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"The Comparability of Accounting Rates of Return Under Historical Cost Accounting"

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The Comparability of Accounting Rates of Return Under Historical Cost Accounting[†]

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Comments Welcome.

ABSTRACT: We investigate a possible weakness of measuring assets using historical cost. Our results suggest that an economically significant portion of the return on net operating assets reported by firms with older assets is an artifact of historical cost accounting rather than superior economic performance. We document that this feature of historical cost accounting lowers the comparability and value-relevance of accounting-based rates of return. Results are concentrated in firms with high proportions of PPE, and alternative explanations due to variation in the age of the firm, managerial ability and competitive advantages are not supported by the data. Our results have implications for the ongoing debate on the appropriate measurement techniques for assets.

Keywords: Accounting rates of return, measurement basis, historical cost.
Data Availability: All data is available from the sources described in the text.

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I. INTRODUCTION

In this study we investigate how the measurement of assets affects the comparability and value relevance of accounting rates of return. Specifically, we examine how the natural variation in the age of firm's appreciable assets affects the comparability of performance metrics when assets are measured at historical cost. This question is of interest to policymakers as the Financial Accounting Standards Board's (FASB) and International Accounting Standards Board's (IASB) joint conceptual framework project does not provide analyses of the strengths and weaknesses of various measurement bases but highlights that the measurement chapter should "describe the advantages and disadvantages of each measurement in terms of the qualitative characteristics of useful financial information" (FASB, Project Update, Conceptual Framework—Measurement 2010). Central to the discussion of asset measurement techniques is the long-standing debate about whether the application of alternative measurement approaches, such as fair value, can potentially replace historical cost to measure of nonfinancial assets (Edwards and Bell 1961; Barth and Clinch 1998; FASB 2008; Nissim and Penman 2008; FASB Valuation Resources Group 2009).[1] Examining potential weaknesses with historical cost measurement is a crucial first step in assessing whether users of financial statements would benefit from the replacement of historical cost accounting. Our contribution is to provide direct evidence on a specific weakness with historical cost — reduced comparability and value-relevance of accounting information — which arises due to natural variation in the age of firms' appreciable assets.

Accounting rates of return, such as return on assets, allow for the comparison of performance across entities with different amounts of assets under their control and the comparison of an entity's own performance over time. With a focus on limiting the recognition

[1] The long-standing debate over the possible disclosure of nonfinancial asset fair values, using current entry prices and/or pricing models, has generally been opposed by accounting standard setters due to concerns over reliability (e.g., Barth and Landsman 1995; Barth and Clinch 1998; Barlev et al. 2007; Zeff 2007).

of asset values to transaction amounts, historical cost accounting produces a systematic difference in the value of assets reported on the balance sheet relative to the value of assets under managements' control. For firms with substantial amounts of appreciable assets, historical cost measurement biases reported assets downwards relative to their current value and results in accounting rates of return that are biased upwards (e.g., Aboody et al. 1999; Brown et al. 1992). Unless managers provide additional voluntary disclosures about current asset values, this measurement error will be difficult to assess over time as the current values of assets change.[2]

The measurement of accounting rates of return relies critically on both the numerator (i.e., income) and the denominator (i.e., assets). Some weaknesses associated with historical cost in measuring the numerator, income, have been documented in prior literature. For example, historical cost income does not appear to be as value-relevant as fair value income (e.g., Barth 1994; Hodder et al. 2006; Barth et al. 2008). Konchitchki (2011) provides evidence that historical cost income is inconsistent with the monetary assumption, leading to less useful measures of income. Our analysis complements this literature by focusing on possible denominator-based effects. Specifically, we investigate two hypotheses that examine possible weaknesses in comparability and value-relevance of the accounting rates of return reported by firms with older assets due to natural variation in asset age. Our first hypothesis predicts a positive relation between the age of a firm's property, plant, and equipment (PPE) and accounting rates of return after controlling for economic factors associated with performance. Our second hypothesis predicts a lower contemporaneous association between accounting rates of return and market returns for firms with older appreciable assets (i.e., lower value-relevance of accounting rates of return for firms with older appreciable assets).

[2] Specifically, when assets are measured at past amounts, accounting rates of return reflect performance relative to the cost of its assets. In order to reflect performance relative to assets under management's control, assets would need to be measured at current values (Barth 2006).

We measure asset age as the average age of the firm's property, plant and equipment calculated as the proportion of fixed assets depreciated to date (Chaney et al. 2009; Balakrishnan et al. 2011).[3] We industry-adjust this metric by subtracting from the firm's asset age, the median asset age of its industry counterparts. We then rank industry-adjusted asset age within quintiles of industry-adjusted profit margin, our proxy for competitive strategy, to sort firms into five groups. Group one includes firms with relatively new assets compared to those of their industry peers undertaking a similar competitive strategy (product differentiation vs. cost leadership), while group five includes firms with relatively older assets compared to those of their industry peers. Consequently, our asset age variable reflects differences in the average age of assets among same industry counterparts undertaking a similar competitive strategy. Likewise, we measure accounting rates of return as the return on net operating assets (*RNOA)* and industry-adjust *RNOA* by subtracting the annual industry median from the firm's financial ratio (Dickinson and Sommers 2011).

Our results suggest that firms with older appreciable assets report inflated accounting rates of return due to the asset turnover portion of RNOA (i.e., the portion of RNOA impacted by asset measurement). In regression analyses, after controlling for economic determinants of performance, firm age, and firm risk characteristics, we document higher abnormal *RNOA* for firms whose assets are older than those of their industry peers. This finding suggests that a portion of the abnormal *RNOA* reported by older-asset firms is an artifact of historical cost accounting rather than superior economic performance and thus reduces comparability across firms. We next investigate whether there is a difference in the persistence of accounting rates of

[3] We define this variable as accumulated depreciation divided by gross PPE. This measure of asset age has the useful property that it is scaled from zero to one, and can be considered as a measure of the proportion of the asset "used up." Our conclusions are unchanged when we replace this measure with an alternative measure of asset age (accumulated depreciation/depreciation expense) which is an approximation of the average number of years since the assets of the firm have been purchased.

return for firms with older assets. We find that accounting based rates of return for older-asset firms have lower persistence, indicating that the measurement of assets at historical cost also reduces comparability over time. These results provide preliminary evidence that the measurement of assets using historical cost accounting leads to a reduction in comparability. These findings provide support for our first hypothesis.

We next document that accounting rates of return are value-relevant, consistent with prior research.[4] We extend prior research by documenting that the value-relevance of accounting based rates of return is affected by variation in asset age. Specifically, abnormal *RNOA* of firms with assets purchased more recently are more value-relevant than those of firms with older assets. These results provide further evidence of a lack of comparability due to the measurement of assets at historical cost and support our second hypothesis. In addition, these results could also be interpreted as evidence that investors perceive a higher level of representational faithfulness for accounting rates of return when assets are measured closer to their current values.[5]

In our robustness analysis we document that alternative explanations based on firm-age, managerial ability, differences in operating risk, and the treatment of operating leases are not supported by the data. We also document that the bias in RNOA is reduced when large acquisitions of new assets or sales of older assets reduce the average age of firm's appreciable assets. Moreover, our results are robust to alternative measures of asset age. Finally, our results are strongest for firms that have larger proportions of nonfinancial assets (relative to financial assets, which are typically measured closer to current entry prices). Taken together, our

[4] Studies documenting the value-relevance of accounting rates of return include: Freeman et al. (1982), Nissim and Penman (2001), Fairfield and Yohn (2001), Rajan et al. (2007), Soliman (2008) and Dickinson and Sommers (2011).

[5] Where faithful representation is defined by the FASB as: "The level of confidence that can be placed on alternative measurements as representations of the asset or liability being measured" (FASB 2008).

robustness tests support that our results are based on denominator effects that relate to asset measurement.

Our results, however, must be interpreted with the important caveat that there is considerable discretion in the timing of when management can make changes to the assets under their control. This includes decisions of when to purchase newer assets or dispose of older assets and decisions to lower asset balances through impairment. Discretionary decisions made by managers could affect our inferences. A further possible caveat is that firms with older assets are potentially less risky. In our analyses, however, we control for firm-characteristics associated with risk, operating cost of capital, and firm age. Thus, a risk-based explanation appears unlikely.

The remainder of the paper is organized as follows. We present our hypotheses in section 2 and our sample in section 3. We present our analyses in section 4, and we present robustness tests in section 5. We conclude the paper in section 6.

