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Do Nonexecutive Employees Have Valuable Information? Evidence from Employee Stock Purchase Plans

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Using novel data on employee stock purchase plans (ESPPs), we show that aggregate purchases of company stock by lower-level employees predict future stock returns. Firms in the top quartile of ESPP purchases outperform those in the bottom quartile by 10% in the year after purchase. The relation between ESPP purchases and future stock returns is stronger for firms with high information asymmetry. Furthermore, we find that high ESPP purchases are associated with a lower likelihood of breaks in strings of consecutive earnings increases, as well as higher future sales growth and more innovation. These findings support the hypothesis that lower-level employees have information about future firm performance. We examine and reject a number of alternative explanations. Our results have implications for firms using employees as a source of capital, accounting issues related to expensing of equity-based compensation, and disclosure policy.

Data, as supplemental material, are available at <http://dx.doi.org/10.1287/mnsc.2015.2226>.

Keywords: insider trading; ESPP; nonexecutive compensation; return predictability

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1. Introduction

Trading by corporate insiders in their company stock commands widespread attention in the financial community. The academic literature in this area focuses almost exclusively on abnormal returns following trades by top corporate officers, directors, and large shareholders (defined as insiders in §16 of the Securities Exchange Act), who are required to report their trades to the Securities and Exchange Commission (SEC). By contrast, we know very little about trades by lower-level employees, and whether such employees have price-relevant information is an open question. In this paper, we attempt to fill this gap in the literature by using a large novel data set on employee stock purchase plans (ESPPs), which are company-run programs that allow participating employees to purchase company shares at a discounted price. To our knowledge, we are the first to provide broad-based evidence that lower-level nonexecutive employees have information about their companies' future stock performance.

Employees often come across information relevant to a firm's future prospects in the course of their interactions with customers, suppliers, senior managers, and other employees. Unlike speculators

who deliberately seek and acquire costly information or high-profile executives who are informed about strategic firm initiatives, employees may stumble upon valuable information in their day-to-day activities while on the job.¹ Because total ESPP purchases reflect the decisions of thousands of employees and the noise in individual information sets is averaged away, aggregate purchases can provide a reliable signal of future performance.² For example, Wolfers and Zitzewitz (2004) note that the employee prediction market at Hewlett-Packard produced more accurate forecasts of printer sales than did the firm's internal processes. Similarly, Ortner (1998) finds that employee trading at Siemens accurately predicted that the firm would fail to deliver on a software

¹ Subrahmanyam and Titman (1999) define such information acquisition process as "serendipitous."

² Surowiecki (2003) argues that even if most of the people within a group are not especially well informed or rational, the aggregation of information possessed by independently acting individuals can lead to a collectively wise decision. He provides a wealth of anecdotal evidence about the "wisdom-of-the-crowd" effect in diverse contexts. A similar argument likely holds in the context of aggregate ESPP purchases, where each individual employee might not be very well informed but can draw on some local knowledge when deciding whether to participate in an ESPP.

project on time, even when traditional planning tools suggested that the deadline could be met. Given this anecdotal evidence, a study of whether employees at large have the ability to predict future firm performance is warranted.

Market participants following insider trades should also be interested in trades by lower-level employees. There are two main reasons why purchase decisions by lower-level employees through ESPPs may have information over and above information contained in trades by top executives. First, employees may have access to a different kind of information (e.g., future demand from the customer base for firm's products, the likely success of development of new technologies, employee work morale). Second, employees may be less restricted in using their information for trading purposes.³ Lower-level employees are not considered insiders, and they are not required to report their stock purchases to the SEC.⁴ Unlike trades of top executives, employee trades do not face intense public scrutiny and have a low risk of attracting allegations of insider trading.

To analyze the information content of employee trading, we obtain data on ESPP participation by conducting a manual search of 10-K forms of S&P 500, S&P 400 Midcap, and NASDAQ 100 constituent firms for the fiscal years 1998–2009. For firms with ESPPs (4,576 firm-years and 473 unique firms), we obtain the detailed terms of the plans from previous 10-K, 10-Q, and 8-K forms or proxy statements. Using a calendar time methodology, we find that firms in the top quartile of employee stock purchases earn approximately 10% higher abnormal returns in the next 12 months than do firms in the bottom quartile. In a cross-sectional regression setting, ESPP participation also forecasts the next year's buy-and-hold abnormal returns. Since participation in ESPPs is typically open to all employees in the firm (often with the exception of top management), our evidence suggests that nonexecutives have price-relevant information in the aggregate.

To refine the tests of the information hypothesis, we use cross-sectional differences in firm and plan characteristics. If the empirical relation between ESPP participation and future returns is driven by employee information, it should be stronger when employees are likely to have a greater informational advantage over outsiders. Indeed, we find that return

predictability is greater in small firms and in firms followed by fewer analysts. Furthermore, because investing in company stock represents an undiversified bet for employees, we also expect stronger return predictability in firms that require employees to hold the stock following a purchase. Accordingly, we find that ESPP participation is a stronger predictor of returns for firms with explicit sale restrictions.

We examine and reject a number of alternative explanations for a relation between ESPP purchases and future abnormal returns. One possibility is that employees follow trades by senior executives. However, the correlation between employee and insider stock purchases is statistically indistinguishable from zero, and ESPP participation predicts stock returns even when we explicitly control for trading by top insiders. It is also unlikely that the relation between ESPP purchases and returns is driven by the direct participation of top management in the firm's ESPP. Specifically, we find that ESPP participation is a significantly better predictor of future abnormal returns for tax-qualified plans that are open to all employees, as required by tax regulations, than it is for non-qualified plans that are offered to senior management. Finally, our results also do not appear to be driven by top managers tailoring the terms of a stock purchase plan to make it more attractive to lower-level employees ahead of good news.

Another alternative explanation is that ESPP purchases cause rather than forecast higher returns. For example, higher returns following higher ESPP participation could be due to greater motivation of employees after they increase their equity ownership. To examine this hypothesis, we rely on the instrumental variables approach. An exogenous increase in ESPP participation should predict returns if ESPP purchases cause higher stock returns. We use the median industry wages as our instrument because employees with higher wages can afford to invest more capital in an ESPP. We also use plan characteristics that affect the attractiveness of the plan lagged for two years. The results of the estimation show that there is no relation between instrumented ESPP participation and stock return performance. Therefore it is unlikely that return predictability is due to higher ESPP participation *causing* high stock returns.⁵

Another possible concern is that firms with high ESPP participation can have a high loading on some risk factor or have a characteristic that is related to returns but is not captured by matching on size, book-to-market, and momentum characteristics. If this were

³ Insiders are explicitly precluded from capitalizing on their information advantage. Section 16(b) of the Securities Exchange Act requires them to forfeit all trading profits made on round-trip transactions that take place within six months of each other.

⁴ Before August 29, 2002, Section 16(a) insiders were required to report their trades to the SEC no later than the 10th day of the next calendar month. After August 29, 2002, trades have to be reported within two business days.

⁵ A possible reason why we do not see a positive causal relation between increases in employee ownership through ESPP purchases and firm performance is that incentives provided by ESPPs are relatively small (e.g., compared with those provided by stock options and bonuses).

the case, abnormal returns for these firms should persist for some time and ESPP participation should be related to abnormal returns several years in the future. However, we find that return predictability disappears over the horizons that are longer than 12 months after the 10-K filing date. Thus it is unlikely that ESPP participation proxies for loading on risk factors or other characteristics related to returns.

An interesting question is what kind of information employees have that is relevant to future firm performance. One possibility is that employees are informed about the quality of new products by the firm or by customer orders for new products and can therefore predict demand. Indeed, we find that greater employee participation in a firm's ESPP is associated with higher future sales growth and with a lower likelihood of a break in consecutive earnings increases. Furthermore, we find evidence that employees are informed about the quantity and quality of innovation taking place within the firm. For example, a one-standard-deviation increase in participation translates into a 24.6% increase in patent applications the following year and a 28.6% increase in the number of citations across patents applied for in the following year. Overall, these results suggest that employees have information about innovation, future firm sales, and earnings.

To understand whether employees obtain their information primarily by observing the firm's day-to-day operations or through interactions with top management, we further examine whether ESPP participation predicts corporate events that are likely to be under control of management: announcements of seasoned equity offerings (SEOs), share repurchases, and dividend increases. For example, it is somewhat unlikely that employees can predict the announcement of a new equity issue simply by observing the firm's daily operations. Yet they might be able to do so if their information came mainly from the management. Our results show, however, that employee participation in an ESPP does not have predictive power for share repurchases, dividend increases, or SEOs, strengthening our conclusion that the information that the employees use in ESPP participation decisions does not come from the management.

That employees have price-relevant information about their firms has a number of implications. First, firms may want to use informed employees as providers of capital (Garmaise 2008). Second, regulators might consider requiring disclosure of aggregate employee trades in company stock in a fashion that would allow easy incorporation of this information into prices and increase efficiency. Finally, if shareholders do not realize that higher purchases through ESPPs tend to precede higher stock returns, they will systematically underestimate the cost of employee

compensation. Although we do not take a stand on whether shareholders care about underreporting of compensation expense, we note that firms that had backdated stock option grants saw a precipitous drop in their stock price when the backdating was revealed to the markets (Bernile and Jarrell 2009). In our setting, potential underestimation of compensation amounts to approximately 1% of a firm's net income for the median firm in the top quartile of participation.

Our paper is one of the first to provide broad-based evidence that lower-level employees hold price-relevant information about their firms. Huddart and Lang (2003) analyze option exercises by lower-level employees at seven large firms over the period 1985–1994 and find that the raw and market-adjusted stock returns are 10% higher in the six months following low option exercises. Although their results might be taken as evidence that lower-level employees have information, Kasznik (2003) points out several reasons why such a conclusion may not be warranted. First, many employees do not sell their stock following the exercise (Aboody et al. 2008, Cicero 2009). Therefore, a test of the information hypothesis using data on option exercises is difficult to interpret. Second, a negative relation between option exercises and returns might arise from the market reaction to stock dilution. Our results, although consistent with those of Huddart and Lang (2003), do not suffer from the above criticisms. ESPP participation unambiguously represents a purchase of stock by employees. High ESPP purchases would lead to lower returns because of dilution, whereas the information story predicts higher returns. Furthermore, our results are based on a much larger sample of firms, and we identify what kind of information employees may possess.

