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PRODUCTION TECHNOLOGY CHOICE AND EARNINGS MANAGEMENT INCENTIVES AND STRATEGIES: THE CASE OF JUST-IN-TIME

A Dissertation

by

WILLIAM FRANCIS WEMPE

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 1998

Major Subject: Accounting

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August 1998

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ABSTRACT

Production Technology Choice and Earnings Management Incentives and Strategies: The Case of Just-In-Time. (August 1998)

William Francis Wempe, A.A., Hutchinson Community College; B.S., McPherson College; M.B.A., Wichita State University

Chair of Advisory Committee: Dr. Michael R. Kinney

A sample of Just-In-Time (JIT) adopters is used to address two research questions: 1) Do earnings management incentives influence managers' production technology choices? and 2) Do managers' production technology choices influence their earnings management strategies?

Prior earnings management research focuses on managers' accounting choices. This study examines whether a fundamental business decision (JIT implementation) with nonrecurring, short-term earnings effects is influenced by earnings management incentives. Results of the study suggest that managers' decisions to adopt (or not adopt) JIT are influenced by their firms' earnings management histories. In periods preceding the JIT adoption decision year, adopters, compared to matched nonadopters, exercised significantly less accounting discretion with regard to earnings reported to shareholders.

Results of the study also indicate that managers' JIT adoption decisions are influenced by the well-documented desire to report smooth earnings streams. Among firms employing the FIFO inventory method (for which JIT adoption is presumed to be an income-decreasing action in the adoption year), JIT adopters, compared to matched

nonadopters, report much stronger pre-managed adoption year earnings. However, among firms utilizing the LIFO inventory method (for which income from LIFO reserve liquidations can offset JIT's substantial up-front implementation costs) this relationship between JIT adoption and strength of pre-managed adoption year earnings is much weaker.

Results with respect to the study's first research question are also consistent with the debt covenants and tax hypotheses, although significance levels in statistical tests are not as strong as those for the earnings management history and smoothing hypotheses.

The results of empirical tests of the effect of JIT utilization on earnings management strategies are inconclusive. It is hypothesized that JIT utilization reduces a manager's ability to employ transaction-driven earnings management strategies (e.g., transactions involving inventory) to respond to earnings management incentives. Multiple tests designed to detect increased earnings variation for JIT adopters and/or a shift in adopters' earnings management strategies toward accounting-driven techniques (i.e., strategies not requiring an actual economic transaction) produce inconsistent, and therefore inconclusive, results.

DEDICATION

This dissertation is dedicated to my children, Madison and Zachary, both of whom were born while I was in the doctoral program at Texas A&M, and to the memory of a child I never held. After four years of doctoral studies, it is abundantly clear that life's greatest pleasures will come not from the challenges of research and teaching, which I enjoy, but from my role as father to Madison and Zachary.

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I also wish to acknowledge Texas A&M University and Coopers & Lybrand for their generous financial assistance during my doctoral program. Both provided funding that greatly reduced the financial discomfort that otherwise would have persisted over the previous four years.

I want to thank the Accounting faculty at Texas A&M, who foster a productive and supportive research environment. The friendship of fellow graduate students also enriched my doctoral program. I particularly want to acknowledge my five classmates -- Curtis Clements, Kingsley Olibe, Beverly Rowe, Carolyn Strand, and Jerry Thorne.

The support of family was instrumental in the completion of my doctoral program. My parents (Jack and Vicky Wempe) and parents-in-law (Jolly and Hazel White) have contributed significantly to my pursuit of a doctorate. The support of other family and friends is also gratefully acknowledged.

Finally, the greatest thanks goes to my wife, Nancy. Without her love and support, I could never have even begun, much less completed, a doctoral program in accounting -- thus, the Texas A&M diploma bearing my name is certainly a joint achievement.

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CHAPTER I

INTRODUCTION

Prior research demonstrates that managers' accounting choices often differ from those that would be made in single-owner, owner-managed firms in which capital market, tax and agency considerations are less pervasive. Diverse ownership, professional management, income taxes and debt financing create incentives for managers to engage in earnings management, defined by Schipper (1989, p. 92) as "a purposeful intervention in the external financial reporting process, with the intent of obtaining some private gain (as opposed to, say, merely facilitating the neutral operation of the process)."

The focus of prior earnings management research has been to assess the effect of various earnings management incentives on accounting decisions that have virtually no impact on a firm's underlying business operations or prospects for long-term success. For example, prior research examines managers' decisions regarding adoption of new accounting standards (e.g., Gujarathi and Hoskin, 1992), choice of accounting methods (e.g., Zmijewski and Hagerman, 1981) and accruals (e.g., Jones, 1991). Although each of these is an important accounting decision worthy of empirical inquiry, none can be described as a fundamental business decision. A manager's decision regarding the adoption of SFAS 96[1] or his depreciation method choices are financial reporting concerns far removed from the firm's fundamental reasons for existence -- providing customers goods and/or services for the purpose of increasing shareholder wealth. To date, the

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This dissertation follows the style and format of the Journal of Accounting & Economics.

[1] Statement of Financial Accounting Standards No. 96, Accounting for Income Taxes.

earnings management literature has not examined the extent to which earnings management incentives influence decisions with both nonrecurring, near-term earnings effects and significant long-term business implications.[2]

This study's first objective is to assess whether short-term earnings incentives influence the adoption (or nonadoption) of a production technology known as Just-In-Time (JIT).[3] Since the early 1980s, many US firms have adopted JIT, and undoubtedly expect long-term benefits from doing so. However, the near-term earnings effect of JIT adoption is less clear.[4] For many firms, substantial up-front costs associated with proper implementation of JIT will render JIT adoption an income-reducing decision in the year of adoption. However, a primary tenet of the JIT philosophy is inventory reduction, which, for LIFO firms, can result in earnings increases via liquidation of the LIFO reserve. The research design and empirical tests utilized in meeting this study's first objective include 1) making plausible assumptions regarding the adoption-year earnings effect of JIT adoption, 2) controlling for firms' non-earnings management incentives to adopt JIT[5] and 3) testing for associations between variables capturing earnings management incentives and managers' JIT adoption decisions.

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[2] Prior research that could be considered exceptions to this generalization are studies that examine earnings management incentives with respect to asset acquisitions or dispositions (e.g., Bartov, 1993; Kinney and Trezevant, 1997).

[3] Chapter II includes an overview of the JIT philosophy.

[4] In most prior earnings management studies, the income-increasing or -decreasing character of a given accounting choice could be readily determined. Therefore, the uncertainty in the present study regarding the adoption-year earnings effect of JIT presents design challenges not generally present in prior studies.

[5] Controlling for non-earnings management incentives in the present study is more critical than in most prior earnings management studies. Although it's not clear how they might be correlated with earnings management incentives, it seems likely that non-earnings management incentives in the present study are greater in both number and influence, relative to the non-earnings management incentives related to an accounting choice.

Research designs utilized in prior studies reflect the emphasis on examining the influence of earnings management incentives on accounting choices. The dependent variable is typically some accounting choice over which the manager can exercise considerable discretion, while independent variables capture incentives arising from capital market, tax or other incentives. The power of tests in such a design is greatest when the management discretion present in the dependent variable is adequately representative of the discretion present in all earnings management tools available to the manager, and when firms in the sample are all highly capable of exercising discretion over the dependent variable. The second objective of this dissertation is to examine whether changes in production technology, or cross-sectional differences in production technologies, affect the type and level of discretion that managers can exercise when managing earnings. In other words, the present study examines whether a manager's production technology choice influences the tool(s) he chooses to manage earnings.

Managers typically have at their disposal a number of earnings management techniques. This study examines the effect of JIT utilization on the relative use and/or effectiveness of two categories of earnings management tools. The first category of earnings management tools includes earnings manipulations for which some economic action, or transaction, is a prerequisite (hereafter, "transaction-driven" earnings management). Specifically, transaction-driven earnings management requires that some

activity in a firm's normal course of business[6] be executed before related accounting entries are recorded.

The second category of earnings management tools includes earnings manipulations for which a transaction is not a prerequisite (hereafter, "accounting-driven" earnings management). Accounting-driven earnings management encompasses several techniques, such as changes in accounting estimates or methods, and execution of transactions that are only indirectly related to the firm's normal course of business.

With the contents of managers' earnings management toolboxes described as above, it is hypothesized that JIT utilization may affect the relative use and effectiveness of transaction- and accounting-driven earnings management tools. The JIT philosophy emphasizes quality in products and processes, efficiency, lean operations (including maintenance of minimum inventories of all types), and an enhanced focus on value-added activities. Consequently, the complete adoption of JIT may preclude, or render cost-prohibitive, activities or transactions that would either hinder or be considered unrelated to a firm's normal course of business. The clearest examples include transactions involving inventory. For firms completely committed to the JIT philosophy, minimal inventory levels, pull-system production methods and smooth, uniform production rates (from material acquisition to the shipment of completed goods) should discourage

[6] In the case of a manufacturer, for example, the "normal course of business" includes activities generally undertaken to acquire raw materials, transform these materials into finished products, and sell and ship completed goods to customers. Note that this characterization of transaction-driven earnings management excludes earnings management that requires a transaction largely unrelated to the firm's normal course of business (e.g., debt-equity swaps as in Hand, 1989).

transaction-driven earnings management for which an inventory-related activity or transaction is a prerequisite.

If JIT adoption constrains the use of transaction-driven earnings management tools, then one of two results should be observed. The limited usefulness of such tools may reduce the practice of earnings management among firms that have adopted the JIT philosophy. Alternatively, JIT adoption may induce firms to shift the relative use of transaction- and accounting-driven earnings management tools toward the latter techniques.

Results of the study support the prediction that managers' JIT adoption/nonadoption decisions are associated with earnings management incentives. Specifically, empirical tests strongly suggest that firms' earnings management histories (i.e., the extent to which firms managed earnings in years prior to the adoption decision year) are strongly associated with their decisions to adopt (or not adopt) JIT.[7] In addition, firms' adoption decisions are very consistent with the predictions of the income-smoothing hypothesis. Adopters utilizing the FIFO inventory method (for which adoption is presumed to be an income-decreasing decision in the adoption year) have much stronger adoption-year earnings than nonadopting firms utilizing the FIFO inventory method. Furthermore, empirical tests suggest that managers' JIT adoption decisions are influenced by the potential for income generated via liquidation of LIFO

[7] One hypothesis tested with respect to managers' JIT adoption decisions is that a firm with a history of aggressive earnings management is less likely to adopt JIT. This hypothesis is consistent with the belief that several characteristics of the JIT philosophy could make earnings management more difficult to effect.

inventory layers to offset JIT's substantial up-front costs; that is, in LIFO firms, the association of JIT adoption with strong adoption-year earnings is much weaker than the association observed in FIFO firms.

Managers' JIT adoption decisions are also found to be consistent with the predictions of the tax and debt covenants hypotheses, although significance levels in statistical tests are generally weaker and sensitive to model specification. Finally, tests of the effect of JIT utilization on managers' relative use of transaction- and accounting-driven earnings management tools are inconclusive.

In summary, this study makes two contributions to the earnings management literature. First, it provides evidence that the accounting decision earnings management behavior documented in prior literature may extend to management decisions with long-lasting, fundamental business implications. When properly implemented, JIT is not merely an inventory reduction program; instead, JIT is a set of numerous business practices that collectively entail a substantial shift in a firm's operating environment and production philosophy. Evidence that short-term earnings incentives are associated with managers' JIT adoption decisions is an important extension of prior literature.[8]

Tests conducted in this study do not support the prediction that JIT utilization will either reduce earnings management or result in a shift in earnings management strategies. Nonetheless, an interesting line of future research could reassess this research question in

[8] It should be noted that evidence of an association between earnings management incentives and JIT adoption decisions provides no insight into the question of whether JIT is an effective business philosophy. JIT's effect on firm performance is a research question beyond the scope of this study.

an effort to determine whether the inconclusive results reported in this study are the result of an inadequate research design or simply a reflection of the fact that no effects exist.

In addition to earnings management researchers, several other parties should be interested in this research. Many industry leaders and scholars (e.g., Crawford and Cox, 1991; McLaughlin, 1989) believe JIT is a significant improvement over more traditional modes of conducting business. The association between JIT adoption and contractual obligations (e.g., in debt agreements) should be of interest to contracting parties. If, for example, contract parameters discourage the adoption of what may be a superior business philosophy, perhaps the appropriateness of such parameters should be reconsidered.

The present study posits that earnings management techniques are of two general types, transaction-driven and accounting-driven. In the case of the former, the requirement that an economic transaction be executed before related accounting entries are recorded serves as a natural impediment to their use, since executing such transactions is costly. Conversely, accounting-driven earnings management is much less costly to effect because it requires no economic transaction. Accounting policymakers, who must continually balance the capital markets' needs for comparability across financial statements against the benefits of allowing firms flexibility in financial reporting, should benefit from empirical evidence regarding the impact of JIT adoption on the type and magnitude of accounting discretion exercised by managers. If JIT adoption increases the cost of transaction-driven earnings management, evidence regarding the extent to which managers respond by increasing the use of techniques subject to few economic impediments should be useful to policymakers. Similarly, parties responsible for

monitoring or investigating alleged earnings management (e.g., auditors or the Securities and Exchange Commission) should consider the extent to which cross-sectional differences in production philosophies affect the relative use of various earnings management techniques.

The remainder of this study is organized as follows. Chapter II reviews prior earnings management research and provides an overview of the JIT philosophy. Chapter III develops and explains eight research hypotheses. Chapter IV describes the sample selection process, provides a brief description of JIT adopter and control firms, and explains the research methodology and empirical models. Chapter V provides empirical results and Chapter VI summarizes and concludes the study.

CHAPTER II

LITERATURE REVIEW

This chapter reviews two literature streams. The first section reviews prior earnings management literature. Included in this section are 1) brief explanations of six frequently tested hypotheses 2) a discussion of earnings management tools available to managers, and 3) a summary of major research findings to date.

The second section examines research related to the JIT philosophy. Although an exhaustive examination of the JIT philosophy is beyond the scope of this study, the first part of this section provides evidence supportive of the notion that earnings management strategies may differ in JIT and non-JIT environments. The second part of the JIT literature review considers possible financial statement effects related to JIT adoption.

Earnings management

Hypotheses tested

Earnings management can exist only if managers respond to one or more incentives to manipulate reported earnings. Six incentives, or categories of incentives, have been identified and tested in prior research:

1. Smoothing
2. Bonus plan
3. Size
4. Debt covenants
5. Tax
6. Desire to gain advantage over an adversary

The smoothing hypothesis implies that earnings management may be undertaken to reduce the variability of earnings over time. The financial press has noted equity investors' preferences for smooth, upward-sloping earnings trends (e.g., Wall Street Journal, 1994).[9] Earnings smoothing has also been attributed to managers responding to efficient compensation contracts (Lambert, 1984; Dye, 1988). Trueman and Titman (1988) demonstrate that managers may smooth earnings to lower investors' assessments of the variance of firms' underlying economic earnings. Debtholders in particular may associate high earnings variability with greater default risk. Hunt et al. (1997) argue that smoothing may be consistent with managers truthfully and credibly signaling private information about their firms' future prospects. Finally, in a progressive-rate income tax system, firms with greater earnings variability may pay more taxes (Smith and Stulz, 1985).

The bonus plan hypothesis states that managers will opportunistically manipulate reported earnings in order to maximize their compensation from firms' formal bonus plans. Under this hypothesis, managers may transfer wealth from other firm stakeholders when they manipulate earnings to maximize their own wealth. Early tests of the hypothesis assumed that managers would consistently accelerate income from future periods into the current period. Later studies (e.g., Healy, 1985) incorporated formal bonus plan details to refine predictions regarding managers' earnings manipulation behavior. In these studies, managers may attempt to either increase or decrease reported

[9] Additionally, the findings of Barth et al. (1992) indicate that a pattern of increasing earnings is rewarded with a premium price-earnings ratio.

earnings, depending on the level of unmanaged earnings relative to bonus plan parameters. Finally, the bonus plan hypothesis' predictions have been generalized to settings where no formal bonus plan exists (e.g., McNichols and Wilson, 1988).

The size hypothesis suggests that the larger the firm, the more likely the manager is to choose accounting procedures that defer reported earnings from current to future periods. The hypothesis is based on the assumption that large firms are subject to greater wealth transfers via the political process (Watts and Zimmerman, 1986). Therefore, managers of large firms attempt to avoid such political costs (e.g., higher taxes, regulation) by managing reported earnings downward.

The debt covenants hypothesis suggests that firms with binding debt covenants or firms for which covenant violations are very costly will manage reported earnings upward. Early researchers tested the simpler, but closely related, hypothesis that managers of highly leveraged firms would manage earnings upward.[10] Recent research (e.g., Beneish and Press, 1993) provides evidence that violating debt covenants is indeed quite costly, thereby providing managers whose firms face binding covenants strong incentives to manage earnings upward.

The tax hypothesis reflects the fact that, all else equal, managers prefer that their firms pay the minimum amount of income taxes. The hypothesis predicts that low-tax firms accelerate income from future periods into the present period, while high-tax firms

[10] For a formal explanation of the close connection between the debt covenants and leverage hypotheses, see Watts and Zimmerman (1986, p. 216). Press and Weintrop (1990) provide evidence of an association between leverage and several common covenant restrictions. However, based on the results of their study, they caution that researchers who use leverage as a proxy for nearness to covenant restrictions may be attributing the effect of other factors (e.g., investment opportunity set) to covenant restrictions.

defer recognition of income to future periods.[11] Although U.S. firms are subject to tax reporting rules that differ from GAAP, for many transactions the tax and financial statement treatments are identical. Therefore, a given firm's tax and other earnings management incentives are frequently unaligned. Some prior research (e.g., Frankel and Trezevant, 1994; Dhaliwal et al., 1994) supports tax planning as an earnings management incentive; other studies (e.g., Atwood, 1995; Hunt et al., 1996) suggest that managers incur significant tax costs to meet smoothing or debt-related earnings objectives.

The final hypothesis is characterized as earnings management to gain advantage over an adversary. For example, Cahan (1992) tested for earnings management among firms under investigation for anti-trust violations.[12] Similarly, DeAngelo (1986) examined manipulation of income during periods in which managers propose to take their firms private.

Earnings management strategies and results of prior research

This subsection of the earnings management literature review explains how managers manipulate reported earnings and summarizes the results of prior research. Despite the fact that earnings management techniques (and research designs utilized in

[11] This characterization of the tax hypothesis is oversimplified. In reality, firm managers consider tax consequences in the context of maximizing after-tax returns. Therefore, managers are likely to trade off tax and nontax costs. This type of efficient tax planning may differ markedly from mere tax minimization (Scholes and Wolfson, 1992).

[12] This study could also be viewed as a more refined test of the political cost hypothesis. Political sensitivity in less specific settings is often proxied by firm size.

prior studies) do not fit neatly into categories, six categories have been created for expository purposes:

1. Accruals
2. Inventory methods and transactions[13]
3. Other accounting choices within the accepted set of choices
4. Timing and method of accounting standard adoption
5. Acquisitions or dispositions of assets or debt (including write-offs)
6. Other

Accruals

Many prior studies examine managers' manipulation of accruals in response to one or more earnings management incentives. A typical study includes some measure of accrual manipulation (i.e., discretionary accruals)[14] as the dependent variable and independent variables that proxy for one or more earnings management incentives.

The specification of the dependent variable in the accrual methodology has changed as the literature has progressed. Early studies (e.g., Healy, 1985) assumed that the nondiscretionary portion of total accruals was the average of total accruals over some multi-year estimation period. Discretionary accruals were defined as the difference between total accruals in the event period and this estimate of nondiscretionary accruals. Later studies (e.g., DeAngelo, 1986) assumed that accruals follow a random walk process, and therefore used the first difference in total accruals as a surrogate for discretionary accruals. Finally, many recent studies attempt to model discretionary

[13] Many research designs utilized in prior studies consider earnings management techniques involving inventory to be a subset of accruals.

[14] By definition, total accruals equal the sum of nondiscretionary and discretionary accruals. Managers are able to respond to earnings management incentives through the manipulation of discretionary

accruals much more carefully. Following Jones (1991), researchers use either intra-firm or cross-sectional (by industry) regression to develop a prediction equation for total accruals, with the economic determinants of total accruals included as independent variables. Discretionary accruals are presumed to be the difference between actual accruals and the level of accruals specified by the prediction equation.[15]

Healy (1985) made a significant contribution to the literature by using the accrual methodology and contract-level data to test the bonus plan hypothesis. He found that firm managers make income-decreasing accruals when earnings are either below or above bonus plans' lower or upper bounds, respectively,[16] and income-increasing accruals otherwise.[17] Without using contract-level bonus plan parameters, McNichols and Wilson (1988) found similar accrual behavior using their model for a single accounting accrual (bad debt expense).[18]

Gaver et al. (1995) re-examined Healy (1985). Using the Jones (1991) model, they found that managers of firms with earnings below bonus plans' lower bounds managed earnings upward, a result consistent with the smoothing hypothesis. Gaver et

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accruals only.

[15] While much recent research utilizes the Jones (1991) model for determining discretionary accruals, the method is not free of criticism. See, for example, Bernard and Skinner (1996).

[16] A bonus plan's bounds effectively determine the earnings range within which an increase in income would increase managers' bonuses.

[17] This behavior is consistent with managers considering a multi-period time horizon when behaving opportunistically in order to maximize their bonuses. Negative accruals made when earnings are either (respectively) below or above a plan's lower or upper bounds would likely increase future bonus payments, with no related decrease in managers' present period bonuses.

[18] McNichols and Wilson emphasize that, although firms without formal bonus plans may incorporate implicit bounds in determining bonus payments, they do not re-test Healy's (1985) hypothesis. In fact, it is somewhat difficult to consider their findings supportive of the bonus plan hypothesis, given that they detect bathing and smoothing among firms in their sample, without regard to the existence of formal bonus plans. Such accrual behavior may be consistent with managers simply acting in the best interests

al. attributed Healy's bathing observation in such circumstances to his use of a less refined proxy for the nondiscretionary portion of total accruals.

Atwood (1995) hypothesizes that smoothing decreases as firms' tax rates increase because high-tax firms have lower variance in earnings. In addition, she predicts that this relationship will be stronger when bonus plans are based on after-tax measures. Using an accrual methodology, Atwood found support for both hypotheses. The tax hypothesis was not supported.

Guenther (1994) predicts managers manipulated income downward in the year prior to the tax rate reductions included in the Tax Reform Act of 1986. This hypothesis was not supported. Size and leverage hypotheses were supported in his study. Hunt et al. (1996) use a simultaneous equation approach to test managers' use of inventory, current accruals (excluding inventory) and depreciation to meet smoothing, debt-covenant and income tax earnings objectives. The authors' results suggest inventories and current accruals are used to smooth earnings and decrease debt-related costs. Their evidence also indicates that managers adjust current accruals to decrease taxes, and that managers treat adjustments to inventories and other current accruals as substitutes.

DeFond and Jiambalvo (1994) used the Jones (1991) model and found evidence of positive total and working capital accruals in the year prior to 94 firms' debt covenant violations. For the year of violation, evidence of positive discretionary accruals was found after controlling for going concern opinions and management changes.

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of shareholders.

Boynton et al. (1992), Gramlich (1991), Dhaliwal and Wang (1992) and Manzon (1992), study accrual management undertaken to avoid 1987 exposure to the alternative minimum tax.[19] The studies provide strong support for the prediction of income-decreasing accruals in 1987, and weak support for anticipatory income-increasing accruals in 1986.

Several studies have used an accrual methodology to examine earnings management in special circumstances. Cahan (1992) found that managers of firms under investigation for anti-trust violations made income-decreasing discretionary accruals during the period of investigation. DeAngelo (1986) found no evidence of unusually negative accruals during periods in which corporate managers propose to take their firms private. DeAngelo (1988) found evidence that earnings are managed upward during proxy fights, and that successful dissidents take an earnings bath following their takeovers of firms. In addition to refining the accrual methodology, Jones (1991) concluded that earnings are managed downward during import relief investigations. Finally, Perry and Williams (1994) re-examined DeAngelo's (1986) question regarding downward management of earnings during periods in which managers propose to take their firms private. Using the Jones (1991) model, the authors found strong support for downward manipulation of earnings during such periods.

[19] The book income adjustment in the alternative minimum tax computation potentially subjects a firm to paying taxes on some portion of the excess of book income over taxable income. The alternative minimum tax was included in the Tax Reform Act of 1986.

Inventory methods and transactions

Prior research has tested for earnings management via inventory method choices and actual inventory transactions. Although generally increasing price levels would seem to make the LIFO method preferable to FIFO (due to related tax savings),[20] most firms continue to use the FIFO method. Researchers have attempted to explain this anomaly by examining the association between inventory method and other earnings management incentives.[21] Cushing and LeClere (1992) demonstrated that estimated tax savings, firm size, leverage and current ratio were all significantly related to the LIFO/FIFO choice. Ninety-nine of 227 respondents to a survey conducted by the authors indicated that estimated tax savings was the primary motivation for using LIFO. Dopuch and Pincus (1988) concluded that inventory choice and tax savings are related. Although their results were also consistent with certain nontax explanations of inventory choice, the authors documented that most nontax differences across firms were induced by the inventory accounting methods themselves. Dopuch and Pincus also found that FIFO firms had not foregone substantial tax savings because of their choice of inventory method.[22] Johnson and Dhaliwal (1988) concluded that debt covenant incentives related to 87 firms' LIFO abandonments dominated any tax cost of abandoning LIFO.

LIFO firms in particular may time inventory transactions to manage earnings. For example, firms with LIFO reserves may decrease year-end purchases (or production) to

[20] Internal Revenue Code Section 472 requires firms electing LIFO for tax purposes to also use LIFO for financial reporting.
[21] The functionally fixated market hypothesis has also been offered as an explanation for the use of FIFO.
[22] The authors found that LIFO firms *had* reduced tax costs considerably with their inventory choice. FIFO firms may suffer little tax penalty related to their choice if, for example, inventories are immaterial,

reduce (increase) cost of sales (net income). Several prior studies have tested for this type of earnings management. Biddle (1980) found evidence that managers' year-end inventory decisions are influenced by the tax-related cash flow incentives of their firms' inventory methods. Dhaliwal et al. (1994) reported four results related to LIFO layer liquidations. They determined that LIFO liquidation is 1) more likely and of greater magnitude in a year in which a firm has a tax loss carryforward, 2) more likely in a bad earnings year, 3) used to reduce the variability of earnings, and 4) used to reduce debt covenant constraints.