II. HYPOTHESES

Accounting rates of return and asset measurement

Accounting rates of return (ARR) are important metrics for users of financial reports. ARR are often used: 1) to compare current period performance of different firms or same-firm performance over time, 2) to forecast future profitability, and 3) as an input into lending and compensation decisions (e.g., Freeman et al. 1982; Fairfield and Yohn 2001; Rajan et al. 2007; Penman 2007; Lundholm and Sloan 2007; Dickinson and Sommers 2011). These studies show that ARR are important indicators of performance and are used by market participants in a variety of settings. At the same time, however, other research documents upward bias in ARR because of conservative accounting, which may limit the usefulness of ARR (Feltham and Ohlson 1995; Beaver and Ryan 2000; Liu and Ohlson 2000; Penman and Zhang 2002; Ohlson and Juettner-Nauroth 2005). Measuring appreciable assets at historical cost is a conservative accounting method that produces an unobservable error in the value of assets reported on the balance sheet relative to the value of assets under managements' control.[6] As ARR are typically measured as income to the value of reported assets (or net assets) any unobserved errors in the measurement of assets will affect the measurement of the ARR.

The extent that the measurement of assets impacts comparability of ARR will depend on the magnitude of the errors and the extent of the cross-sectional variation in these errors. There is some preliminary evidence, from research examining upward revaluations of appreciable assets, that the magnitude of the errors is large enough to impact perceptions of profitability and contractual outcomes (Brown et al. 1992; Whittred and Chan 1992; Easton et al. 1993; Barth and Clinch 1998; Aboody et al. 1999; Lin and Peasnell 2000; Barlev et al. 2007). These studies investigate the motivations for and impact of measuring PPE at current values rather than historical cost in countries where upward revaluation is permitted.[7] In addition, Barlev et al. (2007) and Aboody et al. (1999) suggest that upward revalued assets generate greater returns, consistent with managers using appreciated assets to generate greater earnings (i.e., higher rates of return). The focus of these studies is on the incremental value-relevance of managers' discretionary decisions to recognize increases in asset values. As upward revaluation is discretionary, these studies do not provide direct evidence of how the non-discretionary

[6] Appreciable assets are those that increase in value following their purchase. Appreciable assets include both those that increase in value over time due to inflation (e.g., machinery, capital leases, furniture and fixtures) and those that increase over time due to other factors such as increasing scarcity (e.g., real estate) or uniqueness (e.g., brand names).

[7] These papers suggest a broad set of motivations for managers' decisions to revalue PPE upward including reducing political costs by lowering ARR and increasing debt capacity.

application of historical cost measurement and natural variation in age of appreciable assets impacts the comparability of ARR.

Over our sample period, asset prices have generally appreciated (see also Konchitchki 2011). Thus, we expect that, on average, ARR of firms with older average assets will be biased upwards. Specifically, the ARR is a biased measure of a firm's current economic performance and the firm's current internal rate of return when the firm has older appreciable assets. Holding the economic determinants of profitability constant, firms with older assets will have inflated accounting rates of return. Specifically, we hypothesize that:

H1: The average age of a firm's PPE is positively associated with the level of RNOA, controlling for the economic determinants of abnormal profitability.

To test Hypothesis 1, we examine the relation between asset age and industry-adjusted RNOA controlling for competitive strategy, firm age, and economic performance. If asset age impacts the comparability of RNOA, then we expect that asset age will positively correlate with abnormal profitability after we control for the economic determinants of profitability. We also expect that the bias in RNOA is primarily due to the denominator; hence, if we use the DuPont decomposition, we expect effects due to asset age to be concentrated in the (industry-adjusted) asset turnover component of RNOA, rather than profit margin. Finally, we examine the persistence of the abnormal RNOA reported by older-asset firms and expect differential persistence for this biased portion of RNOA. Evidence consistent with Hypothesis 1 would suggest that asset age affects the comparability of ARR by inflating the abnormal RNOA reported by older-asset firms.

There are clear alternatives to Hypothesis 1. First, it is possible that technological innovation and efficiency will offset any bias, on average, in ARR. Specifically, if newer assets are, on average, more efficient than their older counterparts, then it is possible that denominator effects due to understated asset values are subsumed by numerator effects due to lower profitability. Second, it is also possible that given the asset mix of the average company, the proportion of a firm's assets where replacement cost exceeds book value is too small to be economically significant. For example, in industries where a large portion of their total assets are measured using current values (e.g., banks) the difference between the reported book value of assets and the current value of assets will be small, and the effect of older assets on the measurement of RNOA will be insignificant. If either of these alternatives describe the average firm, then we will not find a positive relation between asset age and abnormal RNOA.

Value-relevance of accounting rates of return and asset age

Prior literature documents strong associations between current and future ARR, and between ARR and stock returns (e.g., Freeman et al. 1982; Nissim and Penman 2001; Fairfield and Yohn 2001; Soliman 2008; Dickinson and Sommers 2011). Financial statement analysis textbooks also advocate ratio analysis as a means of better understanding the firm and to develop superior predictions and trading strategies (e.g., Lundholm and Sloan 2007). These studies suggest that ARR are value-relevant and provide useful information to market participants. Specifically, ARR provide useful information because they aid investors in measuring economic rates of returns.

The value-relevance, or usefulness, of ARRs depends on how well ARRs measure, or faithfully represent, economic rates of return. We predict that as asset age increases, the representational faithfulness of ARR will be reduced. Faithful representation is defined by the FASB as: "The level of confidence that can be placed on alternative measurements as representations of the asset or liability being measured" (FASB 2008). Specifically, as historical cost focuses on transaction amounts rather than current amounts, it is difficult for investors to assess the rate of return from the assets at managements' disposal. As assets become older, reconciling the rate of return calculated using historical cost asset values with the return from current cost asset values (i.e., return from assets at managements' disposal) will become increasingly difficult. We predict therefore, that the ARR of firms with assets purchased more recently are more useful to investors, as they are more representative of the return over assets at managements' disposal. Stated as a hypothesis:

H2: The association between abnormal RNOA and market adjusted returns is lower for firms with older PPE.

To test Hypothesis 2, we examine the relation between market-adjusted returns and the interaction of asset age with industry-adjusted RNOA, controlling for firm characteristics associated with risk, competitive strategy, firm age, and economic performance. If asset age impacts the value-relevance of RNOA, then we expect the coefficient on the interaction between asset age and industry-adjusted RNOA to be negative. Evidence supporting Hypothesis 2 would suggest that historical cost accounting affects the usefulness of ARR for older-asset firms. Similar to H1, we will not find support for H2, if the proportion of a firm's assets where replacement cost exceeds book value is too small to be economically significant and/or if market participants view performance relative to the historical cost of assets as the most useful rate of return.

III. SAMPLE AND MEASUREMENT OF VARIABLES

Data sources and sample selection

To test our hypotheses, we gather a broad sample of firms from Compustat and collect returns data from the Center for Research in Security Prices (CRSP) from 1963 to 2009. We end our sample in 2009 because our tests require future accounting and returns data. We require firms to have non-missing accumulated depreciation and gross PPE so that we can calculate the relative age of assets. We eliminate firms from our sample that are missing assets, net income, shares outstanding, price at the end of the fiscal year, and one-year-ahead *RNOA* or returns, all of which are necessary for our main analysis. Similar to prior researchers, we reduce the impact of extreme observations by excluding, in year *t*, firms with *RNOA* in excess of 1 or less than –1, and firms in the top and bottom 1 percent of asset turnover (*ATO*), profit margin (*PM*) and returns (e.g., Beaver and Ryan 2000; Penman et al. 2007). Our final sample contains 114,480 firm-year observations.

Measurement of variables

We measure accounting rates of return as the return on net operating assets, which prior research shows is more relevant for forecasting future profitability than ROA (Fairfield and Sweeney 1996; Nissim and Penman 2001; Dickinson and Sommers 2011). Specifically, *RNOA* is return on net operating assets defined as operating income after depreciation divided by net operating assets (*NOA*).[8] Following Nissim and Penman (2001), *NOA* is calculated as book value plus net debt.[9] We measure asset turnover (*ATO*) as *Sales*/*NOA* and the profit margin ratio (*PM*)

[8] Our results are qualitatively similar when using operating income before depreciation.

