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Inventory Write-downs in the Semiconductor Industry

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Abstract: We study motives for and impacts of management discretion in inventory valuation. The semiconductor industry, with continual output price declines and rapid product obsolescence, provides an ideal setting to examine managers' inventory write-down and production decisions. In this context, we develop a measure of 'excess inventory' and find that inventory write-downs are strongly correlated with this measure. We also find that inventory write-downs are timed strategically in periods of poor performance consistent with 'big bath' incentives. We construct a proxy for abnormal write-downs, and find that it is positively associated with subsequent operating performance, and negatively associated with future write-downs. Neither analysts, nor investors appear to fully appreciate the predictable implications of abnormal write-downs for subsequent operating performance.

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1. Introduction

Under Generally Accepted Accounting Principles (GAAP), firms are required to implement the lower-of-cost-or-market (LCM) rule and to write down the value of inventory if its market value falls below historical cost.[1] Such write-downs lead to lower reported earnings for the same period. Firms must consider multiple, potentially subjective factors that are relevant to the market value of inventories in making write-down decisions. Examples of such factors include an estimate of the hypothetical replacement cost of the inventory, forecast demand for the firm's products, and expected costs of disposal.

In this paper, we study issues related to subjectivity in inventory valuation. First, following prior research on asset write-downs, we hypothesize and test whether firms exploit subjectivity in their inventory write-down decisions. We do so by correlating inventory write-downs with several proxies for opportunism. In conducting these tests, we recognize that write-downs also reflect consideration of economic factors and attempt to control for these factors. Second, we argue that there are predictable consequences for subsequent operating performance when firms' inventory write-downs deviate from an expected level in a given period. More specifically, we use an inventory write-down expectation model based on Bernard and Noel (1991) to compute a proxy for 'abnormal' write-downs. We then test for the relation between 'abnormal' write-downs and subsequent operating performance and write-downs. Finally, we examine whether market participants appear to appreciate the predictable reversing nature of accrual-based earnings management through inventory. To this end, we test whether subsequent

[1] Accounting Research Bulletin 43 (1953) defines 'market' as current replacement cost, but that amount extends over the following range: the maximum is expected selling price less costs of completion and disposal (also known as net realizable value), the minimum is net realizable value less the mark-up to sales price.

analyst forecast errors and risk-adjusted returns are correlated with 'abnormal' inventory write-down.

We conduct our tests using a panel of firm years from the semiconductor manufacturing industry. The semiconductor industry is characterized by rapid innovation with new generations of more powerful semiconductors (chips) continually entering the market place. Existing chips tend to be priced downward to be competitive with the performance level and pricing of new chips. Consequently, the economic magnitude and frequency of inventory write-downs in this industry are larger than most other industries.[2] The second distinguishing characteristic of the semiconductor industry is its pronounced cyclicality. Cyclicality causes earnings to be unusually volatile which in turn increases incentives to manage earnings. Thus, the semiconductor industry provides an excellent setting within which to examine inventory write-down decisions.

Our design and methodological approach consists of the following choices. Our sample consists of an unbalanced panel of semiconductor firms for the period 1993-2007. We read all the 10-Ks / annual reports for our sample firm years and obtain data on whether a write-down was recorded and, if so, its dollar amount. We use a two-stage approach to compute our measure of excess inventory. In the first stage, we use a pooled time-series and cross-sectional regression to estimate 'required' inventory levels based on company-specific, as well as industry-wide factors. Specifically, for each year, we use the preceding ten years of available information to year t-1 relative to the sample year to estimate the industry-level coefficients of our inventory prediction model. In the second stage, using the estimated model coefficients and the related independent variables, we predict the 'required' inventory level for each firm-year. We deem the difference between the predicted and actual inventory level as excess inventory that will

[2] Of all the industries in the U.S., the semiconductor industry experienced the largest decline in its producer price index over the last two decades.

potentially be written off in year t. We then conduct our first set of tests via regressions of inventory write-downs on our 'excess' inventory variable, various proxies of managerial opportunism, a real production activity management proxy from Roychowdhury (2006), and other economic determinants. This enables us to revisit the issue of whether inventory write-downs appear to be managed, a finding not established by prior research.

We then compare our 'excess' inventory measure to the actual write-down and label the difference the 'abnormal' write-down in year t. We argue that abnormally high (low) write-downs in year t are likely to reverse, leading to improvements (declines) in future operating performance, measured by changes in gross margin and return on assets. Additionally, if firms delay taking write-downs, then abnormally low write-downs in year t are likely associated with higher future write-downs. In addition, we examine whether abnormal write-downs are associated with analyst forecast errors and future stock returns. If analysts appropriately incorporate information regarding future implications of 'abnormal' write-down activity into their forecasts, there should be no relation between 'abnormal' write-downs and subsequent forecast errors. Further, in an efficient market, information related to write-downs should be immediately incorporated into the price, thus resulting in no correlation between 'abnormal' write-downs and future stock returns.

Several important findings emerge from our research. First, we find that our estimates of excess inventory are highly correlated with actual inventory write-downs, validating our model of 'required' inventory levels. Second, we find evidence consistent with managers' 'bath-taking' incentives impacting write-down decisions – firms tend to take larger write-downs when pre-write-down performance is poor. Further, we find modest evidence of firms avoiding write-downs to avoid reporting losses. Third, we find that both abnormal inventory write-downs are significantly positively related to subsequent changes in operating performance. Fourth, we find that abnormal write-downs in year t are negatively related to subsequent write-downs. We interpret this as evidence of firms delaying write-downs in year t and being forced to take write-downs in year t+1. Fifth and finally, we find that neither analysts, nor investors seem to understand the implications of abnormal write-downs for future performance in that, current abnormal write-downs are correlated with the subsequent analyst forecast errors and subsequent stock returns. Our returns results obtain after controlling for standard risk factors (size, book-to-market-ratio, and momentum) as well as three other accrual variables that have been shown to predict future returns: working capital accruals, changes in inventories, and special items (Sloan (1996); Thomas and Zhang (2002); Dechow and Ge (2006)).

We contribute to the existing literature in the following ways. First, we add to the limited prior research on earnings management through inventory write-downs by providing initial evidence that managers are more likely to take write-downs when performance is very poor and to avoid reporting a loss.[3] Francis, Hanna, and Vincent (1996) (FHV, henceforth) study inventory write-downs along with other asset write-down decisions; but they do not find evidence consistent with managerial incentives influencing inventory write-downs. FHV conclude that inventory write-offs are not driven by incentives, arguing that market values are readily available and that the LCM rule provides guidance which diminishes the role for judgment. Our findings, however, are consistent with managerial incentives to strategically use inventory write-downs, perhaps for the managers' interests.[4] The contrast between FHV's findings and ours can be potentially attributed to the differences in sample composition. Their

[3] Prior studies examine discretion over write-downs in other asset types including Strong and Meyer (1987), Elliot and Shaw (1988), Zucca and Campbell (1992), Rees, Gill, and Gore (1996), Riedl (2004), Beatty and Weber (2006), and Ramanna and Watts (2012).

[4] This finding is consistent with Baldenius and Reichelstein (2005), who analytically demonstrate that managers' decisions on inventory management depend on their performance metrics.

analysis is based on a sample drawn from different industries. In contrast, we focus on the semiconductor industry where the magnitude and frequency of inventory write-downs is higher. In addition, we collect our write-down data from 10-Ks, whereas FHV focus on public newswire announcements of write-downs.

Second, we also contribute to the earnings management literature by studying accrual-based earnings management through inventories. We develop an 'abnormal' inventory write-down proxy that manifests a reversal property – it is positively correlated with future profitability. Interestingly, our measure of abnormal write-down is negatively related to subsequent actual write-downs, consistent with firms delaying recording write-downs. Our study complements and extends a rich accounting literature on earnings management in single accounts and specific industries. Beaver (1996) notes that context-based research can address specific accounting issues that are more relevant to some firms (or industries) than to others. Healy and Wahlen (1999) also argue that evidence related to specific forms of earnings management can provide more information to standard setters.[5] By focusing on a single industry and single account, we exploit the advantage afforded by more carefully modeling managerial discretion, and consequently reduce noise in our regressions. A cost of these choices is generalizability of the results.

Third, we provide new evidence that market participants do not correctly process the information in abnormal write-downs for future profitability changes. Beginning with Sloan (1996), several studies document a negative relation between accruals and subsequent stock

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[5] Many prior studies adopt this approach and focus on a single industry or single account for this purpose el (e.g., Moyer (1990); Petroni (1992); Beatty, Chamberlain, and Magliolo (1995); Collins, Shackelford, and Wahlen (1995); Beaver and Engel (1996), Key (1997); Miller and Skinner (1998); Ayers (1998); Schrand and Wong (2003); Jackson and Liu (2010)). Similar to Beaver and Engel (1996), who focus on loan loss reserves in banks, we investigate a sample of firms where the accrual choice is likely to be important in a sample of firms with relatively similar characteristics.

returns. Thomas and Zhang (2002) and Chan, Chan, Jegadeesh, and Lakonishok (2006) document that inventory changes are the primary cause of the negative relation between accruals and future abnormal returns. We find that, at least in the semiconductor industry, it is earnings management through inventory that is misinterpreted by analysts and mispriced by the market. Specifically, the evidence on forecast errors indicates that analysts do not fully incorporate information conveyed in 'abnormal' write-downs into their forecasts. Also, controlling for other risk factors and accrual/inventory-related anomalies, 'abnormal' write-downs are related to subsequent market returns.

2. Semiconductor Industry

The semiconductor industry is among the largest manufacturing industries in the United States. Since the 1960s, semiconductor devices have found applications in a diverse set of products that range from digital watches, computers, and cellular phones to medical equipment, automobiles, and weapon systems. The manufacture and sale of semiconductors is so crucial to the U.S. economy that the Congress holds hearings on the industry to discuss its impact on national policy. Scalise (2004), in his Congressional Testimony, summarizes the importance of the semiconductor industry to the U.S. economy.[6] He states that, "[s]emiconductors are, in effect, the brains and nerve center for almost all electronic products today and are thus at the heart of the entire IT sector, enabling everything from advanced computers to medical equipment to weapons systems and contributing $75 billion annually to U.S. GDP, more than any other single manufacturing technology."

From its inception in 1958, when the first integrated circuit was developed, the semiconductor industry has been *cyclical*, with alternating periods of rapid and slow growth.

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[6] George Scalise was the President of the U.S. Semiconductor Industry Association (SIA), at the time of this testimony.