Frankel and Trezevant (1994, p. 397) also reported empirical evidence consistent with four predictions: 1) high-tax LIFO firms are more likely to purchase extra inventory at year-end than low-tax LIFO firms, 2) LIFO firms are more likely to purchase extra inventory at year-end than FIFO firms, 3) no difference in year-end inventory purchases exists for FIFO firms as a function of their tax status, and 4) a LIFO firm purchases more extra inventory at year-end if it faces a declining marginal tax rate in future years than if it faces the same marginal tax rate over time.

Other accounting choices within the accepted set of choices

Inventory method is but one accounting choice made from an accepted set of choices. Prior research has attempted to explain other accounting choices with earnings management incentives.

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industry-specific price levels have not increased significantly, or if tax loss carryforwards are available.

Bowen et al. (1981) examined the corporate decision to capitalize interest. Results of their study indicate that firms near debt covenant constraints were more likely to capitalize interest. The size and bonus plan hypotheses were not supported. Daley and Vigeland (1983) found support for the debt covenant and size hypotheses in their study of managers' decisions regarding the accounting for R&D costs. Dhaliwal (1980) found that high leverage firms were more likely to use the full cost method of accounting for oil exploration expenditures.

Zmijewski and Hagerman (1981) tested the association of firms' accounting choice portfolios with earnings management incentives.[23] They concluded that size, existence of profit-sharing plans, concentration and debt-to-total assets ratios were all associated with the overall income-increasing or -decreasing nature of the four-choice portfolio.

Finally, Christie and Zimmerman (1994) attempted to measure the degree to which accounting choice is determined by managers' opportunistic behavior.[24] They compared the accounting choices of firms involved in corporate control contests (treatment firms) to the accounting choices of similar firms not engaged in such contests (control firms, which, by virtue of the fact that they are not engaged in corporate control contests, are presumed to have utilized efficient accounting methods). The authors' results indicate some accounting opportunism on the part of treatment firms' managers,

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[23] The authors include four accounting choices in the portfolio: depreciation, inventory, investment tax credit and amortization of past pension service costs. Results in the authors' 1981 study were much stronger than those reported in an earlier paper in which the four accounting choices were modeled separately (Hagerman and Zmijewski, 1979).

[24] See Holthausen (1990) for a discussion of the difficulty inherent in distinguishing among the

but also suggest that efficiency was the more important explanation of accounting choice. In fact, the authors described opportunistic behavior as a second order effect.

Timing and method of accounting standard adoption

The Financial Accounting Standards Board (FASB) frequently allows flexibility in the method and timing of adoption of new accounting standards. Several studies have examined how such flexibility is used to manage earnings. Ali and Kumar (1994) examined the accounting choice decision in the context of the timing of SFAS 87[25] adoption. They found support for the political cost, debt covenants, and bonus plan hypotheses.

Calendar-year firms were permitted to adopt SFAS 52[26] in 1981, 1982 or 1983. For 1981 adopters, adoption was generally an income-increasing change. Ayres (1986) found that size, smoothing and debt covenant variables were useful in explaining early adoption of the standard.[27]

Gujarathi and Hoskin (1992) provide evidence that firms used the flexibility permitted in the timing and method of SFAS 96 adoption to manage earnings. For early adopters, adoption generally had a positive financial statement effect. The authors found that early adopters typically had a need for upward smoothing and generally chose the adoption method (cumulative effect) that increased current period earnings. Firms for

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opportunistic behavior, efficient contracting and information perspectives in studies of accounting choice.

[25] Statement of Financial Accounting Standards No. 87, Employers' Accounting for Pensions.

[26] Statement of Financial Accounting Standards No. 52, Foreign Currency Translation.

[27] Ayres also found support for an owner- vs. manager-controlled hypothesis. Early adopters, compared to later adopters, were found to have a lower percentage of stock owned by directors and officers.

which SFAS 96 had a negative financial statement effect generally elected retroactive restatement (thereby bypassing current period earnings).

Balsam et al. (1995) examined firms' adoption behavior with respect to eleven FASB-mandated standards. They found that firms experiencing low pre-adoption return on assets and expecting positive income effects from the adoption of new standards accelerated implementation of the standards.

Acquisitions or dispositions of assets or debt (including write-offs)

Earnings management incentives may affect managers' decisions regarding the sale or acquisition of assets. Bartov (1993) concluded that the timing of asset sales (and the related gain or loss on sale) is consistent with smoothing, debt-related, bonus plan and tax explanations. Kinney and Trezevant (1997) examined the association between recognition of the investment tax credit (ITC) and the difference between pre-ITC book income and expected book income. They found evidence of both bathing and smoothing. In addition, the authors' results indicate that firms accelerated ITC-eligible capital investment for tax and earnings management purposes, and that firms recognized the ITC to reduce the variability of book income over time.

Pourciau (1993) examined accruals, special items and write-offs in her tests of earnings management related to nonroutine executive changes. She concluded that incoming executives managed accruals and write-offs in a manner consistent with earnings management (i.e., income-decreasing in the year of change and income-

increasing in the subsequent year). Contrary to expectations, Pourciau's results also indicate that outgoing executives managed earnings downward in their final year.

Zucca and Campbell (1992) examined writedowns of impaired assets. They found that the majority of firms wrote down assets in periods of already depressed earnings, a result consistent with the bathing hypothesis. However, evidence of smoothing behavior was also noted. Twenty-five percent of firms recording writedowns offset the writedown with other gains or unusually high earnings.

Hand (1989) considered whether firms undertook equity swaps from 1981 to 1984 to smooth earnings or to relax sinking fund constraints (i.e., for true financial gain). Although Hand's results suggest that both motivations were present, the smoothing hypothesis was more strongly supported.

Other earnings management techniques

In addition to prior research testing for earnings management via the five techniques above, three other studies are noteworthy. Dempsey et al. (1993) examined the reporting of extraordinary items during a period in which GAAP allowed considerable flexibility in such matters. Their results indicate that 1) managers tend to report extraordinary gains in the income statement and extraordinary losses in the statement of retained earnings, and that this behavior is more prevalent among non-owner managers, and 2) manager-controlled firms tend to report losses as extraordinary and gains as ordinary. Beattie et al. (1994) examined United Kingdom firms' classification choices, which may significantly affect reported ordinary income. They found that classificatory

choices consistent with income smoothing were positively associated with earnings variability and managerial share options, and negatively associated with dividend cover and outside ownership. Finally, DeFond and Jiambalvo (1991) found that firms correcting (income-overstating) accounting errors have more diffuse ownership and lower growth in earnings than other firms. The magnitude of overstatements was negatively correlated with earnings growth.

The JIT philosophy

Description of JIT

A universally accepted definition of the JIT philosophy, and its components, is elusive. McIlhattan (1987, p. 23) states: "The most widely accepted definition of JIT is the constant and relentless pursuit of the elimination of waste, with waste being defined as anything that does not add value to a product -- inspection, queue time, and stock." McIlhattan also notes that "the JIT concept is built on the philosophy of lead time reduction from suppliers, through operations, and to customers. The common denominator for this concept is the pursuit of zero inventories, zero defects, flexibility and zero schedule interruptions." Saipe and Schonberger (1984, p. 60) define JIT more broadly, stating "to most of the North American manufacturing companies that have adopted it, JIT is an overall performance improvement program. (JIT) is 'back to basics' with a vengeance, and, more importantly, with a knowledge of which basics we should be getting back to."

Dilworth (1986) lists eight key features of the JIT philosophy:

1. A smooth, uniform production rate. A smooth process, from material acquisition to the shipment of completed goods, helps eliminate excess inventories.

2. A pull method of coordinating steps in the production process. This method, where manufacturing in a given stage occurs only when demanded by a subsequent stage, helps eliminate work-in-process and waiting time.

3. Purchase of materials and manufacture of products (including subassemblies) in small lot sizes. An outgrowth of the pull method, this also helps reduce storage and waiting time.

4. Quick and inexpensive setups of production machinery. This is necessary if manufacturing is to occur in small lot sizes.

5. An emphasis on quality, from raw materials to finished goods. If only minimum inventory (of all types) is to be maintained, high quality is imperative.

6. Effective preventive maintenance of equipment. Preventive maintenance is necessary if minimal inventory, smooth production rates and high quality are to be achieved.

7. An atmosphere of teamwork to improve the production system. If quality in products and processes is to be attained, employee input is critical.

8. Multi-skilled workers and flexible factories. Equipment and employees alike must be flexible and capable of performing multiple tasks.

JIT is not an all-or-nothing decision. The JIT philosophy consists of many JIT practices. A company need not simultaneously adopt all of them.[28] Im and Lee (1989) report results from a 1985 survey of JIT adopters. Their survey identified thirteen major JIT practices, and asked respondents to indicate which practices had been adopted. Survey results were as follows:

[28] This aspect of JIT adoption is discussed further in the sample selection section of this study.

JIT Practice	% of Respondents
Small lot sizing	78.8
Kanban	69.7
Flexible workforce	69.7
JIT purchasing	66.7
Dedicated lines	63.6
Plant compression	60.6
Quality circle	60.6
Preventive maintenance	60.6
Mixed model production	57.6
Level production	54.5
U-shaped layout	51.5
Cellular manufacturing	51.5
Autonomation	24.2

Im and Lee note that only 24.2% of respondents had implemented autonomation, which allows each worker the right to halt production when corrective action is necessary (e.g., if quality problems are evident). The authors attribute this low adoption of autonomation to its costliness in the early stages of JIT implementation. Therefore, firms typically do not implement this JIT practice until other practices have been implemented and refined.

Im and Lee also attempted to determine firms' implementation schedules for various JIT practices. Although a general implementation pattern was difficult to discern, they did note differences across industries. In addition, they found that firms opted to first implement those JIT practices providing the most immediate and tangible returns.

Financial benefits of JIT adoption

Firms will adopt JIT only if it is perceived to be a positive net present value project. Therefore, firms adopt JIT with the expectation that financial benefits will result. Several studies have examined the financial benefits of JIT adoption.

Balakrishnan et al. (1996) examined the effect of JIT adoption on 46 firms' return on assets (ROA). They found no significant ROA response to JIT adoption.[29] The authors provide evidence of a superior ROA response for firms with diffuse customer bases and lower inventory turns in the JIT adoption year. Finally, results of the study did not support a prediction that firms with lower committed costs would realize a greater ROA response.

Huson and Nanda (1995) found that JIT adopters reduced the labor content in facilities, increased turnover and enhanced earnings. Billesbach and Hayen (1994) noted evidence of improved inventory management in a sample of 28 JIT adopters. Finally, Anyane-Ntow (1991) compared inventory levels and profitability of Japanese and non-Japanese JIT adopters. Consistent with the belief that complete realization of JIT benefits takes several years, Anyane-Ntow's results suggest that Japanese firms maintain lower inventory levels than non-Japanese firms. However, no difference in the profitability of the two groups was noted.

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[29] It should be noted that inclusion in the authors' sample required JIT adoption *and* improved inventory utilization (i.e., turnover). Therefore, the authors' sample might be viewed as a sample of companies that have *successfully* adopted the JIT philosophy. The lack of a positive ROA effect for these firms, relative to firms that have not adopted JIT, might be viewed by some as an indictment of JIT as ineffective. However, the sign of the ROA effect was correct, but insignificant at the 0.26 level. In addition, the authors' sample contained only 46 JIT firms, each with only 3 or 4 years of post-adoption data.

CHAPTER III

RESEARCH HYPOTHESES

This chapter develops the eight research hypotheses tested in this study. The hypotheses are summarized in Table 1. The first section following states a non-earnings management hypothesis tested primarily as a means of determining whether JIT utilization has any measurable financial effect on firms' operations. The next section develops and explains the five hypotheses tested to assess the effect of earnings management incentives on managers' JIT adoption decisions. The final section of this chapter develops and explains the two hypotheses regarding JIT's effect on managers' post-adoption earnings management strategies.

Table 1
Summary of research hypotheses

H1:	Compared to nonadopters, JIT adopters achieve greater improvement in inventory utilization.
H2:	Firms that have historically engaged in significant earnings management are less likely to adopt JIT.

JIT adoption is expected to reduce a firm's ability to utilize transaction-driven earnings management strategies. Therefore, firms that have aggressively managed earnings in years preceding the JIT adoption decision year (and presumably desire to continue doing so) are less likely to adopt JIT.

Table 1 (Continued)

H3: The JIT adoption decision is influenced by adoption-year smoothing incentives.

JIT adoption is expected to have a single adoption-year earnings effect for firms utilizing the FIFO inventory method -- income reducing, up-front implementation costs. Therefore, the smoothing hypothesis suggests that FIFO firms will adopt JIT in strong earnings years. LIFO firms are expected to experience two adoption-year earnings effects: 1) income-reducing up-front implementation costs, and 2) income-increasing LIFO reserve liquidations. Therefore, for LIFO firms, JIT adoption is less likely to be associated with strong earnings years.

H4: Existence of an earnings-based bonus plan increases the influence of adoption-year smoothing incentives on the JIT adoption decision.

Since shareholders prefer smooth earnings streams, compensation committees are presumed to design earnings-based bonus plans in a manner that rewards such earnings patterns. Therefore, the JIT adoption decisions of managers compensated under earnings-based bonus plans, compared to managers not covered by such plans, will be more consistent with the smoothing hypothesis' predictions.

H5: The JIT adoption decision is influenced by incentives arising from covenants in debt agreements.

FIFO firms close to violating debt covenants are less likely to make the income-reducing decision to adopt JIT. Since LIFO firms are expected to experience two adoption-year earnings effects (see H3 above), being close to debt covenant violations is less likely to discourage JIT adoption.

H6: The JIT adoption decision is influenced by tax incentives.

High-tax status encourages FIFO firm managers to make the income-reducing decision to adopt JIT. Since managers of LIFO firms expect two adoption-year earnings effects (see H3 above), high-tax status is less likely to encourage JIT adoption.

Table 1 (Continued)

H7:	JIT adoption is associated with reduced earnings management. Minimal inventories and other JIT objectives are expected to reduce managers' ability to manage earnings via actual economic transactions. All else equal, a reduction in earnings management should be observed.
H8:	JIT adoption results in a shift in earnings management strategies away from transaction-driven techniques and toward accounting-driven techniques. After JIT adoption, managers' reduced ability to manage earnings via actual economic transactions is predicted to result in a shift toward earnings management techniques not requiring such transactions (e.g., discretionary use of accounting estimates).

JIT's effect on firms' operations

This study posits that earnings management incentives are associated with JIT adoption decisions, and that JIT utilization affects the earnings management strategies managers employ. For either assertion to be true, JIT must significantly alter important aspects of firms' operating environments (e.g., inventory levels, production processes, etc.). Although a detailed analysis of the effect of JIT on firms' operations is beyond the scope of this study, the first hypothesis addresses the above necessary condition:[30]

H1: Compared to nonadopters, JIT adopters achieve greater improvement in inventory utilization.

[30] All hypotheses are stated in the alternative form.

Earnings management incentives and the JIT adoption decision

As noted in the earnings management literature review, several prior studies (e.g., Ali and Kumar, 1994; Ayres, 1986; and Gujarathi and Hoskin, 1992) provide evidence that the timing of accounting standard adoptions is in part explained by earnings management incentives. In addition, other research (e.g., Bartov, 1993; Kinney and Trezevant, 1997; and several LIFO liquidation studies) demonstrates that firms will time the execution of actual transactions in response to earnings management incentives. The first objective of this study is to determine whether earnings management incentives are associated with JIT adoption decisions. The first subsection following provides a simple theoretical model for explaining firms' JIT adoption decisions. The next subsection explains this study's critical assumptions regarding the adoption-year earnings effect of JIT adoption. The last five subsections state and explain the five earnings management hypotheses regarding the JIT adoption decision.

Theoretical model

The following theoretical model for a firm's decision to adopt (or not adopt) JIT is proposed:

JIT Adoption = f(management's assessment, firm effectiveness, earnings management history, adoption-year smoothing, bonus plan, debt covenants, and tax status)

where:

management's assessment is management's true assessment of the long-term necessity or appropriateness of adopting JIT in the firm's operations,

firm effectiveness measures the firm's ability to derive benefits from new production technologies or business practices,[31]
earnings management history measures the extent to which a firm has managed earnings in years preceding the JIT adoption decision year,
adoption-year smoothing measures firms' adoption-year financial reporting incentives,
bonus plan captures managers' incentives arising from formal bonus plans,
debt covenants represents incentives related to covenants in firms' debt agreements, and
tax status captures firms' tax planning incentives.

Adoption-year earnings effect of JIT

For most firms, JIT adoption represents a significant shift in business philosophy and requires numerous costly changes in existing production methods. Although firms adopting JIT undoubtedly expect to ultimately reap financial benefits, these rewards may not be realized for several years. Balakrishnan et al. (1996) note several reasons that the near-term income effect of JIT adoption may be negative: 1) JIT adoption entails substantial training and implementation costs that increase overhead, 2) capital expenditures associated with adoption increase depreciation expense, 3) reducing raw materials inventory may result in higher stock-out costs, and 4) reducing inventory levels negatively affects income through the mechanics of absorption costing. These implementation costs will be incurred over a time horizon consistent with the fact that JIT is typically adopted over a period of several years. However, it seems plausible to assume

[31] As an empirical matter, management's assessment and firm effectiveness are included in the model as control variables only. While their inclusion in the model should, in theory, improve its prediction capability, the overall ability of the model to classify firms as adopters or nonadopters is not a primary interest in the present study. These two variables are included in the model in an effort to control for firms' non-earnings management incentives to adopt JIT. It's not clear how these incentives might be

that many of these costs will be incurred in the initial year of JIT adoption and, consistent with the analysis of Balakrishnan et al. (1996), that these adoption-year costs will dominate any adoption-year productivity or efficiency gains attributable to JIT. Therefore, for firms utilizing the FIFO inventory method, it is assumed that the adoption-year earnings effect of JIT implementation is negative.

JIT adopters utilizing the LIFO inventory method are likely to experience two adoption-year earnings effects: 1) income-reducing, up-front implementation costs (in excess of any adoption-year productivity or efficiency gains attributable to JIT) identical to those incurred by FIFO firms, and 2) income-increasing LIFO reserve liquidations arising from the elimination of low-cost inventory layers. Although it is difficult to assess, *a priori*, the relative magnitudes of these two earnings effects, the potential earnings increase attributable to LIFO reserve liquidation should, at a minimum, serve to mitigate the earnings decline associated with JIT's up-front implementation costs. Therefore, in testing earnings management hypotheses regarding the JIT adoption decision, it is assumed that the adoption-year earnings effect for LIFO firms is, at worst, not as negative as the adoption-year earnings effect for FIFO firms.

Earnings management history hypothesis

JIT emphasizes smooth production schedules, minimal inventories, carefully scheduled preventive maintenance for machinery, strict incoming and outgoing delivery schedules and other practices designed to reduce non-value added costs and generally

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correlated with earnings management variables.

improve efficiency. In a JIT environment, then, transactions executed primarily to manage earnings are likely to be more disruptive and costly to execute than in non-JIT environments (particularly, it seems, if such transactions involve inventory). If firms' earnings management histories are positively correlated with their desire to manage earnings in future years, the following hypothesis is suggested:

H2: Firms that have historically engaged in significant earnings management are less likely to adopt JIT.

Smoothing hypothesis

The smoothing hypothesis has received much attention in prior earnings management studies. The second earnings management hypothesis tested with respect to the JIT adoption decision considers whether the decision is influenced by a firm's desire for a smooth earnings trend:

H3: The JIT adoption decision is influenced by adoption-year smoothing incentives.

As previously noted, the adoption-year earnings effect of JIT implementation for FIFO firms is assumed to be negative. For LIFO firms, it is assumed that the earnings effect of JIT adoption is (at worst) not as negative as that for FIFO firms. Therefore, support for the smoothing hypothesis requires that JIT adopters utilizing FIFO exhibit stronger adoption-year earnings than non-adopters utilizing FIFO, but that this relationship between JIT adoption and earnings be less apparent for firms utilizing LIFO (i.e., for LIFO firms, the positive association between JIT adoption and strong earnings years should be less significant than the association for FIFO firms).

Bonus plan hypothesis

In recent studies, more powerful tests of the bonus plan hypothesis have been conducted as researchers have incorporated the details of bonus plan parameters available in some firms' proxy statements (e.g., Healy, 1985). In the present study, an insufficient number of sample firms report bonus plan details that would allow powerful tests to be conducted. However, a large number of sample firms' proxies provide sufficient information to ascertain whether managers' bonuses are earnings-based or determined by other parameters. Therefore, the bonus plan hypothesis tested in the present study is based on the premise that managers covered under earnings-based bonus plans are awarded for achieving the smooth earnings trends preferred by most firms:

H4: Existence of an earnings-based bonus plan increases the influence of adoption-year smoothing incentives on the JIT adoption decision.

Debt covenants hypothesis

Prior research (e.g., Beneish and Press, 1993) has documented that violating debt covenants is costly. This costliness and the expected adoption-year earnings effect of JIT implementation (discussed previously) suggest the following hypothesis:

H5: The JIT adoption decision is influenced by incentives arising from covenants in debt agreements.[32]

[32] As expected, very few sample firms' SEC filings provide details regarding covenants in their debt agreements. Therefore, in conducting tests, leverage is used as a surrogate for nearness to covenant violations.

Given the expected adoption-year earnings effect of JIT implementation, support for the debt covenants hypothesis requires that FIFO firms nearing debt thresholds be less likely to adopt JIT, and that this relationship be less apparent (or nonexistent) for LIFO firms.

Tax hypothesis

Section 472 of the Internal Revenue Code requires firms electing LIFO for tax purposes to also use LIFO for financial reporting. Therefore, JIT adoption should have similar effects on financial statement net income and income reported for tax purposes.[33] Since firms generally desire to avoid (or at least defer) the payment of income taxes, the following hypothesis is suggested:

H6: The JIT adoption decision is influenced by tax incentives.

Given the expected earnings effect of JIT adoption, support for this hypothesis requires that high-tax FIFO firms (compared to low-tax FIFO firms) be more likely to adopt JIT, but that this positive relation between tax burden and likelihood of JIT adoption be less significant (or nonexistent) for LIFO firms.

Effect of JIT utilization on managers' earnings management strategies

The JIT philosophy emphasizes reduction of waste, quality, minimum inventories and an enhanced focus on value-added activities. In a true JIT operating environment,

[33] It is assumed that firms using LIFO for financial reporting would not elect to use FIFO for tax reporting.

then, activities (and transactions) for which the primary motivation is earnings management are less likely to be executed. For example:

Transactions in inventory -- in non-JIT environments, firms manage year-end shipments, year-end purchases and production schedules in response to one or more earnings management incentives. JIT firms with minimal inventories and pull-system production methods are much less likely to engage in earnings management through transactions in inventory.

Maintenance of plant and equipment -- in non-JIT environments, plant and equipment maintenance is often executed on an intermittent basis. The JIT philosophy's emphasis on minimum inventories and zero defects requires that preventive maintenance be performed according to systematic, pre-determined schedules. In JIT environments, then, maintenance is much less likely to be timed in accordance with contemporaneous earnings incentives.

Transactions in production assets -- non-JIT firms may time the purchase or sale of production assets in response to earnings management objectives.[34] JIT firms' emphasis on value-added activities and lean operations reduces the role of earnings management incentives in such decisions.

The expectation of reduced usefulness (or increased costliness) of transaction-driven earnings management tools among JIT adopters suggests the following hypothesis:

[34] Firms may cherry-pick production assets at year-end, whereby the determination of which assets to sell is made by reference to earnings management incentives and the potential gain or loss recognizable on the disposal of such assets (see, for example, Bartov, 1993).

H7: JIT utilization is associated with reduced earnings management.

Hypothesis 7 will be supported if JIT utilization constrains the use of transaction-driven earnings management tools and managers do not respond by shifting toward greater relative use of earnings management tools not requiring an actual economic transaction (i.e., accounting-driven earnings management tools, such as changes in accounting estimates or other strategies not requiring a transaction in the normal course of business). The final hypothesis suggests that JIT adoption changes managers' earnings management strategies:

H8: JIT adoption results in a shift in earnings management strategies away from transaction-driven techniques and toward accounting-driven techniques.

CHAPTER IV

RESEARCH METHODOLOGY

The first section following explains the procedures undertaken to generate a sample of JIT adopters and control firms and describes the sample with respect to JIT adoption year, industry membership and inventory method. The next section describes the empirical tests conducted to test the eight research hypotheses.

Sample selection

Two factors related to sample selection may reduce the ability of tests to detect evidence in support of the eight hypotheses. First, complete adoption of all JIT practices is unlikely to occur in a single year; JIT adoption generally proceeds incrementally. Therefore, identifying a JIT adoption year is perhaps better described as identifying the first of several years in which JIT practices are implemented.

The second difficulty in identifying a specific JIT adoption year arises from the fact that disclosure of JIT adoption is not required. The sample selection procedures entailed examining publicly available information to identify the sample of JIT adopters, and adopters were most commonly identified in the Management Discussion and Analysis portion of firms' annual reports.

The above difficulties with sample selection are most problematic with respect to the study's first objective, in which the expected adoption-year earnings effect of JIT implementation is hypothesized to influence the adoption decision. If JIT adoption years are mis-identified for a substantial portion of the sample, or if the implementation costs

and LIFO liquidations associated with JIT are not substantially realized in the year identified as the JIT adoption year, then the power of statistical tests will be reduced.