[9] Specifically, we calculate book value (*BVE*) as common equity plus any preferred treasury stock less any preferred dividends in arrears (Compustat variables (*CEQ+TSTKP–DVPA*)) and net debt as the difference between financial liabilities and financial assets (Compustat variables ((*DLTT+DLC+PSTK+DVPA–TSTKP*)–*CHE*)).

as *OIAD/Sales*. We industry-adjust *RNOA*, *ATO* and *PM* by subtracting the annual industry median from the firm's financial ratio and denote the adjusted ratios with the subscript *ia*. We define industries using the 48 categories in Fama and French (1997). To estimate the age of the firm's property we first measure the proportion of fixed assets depreciated to date with the relative age percentage ratio (Accumulated Depreciation/Gross PPE). To control for differences across industries in salvage values and in the costs associated with utilizing older assets, we industry adjust *AssetAge* by subtracting from the firm's *AssetAge* the median *AssetAge* for all firms in the same industry-year. We then rank industry-adjusted *AssetAge* within quintiles of industry-adjusted profit margin to sort firms into five groups. Quintile 1 includes firms with relatively new assets compared to those of their industry peers undertaking a similar competitive strategy (product differentiation vs. cost leadership) and vice versa for quintile 5. Consequently, our asset age variable reflects differences in the average age of assets among same industry counterparts undertaking a similar competitive strategy. We use this ranked variable in all portfolio and regression analyses to reduce the likelihood that our asset age measure reflects factors other than the age of the firm's assets.

We measure each firm's returns as the market-adjusted buy-and-hold return using the value-weighted market return (*MA-RET*). We calculate delisting returns following Beaver et al. (2007) for firms whose stock delists over our return holding periods. Specifically, if the firm's return is missing during the delisting month, then the monthly return is replaced with the delisting return. If the monthly return is not missing during the delisting month, then the delisting month's return is added to the monthly return. Our regression analyses also include controls for firm age (*FirmAge*), the firm's book-to-market ratio (*BM*), firm size (*Size*), and an indicator for firm years with negative net income (*Loss*). The appendix provides detailed variable descriptions.

Descriptive statistics

In Panel A of Table 1, we present our descriptive statistics. On average, our sample firms report assets (*Assets*) of $1,754 million and have a market capitalization (*MVE*) of $1,318 million. The average firm has an *RNOA* of 13 percent and has contemporaneous, market-adjusted returns of 2 percent. Finally, we find that the average firm has depreciated about 42 percent of its PPE (*AssetAge*). Thus, average PPE is about 6 years old ($AssetAge_{years}$), and the average firm has been publicly traded for over 14 years (*FirmAge*). $AssetAge_{years}$ is an alternative measure of asset age and is calculated as accumulated depreciation divided by depreciation expense.

In Panel B of Table 1, we present some preliminary evidence consistent with Hypothesis 1. Specifically, we present average *RNOA*, *ATO*, *PM* and industry-adjusted ratios by quintiles formed based on the age of the firm's assets relative to industry peers. We observe that average *RNOA* for firms with relatively new assets is 0.10 (Quintile 1), which is significantly lower than the average *RNOA* of 0.14 for firms with older assets (Quintile 5). In addition, we find that asset turnover (*ATO*) ratios increase monotonically with asset age. The difference between *ATO* for newer-asset firms (*ATO* = 2.04) and *ATO* for older-asset firms (*ATO* = 2.66) is 0.62, greater by over 30 percent. We do not observe a similar monotonic increase in profit margin across *AssetAge* quintiles. We document similar results when we examine the industry-adjusted ratios $RNOA_{ia}$, ATO_{ia}, and PM_{ia}. Finally, we note that Net PPE, and the firm's book-to-price (BP) ratio do not differ significantly for firms in the oldest quintile of asset age relative to firms in the newest quintile, but older-asset firms have significantly higher 12 month abnormal returns.

IV. RESULTS

In this section we discuss the results from the tests of our two hypotheses. We present three sets of tests that provide evidence on H1. First, we perform two way sorts based on industry-adjusted profit margin and *AssetAge*. Under H1, we expect accounting rates of return and asset turnover ratios to increase across *AssetAge* quintiles. Second, we examine the relation between *AssetAge* and contemporaneous abnormal *RNOA* while controlling for the economic determinants of abnormal profitability. Support for H1 is provided if *AssetAge* exhibits a positive and significant relation with abnormal RNOA. Third, we examine the differential persistence of abnormal RNOA for older-asset firms. We expect that abnormal profitability reported by older-asset firms to exhibit differential persistence relative to the abnormal profitability reported by firms with newer assets.

To test our second hypothesis that the value-relevance of abnormal RNOA is lower for firms with older assets we examine the differential relation between abnormal RNOA and contemporaneous abnormal returns for older-asset firms. Under H2, we expect to observe an attenuated relation between abnormal RNOA and contemporaneous abnormal returns for older asset firms.

Tests of hypothesis 1

Two-way sorts based on industry-adjusted profit margin and industry-adjusted asset age

We sort firms into portfolios based on industry-adjusted profit margin. We assume that a firm's rate of profit margin reflects the firm's competitive strategy (i.e., high profit margins correspond to a product differentiation strategy and low profit margins correspond to a high-turnover strategy). In our setting, profit margin is also a useful measure of current economic performance (given the firm's competitive strategy), as it is not directly affected by the measurement of the firm's assets. We form *AssetAge* quintiles annually based on industry-adjusted asset age within quintiles of PM_{ia}. We denote this ranked variable as $AssetAge_{ia}\_rk$. Panel A and B of Table 2 report the results from these analyses, which show that across all but one profit margin quintile, older-asset firms report significantly higher $RNOA_{ia}$ and ATO_{ia} than newer-asset firms. The exception is $RNOA_{ia}$ for firms with the lowest abnormal profit margins (PM_{ia})—for these firms we observe no difference in the $RNOA_{ia}$ reported by older asset firms relative to the $RNOA_{ia}$ reported by younger-asset firms. In untabulated analyses, we sort firms based on PM_{ia} and firm age (rather than asset age); we do not observe a similar pattern of results.[10] These findings suggest that the age of the firm's asset is associated positively with abnormal profitability and provide support for H1.

Regressions analyses of the relation between asset age and industry-adjusted RNOA

We next investigate whether $AssetAge_{ia}\_rk$ impacts contemporaneous industry-adjusted $RNOA_{ia}$ controlling for the economic determinants of abnormal profitability. Specifically, we implement a regression analysis that investigates the impact of $AssetAge_{ia}\_rk$ on $RNOA_{ia}$, after controlling for firm age ($FirmAge_{ia}$), prior period performance (lagged $RNOA_{ia}$), competitive strategy (PM_{ia}), the book-to-price ratio (*BP*), firm size (*Size*), and an indicator variable for firm-years with negative operating income (*Loss*). We provide the model below:

$$RNOA_{ia,t} = a_0 + a_1 RNOA_{ia,t-1} + a_2 AssetAge_{ia}\_rk_t + a_3 FirmAge_{ia}\_rk_t + a_4 PM_{ia,t-1} + a_5 BP_{t-1} + a_6 Size_{t-1} + a_7 Loss_{t-1} + e_t \quad (1).$$

In Hypothesis 1 we predict a positive coefficient on $AssetAge_{ia}\_rk$, the quintile rank of the firm's industry-adjusted asset age where asset age quintiles are formed within PM_{ia} quintiles.

[10] We discuss this test further in Section V, the Robustness Analyses section.

We include a control for the rank of industry-adjusted firm age (also ranked within PM_{ia} quintiles) to reduce the likelihood that our results are driven by factors related to firm age.[11] In addition, we include PM_{ia} to control for competitive strategy of the firm, *BP* (the book-to-price ratio) and *Size* (the logarithm of the firm's market capitalization) to control for firm characteristics that may impact changes in rates of return due to variation in risk. Following Hayn (1995), we include an indicator for loss years (*Loss*). We report the results from this analysis in Table 3. As our tests are based on panel data, we report *p*-values based on standard errors clustered by firm and year (Petersen 2009) in this analysis and all subsequent regression analyses. Across all specifications we observe a significant and positive relation between prior year's $RNOA_{ia}$ and current $RNOA_{ia}$. In support of H1, we document a positive and significant coefficient on $AssetAge_{ia}\_rk$ (*t*-statistic = 22.16), the coefficient suggests that older firms have an economically significant higher level of RNOA of 4%.

In summary, these results suggest that after controlling for firm age, lagged performance, and firm characteristics, firms with older assets (relative to same year industry peers with similar profit margins) report higher levels of $RNOA_{ia}$ than firms with newer assets. These findings support H1.