Despite these periods of slow growth, during the years 1975-2000, the industry recorded an impressive 16.1 percent compound annual growth rate (SIA (2004)). However, the industry recorded its worst collapse in 2001, when, after achieving more than $200 billion in worldwide sales in 2000, it witnessed a steep decline in sales of over thirty percent. A sharp decline in sales of personal computers, cellular phones, and networking and communications equipment in 2001 negatively affected the demand for semiconductors.

As a response to the lowering market demand in 2001, the semiconductor industry arguably took the biggest collective write-down decision in history. Semiconductor firms, along with other technology firms, took sizable inventory write-offs (e.g., Conexant Systems took a $149 million write-off and Xilinx took a $32 million write-off). In fact, the write-downs were so large that they were considered to be overly aggressive by investors and the SEC "was closely watching (Pender, 2001)."

The second striking feature of the industry is the high levels of research and development activity and the consequent rapid rate of *technological obsolescence*. The famous prediction by Gordon Moore, Intel Corp's co-founder, in 1965, informally known as Moore's law, has been fairly accurate – the number of transistors on a chip tends to double every eighteen to twenty-four months.[7] New generations of faster and more powerful chips enter the market very frequently, rendering the previous generation obsolete. This provides the second reason for the high incidence of inventory build-ups and more frequent write-downs in this industry.

The third key aspect of the semiconductor industry is that chip *selling prices fall continually*. Aizcorbe (2002) documents that, for the years 1993-1999, these declines are primarily related to technological innovations, and to a lesser extent to lower manufacturing

[7] For example, in 1971, the Intel 4004 microprocessor contained 2,300 transistors; in 1998, the Pentium II contained 7.5 million transistors.

costs. In addition, she finds that some of these price declines are related to the pricing strategy of Intel Corporation, the dominant player in the semiconductor industry: Intel reduced its mark-ups over costs during the 1990s. Because selling prices can fall below costs quite often, semiconductor firms, more than firms in most other industries, are likely to take frequent inventory write-downs.

To provide evidence on declining chip prices, we obtain Producer Price Index (PPI) data for the semiconductor industry from the website of the Bureau of Labor Statistics, www.bls.gov. PPI is a family of indexes that measures the average selling prices received by producers of goods and services in the United States. The Bureau computes these indexes from data obtained from over 25,000 establishments that provide approximately 100,000 price quotations per month. In Figure 1, we report the monthly values of the PPI for the semiconductor industry for the years 1990-2008. Consistent with Aizcorbe (2002), semiconductor prices have declined considerably, with the PPI falling from 153.4 points in the beginning of 1990 to 51.4 points at the end of 2008. The downward trend is steady, with price declines occurring in 168 of the 228 months over the sample period, or nearly seventy-four percent of the time. The mean January–to–January annual percentage decline in the index is 5.5 percent with the largest decline in prices occurring in 2008 (20 percent). Importantly, in untabulated analysis, we find that, among all industries in the U.S., the semiconductor industry experienced the largest price declines over this period. Producer price indices for other industries generally increase (e.g., for electronic capacitors the series is more variable, but has increased by slightly over one percent over the same period).

Lastly, semiconductor firms are highly *capital intensive* – their operation requires substantial investments in capital equipment. Because firms need to recover the high cost of their equipment, they tend to produce at capacity even in periods of low demand. This tendency, coupled with the high levels of technological obsolescence leads to build-up of inventories during periods of low demand.

In sum, the semiconductor industry is characterized by cyclicality, rapid technological change, continual price declines, and high capital costs. These industry characteristics result in high risks of excess capacity and technological obsolescence and thus increase the likelihood of inventory write-downs. Thus, this industry provides an excellent setting to study accruals management via inventory write-downs.

3. Related Literature and Hypotheses Development

In this section, we link write-downs to managerial incentives, future profitability, subsequent analyst forecast errors, and future stock returns.

3.1. Inventory Write-downs and Managerial Incentives

Prior research studies managerial motivations to opportunistically write-down asset values. Most of these studies focus on discretion related to write-downs of *long-lived assets*. Strong and Meyer (1987) find that write-downs are associated with senior management turnover in the year of the write-down. Zucca and Campbell (1992) and Rees, Gill, Gore (1996) find that write-downs of long-lived assets are more frequent in periods of "below-normal" earnings (a big bath). FHV find that proxies for incentives are related to goodwill write-downs and restructuring charges, but not to property, plant, and equipment write-downs. Riedl (2004) finds that long-lived asset write-downs have greater (lower) association with big bath behavior in the period after (before) the introduction of the standard on asset impairments (FAS 121). Beatty and Weber (2006) and Ramanna and Watts (2012) find that goodwill write-downs are influenced by several incentive variables such as the magnitude of slack in the net worth covenant, risk, earnings response coefficients, the presence of an earnings-based bonus plan, CEO tenure, exchange listing requirements, and measures of flexibility in estimating the fair value of reporting units' net assets.

FHV is the only study that examines motivations for inventory write-downs as a separate category.[8] They analyze 142 inventory write-downs that are publicly announced via press releases or through newswires in the years 1988-1992 and find that three incentive related variables – management turnover, the propensity to take a big bath, and income smoothing, are unrelated to inventory write-downs. FHV argue that the ready availability of market values for inventories and the guidance provided by Accounting Research Bulletin No. 43 reduces the scope for judgment in valuing inventories. They conclude that the limited role of judgment causes managerial incentives to be unrelated to inventory write-downs.

While we do not question FHV's findings for their multi-industry sample, we believe that the semiconductor industry provides a more powerful setting to detect the influence of managerial incentives on write-downs. The primary reason for this is that inventory write-down estimates in this industry are partly based on future uncertain conditions. Consequently, the potential for judgment and discretion related to write-down amounts is magnified. For example, Cypress Semiconductor Corporation in its 10-Q for fiscal quarter ended March 31, 2007 states that,"*[w]e record inventory write-downs as a result of our normal analysis of demand forecasts and the aging profile of the inventory. We record charges to cost of revenues to write down the carrying values of our inventories when their estimated market values are less than their carrying values. The inventory write-downs reflect estimates of future market pricing relative to the costs of production and inventory carrying values and projected timing of product sales.*"

[8] Allen, Larson, and Sloan (2013) also examine inventory write-downs. Their focus is on investigating if write-downs represent reversal of prior estimation errors. They find that, for a cross-section of firms from different industries, their proxy for estimation error is significantly and positively correlated with inventory write-downs, and negatively (but not significantly) correlated with subsequent inventory write-downs.

Similarly, Vitesse Semiconductor Corporation in its 10-K for the fiscal year ended September 30, 2012, states that, "*[w]e evaluate inventories for excess quantities and obsolescence. Our evaluation considers market and economic conditions; technology changes, new product introductions, and changes in strategic business direction; and requires estimates that may include elements that are uncertain.*" In light of the potential discretion that semiconductor firms' managers have over the timing and magnitude of write-downs, we hypothesize (in alternative form):

> **H1:** Inventory write-downs in the semiconductor industry are influenced by managerial incentives.

3.2. Inventory Write-downs, Future Profits, and Subsequent Write-downs

Very little evidence on the relation between write-downs and subsequent profitability is available from prior research. Further, available evidence pertains to long-lived assets. Elliot and Shaw (1988) find that median earnings divided by market value of equity increases subsequent to the year of the write-down. Zucca and Campbell (1992) find that mean quarterly return on assets for firms that recorded relatively large write-downs are significantly lower than that of a control sample in the three years following the write-down year. Rees, Gill and Gore (1996) find that industry-adjusted return on assets are not significantly different from zero for firms that recorded a single write-down in their sample period, but negative and significant for firms that recorded multiple write-downs.

In contrast to write-downs of long-lived assets that have multi-year effects, inventory write-downs are likely to affect only subsequent-year profits because inventory holding periods are usually much shorter. Specifically, for our semiconductor industry sample, the mean (median) inventory holding period is 114 days (92 days). Holding other things constant, by lowering the cost of inventory, write-downs result are likely to result in lower cost of goods sold and higher margins in the subsequent year when the inventory is sold.[9]

Recent research on accruals has shown that different accrual components have different implications for future earnings. Xie (2001) presents evidence that the abnormal accrual component is less persistent than the normal accrual component. Additionally, Allen, Larson, and Sloan (2013) find that normal accruals and estimation errors have different reversing patterns. Therefore, we decompose write-downs into predicted and abnormal write-downs, and in light of the evidence in Xie (2001), to enhance the power of our tests, we correlate *abnormal* write-downs with subsequent profit margins. Further, because abnormal write-downs represent an estimation error in year t, we interpret low abnormal write-downs as evidence of delay in writing down inventories. Consequently, we expect it to be negatively related to actual write-downs in the next year. Thus, we make the following two predictions:

H2: Abnormal inventory write-downs are positively related to future profit margins.

H3: Abnormal inventory write-downs are negatively related to subsequent inventory write-downs.

3.3. Inventory Write-downs and subsequent Analyst Forecast Errors and Stock Returns

Prior research provides evidence that analysts ignore publicly-available information in forming earnings forecasts (e.g., Bradshaw, Richardson, and Sloan (2001) and Ikenberry and Ramnath (2002)). Our second hypothesis, H2, predicts a positive relation between abnormal write-downs and subsequent profits. If analysts do not incorporate this pattern into their forecasts of future earnings, then abnormal write-downs will be positively related to subsequent forecast errors. However, if analysts efficiently process accounting information, there should be

[9] If write-downs are associated with excess inventories, in competitive markets, firms might have to lower selling prices to dispose the excess inventories in the following year causing margins to decline. This selling price effect would offset some or all of the increase in profit associated with write-down reversals.

no discernible relation between 'abnormal' inventory write-downs and subsequent forecast errors. Thus, our fourth hypothesis stated in alternate form is:

> **H4:** Abnormal inventory write-downs are positively related to subsequent analyst forecast errors.

A few prior studies have examined whether write-down announcements are followed by abnormal stock returns. Strong and Meyer (1987) find that for a sample of 78 write-down announcements from 1981-1985, the mean sixty-day post write-down announcement cumulative abnormal return (CAR) is +1.88 percent (t-statistic = 1.63). Elliott and Shaw (1988) examine 208 write-off firms from 1982-1985 and report a median cumulative industry-adjusted returns of -3.1 percent for the six-month period after the write-off announcement. Bartov, Lindahl, and Ricks (1998) examine 184 write-down announcements for the years 1984 and 1985. They document mean (median) cumulative beta-adjusted excess return of -12 percent (-7.3 percent) in the one year following the write-down announcement.

