.53	0.52	0.53	0.52	0.49	0.52	0.52	0.50	0.47
3Q/9M	0.41	0.43	0.49	0.51	0.45	0.50	0.53	0.53	0.50	0.51	0.51	0.49	0.51	0.51	0.49	0.47
3Q/12M	0.39	0.41	0.47	0.50	0.44	0.49	0.53	0.55	0.48	0.51	0.52	0.52	0.51	0.52	0.52	0.51
4Q/3M	0.38	0.43	0.48	0.49	0.44	0.49	0.52	0.51	0.49	0.50	0.49	0.46	0.52	0.51	0.49	0.45
4Q/6M	0.35	0.40	0.46	0.48	0.41	0.46	0.50	0.51	0.47	0.50	0.50	0.48	0.52	0.52	0.50	0.48
4Q/9M	0.30	0.34	0.40	0.44	0.36	0.42	0.47	0.49	0.43	0.46	0.48	0.47	0.49	0.50	0.50	0.49
4Q/12M	0.26	0.31	0.37	0.41	0.33	0.39	0.45	0.48	0.40	0.44	0.47	0.48	0.47	0.50	0.51	0.51

Table 10b: Correlation matrix of various CI-based zero-investment strategies

This table presents the correlation coefficients among various zero-investment corporate innovation (CI) portfolios. The portfolios are labeled based on the formation and holding periods. For instance, the label 1Q/3M indicates that the portfolios were formed based on the CI over the past one quarter, and held for 3 months. Similarly 3Q/9M denotes the portfolios formed on the basis of CI measured over the past 3 quarters, and held for 9 months.

CORPORATE INNOVATION ZERO-INVESTMENT PORTFOLIOS	CORPORATE INNOVATION ZERO-INVESTMENT PORTFOLIOS															
	1Q/3M	1Q/6M	1Q/9M	1Q/12M	2Q/3M	2Q/6M	2Q/9M	2Q/12M	3Q/3M	3Q/6M	3Q/9M	3Q/12M	4Q/3M	4Q/6M	4Q/9M	4Q/12M
1Q/3M	1.00															
1Q/6M	0.79	1.00														
1Q/9M	0.68	0.88	1.00													
1Q/12M	0.62	0.80	0.92	1.00												
2Q/3M	0.67	0.85	0.70	0.61	1.00											
2Q/6M	0.43	0.74	0.79	0.70	0.84	1.00										
2Q/9M	0.32	0.60	0.73	0.75	0.66	0.91	1.00									
2Q/12M	0.37	0.60	0.69	0.76	0.63	0.83	0.96	1.00								
3Q/3M	0.52	0.65	0.71	0.60	0.72	0.81	0.73	0.68	1.00							
3Q/6M	0.29	0.55	0.66	0.67	0.58	0.81	0.88	0.84	0.85	1.00						
3Q/9M	0.28	0.48	0.62	0.65	0.49	0.72	0.86	0.88	0.77	0.95	1.00					
3Q/12M	0.31	0.48	0.56	0.62	0.50	0.66	0.80	0.86	0.70	0.88	0.96	1.00				
4Q/3M	0.30	0.47	0.54	0.57	0.49	0.65	0.68	0.68	0.68	0.77	0.75	0.70	1.00			
4Q/6M	0.21	0.43	0.52	0.56	0.43	0.65	0.72	0.74	0.64	0.79	0.80	0.77	0.95	1.00		
4Q/9M	0.16	0.36	0.47	0.51	0.37	0.59	0.68	0.72	0.58	0.75	0.78	0.78	0.90	0.98	1.00	
4Q/12M	0.16	0.33	0.41	0.46	0.35	0.53	0.61	0.68	0.53	0.69	0.74	0.78	0.84	0.93	0.97	1.00

TABLE 11: Regressions of Momentum Strategies Returns on CI-Strategies Returns.
The returns are from January 1976 to December 2001. The R-squares are adjusted for degrees of freedom. T-values computed from Newey-West standard errors appear in parentheses below the coefficient estimates.

Panel A: Contemporaneous regressions of the returns of momentum strategies on the returns of CI-based strategies.