Our findings also contribute to the insider trading literature documenting that executives and directors earn abnormal returns on their stock purchases (Seyhun 1986, Lakonishok and Lee 2001, Jeng et al. 2003, Fidrmuc et al. 2006, Ravina and Sapienza 2010). Several studies also find evidence that executives successfully time the exercise of stock options (Aboody et al. 2008, Cicero 2009), whereas Carpenter and Remmers (2001) find no such evidence in the post-1991 period.

Finally, our results provide support for a theory developed by Van Nieuwerburgh and Veldkamp (2006, 2010) that employees' trades should earn abnormal returns. Specifically, they posit that because the value of company stock is positively correlated with the employees' labor income, any information employees acquire about their own earnings gives them an informational advantage in trading the company stock. The positive correlation gives employees an additional incentive to gather information about

their own firms so as to increase their returns on a risk-adjusted basis.

In a related paper, Babenko and Sen (2014) analyze the ESPP participation decisions of employees and argue that employees do not take full advantage of the discount provided by these plans, thereby “leaving money on the table.” One might wonder whether purchase decisions of these seemingly unsophisticated employees can provide information about future firm performance. Because the level of participation increases with plan benefits and employee salary, this suggests that employees behave as if there are significant fixed costs of participation, which they trade off against the benefits of participation. The reasons for nonparticipation could be rational (e.g., liquidity constraints, transaction costs, and tax complications) or behavioral (e.g., a tendency to procrastinate). Therefore, if employees expect the stock to perform well in the future, the gains from participation are larger and employees are more likely to participate in the ESPP.⁶ Babenko and Sen (2014) also show that the least sophisticated and uneducated employees never participate in company ESPPs. Therefore the observed ESPP participation likely reflects the aggregation of the decisions of relatively more sophisticated employees.

2. Background

An employee stock purchase plan is a company-run program that allows participating employees to purchase company shares at a discounted price. Some plans allow employees to buy stock using their own money. Most plans, however, require employees to contribute through payroll deductions, which accumulate between the offering date and the purchase date. From time to time, employees are allowed to increase or decrease their contributions to the plan during the offering period, and most firms allow employees to withdraw from the plan up to the date of a purchase. On the purchase date, the company uses the accumulated funds (usually without paying interest) to purchase shares in the company on behalf of the participating employees.

The amount of the discount varies by plan, but most often it is set at 15% below the market price. Most ESPPs also have a built-in option, called a lookback feature. The lookback feature allows employees to purchase stock at the discounted price based on the lower of the prices at the beginning and the end of the offering period.

⁶ For example, an employee who procrastinates and therefore often misses out on the gains from ESPP participation might get around to signing up when she is excited about the company stock or knows something that is likely to lead to higher stock performance in the future.

From a tax perspective, most ESPPs are tax-qualified (Section 423 plans).⁷ To satisfy the requirements of Section 423, a plan must (1) allow all employees to participate, except executives who own more than 5% of the firm’s stock;⁸ (2) set the discount at no more than 15% of the price on the grant date or purchase date, whichever is lower; (3) guarantee that no single employee contributes more than \$25,000 per year to the plan; and (4) set the offering period at no longer than 27 months if there is a lookback feature. Prior to the change in expensing rules by the Financial Accounting Standards Board in December 2004, tax-qualified plans were considered non-compensatory, which gave them favorable accounting treatment. Some firms target their plan at senior executives and not all employees; these plans are not tax qualified.

3. Data and Summary Statistics

We obtain data on employee stock purchase plans by manually searching 10-K forms for a sample of firms in the S&P 500 index, the NASDAQ 100 index, and the S&P 400 Midcap index for the fiscal years 1998–2009. For companies with ESPPs, we obtain detailed descriptions of each plan. Such contracts are typically located in past 10-K, 10-Q, 8-K, and S-8 forms or in firm proxy statements. To our knowledge, this is the first data set on employee stock purchase plans covering a large cross section and time series. Engelhardt and Madrian (2004) used detailed time-series data for a single healthcare company, and Bhagat et al. (1985) studied the market reaction to authorizations of 130 stock purchase plans from 1970 through 1982. Our data set has information on whether a company has an ESPP, whether the plan is tax qualified, the percentage of compensation that employees are allowed to allocate to stock purchases, the maximum annual dollar limit on participation, the number and price of shares issued through the plan during a fiscal year, the length of the offering period, whether the plan has a lookback feature, the discount at which shares can be bought, and the length of the period (if any) during which the employees cannot dispose of the acquired shares.

⁷ For tax-qualified plans, the company does not receive any tax deduction as long as employees sell the shares more than two years after the offering date and at least one year after the purchase date (qualified disposition). Employees do not pay any tax at the time of purchase. At the time of sale, employees are taxed at the ordinary income tax rate on the amount of either (1) the discount they received at the time of the grant or (2) the total gain, i.e., the spread between the purchase price and the sale price, whichever is less.

⁸ In addition, a company is allowed (but not required) to exclude employees with less than two years’ tenure, employees working less than 20 hours per week, and “highly compensated employees,” as defined in §414(q) of the Internal Revenue Code.

We start with a sample of 918 firms and 10,269 firm-year observations with 10-K data.⁹ Approximately 44.6% of the firm-years have an active ESPP, so our final sample contains data on 473 firms with ESPPs over the period 1998–2009, for a total of 4,576 firm-year observations. Some firms in the sample have fewer than 12 years of coverage because their 10-K forms were unavailable or because of firm entry or exit. In some cases, firms mention that they have an ESPP but do not provide enough information about participation. For a total of 3,420 firm-years we are able to calculate our main measure of ESPP participation. We also obtain data on employee stock option grants and exercises for firms in our sample. These data are available through the RiskMetrics database for the period 1999–2005 and from Compustat for a later period.

The data on stock purchase plans are merged with financial data from the Compustat and Center for Research in Security Prices (CRSP) databases by manually matching on company name and ticker. Table 1 compares the characteristics of companies in our sample that have an ESPP plan with those that do not. Firms with ESPPs tend to have higher *Q*, grant more stock options to employees, have lower leverage, and are followed by more security analysts than firms without such plans. To the extent that these firm characteristics are correlated with firms' propensity to employ highly skilled and educated labor (e.g., in the high-tech industry), it is possible that our results on return predictability through employee trading will not generalize to the whole universe of firms. However, it is worth noting that since we focus on S&P 500, S&P 400, Midcap, and NASDAQ 100 firms, our sample is naturally tilted toward larger and more mature firms than an average firm in Compustat. Since previous research has found that the informational advantage of insiders is larger in small firms (e.g., Lakonishok and Lee 2001), it is also possible that our results would be more pronounced in a broader sample.

The summary statistics for our sample with ESPPs are reported in Table 2. More than 82% of stock purchase plans are considered qualified for tax purposes. Each year, companies issue, on average, 0.30% of their outstanding shares for purchase by employees in these plans. Employees' annual ESPP contributions average \$21.6 million per firm, or approximately \$1,604 per employee.¹⁰ Although we do not have comprehensive data on participation in ESPPs (other than

Table 1 Descriptive Statistics of Firm Characteristics

Variable	Firms with ESPP (4,576 obs.)		Firms without ESPP (5,693 obs.)		Difference in means <i>t</i> -Test
	Mean	Median	Mean	Median	
<i>Assets</i> (\$ billion)	19.90	3.22	25.87	4.72	−1.17
<i>Q</i>	2.06	1.49	1.46	1.10	7.57***
<i>Leverage</i> (%)	21.55	18.57	26.73	25.59	−5.08***
<i>Analysts</i>	13	12	11	11	4.93***
<i>Wage/emp</i>	\$60,642	\$54,583	\$60,271	\$55,898	0.19
<i>Option grants/emp</i>	\$13,931	\$2,601	\$4,782	\$1,017	7.49***

Notes. The table presents descriptive statistics of firm characteristics for our sample firms (S&P 500, S&P 400 Midcap, and NASDAQ 100) for the period 1998–2009. *Assets* is defined as the book value of assets. *Q* is equal to the sum of market value of equity and book value of debt normalized by the book value of assets; *leverage* is equal to the sum of total long-term debt and debt in current liabilities, normalized by the book assets; *analysts* is the average number of analysts with outstanding valid forecasts in the previous fiscal year; *wage/emp* is equal to the staff expense (from Compustat) normalized by the number of employees; whenever this item is missing, it is set to the median value within the industry (defined by two-digit SIC code) for that year; and *option grants/emp* is the value of granted employee stock options, normalized by the number of employees. A *t*-test is used for the difference in means between the two samples and is adjusted for within-firm correlation.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

share issuance), the participation rate for companies that report voluntarily is less than 40% on average.¹¹ The participation rate is even lower if one considers, as we do, that employees who participate in a plan tend to contribute, on average, only 20% of the allowed limit (see Engelhardt and Madrian 2004). Employees might not choose to participate in an ESPP to the full extent because of transaction costs, liquidity constraints, tax complications, and portfolio risk (in cases where employees are explicitly or implicitly required to hold on to the shares for some period of time after purchase). In addition, behavioral factors identified in the stock market participation literature, such as the tendency of individuals to procrastinate, can result in lower participation. For example, an employee might not get around to participating in her firm's ESPP unless she has a really good feeling about the company stock or knows something that is likely to lead to higher stock performance in the future. If employees have unfavorable information about the firm in a particular year, the participation rate is likely to be low for that year. Importantly, we observe that the participation rate varies substantially from year to year within a single firm despite the fact that the terms of the plan rarely change.¹² For example, the

⁹ Our initial sample of S&P 500, S&P 400 Midcap, and NASDAQ 100 contains 918 firms. This is because there are 7 foreign firms listed on NASDAQ that do not file 10-K forms, 21 firms are in both the S&P 400 Midcap and the NASDAQ 100, and 54 firms are in both the S&P 500 and the NASDAQ 100 indices.