Beginning with Sloan (1996), several studies have documented a negative relation between accruals and future stock returns and have interpreted this finding as consistent with a market that over-estimates the persistence of accruals. Thomas and Zhang (2002) find that the negative relation between accruals and future abnormal returns documented by Sloan (1996) is due mainly to inventory changes. They conjecture that this effect is in turn is caused by investors not anticipating the reversal of earnings management related to inventories. We build on this conjecture and examine the possibility that investors fail to anticipate the reversal in profits in year t+1 that is caused by abnormal write-downs in year t. This leads to our fifth hypothesis (in alternative form):

> **H5:** Abnormal inventory write-downs are positively related to subsequent one-year stock returns.

4. Empirical Model and Data Sources

To test our first hypothesis, we model write-downs as a function of managerial incentives and control variables. Our proxies for managerial incentives to manage earnings via write-downs include: the tendency to take "big baths" when profits are low, income smoothing, avoiding losses, top management turnover, public issuance of equity or debt, and avoiding costs of violating debt covenants. Our control variables in inventory write-down regressions include excess inventory levels, past performance, industry demand, lagged write-downs, abnormal production, and firm size. Thus, our model is:

$$
\begin{aligned}
ACTWD_t = {} & \gamma_0 + \gamma_1 BOT10_t + \gamma_2 TOP10_t + \gamma_3 NEGSPEC_t + \gamma_4 MBZERO_t + \\
& \gamma_5 \Delta MGMT_t + \gamma_6 OFFER_t + \gamma_7 LTDDTA_t + \gamma_8 PREDWD_t + \gamma_9 FYRET_t + \\
& \gamma_{10} NEGRET_t + \gamma_{11} NEGRET_t \times FYRET_t + \gamma_{12} BTM_t + \gamma_{13} \Delta BTM_t + \\
& \gamma_{14} \Delta ROA_t + \gamma_{15} PCHCS_t + \gamma_{16} LAGWD_t + \gamma_{17} ABPROD_t + \gamma_{18} LABPROD_t \\
& + \gamma_{19} LNSALES_t + \varepsilon_t \qquad (1)
\end{aligned}
$$

where:

$ACTWD_t$ = actual amount of write-down divided by sales (COMPUSTAT data item REVT) in year t;

$BOT10_t$ = indicator variable equal to one if *UE* is in the bottom decile, zero otherwise, where *UE* is defined as year t operating income after depreciation (COMPUSTAT data item OIADP), but prior to inventory write-downs less year t-1 operating income after depreciation, divided by year t-1 total assets (COMPUSTAT data item AT);

$TOP10_t$ = indicator variable equal to one if *UE* is in the top decile, zero otherwise, where *UE* is defined above;

$NEGSPEC_t$ = indicator variable equal to one if the company has other income-decreasing special items (COMPUSTAT data item SPI) in year t, and 0 otherwise.

$MBZERO_t$ = indicator variable equal to one if income before extraordinary items (COMPUSTAT data item IB) scaled by beginning of year market capitalization is greater than or equal to 0.00 and less than 0.01;

$\Delta MGMT_t$ = indicator variable equal to one if there is a change in any of the top three executive positions (chairman of the board, chief executive officer, or president) in year t or year t-1, and 0 otherwise;

$OFFER_t$ = indicator variable equal to one if the firm has one or more offerings (debt or equity) during year t, and zero otherwise;

$LTDDTA_t$ = long-term debt (COMPUSTAT data item DLTT) divided by total assets at the end of year t;

$PREDWD_t$ = predicted amount of write-down in year t from Eq (2) in the appendix;

$FYRET_t$ = size-adjusted return compounded over the twelve months ending on the fiscal year end date of the year t;

$NEGRET_t$ = indicator variable equal to one if $FYRET_t$ is less than zero and zero otherwise;

BTM_t = ratio of pre-write-down book value of equity (COMPUSTAT data item CEQ) to the market value of equity (COMPUSTAT data item PRCC_F × COMPUSTAT data item CSHO) at the end of year t;

ΔBTM_t = change of *BTM* from year t-1 to t;

ΔROA_t = year t-1 to year t change in pre-write-down operating income after depreciation (COMPUSTAT data item OIADP) divided by average total assets in year t (COMPUSTAT data item AT);

$LAGWD_t$ = write-down in year t-1 scales by sales (COMPUSTAT data item REVT) in that year;

$PCHCS_t$ = percentage change in computer shipments for the fiscal-year from the US Bureau of Labor Statistics;

$ABPROD_t$ = abnormal production, captured by the residual from the year-by-year estimation of the production model, Eq. (3), described in the Appendix;

$LABPROD_t$ = the lagged value of $ABPROD_t$;

$LNSALES_t$ = log of sales (COMPUSTAT data item REVT) in year t;

We next describe the model variables in Eq. (1) in greater detail. FHV argue that the propensity to take write-downs is likely related to the operating performance in the write-down year. Specifically, if income is already low and managers are implicitly or explicitly rewarded based on the level of earnings, managers have incentive to "take a bath" (accelerate write-down recognition) to increase the probability of enjoying rewards in the future.[10] Alternatively, if semiconductor firms are more concerned about reporting a smooth earnings stream (a difficult task in a cyclical industry), we expect a positive relation between write-downs and pre-write-down earnings.[11] We distinguish between bath-taking and smoothing explanations by including two variables, *BOT10* and *TOP10*, in the model. We use a random walk expectation to model earnings and define unexpected earnings (UE) as the pre-write-down operating income after depreciation (OIADP) in year t, less the reported OIADP in year t-1, divided by total assets at the end of year t-1.[12] *BOT10* is an indicator variable equal to one if UE is in the bottom decile, zero otherwise; and *TOP10* is an indicator variable equal to one if UE is in the top decile, zero otherwise. Deciles are based on the year-by-year cross-sectional distribution of UE. If firms tend to take earnings baths via inventory write-downs, then *BOT10* will be positively related to write-downs. If smoothing is the dominant motivating factor, then the sign of the coefficient on *TOP10* should be positive and *BOT10* should be negative.

As an additional proxy for big bath behavior, following FHV, we include an indicator variable, *NEGSPEC*, which equals one if the company reports other income-decreasing special

[10] The vast majority of our inventory write-downs are included in cost of goods sold; hence, compared to write-downs of other asset classes, concerns about whether managers are compensated based on income before or after non-recurring charges are less relevant.
[11] In their two-period model, Kirschenheiter and Melumad (2002) show that managers tend to under-report to the maximum possible extent when earnings news is sufficiently bad and smooth earnings when earnings news is good.
[12] We use pre-write-down earnings in the current year because the write-down decision is made prior to the write-down itself. We do not adjust the prior year earnings for any write-downs because managers are more likely to view reported earnings, as opposed to earnings adjusted for operating items such as write-downs, in the previous year, as the benchmark for the current year.

items (charges) in year t. We expect *NEGSPEC* to be positively related to inventory write-downs consistent with write-downs being motivated as part of a broader "big bath" decision.[13]

Dechow and Skinner (2000), in their commentary on earnings management, argue that managers have strong incentives to manage earnings by beating benchmarks. Survey evidence in Graham, Harvey, and Rajagopal (2006) suggests that managers are willing to even forgo positive NPV projects to beat benchmarks. We use the zero benchmark as our proxy and define *MBZERO* as an indicator variable equal to one if income before extraordinary items scaled by beginning-of-year market capitalization is in the range [0.00, 0.01). This approach is similar to Roychowdhury's (2006) identification of 'suspect years' to investigate real earnings management.

We expect that management changes are likely to precipitate inventory write-downs. In our setting, it seems reasonable that new management would benefit by writing down inventory and attributing the charge to prior management. If the cost of the inventory sold during the new management regime is artificially reduced based on a generous write-down, higher profits will be reported when the chips are sold under current management, ceteris paribus. Consistent with FHV, we include a dummy variable that equals one when there is a change in any of the top three executive positions (chairman of the board, chief executive officer, or president) in the year of, or the year prior to, the write-down (*ΔMGMT*). We expect *ΔMGMT* to be positively related to inventory write-downs.

Firms that are considering public issues of debt or equity may have an incentive to inflate earnings to obtain favorable prices on stock issuances or favorable credit terms on debt issues (Teoh, Welch, and Wong, 1995). We obtain issuance data from the SDC database and define the

[13] We note support for this argument in the popular press. Pender (2001) suggests that "[i]f a company announces a big inventory write-off along with restructuring charges, it can probably persuade analysts to disregard the inventory write-off, too." We also use a continuous measure of special item charges and find similar results.

variable *OFFER* as 1 if the firm has one or more offerings (debt or equity) during year t, and zero otherwise. We expect *OFFER* to be negatively related to inventory write-downs.

Defond and Jiambalvo (1994) present evidence that firms manage earnings via accruals in response to their debt contracts. More recently, Beatty and Weber (2006) argue that firms that are close to violating debt covenants are less likely to record goodwill impairment charges. Therefore, we predict that firms time inventory write-downs so as to avoid violating debt covenants. We measure proximity to debt covenant violation as long-term debt divided by total assets (*LTDDTA*) in year t.[14]

Turning to our control variables, our first measure is the predicted write-down. Firms record write-downs when there is a buildup of excess inventories and when market demand for their products is expected to decline in the following year.[15] We measure excess inventories (*PREDWD*) as the difference between pre-write-down inventories and expected inventories. Our measure of expected inventories is based on a time-series model for inventories developed by Bernard and Noel (1992, BN henceforth). We expect *PREDWD* in year t to be positively related to write-downs in that year.

To estimate excess inventory (*PREDWD*), we use a two-stage procedure. In the first stage, for every year t, we use the previous ten years of data (year t-10 to t-1) for a sample of all semiconductor firms (SIC 3674) and estimate a pooled, cross-sectional time-series regression of inventory levels on its determinants. In the second stage, we compute the predicted inventory level for each firm in year t as the product of the coefficients from the first stage regression and the actual values of independent variables for each firm in year t. The difference between the

[14] We considered using the debt-to-equity ratio, but do not do so because a non-trivial number of our firm-year observations have negative stockholders' equity.
[15] To better understand the determinants of write-downs we corresponded with a few semiconductor manufacturers. In general, our interviews suggest that write-down decisions are based on current inventory levels and assessments of expected market demand for firms' products.

actual inventory level before the write-down and the predicted inventory is our estimate of ‘excess’ inventories or, alternatively, the predicted write-down. We repeat this procedure for every year in our sample, thus allowing model coefficients in the first-stage regression to change over time.

We employ the expectations model for inventory levels proposed by BN) to estimate the first-stage estimation period regressions. BN use quarterly data in their study; we use their independent variables but adapt their model to annual data because almost all write-down disclosures are provided only in 10-Ks / annual reports. In the BN model, current inventory as a percentage of sales is modeled as a function of its lagged value, current sales growth, lagged sales growth, and lagged change in inventory divided by sales. In addition to the BN variables, we include the annual change in the Producer Price Index *(ΔPPI*) for the semiconductor industry obtained from www.bls.gov. By doing so, we control for the impact of industry-level price changes on firm-inventory levels.