Inclusion in the initial sample of JIT adopters required the following:

1. Evidence in a publicly available source that a firm has adopted JIT in its own operations.[35]
2. The year of initial adoption of JIT practices is stated in or estimable from the publicly available source.
3. A reasonable amount of pre-adoption and post-adoption financial data are available on the 1995 COMPUSTAT tapes.

Table 2 describes the specific procedures undertaken to generate a sample of 305 JIT adopters. Table 3 (Panel A) describes the distributions of these firms' JIT adoption years, two-digit industry classifications, and inventory methods. As noted in the footnotes to Table 2, detailed 10Ks and annual reports were not available in the Lexis/Nexis COMPANY file for years prior to 1987. Although the NAARS and Lexis/Nexis ALLNEWS files were searched in an effort to identify pre-1987 adopters, it is unlikely that the adoption year distribution reported in Table 3 (Panel A) is representative of the population of all JIT adopters (i.e., pre-1987 adopters are probably under-represented). Table 3 (Panel B) provides adoption year, two-digit industry, and inventory method distributions for a subsample of 191 JIT adopters used in testing Hypotheses 1-6.[36]

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[35] Evidence that a firm simply supplies its customers on a JIT basis is not sufficient for inclusion in the sample. Inclusion requires evidence that a firm has integrated JIT practices into its own operations.

[36] The reduction in sample size for tests of Hypotheses 1-6 is the result of a data availability requirement imposed to allow a reasonable estimation of firms' earnings management histories. As further explained later in this chapter, the subsample of 191 firms are those for which total accruals (calculated as in Jones, 1991) could be calculated in at least seven years preceding JIT adoption.

Table 2
Sample selection procedures

Procedure	Sample Size
Searched Lexis/Nexis COMPANY file for years 1979 - 1996 (Note 1)	408
Searched NAARS for years 1972 - 1994 (Note 2)	9
Searched Lexis/Nexis ALLNEWS file for years 1980 - 1987	142
Additional firms identified during the literature review	55
Additional firms provided by Balakrishnan et al. (1996)	9
Total potential sample firms	623
Less: Firms not on the 1995 COMPUSTAT tape (Note 3)	-151
Less: Firms with less than five years sales data on the 1995 COMPUSTAT tape (1977 - 1995)	-27
Total potential sample firms after initial data availability screens	445
Less: Firms eliminated because examination of annual report, 10K, news story, etc. indicated only a passing reference to JIT, or the JIT adoption date was outside the range of years for which sales data are available on the 1995 COMPUSTAT tape (Note 4)	-127
Less: Firms for which inventory method in the year preceding JIT adoption was not available on the 1996 COMPUSTAT tape	-4
Less: Firms for which an acceptable match could not be found on the 1996 COMPUSTAT tape (Note 5)	-9
Final sample	305

Note 1: The COMPANY file includes detailed 10Ks and annual reports back to 1987 only. The NAARS and ALLNEWS files were searched in an effort to obtain pre-1987 adopters. The search string utilized was ((just in time) or (JIT) or (pull system) or (continuous flow manufacturing) or (zero inventor!)) w/10 ((implement!) or (chang!) or (switch!) or (adopt!) or (enhanc!) or (expand!) or (refin!) or (extend!)).
Note 2: The NAARS file does not contain the MDA portion of firms' financial statements.
Note 3: These were (presumably) private firms, subsidiaries or divisions of other firms, or firms that, for some other reason, were not included on the COMPUSTAT tapes.
Note 4: "Passing references" to JIT included discussions regarding supplying customers on a JIT basis, with no indication that the firm had adopted JIT practices in its own operations.
Note 5: These firms could not be matched on inventory method at the two-digit industry level.

Table 3
JIT adoption year, industry and inventory method distributions

Panel A: Final Sample Identified in Table 2 (N = 305)

Distribution of JIT Adoption Years

Year	Number	Percent	Year	Number	Percent
1982	4	1.31	1989	31	10.16
1983	6	1.97	1990	36	11.80
1984	15	4.92	1991	33	10.82
1985	17	5.57	1992	23	7.54
1986	26	8.52	1993	27	8.85
1987	29	9.51	1994	11	3.61
1988	38	12.46	1995	9	2.95

Distribution of Firms Across 2-Digit Industry Classifications (Note 1)

Class	# Firms	Percent	Class	# Firms	Percent
15	1	.33	35	58	19.02
17	1	.33	36	65	21.31
20	2	.66	37	27	8.85
21	1	.33	38	36	11.80
22	4	1.31	39	7	2.30
23	2	.66	48	1	.33
24	2	.66	50	6	1.97
25	11	3.61	52	1	.33
26	4	1.31	53	5	1.64
27	5	1.64	54	2	.66
28	8	2.62	56	1	.33
30	8	2.62	57	2	.66
31	2	.66	59	3	.98
32	2	.66	73	4	1.31
33	15	4.92	99	1	.33
34	18	5.90			

Distribution of Firms Across Inventory Methods (Note 2)

Classification Scheme 1			Classification Scheme 2		
Method	# Firms	Percent	Method	# Firms	Percent
FIFO	178	58.36	FIFO	145	47.54
LIFO	127	41.64	LIFO	160	52.46

Table 3 (Continued)

Panel B: Sample Used in Hypotheses 1 - 6 Tests (N = 191)

Distribution of JIT Adoption Years

Year	Number	Percent	Year	Number	Percent
1982	4	2.09	1989	20	10.47
1983	5	2.62	1990	19	9.95
1984	13	6.81	1991	13	6.81
1985	14	7.33	1992	15	7.85
1986	15	7.85	1993	15	7.85
1987	20	10.47	1994	5	2.62
1988	28	14.66	1995	5	2.62

Distribution of Firms Across 2-Digit Industry Classifications (Note 1)

Class	# Firms	Percent	Class	# Firms	Percent
15	1	.52	34	12	6.28
17	1	.52	35	35	18.32
20	1	.52	36	35	18.32
21	1	.52	37	17	8.90
22	3	1.57	38	21	10.99
23	1	.52	39	4	2.09
24	1	.52	48	1	.52
25	9	4.71	50	4	2.09
26	4	2.09	53	4	2.09
27	3	1.57	54	2	1.05
28	7	3.66	56	1	.52
30	5	2.62	57	2	1.05
31	2	1.05	73	1	.52
32	1	.52	99	1	.52
33	11	5.76			

Distribution of Firms Across Inventory Methods (Note 2)

Classification Scheme 1			Classification Scheme 2		
Method	# Firms	Percent	Method	# Firms	Percent
FIFO	100	52.36	FIFO	75	39.27
LIFO	91	47.64	LIFO	116	60.73

Note 1: Although the distribution of sample and control firms across industries is presented based on 2-digit classifications, the actual matching procedure undertaken resulted in 136 (71.2%) 4-digit matches, 21 (11.0%) 3-digit matches and 34 (17.8%) 2-digit matches (for the N = 191 sample). Overall, 29 (107) 2-digit (4-digit) industry classifications are represented in the N = 191 sample.

Note 2: Firms were coded as LIFO users for purposes of Scheme 1 if the first digit in COMPUSTAT Item 59 indicated LIFO usage; otherwise, firms were coded as FIFO users. Firms were coded as LIFO users under Scheme 2 if *any* digit in Item 59 indicated LIFO usage; otherwise firms were coded as FIFO users under Scheme 2. A small number of firm pairs could not be matched identically under Scheme 1. All firm pairs are matched under Scheme 2, which is used throughout this study to identify firms' inventory methods.

Empirical tests involve comparisons of JIT adopters and non-adopters. Therefore, a control sample of non-JIT firms was drawn, with firms matched on industry, inventory method and size. To remain in the sample, a JIT adopter had to be matchable under the less restrictive of two alternative inventory method classification schemes (described in Table 3, Note 2) at no worse than the two-digit industry level.[37] As noted previously, the sample selection procedures assume that JIT adopters disclose in their annual reports the fact that they have adopted JIT. To the extent that some members of the control sample are in fact JIT adopters (but made no such disclosure), empirical tests will be biased against the rejection of null hypotheses.

Empirical tests

The first subsection following explains the univariate test of Hypothesis 1 (inventory utilization hypothesis). The next subsection describes the univariate and multivariate tests of Hypotheses 2-6 (regarding the JIT adoption decision). The final section describes tests of Hypotheses 7 and 8 (regarding JIT's effect on earnings management strategies). Table 4 provides definitions of all variables used in tests of hypotheses.

[37] As noted in Table 3 (Note 1), 71.2% of JIT adopters were matched at the four-digit industry level. The sample selection procedures placed greatest emphasis on matching adopters on industry and inventory method, with relatively less emphasis on the size criterion, with the result that a size difference exists between JIT adopters and control firms.

Table 4
Variable definitions

Variable	Definition
Variable definitions in univariate tests of Hypotheses 1-6:	
TRNCHG	Percentage change in total inventory turnover relative to the average total inventory turnover in the three years preceding JIT adoption. DFTRNCHG is the paired difference in TRNCHG for an adopter/nonadopter matched pair.
EMHISTOR	EMHISTOR is a surrogate for a firm's earnings management history and is the mean of the absolute value of discretionary accruals (defined as in Jones, 1991) in years preceding JIT adoption. HISTDIFF is the paired difference in EMHISTOR for an adopter/nonadopter matched pair.
EARNCHG	EARNCHG is a surrogate for firms' financial reporting incentives, and is defined as income before extraordinary items (before the after-tax effect of discretionary accruals, determined as in Jones, 1991) divided by beginning-of-year total assets, minus reported income before extraordinary items in the prior year, also scaled by beginning-of-year total assets. DFERNCHG is the paired difference in EARNCHG for an adopter/nonadopter matched pair.
Conforming Behavior	A dummy variable coded Yes if a firm's JIT adoption decision, in light of its inventory method and EARNCHG sign, is consistent with the smoothing hypothesis; No otherwise.
Bonus Plan	A dummy variable coded Yes if a firm's managers were covered under an earnings-based bonus plan in the JIT adoption decision year; No otherwise.
LEV	LEV is a surrogate for firms' earnings incentives arising from covenants in debt agreements, and is defined as total debt divided by total assets. DFLEV is the paired difference in LEV for an adopter/nonadopter matched pair.
TAXRTE	TAXRTE is a surrogate for firms' tax reporting incentives and is defined as the current portion of income tax expense divided by income before taxes. DFTAXRTE is the paired difference in TAXRTE for an adopter/nonadopter matched pair.

Table 4 (Continued)

Variable	Definition
	Definitions of additional variables used in multivariate tests of Hypotheses 2-6:
ADOPT	A dummy variable coded 1 if a firm is the JIT adopter in an adopter/nonadopter matched pair; 0 otherwise.
SIZE	Total assets.
INVTO	INVTO is a surrogate for management's assessment of the benefits that could be derived from JIT adoption, and is defined as average total inventory turnover in the three years preceding the JIT adoption decision year.
CAPTURN	CAPTURN is a surrogate for firm, or management, effectiveness, and is defined as the average total asset turnover in the three years preceding the JIT adoption decision year.
RDRAT	RDRAT is a surrogate for firm innovativeness, and is defined as the average R&D to sales ratio in the three years preceding the JIT adoption decision year.
LIFO	A dummy variable coded 1 if the firm uses LIFO to value any inventory.
TAX	TAX is a surrogate for firms' tax reporting incentives, and is defined as a dummy variable coded 1 if the firm reported a tax loss carryforward in the year preceding the JIT adoption decision year; 0 otherwise.
EBPLAN	A dummy variable coded 1 if a firm's managers were covered under an earnings-based bonus plan in the JIT adoption decision year; 0 otherwise.
	Variable definitions in univariate tests of Hypothesis 7:
DIFFVAR1	The change in earnings variation, defined specifically as $(\sigma_{NIBEI}/\mu_{ASSETS})_{post\text{-}adoption} - (\sigma_{NIBEI}/\mu_{ASSETS})_{pre\text{-}adoption}$, where σ_{NIBEI} is the standard deviation of income before extraordinary items and μ_{ASSETS} is mean total assets. PDDFVAR1 is the paired difference in DIFFVAR1 for an adopter/nonadopter matched pair.

Table 4 (Continued)

Variable	Definition
DIFFVAR2	The change in earnings variation, defined specifically as $(\sigma_{NIBEI}/\mu_{NIBEI})_{post\text{-}adoption} - (\sigma_{NIBEI}/\mu_{NIBEI})_{pre\text{-}adoption}$, where σ_{NIBEI} and μ_{NIBEI} are, respectively, the standard deviation and mean of income before extraordinary items. PDDFVAR2 is the paired difference in DIFFVAR2 for an adopter/nonadopter matched pair.
DIFFVAR3	The change in earnings variation, defined specifically as $(\sigma_{ROABEI})_{post\text{-}adoption} - (\sigma_{ROABEI})_{pre\text{-}adoption}$, where σ_{ROABEI} is the standard deviation of return on assets before extraordinary items. PDDFVAR3 is the paired difference in DIFFVAR3 for an adopter/nonadopter matched pair.
DIFFVAR4	The change in earnings variation, defined specifically as $(\sigma_{ROABEI}/\mu_{ROABEI})_{post\text{-}adoption} - (\sigma_{ROABEI}/\mu_{ROABEI})_{pre\text{-}adoption}$, where σ_{ROABEI} and μ_{ROABEI} are, respectively, the standard deviation and mean of return on assets before extraordinary items. PDDFVAR4 is the paired difference in DIFFVAR4 for an adopter/nonadopter matched pair.
DIFFVARA	The change in earnings variation, defined specifically as $(\sigma_{RESID,NIBEI}/\mu_{ASSETS})_{post\text{-}adoption} - (\sigma_{RESID,NIBEI}/\mu_{ASSETS})_{pre\text{-}adoption}$, where $\sigma_{RESID,NIBEI}$ is the standard deviation of the residual in a regression of income before extraordinary items on event time and μ_{ASSETS} is mean assets during the period. PDDFVARA is the paired difference in DIFFVARA for an adopter/nonadopter matched pair.
DIFFVARB	The change in earnings variation, defined specifically as $(\sigma_{RESID,NIBEI}/\mu_{NIBEI})_{post\text{-}adoption} - (\sigma_{RESID,NIBEI}/\mu_{NIBEI})_{pre\text{-}adoption}$, where $\sigma_{RESID,NIBEI}$ is the standard deviation of the residual in a regression of income before extraordinary items on event time and μ_{NIBEI} is mean income before extraordinary items during the period. PDDFVARB is the paired difference in DIFFVARB for an adopter/nonadopter matched pair.
DIFFVARC	The change in earnings variation, defined specifically as $(\sigma_{RESID,ROABEI})_{post\text{-}adoption} - (\sigma_{RESID,ROABEI})_{pre\text{-}adoption}$, where $\sigma_{RESID,ROABEI}$ is the standard deviation of the residual in a regression of return on assets before extraordinary items on event time. PDDFVARC is the paired difference in DIFFVARC for an adopter/nonadopter matched pair.

Table 4 (Continued)

Variable	Definition
DIFFVARD	The change in earnings variation, defined specifically as $(\sigma_{RESID,ROABEI}/\mu_{ROABEI})_{post\text{-}adoption} - (\sigma_{RESID,ROABEI}/\mu_{ROABEI})_{pre\text{-}adoption}$, where $\sigma_{RESID,ROABEI}$ is the standard deviation of the residual in a regression of return on assets before extraordinary items on event time and μ_{ROABEI} is mean return on assets before extraordinary items during the period. PDDFVARD is the paired difference in DIFFVARD for an adopter/nonadopter matched pair.
Variables used in tests of Hypothesis 8:	
TRANDR	TRANDR is transaction-driven accruals, defined as the change in gross accounts receivable plus the change in total inventory minus the change in accounts payable, all scaled by beginning-of-year total assets.
ACCTDR	ACCTDR is accounting-driven accruals, defined as total accruals (as in Jones, 1991) excluding transaction-driven accruals and depreciation expense, scaled by beginning-of-year total assets.
DEPR	-1 * depreciation and amortization expense, scaled by beginning-of-year total assets.
DIFFTRAN	The change in the descriptiveness of the economic determinants of transaction-driven accruals, defined as $(\sigma_{RESID,TRANDR})_{post\text{-}adoption} - (\sigma_{RESID,TRANDR})_{pre\text{-}adoption}$, where $\sigma_{RESID,TRANDR}$ is the standard deviation of the residual in a regression of TRANDR on its economic determinants. PDDFTRAN is the paired difference in DIFFTRAN for an adopter/nonadopter matched pair.
DIFFACCT	The change in the descriptiveness of the economic determinants of accounting-driven accruals, defined as $(\sigma_{RESID,ACCTDR})_{post\text{-}adoption} - (\sigma_{RESID,ACCTDR})_{pre\text{-}adoption}$, where $\sigma_{RESID,ACCTDR}$ is the standard deviation of the residual in a regression of ACCTDR on its economic determinants. PDDFACCT is the paired difference in DIFFACCT for an adopter/nonadopter matched pair.

Table 4 (Continued)

Variable	Definition
DIFFDEPR	The change in the descriptiveness of the economic determinants of depreciation accruals, defined as $(\sigma_{RESID,DEPR})_{post\text{-}adoption} - (\sigma_{RESID,DEPR})_{pre\text{-}adoption}$, where $\sigma_{RESID,DEPR}$ is the standard deviation of the residual in a regression of DEPR on its economic determinants. PDDFDEPR is the paired difference in DIFFDEPR for an adopter/nonadopter matched pair.
JIT	A dummy variable coded 1 if a firm is the adopter member of an adopter/nonadopter matched pair; 0 otherwise.
POST	A dummy variable coded 1 if a year is greater than or equal to the year in which the adopter member of an adopter/nonadopter matched pair implemented JIT; 0 otherwise.
TAXDUM	A dummy variable coded 1 in year t if the firm reported a tax loss carryforward in year t-1.
CHGREV	Current year net sales less prior year net sales, scaled by beginning-of-year total assets.
CHMDREV	Change in net sales minus the change in accounts receivable, scaled by beginning-of-year total assets.
SCALPPE	Property, plant and equipment, scaled by total assets.

Univariate test of the inventory utilization hypothesis

The difference in the changes in JIT adopters' and nonadopters' inventory utilizations is tested as follows:

$$DFTRNCHG_{i,t} = TRNCHG_{i,t} - TRNCHG_{j,t}$$

where:

i is the index for a JIT adopter,
j is the index for adopter i's nonadopting matched counterpart,

t is the number of years following firm i's adoption of JIT,[38] and
TRNCHG is the percentage change in total inventory turnover relative to the average total inventory turnover in the three years preceding firm i's adoption of JIT.

Mean $DFTRNCHG_{i,t}$ (calculated and tested separately for the adoption year and each of years 1 through 5 following firm i's adoption of JIT) greater than zero supports Hypothesis 1.[39]

Univariate tests of earnings management in the JIT adoption decision

Earnings management history hypothesis

EMHISTOR, the mean of the absolute value of discretionary accruals in all years preceding JIT adoption,[40] is a measure of a firm's pre-JIT adoption propensity to manage earnings. Paired differences in adopters' and nonadopting matched counterparts' pre-adoption propensities to manage earnings are used to test the earnings management history hypothesis (Hypothesis 2):

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[38] The indices for adopters, nonadopters and event time are identical in all empirical tests.

[39] Unless otherwise noted, univariate tests of Hypotheses 1, 2, 3, 5 and 6 are conducted with the paired t-test and the Wilcoxon signed-rank test.

[40] Discretionary accruals (DA) are estimated using the modified Jones (1991) method (Dechow et al., 1995). The definition of total accruals used throughout this study is as follows (COMPUSTAT item numbers are in brackets): TA_t = (Δcurrent $assets_t$ [I4] - Δcurrent $liabilities_t$ [I5] - $\Delta cash_t$ [I1] + Δcurrent portion of long-term $debt_t$ [I34] + Δincome taxes $payable_t$ [I71] - $depreciation_t$ [I14])/total $assets_{t-1}$ [I6]. If firm i has n pre-adoption years of data on the 1996 COMPUSTAT tapes, nondiscretionary accruals (NDA) in the k^{th} year preceding JIT adoption are estimated using a two-stage procedure. First, the parameters of a NDA_k prediction equation are estimated with the model $TA_t = \beta_0(1/\text{total assets}_{t-1}) + \beta_1(\Delta\text{revenue}_t$ [I12]/total $assets_{t-1}) + \beta_2$(property, plant and equipment$_t$ [I7]/total $assets_{t-1}) + \varepsilon_t$, where t = n,...(k + 1), (k-1),...1. The estimated NDA in year k is then $NDA_k = b_0(1/\text{total assets}_{k-1}) + b_1([\Delta\text{revenue}_k$ - Δaccounts $receivable_k$ [I2]]/total $assets_{k-1}) + b_2$(property, plant and equipment$_k$/total $assets_{k-1}$). The discretionary accrual in year k is then $DA_k = TA_k - NDA_k$, and EMHISTOR for each firm i is $(\Sigma\ |DA_k|)/n$, with k = 1,...n. Firms with less than seven pre-adoption years for which data are available to calculate TA are deleted from the sample.

$$HISTDIFF_i = EMHISTOR_i - EMHISTOR_j$$

Mean $HISTDIFF_i$ less than zero supports the prediction that firms with a history of aggressive earnings management are less likely to adopt JIT.

Smoothing hypothesis

Results of four empirical tests jointly determine the level of univariate support for Hypothesis 3. The smoothing hypothesis suggests that JIT adopters using FIFO, compared to nonadopters using FIFO, will have stronger earnings (EARNCHG[41]) in the JIT adoption year:

$$DFERNCHG_{i,(FIFO)} = EARNCHG_{i,(FIFO)} - EARNCHG_{j,(FIFO)}$$

Mean $DFERNCHG_{i,(FIFO)}$ greater than zero supports Hypothesis 3.

An analogous test is conducted for LIFO firms:

$$DFERNCHG_{i,(LIFO)} = EARNCHG_{i,(LIFO)} - EARNCHG_{j,(LIFO)}$$

If managers of LIFO firms contemplating JIT adoption expect income via liquidation of the LIFO reserve to dominate JIT's implementation costs, then mean $DFERNCHG_{i,(LIFO)}$ is negative. Positive mean $DFERNCHG_{i,(LIFO)}$ is consistent with managers anticipating that implementation costs will dominate income generated via liquidation of the LIFO reserve.[42]

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[41] EARNCHG is the difference between pre-managed income before extraordinary items in the JIT adoption year and reported income before extraordinary items in the preceding year, each scaled by beginning-of-year assets. Therefore, $EARNCHG_t$ = {[income before extraordinary $items_t$ [I18]/total $assets_{t-1}$] - [(1 - book tax $rate_t$)(DA_t)]} - (income before extraordinary $items_{t-1}$/total $assets_{t-2}$), where DA is discretionary accruals and t is the JIT adoption year.

[42] Due to the uncertainty regarding the earnings effect of JIT adoption for LIFO firms, mean $DFERNCHG_{i(LIFO)}$ is tested with a two-tailed test. If the analogous test for FIFO firms indicates a

Two intra-sample (adopter and nonadopter) tests are also conducted:

$$DFERNCHG_{JIT,(FIFO - LIFO)} = mean(EARNCHG_{JIT,(FIFO)}) - mean(EARNCHG_{JIT,(LIFO)})$$

$DFERNCHG_{JIT,(FIFO - LIFO)}$ greater than zero supports the smoothing hypothesis since, under an earnings management explanation for JIT adoption, FIFO-using JIT adopters, compared to LIFO-using JIT adopters, should have stronger earnings. An identical test is conducted on the sample of control firms. $DFERNCHG_{CONTROL,(FIFO - LIFO)}$ less than zero supports Hypothesis 3 since, under an earnings management explanation for JIT (non)adoption, FIFO firms should have weaker earnings.

Bonus plan hypothesis

Hypothesis 4 suggests that the JIT adoption behavior of managers subject to earnings-based bonus plans, compared to the behavior of managers not subject to such plans, should be more consistent with the smoothing hypothesis' prediction. The first test of this hypothesis is a χ^2 test of the independence of conforming behavior and bonus plan existence:[43]

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significant difference, mean $DFERNCHG_{i(LIFO)}$ not significantly different from zero supports the notion that managers view income generated via liquidation of the LIFO reserve as counterbalancing JIT's up-front implementation costs.

[43] Although few sample and control firms report specific bonus plan parameters in SEC filings, many report details sufficient to assess, with a reasonable degree of accuracy, whether the bonus plan is earnings-based. Of the 191 firm-pairs on which tests of hypotheses 1, 2, 3, 5 and 6 are based, 186 pairs reported sufficient bonus plan information to permit such an assessment. For post-1986 adoptions, this information was gathered from the Lexis/Nexis Proxy file. For pre-1987 adoptions, the information was gathered from firms' Proxy Statements on Q-Data microfiche.

		Conforming Behavior		
		No	Yes	Total
Bonus Plan	No	n_{11}	n_{12}	$n_{11} + n_{12}$
	Yes	n_{21}	n_{22}	$n_{21} + n_{22}$
	Total	$n_{11} + n_{21}$	$n_{12} + n_{22}$	n_{total}

where:

Conforming Behavior is coded Yes if a firm's JIT adoption decision, in light of its inventory method and EARNCHG sign, is consistent with the smoothing hypothesis; No otherwise, and
Bonus Plan is coded Yes if a firm has an earnings-based bonus plan; No otherwise.

$$\chi^2 = \sum_{x,y}\left[\frac{(n_{xy} - E_{xy})^2}{E_{xy}}\right]$$

where:

n_{xy} is the observed number in row x, column y, and
E_{xy} is the expected number in row x, column y, if Conforming Behavior and Bonus Plan are independent.[44]

Tests are conducted on three samples: FIFO firms only, LIFO firms only and all firms combined.[45] Observation of cell values in the preceding contingency table determines whether any dependence detected is in the predicted direction.

[44] E_{ij} = [(row x total)(column y total)]/n_{total}.
[45] The test is most powerful for firms using the FIFO inventory method, since the smoothing hypothesis' predictions are unambiguous for such firms (i.e., FIFO firms are expected to have a single JIT adoption earnings effect -- JIT's up-front implementation costs).