¹⁰ This estimate includes employees with zero ESPP contributions.

¹¹ For example, the average participation using head count ranges from 23.8% to 37.6% in the 2009 ESPP survey data by the National Center of Employee Ownership (<https://www.nceo.org/ESPP-Survey-Results/m/152/>, accessed November 9, 2015).

¹² Table A.1 in the appendix shows that firm-year observations with changes in the terms of the ESPP plan account for only 3.85% of

Table 2 Descriptive Statistics of ESPP Characteristics

Variable	Firm-years with ESPP during period 1998–2009					
	Obs.	Mean	SD	10%	50%	90%
<i>Shares issued/outstand. (%)</i>	3,338	0.300	0.329	0.042	0.193	0.675
<i>Contributions (\$million)</i>	3,539	21.60	59.96	0.86	5.51	46.72
<i>Contributions/assets (%)</i>	3,484	0.374	0.435	0.018	0.243	0.894
<i>Contributions/employee (\$)</i>	3,420	1,604	1,985	120	779	4,420
<i>Participation (%)</i>	3,420	8.09	11.08	0.58	3.86	21.34
<i>CV participation (%)</i>	386	41.23	23.89	15.49	37.98	75.49
<i>Plan 423 (tax-qualified)</i>	4,205	0.822	0.383	0	1	1
<i>Years since adoption</i>	4,374	9.54	7.24	2	8	18
<i>% of comp.</i>	3,972	19.89	24.86	10	10	25
<i>Discount (%)</i>	4,373	14.38	5.75	10	15	15
<i>Lookback</i>	4,363	0.689	0.463	0	1	1
<i>Purchase period (months)</i>	4,115	5.74	4.11	1	6	12
<i>Holdup</i>	3,988	0.219	0.413	0	0	1
<i>Holding period (months)</i>	838	14.43	8.81	6	12	24
<i>Option grants/emp (\$)</i>	3,781	13,931	32,107	111	2,601	37,012
<i>Option exercises/emp (\$)</i>	3,809	7,032	11,565	172	2,382	20,334
<i>Insider purchases (%)</i>	4,377	0.057	0.273	0	0.002	0.043

Notes. The table presents descriptive statistics for the sample of S&P 500, S&P 400 Midcap, and NASDAQ 100 firms for which we were able to obtain data and have a stock purchase plan. *Shares issued/outstand.* is the number of shares issued to employees participating in ESPP during the fiscal year normalized by the number of outstanding shares at the end of the year; *contributions* is the dollar amount contributed by employees to the ESPP during the fiscal year. Whenever the dollar contributions are missing, they are set to the number of shares issued in a plan multiplied by the end-of-year price and one minus the discount. *Contributions/assets (contributions/employee)* is the ESPP contributions normalized by the book assets (number of employees); *participation* is the contributions per employee normalized by the annual dollar limit allowed by a company; *CV participation* is the coefficient of variation of the participation rate calculated for each firm using time-series data. Note that the number of observations for coefficient of variation is lower because it is calculated for a firm and not for a firm-year observation. *Plan 423 (tax-qualified)* is equal to 1 if the plan is open to all employees in the firm and is tax qualified by the IRS; *Years since adoption* is the number of years since the plan was disclosed in SEC filings; *% of comp.* is the maximum percentage of compensation the employees are allowed to contribute to ESPP; *discount* is the percentage discount at which employees can buy stock; *purchase period* is the period over which payroll deductions are made for the purchase of shares through the ESPP; *lookback* is equal to 1 if the price at which employees can buy the stock is the lower of the prices at the beginning and at the end of the purchase period minus the specified discount; *holdup* is equal to 1 if employees are not allowed to dispose of the stock immediately after the purchase; *holding period* is the minimum number of months the employee is required to hold the stock (when there is such a requirement); *option exercises/emp* is the cash inflow associated with employee stock option exercises, normalized by the number of employees; *option grants/emp* is the value of granted employee stock options, normalized by the number of employees; and *insider purchases* is the number of shares purchased by officers as disclosed in the Thomson Financial database during the fiscal year, normalized by the number of shares outstanding. When no transactions are reported for a particular year, we set insider purchases to 0.

average coefficient of variation of the ESPP participation rate, calculated for each firm using the time-series data, is over 41%.¹³

The contract features of stock purchase plans are provided in Table 2. Typically, plans allow employees to purchase stock at a 15% discount from the market price, although some firms offer no discount at all and some provide discounts as high as 75%. Approximately 68.9% of all purchase plans have a lookback feature, although changes in expensing rules have caused some firms to eliminate this feature (76.5% of plans had it in 2002, and only 55.4% did in 2009). The average purchase period is slightly less than 6 months in our sample, but the variation in purchase periods is large, ranging from 1 to 27 months. We find that 21.9% of firm-year observations explicitly specify that employees cannot dispose of company stock

immediately. The minimum holding period in companies that do not allow immediate disposition ranges from 1 to 48 months, with a median of 12 months.

4. Empirical Results

4.1. Abnormal Returns and ESPP Participation

Our main empirical hypothesis is that lower-level employees (below top management) have price-relevant information about their own company stock. They could obtain information about future prospects from their interactions with customers, suppliers, senior managers, and other employees. As a result, employees in the aggregate can have information about the firm's future earnings, its plans for entering new markets, the development of new products and technologies, likely future demand from the customer base for the firm's products, the quality of management, or overall employee work morale. A number of studies on insider trading examine whether trades by top insiders predict returns in the future. In the same spirit, we first examine whether aggregate ESPP purchases by employees predict future stock returns.

our sample. The changes are concentrated in the years 2005–2006, when new expensing rules were introduced (see Figure A.1).

¹³ The number of observations for the coefficient of variation is lower because it can only be calculated for a firm and not for each firm-year observation.

4.1.1. Calendar Time Tests. We test whether there is return predictability using a calendar time approach similar to that recommended by Lyon et al. (1999). We obtain the abnormal returns on annually rebalanced quartile portfolios for our sample period, and calculate the abnormal returns on the long–short portfolio that goes long in the firms that are in the top quartile of ESPP participation and short in the bottom quartile. Since we are unable to verify that the period over which the aggregate annual ESPP participation is reported corresponds exactly to the fiscal year for all firms in our sample, we assign firms to portfolios only after the date on which the 10-K form was filed with the SEC. This ensures that we do not use any future information in the formation of portfolios. Furthermore, since all information is publicly available by the filing date, valid trading strategies can be considered. Specifically, we assign firms to groups at the end of every June from 1999 to 2010 based on information in the most recent form 10-K filed during the previous 12 months. For each firm, we first construct

three variables: participation, defined as contribution per employee normalized by the annual dollar limit; shares issued through an ESPP as a proportion of shares outstanding; and dollar contributions during the year as a proportion of book value of assets. Firms are then sorted into four groups based on participation rates and assigned to portfolios from July of that year through June of the subsequent year. The returns for all firms in these portfolios are averaged for each calendar month to obtain a monthly return series for each portfolio. We then regress the time series of returns minus the risk-free rate on the three Fama–French and momentum factors. The results are reported in Table 3. We also obtain the time series of the difference in returns between the top quartile portfolio and the bottom quartile portfolio and regress these on the four factors. The alpha from this regression can be viewed as the abnormal returns from a trading strategy that goes long in the firms in the top quartile of ESPP participation and short in the bottom quartile, with annual rebalancing at the end of every June.

Table 3 Calendar Time Abnormal Returns

	Characteristic-adjusted abnormal returns	Monthly alpha	$R_M - r_f$	HML	SMB	UMD
Panel A: Monthly regressions of quartile portfolio returns starting from month 1 to month 12 from the filing date on Fama–French factors and momentum based on <i>participation</i> as the sorting variable						
Q1	0.18 (0.84)	0.45* (1.72)	0.99 (16.62)	0.58*** (7.70)	0.37*** (5.04)	−0.21*** (−4.59)
Q2	0.32** (2.06)	0.58** (3.19)	1.05 (25.33)	0.39*** (7.42)	0.23*** (4.44)	−0.17*** (−5.55)
Q3	1.03*** (3.75)	1.23*** (4.96)	1.18 (20.89)	−0.18** (−2.50)	0.31*** (4.38)	−0.12*** (−2.76)
Q4	1.18*** (3.40)	1.30*** (4.29)	1.40 (20.34)	−0.71*** (−8.11)	0.36*** (4.14)	−0.07 (−1.31)
Q4 − Q1 <i>participation</i>	1.00** (2.26)	0.85** (2.06)	0.41*** (4.38)	−1.29*** (−10.87)	−0.02 (−0.16)	0.14** (1.96)
Panel B: Monthly regressions of quartile portfolio returns from month 1 to month 12 from the filing date on Fama–French factors and momentum based on <i>shares issued/outstand.</i> and <i>contributions/assets</i> as the sorting variables						
Q4 − Q1 <i>shares issued/outstand.</i>	1.00*** (3.00)	0.81** (2.37)	0.25*** (3.28)	−0.44*** (−4.49)	0.22** (2.25)	0.12** (2.05)
Q4 − Q1 <i>contributions/assets</i>	1.03*** (2.87)	0.83** (2.35)	0.01 (0.13)	−1.01*** (−9.87)	0.26*** (2.58)	0.16*** (2.69)