Two clarifications are in order. First, we do not adjust estimation period inventories for write-downs (i.e., we assume that firms do not use write-downs to manage earnings in the estimation period). While this induces noise in inventory data for individual firm-years, we expect that this noise is diversified away when we pool across firms and years. Second, we focus our study on total inventories because inventory reserves and write-downs are typically not delineated by type of inventory (i.e., raw materials, work-in-process, and finished goods). Details of our adaptation of the BN model are provided in the Appendix.

We also include control variables related to a firm’s past stock market and accounting performance to explain inventory write-downs. Stock prices are known to be leading indicators of firm performance (Kothari and Sloan, 1992). Firms with poor stock price performance in the current year are more likely to experience diminished sales and margins in the future. Such firms are more likely to have impaired assets including overvalued inventory, and therefore are more likely to write-down inventory in the current year. Accordingly, we expect stock returns for the year t (*FYRET*) to be negatively related to the amount of the write-down. *FYRET* is computed as the size-adjusted return, compounded over the twelve months ending with fiscal year end date of year t.

Basu (1997) and others argue that firms use accrual adjustments to report conservatively; that is, they are likely to record losses earlier than gains. To model this, consistent with Basu (1997), we include (a) an indicator variable that equals one if *FYRET* is negative and zero otherwise (*NEGRET*) and (b) the interaction between *FYRET* and *NEGRET*. If firms use write-downs to report conservatively, we predict that the coefficient on the interaction term will be negative.

A related measure of potentially overvalued assets is the firm's book-to-market ratio. Firms with high book-to-market ratios are more likely to have inventory with market prices below cost. Therefore, we expect the ratio of book value of equity to market value of equity (*BTM*) at the end of the year t to be positively related to inventory write-downs in year t. We add back the tax-adjusted write-down amount to book value of equity to measure *BTM* prior to the write-down decision. To capture the effect of relative declines in market value, we also include the change in *BTM* (*ΔBTM*) from year t-1 to year t as an additional explanatory variable and expect *ΔBTM* to be positively related to inventory write-downs.

Declining profitability is also an indicator of falling asset values; hence, we expect it to increase the likelihood of inventory write-downs. We use a firm's change in return on assets (*ΔROA*) from year t-1 to year t as our measure of change in profitability and expect *ΔROA* to be negatively related to inventory write-downs. *ROA* is defined as pre-write-down operating income after depreciation divided by average total assets.

We control for industry-level demand in the year of the write-down. Because computer manufacturers are the leading buyers of semiconductors, we include the year t percentage change in computer shipments (*PCHCS*) obtained from the U.S. Bureau of Labor Statistics. Because a positive *PCHCS* indicates increasing demand for computers, we predict that it is negatively related to inventory write-downs.

To the extent that negative inventory and product impacts are persistent, write-downs are likely to be positively serially correlated. Therefore, we include the lagged value of inventory write-down as an independent variable (*LAGWD*) in the model.

Abnormal production (*ABPROD*) is likely to influence write-downs in two ways. First, if production exceeds sales, a firm's fixed costs will be spread over a larger number of units leading to lower cost per unit. Because this is an accounting artifact, the market value per unit is unlikely to be affected by this change in cost, per se. As market values have to "travel downward" by a larger amount, increases in production reduce the likelihood of inventory write-downs. Second, if firms deliberately increase production to lower cost of goods sold and thus achieve their earnings targets, in general, the need to improve earnings through inventory write-downs is reduced. Zang (2011) provides evidence consistent with this substitution effect; her findings suggest that firms "fine-tune" accruals after the fiscal year-end based on the realized real activities manipulation. On the other hand, producing more units could lead to excess inventories and result in the need for subsequent write-downs, so the relation between abnormal production and write-downs is equivocal. We also include lagged abnormal production costs in our model (*LAGABPROD*) as excess production in the prior year could lead to subsequent write-downs. We measure *ABPROD* and *LAGABPROD* following Roychowdhury (2006). Details of this approach are provided in the Appendix.

Finally, we include the natural log of firm's sales in year t (*LNSALES*) as an additional factor that is potentially related to firms' write-down decisions. Larger firms are likely to possess products that are less prone to obsolescence and may also be able to withstand temporary downturns in demand. We expect *LNSALES* to be negatively related to inventory write-downs.

We collect write-down amounts from 10-Ks in the SEC Filings Library of the LexisNexis database and the Securities and Exchange Commission's web site, www.sec.gov. We find write-down data both from "Valuation and Qualifying Accounts," alternatively reported on Schedule II, VII, or VIII, typically at the end of the 10-K and by searching 10-Ks and annual reports for the occurrence of the words "write" or "charge" or "adjust" with any suffix, within fifteen words of "inventor"; the latter effectively captures potential variations of the word "inventory."[16] Where no write-down information is disclosed, we set the write-down amount to equal zero.

Our data sources for the independent variables in Eq. (1) are the University of Chicago's CRSP, COMPUSTAT, company 10-Ks, and the Bureaus of Labor Statistics' web site. Data on management changes are coded based on comparisons of top management lists of consecutive annuals reports. We describe how we code write-downs in the next section.

5. Sample

The semiconductor industry can be broadly divided into three sectors: firms that are primarily in the business of manufacturing and selling semiconductors, vertically-integrated firms that produce semiconductors as inputs for products that they manufacture (e.g., IBM and

[16] While write-downs are occasionally re-stated in subsequent years, our tabulated results are based on initially reported write-down amounts. We also perform analyses with restated amounts, and the results remain the same.

Sun Microsystems), and firms that do not manufacture semiconductors but which focus on research and design of semiconductors (known as fabless firms, in industry parlance).

To arrive at our sample, we examine the CorpTech Directory of Technology Companies for each of the years 1992-2007. This annual directory provides a comprehensive listing of all firms in the semiconductor industry. Our initial sample consists of 220 firms that appeared in at least one of the annual editions for the years 1992-2007, were domiciled in the U.S., were publicly traded, and were not subsidiaries. From this initial sample, we exclude 73 vertically integrated firms or firms that were not semiconductor manufacturers (based on our reading of their 10-Ks), 13 fabless firms, 14 firms that are not listed on the CRSP database, and 8 firms for which financial data was missing throughout our sample period on COMPUSTAT. We exclude vertically integrated firms to achieve a sample of firms with fairly homogenous production functions and fabless firms because they do not carry inventories. This yields a sample of 112 unique firms.

Our sample period consists of the 15 years, 1993-2007. The final sample consists of 861 firm-year observations for which we are able to determine the inventory write-down amounts from firms' form 10-Ks or annual reports and for which other requisite data are available on CRSP and COMPUSTAT. The details regarding how we arrive at the final sample are presented in panel A of table 1. The sample is an unbalanced panel, with the number of observations per firm ranging from one to fifteen. The sample employed in our subsequent tests changes because of additional data requirements; therefore, panel A also presents the sample sizes for all the tables.

Panel B of table 1 provides descriptive statistics related to our sample. The mean (median) firm-year level of sales in our sample is $979.72 ($208.68) million. The mean (median) total assets is $1,478.04 ($310.03) million, and the mean (median) market capitalization is $4,096.56 ($603.13) million. Reported end-of-year inventory across firm-years has a mean (median) value of $105.77 ($27.52) million. The mean (median) write-downs scaled by sales is 2.29% (0.00%) reflecting the fact that over 75% of the sample report no write-downs.

6. Results - Determinants of Write-downs

We model sales-deflated write-downs (*ACTWD*) as a function of managerial incentives and other control variables. Before turning to the analyses of write-down determinants, we present the coefficient estimates from the inventory model that we use to compute *PREDWD* (Eq. (2)). Our model is a pooled, cross-sectional time-series regression of inventory levels on its determinants. We estimate this model for every year t using the previous ten years of data (year t-10 to t-1), with t ranging from 1993-2007. We also present the coefficients of the production cost model Eq. (3) suggested by Roychowdhury (2006).

Panel A of Table 2 reports the average coefficients from the 10-year rolling regressions and t-statistics from estimating Eq. (2) based on the distribution of the yearly coefficients (Fama and MacBeth (1973)). The signs of the coefficients are consistent with results reported in BN and all the coefficients are significant at less than the 1% level. Not surprisingly, the lagged inventory-to-sales ratio is the most significant determinant of current year's inventory-to-sales ratio. Consistent with BN, we also find that current year's inventory-to-sales ratio is negatively related to current year's sales growth, suggesting that inventory adjustment to sales is not instantaneous. The average adjusted R^2 from the regressions is 68.87%, indicating that the model captures significant variation in inventory levels.

Panel B of Table 2 reports average coefficients from cross-sectional year-by-year estimation of Eq. (3) following Roychowdhury (2006). We use residuals from this model as our proxy for abnormal production costs. As with Roychowdhury, the most important factor in the model by far is concurrent asset-scaled sales, and our average yearly coefficient for the semiconductor industry (0.6346) is similar to the average in Roychowdhury estimated across years and industries (0.7874).

We next analyze the determinants of inventory write-downs. In panel A of table 3, we compare the mean and median values of independent variables in our write-down model across the subsamples of firm-years with write-downs and those with no write-downs (345 and 348 observations, respectively). We use t-tests (Wilcoxon tests) to test for significant differences in means (distributions).

The means and medians of *ACTWD* and *PREDWD* for the write-down group are both significantly higher than those of the no-write-down group. *ACTWD* is the basis for defining the two sub-samples and hence the result is obtained by construction. The difference between the average amounts of *PREDWD* of the two sub-samples attests to the predictive ability of our model of excess inventory. The means and medians of most of the other independent variables differ between the write-down and the no-write-down subsamples largely in the expected manner. The means and medians of both *ABPROD* and *LAGABPROD* are significantly higher for the write-down group, which on the surface indicates that overproduction begets current and subsequent write-downs. *LAGWD* values are higher for the write-down group. Both median and mean *FYRET* (size-adjusted fiscal year returns) are significantly lower for the write-down sub-sample than those of the no write-down sub-sample, supporting the hypothesis that firm stock returns concurrently reflect or are leading indicators of write-downs. The proxy for conservatism in reporting (*NEGRET * FYRET)* is more negative for the write-down subsample than the non-write-down sample, which is indicative of conservatism in reporting. Consistent with expectation, *BTM* (book-to-market ratio) and *ΔBTM* are significantly higher, and *ΔROA*, *PCHCS*, and *LNSALES* are lower for the write-down sub-sample.