Debt covenants hypothesis

The debt covenants hypothesis suggests that firms near violation of covenants or firms for which violation is very costly will manage earnings upward. The univariate test of this hypothesis is:[46]

$$DFLEV_{i,(FIFO)} = LEV_{i,(FIFO)} - LEV_{j,(FIFO)}$$

$$DFLEV_{i,(LIFO)} = LEV_{i,(LIFO)} - LEV_{j,(LIFO)}$$

where LEV is total debt divided by total assets. Mean $DFLEV_{i,(FIFO)}$ less than zero supports the prediction that FIFO firms near debt covenant violation, relative to FIFO firms not near such violation, are less likely to make the income-reducing decision to adopt JIT. If managers of LIFO firms contemplating JIT adoption expect income via liquidation of the LIFO reserve to dominate JIT's implementation costs, then mean $DFLEV_{i,(LIFO)}$ is positive. Negative mean $DFLEV_{i,(LIFO)}$ is consistent with managers anticipating that implementation costs will dominate income generated via liquidation of the LIFO reserve.[47]

Tax hypothesis

The tax hypothesis predicts that high-tax (low-tax) firms will manage earnings downward (upward). The univariate test of this hypothesis is as follows:

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[46] As previously noted, very few sample firms report detailed debt covenant provisions in their SEC filings. Therefore, leverage (total debt/total assets) is used as a proxy for nearness to debt covenant violation.

[47] Due to the uncertainty regarding the earnings effect of JIT adoption for LIFO firms, mean $DFLEV_{i(LIFO)}$ is tested with a two-tailed test. If the analogous test for FIFO firms indicates a significant difference, mean $DFLEV_{i(LIFO)}$ not significantly different from zero supports the notion that managers view income generated via liquidation of the LIFO reserve as counterbalancing JIT's up-front implementation costs.

$$DFTAXRTE_{i,(FIFO)} = TAXRTE_{i,(FIFO)} - TAXRTE_{j,(FIFO)}$$

$$DFTAXRTE_{i,(LIFO)} = TAXRTE_{i,(LIFO)} - TAXRTE_{j,(LIFO)}$$

where TAXRTE is the current portion of income tax expense divided by income before taxes. Mean $DFTAXRTE_{i,(FIFO)}$ greater than zero supports the prediction that high-tax FIFO firms, compared to low-tax FIFO firms, are more likely to make the income-reducing decision to adopt JIT. If managers of LIFO firms contemplating JIT adoption expect income via liquidation of the LIFO reserve to dominate JIT's implementation costs, then mean $DFTAXRTE_{i,(LIFO)}$ will be negative. Positive mean $DFTAXRTE_{i,(LIFO)}$ is consistent with managers anticipating that implementation costs will dominate income generated via liquidation of the LIFO reserve.[48]

Multivariate test of earnings management in the JIT adoption decision

The univariate tests of Hypotheses 2-6 are subject to the caveats of correlation among test variables and correlation of test variables with omitted variables. Therefore, the following logistic regression model is estimated in a multivariate test of Hypotheses 2 through 6 (firm subscripts are suppressed):[49]

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[48] Due to the uncertainty regarding the earnings effect of JIT adoption for LIFO firms, mean $DFTAXRTE_{i(LIFO)}$ is tested with a two-tailed test. If the analogous test for FIFO firms indicates a significant difference, mean $DFTAXRTE_{i(LIFO)}$ not significantly different from zero supports the notion that managers view income generated via liquidation of the LIFO reserve as counterbalancing JIT's up-front implementation costs.

[49] Although the regression model is helpful in addressing the two caveats noted, it is subject to two criticisms common in studies of this type. First, JIT and control firms are matched on industry, inventory method and size, indicating cross-sectional dependence among independent variables. In addition, regressors used in the model may not be exogenous (e.g., some unidentified variable may drive both the JIT adoption decision and the choice of inventory method). Therefore, some caution should be exercised in interpreting the regression results.

$$ADOPT = \beta_0 + \beta_1 SIZE_{t-1} + \beta_2 INVTO + \beta_3 CAPTURN + \beta_4 EMHISTOR + \beta_5 EARNCHG_t + \beta_6 EARNCHG_t * LIFO_t + \beta_7 LEV_t + \beta_8 LEV_t * LIFO_t + \beta_9 TAX_t + \beta_{10} TAX_t * LIFO_t + \varepsilon_t \quad (1)$$

where:

ADOPT is equal to 1 if a firm is a JIT adopter; 0 otherwise,
SIZE is a firm's total assets,[50]
INVTO is a firm's average total inventory turnover ratio in years t-3...t-1,
CAPTURN is a firm's average total asset turnover ratio in years t-3...t-1,[51]
LIFO is equal to 1 if a firm uses the LIFO inventory method; 0 otherwise,
TAX is a dummy variable coded 1 if the firm did not have a tax loss carryforward in year t-1; 0 if the firm did report such a carryover, and
all other variables are as previously defined.

If firms with low inventory turns expect to derive the greatest benefit from JIT adoption,[52] β_2 is negative. CAPTURN is a surrogate for firm effectiveness. If firms effectively utilizing existing capital (i.e., those with large CAPTURN) expect to derive the greatest benefit from JIT adoption, β_3 is positive.

Coefficients on remaining variables are used to test Hypotheses 2, 3, 5 and 6. If firms with a history of aggressive earnings management are less likely to adopt JIT, β_4 is negative in support of Hypothesis 2. Positive β_5 supports the prediction that FIFO firms adopt JIT (and incur its income-reducing implementation costs) in strong earnings years. Negative β_6 suggests that potential income via liquidation of the LIFO reserve mitigates

[50] SIZE is included in the model as a control variable only. Results of univariate tests indicate that sample JIT adopters are significantly larger than sample control firms.
[51] INVTO (a surrogate for benefits that could be derived from JIT adoption) and CAPTURN (a surrogate for firm, or management, effectiveness) are control variables. *A priori*, it's not clear how they might be correlated with earnings management variables. The model is also estimated with RDRAT (average R&D to sales ratio in the three years preceding JIT adoption), a surrogate for firm innovativeness, substituted for CAPTURN. However, the R&D data item in COMPUSTAT [I46] is not available for many firms, resulting in a substantial reduction in sample size.
[52] This prediction is consistent with Balakrishnan et al. (1996).

the expected costliness of JIT implementation in the adoption decision. β_7 (β_8) is predicted to be negative (positive) in support of the debt covenants hypothesis. The tax hypothesis is supported by positive (negative) β_9 (β_{10}).[53]

An expanded model is required to test the bonus plan hypothesis:

$$ADOPT = \beta_0 + \beta_1 SIZE_{t-1} + \beta_2 INVTO + \beta_3 CAPTURN + \beta_4 EMHISTOR + \beta_5 EARNCHG_t + \beta_6 EARNCHG_t * LIFO_t + \beta_7 EBPLAN_t + \beta_8 EARNCHG_t * EBPLAN_t + \beta_9 EARNCHG_t * LIFO_t * EBPLAN_t + \beta_{10} LEV_t + \beta_{11} LEV_t * LIFO_t + \beta_{12} TAX_t + \beta_{13} TAX_t * LIFO_t + \varepsilon_t \quad (2)$$

where:

EBPLAN is coded 1 if a firm's managers were covered by an earnings-based bonus plan in the JIT adoption year; 0 otherwise, and all other variables are as previously defined.

If an earnings-based bonus plan increases the influence of smoothing incentives in the JIT adoption decision, then β_8 is positive and β_9 is negative.

Tests of JIT's effect on earnings management strategies

The second objective of this study is to assess the impact of JIT adoption on the relative use of transaction- and accounting-driven earnings management techniques. Hypotheses 7 and 8 both predict that JIT adoption will reduce the practice of transaction-driven earnings management. Hypothesis 7 suggests that reduced utilization of transaction-driven earnings management tools will result in a reduction in total earnings management. Hypothesis 8 suggests that the reduced usefulness of transaction-driven

[53] Negative ($\beta_5 + \beta_6$), positive ($\beta_7 + \beta_8$) and negative ($\beta_9 + \beta_{10}$) suggest that LIFO firm managers expect income from liquidation of the LIFO reserve to dominate JIT's up-front implementation costs.

earnings management tools results in a shift toward greater utilization of accounting-driven earnings management tools.

Hypothesis 7 tests

Two tests for a reduction in total earnings management are conducted. Both tests rely on the assumption that smoothing is a very strong earnings management incentive.[54] If JIT adoption reduces the ability of managers to utilize transaction-driven earnings management tools, then, all else equal, an increase in earnings variability should be observed for JIT adopters. The first test utilizes four earnings variation metrics to examine whether the change in earnings variation (after JIT adoption) for JIT adopters exceeds the change in earnings variation for their matched counterparts:[55]

$$PDDFVARn_i = DIFFVARn_i - DIFFVARn_j$$

where:

$$DIFFVAR1 = (\sigma_{NIBEI}/\mu_{ASSETS})_{post\text{-}adoption} - (\sigma_{NIBEI}/\mu_{ASSETS})_{pre\text{-}adoption},$$
$$DIFFVAR2 = (\sigma_{NIBEI}/\mu_{NIBEI})_{post\text{-}adoption} - (\sigma_{NIBEI}/\mu_{NIBEI})_{pre\text{-}adoption},$$
$$DIFFVAR3 = (\sigma_{ROABEI})_{post\text{-}adoption} - (\sigma_{ROABEI})_{pre\text{-}adoption}, \text{ and}$$
$$DIFFVAR4 = (\sigma_{ROABEI}/\mu_{ROABEI})_{post\text{-}adoption} - (\sigma_{ROABEI}/\mu_{ROABEI})_{pre\text{-}adoption}.$$[56]

[54] As noted in the earnings management literature review, financial reporting incentives, managers' compensation contracts, debt covenants and tax considerations may all induce managers to smooth reported earnings.

[55] For a matched pair to be included in either of the two Hypothesis 7 tests, each member of the pair must have five pre-JIT adoption years and five post-JIT adoption years in which income before extraordinary items is available on the 1996 COMPUSTAT tapes.

[56] σ and μ refer to standard deviation and mean, respectively. NIBEI, ASSETS, and ROABEI refer to net income before extraordinary items, total assets and return (before extraordinary items) on assets, respectively.

Support for Hypothesis 7 requires that the change in earnings variation (after JIT adoption) for adopters exceed that of nonadopters (i.e., positive mean $PDDFVARn_i$ supports the hypothesis).

The second test of Hypothesis 7 is analogous to the first test, but examines the variation in earnings about a time trend in the pre- and post-adoption periods, rather than a scaled variation in earnings about mean earnings in each period. In both the pre- and post-adoption periods, the following intra-firm regression is estimated:

$$NIBEI_{i,t} \text{ (or } ROABEI_{i,t}) = \beta_0 + \beta_1 EVNTTIME + \varepsilon_{i,t}$$

where EVNTTIME is -n, -n +1, ...-1 in the pre-JIT adoption regressions and 1, 2, ...n in the post-JIT adoption regressions.

Test statistics are:

$$PDDFVARn_i = DIFFVARn_i - DIFFVARn_j$$

where:

$$DIFFVARA = (\sigma_{RESID,NIBEI}/\mu_{ASSETS})_{post\text{-}adoption} - (\sigma_{RESID,NIBEI}/\mu_{ASSETS})_{pre\text{-}adoption},$$
$$DIFFVARB = (\sigma_{RESID,NIBEI}/\mu_{NIBEI})_{post\text{-}adoption} - (\sigma_{RESID,NIBEI}/\mu_{NIBEI})_{pre\text{-}adoption},$$
$$DIFFVARC = (\sigma_{RESID,ROABEI})_{post\text{-}adoption} - (\sigma_{RESID,ROABEI})_{pre\text{-}adoption}, \text{ and}$$
$$DIFFVARD = (\sigma_{RESID,ROABEI}/\mu_{ROABEI})_{post\text{-}adoption} - (\sigma_{RESID,ROABEI}/\mu_{ROABEI})_{pre\text{-}adoption}.$$

[57]

Support for Hypothesis 7 requires that the change in earnings variation (after JIT adoption) for adopters exceed that of nonadopters (i.e., positive mean $PDDFVARn_i$ supports the hypothesis).

[57] $\sigma_{RESID,NIBEI}$ and $\sigma_{RESID,ROABEI}$ refer, respectively, to the standard deviation of the residual in regressions with NIBEI and ROABEI as dependent variables.

Hypothesis 8 tests

Three circumstances could lead to test results that fail to support Hypothesis 7. First, JIT utilization may have no effect on managers' earnings management strategies. Second, the tests conducted to detect the hypothesized effect may lack power. Third, as predicted by Hypothesis 8, JIT adoption may induce managers to shift their earnings manipulation strategies from transaction-driven to accounting-driven techniques.

The three empirical tests of Hypothesis 8 require that earnings management strategies be divided into those with an activity or transaction prerequisite, and those without such a prerequisite. Because the actual character of transactions cannot be observed in publicly available financial data, such a division is difficult, indicating that surrogates for transaction- and accounting-driven earnings management are likely to contain significant measurement error. The surrogates utilized in this study are a decomposition of the total accrual metric used in many prior studies. Healy (1985), Jones (1991) and Dechow et al. (1995) define total accruals as follows:

$$TA_t = (\Delta CA_t - \Delta CL_t - \Delta Cash_t + \Delta STD_t + \Delta ITP_t - Depr_t)/A_{t-1}$$

where:

ΔCA is the change in current assets,
ΔCL is the change in current liabilities,
ΔCash is the change in cash and cash equivalents,
ΔSTD is the change in debt included in current liabilities,
ΔITP is the change in income taxes payable,
Depr is depreciation and amortization expense, and
A is total assets.

Total accruals (TA) are decomposed into transaction-driven accruals (TRANDR), accounting-driven accruals (ACCTDR) and depreciation (DEPR) as follows:

$$TRANDR_t = (\Delta GROSSAR_t + \Delta INV_t - \Delta AP_t)/A_{t-1}$$

where:

ΔGROSSAR is the change in gross accounts receivable,
ΔINV is the change in total inventory,
ΔAP is the change in accounts payable, and
A is total assets.

$$ACCTDR_t = [(\Delta CA_t - \Delta GROSSAR_t - \Delta INV_t) - (\Delta CL_t - \Delta AP_t) - \Delta Cash_t + \Delta ITP_t + \Delta STD_t]/A_{t-1}$$

where all variables are as previously defined.

$$DEPR_t = (-1 * \text{depreciation and amortization expense in year t})/A_{t-1}$$[58]

Hypothesis 8: Test #1

Hypothesis 8 predicts that JIT adoption will cause managers to shift their earnings management strategies away from transaction-driven techniques (TRANDR) and toward accounting-driven techniques (ACCTDR and/or DEPR). The first test of Hypothesis 8 is derived from the Jones (1991) method of estimating nondiscretionary accruals. Jones' method assumes the following general model for accruals:

[58] It is easily verified that these equations simply decompose the total accrual metric used in prior studies (i.e., $TA_t = TRANDR_t + ACCTDR_t + DEPR_t$). In this decomposition, the greatest potential for measurement error is the assumption that accounts payable relate entirely to accruals with transaction prerequisites, and all other current liabilities (excluding the current portion of long-term debt and income taxes payable) relate to accruals with no transaction prerequisite. However, this characterization is reasonably consistent with the COMPUSTAT description of relevant data items. The current liabilities data item in COMPUSTAT [I5] is comprised of accounts payable [I70], current liabilities - other [I72], debt in current liabilities [I34] and income taxes payable [I71]. Accounts payable represents only trade obligations due within 1 year or the normal operating cycle of the company, and includes such items as trade acceptances, trade accounts payable not yet billed (when included as current) and trade notes payable. Current liabilities - other represents both accrued expenses incurred for which payment is deferred until a subsequent period and residual items containing current liabilities not considered as debt or trade accounts payable.

Total accruals = *f*(economic determinants of accruals) + error

In other words, the variation in total accruals (through time) is a combination of 1) variation attributable to changing economic circumstances, and 2) unexplained variation. The latter component, unexplained variation, can be further segmented into 1) variation attributable to managers' discretionary accruals, and 2) true error.

If, after adoption, JIT adopters decrease the use of TRANDR when managing earnings, then the economic determinants of TRANDR will explain a greater portion of its variation through time (i.e., after JIT adoption, the deterministic portion of a general model for TRANDR should explain more of its variation, and the stochastic portion of the general model should become relatively less important). Similarly, if JIT adopters increase their use of ACCTDR and DEPR in managing earnings, then the respective economic determinants of ACCTDR and DEPR will explain less of their variation through time (i.e., after JIT adoption, the deterministic portions of general models for ACCTDR and DEPR will explain a smaller portion of the total variation, and the stochastic portion of the general models will become relatively more important). Therefore, the following models are estimated, intra-firm, separately in the pre-adoption and post-adoption periods:

$$TRANDR_t = \beta_0 1/A_{t-1} + \beta_1 \Delta REV_t/A_{t-1} + \varepsilon_t$$

$$ACCTDR_t = \beta_0 1/A_{t-1} + \beta_1 \Delta MODREV_t/A_{t-1} + \varepsilon_t$$

$$DEPR_t = \beta_0 1/A_{t-1} + \beta_1 PPE_t/A_{t-1} + \varepsilon_t$$

where:

ΔREV is the change in net sales,
ΔMODREV is the change in net sales minus the change in accounts receivable,
PPE is property, plant and equipment, and
all other variables are as previously defined.[59]

Error standard deviations from the regressions above are used to generate the test statistics in the first test of Hypothesis 8:

$$PDDFTRAN_i = DIFFTRAN_i - DIFFTRAN_j,$$

$$PDDFACCT_i = DIFFACCT_i - DIFFACCT_j, \text{ and}$$

$$PDDFDEPR_i = DIFFDEPR_i - DIFFDEPR_j.$$

where:

$$DIFFTRAN = (\sigma_{RESID,TRANDR})_{post\text{-}adoption} - (\sigma_{RESID,TRANDR})_{pre\text{-}adoption},$$
$$DIFFACCT = (\sigma_{RESID,ACCTDR})_{post\text{-}adoption} - (\sigma_{RESID,ACCTDR})_{pre\text{-}adoption}, \text{ and}$$
$$DIFFDEPR = (\sigma_{RESID,DEPR})_{post\text{-}adoption} - (\sigma_{RESID,DEPR})_{pre\text{-}adoption}.$$[60]

If, after JIT adoption, managers shift earnings management strategies away from transaction-driven earnings management tools and toward accounting-driven tools, mean $PDDFTRAN_i$ (mean $PDDFACCT_i$ and mean $PDDFDEPR_i$) is (are) negative (positive).

Hypothesis 8: Test #2

The second approach to testing Hypothesis 8 is common in prior literature, with the exception that the three components of total accruals are separately analyzed. The

[59] These regressions are analogous to the nondiscretionary accrual prediction equations estimated in several prior earnings management studies using the accrual methodology (e.g., Dechow et al., 1995). The use of MODREV as the economic determinant of ACCTDR is consistent with Hunt et al. (1996). To be included in this test, each member of a matched pair must have at least five pre-adoption years and five post-adoption years of data available on the 1996 COMPUSTAT tapes.

[60] $\sigma_{RESID,TRANDR}$, $\sigma_{RESID,ACCTDR}$ and $\sigma_{RESID,DEPR}$ are the residual standard deviations from the regressions with (respectively) TRANDR, ACCTDR and DEPR as dependent variables.

tests examine the association of the discretionary portion of each total accrual component with earnings management incentives. Therefore, estimates of the nondiscretionary portion of each component of total accruals are required:[61]

$$TRANDR_{ND,t} = a_1(1/A_{t-1}) + a_2(\Delta REV_t)/A_{t-1} + a_3(\Delta REV_t)/A_{t-1}*POST,$$

$$ACCTDR_{ND,t} = a_1(1/A_{t-1}) + a_2((\Delta REV_t - \Delta REC_t)/A_{t-1}) + a_3((\Delta REV_t - \Delta REC_t)/A_{t-1})*POST, \text{ and}$$

$$DEPR_{ND,t} = a_4(1/A_{t-1}) + a_5(PPE_t/A_{t-1}) + a_6(PPE_t/A_{t-1})*POST.$$

where POST is coded 1 if year t is a post-adoption year (0 otherwise) and all other variables are as previously defined.

Firm-specific estimates of a_1, a_2 and a_3 are obtained from the following intra-firm regressions:[62]

$$TRANDR_{ACT,t} \text{ (or } ACCTDR_{ACT,t}) = \alpha_1(1/A_{t-1}) + \alpha_2(\Delta REV_t/A_{t-1}) + \alpha_3(\Delta REV_t/A_{t-1})*POST + \varepsilon_t.$$

Firm-specific estimates of a_4, a_5 and a_6 are obtained from the following intra-firm regression:

$$DEPR_{ACT,t} = \alpha_4(1/A_{t-1}) + \alpha_5(PPE_t/A_{t-1}) + \alpha_6(PPE_t/A_{t-1})*POST + \varepsilon_t.$$

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[61] For TRANDR, the approach is identical to the Jones (1991) method for estimating discretionary accruals. For ACCTDR, the modified Jones method (Dechow et al., 1995) is used (with property, plant and equipment omitted from the estimation period regressions and the nondiscretionary ACCTDR prediction equation). This use of the Jones and modified Jones methods is consistent with their use in Hunt et al. (1996) as controls for the nondiscretionary portions of inventory-related and non-inventory-related current accruals. For DEPR, the estimation period regressions and prediction equations include only property, plant and equipment as an independent variable. ND subscripts refer to nondiscretionary accruals. ACT subscripts refer to actual accruals. The discretionary amount of each adjustable measure (denoted with a D subscript) is the actual amount minus the estimated nondiscretionary amount.

[62] Firm specific parameters are estimated with all available data. The interaction term is included to account for any structural shift in the economic determinants of accruals that is attributable to JIT adoption. To be included in these tests, a firm must have at least five years of data available in the pre-adoption and post-adoption periods to estimate a given nondiscretionary accrual prediction equation.

The models estimated to test Hypothesis 8 are regressions of the discretionary portion of each total accrual component (i.e., the actual accrual in a given year minus the estimated nondiscretionary portion) on independent variables that proxy for earnings management incentives. Each earnings management incentive included in a model as a main effect is also included in three different interaction terms: 1) a two-way interaction term that controls for pre-adoption differences in the earnings management behavior of adopting and nonadopting firms, 2) a two-way interaction that controls for intertemporal changes in earnings management behavior not attributable to JIT adoption, and 3) a three-way interaction that provides the test of Hypothesis 8. The models are estimated using pooled data for years -5, -4,...+4, +5, excluding years -1, 0, and +1.[63] The model for $TRANDR_D$ is:[64]

$$TRANDR_D = \beta_0 + \beta_1 JIT + \beta_2 POST + \beta_3 JIT*POST + \beta_4 EARNCHG + \beta_5 ERNINT1 + \beta_6 ERNINT2 + \beta_7 ERN3WAY + \beta_8 LEV + \beta_9 LEVINT1 + \beta_{10} LEVINT2 + \beta_{11} LEV3WAY + \beta_{12} TAXDUM + \beta_{13} TAXINT1 + \beta_{14} TAXINT2 + \beta_{15} TAX3WAY + \beta_{16} LAGTRN + \varepsilon \quad (3)$$

where:

JIT is a dummy variable coded 1 if a firm is a JIT adopter; 0 otherwise,
POST is a dummy variable coded 1 if the year is after the JIT adoption year of the JIT adopter in an adopter/nonadopter matched pair; 0 otherwise,
EARNCHG is the difference between pre-managed earnings in year t and reported earnings in year t-1,
ERNINT1 is EARNCHG*JIT,
ERNINT2 is EARNCHG*POST,
ERN3WAY is EARNCHG*JIT*POST,

[63] Omission of years prior to -5 and later than year +5 is an attempt to reduce the effect of differences between adopting and nonadopting firms that cannot be attributed to JIT adoption. Years -1, 0, and +1 are omitted to reduce noise attributable to possible mis-identification of the JIT adoption year.
[64] Firm and time subscripts are suppressed in models 3, 4 and 5.

LEV is the total debt-to-total assets ratio,
LEVINT1 is LEV*JIT,
LEVINT2 is LEV*POST,
LEV3WAY is LEV*JIT*POST,
TAXDUM is a dummy variable coded 1 if the firm had a tax loss carryforward in year t-1; 0 otherwise,
TAXINT1 is TAXDUM*JIT,
TAXINT2 is TAXDUM*POST,
TAX3WAY is TAXDUM*JIT*POST, and
LAGTRN is the lagged value of $TRANDR_D$.

If nonadopters used transaction-driven accruals to manage earnings in periods preceding matched counterparts' implementation of JIT, the coefficients on EARNCHG, LEV and TAXDUM (β_4, β_8 and β_{12}, respectively) are negative, positive and positive, respectively. Any differences in JIT adopters' and nonadopters' use of transaction-driven accruals in managing earnings in the pre-adoption period are captured by β_5, β_9 and β_{13}. Intertemporal shifts (from the period preceding JIT adopters' implementation of JIT to the period after) in nonadopters' use of $TRANDR_D$ to manage earnings are reflected in the coefficients on ERNINT2, LEVINT2 and TAXINT2 (β_6, β_{10} and β_{14}, respectively). Coefficients on ERN3WAY, LEV3WAY and TAX3WAY (β_7, β_{11} and β_{15}, respectively) measure the extent to which changes in JIT adopters' use of $TRANDR_D$ to manage earnings differ from changes in nonadopters' use of $TRANDR_D$ to manage earnings.[65] If JIT adopters, relative to nonadopters, reduce their use of transaction-driven accruals to manage earnings, β_7 is positive, and β_{11} and β_{15} are negative. Finally, if earnings

[65] Two equivalent interpretations of coefficients on three-way interactions are possible. For example, β_7 can be considered POST's effect on JIT's effect on EARNCHG (i.e., whether membership in the JIT sample changes the coefficient on EARNCHG by an amount dependent on whether the period is one preceding or succeeding the adoption of JIT). Alternatively, β_7 might be considered JIT's effect on POST's effect on EARNCHG (i.e., whether intertemporal changes in the coefficient on EARNCHG are

management in one year makes it less feasible to manage earnings in the same direction in the subsequent year, then β_{16} is negative.