Notes. This table shows the alphas to calendar time portfolios that assign firms into quartiles based on ESPP participation and the portfolio that goes long in the top quartile of ESPP participation and short in the bottom quartile. At the end of every June from 1999 to 2010, we identify all firms in our sample that filed form 10-K within the previous 12 months. We then construct three variables of ESPP participation as defined in Table 2: *participation*, *shares issued/outstand.*, and *contributions/assets*. Firms are sorted into quartiles based on the ESPP participation variable as defined in Table 2 and assigned to portfolios from July of that year through June of the subsequent year. The returns are averaged by each calendar month for each portfolio. To get the factor-adjusted alphas, we regress the time series of portfolio returns for each quartile portfolio minus the risk-free rate on the three Fama and French (1993) factors, excess returns on the market, high minus low, and small minus big ($R_M - r_f$, HML, and SMB, respectively) and the momentum factor (UMD). To get the characteristic-adjusted alphas, we use the following method. For every firm, we identify a portfolio of firms with similar characteristics. The assignment of firms into characteristic portfolios follows that available on the website of Russ Wermers (<http://alex2.umd.edu/wermers/>, accessed November 9, 2015). We obtain characteristic-adjusted abnormal returns for all firms by subtracting the return on the portfolio of firms with similar characteristics from the return of the firm. These abnormal returns are averaged by each month for each quartile portfolio. Panel A shows the regression coefficients of the time series of returns minus the risk-free rate on the four factors for the four quartile portfolios and the portfolio that goes long in the top quartile of ESPP participation and short in the bottom quartile. The characteristic-adjusted abnormal returns for these portfolios are also presented. For panel B we define the quartile portfolios based on the participation variables defined in Table 2: *shares issued/outstand.* and *contributions/assets*. It shows the result of regressing the returns on the long–short portfolio on the four Fama–French–Carhart factors. It also shows the characteristic-adjusted abnormal returns for the long–short portfolio. *t*-Statistics are shown in parentheses.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

A different strategy for calculating abnormal returns is to adjust for characteristics in the spirit of Daniel et al. (1997), which we implement as follows. For every firm, we identify a portfolio of firms with similar size, book-to-market, and momentum characteristics at the end of June. The assignment of firms into characteristic portfolios follows that available on the website of Russ Wermers. We next obtain characteristic-adjusted abnormal returns for all firms and all months by subtracting the return on the portfolio of firms with similar characteristics from the return of the firm. We calculate the average characteristic-adjusted abnormal return in every month for each of the participation quartile portfolios. These are reported in Table 3. The time-series average of the difference in characteristic-adjusted abnormal return of the highest and lowest quartile abnormal returns gives us the characteristic-adjusted abnormal returns for the same long–short trading strategy as described earlier.

We find that monthly abnormal returns for the portfolio that goes long in the top quartile of participation and short in the bottom quartile vary between 0.81% and 1.03%, depending on the measure of participation and the method of calculating alphas. Every estimate of abnormal returns is significant at the 5% level or lower for all three measures of ESPP participation and the two methods of calculating abnormal returns. These results lend support to the forecasting power of ESPP participation for future returns.

Note that the portfolios are rebalanced at a lower frequency than the rate at which employee information sets change. For example, ESPP purchases typically take place twice a year, although we rebalance the portfolios only once a year. Moreover, since portfolio assignment is done every June, there is a delay between the time of ESPP purchase and when the firm is assigned to the portfolio based on this information. If there were any short horizon predictability (e.g., in the month after ESPP purchase), our abnormal returns would not capture it. Therefore, it may be possible to find even higher abnormal returns if one rebalanced the portfolios more frequently or had access to intrayear ESPP participation in a more timely manner. Our cross-sectional tests do a little better on this front as we consider abnormal returns right after that filing, eliminating any delay between the filing of 10-K forms and the return examination period.

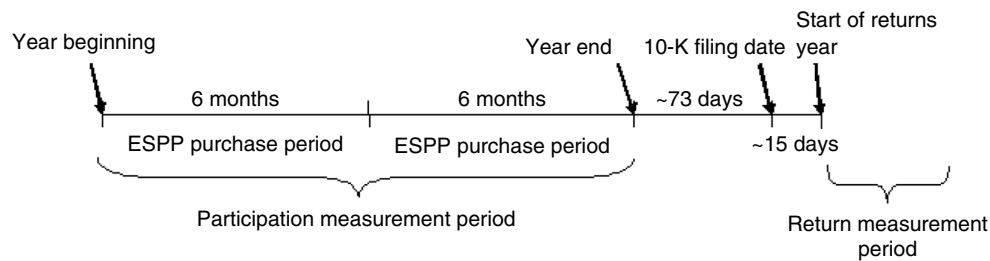
4.1.2. Cross-Sectional Tests. To check the robustness of our results and to examine in which firms the predictability is stronger, we also regress the 12-month buy-and-hold abnormal returns (BHARs) starting from the beginning of the calendar month following the filing date of the 10-K form on the

ESPP participation (see Figure 1).¹⁴ Since participation rates may be higher in all firms at certain times (e.g., when employee sentiment about a particular industry is high), it is possible that a clustering of participation rates affects statistical inference in our cross-sectional tests. We therefore cluster standard errors in regressions by industry (one-digit Standard Industrial Classification (SIC) code) and year. We calculate BHAR as the return on the stock over these 12 months minus the return on a portfolio of stocks with similar size, book-to-market, and momentum characteristics during the same period. The assignment of firms into characteristic portfolios follows that available on the website of Russ Wermers. Participation is measured as the aggregate dollar amount of employee contributions to a plan during the year, normalized by the maximum allowed annual contribution per employee stipulated by the company (typically \$25,000) and the number of eligible employees. We also provide the results using alternative measures of participation, such as the number of shares issued through an ESPP normalized by the number of shares outstanding and the dollar contributions divided by the book value of assets.

The results in Table 4 show that wider employee participation in an ESPP in a particular year is associated with statistically higher abnormal returns in the next year (column (1)). For example, a one-standard-deviation increase in participation is associated with 2.79% higher annual risk-adjusted returns. The results are similar when we use alternative measures of employee participation in the plan (columns (2) and (3)), although the economic magnitudes are somewhat larger.

When a firm imposes an explicit holding period requirement for purchases made under an ESPP, the cost of such a purchase is higher from the employees' perspective. For example, Benartzi (2001) and Cohen (2009) argue that employees who invest in their own company's stock take on additional risk since their human capital is positively correlated with the firm's stock returns. In such cases, ESPP participation should be more closely related to employees' information and expectations for the company's future performance. Furthermore, since the median holding period is 12 months, ESPP participation in firms with holding restrictions is likely to reflect relatively longer-term information, which would correspond more closely with the time window over which the BHARs are measured. Column (4) presents the results of a regression in which we include the interaction of the aggregate employee participation

¹⁴ The examination of abnormal returns over the 12-month horizon is motivated by the fact that predictability seems to be over this horizon. The tests over different horizons are described in §4.1.3.

Figure 1 The Period of BHAR Calculation with Respect to Period of ESPP Participation

Notes. In this diagram, we have chosen a company with a purchase period of six months, which is the sample median. We start the returns' year from the first of the month following the filing date of 10-K form. The average number of days between year-end and the filing date is 73 in our sample.

in the plan with a dummy variable that captures whether an employee is explicitly prohibited from selling the shares after purchase. We find that in companies that explicitly prohibit employees from selling stock immediately after purchasing it through an ESPP, participation is related to considerably higher future abnormal returns. A one-standard-deviation increase in participation for such firms is associated with an additional increase of approximately 5.46% in annual abnormal returns.¹⁵

Our next set of tests compares differences in predictability across firms with differences in the information advantage between employees and outsiders. When there is a lot of public information available about the firm, ESPP purchases by employees should provide very little additional information about future stock returns. Thus we expect a stronger positive relation between ESPP purchases and future stock returns for informationally opaque firms. For example, since information about large firms is more readily available to outsiders, we conjecture that employees of smaller firms enjoy a greater information advantage. The results show that the predictability of future returns using ESPP participation is significantly stronger in smaller firms (column (5)). These results are in line with prior evidence on purchases by top executives. For example, Lakonishok and Lee (2001) show that top executives are able to predict stock returns in small companies but do not earn abnormal returns in large companies.

When a firm is followed by a large number of analysts, market participants have regular access to information about the firm. Consequently, the number of analysts following a firm should be negatively related to the information advantage of employees. Indeed, we find that the relation between participation and future returns weakens significantly as the number of analysts increases (column (6)). Since larger firms

tend to be followed by more analysts, we also interact ESPP participation with the residual analyst coverage, where the latter is calculated as the residual of a regression of the number of analysts on firm size. Column (7) shows that the interaction term of participation and residual analysts is negative, although the effect is not statistically significant. Taken together, our results suggest that ESPP participation is a better predictor of future returns when employees are likely to have an information advantage over market participants.

4.1.3. Longevity of Returns. We next investigate whether return predictability is primarily driven by the time series or by cross-sectional variation of ESPP participation. For example, a cross-sectional relation can arise if high ESPP participation proxies for an unobservable risk factor that produces positive alphas not captured by matching on size, book-to-market (B/M), and momentum characteristics. One way to investigate this issue is by including firm fixed effects. However, in the context of forecasting returns, a firm fixed effects specification is inappropriate since results can be subject to a look-ahead bias. In unreported results, we find that with firm fixed effects, two out of three measures of participation are significantly positively related to future abnormal returns.

If the relation between ESPP participation and abnormal returns were purely cross sectional, then participation should be related to abnormal returns far into the future. Therefore, we investigate how long into the future ESPP participation predicts stock returns. Table 5 shows that the relation between abnormal stock returns and ESPP participation is strong and economically significant for 1 to 6 months and 1 to 12 months following the filing of the 10-K. It weakens considerably during the 13- to 24-month period after filing, and it disappears completely over longer time horizons. Although these results are in the calendar time framework, we obtain qualitatively similar results in a cross-sectional regression setup.

Since the relation is mostly due to time-series variation, it is unlikely that ESPP participation proxies

¹⁵ The negative and significant coefficient on holdup is difficult to interpret because the regression includes an interaction term with holdup. The average effect of holdup on future stock returns is -2.32 , and it is statistically indistinguishable from zero (t -stat = -1.18).