Formation Period \ Holding Period	3 Months			6 Months			9 Months			12 Months		
	Constant	CI	R-square	Constant	CI	R-square	Constant	CI	R-square	Constant	CI	R-square
One-Quarter CI, 3-Month Past Returns	-0.01	0.86	0.16	0.00	1.21	0.26	0.00	1.34	0.27	0.00	1.27	0.24
	(-1.48)	(2.41)		(-1.23)	(3.39)		(-1.05)	(3.17)		(-0.67)	(5.17)	
Two-Quarter CI, 6-Month Past Returns	0.00	1.04	0.23	0.00	1.21	0.27	0.00	1.22	0.27	0.00	1.18	0.27
	(-0.93)	(3.57)		(-0.69)	(3.81)		(-0.30)	(5.08)		(0.01)	(7.54)	
Three-Quarter CI, 9-Month Past Returns	-0.01	1.07	0.25	0.00	1.11	0.28	0.00	1.04	0.26	0.00	1.07	0.26
	(-1.24)	(3.72)		(-0.58)	(6.02)		(-0.29)	(6.53)		(-0.22)	(6.81)	
Four-Quarter CI, 12-Month Past Returns	-0.01	0.93	0.27	0.00	0.84	0.27	0.00	0.80	0.25	0.00	0.83	0.26
	(-1.49)	(5.02)		(-0.71)	(5.59)		(-0.78)	(5.23)		(-0.77)	(5.55)	

Panel B: One month ahead predictive regressions of the returns of momentum strategies on the returns of CI-based strategies.

Formation Period\Holding Period	3 Months			6 Months			9 Months			12 Months		
	Constant	CI	R-square	Constant	CI	R-square	Constant	CI	R-square	Constant	CI	R-square
One-Quarter CI, 3-Month Past Returns	0.00	-0.37	0.03	0.01	-0.39	0.02	0.01	-0.49	0.03	0.01	-0.39	0.02
	(0.82)	(-1.53)		(2.55)	(-1.43)		(3.16)	(-1.61)		(3.10)	(-1.74)	
Two-Quarter CI, 6-Month Past Returns	0.01	-0.30	0.02	0.01	-0.42	0.03	0.01	-0.40	0.03	0.00	-0.25	0.01
	(2.55)	(-1.34)		(3.60)	(-1.78)		(3.40)	(-1.94)		(2.25)	(-1.59)	
Three-Quarter CI, 9-Month Past Returns	0.01	-0.34	0.02	0.01	-0.33	0.02	0.01	-0.14	0.00	0.00	0.00	0.00
	(2.94)	(-1.37)		(3.39)	(-1.76)		(2.25)	(-0.90)		(1.18)	(0.04)	
Four-Quarter CI, 12-Month Past Returns	0.01	-0.19	0.01	0.01	-0.09	0.00	0.00	-0.03	0.00	0.00	0.07	0.00
	(2.29)	(-1.14)		(1.79)	(-0.87)		(0.98)	(-0.29)		(0.34)	(0.72)	

Table 12: **Average monthly returns of 60-month/60-month momentum strategy.**

This strategy is equivalent to a 5-year, 5-year contrarian strategy. The returns are from January 1976 to December 2001. Portfolio characteristics such as Corporate Innovations (CI) and average annualized firm level volatility (see Campbell, Lettau, Malkiel, and Xu (2001)) are computed for the date of the portfolio formation. The average CI of the portfolios at formation (current) and 1, 2, 3, 4, and 5 after the formation date are reported. T-values appear in parentheses.

60-Month/60-Month Momentum								
	Returns	CI(current)	CI(1 year ahead)	CI(2 year ahead)	CI(3 year ahead)	CI(4 year ahead)	CI(5 year ahead)	Volatility
P 1	0.0155	0.0057	0.047	0.1041	0.0384	0.0578	0.0537	17.8339
	-4.88							
P 2	0.0149	0.035	0.0828	0.045	0.0626	0.0632	0.0733	11.2878
	-5.39							
P 3	0.0144	0.0575	0.0749	0.0578	0.0596	0.0603	0.0536	9.2373
	-5.85							
P 4	0.015	0.0713	0.0697	0.0748	0.0604	0.0516	0.0487	8.2693
	-6.33							
P 5	0.0145	0.0848	0.0736	0.075	0.0682	0.0574	0.0485	7.6247
	-6.2							
P 6	0.0142	0.0719	0.0738	0.0719	0.0639	0.0654	0.0484	7.2392
	-6.16							
P 7	0.0136	0.0893	0.0722	0.0683	0.0722	0.0474	0.045	7.1944
	-5.92							
P 8	0.0134	0.1054	0.0831	0.0665	0.0561	0.0942	0.0387	7.3776
	-5.57							
P 9	0.0125	0.1078	0.07	0.072	0.0648	0.0464	0.0506	7.8698
	-4.88							
P 10	0.0117	0.1433	0.0819	0.0528	0.0574	0.0569	0.0402	8.8261
	-3.87							
P 10 -1	-0.0038							
	(-1.70)							