Regressions investigating the persistence of industry-adjusted RNOA for older-asset firms

Abnormal profitability reported by older asset firms may exhibit differential persistence relative to "true" abnormal economic profits as long as older assets are retained. Ex ante it is difficult to predict the sign of this coefficient as it depends on the rate of mean reversion in

[11] It is possible that *FirmAge* correlates with asset age, in some instances, and firm age might also correlate with factors associated with sustained ability to generate abnormal profits (e.g., life-cycle effects, business-specific advantages (McGahan and Porter 2003), or competitive advantages resulting from learning over time (e.g., Amit 1986)).

abnormal economic performance relative to the persistence of the bias in *RNOA* caused by asset age. We examine the persistence of abnormal profitability for older-asset firms with the following model and expect to observe a significant coefficient for $RNOA_{ia} \times AssetAge_{ia}\_rk$.

$$RNOA_{ia,t+1} = a_0 + a_1 RNOA_{ia,t} + a_2(RNOA_{ia} \times AssetAge_{ia}\_rk)_t + a_3 AssetAge_{ia}\_rk_t + a_4 FirmAge_{ia}\_rk_t + a_5 PM_{ia,t} + a_6 BP_t + a_7 Size_t + a_8 Loss_t + e_{t+1} \quad (2).$$

We report the results from this analysis in the final columns reported in Table 3. We continue to observe a positive and significant coefficient for $AssetAge_{ia}\_rk$ suggesting that the bias in abnormal RNOA from appreciable asset measurement persists. We also find a significant and negative coefficient for $RNOA_{ia} \times AssetAge_{ia}\_rk$ indicating that the abnormal RNOA reported by firms with older appreciable assets is less persistent than industry counterparts with similar profit margins, but whose PPE are newer. In untabulated analyses, we supplement equation (2) with an interaction variable between $RNOA_{ia}$ and firm age ($FirmAge_{ia}\_rk$). We find a significant and positive coefficient for the interaction term indicating that the abnormal profitably reported by older firms is more persistent than the abnormal profitability reported by younger firms. At the same time, we continue to observe the significant and negative coefficient for the interaction of $RNOA_{ia}$ and *AssetAge.* This finding provides some corroborating evidence that our asset age variable reflects asset age and not firm age.

Test of hypothesis 2

Hypothesis 2 predicts that equity investors react differently to the abnormal RNOA reported by firms with older, appreciated assets. We test H2 with equation (3) and expect to observe a significant negative coefficient on $RNOA_{ia} \times AssetAge_{ia_{rk}}$ as $RNOA_{ia}$ is less useful in measuring true economic performance for firms with older appreciable assets.

$$MA\_RET_t = a_0 + a_1 RNOA_{ia,t} + a_2(RNOA_{ia} \times AssetAge_{ia}\_rk)_t + a_3 AssetAge_{ia}\_rk_t + a_4 FirmAge_{ia}\_rk_t + a_5 PM_{ia,t} + a_6 BP_t + a_7 Size_t + a_8 Loss_t + e_{t+1} \quad (3).$$

Table 4 reports the results. As expected we find a significant and positive coefficient for abnormal RNOA indicating that equity investors respond positively to firm's reporting of abnormal profitability. In support of H2 we also find a significant and negative coefficient on the interaction term ($RNOA_{ia} \times AssetAge_{ia}\_rk$) suggesting that market participants respond less strongly to the RNOA reported by older-asset firms than their response to same industry counterparts with newer fixed assets.[12]

We also estimate a variant of equation (2) by asset age quintiles ($AssetAge_{ia}\_rk$). This estimation allows the coefficients on each of the control variables to vary with asset age. To estimate these specifications we exclude asset age and the interaction term from the model. We observe a significantly greater coefficient for abnormal RNOA for low asset-bias firms (Q1, coefficient = 0.47) than for high-bias firms (Q5, coefficient = 0.34). Together these findings suggest that market participants respond less to the abnormal RNOA reported by firms with older PPE and provide support for H2.

V. ROBUSTNESS ANALYSES

In this section we report three sets of robustness analyses. The aim of the first set is to determine whether or not other firm and industry characteristics drive the bias in RNOA that we attribute to asset age. The second set examines the sensitivity of our findings to controlling for managerial ability. The third section discusses tests aimed at assessing the sensitivity of our results to other research design decisions (e.g., capitalizing operating leases).

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[12] Interestingly, the negative coefficient on the interaction term ($RNOA_{ia} \times AssetAge_{ia}\_rk$) remains when we replace contemporaneous abnormal returns with future (one-year forward) abnormal returns.

Asset Age robustness tests

We discuss seven analyses in this section. First, in untabulated analyses, we perform two-way sorts based on PM_{ia} and age of the firm ($FirmAge_{ia}$) since incorporation (also industry adjusted). We do not observe a similar pattern of increase in $RNOA_{ia}$ and ATO_{ia} across firm age quintiles. These results are consistent with difference in measurement of assets driving our results, rather than firm life-cycle effects.

Second, we examine whether the asset age bias is reduced when changes in the firm's asset base result in changes in the asset-age-related bias in RNOA. We expect the asset age bias to persist until firms invest in new fixed assets or dispose of older assets at which point in time we expect a decline in the inflation in $RNOA_{ia}$. We investigate this prediction by examining means of portfolios formed based on changes in asset age and by examining with regression analyses whether declines in asset age correspond with declines in $RNOA_{ia}$.

Table 5 reports the results from the portfolio analyses. Within each industry-adjusted profit margin quintile, we sort firms into five groups based on the change in asset age, where quintile five (one) includes firms with the largest increase (decrease) in asset age (i.e., quintile five (one) includes firms with the largest increase (decrease) in the bias in ARR from historical cost measurement). Panel A (Panel B) reports the results for $\Delta RNOA_{ia}$ (ΔATO_{ia}). With the exception of the first PM_{ia} quintile for $RNOA_{ia}$, we find that firms with the greatest increases in asset age (increase in the bias) report the greatest increases in $RNOA_{ia}$ and ATO_{ia}. Similarly, firms with the greatest decreases in asset age (decrease in the bias) report the greatest decreases in $RNOA_{ia}$ and ATO_{ia}.

For the regression analyses, we supplement equation (2) with an indicator variable for firms with substantial decreases in asset age due to investment in new fixed assets, sales of older fixed assets, or both. We define $DropAssetAge_{ia}$ as an indicator variable set equal to one for firms whose $AssetAge_{ia}$ rank in fiscal year *t* is equal to 5 (the oldest *AssetAge* quintile), but less than 5 in fiscal year *t*+1. We expect to observe a negative coefficient for this variable, as we expect it to be associated with a reduction in the asset-age bias. As investment in future periods is not known as of the end of fiscal year *t*, this specification is not a prediction model, but does allow us to corroborate that the source of inflation in $RNOA_{ia}$ is due to older assets. Confirming our prediction, the coefficient for $DropAssetAge_{ia}$ is negative and significantly different from zero. We find similar results (untabulated) when we include controls for contemporaneous managerial ability and the change in PPE in year *t*+1.

For our third asset-age robustness analyses, we re-calculate asset age using only buildings for a sub-set of firms with available data.[13] We find a positive relation between building age and future $RNOA_{ia}$ that is attenuated when building age decreases. Fourth, rather than ranking industry-adjusted asset age within industry-adjusted profit margin (PM_{ia}) quintiles, we rank asset age based solely on industry-adjusted asset age ($AssetAge_{ia}$) and we find qualitatively similar results.

Fifth, we define asset age using an alternative metric calculated as depreciation expense divided by accumulated depreciation and multiplied by -1 (*AssetAge2*).[14] As with *AssetAge*, we industry this metric and rank it annually within industry-adjusted profit margin quintiles. $AssetAge_{ia}\_rk$ positively correlates with $AssetAge2_{ia}\_rk$ (Pearson correlation = 0.57). We find

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[13] Specifically, we define $AssetAge_{BLDS}$ as the quintile rank of the age of the industry-adjusted age of the firm's buildings. As with *AssetAge*, quintile ranks of $AssetAge_{BLDS}$ are defined within each quintile of industry-adjusted profit margin. We calculate the relative age of a firm's buildings as accumulated depreciation/ending gross *PPE* (*FATB-PPENB/FATB*). The correlation between *AssetAge* and $AssetAge_{BLDS}$ is 0.65, which suggests that both variables reflect similar information.

[14] Accumulated depreciation divided by depreciation expense is the usual calculation for asset age in years and is also how we calculate *AssetAge2* reported in Table 1. In regression analyses, we use the inverse (Depreciation expense/accumulated depreciation) and multiply it by -1 to avoid the small denominator problem associated with dividing by depreciation expense.

that $AssetAge2_{ia}\_rk$ positively correlates with abnormal profitability ($RNOA_{ia}$) after controlling for the economic drivers of profitability, and less closely corresponds to contemporaneous and future abnormal returns than the $RNOA_{ia}$ reported by similar firms with newer appreciable assets, i.e., is less value relevant.