The model for $ACCTDR_D$ is:

$$ACCTDR_D = \beta_0 + \beta_1 JIT + \beta_2 POST + \beta_3 JIT*POST + \beta_4 EARNCHG + \beta_5 ERNINT1 + \beta_6 ERNINT2 + \beta_7 ERN3WAY + \beta_8 LEV + \beta_9 LEVINT1 + \beta_{10} LEVINT2 + \beta_{11} LEV3WAY + \beta_{12} TAXDUM + \beta_{13} TAXINT1 + \beta_{14} TAXINT2 + \beta_{15} TAX3WAY + \beta_{16} LAGACT + \varepsilon \quad (4)$$

where:

LAGACT is the lagged value of $ACCTDR_D$, and
all other variables are as previously defined.

The interpretations of coefficients on main effects, two-way interactions and the lagged value of the dependent variable in the $ACCTDR_D$ model are identical to those offered for the $TRANDR_D$ model. Like the $TRANDR_D$ model, the coefficients on ERN3WAY, LEV3WAY and TAX3WAY (β_7, β_{11} and β_{15}, respectively) measure the extent to which changes in JIT adopters' use of the dependent variable ($ACCTDR_D$ in this case) to manage earnings differ from changes in nonadopters' use of the dependent variable to manage earnings. If JIT adopters, relative to nonadopters, increase the use of accounting-driven accruals to manage earnings, β_7 is negative, and β_{11} and β_{15} are positive.

The model for $DEPR_D$ is:[66]

$$DEPR_D = \beta_0 + \beta_1 JIT + \beta_2 POST + \beta_3 JIT*POST + \beta_4 EARNCHG + \beta_5 ERNINT1 + \beta_6 ERNINT2 + \beta_7 ERN3WAY + \beta_8 LEV + \beta_9 LEVINT1 + \beta_{10} LEVINT2 + \beta_{11} LEV3WAY + \beta_{12} LAGDEP + \varepsilon \quad (5)$$

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dependent on whether a firm is a JIT adopter or nonadopter).

[66] The omission of the tax variable and related interactions in this model reflects the fact that firms are allowed to use different useful lives and depreciation methods for tax and financial reporting purposes.

where:

LAGDEP is the lagged value of $DEPR_D$, and
all other variables are as previously defined.

The interpretations of coefficients on main effects and two-way interactions are identical to those offered for the $TRANDR_D$ and $ACCTDR_D$ models. Unlike the two previous models, the expected sign on the lagged value of the dependent variable (LAGDEP in this case) is positive. This prediction reflects the fact that choices with respect to useful lives and depreciation methods for property, plant and equipment will have similar directional effects on reported income for several years. Like the two previous models, the coefficients on ERN3WAY and LEV3WAY (β_7 and β_{11}, respectively) measure the extent to which changes in JIT adopters' use of the dependent variable ($DEPR_D$ in this case) to manage earnings differ from changes in nonadopters' use of the dependent variable to manage earnings. If JIT adopters, relative to nonadopters, increase their use of depreciation accruals to manage earnings, β_7 (β_{11}) is negative (positive).

Hypothesis 8: Test #3

Designs utilized in recent research acknowledge the fact that managers adjust accounting measures jointly to meet various earnings management objectives. Beatty et al. (1995) use a simultaneous equations approach to examine how banks use loan charge-offs, the loan loss provision, miscellaneous gains and losses, pension settlement gains and external funding to meet primary capital, tax and earnings objectives. The authors'

results indicate that taking account of simultaneity is important for three of the five modeled choices, and note that their paper "provides a framework which can be applied to other settings where managers make accounting, financing and operating decisions with tax and other contracting cost implications" (p. 232).

Hunt et al. (1996) utilize a simultaneous equations approach to examine how managers of LIFO firms use adjustments of interacting accounting measures to meet various earnings management objectives. The authors note their results indicate that "modeling interacting accounting measures, such as other current accruals and depreciation, leads to differing conclusions about the role of taxes" (p. 339). In addition, the authors conclude that the simultaneous equations approach "permits researchers to model multiple adjustments, incorporating differences in the costs of adjusting accounting measures. For example, (the authors') model reflects the reasonable assertion that the costs of revising accounting estimates likely differ from the costs of changing real inventory levels" (p. 369).

Hypothesis 8 predicts that managers of JIT firms shift their earnings management strategies away from transaction-driven tools and toward accounting-driven tools. The logic behind this prediction is that JIT adoption increases the costliness of transaction-driven earnings management, relative to accounting-driven earnings management, because a transaction executed solely for earnings management reasons is expected to be more disruptive (or otherwise costly) in a JIT environment than in a non-JIT environment.

The third test of Hypothesis 8 is conducted using a system of simultaneous equations with TRANDR, ACCTDR and DEPR as dependent variables. It is assumed

that managers minimize the joint cost of deviating from financial reporting, debt covenant and tax earnings objectives, and from predetermined (or unmanaged) levels of TRANDR, ACCTDR and DEPR. Therefore, the following cost minimization problem is suggested (with firm and time subscripts suppressed):[67]

$$\underset{TRANDR,\ ACCTDR,\ DEPR}{\text{Min}} \quad Cost = \lambda_1(NI - NI_{OPT})^2 + \lambda_2(SE - SE_{OPT})^2 + TR*TI + \lambda_3(TRANDR - TRANDR_{PRE})^2 + \lambda_4(ACCTDR - ACCTDR_{PRE})^2 + \lambda_5(DEPR - DEPR_{PRE})^2$$

subject to:

$$NI = NI_{PRE} + \delta TRANDR + \delta ACCTDR + \delta DEPR$$

$$SE = SE_{PRE} + \delta TRANDR + \delta ACCTDR + \delta DEPR$$

$$TI = TI_{PRE} + TRANDR + \phi ACCTDR$$

where:

NI is reported net income,
NI_{OPT} is the optimal net income to report,[68]
NI_{PRE} is net income before the effect of adjustable accounting measures,
SE is reported stockholders' equity,
SE_{OPT} is the optimal stockholders' equity to report,[69]
SE_{PRE} is stockholders' equity before the effect of adjustable accounting measures,
TR is the tax rate,
TI is taxable income,
TI_{PRE} is taxable income before the effect of adjustable accounting measures,
TRANDR is transaction-driven accruals,
$TRANDR_{PRE}$ is predetermined transaction-driven accruals,
ACCTDR is accounting-driven accruals,
$ACCTDR_{PRE}$ is predetermined accounting-driven accruals,

[67] The cost model and derivation of simultaneous equations are similar to Hunt et al. (1996).
[68] Optimal net income is determined by assuming that earnings follow a random walk.
[69] Optimal stockholders' equity is the level of equity required to report a debt/equity ratio equal to the mean ratio of all firms in the sample firm's industry. The model assumes that the level of debt is fixed at year-end, and that the debt/equity ratio is manipulated only through earnings management.

DEPR is depreciation and amortization expense,
$DEPR_{PRE}$ is predetermined depreciation and amortization expense,
λ_1 and λ_2 are the marginal costs of deviating from optimal income and stockholders' equity levels, respectively,
λ_3, λ_4 and λ_5 are the marginal costs of adjusting TRANDR, ACCTDR and DEPR from their predetermined levels,
δ is (1 - the book tax rate), and
ϕ captures what is expected to be an imperfect association between accounting-driven accruals and taxable income.

Substituting the identities into the cost function and differentiating with respect to TRANDR, ACCTDR and DEPR produces three reduced form equations as follows (firm and time subscripts are suppressed):

$$TRANDR = \beta_0 + \beta_1 (NI_{PRE} - NI_{OPT}) + \beta_2 (SE_{PRE} - SE_{OPT}) + \beta_3 ACCTDR + \beta_4 DEPR + \beta_5 TR + \beta_6 TRANDR_{PRE} + \varepsilon_I$$

$$ACCTDR = \alpha_0 + \alpha_1 (NI_{PRE} - NI_{OPT}) + \alpha_2 (SE_{PRE} - SE_{OPT}) + \alpha_3 TRANDR + \alpha_4 DEPR + \alpha_5 TR + \alpha_6 ACCTDR_{PRE} + \varepsilon_A$$

$$DEPR = \gamma_0 + \gamma_1 (NI_{PRE} - NI_{OPT}) + \gamma_2 (SE_{PRE} - SE_{OPT}) + \gamma_3 TRANDR + \gamma_4 ACCTDR + \gamma_5 DEPR_{PRE} + \varepsilon_D$$

The system above views each adjustable earnings management tool as a function of 1) the desired magnitude and direction of smoothing (i.e., $NI_{PRE} - NI_{OPT}$), 2) the desired equity with respect to reporting the optimal debt/equity ratio (i.e., $SE_{PRE} - SE_{OPT}$), 3) the levels of the other two earnings management tools, and 4) the predetermined level of each total accrual component prior to any adjustments. In addition, the TRANDR and ACCTDR equations also include incentives arising from the firm's tax status (TR). Table 5 provides 1) the relationships between regression coefficients and the parameters in the

original cost minimization problem, 2) sign predictions for coefficients in the three-equation system, and 3) explanations, in terms of the parameters in the underlying cost minimization problem, regarding how regression coefficients for JIT and control firms are expected to differ.

The actual system estimated differs from the above in two ways. First, like the earlier models (3, 4 and 5) with discretionary accrual components as dependent variables, each earnings management incentive is included as both a main effect and as part of three interactions: 1) a two-way interaction controlling for differences in adopters' and nonadopters' earnings management strategies prior to adopters' implementation of JIT, 2) a two-way interaction controlling for intertemporal changes in earnings management strategies that are not attributable to JIT adoption, and 3) a three-way interaction that provides the test of Hypothesis 8.[70] Second, each equation includes the lagged value of the dependent variable and variables controlling for the predetermined level of each adjustable accounting measure.[71] The following system is estimated with pooled data using Two-Stage Least Squares regression.[72]

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[70] The interpretations of coefficients on three-way interactions are identical to those offered in the discussion of Models 3, 4 and 5.

[71] The control variables are consistent with the modified Jones (1991) method (Dechow et al., 1995) of estimating nondiscretionary accruals, and are the same as those found in Hunt et al. (1996). The TRANDR equation includes ΔRevenue. The ACCTDR equation includes ΔRevenue - ΔReceivables. The DEPR equation includes property, plant and equipment.

[72] Like the estimation of Models 3, 4 and 5, years -5, -4,...+4, +5 (excluding -1, 0 and +1) are used to estimate the system. In estimating the system, TRANDR, ACCTDR and DEPR, along with related two- and three-way interactions are assumed to be endogenous.

Table 5
Coefficient predictions in the three-equation system

Variable Name	Coefficient: Regression	Coefficient: Cost Model	Predicted Sign	Prediction Rationale
$NI_{PRE} - NI_{OPT}$	β_1	$-\delta\lambda_1/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_3)$	–	For non-JIT firms, negative prediction because firms smooth earnings and λs and δ exceed 0. For JIT firms, β_1 is less negative because λ_3 (the cost of adjusting predetermined TRANDR) is greater in a JIT firm.
$SE_{PRE} - SE_{OPT}$	β_2	$-\delta\lambda_2/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_3)$	–	Same prediction and rationale as β_1.
ACCTDR	β_3	$-(\lambda_1\delta^2 + \lambda_2\delta^2)/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_3)$	–	For non-JIT firms, negative prediction because λs and δ exceed 0 and TRANDR and ACCTDR are substitute means of managing earnings. For JIT firms, β_3 is less negative because λ_3 is greater in a JIT firm and TRANDR and ACCTDR are less likely to be substitutes.
DEPR	β_4	$-(\lambda_1\delta^2 + \lambda_2\delta^2)/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_3)$	–	Same prediction and rationale as that for β_3.
TR	β_5	$-1/2(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_3)$	–	Same prediction and rationale as that for β_1 and β_2.
$TRANDR_{PRE}$	β_6	$\lambda_3/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_3)$	+	Prediction is positive, since the level of pre-managed TRANDR should significantly influence its actual level and λs and δ exceed 0. For JIT firms, β_6 is more positive, since reduced earnings management with TRANDR implies TRANDR is more strongly influenced by its economic determinants.
$NI_{PRE} - NI_{OPT}$	α_1	$-\delta\lambda_1/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_4)$	–	For non-JIT firms, negative prediction because firms smooth earnings and λs and δ exceed 0. For JIT firms, α_1 is more negative because λ_4/λ_3 (the cost of adjusting predetermined ACCTDR relative to the cost of adjusting predetermined TRANDR) is smaller in a JIT firm.

Table 5 (Continued)

Variable Name	Coefficient: Regression	Coefficient: Cost Model	Predicted Sign	Prediction Rationale
$SE_{PRE} - SE_{OPT}$	α_2	$-\delta\lambda_2/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_4)$	–	Same prediction and rationale as that for α_1.
TRANDR	α_3	$-(\lambda_1\delta^2 + \lambda_2\delta^2)/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_4)$	–	For non-JIT firms, negative prediction because λs and δ exceed 0 and ACCTDR and TRANDR are substitute means of managing earnings. For JIT firms, α_3 is more negative because λ_4/λ_3 is smaller in a JIT firm.
DEPR	α_4	$-(\lambda_1\delta^2 + \lambda_2\delta^2)/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_4)$	–	For non-JIT firms, negative prediction because λs and δ exceed 0 and ACCTDR and DEPR are substitute means of managing earnings. Prediction is no different for JIT firms, since λ_4/λ_5 (the cost of adjusting predetermined ACCTDR relative to the cost of adjusting predetermined DEPR) is no different in non-JIT and JIT environments.
TR	α_5	$-1/2(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_4)$	–	Same prediction and rationale as that for α_1 and α_2.
$ACCTDR_{PRE}$	α_6	$\lambda_4/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_4)$	+	Prediction is positive, since the level of pre-managed ACCTDR should significantly influence its actual level and λs and δ exceed 0. For JIT firms, α_6 is less positive, since increased earnings management with ACCTDR implies ACCTDR is less influenced by its economic determinants.
$NI_{PRE} - NI_{OPT}$	γ_1	$-\delta\lambda_1/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_5)$	–	For non-JIT firms, negative prediction because firms smooth earnings and λs and δ exceed 0. For JIT firms, γ_1 is more negative because λ_5/λ_3 (the cost of adjusting predetermined DEPR relative to the cost of adjusting predetermined TRANDR) is smaller in a JIT firm.
$SE_{PRE} - SE_{OPT}$	γ_2	$-\delta\lambda_2/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_5)$	–	Same prediction and rationale as that for γ_1.

Table 5 (Continued)

Variable Name	Coefficient: Regression	Coefficient: Cost Model	Predicted Sign	Prediction Rationale
TRANDR	γ_3	$-(\lambda_1\delta^2 + \lambda_2\delta^2)/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_5)$	–	For non-JIT firms, negative prediction because λs and δ exceed 0 and DEPR and TRANDR are substitute means of managing earnings. For JIT firms, γ_3 is more negative because λ_5/λ_3 is smaller in a JIT firm.
ACCTDR	γ_4	$-(\lambda_1\delta^2 + \lambda_2\delta^2)/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_5)$	–	For non-JIT firms, negative prediction because λs and δ exceed 0 and DEPR and ACCTDR are substitute means of managing earnings. Prediction is no different for JIT firms, since λ_5/λ_4 (the cost of adjusting predetermined DEPR relative to the cost of adjusting ACCTDR) is no different in non-JIT and JIT environments.
$DEPR_{PRE}$	γ_5	$\lambda_5/(\lambda_1\delta^2 + \lambda_2\delta^2 + \lambda_5)$	+	Prediction is positive, since the level of pre-managed DEPR should significantly influence its actual level and λs and δ exceed 0. For JIT firms, γ_5 is less positive, since increased earnings management with DEPR implies DEPR is less influenced by its economic determinants.

Note: In estimating the three-equation system with Two Stage Least Squares, each independent variable is included as a main effect and as part of three interactions: 1) a two-way interaction that controls for differences in adopters' and nonadopters' earnings management strategies in pre-adoption periods, 2) a two-way interaction that controls for intertemporal changes in the earnings management strategies of nonadopters (i.e., changes that cannot be attributed to JIT adoption), and 3) a three-way interaction, the coefficient of which provides the test of Hypothesis 8. In the system actually estimated, the economic determinants of a total accrual component are substituted for the total accrual component's pre-determined level. The economic determinants are consistent with those used in prior literature. TR in the system above is the firm's tax rate. In the system actually estimated, TAXDUM, a dummy variable coded 1 if a firm has a tax loss carryforward (0 otherwise), is substituted for TR. Therefore, predictions for TAXDUM are opposite of those indicated for TR in the system above. Finally, the system is estimated with TRANDR, ACCTDR and DEPR, along with related two- and three-way interactions, coded as endogenous variables.

$$TRANDR = \beta_0 + \beta_1 JIT + \beta_2 POST + \beta_3 JIT*POST + \beta_4 ACCTDR + \beta_5 ACCTDRI1 + \beta_6 ACCTDRI2 + \beta_7 ACCTDRI3 + \beta_8 DEPR + \beta_9 DEPRI1 + \beta_{10} DEPRI2 + \beta_{11} DEPRI3 + \beta_{12} EARNCHG + \beta_{13} EARNI1 + \beta_{14} EARNI2 + \beta_{15} EARNI3 + \beta_{16} DEBTCOV + \beta_{17} DBTCOVI1 + \beta_{18} DBTCOVI2 + \beta_{19} DBTCOVI3 + \beta_{20} TAXDUM + \beta_{21} TAXDUMI1 + \beta_{22} TAXDUMI2 + \beta_{23} TAXDUMI3 + \beta_{24} CHGREV + \beta_{25} CHGREVI1 + \beta_{26} CHGREVI2 + \beta_{27} CHGREVI3 + \beta_{28} LAGTRNDR + \beta_{29} LAGTRNI1 + \beta_{30} LAGTRNI2 + \beta_{31} LAGTRNI3 + \varepsilon_T$$

$$ACCTDR = \alpha_0 + \alpha_1 JIT + \alpha_2 POST + \alpha_3 JIT*POST + \alpha_4 TRANDR + \alpha_5 TRANDRI1 + \alpha_6 TRANDRI2 + \alpha_7 TRANDRI3 + \alpha_8 DEPR + \alpha_9 DEPRI1 + \alpha_{10} DEPRI2 + \alpha_{11} DEPRI3 + \alpha_{12} EARNCHG + \alpha_{13} EARNI1 + \alpha_{14} EARNI2 + \alpha_{15} EARNI3 + \alpha_{16} DEBTCOV + \alpha_{17} DBTCOVI1 + \alpha_{18} DBTCOVI2 + \alpha_{19} DBTCOVI3 + \alpha_{20} TAXDUM + \alpha_{21} TAXDUMI1 + \alpha_{22} TAXDUMI2 + \alpha_{23} TAXDUMI3 + \alpha_{24} CHMDREV + \alpha_{25} CHMDRVI1 + \alpha_{26} CHMDRVI2 + \alpha_{27} CHMDRVI3 + \alpha_{28} LAGACTDR + \alpha_{29} LAGACTI1 + \alpha_{30} LAGACTI2 + \alpha_{31} LAGACTI3 + \varepsilon_A$$

$$DEPR = \gamma_0 + \gamma_1 JIT + \gamma_2 POST + \gamma_3 JIT*POST + \gamma_4 TRANDR + \gamma_5 TRANDRI1 + \gamma_6 TRANDRI2 + \gamma_7 TRANDRI3 + \gamma_8 ACCTDR + \gamma_9 ACCTDRI1 + \gamma_{10} ACCTDRI2 + \gamma_{11} ACCTDRI3 + \gamma_{12} EARNCHG + \gamma_{13} EARNI1 + \gamma_{14} EARNI2 + \gamma_{15} EARNI3 + \gamma_{16} DEBTCOV + \gamma_{17} DBTCOVI1 + \gamma_{18} DBTCOVI2 + \gamma_{19} DBTCOVI3 + \gamma_{20} SCALPPE + \gamma_{21} SCLPPEI1 + \gamma_{22} SCLPPEI2 + \gamma_{23} SCLPPEI3 + \gamma_{24} LAGDEPR + \gamma_{25} LAGDPRI1 + \gamma_{26} LAGDPRI2 + \gamma_{27} LAGDPRI3 + \varepsilon_D \quad (6)$$

where:

TRANDR is transaction-driven accruals,
TRANDRI1 is TRANDR*JIT,
TRANDRI2 is TRANDR*POST,
TRANDRI3 is TRANDR*JIT*POST,
ACCTDR is accounting-driven accruals,
ACCTDRI1 is ACCTDR*JIT,
ACCTDRI2 is ACCTDR*POST,
ACCTDRI3 is ACCTDR*JIT*POST,
DEPR is depreciation and amortization expense,
DEPRI1 is DEPR*JIT,
DEPRI2 is DEPR*POST,
DEPRI3 is DEPR*JIT*POST,
JIT is a dummy variable coded 1 if a firm is a JIT adopter; 0 otherwise,
POST is a dummy variable coded 1 if the year is after the adoption year of the adopting member of an adopter/nonadopter matched pair; 0 otherwise,

EARNCHG is the difference between pre-managed earnings in year t and reported earnings in year t-1,
EARNI1 is EARNCHG*JIT,
EARNI2 is EARNCHG*POST,
EARNI3 is EARNCHG*JIT*POST,
DEBTCOV is the difference between pre-managed shareholders' equity and the shareholders' equity required to report a total debt-to-equity ratio equal to the mean ratio of all firms in the sample firm's two-digit industry code,
DBTCOVI1 is DEBTCOV*JIT,
DBTCOVI2 is DEBTCOV*POST,
DBTCOVI3 is DEBTCOV*JIT*POST,
TAXDUM is a dummy variable coded 1 if the firm had a tax loss carryforward in year t-1; 0 otherwise,
TAXDUMI1 is TAXDUM*JIT,
TAXDUMI2 is TAXDUM*POST,
TAXDUMI3 is TAXDUM*JIT*POST,
LAGTRNDR is the lagged value of TRANDR,
LAGTRNI1 is LAGTRNDR*JIT,
LAGTRNI2 is LAGTRNDR*POST,
LAGTRNI3 is LAGTRNDR*JIT*POST,
LAGACTDR is the lagged value ACCTDR,
LAGACTI1 is LAGACTDR*JIT,
LAGACTI2 is LAGACTDR*POST,
LAGACTI3 is LAGACTDR*JIT*POST,
LAGDEPR is the lagged value of DEPR,
LAGDPRI1 is LAGDEPR*JIT,
LAGDPRI2 is LAGDEPR*POST, and
LAGDPRI3 is LAGDEPR*JIT*POST.

If managers use TRANDR, ACCTDR and DEPR as substitute means of managing earnings, then the coefficients on two of these variables will be negative when included as independent variables in a regression with the third as the dependent variable (e.g., coefficients on ACCTDR and DEPR will be negative in the equation with TRANDR as the dependent variable).

Main effects and two-way interactions (e.g., EARNI1 and EARNI2) are interpreted in a manner identical to the explanations offered for such terms in Models 3, 4 and 5. Coefficients on EARNI3, DBTCOVI3 and TAXDUMI3 provide the tests of Hypothesis 8. If managers reduce the utilization of transaction-driven accruals to manage earnings after JIT is adopted, then β_{15} and β_{19} are positive, and β_{23} is negative. If, after JIT adoption, managers increase the use of accounting-driven accruals to manage earnings, then α_{15} and α_{19} are negative, and α_{23} is positive. Finally, increased utilization of depreciation accruals to manage earnings is supported by negative γ_{15} and γ_{19}.

CHAPTER V

RESULTS

This chapter includes results of empirical tests and related analysis and discussion. The first section following provides a descriptive analysis of the JIT adopter and nonadopter samples. The second section reports test results related to Hypothesis 1 (inventory utilization hypothesis). The third section following reports results related to tests of Hypotheses 2-6 (regarding earnings management explanations for the JIT adoption decision). The final section in this chapter provides results of tests of Hypotheses 7 and 8 (regarding changes in earnings management strategies following JIT adoption).

Descriptive analysis

As indicated in Chapter IV, Table 3 (page 41) describes the JIT and control firms in terms of adoption years, two-digit industry classifications and inventory valuation methods.[73] The weighted average JIT adoption year for the full sample (Panel A) is 1989.0. For the sample on which tests of Hypotheses 1-6 are conducted (Panel B), the weighted average adoption year is 1988.5. Industry classification distributions for both the full and reduced samples indicate a concentration of firms in classifications 33 through 38.[74] In the full (reduced) sample, 71.8% (68.6%) of all firms are in one of these six

[73] As previously noted, the two-digit industry classifications and inventory methods under Classification Scheme 2 are identical for JIT adopters and nonadopters. Classification Scheme 2 is used throughout the study to code firms' inventory methods.

[74] These industries are, respectively, Primary Metals, Fabricated Metals, Industrial and Commercial Machinery (including Computers), Electrical Equipment, Transportation Equipment and Measuring

classifications, with 40.3% (36.6%) in codes 35 or 36. Finally, in the full sample, 52.5% of firms are classified as LIFO-users under Classification Scheme 2. The analogous percentage for the reduced sample is 60.7%.

Included in Table 6 are means and medians for twelve attributes of the JIT adopter and control samples used in testing Hypotheses 1-6, along with tests of paired differences (adopter minus control) for each.[75] The results in Table 6 clearly indicate a size difference in the JIT adopter and control samples. Mean (median) total assets for JIT adopters in the year preceding JIT adoption is $2.43 billion ($406 million). For control firms, mean (median) total assets is $1.20 billion ($233 million), which is significantly less than adopters at the .01 level. Paired differences for net sales and total inventory also indicate a difference in firm size that is significant at the .01 level.

Total inventory-to-total assets ratios indicate that adopters and nonadopters alike maintain inventory levels that comprise approximately one-fourth of total assets. Ratios of inventory components (raw materials, work-in-process and finished goods) to total inventory also indicate no significant differences in JIT adopters and control firms. Finished goods comprise approximately 40% of total inventory for both samples, with the remaining 60% nearly evenly divided between raw materials and work-in-process.