Table 4 Employee Information and Annual BHARs

	Dependent variable = <i>annual BHAR</i>						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Participation</i>	0.25*** (2.97) 2.79%			0.16* (1.84) 1.77%	1.57*** (3.74) 17.38%	0.61*** (2.91) 6.75%	0.44*** (3.19) 4.87%
<i>Shares issued/outstand.</i>		20.56** (2.43) 6.76%					
<i>Contributions/assets</i>			9.89*** (3.15) 4.30%				
<i>Holdup</i>				−5.05** (−2.11)			
<i>Participation × Holdup</i>				0.49* (1.80)			
<i>Firm size</i>					−1.86 (−1.61)		
<i>Participation × Firm size</i>					−0.17*** (−3.55)		
<i>Analysts</i>						−0.39** (−2.13)	
<i>Participation × Analysts</i>						−0.01* (−1.70)	
<i>Residual analysts</i>							−0.25 (−1.45)
<i>Participation × Residual analysts</i>							−0.02 (−1.39)
Adjusted R^2 (%)	5.94	7.38	6.08	6.49	6.63	6.34	6.08
Observations	3,187	3,117	3,240	2,947	3,187	3,187	3,187

Notes. The dependent variable is the abnormal buy-and-hold return (BHAR) from the first month after the filing date of the firm's 10-K form until month 12. *Residual analysts* is the residual of the regression of the number of analysts covering the firm on firm size. The additional variables are defined in Table 2. The estimation includes intercept, year fixed effects, and industry fixed effects (defined by one-digit SIC codes). *t*-Statistics based on robust standard errors clustered by year and industry are listed in parentheses. The number below the *t*-statistic is the change in the abnormal buy-and-hold return for a one-standard-deviation increase in the independent variable.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

for risk characteristics. Additionally, the above analysis shows that the information that employees have is relevant for 6 to 12 months. This is in line with the median minimum holding period of 12 months for firms that place such restrictions. Our results are also comparable to findings from the insider trading literature, which documents that insiders possess, and trade on, their knowledge of economically significant information starting more than two years prior to its disclosure (Ke et al. 2003).

4.1.4. Short-Term Market Response to ESPP Purchases by Employees. Given that employee stock purchases predict future stock returns over the long-term horizon, an interesting question is whether the market reacts to higher ESPP purchases when they are first reported. To answer this question, we construct the three-day abnormal returns around the filing dates of firms' 10-K reports and regress them on different measures of ESPP participation (Table 6). We find that the returns around the reporting dates are

largely unrelated to ESPP participation, suggesting that the market does not react to employee trades efficiently. This result is perhaps not surprising in light of the evidence by Lakonishok and Lee (2001) and Seyhun (1986), who find that the market response to insider trading around the reporting dates is close to zero for large firms. Furthermore, unlike insider trades, which are disclosed in short easily digestible reports (SEC Form 4), employee purchases over the course of year are reported only in firms' annual reports, which contain a myriad of other information relevant for firm valuation. Nevertheless, these results imply that the market underreacts to the information about ESPP participation contained in 10-K when they are filed.

4.2. Alternative Explanations

We would like to rule out the possibility that employees do not have information about future firm performance, and yet there is a relation between ESPP

Table 5 Longevity Analysis

Sorting variable	Participation		Shares issued/outstand.		Contributions/assets	
	Monthly alpha	Characteristic-adjusted abnormal returns	Monthly alpha	Characteristic-adjusted abnormal returns	Monthly alpha	Characteristic-adjusted abnormal returns
1 to 6 months	1.76*** (2.77)	1.74*** (2.97)	1.10** (2.20)	1.39*** (3.26)	1.50*** (2.86)	1.41*** (3.24)
1 to 12 months	0.85** (2.06)	1.00** (2.26)	0.81** (2.37)	1.00*** (3.00)	0.83** (2.35)	1.03*** (2.87)
13 to 24 months	0.30 (0.70)	0.52 (1.35)	0.17 (0.54)	0.26 (0.88)	0.33 (0.94)	0.27 (0.89)
25 to 36 months	−0.03 (−0.08)	−0.02 (−0.05)	0.25 (0.81)	0.24 (0.90)	0.12 (0.37)	−0.02 (−0.07)
37 to 48 months	0.04 (0.13)	0.22 (0.72)	0.32 (1.11)	0.31 (1.08)	0.27 (0.98)	0.22 (0.82)
49 to 60 months	−0.08 (−0.29)	0.08 (0.29)	−0.14 (−0.56)	−0.03 (−0.11)	−0.06 (−0.20)	−0.04 (−0.13)

Notes. This table shows the abnormal returns to a calendar time portfolio that goes long in the top quartile of ESPP participation and short in the bottom quartile. At the end of every June from 1999 to 2010, we identify all firms in our sample that filed form 10-K within the previous 12 months. We then construct three variables of ESPP participation as defined in Table 2: *participation*, *shares issued/outstand.*, and *contributions/assets*. Firms are sorted into quartiles based on each of these values and assigned to portfolios for the period mentioned relative to that June. The returns are averaged by each calendar month for each portfolio. To get the factor-adjusted alphas, we regress the time series of portfolio returns for the long–short portfolio on the three Fama–French factors and the Carhart momentum factor and obtain the intercept from that regression. To get the characteristic-adjusted alphas, we use the following method. For every firm, we identify a portfolio of firms with similar characteristics. The assignment of firms into characteristic portfolios follows that available on the website of Russ Wermers. We obtain characteristic-adjusted abnormal returns for all firms by subtracting the return on the portfolio of firms with similar characteristics from the return of the firm. These abnormal returns are averaged by each month for the highest and the lowest participation quartile portfolios. These two series are subtracted to obtain the characteristic-adjusted abnormal returns time series of the long–short portfolio. The average of this series is reported. In both panels, *t*-statistics are shown in parentheses.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

purchases and future returns. Below we discuss alternative hypotheses that can give rise to such a relation.

4.2.1. Management Information. Given that some ESPP plans allow participation by the top management, it is important to determine whether the observed relation between participation and returns is driven by management purchases. Note that the majority of stock purchase plans do not allow executives

to contribute more than \$25,000 per year. This implies that the combined contributions by the top 20 executives account, on average, for only about 2% of total plan contributions in a year. Furthermore, there is no significant correlation between insider purchases and purchases by nonexecutive employees.¹⁶

To further examine this issue, we exploit variation in plan structure. Since tax-qualified plans are open to all full-time employees (occasionally with the exception of top management) and nonqualified plans are typically open only to senior employees, we expect to find greater return predictability for non-qualified plans if results are driven primarily by purchases of executives and senior managers. In fact, we find the opposite: there is stronger predictability of returns in plans that are open to all employees in the firm (see column (1) of Table 7). These results suggest that management participation in ESPPs is not responsible for the observed relation between ESPP participation and future returns.

Trades by top management are publicly observable and predict future returns (Seyhun 1986, Lakonishok and Lee 2001). If employees were to simply follow these trades, ESPP purchases would also predict

Table 6 ESPP Participation and Short-Term Market Reaction

	Dependent variable = <i>three-day BHAR</i>		
	(1)	(2)	(3)
<i>Participation</i>	−0.000 (−0.95)		
<i>Shares issued/outstand.</i>		0.001 (0.49)	
<i>Contributions/assets</i>			−0.002 (−0.77)
Adjusted <i>R</i> ² (%)	0.50	0.62	0.53
Observations	3,163	3,089	3,215

Notes. The dependent variable is the abnormal buy-and-hold return in the three-day window [−1, +1] around the filing date of the firm's 10-K report. The estimation includes intercept, year fixed effects, and industry fixed effects (defined by one-digit SIC codes). *t*-Statistics based on robust standard errors clustered by year and industry are listed in parentheses.

¹⁶Specifically, the correlation of employee participation with contemporaneous and lagged insider purchases is −0.004 (*p*-value = 0.83) and 0.013 (*p*-value = 0.46), respectively.

Table 7 Alternative Explanations for Relation Between ESPP Participation and Annual BHARs

	Dependent variable = <i>annual BHAR</i>				
	(1)	(2)	(3)	(4)	(5)
<i>Participation</i>	−0.02 (−0.21) −0.22%	0.26*** (3.15) 2.90%	0.18* (1.79) 2.05%	0.29** (2.35) 3.21%	0.25*** (2.91) 2.77%
<i>Plan 423</i>	1.78 (0.61)		4.12 (1.00)		
<i>Participation × Plan 423</i>	0.33** (2.31)				
<i>Insider purchases</i>		14.68* (1.75) 4.00%			
<i>Discount</i>			30.34 (1.44)		
<i>Lookback</i>			5.13* (1.83)		
<i>Purchase period</i>			−0.37 (−1.32)		
<i>Holdup</i>			−2.76 (−1.28)		
<i>% comp</i>			0.02 (0.42)		
<i>Option exercises/emp</i>					−0.27*** (−2.91)
<i>Option grants/emp</i>					0.06 (1.12)
Adjusted R^2 (%)	6.40	6.34	7.11	6.33	2.94
Observations	3,045	3,186	2,794	2,123	2,866

future returns. If this were the case, there should not be any relation between ESPP purchases and future returns other than through top insider trades. Column (2) of Table 7 shows that the economic effect of stock purchases on future returns is unchanged if we explicitly control for Section 16 insider purchases made during the same fiscal year.¹⁷ Our results may be taken to imply that insider trades are not more informative because insiders, who are subject to greater public scrutiny, are reluctant to use their informational advantage; firms impose more trading restrictions on top executives, such as blackout periods (Roulstone 2003, Bettis et al. 2000); and they face greater risk of prosecution for illegal insider trading.

Another possibility is that the firm's top management establishes the terms of the employee stock purchase plan in such a manner as to make it more attractive to junior employees when management expects the stock to perform well.¹⁸ Employees might react to changes in the terms of ESPPs because they

take into account the opportunity costs of plan participation and participate only when a plan is sufficiently profitable. Alternatively, if managers perceive the likelihood of a hostile takeover, they may want to put more stock in the friendly hands of employees by changing the terms of the stock purchase plan. It is possible that future stock returns will be higher when managers' information about a potential takeover becomes public.¹⁹

To determine whether our results are attributable to dynamic adjustment of the terms of stock purchase plans, we control for them explicitly and find similar results (column (3) of Table 7). Additionally, changes in the terms of ESPPs are rather rare and account for only 3.85% of all firm-years in our sample (see Appendix A). Our results are also robust to excluding all firms that ever experienced a change in the terms of the plan (including the no-change years for these firms) during the sample period (column (4)).

¹⁷ Similar results are obtained if we control for insider sales, insider purchases net of sales, or insider purchases made during the previous fiscal year.