Sixth, we attempt to directly measure the appreciation of assets using the method described in Chaney et al. (2009) and Balakrishnan (2011) for the subset of our firms with available data (N = 9,585). We begin with AssetAge ($Accumulated\ depreciation/gross\ PPE$). Following Balakrishnan (2011) we assume that PPE is used for 40 years and multiple $AsserAge$ by 40 to estimate the number of years the firm has held the asset. Next, we determine the rate of appreciation in the state for which the firm is headquartered over the time frame that the firm has held the asset. We then use this information to calculate an estimate of the current value of the asset. Next, we separate reported RNOA into two parts: 1) RNOA stemming from assets under management's control, and 2) the inflated portion stemming from the measurement of assets (i.e., using a denominator that is too small). Consistent with our reported analyses, we find that the inflated portion of RNOA is less persistent and less value relevant.

Finally, we perform industry analyses and report the results in Table 6. We re-estimate our analyses for two subsets of firms. Our first subset is banks. We expect the impact of the asset age bias to be minimal for banks as they measure many of their assets at fair value and they generally have small amounts of appreciable fixed assets on their balance sheet. We define banks per the Fama and French (1997) industry classifications and refer to this group as "low asset appreciation firms". Our second subset of firms includes firms for which we expect the asset age related bias to be particularly strong. To identify this subset of firms we calculate the proportion of NOA from land and buildings (*Land_Build%)* as we expect land and buildings are two assets likely to appreciate in value over time. We include in this group firms in the top quartile of *Land_Build%* and refer to these firms as the "high asset appreciation firms". The sample size for this analysis is reduced because information necessary for determining the portion of assets attributed to property and buildings (Compustat items PPENLI and PPENB) is not available for all sample years. We re-estimate our analyses for these two subsets of firms and report the results in Table 7.

In Panel A (Panel B) of Table 6 we report mean $RNOA_{ia}$ (ATO_{ia}) for the first and fifth quintiles of asset age. We report these averages separately for our high and low asset appreciation groups. As expected, we find no evidence that $RNOA_{ia}$ and ATO_{ia} increase across asset age quintiles for banks (i.e., low asset appreciation firms). In contrast, we find strong evidence (particularly for the asset turnover portion of RNOA) that accounting rates of return increases with asset age for firms with large amounts of appreciable assets on their balance sheets. Panels C and D of Table 6 replicate our main analyses for these two subsets of firms. The results suggest that the positive relation between asset age and abnormal performance, and the reduced value relevance of $RNOA_{ia}$ for older-asset firms is driven by firms with large amounts of appreciable assets on their balance sheets and not apparent for our subsample of firms whose balance sheets comprise few appreciable assets measured using modified historical cost.

Taken together, these findings corroborate our main tests of our Hypotheses. They provide corroborating evidence that historical cost measurement of appreciable assets makes unadjusted accounting-based rates of return less comparable.

Sensitivity of our findings to controlling for managerial ability

An alternative explanation for our findings related to *AssetAge* is that *AssetAge* reflects superior managers' ability to transact at lower prices (e.g., time the purchase of assets to take advantage of temporarily reduced prices or negotiate better terms). Based on prior literature, we measure managerial ability with *MgrAbility*, the ability score developed and made available by Demerjian et al. (2010). We expect to observe a positive relation between managerial ability and performance.[15] We re-estimate our analyses including this control variable for managerial ability. The sample size is reduced for these specifications as the managerial ability metric is only available for a subset of our sample. As shown in Table 7, we continue to observe a positive and significant relation between AssetAge and abnormal profitability and a negative relation between the interaction term $(RNOA_{ia} \times AssetAge_{ia}\_rk)$ and both future $RNOA_{ia}$ and contemporaneous abnormal returns (*MA_RET*). In untabualted analyses, following Fee and Hadlock (2003), we also measure managerial ability with historical five-year returns (*HisRet*) and find similar results to those reported.

Additional robustness tests

In this section we document additional robustness analyses (results are not tabulated for these analyses). First, we include the change in abnormal RNOA in all regression models ($\Delta RNOA_{ia}$) and find results that are qualitatively similar to those reported. Second, we consider the impact of differences in operating risk on our results by adjusting abnormal RNOA for operating risk following the method implemented by Dickinson and Sommers (2011).

[15] *HisRet* is measured as 5-year past value-weighted industry-adjusted return using monthly CRSP data and *MgrAbility* is the managerial efficiency score from Demerjian et al. (2010). Following Demerjian et al. (2011), in cross-sectional regressions, we use the quintile rank of this variable where firms are ranked annually within Fama and French (1997) industries.

Specifically, we subtract from RNOA an estimate of expected operating risk (weighted average cost of capital—WACC Dickinson and Sommers (2011)—and use this risk-adjusted abnormal RNOA metric in all analyses. We find similar results to those reported.

Third, we investigate the sensitivity of our findings to capitalizing operating leases. Our results are not sensitive to treating operating leases as purchases of fixed assets although the statistical significance of the differential persistence of abnormal RNOA for older asset firms is weaker, likely because our sample size is reduced by about 50 percent due to missing information.

VI. CONCLUSION

We present evidence that the comparability and value-relevance of accounting rates of return are reduced when assets are measured at historical cost. Our results are due to the natural cross-sectional variation the average age of firms' appreciable assets, which exists due to variation in the timing of purchases and disposals of property, plant, and equipment. Our investigation is motivated by the importance of documenting specific weaknesses with particular asset measurement techniques. Our results provide a crucial first step in the assessment of replacing the primacy of historical cost with alternative measurement techniques for long-lived assets.

We measure asset age as the average age of the firm's property, plant and equipment calculated as the proportion of fixed assets depreciated to date (accumulated depreciation/gross property, plant, and equipment). We industry-adjust this metric by subtracting from the firm's asset age, the median asset age of its industry counterparts. We then rank industry adjusted asset age within quintiles of industry-adjusted profit margin. Consequently, our asset age variable reflects differences in the average age of assets among same industry counterparts undertaking a similar competitive strategy.

We document that older-asset-age firms have systematically higher accounting rates of return. Portfolio analyses suggest that the higher abnormal RNOA reported by older-asset firms is driven by the asset turnover portion of RNOA—the component impacted by asset measurement. Regression analyses suggest that after controlling for the economic factors associated with abnormal performance, firms with older assets report higher abnormal RNOA—results that suggest a portion of the abnormal profitability reported by older asset firms is unrelated to economic performance and stems from historical cost accounting for appreciable assets. In addition, decreases in a firm's average age of assets (through purchases or disposals) are associated with lower accounting based rates of return. We also document that the results are strongest in industries that have a large proportion of long-lived nonfinancial assets.

Our second set of tests is aimed at investigating whether the lack of comparability arising from the use of historical cost in the measurement of nonfinancial assets has implications for investors. We find that accounting rates of return for firms with older assets are significantly less value-relevant than those of firms with younger assets. Taken together our findings suggest that historical cost leads to a less comparable and less informative accounting rates of return.

It is important to note that because our analyses do not provide evidence on all of the costs and benefits of competing measurement techniques, we cannot speak to the best measurement technique per se. Instead, our findings contribute to the measurement discussion by providing empirical evidence of a significant drawback of historical cost measurement — a reduction of the comparability of accounting based rates of return. Our results complement prior studies which have documented enhanced comparability and value-relevance of financial information measured using current market values. Future research could investigate the impact biased accounting rates of returns and asset age on various contractual applications of accounting such as investment and compensation decisions.