In terms of incentive-related factors, both the mean and median *LTDDTA* are higher for the write-downs group, which is inconsistent with an incentive to convey profitability when debt is high. The difference in *BOT10* between the two subsamples is marginally significant, providing preliminary evidence that semiconductor firms are likely to take write-downs when performance is already poor. The differences in *TOP10* between the two samples are not significant, implying that income smoothing is unlikely a primary incentive in our sample firms' write-down decisions. The difference in *NEGSPEC* (an indicator variable signifying that a negative special item was recognized during the year) suggests that firms that take charges in either direction are more apt to have a concurrent negative special item charge, again confirming the big-bath incentive. The average values of *ΔMGMT*, *OFFER*, *MBZERO* are not significantly different between the two sub-samples. These univariate results are suggestive at best and the multivariate analyses that we report next are intended to simultaneously control for non-strategic (i.e., economic) and incentive-related motivations for write-downs.

We report results from the multivariate analysis of inventory write-downs in panel B of table 3. We estimate model (1) using Tobit regressions as the dependent variable is non-negative and has a preponderance of values that equal zero.[17] Panel B of table 3 indicates that the coefficients of *PREDWD* and *LAGWD* are both significantly positive, similar to the results from the univariate analyses. The coefficient on *PREDWD* shows that our empirical estimate of the write-down amount captures the potential overvaluation in pre-write-down inventory. *ABPROD* is negative and significant, suggesting that overproduction and inventory write-downs are

[17] We obtain similar results using OLS estimation.

substitute mechanisms to manage earnings. *LAGABPROD* is positively associated with inventory write-downs, indicating that prior overproduction leads to subsequent write-downs..

Among the other economic factors, *FYRET* is significantly and negatively related to the write-downs, confirming that stock performance is an important factor in inventory write-down decisions. *PCHCS* is also negative and significant, indicating that a higher market demand is less likely to lead to inventory write-downs. Similarly, *LNSALES* is also significant and negative, as firms with higher sales are less likely to have the need to write down their excess inventory.

Among the incentive-related variables, *BOT10* and *NEGSPEC* are both significantly positive, providing evidence that our sample firms make write-down decisions consistent with 'big bath' motives. Since we find *TOP10* is insignificant, we conclude that these sample firms do not seem to use inventory write-downs for the purpose of income-smoothing. The results indicate that *MBZERO* is negative and significant at the 10% level, suggesting that firms whose scaled earnings ex-post marginally exceed zero are less likely to have taken inventory write-downs. Evidence with respect to debt covenant violation avoidance is opposite to our expectations in that *LTDDTA* is positively associated with write-down magnitudes. Controlling for other factors, we do not find support for stock/debt issuance or management turnover driving firms' inventory write-down decisions.

Overall, our evidence on the determinants of write-downs suggests that firms are more likely to take write-downs when they experience extremely poor performance (i.e., big bath behavior). We also provide evidence that firms avoid write-downs to avoid reporting a loss.

7. Abnormal Inventory Write-downs, Subsequent Operating Performance and Subsequent Inventory Write-downs

We next examine how abnormal inventory write-downs relate to future operating performance and future inventory write-downs. To conduct our tests, we require a proxy for excess or abnormal write-downs. We measure abnormal write-down (*ABWD*) in any firm year as the difference between the actual write-down in the year (*ACTWD*) and the predicted write-down (*PREDWD*). The predicted write-down is our estimate of excess inventory computed as the difference between the reported inventory-to-sales ratio and the predicted inventory-to-sales ratio (see section 4 above).[18] We expect *ABWD* in year t to be positively related to year t+1 change in both gross margin (COMPUSTAT data item *GP*) divided by sales (ΔGM_{t+1}) and return on assets (ΔROA_{t+1}).

Panel A of table 4 contains univariate comparisons between firms that have positive (*HIGHWD*) and negative (*LOWWD*) values of *ABWD*. Tests of significance are based on t-tests for means and non-parametric Wilcoxon tests for distributions. The sample size is 668 firm years, which is smaller than that of the previous table because we require subsequent operating performance data. Of the 668 firm-year observations, a majority of the firms (389) have larger than predicted write-downs, whereas 279 firm-year observations record smaller than predicted write-downs. As expected, both mean and median year t+1 change in profitability, measured as ΔGM_{t+1} or ΔROA_{t+1}, are higher for the positive *ABWD* sub-sample. The univariate measures support the hypothesis that year t abnormal write-downs reverse in the next year. Similarly, the magnitude of inventory write-downs in the subsequent year ($ACTWD_{t+1}$) is greater for *LOWWD* firm-years than for *HIGHWD* firm-years, indicating that our proxy for abnormal write-downs is negatively related to subsequent write-downs.

We also report univariate comparisons of other year t variables that are likely to influence future performance: book-to-market ratio (BTM_t), size-adjusted annual return ($FYRET_t$), and current change in profitability (ΔROA_t and ΔGM_t). As Panel A indicates, both mean and median

[18] We do not use the data from table 3 to more finely separate write-downs into economic and opportunistic elements because we do not have a long time series of write-down determinants available for out of sample estimation.

BTM (ΔROA_t) are lower (higher) for the *HIGHWD* sub-sample. Further, mean and median $FYRET_t$ and ΔGM_t are higher for the *HIGHWD* sub-sample.

To ensure that the effects of *ABWD* on subsequent year's performance are incremental to other factors, we include BTM_t, $FYRET_t$, and lagged change in performance as control variables in multivariate regressions. In panel B of table 4 we present results from pooled regressions of year t+1 operating performance measures on *ABWD*. Our dependent variables are change in gross margin, change in *ROA*, and inventory write-downs (*ACTWD*), all measured in year t+1. We expect that firms with lower (higher) than expected inventory write-downs in year t to report lower (higher) profits and higher (lower) than expected write-downs in year t will report lower (higher) write-downs in year t+1. Consistent with this expectation, we find that *ABWD* is positively related to next year's changes in gross margin and return on assets. Consistent with prior research (Fairfield and Yohn, 2001), we also find that profitability changes in year t are negatively related to profitability changes in year t+1, for both return on assets and gross margin. We also find evidence that controlling for current write-downs, abnormal write-downs are negatively-related to subsequent write-downs. This result is consistent with Allen et al. (2013) who suggest that inventory write-down estimation error should be negatively related with subsequent write-downs. Overall, the results in table 4 support the alternative hypothesis that firms recording abnormally high or low write-downs experience profit reversals.[19] The results also indicate support for the alternative hypothesis that 'over'- ('under') inventory write-downs in one year manifests itself in lower (higher) write-downs in the next year.

8. Tests of market's ability to process implications of write-downs for future performance

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[19] To confirm that there is no 'mechanical effect' of year t actual write-downs (*ACTWD*) impacting our subsequent performance results, we also run these models with *ACTWD* included as a regressor and our results are similar. The coefficients on *ACTWD* are uniformly not significantly different from zero.

We next examine whether market participants are able to understand the implications of current period write-downs for future operating performance. We use analyst forecasts and stock returns in the year following the write-down year to conduct two sets of tests.

8.1 Abnormal inventory write-downs and subsequent forecast errors

Prior research provides evidence that analysts ignore publicly-available information in forming earnings forecasts (e.g., Bradshaw, Richardson, and Sloan, 2001 and Ikenberry and Ramnath, 2002). In the previous section, we document a positive relation between abnormal write-downs and subsequent operating performance. If analysts do not incorporate this pattern into their forecasts of future earnings, then abnormal write-downs will be positively related to subsequent forecast errors. However, if analysts efficiently process accounting information, there should be no discernible relation between 'abnormal' inventory write-downs and subsequent forecast errors.

To calculate analyst forecast errors for year t+1 earnings, we compute mean consensus forecasts of annual earnings per share (*EPS*) for year t+1 from forecasts made within 60 days of the beginning of month +4 relative to year end t. Our intent is to ensure that analysts have information about year t inventory write-downs before making forecasts of year t+1 EPS. We compute the difference between actual and forecast *EPS* from IBES and scale that difference by price per share (also from IBES) to obtain our forecast error measure (AFE_{t+1}). Prior research indicates that forecast errors are serially correlated (Abarbanell and Bernard, 1992), so we control for forecast errors of a comparable horizon from year t (AFE_t).[20] Prior research also indicates that analysts are more optimistic from a temporal distance (e.g., Richardson, Teoh, and Wysocki, 2004 and Lim, 2001). We control for forecast horizon ($FLAG_{t+1}$) – the number of days between the mean of the forecast dates comprising the consensus, and the earnings

[20] We also run the forecast error model without lagged forecast errors and obtain consistent results.

announcement date per IBES. Additionally, we control for the number of forecasts comprising the consensus ($NFCST_{t+1}$) and firm size ($LNSALES_t$). Because we require two years of IBES forecast data within a sixty-day interval from month t+4, and because not all sample firms are covered in the IBES database, we have 472 firm year observations, fewer than the number of observations in table 4.

We provide univariate and multivariate tests of analyst efficiency with respect to information in abnormal write-downs. Consistent with our analysis of future operating performance, we divide the sample into positive (*HIGHWD*) and negative (*LOWWD*) for abnormal write-downs. Table 5, panel A indicates that year t+1 forecast errors for the *LOWWD* sample are lower than those of the *HIGHWD* sample, consistent with the idea that analysts under-react to information in abnormal write-downs. Results from both parametric and non-parametric tests support this hypothesis.

In table 5, panel B, we regress year t+1 forecast errors (AFE_{t+1}) on $ABWD_t$, AFE_t, $FLAG_{t+1}$, $NFCST_{t+1}$, and $LNSALES_t$. We find that $ABWD_t$ is positively and significantly related to subsequent forecast errors, after controlling for all other factors.[21] The implication is that analysts ignore information available in abnormal inventory write-downs which would improve their forecasts. Alternately stated, analysts are surprised when abnormal write-downs in year t result in earnings reversals in year t+1. Inconsistent with prior research, we note that forecast errors appear *negatively* serially correlated in this sample. However, consistent with prior research, forecast errors are significantly negatively related to $FLAG_{t+1}$, consistent with analyst optimism from a distance. Overall, our results support the alternative hypothesis that analysts ignore information in abnormal write-downs.

[21] We conduct rank (non-parametric) regressions and find very similar results.

8.2 Abnormal inventory write-downs costs and subsequent stock returns

In an efficient market, the implications of year t abnormal inventory write-down for future profits will be priced immediately. Therefore, year t *ABWD* should be uncorrelated with subsequent stock returns. However, if the market fails to appreciate the predictable performance reversals of *ABWD*, subsequent returns will be positively correlated with lagged *ABWD*. That is, firms that take excessive (deficient) write-downs in the current year will have higher (lower) returns in the next year when they report predictably higher (lower) profits

Our future return variable is *FUTRET*, defined as the twelve month return from July of year t to June of year t+1, compounded monthly. To ensure that information on *ABWD* is available to investors before we begin cumulating returns, we measure it from the fiscal years ending during the twelve-month period ending March of year t. Thus, the lag between fiscal year end dates and the beginning of the return accumulation period ranges from three to fourteen months. We are careful and follow the procedure suggested by Beavers, McNichols, and Price (2007) to incorporate delisting returns when computing *FUTRET*.