¹⁸ Although, such a strategy on the part of management may increase total employee compensation, it is possible that when employees are initially hired this effect is already factored into their

contracts. For example, Roulstone (2003) finds that firms in which insiders are subject to trading restrictions (such as blackout periods) pay a 4%–13% premium in total compensation to their insiders.

¹⁹ We do not find, however, any significant relation between the observed frequency of takeover attempt and ESPP plan discount or other features of the plan.

Table 7 (Continued)

Dependent variable =	BHAR	BHAR	Participation	BHAR
	(6)	(7)	(8)	(9)
<i>Participation</i>		0.28*** (3.38) 3.10%		
<i>Exercise-to-hold</i>	0.32** (1.97)			
<i>Exercise-to-sell</i>	−0.19*** (−2.79)			
<i>Recession</i>		1.32 (0.23)		
<i>Participation</i> × <i>Recession</i>		−0.22 (−0.58)		
<i>Best 100 company</i>			5.19*** (2.76)	
<i>Wage/emp</i>			0.03*** (3.18)	
<i>Firm size</i>			−0.18 (−0.51)	
<i>Q</i>			1.22*** (3.91)	
<i>Leverage</i>			−0.06*** (−2.93)	
<i>Analysts</i>			0.36*** (4.89)	
<i>Bonuses</i>			−0.18 (−1.63)	
<i>Dividend increase</i>			−2.07*** (−3.08)	
<i>Share repurchase</i>			0.16 (0.30)	
<i>SEO</i>			−0.23 (−0.23)	
<i>Contemporaneous stock return</i>			0.01* (1.73)	
<i>Discount</i>			33.99*** (5.85)	
<i>Lookback</i>			3.13*** (4.55)	
<i>Holdup</i>			−3.27*** (−4.07)	
<i>Predicted participation</i>				−0.10 (−0.55)
<i>Residual participation</i>				0.24** (2.54)
Adjusted R^2 (%)	2.89	5.91	33.13	6.23
Observations	2,893	3,187	2,679	2,664

Notes. The dependent variable in columns (1)–(7) and (9) is the abnormal buy-and-hold return from the first month after the filing date of the firm's 10-K form until month 12. The dependent variable in column (8) is ESPP participation. The benchmark return is calculated over the same period for a value-weighted portfolio of firms with similar size, B/M, and momentum characteristics. *Exercise-to-hold* is the fitted value of the regression of *option exercises/emp* on participation, *exercise-to-sell* is the residual of this regression, *recession* is equal to 1 if at least six months of the fiscal year fall within the recession period (March 1, 2001–November 20, 2001, or December 1, 2007–June 30, 2009), *best 100 company* is equal to 1 if the company makes the list of 100 best companies to work for during the year, *dividend increase* is equal to 1 if in a given year the firm declares a dividend increase (CRSP), *share repurchase* is equal to 1 if the firm announces a share repurchase program (SDC database), *SEO* is equal to 1 if the firm announces an SEO (SDC database), and *bonuses* is equal to logarithm of 1 plus the average cash bonus of the top five executives (Execucomp). The additional variables are defined in Tables 1 and 2. The estimation includes intercept, year fixed effects (except column (7)), and industry fixed effects (defined by one-digit SIC codes). *t*-Statistics based on robust standard errors clustered by year and industry are listed in parentheses. The number below the *t*-statistic is the change in the abnormal buy-and-hold return for a one-standard-deviation increase in the independent variable.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

4.2.2. Firm Financing Constraints. Another alternative explanation for the predictability result could be related to financing constraints faced by firms. Specifically, it is possible that when employees increase their participation in an ESPP, cash infusion may ease the firm's financing constraints. Such unanticipated easing of financing constraints could be associated with abnormal stock returns. To see whether this effect could drive our results, we investigate whether a higher volume of stock option exercises by employees is associated with higher stock returns in the future.²⁰ The relaxation of financing constraints should be more pronounced following option exercises since the amount of cash that employees bring to the firm is several times greater than that associated with ESPP purchases (see Babenko et al. 2011). For example, average annual stock option proceeds per employee amount to \$7,032, whereas average ESPP proceeds are only \$1,604. Using the data on employee stock options, we show in column (5) of Table 7 that the exercise of stock options forecasts negative abnormal returns. Thus it is unlikely that the predictability of returns based on ESPP participation is due to the relaxation of financing constraints.

Furthermore, this result is fully consistent with the information hypothesis if most option exercises result in the subsequent sale of stock by employees. Since Aboody et al. (2008) and Cicero (2009) note that some employees do not sell their stock when they are able to, we further refine this test by distinguishing between option exercises with intent to sell the stock and with intent to hold the stock. Our reasoning is that if in a given year a high level of ESPP participation coincides with large option exercises, it is more likely that employees are excited about the stock and will hold it following exercise. Therefore, we regress the option exercises on the ESPP participation level and then use the fitted value of option exercises and the residual as explanatory variables in the regression of annual abnormal stock returns (column (6) of Table 7). Our results indicate that option exercises with intent to hold the stock (the fitted value) predict positive abnormal stock returns, whereas option exercises with intent to sell (the residual) forecast negative returns.

Finally, if firm financing constraints explain our results, it must be that ESPP participation is more

important for the firm (and more strongly predicts returns) when the financing conditions are tight. We therefore define a recession dummy, which is equal to 1 if at least six months of the fiscal year fall within the National Bureau of Economic Research (NBER)-identified recession period. The results indicate that predictability with participation is not statistically different in recessions than at other times and the coefficient on the participation variable is very similar in magnitude (column (7) of Table 7). Thus it is unlikely that firm financing constraints explain our predictability results.

4.2.3. Following Corporate Events and Other Explanations. There are several other possible explanations for the predictability result. First, it is possible that share dilution associated with higher ESPP participation leads to more frequent stock buybacks; we therefore simply observe abnormal returns following such share repurchases. If employees buy stock when they see the firm announcing a share repurchase plan, that would give rise to a relation between employee purchases and subsequent stock returns. Ikenberry et al. (1995) find that there is a positive price drift for several years after the announcement of a share repurchase. Similarly, it could be that employee decisions are influenced by observed dividend increases or SEOs during the year and that these events are followed by abnormal stock returns.²¹

Second, higher participation in ESPPs could be a result of larger bonuses received by employees during the year. If a company gives more bonuses to their employees ahead of good news and if employees indeed increase their ESPP participation after receiving them, we would observe a relation between returns and ESPP participation. Finally, we need to consider the possibility that employees do not have any firm-specific information and simply engage in momentum trading (Jegadeesh and Titman 1993) that turns out to be profitable during the sample period.²²

To address all these concerns, we first regress the ESPP participation on firm characteristics (size, employee wages, Q , firm leverage, number of analysts, bonuses), contemporaneous stock returns, ESPP plan characteristics, and variables capturing announcements of share repurchases, SEOs, and dividend increases during the year (column (8) of Table 7).²³ The adjusted R^2 of this regression is relatively high

²⁰ Prior literature on whether stock option grants relax financing constraints is inconclusive. For example, Yermack (1995), Core and Guay (2001), and Kedia and Mozumdar (2002) conclude that firms' option-granting decisions are partly driven by a desire of cash-strapped firms to substitute equity for salary. However, Oyer and Schaefer (2005) argue that it is difficult to distinguish between the motives for granting stock options to relax financing constraints or for sorting employees.

²¹ Benartzi et al. (1997) find modest positive excess returns for three years after a dividend increase, and Loughran and Ritter (1995) find negative abnormal returns following SEOs.

²² Note that our calculation of abnormal stock returns already accounts for momentum in forming benchmark portfolios.

²³ Since information about employee bonuses is usually unavailable, we proxy for them with a logarithm of bonuses to the top five executives.

Table 8 Causal Effects of ESPP Participation on Performance: Instrumental Variables Approach

	Particip.	BHAR	Particip.	BHAR	Particip.	BHAR	Particip.	BHAR
Participation		−0.16 (−0.14)		0.41 (1.13)				
Shares issued/outstand.						22.26 (1.54)		
Contributions/assets								10.30 (0.98)
Median industry wage	35.25*** (3.56)		39.53*** (3.24)		0.61** (2.48)		0.97*** (3.58)	
Lag2 discount			34.50*** (7.13)		1.08*** (4.23)		0.85*** (3.33)	
Lag2 holdup			−3.56*** (−9.10)		−0.09*** (−7.61)		−0.15*** (−11.41)	
Observations	3,008	3,008	2,316	2,316	2,270	2,270	2,294	2,294
Hansen's <i>J</i>		N/A		$0.79 \sim \chi^2(2)$ $p = 0.675$		$1.21 \sim \chi^2(2)$ $p = 0.545$		$1.44 \sim \chi^2(2)$ $p = 0.486$
Joint test of excluded instruments		$12.69 \sim F(1, 109)$ $p = 0.001$		$31.39 \sim F(3, 89)$ $p < 0.001$		$22.77 \sim F(3, 89)$ $p < 0.001$		$47.90 \sim F(3, 89)$ $p < 0.001$

Notes. The table presents the results of LIML estimation of the BHAR from the first month after the filing date of the firm's 10-K form until month 12 and ESPP participation measures. Columns (1), (3), (5), and (7) present the results of the first equation, where dependent variables are various measures of ESPP participation. Columns (2), (4), (6), and (8) present the estimates of the model with BHAR endogenized. The industry median wage is calculated as the median staff expense per employee across all Compustat firms (but excluding the firm itself) for a given year and industry based on two-digit SIC codes. The excluded instruments are industry median wage, discount, and holdup lagged two years back. The additional variables are defined in Table 2. The estimation includes intercept, year fixed effects, and industry fixed effects (defined by one-digit SIC codes). *t*-Statistics based on robust standard errors clustered by year and industry are listed in parentheses.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

at 33.1%, which suggests that we capture a considerable fraction of variation in ESPP participation rates. It can also be seen that employee decisions are not affected by announcements of SEOs, share repurchases, and bonuses, and they are negatively related to dividend increases. This last result may appear because an ESPP with a lookback feature is similar to a call option and has lower value with an increase in dividend payments. We then regress the future abnormal stock returns on expected ESPP participation and the residual (column (9)). If corporate events or firm characteristics affect employee decisions and at the same time are correlated with future stock returns, we should see the predictability with the fitted value of participation. Yet the results show that fitted participation is not related to future returns, though residual participation is.