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Appendix
Variable Definitions

Variable	Definition
AssetAge	estimate of the age of the firm's property, plant and equipment. We measure asset age with a method similar to Chaney et al. (2009) and Balakrishnan (2011). Specifically, we define asset age as the ratio of accumulated depreciation (PPEGT-PPENT) to historic cost of the assets (PPEGT). This variable measures the percentage of assets depreciated to date.
$AssetAge_{ia}$	the industry-adjusted measure of asset age defined as the firm's AssetAge less the median AssetAge same industry and year firms.
$AssetAge_{years}$	an alternative estimate of the age of the firm's property, plant and equipment defined as accumulated depreciation (PPEGT-PPENT) divided by depreciation expense (DP - AM).
Assets ($M)	the firm's assets (AT).
NOA ($M)	the firm's net operating assets defined as book value (BVE) plus net debt, where net debt is calculated as ((DLTT+DLC+PSTK+DVPA-TSTKP)-CHE).
BVE ($M)	the firm's book value of equity (CEQ+ TSTKP-DVPA).
MVE ($M)	the firm's market value of equity (PRCC_F ×CSHO).
RNOA	return on net operating assets defined as operating income after depreciation (OIADP) divided by net operating assets (NOA).
$RNOA_{ia}$	industry-adjusted RNOA defined as the firm's RNOA less the median RNOA for all firms in the same Fama and French (1997) industry and year.
ATO	the firm's asset-turnover ratio (Sales/NOA).
ATO_{ia}	the firm's industry adjusted ATO defined as firm's ATO less the median ATO for all firms in the same Fama and French (1997) industry and year.
PM	the firm's profit margin ratio (OIAD/Sales).
PM_{ia}	the firm's industry adjusted PM defined as firm's PM less the median PM for all firms in the same Fama and French (1997) industry and year.
MA-RET	the firm's market-adjusted return calculated as the firm's buy-and-hold return less the buy-and-hold on the value weighted market portfolio .
BM	the firm's book-to-price ratio (BVE/MVE).
FirmAge	age of the firm defined as the number of years the firm has traded publically on national stock exchanges (i.e., number of years since the firm's IPO).
Size	the logarithm of the firm's market capitalization (MVE).
Loss	an indicator variable set equal to one for firm years with negative net income defined as RNOA < 0; zero otherwise.
HisRet	the firm's historical 60 month return; in cross-sectional regressions we use the quintile rank of this variable where firms are ranked annually within Fama and French (1997) industries.
MgrAbility	managerial ability defined as the managerial efficiency score from Demerjian et al. (2010); in cross-sectional regressions we use the quintile rank of this variable where firms are ranked annually within Fama and French (1997) industries.
_rk	indicates a ranked variable. We ranked firms within industry-adjusted profit margin quintiles (PM_{ia}: proxy for the firm's competitive strategy).

Table 1
Descriptive statistics

Panel A: Sample descriptive statistics (N ≈ 114,480)

Variable	**Mean**	**Median**	**Std. Dev**
Assets ($M)	1,753.56	121.82	15,477.70
NOA ($M)	943.33	74.50	7,187.03
Sales ($M)	1,264.93	135.32	6,727.80
BVE ($M)	516.09	53.93	2,788.84
MVE ($M)	1,318.15	83.23	8,830.03
MA-RET	0.02	-0.05	0.50
BP	0.82	0.65	3.93
RNOA	0.13	0.13	0.20
$RNOA_{ia}$	0.01	0.00	0.19
ATO	2.32	1.92	1.98
ATO_{ia}	0.35	0.00	1.75
PM	0.05	0.08	0.41
PM_{ia}	-0.02	0.00	0.41
Firm Age	14.66	10.00	14.65
Asset Age	0.42	0.42	0.17
Asset Age_{years}	6.32	5.40	11.80
MgrAbility	0.49	0.50	0.34
$HisRet_{5yr}$	0.51	0.50	0.34

Panel B: Average profitability ratios and firm characteristics by asset-age

			Rank of $AssetAge_{ia}$				
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	***Q5-Q1***	***P-Value***
RNOA	0.10	0.13	0.14	0.14	0.14	0.04	<0.01
$RNOA_{ia}$	-0.01	0.00	0.01	0.02	0.03	0.04	<0.01
ATO	2.04	2.20	2.26	2.46	2.66	0.62	<0.01
ATO_{ia}	0.04	0.20	0.32	0.48	0.72	0.68	<0.01
PM	-0.01	0.06	0.08	0.07	0.05	0.06	<0.01
PM_{ia}	-0.07	-0.01	0.00	0.00	-0.01	0.06	<0.01
Firm Age	9.41	13.83	16.72	17.26	16.09	6.68	<0.01
Net PPE	461.9	608.9	657.4	607.4	440.8	-21.10	0.49
MA-RET	-0.01	0.00	0.01	0.02	0.04	0.05	<0.01
MVE	1,183	1,414	1,481	1,336	1,174	-9.00	0.91
BP	0.78	0.84	0.82	0.86	0.79	0.01	0.86

Notes: The sample consists of the intersection of Compustat and CRSP firms from 1963-2009 with the requisite data. We end our sample in 2009 because some tests require future operating and returns performance information. We rank industry adjusted asset age ($AssetAge_{ia}$) within industry-adjusted profit margin quintiles to control for current period economic performance and competitive strategy. The appendix supplies variable definitions for the remaining variables.

Table 2

Profitability ratios by industry-adjusted profit margin and asset-age

Panel A: Average $RNOA_{ia}$

PM_{ia} Rank	**Rank of $AssetAge_{ia}$**						
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	***Q5-Q1***	***P-Value***
1	-0.22	-0.19	-0.17	-0.18	-0.22	0.00	0.17
2	-0.04	-0.03	-0.03	-0.02	-0.02	0.02	<0.01
3	0.01	0.02	0.03	0.04	0.06	0.05	<0.01
4	0.06	0.07	0.08	0.10	0.12	0.06	<0.01
5	0.13	0.14	0.15	0.17	0.20	0.07	<0.01

Panel B: Average ATO_{ia}

PM_{ia} Rank	**Rank of $AssetAge_{ia}$**						
	Q1	**Q2**	**Q3**	**Q4**	**Q5**	***Q5-Q1***	***P-Value***
1	-0.13	0.19	0.38	0.63	0.78	1.91	<0.01
2	0.60	0.80	0.92	1.07	1.31	0.71	<0.01
3	0.21	0.32	0.40	0.47	0.78	0.57	<0.01
4	-0.14	-0.07	0.02	0.17	0.42	0.56	<0.01
5	-0.35	-0.21	-0.10	0.05	0.29	0.64	<0.01

Notes: The sample consists of the intersection of Compustat and CRSP firms from 1963-2009 with the requisite data. We rank industry adjusted asset age ($AssetAge_{ia}$) and industry adjusted firm age ($FirmAge_{ia}$) within industry-adjusted profit margin quintiles to control for current period economic performance and competitive strategy. Changes are calculated as the current year's value less the prior year's value.

Table 3
Multivariate Analysis of the relation between *AssetAge* and *RNOA*$_{ia}$

	Dependent Variable =	
	RNOA$_{ia,t}$	**RNOA**$_{ia,t+1}$
$RNOA_{ia,t-1}$	0.61***	
	51.01	
$AssetAge_{ia}\_rk_t$	0.04***	0.02***
	22.16	*8.35*
$FirmAge_{ia}\_rk_t$	-0.02***	0.008***
	5.81	*3.57*
PM_{ia}	0.00	0.01***
	1.36	*3.21*
BP	0.00	0.00
	0.43	*0.09*
Size	0.01***	0.01***
	9.88	*8.62*
Loss	-0.01**	-0.01**
	2.26	*1.98*
$RNOA_{ia,t}$		0.69***
		45.99
$RNOA_{ia,t} \times AssetAge_{ia}\_rk_t$		-0.06***
		4.07
Intercept	-0.05***	-0.04***
	11.67	*10.27*
N	114,480	114,480
R^2	45.06%	44.11%

Notes: This table reports the coefficients and t-statistics from an OLS regression of $RNOA_{ia}$ on $AssetAge_{ia}$ and other control variables. We report robust t-statics below the coefficient estimates that are clustered firm and year. The Appendix supplies variable definitions for the remaining variables. We measure the control variables (PM, BP. Size and Loss) at time t-1 (time t) in the first (second) specification.

Table 4
Analysis of the relation between AssetAge and Returns

	Dependent Variable = Contemporaneous Market-adjusted Return ($MA\text{-}RET_t$)		
		AssetAge Rank	
	All firms	**Q1**	**Q5**
$RNOA_{ia,t}$	0.51***	0.45***	0.34***
	10.37	*9.33*	*11.69*
$RNOA_{ia,t} \times AssetAge_{ia}\_rk_t$	-0.13***		
	3.54		
$AssetAge_{ia}\_rk_t$	0.05***		
	6.10		
$FirmAge_{ia}\_rk_t$	-0.06***	-0.04***	-0.08***
	4.46	2.60	*4.79*
$PM_{ia,t}$	-0.02***	-0.01*	0.02
	2.50	*1.75*	*0.17*
BP_t	-0.003**	-0.01	0.00
	1.97	*1.37*	*1.03*
$Size_t$	0.02***	0.04***	0.02***
	3.93	*5.40*	*3.86*
$Loss_t$	-0.10***	-0.08***	-0.11***
	3.84	*2.89*	*4.29*
$MgrAbility_t$			
Intercept	-0.06*	-0.13***	0.02
	1.67	*2.95*	*0.65*
N	114,480	22,895	22,895
R^2	6.94%	7.16%	6.20%

Notes: This table reports the coefficients and t-statistics from an OLS regression of market-adjusted returns (MA-RET) on $AssetAge_{ia}$ and other control variables. We report robust t-statics below the coefficient estimates that are clustered firm and year. The Appendix supplies variable definitions for the remaining variables.