To test H3, we estimate a pooled regression of *FUTRET* on lagged *ABWD* and control variables. We include three controls for risk that are commonly employed in return prediction regressions: logarithm of market capitalization measured at the end of June of year t (*LOG MCAP*), the ratio of book equity value (after adding back the after-tax effect of the write-down) to the market value of equity at the end of fiscal year in which *ABWD* is measured (*BTM*), and the lagged value of *FUTRET* measured over the eleven month period ending at the end of May of year t (*LAGRET*). Because change in pre-write-down *ROA* predicts subsequent profits, we include it as an additional predictor. Beginning with Sloan (1996), several studies document that accruals predict future returns. Thomas and Zhang (2002) show that a significant fraction of the accrual effect is driven by the changes in inventories. Additionally, Dechow and Ge (2006) show that special items have incremental explanatory power above accruals for future returns. We therefore include lagged working capital accruals (*WCACC*), lagged change in inventories (*CHINV*), and lagged special items (*SPL_IT*), each scaled by average assets as additional controls.[22]

Table 6 contains our regression results. All standard errors are adjusted to account for heteroscedasticity and clustering across firms at a point in time. The first column presents a univariate regression of *FUTRET* on *ABWD*. Consistent with our expectation, *ABWD* is positively and significantly related to *FUTRET* (coefficient = 1.30, t-statistic = 1.99). In the next column, we regress *FUTRET* on *ABWD* and all our control variables. *ABWD* remains positive and significantly related to future returns with a coefficient of 2.22 (t-statistic = 2.88). The results indicate that *ABWD* have an economically important relation with *FUTRET*; a one percent increase in abnormal write-downs (as a percentage of sales) is associated with a 2.2 percent increase in one-year-ahead returns.

Turning to the control variables, the coefficient on lagged market capitalization (*LOG MCAP*) is negative and statistically significant (t-statistic = -4.16), indicating that large firms perform worse than small firms. Consistent with the superior performance of 'value' stocks documented in prior research (e.g., Lakonishok, Shleifer, and Vishny, 1994), lagged book-to-market ratio is positively related to future returns (t-statistic = 1.76). Lagged stock returns are negatively related to subsequent returns (t-statistic = -1.97), a result that is surprising in light of the momentum effect documented by Jegadeesh and Titman (1993) and others. In contrast to ABWD, neither working capital accruals nor inventory accruals are significantly related to

[22] All three variables are obtained from COMPUSTAT. Working capital accruals are defined as (changes in current assets less change in cash) minus (changes in current liabilities – change in debt in current liabilities). Debt in current liabilities is set to zero when missing.

subsequent returns, using a 10% cut-off for statistical significance. Lastly, consistent with Dechow and Ge (2006), *SPL_IT* has a negative relation with subsequent returns, but its coefficient is not significant at the 10% level.

Overall, our results suggest that investors do not correctly understand the implications of abnormal write-downs for future returns. Abnormal write-downs lead to predictable increases in subsequent profits, and investors are surprised when these reversals occur.

9. Conclusion

We investigate the determinants and future consequences of inventory write-downs in the semiconductor industry. The semiconductor industry is particularly interesting because of the substantial fixed investment necessary to compete and corresponding tendency to produce at capacity, its cyclical nature, and because unit values of inventory generally decrease over time, making inventory write-downs more prevalent relative to most other industries. Overall, we document that inventory levels in the semiconductor industry can be predicted using a simple inventory model. We show that contemporaneous inventory write-downs are related to excess inventories based on this model as well as incentives to take 'big baths.' Finally, we show that abnormal write-downs are significantly correlated with future changes in profitability, write-downs in subsequent years, analyst forecast errors, and risk-adjusted returns. Collectively, our results provide new evidence that the stock market does not correctly process information in abnormal write-downs for future profitability.

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Appendix 1

A. Model for Excess Inventories (PREDWD)

Our first-stage pooled cross-section time series model for inventory is:

$$\frac{I_t}{S_t} = \alpha_0 + \alpha_1 \left[\frac{1}{S_t}\right] + \alpha_2 \frac{I_{t-1}}{S_{t-1}} + \alpha_3 \Delta \left[\frac{I_{t-1}}{S_{t-1}}\right] + \alpha_4\, SG_t + \alpha_5\, SG_{t-1} + \alpha_6\, \Delta\, PPI_t + \varepsilon_t \qquad (2)$$

where firm subscripts are omitted for brevity, and:

I_t = reported inventory at the end of year t (COMPUSTAT data item *INVT*);

S_t = sales for year t (COMPUSTAT data item *REVT*);

$\Delta \left[\frac{I_{t-1}}{S_{t-1}}\right]$ = $\left[\frac{I_{t-1}}{S_{t-1}}\right] - \left[\frac{I_{t-2}}{S_{t-2}}\right]$ is the change in scaled inventory from year t-2 to t-1;

SG_t = $\frac{S_t - S_{t-1}}{S_{t-1}}$ is the percentage growth in sales from year t-1 to t;

SG_{t-1} = $\frac{S_{t-1} - S_{t-2}}{S_{t-2}}$ is the percentage growth in sales from year t-2 to t-1;

ΔPPI_t = percentage change in the semiconductor industry producer price index from year t-1 to t.

In the second stage, we collect the estimated coefficients from Eq. (2) and predict the expected inventory level for year t. For example, to predict the inventory level $\frac{I_t}{S_t}$ for firm i in 1996 (t=1996), we use data for all available firm-years from 1986 to 1995 and estimate the coefficients in equation (1). We then use the estimated coefficients and predict $E\left[\frac{I_{1996}}{S_{1996}}\right]$ for firm i as follows:

$$E\left[\frac{I_{1996}}{S_{1996}}\right] = \widehat{\alpha_0} + \widehat{\alpha_1}\left[\frac{1}{S_{1996}}\right] + \widehat{\alpha_2}\frac{I_{1995}}{S_{1995}} + \widehat{\alpha_3}\Delta\left[\frac{I_{1995}}{S_{1995}}\right] + \widehat{\alpha_4}\, SG_{1996} + \widehat{\alpha_5}\, SG_{1995}$$
$$+ \widehat{\alpha_6}\, \Delta\, PPI_{1996}$$

We use the predicted value of inventory to sales $E\left[\frac{I_t}{S_t}\right]$ described above and compute excess inventory as $\frac{I^*_t}{S_t}$ - $E\left[\frac{I_t}{S_t}\right]$ where I^*_t is the reported inventory for year t plus the inventory write-down for year t (i.e., the pre-write-down inventory level). If the inventory expectation model provides reasonable estimates of 'required' inventory and firms' write-down decisions are related to excess inventory, then the empirically estimated excess inventory, or predicted write-down (*PREDWD* = $\frac{I^*_t}{S_t}$ -$E\left[\frac{I_t}{S_t}\right]$), will be positively related to the actual write-down amounts.

B. Model for Abnormal Production

We estimate the "abnormal" amount of production (ABPROD) for our sample firms through a two-stage approach. First, we follow Roychowdhury (2006) to estimate the expected level of production costs. Then we use the regression coefficients from the first-stage regression to compute the abnormal production costs. The first-stage regression model is:

$$\frac{PROD_t}{A_{t-1}} = \beta_0 + \beta_1\left[\frac{1}{A_{t-1}}\right] + \beta_2 \frac{S_t}{A_{t-1}} + \beta_3\left[\frac{\Delta S_t}{A_{t-1}}\right] + \beta_4\left[\frac{\Delta S_{t-1}}{A_{t-1}}\right] + \varepsilon_t \qquad (3)$$

where firm subscript "i" is suppressed, and:

$PROD_{i,t}$ = Production costs in year t, equal to cost of goods sold in year t ($COGS_{i,t}$) plus the change inventory from t-1 to t ($\Delta INV_{i,t}$), all scaled by assets in t-1 ($A_{i,t-1}$);

$S_{i,t}$ = Revenue in year t;

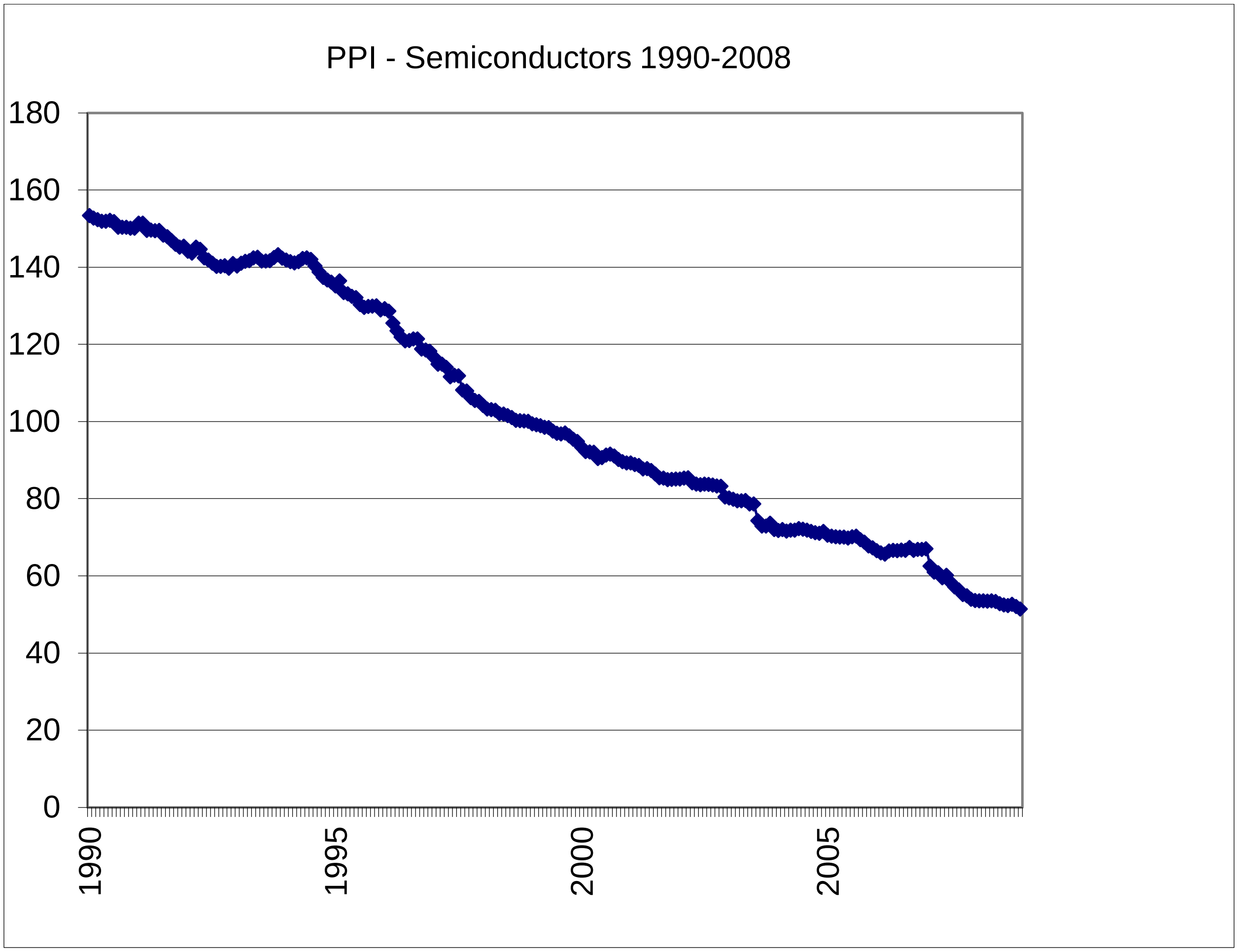
$\Delta S_{i,t}$ = Change in revenue from year t-1 to year t;

