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A Welfare Comparison of Historical Cost and Fair Value Accounting Regimes

Palmer Edholm
Utah State University

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Abstract

With ongoing controversy concerning fair value and historical cost accounting, existing accounting theory is focused on intra-firm decision making and is thus deficient in addressing the issue of maximizing social welfare. I propose models of historical cost and fair value accounting regimes which are embedded in models of monopoly and oligopoly. This allows for social welfare implications. I find that historical cost results in greater expected profits for both monopolists and oligopolists. However, if the market is elastic enough, a fair value regimes is welfare enhancing. Whereas, if the market is inelastic enough, historical cost is welfare enhancing.

1 Introduction

On December 5, 2000, Jackson Day, Deputy Chief Accountant of the SEC, spoke in front of the American Institute of Certified Public Accountants (AICPA) and declared that "all financial instruments should be measured at fair value" ([4]). However, the SEC has delegated the task of passing accounting standards to the Financial Accounting Standards Board (FASB). In September 2006, with the passage of Financial Accounting Standards No. 157 (SFAS 157), the FASB updated Generally Accepted Accounting Principles (GAAP) to include a generalized framework for fair value accounting. With many subsequent standards and codifications, the FASB has ultimately showed that it agrees with Mr. Day. SFAS 157 was codified as Accounting Standards Codification Topic 820 (ASC 820). In ASC 820, the FASB defined fair value as "the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date" ([1]). Many have been critical of such a regime change arguing that it subjects managers to too much subjectivity in having to determine fair market value of assets for which no liquid market exists. There is extensive literature, both empirical and theoretical, on the pros and cons of a fair value regime. However, the one thing lacking in all such literature, is aggregate effects. Existing literature focuses on the effects of fair value on managerial compensation, manipulation of standards, disclosure behavior, etc. The motivation of this paper is to assess the social welfare of a fair value regime versus that of a historical cost regime.

Models of both historical cost and fair value accounting regimes are proposed. To evaluate the welfare effects, they are embedded in a traditional monopoly and an n firm Cournot oligopoly model. To assess to what degree the result that is optimal for social welfare agrees with what is optimal for the firm, expected profits are calculated. Existing research would seem to form the hypothesis that social welfare is greater under a fair value regime because it benefits from more relevant information. However, fair value detractors claim that fair value provides managers with leeway when reporting earnings making reports less reliable for users of financial statements. This would seem to imply that managers manipulate earnings to the detriment of social welfare. The paper proceeds as follows: section 2 reviews all relevant research, section 3 examines the welfare comparison in a monopoly model, and section 4 examines the welfare comparison in an n firm oligopoly model.

2 Literature Review

The majority of accounting research is focused on intra-firm decision making where aggregate effects are ignored. Where the purview of this paper is on the social welfare of accounting decisions, models from existing research, while enlightening, were not utilized when constructing the models used herein. In perhaps the most relevant research, Dye ([6]) utilizes an overlapping generations model to examine the incentives shareholders have to allow managers to engage in earnings management. Dye and Sridhar ([7]) create a model where the accountant is contracted to produce a report based on the aggregated information he gets from the manager where reliability versus relevancy trade-offs arrive when assessing how much weight to place on the information from the manager. Darrough ([3]) looks at disclosure behavior in an oligopolistic environment where there are no mandatory disclosures. Crocker and Slemrod ([2]) create a model of managerial compensation where managers take a costly hidden action and then generate an inflated earnings report with results very similar to [6]. More recently, Kanodia and Sapra ([8]) address the effects of fair value measurement on the firm's investment efficiency and in creating procyclical real effects. Plantin et al. ([9]) show why financial institutions are more apt to prefer historical cost to fair value. The literature on disclosures, standards manipulation, earnings management, and conservatism as they relate to fair value is quite extensive but such issues are assumed away in the models used in this paper.

Empirically, Song et al. ([10]) find value relevance of level 1 and level 2 fair values where level 3 fair values provide value relevance conditioned on strong corporate governance. Dechow et al. ([5]) find that when managers use fair value standards to value retained interest, they're awarded for the gains reported regardless of monitoring efforts.