Table 5
Robustness analyses investigating whether changes in asset age (i.e., changes in the bias) correspond to changes in abnormal profitability

Panel A: Analysis of the relation between AssetAge and future $RNOA_{ia}$ controlling for firms with large decreases in asset age (DropAssetAge)

$RNOA_{ia,t}$	0.66***
	51.26
$AssetAge_{ia}\_rk_t$	0.02***
	10.94
$DropAssetAge_{t+1}$	-0.02***
	6.93
$RNOA_{ia,t} \times AssetAge_{ia}\_rk_t$	-0.06***
	4.11
$FirmAge_{ia}\_rk_t$	0.01***
	3.42
$PM_{ia,t}$	0.01***
	3.15
BP_t	0.00
	0.14
$Size_t$	0.01***
	8.63
$Loss_t$	-0.01*
	1.88
Intercept	-0.04***
	10.47
N	114,480
R^2	44.15%

Panel B: Average $\Delta RNOA_{ia}$ by profit margin and changes in asset age

	Rank of $\Delta AssetAge_{ia}$						
PM_{ia} Rank	**Q1** Decrease in Bias	**Q2**	**Q3**	**Q4**	**Q5** Increase in Bias	***Q5-Q1***	***P-Value***
1	-0.08	-0.06	-0.06	-0.06	-0.09	-0.01	0.01
2	-0.03	-0.01	0.00	0.00	0.02	0.05	<0.01
3	-0.02	0.00	0.01	0.01	0.03	0.06	<0.01
4	-0.02	0.00	0.01	0.02	0.04	0.06	<0.01
5	-0.01	0.00	0.01	0.02	0.04	0.05	<0.01

Panel C: Average ΔATO_{ia} by profit margin and changes in asset age

PM_{ia} Rank	Rank of $\Delta AssetAge_{ia}$ **Q1** **Decrease in Bias**	**Q2**	**Q3**	**Q4**	**Q5** **Increase in Bias**	***Q5-Q1***	***P-Value***
1	-0.27	-0.08	-0.07	-0.08	-0.04	0.23	<0.01
2	-0.22	-0.08	-0.01	0.01	0.02	0.24	<0.01
3	-0.22	-0.05	-0.01	0.02	0.03	0.25	<0.01
4	-0.23	-0.05	-0.02	-0.01	0.00	0.23	<0.01
5	-0.20	-0.06	-0.01	0.00	0.01	0.21	<0.01

Notes: The sample consists of the intersection of Compustat and CRSP firms from 1963-2009 with the requisite data. We rank industry adjusted asset age ($AssetAge_{ia}$) and industry adjusted firm age ($FirmAge_{ia}$) within industry-adjusted profit margin quintiles to control for current period economic performance and competitive strategy. Changes are calculated as the current year's value less the prior year's value. Panel A reports the coefficients and t-statistics from an OLS regression of future $RNOA_{ia}$ ($RNOA_{ia,t+1}$) on $AssetAge_{ia}$ and other control variables. We report robust t-statics below the coefficient estimates that are clustered firm and year. The Appendix supplies variable definitions for the remaining variables.

Table 6

Analyses by subsets of firms expected to be more or less impacted by the asset age bias

Panel A: Average $RNOA_{ia}$

PM_{ia} Rank	**Low Appreciable Asset Firms**			**High Appreciable Asset Firms**		
	Rank of $AssetAge_{ia}$			**Rank of $AssetAge_{ia}$**		
	Q1	**Q5**	***Q5-Q1***	**Q1**	**Q5**	***Q5-Q1***
1	0.01	-0.07	-0.08	-0.24	-0.25	-0.01
2	0.07	0.05	-0.02	-0.04	-0.02	0.02***
3	0.06	0.08	0.02	0.02	0.07	0.05***
4	0.02	0.06	0.04	0.08	0.18	0.10***
5	0.04	0.06	0.02	0.17	0.28	0.11***

Panel B: Average ATO_{ia}

PM_{ia} Rank	**Low Appreciable Asset Firms**			**High Appreciable Asset Firms**		
	Rank of $AssetAge_{ia}$			**Rank of $AssetAge_{ia}$**		
	Q1	**Q5**	***Q5-Q1***	**Q1**	**Q5**	***Q5-Q1***
1	1.38	1.34	-0.04	-0.42	1.45	1.87***
2	0.34	0.15	-0.19	0.80	1.91	1.11***
3	0.19	0.34	0.15	0.18	0.93	0.75***
4	-0.07	0.05	0.12	-0.07	0.81	0.89***
5	-0.07	-0.09	-0.02	-0.28	0.54	0.82***

Panel C: Analyses of the relation between AssetAge and RNOA for firms expected to be more or less impacted by the asset age bias

	Dependent Variable = $RNOA_{ia,t}$	
	Low Appreciable Asset Firms	**High Appreciable Asset Firms**
$RNOA_{ia,t-1}$	0.57***	0.68***
	9.31	40.28
$AssetAge_{ia}\_rk_t$	0.02	0.05***
	1.46	*11.35*
$FirmAge_{ia}\_rk_t$	0.00	-0.01***
	0.12	*8.41*
$PM_{ia,t-1}$	0.02*	0.004***
	1.87	*3.64*
BP_{t-1}	0.00	0.00
	0.74	*1.07*
$Size_{t-1}$	0.00	0.01***
	1.55	*11.18*
$Loss_{t-1}$	0.01	0.00
	0.38	*0.75*
N	816	10,296
R^2	35.19%	53.57%

Panel D: Analyses of the relation between AssetAge and contemporaneous abnormal returns for firms expected to be more or less impacted by the asset age bias

	Dependent Variable = MA-RET$_t$	
	Low Appreciable Asset Firms	**High Appreciable Asset Firms**
RNOA$_{ia,t}$	0.35*	0.69***
	1.67	*12.64*
RNOA$_{ia,t}$ × AssetAge$_{ia}$_rk$_t$	-0.07	-0.11***
	1.08	*6.03*
AssetAge$_{ia}$_rk$_t$	0.04	0.06***
	0.81	*4.06*
FirmAge$_{ia}$_rk$_t$	0.00	-0.02***
	0.08	*4.34*
PM$_{ia,t}$	0.05	-0.10***
	0.70	*3.02*
BP$_t$	-0.08***	0.00
	3.90	*0.47*
Size$_t$	0.03***	0.02**
	2.80	*6.72*
Loss$_t$	-0.11	-0.13***
	1.31	*7.59*
N	816	10,296
R^2	7.84%	8.34%

Notes: The sample consists of the intersection of Compustat and CRSP firms from 1963-2009 with the requisite data. Low Appreciable Asset firms are defined as *Banks* per Fama and French (1997) industry classifications. Consistent with our expectations we find that mean (median) PPE as a percentage of assets for banks is only 8.5% (2%) compared to the sample mean (median) of 40% (28%). We define high appreciable asset firms as those whose property and buildings as a percentage of NOA are among the highest quartile of sample firms with available data. Note that information for asset classes like buildings is only available for a subset of the years covered by our sample. In panels A and B the "***" indicate significant differences in means at the 1 percent alpha level. We rank industry adjusted asset age (AssetAge$_{ia}$) and industry adjusted firm age (FirmAge$_{ia}$) within industry-adjusted profit margin quintiles to control for current period economic performance and competitive strategy. Standard errors for the regression analyses reflect robust standard errors, but we do not, however cluster by firm and year (as we do in previous tables) because our selection of sample firms with high appreciable assets results in some firms being included in some years but not every year; thus we do not utilize panel data and therefore do not cluster by firm and year.