$\Delta S_{i,t-1}$ = Change in revenue from year t-2 to year t-1.

In the second stage, we use the estimated coefficients from equation (2) to predict the expected production cost. Then we use the predicted production cost scaled by firm assets $E\left[\frac{PROD_t}{A_{t-1}}\right]$ to compute abnormal production cost, $\left[\frac{PROD_t^*}{A_{t-1}}\right] - E\left[\frac{PROD_t}{A_{t-1}}\right]$, where $PROD_t^*$ is the reported production cost for year t.

Figure 1

US Monthly Semiconductor Producer Price Index (PPI) for the years 1990-2008



Monthly Producer Price Index (PPI) data for the semiconductor industry are from the website of the Bureau of Labor Statistics, www.bls.gov. Base is December 1998.

Table 1

Sample Selection and Descriptive Statistics

Panel A: Sample Selection

Number of unique firms in sample	112
Maximum firm-years possible for the years 1993-2007	1,680
Less: Firm-years for which form 10-K is unavailable	(143)
Less: Firm-years with no clear write-down information or amount	(173)
Less: Firm-years without inventory data	(10)
Less: Firm-years with insufficient data on CRSP and COMPUSTAT	(493)
Base Sample	861
Less: Firm-years without lagged write-down data (for Table 3)	(168)
Table 3 Sample (firm-year observations)	693
Less: Firm-years without subsequent performance data	(193)
Table 4 Sample (firm-year observations)	668
Less: Firm-years without analyst forecast data	(389)
Table 5 Sample (firm-year observations)	472
Less: Firm-years without accruals or subsequent return data	(49)
Table 6 Sample (firm-year observations)	812

Panel B: Sample Descriptive Statistics

Variable	Mean	Std. Deviation	25th percentile	Median	75th percentile
Inventory ($ millions)	105.77	294.61	10.20	27.52	77.40
Sales ($ millions)	979.72	3,149	79.25	208.68	576.85
Total Assets ($ millions)	1,478.04	4,300	108.21	310.03	1,026.34
Market Value ($ millions)	4,096.56	16,841	150.22	603.13	2,188.85
Inventory Write-down ($ millions)	7.78	41.69	0.00	0.00	3.40
Inventory Write-down as a % of Sales	2.29%	5.18%	0.00%	0.00%	1.91%

Our initial sample is obtained the CorpTech Directory of Technology Companies for the years 1992-2007. It includes publicly-traded U.S firms but excludes (a) subsidiaries, (b) vertically integrated firms, (c) non-semiconductor firms (d) fabless firms, (e) and firms not listed on the Center for Research in Security Prices (CRSP) database. Our sample period consists of the 15 years, 1993-2007. The final base sample consists of 861 firm-year observations for which we are unambiguously able to determine the inventory write-down amounts from firms' form 10-Ks or annual reports and for which other requisite data are available on CRSP and COMPUSTAT. Data for the descriptive statistics are obtained from COMPUSTAT and 10-Ks.

Table 2

Panel A: Ending Inventory Level Estimation

$$\frac{I_t}{S_t} = b_0 + b_1 \left[\frac{1}{S_t}\right] + b_2 \frac{I_{t-1}}{S_{t-1}} + b_3 \, \Delta\left[\frac{I_{t-1}}{S_{t-1}}\right] + b_4 \, SG_t + b_5 \, SG_{t-1} + b_6 \, \Delta \, PPI_t + e_t \qquad (2)$$

	Expected Sign	Mean Coefficient		t-statistic
b_0	?	0.0286	***	17.25
b_1	?	0.1079	***	13.24
b_2	+	0.8346	***	271.60
b_3	?	-0.1147	***	-12.06
b_4	-	-0.0355	***	-17.08
b_5	+	0.0124	***	6.84
b_6	+	0.0701	***	2.57
Mean Adjusted R^2			68.87%	

For every year from 1992 to 2007, regression (1) is estimated using firm-year observations from the previous ten years. Reported coefficients are the mean of the 16 yearly estimates. T-statistics are computed based on the distribution of the 16 yearly coefficients (Fama-MacBeth (1973)). The adjusted R^2 is the mean of the 16 yearly adjusted R^2s. The minimum (maximum) number of observations used in the estimation is 360 (931) firm-years and the mean (median) is 732 (696). *** indicates that the coefficient is significantly different from zero at the p=0.01 level or less.

$I_{i,t}$ is reported inventory for firm *i* in year *t*; $S_{i,t}$ is sales revenue for firm *i* in year *t*;
$\Delta\left[\frac{I_{t-1}}{S_{t-1}}\right] = \left[\frac{I_{t-1}}{S_{t-1}}\right] - \left[\frac{I_{t-2}}{S_{t-2}}\right]$ is the change in scaled inventory from t-2 to t-1;
$SG_t = \frac{S_t - S_{t-1}}{S_{t-1}}$ is the percentage growth in sales from t-1 to t;
$SG_{t-1} = \frac{S_{t-1} - S_{t-2}}{S_{t-2}}$ is the percentage growth in sales from t-2 to t-1;
$\Delta \, PPI_t$ is the percentage change in the semiconductor industry producer price index over the 12-month period from the end of fiscal year t-1 to end of fiscal year t.

Table 2
Panel B: Production Model Estimation

$$\frac{PROD_t}{A_{t-1}} = b_0 + b_1 \left[\frac{1}{A_{t-1}}\right] + b_2 \frac{S_t}{A_{t-1}} + b_3 \left[\frac{\Delta S_t}{A_{t-1}}\right] + b_4 \left[\frac{\Delta S_{t-1}}{A_{t-1}}\right] + e_t \qquad (3)$$

	Expected Sign	Mean Coefficient	t-statistic
b_0	?	-0.0931 ***	-5.225
b_1	?	1.171 ***	5.615
b_2	+	0.6346 ***	32.442
b_3	?	-0.0294	-0.952
b_4	-	-0.0545	-0.617
Mean Adjusted R^2		81.63%	

Regression (2) is estimated by year from 1993 to 2007. Reported coefficients are the mean of the 16 yearly estimates. T-statistics are computed based on the distribution of the 15 yearly coefficients (Fama-MacBeth (1973)). The adjusted R^2 is the mean of the 15 yearly adjusted R^2s. The minimum (maximum) number of observations used in the estimation is 58 (100) firm-years and the mean (median) is 83 (85). *** indicates that the coefficient is significantly different from zero at the p=0.01 level or less.

Firm subscript i is suppressed above.
$PROD_{i,t}$ is production costs in year t, equal to cost of goods sold in year t ($COGS_{i,t}$) plus the change inventory from t-1 to t ($\Delta INV_{i,t}$), all scaled by assets in t-1 ($A_{i,t-1}$);
$S_{i,t}$ is revenue in year t;
$\Delta S_{i,t}$ is the change in revenue from year t-1 to year t;
$\Delta S_{i,t-1}$ is the change in revenue from year t-2 to year t-1.

Table 3

Determinants of Inventory Write-downs

Panel A: Univariate Comparisons

	Write-down firm-years (N=345)		No Write-down firm-years (N=348)	
	Mean	Median	Mean	Median
ACTWD (% of Revenues)	4.705***	1.928***	0.000	0.000
PREDWD (% of Revenues)	5.041***	2.159***	-0.362	-0.678
ABPROD	0.009***	0.009***	-0.033	-0.042
LAGABPROD	0.007***	0.007***	-0.026	-0.035
LAGWD(%)	3.599***	1.058***	0.681	0.000
FYRET (%)	17.314*	-12.375***	33.950	-0.664
NEGRET	0.600**	1.000**	0.514	1.000
*NEGRET*FYRET*	-0.237***	-0.124***	-0.177	-0.007
BTM	0.589***	0.484***	0.454	0.354
Δ BTM	0.066**	0.043**	0.008	0.000
Δ ROA	0.029***	0.042***	0.078	0.097
PCHCS	-0.012***	-0.009***	0.016	0.009
LNSALES	5.175***	5.203***	5.596	5.499
Δ MGMT	0.328	0.000	0.319	0.000
OFFER	0.072	0.000	0.063	0.000
LTDDTA	0.098**	0.015***	0.073	0.005
MBZERO	0.046	0.000	0.055	0.000
BOT10	0.122*	0.000*	0.080	0.000
TOP10	0.093	0.000	0.112	0.000
NEGSPEC	0.591***	1.000***	0.434	0.000

***, **, * indicates that the value for write-down observations is significantly different from the value for the no-write-down firm-year observations at the 0.01, 0.05, or 0.10 level, respectively. Significance levels are based on the t-test for difference in means and the Wilcoxon test for difference in medians.