The last five firm attributes in Table 6 are profitability measures. The mean (median) paired difference in gross margin percentage (gross margin divided by sales) is

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Instruments.

[75] As indicated in the footnote to Table 6, distributions for adopters, nonadopters and paired differences are winsorized at 2% and 98% to alleviate the effect of outliers.

Table 6
Means and medians of twelve attributes of JIT and control firms

Attribute	JIT Firms N	JIT Firms Mean	JIT Firms Median	Control Firms N	Control Firms Mean	Control Firms Median	Paired Differences (JIT minus Control) N	Paired Differences (JIT minus Control) Mean	Paired Differences (JIT minus Control) Median
Total assets (millions)	191	2426.70	406.04	191	1195.02	233.49	191	1231.68 [B,b]	71.38
Net sales (millions)	191	2919.19	543.99	191	1378.79	305.29	191	1540.41 [B,b]	101.84
Total inventory (millions)	191	448.33	99.34	191	232.08	56.78	191	216.25 [B,b]	18.13
Total inventory/total assets	191	.2527	.2375	191	.2565	.2498	191	-.0041	.0059
Raw materials/total inventory	143	.3217	.3041	138	.3304	.3275	114	-.0037	-.0031
Work-in-process/total inventory	126	.3210	.2865	125	.3035	.2449	98	-.0092	-.0103
Finished goods/total inventory	144	.3971	.3844	138	.4118	.4019	115	-.0137	-.0066
Gross margin	191	.3381	.3189	191	.3176	.2920	191	.0187 [A,a]	.0233
Operating margin	191	.0744	.0710	191	.0684	.0655	191	.0037	.0024
Net margin	191	.0314	.0388	191	.0355	.0377	191	-.0057	.0004
Operating return	191	.0984	.1001	191	.0972	.0887	191	.0008	-.0004
Net return	191	.0427	.0497	191	.0501	.0545	191	-.0097	-.0017

Note: The distributions of all attributes, other than the first three, are winsorized at the 2nd and 98th percentiles. A (a) and B (b) indicate significance at the .10 and .01 levels, respectively, in a two-tailed paired t-test (Wilcoxon signed-rank test). With the exception of total inventory to total assets, all attributes are measured in the year preceding JIT adoption. Total inventory/total assets is the average ratio in years -3, -2 and -1 relative to the JIT adoption year.

.019 (.023), a difference that is significant at the .10 level in two-tailed parametric and nonparametric tests (of the mean). Higher margin for JIT adopters also extends to operating margin (operating income divided by sales), but the mean (median) difference of .004 (.002) is not significant at the .10 level in two-tailed tests. Mean and median net margins (net income divided by sales) are also not significantly different at the .10 level. Likewise, average operating return (operating income divided by average assets) and average net return (net income divided by average assets) are not significantly different for the two samples.

Univariate tests of Hypotheses 1-6

Hypothesis 1

Results of univariate tests of Hypotheses 1, 2, 3, 5 and 6 are in Table 7. Paired differences in TRNCHG for the adoption year and each of years 1 through 5 following JIT adoption strongly suggest that JIT adopters, compared to nonadopters, achieve much greater improvement in inventory utilization. For each of years 0 through +4, the percentage improvement of adopters exceeds that of nonadopters by an amount that is significant at the .004 level or higher. By year +5, the median improvement for JIT adopters is 23.8%, while the median improvement for control firms is barely one-third as large (8.8%). Overall, Hypothesis 1 is strongly supported, suggesting that the operations of adopters may change substantially after JIT is implemented (a necessary condition for predictions positing a relationship between JIT and earnings management).

Table 7
Univariate tests of Hypotheses 1, 2, 3, 5 and 6

	JIT Firms			Control Firms			Paired Differences (JIT minus Control)			Significance Level	
Variable	N	Mean	Median	N	Mean	Median	N	Mean	Median	Paired t	Signed Rank
Test Variables											
$TRNCHG_0$	191	.0983	.0766	191	.0533	.0296	191	.0479	.0260	.004	.004
$TRNCHG_{+1}$	185	.1576	.0825	187	.0534	.0366	182	.1089	.0698	.000	.000
$TRNCHG_{+2}$	174	.1923	.1614	180	.0696	.0721	169	.1382	.1074	.000	.000
$TRNCHG_{+3}$	160	.2211	.1895	172	.0961	.0627	155	.1258	.1074	.000	.001
$TRNCHG_{+4}$	145	.2533	.2257	158	.1072	.0343	137	.1389	.1220	.001	.001
$TRNCHG_{+5}$	130	.3047	.2380	140	.1975	.0881	120	.0967	.0669	.059	.026
EMHISTOR	191	.0622	.0521	191	.0834	.0659	191	-.0222	-.0148	.000	.000
$EARNCHG_{(FIFO)}$	72	.0174	.0164	74	-.0023	-.0058	72	.0235	.0138	.087	.113
$EARNCHG_{(LIFO)}$	112	.0048	.0014	115	-.0155	-.0058	111	.0224	.0081	.033	.102
$LEV_{(FIFO)}$	75	.4898	.4540	75	.5241	.4786	75	-.0414	-.0484	.136	.221
$LEV_{(LIFO)}$	116	.5151	.5254	116	.5368	.5219	116	-.0189	-.0283	.389	.293
$TAXRTE_{(FIFO)}$	69	.3405	.3199	68	.3634	.3452	62	-.0100	-.0208	.411	.358
$TAXRTE_{(LIFO)}$	107	.3533	.3539	112	.4251	.3740	103	-.0259	-.0161	.335	.297
Control Variables											
SIZE	191	2034.55	406.04	191	1123.49	233.49	191	1011.14	71.38	.000	.000
INVTO	191	4.039	3.638	191	4.696	3.673	191	-.7015	-.0799	.005	.161
CAPTURN	191	1.403	1.341	191	1.439	1.363	191	-.0275	.0508	.253	.427
RDRAT	165	.0368	.0263	149	.0293	.0190	134	.0087	.0047	.001	.001

Note: Distributions of all variables are winsorized at the 2nd and 98th percentiles. The significance levels of all paired differences, with the exception of $EARNCHG_{(LIFO)}$, $LEV_{(LIFO)}$, $TAXRTE_{(LIFO)}$ and SIZE are from one-tailed tests. With the exception of $TAXRTE_{(FIFO)}$ and CAPTURN, all differences for which predictions are made have the predicted sign.

Hypothesis 2

Hypothesis 2 suggests that firms with a history of aggressive earnings management are less likely to adopt JIT. Paired differences in EMHISTOR (the absolute value of discretionary accruals in periods preceding the JIT adoption decision year) for JIT and control firms strongly support this prediction. For JIT adopters, the mean (median) discretionary accrual in pre-adoption periods was 6.2% (5.2%) of beginning-of-year total assets. Analogous percentages for control firms were far greater, with mean (median) discretionary accruals in pre-adoption periods of 8.3% (6.6%) of total assets. The mean (median) paired difference in the pre-adoption discretionary accruals of adopters and control firms was -2.2% (-1.5%), which is significant at the .000 level in a one-tailed test. Overall, the univariate test of Hypothesis 2 strongly supports the prediction that firms with a history of exercising substantial accounting discretion are less likely to adopt JIT.

Hypothesis 3

Tests of paired differences in EARNCHG (the difference between adoption year pre-managed earnings and prior year earnings, each scaled by beginning-of-year assets) suggest that in the JIT adoption decision year, adopters have stronger earnings than nonadopters, regardless of firms' inventory valuation methods.[76] For FIFO firms (for which the adoption year earnings effect of JIT implementation is presumed to be

[76] This result is consistent with the smoothing hypothesis' predictions (for FIFO users and LIFO users) if managers of LIFO firms expect JIT's implementation costs to exceed any income generated via

negative), the mean (median) paired difference is .024 (.014), which is significant at the .087 level in a one-tailed paired t-test. For LIFO firms (for which the adoption year earnings effect of JIT implementation is presumed to be (at worst) not as negative as the earnings effect for FIFO firms), the mean (median) paired difference is .022 (.008), which is significant at the .033 level in a two-tailed test.

Two sample t-tests (results not reported in Table 7) provide limited support for Hypothesis 3. Among JIT adopters, FIFO firms are predicted to have stronger pre-managed adoption year earnings. This prediction is supported at the .164 (.158) level in a one-tailed, two sample t-test (Wilcoxon rank sum test). For nonadopters, the difference (FIFO minus LIFO) in mean (median) EARNCHG in the two samples is .013, which is insignificant at the .326 (.945) level in a two-tailed, two sample t-test (Wilcoxon rank sum test).[77]

Overall, the univariate results in Table 7 suggest that firms adopt JIT in strong earnings years, and that the potential for income from LIFO reserve liquidations is not particularly important in the JIT adoption decision (i.e., in reaching their adoption/nonadoption decisions, managers of LIFO firms anticipate that JIT's implementation costs will dominate income generated via liquidation of the LIFO reserve).

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liquidation of the LIFO reserve.

[77] If managers of nonadopting LIFO firms expect income via LIFO reserve liquidation to dominate JIT's implementation costs, the difference (FIFO minus LIFO) in mean EARNCHG for nonadopters is predicted to be negative. If managers of nonadopting LIFO firms expect JIT's implementation costs to exceed income from liquidating LIFO layers, there is no clear prediction (for nonadopters) for the relationship between FIFO firms' and LIFO firms' EARNCHG.

Hypothesis 4

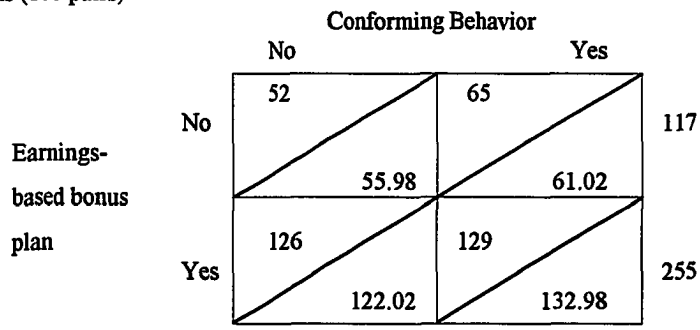
Hypothesis 4 suggests that the JIT adoption decisions of managers covered under earnings-based bonus plans, compared to the decisions of managers not covered under such plans, are more consistent with the smoothing hypothesis' predictions. Results of χ^2 tests of independence reported in Table 8 do not support this prediction. The tests are conducted under the assumption that JIT adoption is income-decreasing (-increasing) for FIFO (LIFO) firms.[78] For the test utilizing all firm pairs for which data were available to assess whether managers' bonuses were earnings based (186 pairs), the observed dependence is in the wrong direction (i.e., a concentration should be, but is not, observed in the lower right quadrant) and insignificant at the .373 level. The test utilizing FIFO firms only (74 pairs) results in observed quadrant concentrations that are virtually identical to those expected if existence of an earnings-based bonus plan and conforming behavior are independent (the significance level is .840). Finally, the most significant result is from the test utilizing LIFO firms only (112 pairs with a significance level of .252). However, the observed dependence is not in the predicted direction.

Overall, the χ^2 tests of independence clearly do not support Hypothesis 4, and it is difficult to discern whether this lack of support should be attributed to the absence of an effect, or to the fact that data limitations permit only a crude test of the bonus hypothesis.

[78] Because of the uncertainty regarding the earnings effect of JIT adoption for LIFO firms, this assumption probably greatly reduces the power of any tests conducted utilizing LIFO firms. The most powerful test is conducted on FIFO firms only, since the JIT adoption year earnings effect is less ambiguous for such firms.

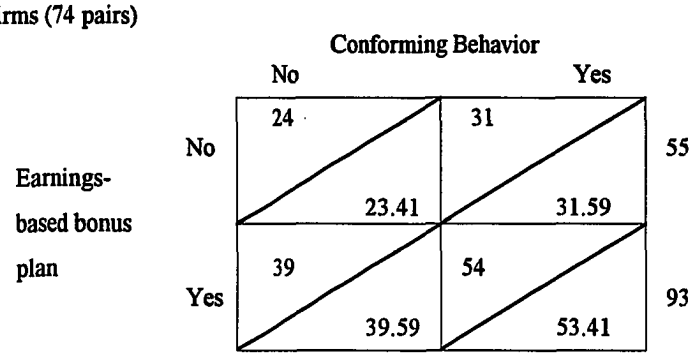
Table 8
Univariate test of Hypothesis 4

All firms (186 pairs)



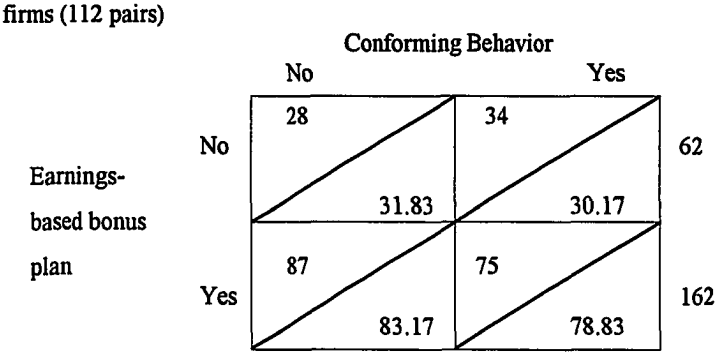
$\chi^2 = .793$ ($p = .373$)

FIFO firms (74 pairs)



$\chi^2 = .041$ ($p = .840$)

LIFO firms (112 pairs)



$\chi^2 = 1.310$ ($p = .252$)

Note: Actual (expected) observations are above (below) the diagonal. Expected observations are calculated under the assumption that existence of an earnings-based bonus plan and conforming behavior are independent.

Hypothesis 5

Hypothesis 5 suggests that high leverage results in a decreased likelihood of FIFO firms adopting JIT, and that this relationship will be less apparent for LIFO firms. The univariate results reported in Table 7 support this prediction, although significance levels are weak. Among FIFO firms, mean (median) leverage for JIT adopters is .490 (.454); for nonadopters, mean (median) leverage is .524 (.479). However, the winsorized difference in actual means (-.041) is significant at only the .136 (.221) level in a one-tailed paired t-test (signed rank test). Among LIFO firms, the mean and median paired differences in leverage are approximately one-half of those reported for FIFO firms, a relationship that is consistent with Hypothesis 5. Overall, the results reported in Table 7 provide moderate support for Hypothesis 5.

Hypothesis 6

The univariate results reported in Table 7 do not support the tax hypothesis. Significance levels for tests of paired differences are poor and, in the case of FIFO firms, the predicted relationship in the tax rates of adopters and nonadopters is in the wrong direction (i.e., FIFO-using JIT adopters are predicted to face greater tax burdens than FIFO-using nonadopters, a result not obtained in Table 7).

Control variables

Paired differences in SIZE, INVTO and RDRAT are consistent with expectations. JIT adopters 1) had significantly greater total assets in the year preceding JIT

implementation (p = .000 in the parametric test), 2) generated fewer inventory turns in the three years preceding JIT adoption (p = .005), and 3) devoted more resources to research and development activities in the three years preceding JIT adoption (p = .001). Univariate results reported for CAPTURN indicate that JIT and control firms achieved similar capital utilizations in the three years preceding the JIT adoption decision year, suggesting (if CAPTURN is an appropriate surrogate for firm effectiveness) that adopters and nonadopters were equally capable of exploiting new production technologies or other business practices in the year that their respective JIT adoption decisions were executed.

Multivariate tests of Hypotheses 2-6

Models excluding the bonus plan variable and related interactions

Models 1 and 2, estimated with logistic regression, provide a multivariate test of the effect of earnings management incentives on the JIT adoption decision, and also permit a clearer analysis of the role of inventory method in managers' adoption decisions.

Table 9 reconciles the 191 firm pairs used in most univariate tests to the number of firm pairs underlying logistic regression results. For the second specification of the model, 62 firm pairs were eliminated because of the unavailability of data needed to calculate one or more independent variables in the model. Most of this sample reduction was attributable to the fact that research and development expense is often not available on the COMPUSTAT tapes. As explained in the footnotes to Table 9, the model was estimated six times, and several common logistic regression diagnostics were examined after each estimation. Regression results reported are from the first model estimation in

Table 9
Sample reconciliation for multivariate tests of Hypotheses 2-6

Condition	Specification 1[1]	Specification 2[2]
Firm pairs with sufficient data to calculate discretionary accruals in at least seven pre-adoption years	191	191
Less: Firm pairs for which data were not available to calculate one or more independent variables in the empirical model	-8	-62
Less: Firm pairs eliminated after examining logistic regression diagnostics from the initial model estimation[3]	-5	-3
Less: Firm pairs eliminated after examining logistic regression diagnostics from the second model estimation	-3	-1
Less: Firm pairs eliminated after examining logistic regression diagnostics from the third model estimation	-2	-1
Less: Firm pairs eliminated after examining logistic regression diagnostics from the fourth model estimation	-2	-1
Less: Firm pairs eliminated after examining logistic regression diagnostics from the fifth model estimation	-2	-1
Final sample size[4]	169	122

Note 1: Specification 1 includes CAPTURN as a surrogate for firm effectiveness.
Note 2: Specification 2 includes RDRAT (a surrogate for firm innovativeness), which accounted for nearly all of the significant sample size reduction.
Note 3: Diagnostics examined in determining whether any observations were heavily influencing the estimated model were hat matrix diagonals, Cook's distance measures, and dfbetas. Various authors offer a number of guidelines in interpreting the severity of influential cases. Hat matrix diagonals greater than 6p/n (where p is the number of parameters estimated and n is the sample size), Cook's distance measures greater than .94 (approximately the 50th percentile of the F distribution with d.f. p,n) and dfbetas greater than $6/n^{1/2}$ were considered outliers (and influential in the case of the latter two diagnostics). These criteria are higher than those most often recommended. This was considered appropriate in light of the fact that the models are estimated using independent variables winsorized at the 2nd and 98th percentiles. Observations exceeding these cutoffs were deleted, without regard to the direction of their excessive influence.
Note 4: Regression diagnostics were also examined for the final models estimated. No violations of the pre-established outlier criteria were present.

Table 10
Simple statistics for samples used in multivariate tests of Hypotheses 2-6

	Specification 1 (N = 338)				Specification 2 (N = 244)			
Variable	Mean	Std. Dev.	Minimum	Maximum	Mean	Std. Dev.	Minimum	Maximum
SIZE	1152.00	2530.00	6.26	24432	1701.60	3768.15	6.26	24432
INVTO	4.3608	2.7811	1.5585	19.7062	3.9200	1.8251	1.5585	12.6384
CAPTURN	1.4210	.4740	.6074	3.1958	n/a	n/a	n/a	n/a
RDRAT	n/a	n/a	n/a	n/a	.0354	.0320	0	.1245
EMHISTOR	.0722	.0468	.0181	.2978	.0709	.0481	.0181	.2978
EARNCHG	.0033	.0809	-.2836	.2562	.0013	.0813	-.2836	.2562
EARNCHG*LIFO	-.0012	.0603	-.2836	.2562	-.0016	.0583	-.2836	.2562
LEV	.5084	.1940	.1241	1.2069	.4864	.1787	.1241	1.0323
LEV*LIFO	.3181	.2875	0	1.2069	.3118	.2769	0	1.0300
TAX	.7899	.4080	0	1	.7664	.4240	0	1
TAX*LIFO	.5030	.5007	0	1	.5041	.5010	0	1

Table 11
Pearson correlation coefficients for samples used in multivariate tests of Hypotheses 2-6

Specification 1

	SIZE	INVTO	CAPTURN	EMHISTOR	EARNCHG	EARNCHG* LIFO	LEV	LEV*LIFO	TAX	TAX*LIFO
SIZE		.052	-.072	-.214 *	-.006	.055	.132 *	.193 *	.062	.128 *
INVTO			.406 *	-.125 *	-.139 *	-.097	.034	.118 *	.120 *	.192 *
CAPTURN				-.011	-.199 *	-.146 *	.016	.029	.131 *	.114 *
EMHISTOR					-.074	-.126 *	.137 *	-.069	-.170 *	-.282 *
EARNCHG						.746 *	-.051	-.105	-.041	-.059
EARNCHG*LIFO							-.064	-.056	.010	-.003
LEV								.393 *	-.178 *	-.040
LEV*LIFO									.005	.640 *
TAX										.519 *

Specification 2

	SIZE	INVTO	CAPTURN	EMHISTOR	EARNCHG	EARNCHG* LIFO	LEV	LEV*LIFO	TAX	TAX*LIFO
SIZE		.098	.108	-.241 *	-.019	.047	.158 *	.164 *	.085	.100
INVTO			-.383 *	-.082	-.126 *	-.119	.072	.206 *	.141 *	.243 *
RDRAT				.144 *	.017	.046	-.169 *	-.351 *	-.047	-.284 *
EMHISTOR					-.095	-.183 *	.102	-.149 *	-.205 *	-.337 *
EARNCHG						.718 *	-.072	-.086	-.011	-.008
EARNCHG*LIFO							-.072	-.063	.064	.040
LEV								.444 *	-.197 *	-.043
LEV*LIFO									.021	.609 *
TAX										.557 *

Note: Correlations significant at .05 are noted with an asterisk.

Table 12
Logistic regression results for Hypotheses 2, 3, 5 and 6

Variable Name	Predicted Sign	Parameter Estimate	Standard Error	Wald Chi-Square	p-value
Specification 1: N = 169 Pairs					
INTERCEPT	None	.8942	.6069	2.1707	.1407
SIZE	None	.000205	.000081	6.4859	.0109
INVTO	-	-.1294	.0540	5.7463	.0165
CAPTURN	+	.5163	.2965	3.0315	.0817
EMHISTOR	-	-11.2168	3.2465	11.9374	.0006
EARNCHG	+	8.9431	2.7028	10.9488	.0009
EARNCHG*LIFO	-	-6.2361	3.4000	3.3641	.0666
LEV	-	-1.6691	.8083	4.2642	.0389
LEV*LIFO	+	.9249	.7946	1.3546	.2445
TAX	+	.4870	.4146	1.3796	.2402
TAX*LIFO	-	-.7380	.4801	2.3629	.1243
Specification 2: N = 122 Pairs					
INTERCEPT	None	.7815	.7333	1.1357	.2866
SIZE	None	.000055	.000046	1.4349	.2310
INVTO	-	.1147	.0880	1.6979	.1926
RDRAT	+	11.5802	5.2571	4.8522	.0276
EMHISTOR	-	-13.0948	3.9194	11.1625	.0008
EARNCHG	+	7.1620	2.9474	5.9046	.0151
EARNCHG*LIFO	-	-7.0791	3.8514	3.3785	.0661
LEV	-	-1.2191	1.0253	1.4137	.2344
LEV*LIFO	+	-.0436	.9355	.0022	.9628
TAX	+	-.2811	.4684	.3601	.5484
TAX*LIFO	-	-.0552	.5497	.0101	.9199

	Covariates Chi-Square	p-value	Concordant Predictions	Discordant Predictions
Model Statistics:				
Specification 1	51.824	.0001	69.8%	29.9%
Specification 2	33.905	.0002	69.1%	30.6%

	EARNCHG	LEV	TAX
LIFO Firm Parameters:			
Specification 1	2.7070	-.7442	-.2510
p-value	.2017	.3133	.4888
Specification 2	.0829	-1.2627	-.3363
p-value	.9731	.1644	.4227

which no pre-established criteria regarding undue influence or outlying observations were violated. Tables 10 and 11 report simple statistics and Pearson correlation coefficients with respect to all independent variables of firm-pairs used in estimating the models for which results are reported in Table 12.

Table 11 indicates that several of the model's independent variables are significantly correlated. For example, CAPTURN and INVTO are positively correlated, which is not surprising, given that inventories comprise approximately one-fourth of total assets for both the adopter and nonadopter samples. In addition, the correlation matrices indicate that EMHISTOR is negatively correlated with SIZE and INVTO, and positively correlated with RDRAT and LEV. Each of these significant correlations is in a direction that raises the possibility that the highly significant univariate results for EMHISTOR (reported in Table 7) could be driven by that fact that EMHISTOR proxies for firm size, management's assessment of the benefits to be derived from JIT adoption, firm innovativeness, tightness of debt covenants or some combination of these variables. Models 1 and 2 discern whether EMHISTOR is capturing an effect independent of the effects captures by SIZE, INVTO, RDRAT and LEV.

Statistics reported near the bottom of Table 12 indicate that both specifications of the model testing Hypotheses 2, 3, 5 and 6 classify 69%-70% of firms correctly, and that both models are significant at the .000 level.[79]

[79] It should be noted that the percentage of concordant predictions should not be interpreted as if the model were estimated with a random sample of firms. With the present research design, random classification would be expected to correctly classify 50% of firms as JIT adopters or nonadopters. Therefore, if the overall predictive ability of the model were a primary interest in the present study, 50% would be the appropriate benchmark to which to compare the actual 69%-70% concordant prediction

The earnings management history hypothesis (Hypothesis 2) is strongly supported by the results reported in Table 12. In both specifications of the model, the coefficient on EMHISTOR is negative and significant at the .001 level, indicating that managers of firms that had exercised substantial accounting discretion in years prior to the JIT decision year were much less likely to adopt JIT.[80] Under the assumption that firms' earnings management histories are highly correlated with their preferences for future earnings management flexibility, this result supports the assertion that managers of nonadopting firms (that have, on average, engaged in substantial earnings manipulation) recognize that JIT utilization would inhibit their ability to manage earnings, and therefore choose to not implement the new production technology.

The level of support for the smoothing hypothesis is assessed by examining the coefficients on EARNCHG and EARNCHG*LIFO. In both specifications of the model, the coefficient on EARNCHG is positive and highly significant, indicating that the (pre-managed) adoption year earnings of adopters utilizing the FIFO inventory method are, on average, much stronger than the (pre-managed) earnings of FIFO users electing to not implement JIT. The smoothing hypothesis is also supported by the slope shift on EARNCHG for firms utilizing the LIFO inventory method (i.e., the coefficient on EARNCHG*LIFO). In both specifications, the coefficient on EARNCHG*LIFO is negative, as predicted, and significant at the .066 level. This result indicates that the

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rates.