4.2.4. Employee Motivation. We next explore the alternative hypothesis that ESPP purchases *cause* (rather than forecast) improvements in firm performance. For example, a relation between ESPP purchases and future stock returns can arise if employees exert greater effort after making ESPP purchases. Hochberg and Lindsey (2010) find that higher option grants lead to better future operating performance. Note, however, that stock ownership by employees through an ESPP is of a much lower magnitude than typical stock option grants. Additionally, Bhagat et al. (1985) find no evidence that ESPPs motivate lower-level employees.

We examine whether greater employee effort contributes to the observed correlation between participation and future returns by using an instrumental variables approach.²⁴ We need economic variables that are strongly correlated with ESPP participation and at the same time do not directly affect future stock return performance. We pick the median industry wage (excluding the firm itself) as our main instrument. Intuitively, in an industry with higher wages, employees have more money to allocate to ESPP contributions. Another two instruments we use are plan discount and holdup. We lag these variables for two years to avoid concerns that management may adjust the terms of the plan in anticipation of future performance. Specifications with multiple instruments allow us to perform the Hansen *J* test of the joint null hypothesis that the model is correctly specified and the instruments are valid. We estimate the model by the limited information maximum likelihood (LIML) since it has better finite-sample properties than two-stage least squares (see Table 8).

Columns (1), (3), (5), and (7) of Table 8 show the estimation of the first stage, where the dependent

²⁴ Note that analyzing how future productivity of the firm depends on ESPP participation does not allow us to distinguish between alternative hypotheses. Finding a positive correlation is consistent with both information and motivation hypotheses, whereas finding no correlation does not rule out employees having price-relevant information as this information can, for example, be related to past accounting fraud or to the firm's future investment opportunities.

variable is ESPP participation. We first use only the median industry wage as the instrument (column (2)), and all four instruments are employed in columns (4), (6), and (8). In each specification, the instruments are strongly correlated with ESPP participation. The joint test of excluded instruments shows that the instruments are collectively strong ($p \leq 0.001$), which is important for consistency of instrumental variables approach in finite samples. Additionally, whenever the model is overidentified, it is never rejected by the Hansen J test. The results of the estimation of the second equation, where the dependent variable is BHAR, show that there is no relation between the instrumented ESPP participation and stock return performance across all specifications. This suggests that it is unlikely that return predictability is because higher ESPP participation causes high stock returns.

4.3. What Information Do Employees Have?

Whereas all our results on stock return predictability are consistent with employees being informed, an interesting question is what kind of information employees might have. Because employees' jobs often involve interactions with customers, suppliers, and other employees, it is conceivable that employees know more than outsiders about the firm's future earnings, its plans for entering new markets, the development of new products and technologies, future demand from the customer base for firm's existing products, and overall employee work morale. In this section, we examine some of these possibilities.

4.3.1. Earnings Breaks. First we investigate whether employees have information about upcoming earnings announcements. We use a methodology similar to that used by Ke et al. (2003), who focus on insider sales prior to the break in earnings increases. Ke et al. document that breaks in earnings are associated with significant negative market price reactions. To identify a break in earnings, we use the basic earnings-per-share data from the quarterly Compustat. We exclude all firm-quarters in which the earnings announcements were not made within a 60-day period after the fiscal quarter end. We set the earnings break equal to 1 if quarterly earnings had been increasing and current earnings are below the previous year's earnings in the same quarter. The model is estimated by logit, where the dependent variable is equal to 1 if there is a break in earnings in the next fiscal year following the year of ESPP participation.

Our controls for earnings breaks include the past year's sales growth because firms that have seen an increase in sales are likely to experience future earnings growth. We also add firm size, Q , and a dummy for dividend payer because firms that pay dividends tend to be more mature and stable, and they are

less likely to see a break in earnings. The year and industry dummies (at the one-digit SIC code) are also included. The results presented in Table 9 indicate that greater participation by employees in ESPPs is associated with the lower likelihood of an earnings break. For example, a one-standard-deviation increase in ESPP participation translates to an approximately 1.37% lower chance that firm earnings will decline after a string of previous increases.²⁵

4.3.2. Firm Sales Growth. Given evidence from an experiment at Hewlett-Packard (Wolfers and Zitzewitz 2004), it is natural to examine whether employee purchases can forecast sales. For example, a salesperson who sees an increase in demand for the product that he sells in the middle of the year could infer that the firm is going to do well and, therefore, could decide to participate in a plan. In this case, we should see a positive correlation between contemporaneous firm sales and ESPP participation. Likewise, an employee might see that the firm's customers are excited about a product and conclude that they will continue to order it in the future. Or an employee may have a personal opinion about the quality of new products that will be offered for sale in the future and therefore about the likely future demand. In this case, employee participation in an ESPP could predict future firm sales.

We explore this possibility in Table 9. Our control variables for sales growth include insider purchases because insiders may be able to predict firm prospects, acquisition activity in the previous year because sales can grow through new acquisitions, lagged sales growth, the firm's Q and size, as well as industry and year fixed effects.

The results suggest that higher ESPP participation predicts higher sales growth in the coming year but is not associated with higher sales growth in the current year (columns (2) and (3)). A one-standard-deviation increase in ESPP participation this year is associated with 2.23% larger sales growth the following year, which is considerable given the average annual sales growth of 12.25% for firms in our sample.

4.3.3. Other Corporate Events. We also test whether employee ESPP purchases predict other corporate events that are likely to be under the control of management. Specifically, we look at future announcements of open market share repurchases (SDC database), declarations of dividend increases by the board (CRSP files), and announcements of seasoned equity offerings (SDC New Issues database). It is less likely that, owing to the nature of their jobs, employees are able to gather information about these

²⁵ We have also explored the possibility that employees may be able to identify accounting problems in their firm. Indeed, we find that ESPP purchases are negatively associated with the likelihood of an earnings restatement in the next year.

Table 9 Employee Participation in ESPP, Future Corporate Events, and Sales Growth

	Earnings break	Next-year sales growth	Current-year sales growth
<i>Participation</i>	−0.01* (−1.69) −1.37%	0.20*** (3.33) 2.23%	0.03 (0.63) 0.32%
<i>Insider purchases</i>	0.04 (0.24)	−2.03* (−1.81)	2.28 (0.88)
<i>Firm size</i>	−0.00 (−0.10)	−1.25*** (−3.80)	−0.04 (−0.10)
<i>Q</i>	0.02 (1.11)	2.63*** (6.67)	3.25*** (7.65)
<i>Acquisitions</i>		12.81*** (3.28)	28.92*** (7.00)
<i>Lagged sales growth</i>	−0.57*** (−3.78)	0.17*** (5.77)	0.27*** (9.03)
<i>Dividend payer</i>	−0.08 (−1.26)		
Events	1,349	N/A	N/A
Observations	3,399	3,371	3,395
Mean CAR (%)	−0.57**	N/A	N/A
<i>t</i> -stat	(−2.12)		
Model χ^2	77.3	N/A	N/A
<i>p</i> -value	<0.001		
	Share repurchase announcement	SEO announcement	Dividend increase announcement
<i>Participation</i>	0.00 (0.25)	0.00 (0.23)	−0.01 (−0.46)
<i>Insider purchases</i>	0.31* (1.74)	−0.27 (−0.57)	−0.50 (−1.28)
<i>Firm size</i>	0.16*** (3.89)	−0.03 (−0.28)	0.13* (1.67)
<i>Q</i>	−0.05 (−1.06)	−0.13 (−0.97)	−0.02 (−0.22)
<i>ROA</i>	5.07*** (5.26)	−4.35*** (−2.78)	11.80*** (5.48)
<i>Option grants</i>	0.004** (2.11)	0.01* (1.69)	0.00 (0.47)
<i>Sales growth</i>	−0.00 (−0.55)	0.01* (1.69)	0.00 (1.00)
<i>Dividend payer</i>	0.42*** (3.17)	0.07 (0.24)	5.11*** (14.31)
Events	769	102	873
Observations	3,037	3,037	3,032
Mean CAR (%)	1.09***	−1.01**	0.50***
<i>t</i> -stat	(6.17)	(−2.37)	(4.69)
Model χ^2	228.51	170.73	377.20
<i>p</i> -value	<0.001	<0.001	<0.001

Notes. The dependent variable in column (1) is equal to 1 if in the next fiscal year the firm has at least one break in earnings. A break is equal to 1 if prior earnings were increasing and if earnings for the quarter are below the earnings for the same quarter of the previous year. The dependent variable in column (2) (column (3)) is the sales growth in the next fiscal year (current fiscal year). The dependent variable in column (4) (column (5)) is equal to 1 if the firm announces a share repurchase program (seasoned equity offering) in the next fiscal year (SDC database). The dependent variable in column (6) is equal to 1 if the firm declares a dividend increase in the next fiscal year (CRSP). *ROA* is the income before extraordinary items divided by book assets, *acquisitions* is a dummy variable equal to 1 if the acquisitions item is greater than 20% of the firm's sales (Efendi et al. 2007), *sales growth* is the growth in sales during the fiscal year, and *dividend payer* is equal to 1 if the firm pays dividends on common stock. The additional variables are described in Tables 1 and 2. The estimation includes industry and year fixed effects. The model is estimated by logit, and *t*-statistics are based on robust standard errors clustered by firm. The number below the *t*-statistic is the increase in the probability of restatement (earnings break) if the dependent variable increases by one standard deviation. The next-to-last row in the table displays the average cumulative abnormal return during the three-day window around the event (restatement date or earnings announcement), calculated using the market model, and the corresponding *t*-statistic for the null hypothesis of zero mean. CAR, cumulative abnormal return.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

events. However, if employees obtain their information mainly from the management, or if they are not informed but simply react to internal marketing efforts by the management, employee participation could predict these events.