Table 3, continued

Panel B: Tobit Model of Factors Associated with Inventory Write-downs

Variable	Predicted Sign	Equation (1) Dependent Variable = *ACTWD*
Intercept	?	-0.0055
		(-0.48)
PREDWD	+	0.4609***
		(15.98)
ABPROD	?	-0.0852***
		(-3.44)
LAGABPROD	?	0.0708***
		(3.33)
<u>*Other Economic Factors*</u>		
LAGWD	+	0.4802***
		(9.70)
FYRET	-	-0.0068**
		(-2.44)
NEGRET	?	-0.0030
		(-0.41)
*NEGRET*FYRET*	-	0.0020
		(0.13)
BTM	+	-0.0015
		(-0.18)
ΔBTM	+	0.0054
		(0.58)
ΔROA	-	0.0278
		(1.47)
PCHCS	-	-0.0505**
		(-2.35)
LNSALES	?	-0.0060***
		(-3.88)
<u>*Incentive Related Factors*</u>		
Δ MGMT	+	0.0060
		(1.21)
OFFER	-	0.0083
		(0.89)
LTDDTA	-	0.0379**
		(2.08)
MBZERO	-	-0.0185*
		(-1.74)
BOT10	+	0.0341***
		(4.31)
TOP10	+	-0.0054
		(-0.63)
NEGSPEC	+	0.0241***
		(4.95)
Pseudo R^2		59.22%

The sample consists of 693 firm-year observations. The t-statistics are reported below parameter estimates. *ACTWD* is the actual inventory write-down for year t scaled by sales for year t; *PREDWD* is the predicted write-down scaled by sales for year t obtained using the coefficient estimates from table 2; *ABPROD* is abnormal production, captured by the residual from Eq. (3), year-by-year estimation of the production model; *LAGABPROD* is the lagged value of *ABPROD*; *FYRET* is the size-adjusted return compounded over the twelve months ending on the fiscal year end date of year t; *NEGRET* is an indicator variable set equal to one if *FYRET* is less than zero and zero otherwise; *BTM* is the ratio of book equity value (after adding back the after-tax effect of the write-down or reversing abnormal production, as applicable) to the market value of equity at the end of year t; *ΔBTM* is the change in *BTM* from year t-1 (using reported book values) to year t; *ΔROA* is the change in *ROA* from year t-1 to year t where *ROA* is pre-write-down operating income after depreciation (*OIADP*), divided by average total assets; *PCHCS* is percentage change in computer shipments for the fiscal-year from the US Bureau of Labor Statistics; *LNSALES* is the natural log of sales for the year t; *ΔMGMT* is an indicator variable set equal to one if any of the three top officers of the company changed in the current or previous year, zero otherwise; *OFFER* is an indicator equal to one if the firm has one or more offerings (debt or equity) during year t, zero otherwise; *LTDDTA* is long-term debt divided by total assets at the end of year t; *MBZERO* is an indicator variable equal to one if earnings before extraordinary items scaled by beginning-of-year market capitalization is greater than or equal to zero, but less than 0.01. *BOT10* is an indicator variable equal to one if *UE* is in the bottom decile, zero otherwise, where *UE* is defined as year t operating income after depreciation (prior to inventory write-downs or abnormal production, as applicable) less year t-1 operating income after depreciation, divided by year t-1 total assets; *TOP10* is an indicator variable equal to one if *UE* is in the top decile, zero otherwise, where *UE* is defined as above; and *NEGSPEC* is an indicator variable set equal to one if the firm has negative special items in year t, zero otherwise. All non-indicator variables are winsorized at 1% and 99%. Data on *ACTWD* and *ΔMGMT* are from 10-Ks; data on *FYRET* is from CRSP; financial statement data are from COMPUSTAT; and data for the *OFFER* variable is from SDC. Equation (1) is estimated via Tobit.
***, **, and * indicate that the coefficient is significantly different from zero at the p=0.01, 0.05 and 0.10 level.

Table 4
Abnormal Write-downs, Subsequent Performance, and Subsequent Write-downs

Panel A: Univariate Comparisons

	HIGHWD ($ABWD > 0$) (N=389)		LOWWD ($ABWD < 0$) (N=279)	
	Mean	Median	Mean	Median
$ABWD_t$ (% of Revenues)	3.50***	2.41***	-4.45	-2.71
ΔGM_{t+1}	0.016***	0.009***	-0.015	-0.008
ΔROA_{t+1}	0.002***	0.003**	-0.022	-0.014
$ACTWD_{t+1}$ (% of Revenues)	1.566***	0.000***	2.710	3.685
$FYRET_t$ (%)	24.35	-7.19	32.23	-10.814
BTM_t	0.463**	0.381**	0.533	0.439
ΔGM_t	0.006	0.007*	-0.005	0.000
ΔROA_t	-0.001*	0.003**	-0.016	-0.009

Panel B: Multivariate Analysis of Abnormal Write-downs and Future Performance

	ΔGM_{t+1}	ΔROA_{t+1}	$ACTWD_{t+1}$
Intercept	-0.009	-0.024***	0.012***
	(-1.19)	(-3.02)	(3.48)
$ABWD_t$	0.288***	0.195***	-0.249***
	(4.33)	(2.62)	(-7.51)
$FYRET_t$	0.005	0.013***	-0.001
	(1.42)	(3.20)	(-0.30)
BTM_t	0.021*	0.023*	0.004
	(1.79)	(1.76)	(0.65)
ΔGM_t	-0.210***	-	-
	(-5.57)		
ΔROA_t	-	-0.197***	-
		(-4.78)	
$ACTWD_t$	-	-	0.277***
			(12.07)
Adjusted R^2	7.05%	4.13%	21.22%

The sample consists of 668 firm-year observations. In panel A, p-values for differences in means are based on two-sample t-tests and differences in medians are based on two-sample Wilcoxon tests. In panel B, the t-statistics are reported below parameter estimates.
All variable values are winsorized at 1% and 99%.
***, **, * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.
$ABWD_t$ is the "abnormal" write-down of inventory in year t, defined as the actual write-down in year t less the predicted write-down (see table 3 for the definition of predicted write-down); ΔGM_{t+1} is the change in gross margin (as a percentage of sales) from year t to year t+1; ΔROA_{t+1} is the change in *ROA* from year t to year t+1 where *ROA* is pre-write-down operating income after depreciation (*OIADP*) divided by average total assets; $ACTWD_{t+1}$ is inventory write-down in year t+1; *FYRET* is the size-adjusted return compounded over the twelve months ending on the fiscal year end date of year t; *BTM* is the ratio of book equity value (after adding back the after-tax effect of the write-down) to the market value of equity at the end of year t. Data on *FYRET* is from CRSP; and financial statement data are from COMPUSTAT.

Table 5
Abnormal Write-downs and Subsequent Forecast Errors

Panel A: Univariate Comparisons

	HIGHWD ($ABWD > 0$) (N=272)		LOWWD ($ABWD < 0$) (N=200)	
	Mean	Median	Mean	Median
$ABWD_t$ (% of Revenues)	2.70***	2.08***	-3.67	-1.94
AFE_{t+1} (% of Price)	0.00***	0.03***	-0.97	-0.24
AFE_t (% of Price)	-0.23	0.05***	-0.65	-0.27
$FLAG_{t+1}$	280.4	277	280.7	277.5
$NFCST_{t+1}$	13.74	11	13.00	11
$LNSALES_t$	6.05	5.84	6.04	5.94

Panel B: Regression of Forecast Errors on Past Abnormal Write-downs

	Predicted Sign	
Intercept		0.0454**
		(2.01)
$ABWD_t$	+	0.0649**
		(2.32)
AFE_t	+	-0.0936**
		(-1.97)
$FLAG_{t+1}$	-	-0.0001**
		(-1.97)
$NFCST_{t+1}$	?	0.0002
		(0.84)
$LNSALES_t$	?	-0.0019
		(-1.37)
Adjusted R^2		1.92%

The sample consists of 472 firm-year observations. In panel A, p-values for difference in means are based on two-sample t-tests and those for difference in medians are based on two-sample Wilcoxon tests. In panel B, the t-statistics are reported below parameter estimates. ***, ** indicate statistical significance at the one percent and five percent levels, respectively. $ABWD_t$ is the "abnormal" write-down of inventory in year t, defined as the actual write-down in year t less the predicted write-down; *HIGHWD* (*LOWWD*) are firm-years for which the write-down was higher (lower) than the predicted values in year t; AFE_{t+1} is the forecast error, the difference between the mean analyst forecast of annual earnings per share for year t+1 and the actual earnings per share (*EPS*) for that year, deflated by stock price; forecasts are made within 60 days following the end of the fourth month in fiscal year t+1. AFE_t is the forecast error for the year t horizon constructed in the same manner; $FLAG_{t+1}$ is the mean forecast lag (calendar days between the mean forecast date and earnings announcement date) of forecasts comprising the consensus for year t+1; $NFCST_{t+1}$ is the number of forecasts used to construct the mean forecast for year t+1 earnings; and $LNSALES_t$ is the natural log of sales in year t. All variable values are winsorized at one percent and ninety-nine percent. Data on write-downs are from 10-Ks; data on *LNSALES* is from COMPUSTAT; data on analyst forecasts, actual EPS, and stock price are from IBES.

Table 6

Abnormal Write-downs and Subsequent Stock Returns

Dependent Variable: Annual Return compounded from July of year t to June of year t+1

	Predicted Sign		
Intercept		0.273***	1.437***
		(8.67)	(4.16)
ABWD	+	1.323*	1.937***
		(1.95)	(3.23)
LOG MCAP	-		-0.098***
			(-4.04)
BTM	-		0.198*
			(1.74)
LAGRET	+		-0.069*
			(-2.19)
Δ ROA	+		0.643
			(1.54)
WCACC	+		-0.555
			(-0.58)
CHINV	+		0.962
			(0.70)
SPL_IT	+		-0.674
			(-1.22)
Adjusted R^2		0.30%	3.44%
Sample size		812	812

The dependent variable is the annual compounded stock return from July of year t to June of year t+1. *ABWD* is the "abnormal" write-down of inventory in year t, defined as the actual write-down in year t less the predicted write-down; *LOG MCAP* is the logarithm of the market capitalization measured on June 30th of year t; *BTM* is the ratio of book equity value (after adding back the after-tax effect of the write-down) to the market value of equity at the end of year t; *LAGRET* is the annual compounded stock return from June of year t-1 to May of year t; *ΔROA* is the change in *ROA* from year t to year t+1 where *ROA* is pre-write-down operating income after depreciation (*OIADP*) divided by average total assets. *WCACC* equals (Change in Current Assets – Change in Cash) – (Change in Current Liabilities – Change in Short-term Debt) for year t divided by average assets in year t. CHINV is the change in inventories in year t divided by average assets in year t. SPL_IT is special items in year t divided by average assets in year t. All the financial statement variables are from before March 31st of year t. All variable values are winsorized at one percent and ninety-nine percent. Data for financial statement variables are from *COMPUSTAT* or Form 10-Ks and stock return data are from CRSP. Standard errors account for heteroscedasticity and clustering across firms.
***, **, and * indicate that the coefficient is significantly different from zero at the p=0.01, 0.05 and 0.10 level.