[80] This result suggests that the univariate results reported in Table 7 are not a result of EMHISTOR serving as a surrogate for SIZE, INVTO, LEV or RDRAT. Of course, the result does not rule out the possibility that EMHISTOR is a proxy for some other unknown variable not included in Model 1.

positive association between strong earnings years and likelihood of JIT adoption observed for FIFO firms is much less prevalent for LIFO firms. The coefficient on EARNCHG for LIFO firms (reported near the bottom of Table 12) in Specification 1 (2) is 2.707 (.083), and is significant at only the .202 (.973) level. Overall, the results reported in Table 12 strongly support the assertions that 1) firms utilizing the FIFO inventory method are much less likely to make the income-reducing decision to adopt JIT in an already-poor earnings year, and 2) in contemplating JIT adoption, managers of LIFO firms view the potential for income from LIFO reserve liquidations as counterbalancing JIT's substantial up-front implementation costs. Each of these findings strongly supports the notion that managers' JIT adoption/nonadoption decisions are associated with contemporaneous income smoothing incentives.

The debt covenants hypothesis is moderately supported by the logistic regression results. In the first specification, the coefficient on LEV is negative, as predicted, and significant at the .039 level. This result supports the assertion that high-leverage firms utilizing the FIFO inventory method are less likely to make the income-reducing decision to adopt JIT. The slope shift on LEV for LIFO firms (i.e., the coefficient on LEV*LIFO) is positive, as predicted, but significant at only the .245 level. In the second specification, the negative coefficient on LEV is less significant than in the first specification, and the slope shift on LEV for LIFO firms is indistinguishable from zero. The coefficient on LEV for LIFO firms is -.744 (-1.263) in the first (second) specification, and significant at only the .313 (.164) level. Overall, the prediction that the negative association between

leverage and JIT adoption observed for FIFO firms would be less apparent among LIFO firms is weakly supported by the results from the first specification of the model only.

The tax hypothesis is weakly supported by the results from the first specification of the model. Regression results reported in Table 12 suggest that high-tax FIFO firms, compared to low-tax FIFO firms, are more likely to make the income-reducing decision to adopt JIT (a conclusion supported by the .487 coefficient on TAX, but significant at only the .240 level). As predicted, this relationship between tax status and likelihood of JIT adoption does not extend to firms utilizing the LIFO inventory method. The coefficient on TAX*LIFO is negative, as predicted, and significant at the .124 level. The coefficient on TAX for LIFO firms is insignificantly negative (-.251). Finally, results with respect to the tax hypothesis in the second specification of the model are insignificant.

Coefficients on control variables in the first specification of the model all have the expected sign and are generally quite significant. Coefficients on SIZE, INVTO and CAPTURN are positive, negative and positive, respectively, and significant at the .011, .017 and .082 levels. In the second specification, coefficients on SIZE and RDRAT have the expected sign, but only RDRAT is significant at conventional levels ($p = .028$).

Overall, the results reported in Table 12 strongly support the earnings management history and smoothing hypotheses, and weakly support the debt covenants and tax hypotheses.

Models including the bonus plan variable and related interactions

Table 13 reports regression results for models that include EBPLAN and related interactions. The models are estimated with the same firm-pairs used in estimating models without EBPLAN, except that three firm pairs are deleted due to unavailability of bonus plan information for one or both members of a matched pair.

The results reported in Table 13 do not support the prediction that the existence of an earnings-based bonus plan will increase the influence of income smoothing incentives in the JIT adoption decision. Coefficients on EARNCHG*EBPLAN and EARNCHG*LIFO*EBPLAN in both specifications are not consistent with predictions and/or are very insignificant. EBPLAN is significant as a main effect in each specification, suggesting that managers covered under earnings-based bonus plans are more likely to adopt JIT.[81]

Inclusion of the EBPLAN variable and related interactions in the model does not change earlier conclusions drawn with respect to Hypotheses 2, 3, 5 and 6. Compared to the earlier results, the results from Specification 1 (2) reported in Table 13 are somewhat less (more) supportive of the smoothing hypothesis. In addition, the TAX*LIFO interaction is more significant in the first specification of the model that includes the bonus plan variables.

[81] The present study posits no relationship between the existence of an earnings-based bonus plan (as a main effect) and likelihood of JIT adoption. It should be noted, however, that the influence of EBPLAN as a main effect in the results reported in Table 13 is independent of any effect of SIZE or EMHISTOR, two variables which would seem to be likely candidates for high correlation with EBPLAN. A more formal analysis of the relationship between bonus plan characteristics and adoption of new production technologies is reserved for future research.

Table 13
Logistic regression results for Hypotheses 2-6

Variable Name	Predicted Sign	Parameter Estimate	Standard Error	Wald Chi-Square	p-value
Specification 1: N = 166 Pairs					
INTERCEPT	None	.3510	.6558	.2864	.5926
SIZE	None	.000207	.000084	6.1189	.0134
INVTO	-	-.1191	.0569	4.3784	.0365
CAPTURN	+	.6064	.3054	3.9429	.0471
EMHISTOR	-	-11.6220	3.3698	11.8947	.0006
EARNCHG	+	7.6607	3.9201	3.8188	.0507
EARNCHG*LIFO	-	-9.2526	5.6693	2.6636	.1027
EBPLAN	None	.8042	.2763	8.4733	.0036
EARNCHG*EBPLAN	+	2.9113	5.2756	.3045	.5811
EARNCHG*LIFO*EBPLAN	-	2.5515	7.1056	.1289	.7195
LEV	-	-1.7646	.8208	4.6218	.0316
LEV*LIFO	+	.9507	.8112	1.3737	.2412
TAX	+	.3902	.4215	.8570	.3546
TAX*LIFO	-	-.8503	.4936	2.9674	.0850
Specification 2: N = 119 Pairs					
INTERCEPT	None	.3537	.7878	.2015	.6535
SIZE	None	.000073	.000053	1.8781	.1706
INVTO	-	.1300	.0899	2.0900	.1483
RDRAT	+	13.1107	5.5440	5.5924	.0180
EMHISTOR	-	-12.7103	4.0169	10.0122	.0016
EARNCHG	+	9.6181	4.5906	4.3897	.0362
EARNCHG*LIFO	-	-13.3327	6.5637	4.1260	.0422
EBPLAN	None	.5828	.3275	3.1665	.0752
EARNCHG*EBPLAN	+	-4.5672	6.1176	.5574	.4553
EARNCHG*LIFO*EBPLAN	-	9.4502	8.1947	1.3299	.2488
LEV	-	-1.2742	1.0783	1.3962	.2374
LEV*LIFO	+	-.1530	.9879	.0240	.8763
TAX	+	-.3834	.4878	.6176	.4319
TAX*LIFO	-	-.0808	.5763	.0196	.8886

	Covariates Chi-Square	p-value	Concordant Predictions	Discordant Predictions
Model Statistics:				
Specification 1	62.355	.0001	72.2%	27.6%
Specification 2	41.014	.0001	71.1%	28.7%

Note: With the exception of three pairs for which bonus plan information was not available, both specifications are estimated with the same data used in the final estimations for which results are reported in Table 12.

Tests of Hypotheses 7 and 8

The first subsection following reports results of the two empirical tests of Hypothesis 7. The second subsection reports results of three tests of Hypothesis 8. The final subsection discusses the level of overall support for the two hypotheses.

Hypothesis 7

Table 14 provides results of the first test of the prediction that JIT utilization is associated with reduced earnings management. As noted in Chapter IV, DIFFVAR1 - DIFFVAR4 are four metrics for variation in firms' earnings streams. The first two columns of Table 14 report and test the average change (post-adoption minus pre-adoption) in earnings variation for JIT and control firms, respectively, under each of the four definitions of earnings variation. The third column reports and tests the average paired difference (JIT adopter minus control firm) in the change in earnings variation.[82] The final four columns in Table 14 provide information with respect to the average number of pre-adoption and post-adoption observations used in calculating the four earnings variation metrics.

Results for DIFFVAR1 (standard deviation of income before extraordinary items scaled by mean total assets) suggest that, relative to earnings variation in the pre-adoption period, earnings variation in the post-adoption period has declined for JIT and control

[82] To alleviate substantial nonnormality, the distributions for JIT firms, control firms and paired differences were truncated at 5% and 95%.

Table 14
Paired differences in changes in earnings variability (Hypothesis 7, Test 1)

	JIT	Control	Paired diff.	No. obs./firm, post JIT	No. obs./firm, post Control	No. obs./firm, pre JIT	No. obs./firm, pre Control
DIFFVAR1 (n = 164 pairs)*							
Mean	-.0160	-.0038	-.0158	9.000	8.646	18.561	16.579
Median	-.0178	-.0080	-.0171	9	8	20	17
t-value	-6.183	-1.075	-3.716				
p-value	.000	.284	.000				
Sign Rank S	-3460	-1416	-1925				
p-value	.000	.020	.001				
Number > 0	42	66	66				
DIFFVAR2 (n = 164 pairs)*							
Mean	.1371	-.0085	-.0741	8.957	8.659	18.384	16.439
Median	-.1152	-.1781	.0232	9	8.5	20	17
t-value	1.233	-.042	-.195				
p-value	.219	.966	.846				
Sign Rank S	-204	-571	227				
p-value	.739	.350	.711				
Number > 0	70	70	82				
DIFFVAR3 (n = 158 pairs)*							
Mean	.0018	.0064	-.0069	9.082	8.842	17.968	15.797
Median	-.0008	.0014	-.0033	9	9	19	17
t-value	.863	2.527	-1.966				
p-value	.389	.013	.051				
Sign Rank S	302	944	-749				
p-value	.602	.102	.195				
Number > 0	74	83	77				
DIFFVAR4 (n = 158 pairs)*							
Mean	.6289	.5351	.1036	8.968	8.696	17.487	15.722
Median	.3015	.1289	.1617	9	8	19	16
t-value	5.332	2.425	.296				
p-value	.000	.016	.767				
Sign Rank S	3579	1750	872				
p-value	.000	.002	.131				
Number > 0	114	96	90				

* DIFFVAR1 is $(\sigma_{NIBEI}/\mu_{ASSETS})_{post\text{-}adoption} - (\sigma_{NIBEI}/\mu_{ASSETS})_{pre\text{-}adoption}$.

DIFFVAR2 is $(\sigma_{NIBEI}/\mu_{NIBEI})_{post\text{-}adoption} - (\sigma_{NIBEI}/\mu_{NIBEI})_{pre\text{-}adoption}$.

DIFFVAR3 is $(\sigma_{ROABEI})_{post\text{-}adoption} - (\sigma_{ROABEI})_{pre\text{-}adoption}$.

DIFFVAR4 is $(\sigma_{ROABEI}/\mu_{ROABEI})_{post\text{-}adoption} - (\sigma_{ROABEI}/\mu_{ROABEI})_{pre\text{-}adoption}$.

σ and μ are the standard deviation and mean, respectively. NIBEI, ASSETS AND ROABEI refer to income before extraordinary items, total assets, and return on assets before extraordinary items, respectively.
To alleviate the effect of outliers, all distributions are truncated at 5% and 95%. All p-values are from two-tailed tests.

firms alike. The reduction for JIT adopters is significant at the .000 level[83] in both a paired t-test and a Wilcoxon signed rank test. For nonadopters, the reduction is significant at the .284 (.020) level in the paired t-test (signed rank test). The third column suggests that the reduction in earnings variation is greater for JIT firms (a result significant at the .001 level, but in a direction opposite of that necessary to support Hypothesis 7).

Tests of DIFFVAR2 (standard deviation of income before extraordinary items scaled by mean income before extraordinary items) suggest that neither JIT nor control firms experience a change in earnings variation after the JIT adoption year. Tests of paired differences in change in earnings variation also yield insignificant results.

Results for DIFFVAR3 (standard deviation of return on assets before extraordinary items) suggest that JIT adopters have experienced no change in earnings variation, but that control firms have experienced an increase in earnings variation. The mean (median) increase for control firms is .0064 (.0014), and significant at the .013 level in a paired t-test and at the .102 level in the nonparametric test. The mean paired difference in change in earnings variation is significant at the .051 and .195 levels in the paired t-test and signed rank tests, respectively. However, the sign of the mean and median paired difference is opposite of that required to support Hypothesis 7.[84]

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[83] All results reported for Hypothesis 7 are from two-tailed tests.

[84] Any significance noted with respect to the tests for control firms and the paired difference in JIT and control firms is subject to the caveat that the distributions related to DIFFVAR3 are not well-behaved. Using a sign test, the median for control firms is significant at only the .578 level and the median for the paired difference is significant at only the .812 level.

Results for DIFFVAR4 (standard deviation of return on assets before extraordinary items scaled by mean return on assets before extraordinary items) suggest that JIT and control firms have both experienced increased earnings variation. This finding is supported at no less than the .016 level in both parametric and nonparametric tests. The paired difference in change in earnings variation is not significant in the paired t-test, and is significant at only the .131 level in the signed rank test. However, in 90 of 158 cases, the change in earnings variation for a JIT firm exceeded the change for the JIT firm's matched counterpart.[85]

The last four columns of Table 14 indicate that earnings variations in the pre-adoption period were calculated, on average, with nearly twice as many observations as were used to calculate post-adoption earnings variations. This observation is generally true for both JIT firms and their matched counterparts.

Overall, the results in Table 14 do not support the prediction that JIT utilization results in a reduction in earnings management (i.e., an increase in earnings variability). The paired difference in DIFFVAR4 is the only one of four metrics that mildly supports Hypothesis 7, and results for DIFFVAR1 are opposite the hypothesis' prediction.[86]

The second test of Hypothesis 7 is similar to the first, but examines changes in the variability of time de-trended earnings. Table 15 reports test results related to four

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[85] In a two-tailed sign test, the paired difference is significant at the .095 level.

[86] DIFFVAR4 and DIFFVAR2 scale the standard deviation of a given earnings measure by the mean value of the earnings measure. Therefore, these two metrics are coefficients of variation. DIFFVAR1 scales the standard deviation of earnings by a proxy for the size of the firm that generated the earnings stream (total assets). For DIFFVAR3, the earnings measure (return on assets) is scaled, and the standard deviation of the earnings measure is unscaled. Later sensitivity tests reported in Table 16 examine the extent to which results reported in Tables 14 and 15 are affected by changes (post-adoption minus pre-

metrics for time de-trended earnings variation. With respect to DIFFVARA (standard deviation of the residual in a regression of income before extraordinary items on event time, scaled by mean assets), the first column of Table 15 suggests that earnings variation has decreased for JIT adopters, a finding significant at the .029 (.007) level in a paired t-test (signed rank test). Results in the second column indicate that earnings variation has not changed for control firms. Results for the paired difference in the change in earnings variation for JIT and control firms (column 3) are in opposition to Hypothesis 7, and significant at the .007 (.035) level in the parametric (nonparametric) test.

Table 15
Paired differences in changes in time de-trended earnings variability (Hypothesis 7, Test 2)

	JIT	Control	Paired diff.
DIFFVARA (n = 164 pairs)*			
Mean	-.0048	.0042	-.0106
Median	-.0074	-.0063	-.0068
t-value	-2.199	1.348	-2.731
p-value	.029	.180	.007
Sign Rank S	-1630	-288	-1284
p-value	.007	.638	.035
Number > 0	61	69	74
DIFFVARB (n = 164 pairs)*			
Mean	.2705	-.0041	.0646
Median	.0723	-.0630	.1196
t-value	2.502	-.022	.118
p-value	.013	.982	.851
Sign Rank S	1368	157	621
p-value	.024	.798	.309
Number > 0	85	80	87

adoption) in scalars.

Table 15 (Continued)

	JIT	Control	Paired diff.
DIFFVARC (n = 158 pairs)*			
Mean	.0039	.0066	-.0040
Median	.0021	.0032	-.0039
t-value	.192	2.647	-.1.204
p-value	.057	.009	.230
Sign Rank S	977.5	1039.5	-320.5
p-value	.090	.071	.580
Number > 0	87	89	74
DIFFVARD (n = 158 pairs)*			
Mean	.6008	.4372	.2205
Median	.2903	.1286	.2402
t-value	5.254	2.335	.750
p-value	.000	.021	.454
Sign Rank S	3497.5	1567.5	978.5
p-value	.000	.005	.089
Number > 0	112	94	92

*DIFFVARA is $(\sigma_{RESID,NIBEI}/\mu_{ASSETS})_{post\text{-}adoption} - (\sigma_{RESID,NIBEI}/\mu_{ASSETS})_{pre\text{-}adoption}$.
DIFFVARB is $(\sigma_{RESID,NIBEI}/\mu_{NIBEI})_{post\text{-}adoption} - (\sigma_{RESID,NIBEI}/\mu_{NIBEI})_{pre\text{-}adoption}$.
DIFFVARC is $(\sigma_{RESID,ROABEI})_{post\text{-}adoption} - (\sigma_{RESID,ROABEI})_{pre\text{-}adoption}$.
DIFFVARD is $(\sigma_{ROABEI}/\mu_{ROABEI})_{post\text{-}adoption} - (\sigma_{ROABEI}/\mu_{ROABEI})_{pre\text{-}adoption}$.
For DIFFVARA and DIFFVARB, $\sigma_{RESID,NIBEI}$ refers to the standard deviation of the residual in a regression of income before extraordinary items on event time. For DIFFVARC and DIFFVARD, $\sigma_{RESID,ROABEI}$ refers to the standard deviation of the residual in a regression of return (before extraordinary items) on assets on event time. Average intra-firm data availability was the same as that reported in Table 14. To alleviate the effect of outliers, all distributions are truncated at 5% and 95%. All p-values are from two-tailed tests.

Results of tests of DIFFVARB (standard deviation of the residual in a regression of income before extraordinary items on event time, scaled by mean income before extraordinary items) are mildly supportive of Hypothesis 7. JIT adopters exhibit a mean increase in earnings variation of .271 which is significant at the .013 (.024) level in a paired t-test (signed rank test). The change in earnings variation for control firms is not distinguishable from zero, and the mean paired difference in JIT and control firms (.065) is in the predicted direction and significant in a two-tailed paired t-test (signed rank test)

at the .118 (.309) level. Under a two-tailed sign test of medians (results not reported in Table 15) the paired difference has the correct sign, but is significant at only the .482 level.

Tests of DIFFVARC (standard deviation of the residual in a regression of return on assets before extraordinary items on event time) suggest that earnings variability has increased for both JIT adopters and nonadopters (significance levels range from .009 to .090 in two-tailed parametric and nonparametric tests). The mean paired difference in change in earnings variability is negative (in opposition to Hypothesis 7) and is not significant at conventional levels.

Finally, results for DIFFVARD (standard deviation of the residual in a regression of return on assets before extraordinary items on event time, scaled by mean return on assets before extraordinary items) indicate that earnings variation has increased for both JIT adopters and nonadopters, a finding significant at no less than the .021 level. Column 3 suggests that the mean increase in earnings variability for adopters exceeds the increase for nonadopters; the paired difference is significant at the .454 (.089) level in a parametric (nonparametric) test. In a two-tailed sign test of the median paired difference in the change in earnings variation, Hypothesis 7 is supported at the .046 level.

Overall, the second test of Hypothesis 7 produces results that are highly dependent upon the specific definition of earnings variation under consideration. Tests of paired differences in DIFFVARD, in which the residual standard deviation is scaled by the mean of the dependent variable in the regression, are somewhat supportive of the prediction of an increase in earnings variability after JIT is adopted. Under other

definitions of time de-trended earnings, however, results are insignificant (DIFFVARB and DIFFVARC) or in opposition to Hypothesis 7 (DIFFVARA).

Much of the difficulty in studying earnings variability and changes therein in the present study can be attributed to the fact that earnings *levels* in the pre-adoption and post-adoption periods can change significantly for a given firm. In addition, the size of the entity generating the earnings streams in the two periods can change substantially (e.g., it should be expected that most sample firms are larger in the post-adoption period than in the pre-adoption period, a result supported by empirical tests not reported).[87]

To assess the sensitivity of results reported in Tables 14 and 15 to changes in earnings levels or firm sizes, the paired differences in changes in earnings variation were regressed on paired differences in the changes in earnings levels or firm sizes. If changes in earnings level or firm size have no effect on changes in earnings variation, β_1 in these regressions will be insignificantly different from zero, and the intercept (β_0) will approximate the mean paired difference in the dependent variable. Results of these sensitivity tests are reported in Table 16.

Results from the first six regressions reported in Table 16 do not change earlier inferences regarding paired differences in changes in earnings variability. For example, in the regressions with PDDFVAR1 and PDDFVAR3 as dependent variables and the paired difference in change in total assets as the independent variable, the coefficients on the

[87] The possibilities of changes in earnings levels and firm size are the motivation behind using metrics of earnings variability that are scaled by some measure of size.

Table 16
Hypothesis 7 sensitivity tests

Dependent variable	Independent variable	R^2	β_0 (p-value)	β_1 (p-value)
PDDFVAR1	$\Delta\mu_{assets,JIT} - \Delta\mu_{assets,Control}$	.001	-.0148 (.001)	.0000001 (.660)
PDDFVAR2	$\Delta\mu_{assets,JIT} - \Delta\mu_{assets,Control}$	.017	-.2106 (.587)	.000038 (.099)
PDDFVAR2	$\Delta\mu_{NIBEL,JIT} - \Delta\mu_{NIBEL,Control}$	.005	-.1500 (.701)	.00902 (.394)
PDDFVAR3	$\Delta\mu_{assets,JIT} - \Delta\mu_{assets,Control}$	.001	-.0068 (.062)	-.00000003 (.885)
PDDFVAR4	$\Delta\mu_{assets,JIT} - \Delta\mu_{assets,Control}$	.000	.0968 (.788)	.000018 (.931)
PDDFVAR4	$\Delta\mu_{ROABEL,JIT} - \Delta_{ROABEL,Control}$	.059	.1419 (.677)	-12.941 (.002)
$\Delta\sigma_{NIBEL,JIT} - \Delta\sigma_{NIBEL,Control}$	$\Delta\mu_{assets,JIT} - \Delta\mu_{assets,Control}$	.446	24.54 (.236)	.014 (.000)
$\Delta\sigma_{NIBEL,JIT} - \Delta\sigma_{NIBEL,Control}$	$\Delta\mu_{NIBEL,JIT} - \Delta\mu_{NIBEL,Control}$	.127	45.807 (.080)	.341 (.000)
PDDFVARA	$\Delta\mu_{assets,JIT} - \Delta\mu_{assets,Control}$	.004	-.0099 (.014)	-.0000002 (.420)
PDDFVARB	$\Delta\mu_{NIBEL,JIT} - \Delta\mu_{NIBEL,Control}$	.004	.0036 (.992)	.0071 (.455)
PDDFVARC	$\Delta\mu_{assets,JIT} - \Delta\mu_{assets,Control}$	.002	-.0036 (.292)	-.0000001 (.599)
PDDFVARC	$\Delta\mu_{ROABEL,JIT} - \Delta\mu_{ROABEL,Control}$	.084	-.0028 (.373)	-.1740 (.000)
PDDFVARD	$\Delta\mu_{ROABEL,JIT} - \Delta\mu_{ROABEL,Control}$	.034	.2476 (.395)	-8.115 (.020)

Note: All p-values are from two-tailed tests.

independent variable are insignificant (thus the low R^2s) and the intercepts are nearly identical to the paired differences in DIFFVAR1 and DIFFVAR3 reported in Table 14.

The seventh and eighth regressions reported in Table 16 provide limited support for Hypothesis 7. In both regressions, the dependent variable is the paired difference in the change in standard deviation of income before extraordinary items. Results from the seventh regression indicate that the change in standard deviation of earnings for adopters exceeds the change in standard deviation for nonadopters (a finding significant at the .236 level in a two-tailed test), after controlling for changes in firm size (which, given the unscaled dependent variable, is predictably significant). Results from the eighth regression are more significant. The change in standard deviation of earnings for adopters exceeds the change in standard deviation of earnings for nonadopters (a finding significant at the .080 level in a two-tailed test), after controlling for changes in earnings levels (which, given the unscaled dependent variable, is predictably significant).

Finally, results reported in Table 16 for the last five regressions do not alter earlier conclusions drawn with respect to Hypothesis 7. In each of the five regressions, the estimated intercept is similar in magnitude and significance to the mean paired differences reported in Table 15.

In summary, neither the two primary tests of Hypothesis 7 nor the related sensitivity tests strongly supports the prediction that JIT utilization will result in reduced earnings management. Consistent and reliable evidence of an increase in earnings variability for JIT adopters is not found in the results presented in Tables 14, 15 and 16.

Hypothesis 8

Results of the first test of Hypothesis 8 are presented in Table 17. Support for Hypothesis 8 requires that the average paired difference in DIFFTRAN be negative and that the average paired differences in DIFFACCT and DIFFDEPR be positive.

Results for the paired difference in DIFFTRAN support the prediction that managers will exercise less discretion with transaction-driven accruals after JIT is adopted, although significance levels are low (.191 and .348 in two-tailed paired t and signed rank tests, respectively). Similarly, the sign of the mean paired difference in DIFFACCT is correct (positive), but significance levels are very weak (.554 and .421). The mean paired difference in DIFFDEPR has the incorrect sign and is insignificant. Overall, the results reported in Table 17 provide very little support for Hypothesis 8.