The results are presented in columns (4)–(6) of Table 9. We find that ESPP participation does not predict future buybacks, SEOs, or dividend increases by the firm. By contrast, larger insider purchases of company stock are associated with more share repurchase announcements in the future. Overall, this evidence suggests that employees are unlikely to get their information from the management.

4.3.4. Innovation. Finally, we also examine the hypothesis that employees have information about the quantity and quality of innovation taking place in the firm. We use data from the NBER patent database, which includes applications for patents that were eventually granted by the end of 2006. Given the time lag between patent application and patent grant, we end our sample period in 2003. Following Hirshleifer et al. (2012), we examine several measures of innovative output by the firm. The first measure is the number of patents applied for by the firm during the year following the year of ESPP participation. The second measure is similar but takes into account the differing propensity for patents to be granted in different technology classes. Since patents differ greatly in quality, we also use the total citation count, the citation count normalized by the average citation count for patents

in the same technology class and year, and the citation count multiplied by the weighting index from Hall et al. (2005) that accounts for the fact that more recent patents have less time to accumulate citations. Given evidence in Hall et al. (2005) that patent citations are positively correlated with firm value, it is reasonable to believe that if employees know about the quality of patents applied for that knowledge helps them to forecast stock returns.

Following Hirshleifer et al. (2012), we control for firm size, stock returns, institutional ownership, and capital, as well as firm and industry fixed effects. Additionally, we control for the research and development (R&D) expenses per employee since firms with higher R&D spending are more likely to apply for patents, and we would like to measure innovative output. Note that our results are stronger if we do not control for R&D per employee.

Table 10 presents our results. We find that higher participation is associated with more patent applications in the following year (columns (1) and (2)) and that these patents are of better quality (columns (3), (4), and (5)). For example, a one-standard-deviation increase in participation translates into a 24.6% increase in patent applications in the following year and a 28.6% increase in the number of patent citations.

4.4. Implications

The new evidence that employees other than Section 16 insiders may be informed about future stock prices can have several implications.

Table 10 Employee Participation in ESPP and R&D Outcomes

	$\log(1 + \text{Patent})$	$\log(1 + T\text{patent})$	$\log(1 + \text{Citation})$	$\log(1 + T\text{citation})$	$\log(1 + Q\text{citation})$
<i>Participation</i>	0.02*** (3.47)	0.01** (2.09)	0.02*** (3.37)	0.01** (2.44)	0.03*** (3.81)
	0.22	0.09	0.25	0.10	0.38
$\log(\text{Sales})$	0.50*** (7.66)	0.20*** (5.66)	0.52*** (6.96)	0.19*** (5.54)	0.61*** (7.00)
$\log(1 + \text{PPE}/\text{emp})$	−0.67 (−1.41)	−0.00 (−0.03)	−0.62 (−0.92)	0.00 (0.02)	−1.21 (−1.37)
$\log(1 + \text{R\&D}/\text{emp})$	13.24*** (4.18)	6.26*** (4.40)	12.93*** (3.71)	6.02*** (4.20)	16.96*** (3.63)
<i>Past stock returns</i>	−0.00 (−1.45)	−0.00 (−1.28)	0.00 (0.63)	−0.00 (−0.80)	−0.00 (−0.10)
<i>Institutional ownership</i>	−0.79** (−2.18)	−0.54*** (−3.41)	−0.75* (−1.66)	−0.50*** (−3.12)	−0.85 (−1.45)
Adjusted R^2 (%)	68.99	55.85	65.60	52.88	66.91
Observations	1,214	1,214	1,214	1,214	1,214

Notes. *Patent* is the number of patents applied for during the year following the fiscal year of participation. *Tpatent* is the number of patents applied for during the year following the fiscal year of participation divided by the average number of patents in the same technology class and applied in the same year. *Citation* is the total number of citations summed across all patents applied for during the year following the fiscal year of participation; *Qcitation* is the total number of citations summed across all patents applied for during the year. Each patent's number of citations is multiplied by the weighting index from Hall et al. (2005). *Tcitation* is the total number of patent citations during the year following the fiscal year of participation divided by the average citation count of all patents in the same technology class and applied for in the same year. *R&D/emp* is research and development expenses per employee. *PPE/emp* is property, plant, and equipment, per employee. The estimation includes Fama–French 47 industry fixed effects and year fixed effects. *t*-Statistics are based on robust standard errors clustered by firm.

Significance at the 1%, 5%, and 10% levels is denoted by ***, **, and *, respectively.

4.4.1. Underestimation of Compensation. Given that the market does not immediately incorporate the information on ESPP participation into prices, it is likely that the shareholders do not fully realize that these contributions will earn positive abnormal returns in the future. Specifically, the accounting expense for ESPPs does not take into account information rents, and the cost of compensating employees through ESPPs appears to be relatively small on accounting statements. Therefore, shareholders may not be fully aware of this part of compensation (see Hall and Murphy 2003 for a similar argument for stock options). At the same time, employees who are able to pocket significant gains from ESPP participation are more likely to be satisfied with their compensation and less likely to change jobs. This arrangement could motivate greater use of ESPPs by firms.

Our rough estimates suggest that, given 10% abnormal returns in the next fiscal year, an employee contribution of \$1,600 per year, and a firm with an average of 30,000 employees, the compensation expense is underestimated by approximately \$4.8 million per year. For the median firm in the top quartile of participation, the extent of compensation underestimation (i.e., contributions multiplied by the abnormal returns over the subsequent year) is between 0.61% and 1.13% of net income, for different measures of participation. If this fraction represents a permanent part of cash flows lost by shareholders, this would translate into a value loss of approximately 1%. Furthermore, if employees are in possession of relevant information about the firm, they can profitably trade on the open market. This would impose an additional cost on shareholders who are on the other side of the trade. Note also that employees do not usually face any implicit or explicit restrictions when trading on the open market, where their positions and gains could potentially be larger.

It is an open question whether a firm's shareholders care about such additional compensation to executives and employees. According to Bernile and Jarrell (2009), firms that had backdated stock option grants saw large declines in stock prices when such behavior was revealed to the markets. This suggests that shareholders may be concerned about such compensation.

4.4.2. Financing Through Employees. Fama and French (2005) document that firms issue more shares through employees than through SEOs. Our results suggest one possible explanation for this empirical fact. Because employees are likely better informed than investors at large, firms can issue shares to employees in order to take advantage of lower adverse selection costs.²⁶ In a slightly different context, Garmaise (2008)

provides a model showing that if employees are informed, they are a better source of financing (which they provide implicitly by accepting low wages) than the outside market. Our finding that employees can indeed have an information advantage supports the assumption of his model.

4.4.3. Disclosure. Since the passage of the Sarbanes–Oxley Act in 2002, all trades by top executives (classified as Section 16 insiders) in their firm's stock must be reported within two business days, and this information then becomes publicly available. By contrast, no information about open market trades by lower-level employees is available. Even information on ESPP purchases by employees, which does become publicly available, is disclosed only annually and in nonuniform reporting formats. Disclosure of this information in a standardized and salient form and in a more timely fashion would allow the incorporation of relevant information more quickly and easily into prices, thereby increasing market efficiency. Furthermore, regulators might consider requiring firms to collect and disclose aggregate information on open market purchases and sales by employees beyond those currently classified as Section 16 insiders.

5. Conclusion

Using data on voluntary contributions to employee stock purchase plans, we document that, in the aggregate, nonexecutive employees possess value-relevant information about their firms. A trading strategy that goes long in the firms that are in the top quartile of employee stock purchases and short in the firms in the bottom quartile earns 10% in annual abnormal returns. Moreover, we find that aggregate ESPP purchases can be as informative as open market stock purchases by Section 16 insiders. We attribute these results to the fact that employees are less restricted in their trades. Regular employees are not subject to SEC disclosure requirements, they are not burdened by market signaling concerns and pressures from shareholders, and they typically do not face minimum stock holding requirements.

Although it is possible that higher ESPP participation leads to better firm performance through the relaxation of financing constraints or the exertion of greater effort by employees, our results do not support these hypotheses. Instead, we find that the predictability of returns is due to information possessed by employees. Greater participation in ESPPs is associated with a lower likelihood of a break in consecutive earnings increases, higher quantity and

²⁶ It should be pointed out that there may also be disadvantages to using employees as a source of financing, such as their risk aversion and lack of diversification.

better quality of firm innovation, and higher sales growth. These results suggest that employees have some price-relevant information about the likelihood of future corporate events.

Our results have implications for research on why employees choose to invest in their own company's stock (e.g., through 401(k) plans). We do not dispute the fact that employees with undiversified investments expose themselves to considerable risk, but we nevertheless identify a potential informational advantage associated with investing in one's own company's stock that has been overlooked in the prior literature.

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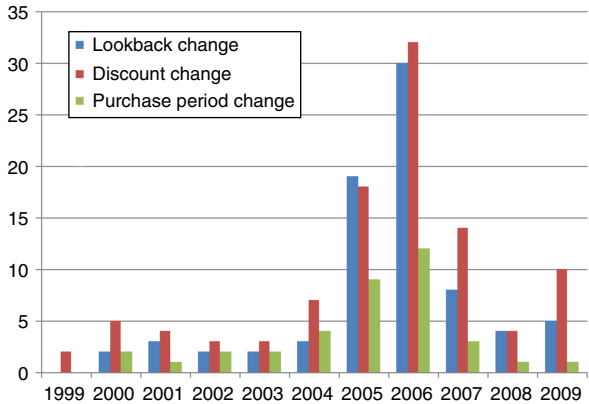
Appendix. Changes in ESPP Plan Features

Table A.1 Frequency of Changes in ESPP Plan Features

	Reduce/ remove	Increase/ introduce	Firm-years with change	% of sample
Discount	80	22	102	2.23
Lookback	71	7	78	1.70
Purchase period	28	9	37	0.81
% of comp.	5	13	18	0.39
Holdup	6	7	13	0.28
Plan 423	2	5	7	0.15
Any changes in features	N/A	N/A	176	3.85

Notes. The table presents the number of firm-years in which changes were made in the features of ESPPs. The definitions of the specific plan features are provided in Table 2.

Figure A.1 (Color online) The Number of Firms with Changes in ESPP Plan Features by Fiscal Year



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