Table 7
Multivariate Analysis of the relation between *AssetAge* and performance controlling for managerial ability

	Dependent Variable =		
	$RNOA_{ia,t}$	***$RNOA_{ia,t+1}$***	***$ME\text{-}RET_t$***
$RNOA_{ia,t-1}$	0.56***		
	40.26		
$AssetAge_{ia}\_rk_t$	0.04***	0.02***	0.06***
	17.26	*7.07*	*7.25*
$FirmAge_{ia}\_rk_t$	-0.01**	0.01***	-0.07***
	1.95	*5.15*	*4.62*
PM_{ia}	0.00	0.01***	-0.02***
	1.06	*3.24*	*2.55*
BP	0.00	0.00	-0.01**
	0.57	*0.06*	*1.98*
Size	0.01***	0.01***	0.03***
	11.08	*11.35*	*5.76*
Loss	-0.01***	-0.01***	-0.09***
	3.18	*2.62*	*2.99*
MgrAbility	0.09***	0.01***	0.03***
	23.81	*4.04*	*4.76*
$RNOA_{ia,t}$		0.67***	0.46***
		36.75	*8.22*
$RNOA_{ia,t} \times AssetAge_{ia}\_rk_t$		-0.06***	-0.12***
		3.52	*2.71*
Intercept	-0.10***	-0.06***	-0.14***
	27.55	*15.66*	*3.57*
N	76,979	76,979	76,979
R^2	46.66%	43.94%	7.56%

Notes: This table reports the coefficients and t-statistics from an OLS regression of $RNOA_{ia}$ on $AssetAge_{ia}$ and other control variables. We report robust t-statics below the coefficient estimates that are clustered firm and year. The Appendix supplies variable definitions for the remaining variables

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PROFESSIONAL EMPLOYMENT

The University of Utah, David Eccles School of Business
Assistant Professor of Accounting, 2007 to current.

Indiana University, Kelley School of Business
Assistant Instructor/Research Assistant, 2002 to 2006.

Hewlett Packard Company, California
Financial Analyst, 2001 to 2002.

EDUCATION

Indiana University, Bloomington, IN, Kelley School of Business
Ph.D. in Business Administration. August 2007.
Major field: Accounting. Minor field: Finance.

Indiana University, Bloomington, IN, Kelley School of Business
Masters of Business. May 2006.

California State University, Fresno, CA, Sid Craig School of Business
Bachelor of Science, Accounting. June 2001. Cum Laude.

RESEARCH INTERESTS

Financial Accounting and Capital Markets
- Earnings quality and the impact of executive-specific traits (talent, integrity) on managerial decisions
- Impact of competing managerial incentives on operating and reporting decisions

TEACHING INTERESTS

- Financial accounting: *scores consistently exceed the subject average*
  –Intermediate Accounting
  –Introductory Accounting

PUBLICATIONS

Beneish, M., I. Jansen, M. Lewis, and N. Stuart. “Diversification to Mitigate Expropriation in the Tobacco Industry”. **Journal of Financial Economics 2008.**

Blacconiere, W., M. Johnson, and M. Lewis. “The Role of Tax Regulation and Compensation Contracts in the Decision to Voluntarily Expense Employee Stock Options”. **Journal of Accounting and Economics 2008.**

WORKING PAPERS

Blacconiere, W., J. Frederickson, M. Johnson, and M. Lewis. "Do Voluntary Disclosures that Disavow the Reliability of Mandated Fair Value Information Reflect Legitimate Concerns about Reliability?" ***Accepted for presentation at the 2010 Journal of Accounting and Economics Conference.***

- **Journal of Accounting and Economics, forthcoming**

Billings, M., and M. Lewis. "Opportunism and the Related Consequences in the IPO Setting".

Curtis, A., and M. Lewis. "The Comparability of Accounting Rates of Return Under Historical Cost Measurement".

- *Under review*

Demerjian, P., M. Lewis, B. Lev, and S. McVay. 2010. "Managerial Ability and Earnings Quality". *Revise and Resubmit for the Accounting Review*

- ***Under review, working on 2nd round re-submission***

Lewis, M. "Assessing Earnings Quality at the IPO: The Role of Reputable Investment Banks". *Won best paper at the 2008 AAA Western Region Meeting, San Francisco, California.*

WORK IN PROGRESS

Demerjian, P. and M. Lewis. "Earnings Quality for firms with Debt".

Demerjian, P. and M. Lewis, S. McVay. "Managerial Ability and Earnings Management".

INVITED PRESENTATIONS

2011 Texas Christian University.
2010: Emory University.
2009: University of Oregon, University of Tennessee, Utah State University.
2008: University of Wisconsin-Madison, University of Notre Dame, Brigham Young University.
2007: Arizona State University, Michigan State University, University of Colorado, University of Georgia , University of Michigan, University of Utah.
2006: Indiana University.
2005: Indiana University.

REFEREED PRESENTATIONS

"Do Voluntary Disclosures that Disavow the Reliability of Mandated Fair Value Information Reflect Legitimate Concerns about Reliability?":
Journal of Accounting and Economics Conference, Illinois– October 2010.

"Managerial Ability and Earnings Quality" and "The Comparability of Accounting Rates of Return Under Historical Cost Measurement":
AAA Annual Meeting, California – August 2010

"Do Voluntary Disclosures that Disavow the Reliability of Mandated Fair Value Information Reflect Legitimate Concerns about Reliability?": FARS Meeting, California– January 2010.

"Do Voluntary Disclosures that Disavow the Reliability of Mandated Fair Value Information Reflect Legitimate Concerns about Reliability?": AAA Annual Meeting, New York – August 2009.

"Opportunism and the Related Consequences in the IPO Setting": Utah Winter Accounting Conference – February 2009.

"Opportunism and the Related Consequences in the IPO Setting": AAA Annual Meeting, California – August 2008.

"Opportunism and the Related Consequences in the IPO Setting": Corporate Governance and Fraud Prevention Conference, George Mason University, Virginia – May 2008.

"Assessing Earnings Quality at the IPO: The Role of Reputable Investment Banks": AAA Western Region Meeting, California – May 2008.

"Voluntary Disclosures That Disavow Mandatory Disclosures: The Case of Stock Options": Conference on Financial Economics and Accounting, California – November 2004.

Undergraduate Honors Thesis, "Quality of Earnings: A Test of the Naïve Investor Theory": Central California Research Symposium, California – May 2001.

DISCUSSIONS

- University of Colorado, Summer Accounting Conference, Colorado – August 2011
- AAA, Financial Accounting and Reporting Section Meeting, Florida – January 2011
- AAA, Annual Meeting, New York – August 2009
- AAA, Financial Accounting and Reporting Section Meeting, Louisiana – January 2009
- Conference on Financial Economics and Accounting, Texas – November 2008
- AAA, Annual Meeting, California – August 2008
- Utah Winter Accounting Conference, Utah - February 2008

PROFESSIONAL AFFILIATIONS AND SERVICE

Ad hoc referee, Contemporary Accounting Research, FARS meeting (2011)
David Eccles School of Business, College Council (2010-2011)
PhD Student Committee Member (Erin McKenzie, Xiaoli Ortega, Ben Whipple) (2010-2011)
Ad hoc referee, Financial Management, Journal of Accounting, Auditing and Finance, FARS meeting, AAA annual meeting (2010)
Ad hoc referee, AAA annual meeting (2009)
FARS Doctoral Consortium Planning Committee (2009)
Ad hoc referee, FARS mid-year meeting (2009)

Ad hoc referee, AAA annual meeting (2008)
Ad hoc referee, AAA Western Region meeting (2008)
Ad hoc referee, AAA FARS mid-year meeting (2005)
Member, American Accounting Association
Member, AAA Financial Accounting and Reporting Section
Member, Beta Alpha Psi, National Accounting Fraternity

HONORS AND ACHIEVEMENTS

- David Eccles Emerging Scholar (2009-2011)
- AAA Western Region Best Paper Award for "Managerial Ability and Earnings Quality" (2010)
- Voted a "Favorite Professor" by the University of Utah Women's Volleyball Team (2008)
- AAA Western Region Best Paper Award for "Assessing Earnings Quality at the IPO: The Role of Reputable Investment Banks" (2008)
- Inducted into the USA Track and Field Pole-Vaulting Hall of Fame (2007)
- AAA/Deloitte/J. Michael Cook Doctoral Consortium Fellow (2006)
- Inducted into the CSU, Fresno Athletic Hall of Fame (2004)
- Received NCAA post-graduate academic scholarship (2001)
- Inaugural member of Sid Craig School of Business Honors Program (1999)
- Member, Arthur Andersen Tax Challenge Team (2000)
- Member, Beta Alpha Psi-National Honorary Accounting Fraternity
- GTE Academic All-American (1999)
- NCAA women's pole-vault champion (1998,1999)
- Track and Field All-American (1998,1999)
- Member, USA Track and Field team. Competed at:
  Olympic Trials, USA (1996, 2000)
  World Championships, Spain (1999)
  World University Games, Spain (1999)
  Goodwill Games, USA (1998)
  World Championships, France (1997)
  Goodwill Games, Russia (1994)