Table 17
Paired differences in changes in the explanatory power of the economic determinants of total accrual components (Hypothesis 8, Test 1)

	JIT	Control	Paired diff.
Transaction-Driven Accruals			
DIFFTRAN* (n = 97 pairs)			
Mean	-.0147	-.0061	-.0089
Median	-.0102	-.0048	-.0033
t-value	-3.283	-1.589	-1.318
p-value	.001	.115	.191
Sign Rank S	-879.5	-427.5	-262.5
p-value	.001	.125	.348
Number > 0	35	41	47

Table 17 (Continued)

	JIT	Control	Paired diff.
Accounting-Driven Accruals			
DIFFACCT* (n = 92 pairs)			
Mean	.0054	.0018	.0026
Median	.0016	.0017	.0013
t-value	1.877	.617	.594
p-value	.064	.539	.554
Sign Rank S	443	212	208
p-value	.085	.412	.421
Number > 0	47	49	48
Depreciation Accruals			
DIFFDEPR* (n = 167 pairs)			
Mean	-.0008	-.0006	-.0001
Median	-.0007	-.0009	-.0003
t-value	-2.175	-1.712	-.287
p-value	.031	.089	.774
Sign Rank S	-1494	-1270	-486
p-value	.017	.042	.439
Number > 0	71	73	78

*DIFFTRAN is $(\sigma_{RESID,TRANDR})_{post\text{-}adoption} - (\sigma_{RESID,TRANDR})_{pre\text{-}adoption}$.
DIFFACCT is $(\sigma_{RESID,ACCTDR})_{post\text{-}adoption} - (\sigma_{RESID,ACCTDR})_{pre\text{-}adoption}$.
DIFFDEPR is $(\sigma_{RESID,DEPR})_{post\text{-}adoption} - (\sigma_{RESID,DEPR})_{pre\text{-}adoption}$.
$\sigma_{RESID,TRANDR}$, $\sigma_{RESID,ACCTDR}$ and $\sigma_{RESID,DEPR}$ refer to residual standard deviations from regressions of TRANDR, ACCTDR and DEPR on their respective economic determinants.
The economic determinants of transaction-driven accruals (TRANDR), accounting-driven accruals (ACCTDR) and depreciation (DEPR) are change in revenue, change in revenue minus the change in receivables, and lagged property, plant and equipment, respectively. To be included in a given test, each member of a matched pair must have at least of five years of data available in the pre- and post-adoption periods. Therefore, the paired differences in changes in the descriptiveness of the economic determinants of accruals are calculated from four regressions with a minimum of three degrees of freedom each.
To alleviate the effect of outliers, distributions are winsorized at 2% and 98%. All p-values are from two-tailed tests.

Models 3, 4 and 5 provide the second test of Hypothesis 8. Each model regresses the discretionary portion of a total accrual component on earnings management incentives and related interactions that control for 1) pre-adoption differences in the earnings management behavior of JIT adopters and nonadopters, and 2) intertemporal shifts in earnings management strategies that are not attributable to JIT adoption. Table 18 reports results related to the estimation of models 3, 4 and 5.

Results for the model with discretionary transaction-driven accruals as the dependent variable are located in the third column of Table 18. The coefficient on EARNCHG is significantly negative, as predicted, indicating that in periods preceding matched counterparts' JIT adoptions, control firms smoothed earnings with transaction-driven accruals.[88] The coefficient on ERNINT1 is negative and weakly significant (p = .100), which suggests that JIT adopters, relative to nonadopters, may have used transaction-driven accruals to a greater degree in smoothing earnings in pre-adoption periods. The coefficient on ERNINT2 is positive and highly significant (p = .000),

Table 18
Results from OLS regressions of discretionary total accrual components on earnings management and control variables (Hypothesis 8, Test 2)

Independent Variables	Pred. sign (3 models)	Dependent Variable TRANDRD (n = 2382)	ACCTDRD (n = 2369)	DEPRD (n = 2333)
Intercept	none	.0020	-.0008	-.0010
		(.592)	(.709)	(.017)
JIT	none	-.0034	-.0004	.0008
		(.524)	(.890)	(.172)
POST	none	-.0045	.0055	.0006
		(.384)	(.0861)	(.281)
JITPOST	none	.0029	-.0045	.0006
		(.691)	(.320)	(.438)
EARNCHG	(-,-,-)	-.5362	-.0920	-.0066
		(.000)	(.000)	(.039)
ERNINT1	none	-.0682	.0039	.0087
		(.100)	(.875)	(.076)
ERNINT2	none	.1812	.0620	.0036
		(.000)	(.008)	(.411)

[88] All p-values reported in Table 18 and in the related discussion are from two-tailed tests (including p-values related to coefficients for which predictions are made).

Table 18 (Continued)

Independent Variables	Pred. sign (3 models)	Dependent Variable TRANDRD (n = 2382)	ACCTDRD (n = 2369)	DEPRD (n = 2333)
ERN3WAY	(+,-,-)	-.0119	-.1047	-.0131
		(.841)	(.004)	(.061)
LEV	(+,+,+)	.0146	.0077	-.0131
		(.413)	(.477)	(.061)
LEVINT1	none	.0217	-.0120	-.0062
		(.410)	(.452)	(.043)
LEVINT2	none	.0086	-.0210	.0036
		(.714)	(.152)	(.411)
LEV3WAY	(-,+,+)	-.0450	.0320	-.0012
		(.197)	(.130)	(.771)
TAXDUM	(+,+,n/a)	.0025	.0038	n/a
		(.648)	(.259)	n/a
TAXINT1	none	.0009	-.0059	n/a
		(.909)	(.239)	n/a
TAXINT2	none	-.0077	.0060	n/a
		(.315)	(.899)	n/a
TAX3WAY	(-,+,n/a)	.0089	-.0071	n/a
		(.422)	(.299)	n/a
LAGTRN	(-,n/a,n/a)	-.1742	n/a	n/a
		(.000)	n/a	n/a
LAGACT	(n/a,-,n/a)	n/a	-.2300	n/a
		n/a	(.000)	n/a
LAGDEP	(n/a,n/a,+)	n/a	n/a	.3680
		n/a	n/a	(.000)
Model Adj. R^2		.35	.09	.17

Note 1: All p-values (shown in parentheses below related coefficient estimates) are from two-tailed tests. The model is estimated with distributions winsorized at 2% and 98%.

Note 2: To assess the effect of cross-sectional dependence, each model was also estimated with dummy variables for each firm present in the sample. For the TRANDRD model, coefficients (p-values) on ERN3WAY, LEV3WAY and TAX3WAY were -.0678 (.290), -.0225 (.572) and .0089 (.495), respectively. For the ACCTDRD model, coefficients (p-values) on ERN3WAY, LEV3WAY and TAX3WAY were -.0761 (.054), .0274 (.264) and .0012 (.879), respectively. For the DEPRD model, coefficients (p-values) on ERN3WAY and LEV3WAY were -.0038 (.609) and -.0061 (.182), respectively.

indicating that control firms used transaction-driven accruals to a lesser degree when smoothing earnings in periods following matched counterparts' implementation of JIT. The coefficient on ERN3WAY is not significantly different from zero (p = .841). This

suggests that the intertemporal shift away from transaction-driven accruals as an earnings smoothing tool is common to control firms and JIT adopters alike.

The leverage and tax variables (and related interactions) in the TRANDRD model are generally insignificant. Among these eight variables, only the coefficient on LEV3WAY (-.045) is weakly significant (p = .197 in a two-tailed test) in the predicted direction. As predicted, the lagged value of TRANDRD has a significantly negative coefficient in the TRANDRD model.

Results related to the ACCTDRD model are somewhat more supportive of Hypothesis 8. The coefficient on EARNCHG is negative (as predicted) and highly significant (p = .000). The coefficient on ERNINT2 is .062 and significant at the .008 level, suggesting that control firms have reduced their use of accounting-driven accruals to smooth earnings. However, the coefficient on ERN3WAY, which provides the test of Hypothesis 8, strongly supports the prediction that JIT adopters will increase the use of accounting-driven accruals to smooth earnings. The coefficient estimate, -.105, is significant at the .004 level. The coefficient estimate on LEV3WAY (.032, p = .130 in a two-tailed test) also supports Hypothesis 8, indicating that JIT adopters increase the use of accounting-driven accruals to manage earnings in response to incentives arising from covenants in debt agreements. The tax variable and related interaction terms are not significant in the ACCTDRD model. Finally, the lagged value of discretionary accounting-driven accruals is significantly negative when included as a regressor in the ACCTDRD model (a result consistent with the prediction).

Hypothesis 8 is also supported by the coefficient on ERN3WAY in the DEPRD model. The coefficient (-.013, p = .061) is consistent with the prediction that after JIT adoption, firms will use depreciation accruals to a greater degree to smooth earnings. The coefficients on EARNCHG and ERNINT1 together suggest that JIT adopters were not using depreciation accruals for this purpose in periods preceding JIT adoption.

Overall, the results reported in Table 18 provide support for the prediction that JIT adopters will decrease (increase) the use of transaction-driven (accounting-driven and depreciation) accruals to smooth reported earnings after JIT is implemented. The results indicate that JIT adopters, like nonadopters, have reduced the use of transaction-driven accruals in smoothing earnings. However, unlike nonadopters, adopters have increased the use of accounting-driven and depreciation accruals to meet financial reporting objectives. Test results with respect to the debt covenants and tax earnings management incentives, however, do not strongly support Hypothesis 8.[89]

The third test of Hypothesis 8 views managers' decisions regarding transaction-driven accruals, accounting-driven accruals and depreciation as joint decisions. The level of each component of total accruals is modeled as a function of 1) its economic determinants, 2) earnings management incentives, and 3) the level of the other two

[89] For two reasons, caution should be exercised when interpreting the results reported in Table 18. First, the models are estimated with the pooled data (i.e., a single firm could represent up to eight observations in the data) of firms matched on size, industry and inventory method, indicating that cross-sectional dependence could be affecting the results. Second, if managers make joint decisions regarding TRANDRD, ACCTDRD and DEPRD, the results reported in Table 18 are subject to simultaneous equation bias. To address the first of these concerns, each model was estimated with dummy variables for each firm represented in the sample. As indicated in Note 2 of Table 18, LEV3WAY was less significant in the TRANDRD and ACCTDRD models, and ERN3WAY was less significant in the DEPRD model when the models were estimated in this manner. Other inferences were unchanged. The

Table 19
Results from Two-Stage Least Squares estimation of the three-equation system (Hypothesis 8, Test 3)

Independent Variable	Pred. Sign (3 Equations)	Dependent Variable TRANDR	p-val	ACCTDR	p-val	DEPR	p-val
Intercept	none	.0035	.585	.0009	.718	-.0023	.000
JIT	none	-.0078	.389	-.0035	.315	.0014	.133
POST	none	.0000	.997	.0026	.457	-.0001	.942
JITPOST	none	.0029	.827	.0006	.913	-.0018	.179
Endogenous variables:							
TRANDR	(n/a,-,-)	n/a	n/a	-.2607	.000	-.0194	.021
TRANDRI1	(n/a,none,none)	n/a	n/a	-.0036	.904	.0208	.109
TRANDRI2	(n/a,none,none)	n/a	n/a	.0648	.042	-.0076	.517
TRANDRI3	(n/a,none,none)	n/a	n/a	.0301	.513	.0135	.445
ACCTDR	(-,n/a.-)	-2.0991	.000	n/a	n/a	.0245	.469
ACCTDRI1	(none,n/a,none)	-.4903	.105	n/a	n/a	.0224	.672
ACCTDRI2	(none,n/a,none)	.1453	.661	n/a	n/a	-.0195	.684
ACCTDRI3	(none,n/a,none)	.1874	.711	n/a	n/a	.1371	.066
DEPR	(-,-,n/a)	-.3989	.005	-.0874	.130	n/a	n/a
DEPRI1	(none,none,n/a)	-.0689	.712	-.0416	.580	n/a	n/a
DEPRI2	(none,none,n/a)	.2038	.285	.1034	.177	n/a	n/a
DEPRI3	(none,none,n/a)	.0561	.829	-.0009	.993	n/a	n/a
Test variables:							
EARNCHG	(-,-,-)	-.6273	.000	-.1887	.000	-.0136	.046
EARNI1	(none,none,none)	-.3236	.000	-.0889	.001	.0192	.151
EARNI2	(none,none,none)	.3198	.000	.1100	.000	.0042	.590
EARNI3	(+,-,-)	.1327	.064	.0363	.267	-.0089	.564
DEBTCOV	(-,-,-)	-.0057	.164	-.0015	.370	-.0002	.620
DBTCOVI1	(none,none,none)	.0015	.809	.0006	.803	-.0007	.309
DBTCOVI2	(none,none,none)	.0008	.890	.0017	.440	.0007	.235
DBTCOVI3	(+,-,-)	.0022	.790	-.0020	.543	.0007	.456
TAXDUM	(+,+,n/a)	.0011	.841	.0004	.864	n/a	n/a
TAXDUMI1	(none,none,n/a)	.0154	.056	.0041	.205	n/a	n/a
TAXDUMI2	(none,none,n/a)	-.0018	.819	.0034	.257	n/a	n/a
TAXDUMI3	(-,+,n/a)	-.0158	.162	-.0103	.021	n/a	n/a

potential for simultaneous equation bias is the motivation for the third test of Hypothesis 8.

Table 19 (Continued)

Independent Variable	Pred. Sign (3 Equations)	Dependent Variable TRANDR	p-val	ACCTDR	p-val	DEPR	p-val
Control variables:							
CHGREV	(+,n/a,n/a)	.1143	.000	n/a	n/a	n/a	n/a
CHGREVI1	(none,n/a,n/a)	-.0134	.484	n/a	n/a	n/a	n/a
CHGREVI2	(none,n/a,n/a)	.0104	.603	n/a	n/a	n/a	n/a
CHGREVI3	(none,n/a,n/a)	.0005	.987	n/a	n/a	n/a	n/a
LAGTRNDR	(-,n/a,n/a)	.0118	.573	n/a	n/a	n/a	n/a
LAGTRNI1	(none,n/a,n/a)	-.0337	.224	n/a	n/a	n/a	n/a
LAGTRNI2	(none,n/a,n/a)	-.0596	.109	n/a	n/a	n/a	n/a
LAGTRNI3	(none,n/a,n/a)	.0870	.130	n/a	n/a	n/a	n/a
CHMODREV	(n/a,none,n/a)	n/a	n/a	.0065	.269	n/a	n/a
CHMDRVI1	(n/a,none,n/a)	n/a	n/a	.0031	.714	n/a	n/a
CHMDRVI2	(n/a,none,n/a)	n/a	n/a	-.0145	.095	n/a	n/a
CHMDRVI3	(n/a,none,n/a)	n/a	n/a	-.0041	.741	n/a	n/a
LAGACTDR	(n/a,-,n/a)	n/a	n/a	-.1852	.000	n/a	n/a
LAGACTI1	(n/a,none,n/a)	n/a	n/a	.0384	.283	n/a	n/a
LAGACTI2	(n/a,none,n/a)	n/a	n/a	.0030	.929	n/a	n/a
LAGACTI3	(n/a,none,n/a)	n/a	n/a	-.0499	.339	n/a	n/a
SCALPPE	n/a,n/a,-)	n/a	n/a	n/a	n/a	-.0144	.000
SCLPPEI1	(n/a,n/a,none)	n/a	n/a	n/a	n/a	.0032	.056
SCLPPEI2	(n/a,n/a,none)	n/a	n/a	n/a	n/a	.0058	.000
SCLPPEI3	(n/a,n/a,none)	n/a	n/a	n/a	n/a	-.0071	.002
LAGDEPR	(n/a,n/a,+)	n/a	n/a	n/a	n/a	.7313	.000
LAGDPRI1	(n/a,n/a,none)	n/a	n/a	n/a	n/a	.1095	.000
LAGDPRI2	(n/a,n/a,none)	n/a	n/a	n/a	n/a	.0998	.000
LAGDPRI3	(n/a,n/a,none)	n/a	n/a	n/a	n/a	-.1514	.000
Avg. 1st-stage Adj. R^2		.72		.22			.95
2nd -stage Adj. R^2		.50		.24			.87
Hausman F-test for endogeneity		302.44 (p=.000)		52.69 (p=.000)			11.01 (p=.000)

Note 1: Each independent variable in the model also appears in three related interactions. For example, EARNI1 is EARNCHG*JIT, where JIT is coded one if the firm is a JIT adopter. Therefore, EARNI1 controls for differences that existed in JIT and control firms before the adoption of JIT. EARNI2 is EARNCHG*POST, where POST is coded 1 if the year is after the year in which the adopting member of a matched pair adopted JIT. Therefore, EARNI2 controls for intertemporal changes in earnings management behavior that are common to all firms in the sample and are therefore not attributable to JIT adoption. The primary test statistics are the three-way interactions (e.g., EARNI3), which capture JIT slope shifts relative to any differences in sample and control firms that existed prior to the control firms' JIT adoption and which are not attributable to intertemporal changes common to both sample and control firms.

Note 2: EARNCHG, DEBTCOV, TAXDUM and the nine related interactions are the endogenous variables in the system. The 1st-stage Adj. R-square shown for each equation in the system is the average 1st-stage Adj. R-square for the main effect and three related interactions.

Note 3: The Hausman test was conducted to assess whether (in general) TRANDR, ACCTDR and DEPR are endogenous. Therefore, the test was conducted on the main effects only (i.e., all interaction terms were ignored).

Note 4: All p-values are from two-tailed tests. The system was estimated with distributions winsorized at 2% and 98%.

components of total accruals. Table 19 reports results from Two-Stage Least Squares estimation of the three-equation system.

Results reported near the bottom of Table 19 indicate that estimating the three equations as a system is appropriate. For each equation, the Hausman F-test for endogeneity is significant at the .000 level, suggesting that managers' actions with respect to TRANDR, ACCTDR and DEPR are the result of a single decision. In the first stage of Two-Stage Least Squares, each endogenous variable is regressed on every exogenous variable in the system, prediction equations are formed, and the predicted values of endogenous variables are used as instruments for the actual values of the endogenous variables in the second stage regressions. Average adjusted R^2s of these first stage regressions were .72, .22 and .95, respectively.[90] Second-stage adjusted R^2s for the TRANDR, ACCTDR and DEPR equations were .50, .24 and .87, respectively.

Results reported in Table 19 indicate that (main effect) endogenous variables generally have negative coefficients when included as regressors in the three equations, a result consistent with the belief that TRANDR, ACCTDR and DEPR are substitute means of managing earnings. Coefficients on control variables representing the economic determinants of the three total accrual components are generally consistent with sign and significance expectations. In the ACCTDR and DEPR equations, the lagged values of dependent variables have the correct sign and are highly significant. In the TRANDR equation, the coefficient on LAGTRNDR has the wrong sign and is insignificant.

[90] For example, the adjusted R^2 reported for TRANDR was the average adjusted R^2 when TRANDR, TRANDRI1, TRANDRI2 and TRANDRI3 were regressed on all exogenous variables in the system.

Overall, the results reported in Table 19 for endogenous and control variables are consistent with expectations.

The middle portion of Table 19 provides results with respect to the third test of Hypothesis 8. Coefficients on main effects (EARNCHG, DEBTCOV, and TAXDUM) all have the correct signs, but only the coefficients on EARNCHG are significant (in all three equations), indicating that in periods preceding JIT adopters' implementation of the production technology, control firms smoothed earnings with each of the total accrual components. Coefficients on EARNI1 are negative and highly significant in the TRANDR and ACCTDR equations, suggesting that prior to adoption, JIT adopters smoothed earnings with these two total accrual components to a greater degree than the smoothing observed for nonadopters. The coefficient on EARNI1 is positive (but significant at only the .151 level in a two-tailed test) in the DEPR equation, suggesting that in periods preceding JIT adoption, adopters did not utilize depreciation accruals for earnings-smoothing purposes to the extent such accruals were utilized by nonadopters of JIT.

Coefficients on EARNI2 in the three equations capture intertemporal shifts in nonadopters' smoothing strategies. Coefficients on EARNI2 in the TRANDR and ACCTDR equations suggest that smoothing has decreased for such firms (i.e., the coefficients are positive and significant at the .000 level), while the coefficient in the DEPR equation is insignificant.

Results for EARNI3 provide the test of Hypothesis 8. JIT adopters are predicted to reduce their reliance on transaction-driven accruals to smooth earnings, and the

prediction is supported at the .064 level. Specifically, in the TRANDR equation, the coefficient on EARNI3 (.133) suggests that JIT adopters have reduced the usage of transaction-driven accruals for income-smoothing purposes to a greater degree than the intertemporal reduction observed for control firms. However, support for Hypothesis 8 also requires that JIT adopters increase the use of accounting-driven accruals for earnings-smoothing purposes, a prediction not supported by the coefficient on EARNI3 in the ACCTDR equation. In the ACCTDR equation, the coefficient on EARNI3 has the wrong sign (positive) and is insignificant.

The remaining results in Table 19 do not support Hypothesis 8. The only coefficients that are even mildly significant are DEBTCOV in the TRANDR equation (-006, p = .164, which is consistent with the prediction), TAXDUMI1 in the TRANDR equation (.015, p = .056, suggesting that, relative to control firms, JIT adopters, in pre-adoption periods, responded to tax incentives with transaction-driven accruals to a greater degree), and TAXDUMI3 in the TRANDR and ACCTDR equations. The result for TAXDUMI3 in the TRANDR equation is consistent with Hypothesis 8 (but significant at only the .162 level in a two-tailed test), and the negative coefficient on TAXDUMI3 (-.010, p = .021) in the ACCTDR equation suggests that adopters have decreased the use of accounting-driven accruals in responding to tax incentives, a result opposite of that predicted by Hypothesis 8.

Conclusions with respect to Hypotheses 7 and 8

In summary, the test results reported above provide little support for Hypotheses 7 and 8. Support for Hypothesis 7 is highly dependent upon the definition of earnings variation utilized in empirical tests. In some tests, the hypothesis is supported at very weak significance levels, and in other tests the results are strongly significant in the wrong direction.

Results are similarly inconclusive with regard to Hypothesis 8 tests. The first test produces results supportive of predictions regarding changes in the utilization of transaction- and accounting-driven accruals for earnings management purposes, although significance levels are poor. The second test suggests that JIT adopters have reduced the utilization of transaction-driven accruals for smoothing purposes only by an amount equal to the intertemporal reduction observed for control firms, and that adopters, relative to nonadopters, have increased the use of accounting-driven accruals to smooth earnings. However, the final test produces results that conflict with this conclusion. Modeled as a three-equation system, the intertemporal reduction in smoothing via transaction-driven accruals observed for JIT adopters exceeds the reduction for nonadopters, and adopters and nonadopters have reduced the utilization of accounting-driven accruals for smoothing purposes to a similar degree.

In the aggregate, the results of the five tests above do not support Hypotheses 7 and 8.

CHAPTER VI

SUMMARY

This study addresses two research questions. First, it examines whether earnings management incentives (e.g., smoothing, income taxes) influence managers' decisions to adopt or not adopt the JIT production technology. Second, the study examines whether the adoption of JIT reduces earnings management or induces a shift in earnings management strategies.

Much prior research examines the effect of capital market, income tax, debt covenant, bonus plan and other incentives on managers' accounting choices. However, few, if any, of these prior studies consider whether fundamental business decisions with nonrecurring, short-term earnings effects are influenced by such incentives. Results of the present study suggest that managers' decisions to adopt or not adopt JIT are associated with short-term earnings objectives.

Earnings management studies require knowledge of, or assumptions regarding, the earnings effect of the decision being modeled. In the present study, up-front implementation costs are assumed to render JIT adoption an income-decreasing decision in the adoption year for firms utilizing the FIFO inventory method. Firms utilizing the LIFO inventory method are assumed to experience two earnings effects related to JIT adoption: income-decreasing, up-front implementation costs identical to those incurred by FIFO-using JIT adopters, and income-increasing LIFO reserve liquidations associated with reductions in inventory levels. Therefore, the adoption year earnings effect of JIT implementation for LIFO firms is difficult to discern. However, it seems plausible to

assume that the adoption year earnings effect of JIT implementation for LIFO firms is, at worst, not as income-decreasing as the effect for FIFO firms.

Utilizing a research design and empirical tests that reflect the above assumptions regarding the earnings effect of JIT adoption, results of the study support the following conclusions. First, the JIT adoption decision is influenced by firms' earnings management histories. Firms that had aggressively managed earnings in years preceding the JIT adoption decision year (and presumably desired to manage earnings in future years) were much less likely to adopt JIT. Second, income-smoothing incentives appear to influence the JIT adoption decision. JIT adopters utilizing the FIFO inventory method exhibit much stronger (pre-managed) adoption year earnings than nonadopters utilizing FIFO. This association was not evident for LIFO users, for which JIT adoption is presumed to be much less income-decreasing. Finally, multivariate tests of the tax and debt covenant hypotheses were also supported, although significance levels were weak and results were sensitive to model specification.

The results of this study do not support any conclusions regarding the effect of JIT on the degree to which earnings are managed, nor do the results indicate that JIT utilization precipitates a shift in managers' earnings management strategies. Tests of changes in the degree of earnings management following JIT adoption utilized four different definitions of earnings variation, and two assumptions regarding how managers' smooth earnings (i.e., smoothing about a multi-period mean earnings level and smoothing about a time trend in earnings levels). Test results were very sensitive to the choice of

size scalar in the various earnings variation metrics, and sensitivity tests did not reduce this ambiguity.

The final hypothesis in this study predicts that JIT adoption will precipitate a shift away from transaction-driven earnings management strategies and toward accounting-driven strategies. Three tests of this hypothesis did not produce consistent and significant results.

Overall, results in the present study suggest that short-term earnings incentives may affect fundamental business decisions such as JIT adoption or nonadoption. This finding is an important extension of prior research documenting the effect of earnings incentives on accounting choices far removed from a firm's fundamental reasons for existence. The study's results do not permit conclusions regarding the effect of JIT utilization on earnings management strategies.

Future research

The present study could be improved or extended in several ways. First, the issue of JIT's effect on earnings management strategies could be readdressed with a more finely partitioned sample (e.g., the sample could be limited to JIT adopters that actually exhibit markedly improved inventory utilizations, as in Balakrishnan et al., 1996) and using a research design not so greatly influenced by the accrual methodology utilized in prior studies. Second, results reported in Table 7 indicate that JIT adopters improve inventory utilization to a greater degree than nonadopters. Future research could assess JIT's effect on other measures of firm performance, including profitability measures (e.g.,

gross and net margins, return on assets), market share, and capacity utilization. Finally, future research could also seek to determine the factors that cause some firms to benefit from JIT adoption, while other firms are less successful with the new production technology.

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