3 Monopoly Model

3.1 Timeline

The manager is tasked with choosing a cost-reducing investment and production level. I assume the investment is non-depreciable to make the model more straightforward. Finding the optimal strategy is done via backward induction of a three stage game of incomplete information that the manager plays with nature. In the first stage, the manager chooses an investment level. In the second stage, after observing the investment made by the manager, nature chooses the cost type. After observing the cost type, the manager makes a production commitment which determines the firm's payoff.

The specifics of the model at each stage of the game follow the timeline of events as outlined in figure 1. I assume the manager is contracted by the shareholders to choose an investment $I \in [0, 1]$ such that firm profits will be maximized. In order to do so, the manager signs a contract wherein she agrees to be compensated based on a fraction ($\alpha \in (0, 1]$) of net income. After the contract is signed, the manager chooses an investment level which is publicly observable. After the investment choice is made, nature chooses between high (c_H) and low (c_L) constant marginal costs. This binary assumption, along with the asssumption of constant marginal costs, is solely for purposes of tractability. I assume the investment is cost-reducing. To model the incentive to choose a cost reducing investment, I assume linear probability functions: $P(H) = 1-I$ associated with high costs and $P(L) = I$ associated with low costs. These probability functions are assumed for mathematical simplicity. I assume the true type chosen by nature is only observable to the manager. Once the manager privately observes her type, she chooses a production quantity which maximizes expected profit. Once a production commitment has been made, the manager is then compensated based on her report. We may assume the report in question is the income statement and the manager is compensated based on her agreed upon proportion (α) of net income.

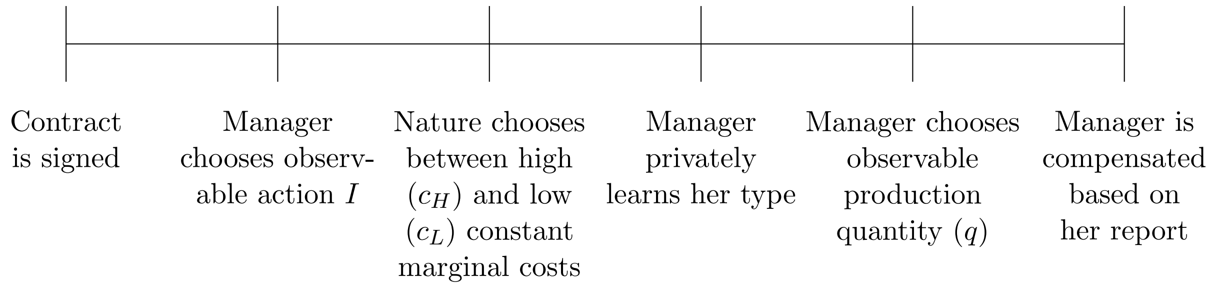

Figure 1: Timeline of events

3.2 Historical Cost

For everything that follows, I assume historical cost and fair value regimes are mutually exclusive to be able to make a general statement about which regime is welfare enhancing. When an investment is acquired, there is no immediate effect on owner's equity. Furthermore, in a historical cost regime, assuming the investment is non-depreciable, the balance sheet value never changes. I assume a linear inverse demand function for tractability. Therefore, the firms profit function is defined as

$$\pi(q) = (a - bq)q - c_j q$$

with constant marginal costs and $j \in \{L, H\}$. Therefore, I define the manager's objective function when choosing the optimal q to be the present value of future discounted cash flows. Thus, the objective function is

$$m(q)_{HC} = \alpha \left[\sum_{t=0}^{\infty} \pi(q)\delta^t \right]$$

where $\delta \in [0, 1)$ is the relevant discount factor. Because $\delta \in [0, 1)$, this is nothing more than a geometric series which converges to

$$m(q)_{HC} = \frac{\alpha\pi(q)}{1-\delta}.$$

Therefore, the optimal choice of q is

$$\max_q \quad m(q)_{HC}$$

which turns out to be

$$q^* = \frac{a - c_j}{2b}. \tag{1}$$

Given (1), I can continue backward inducting and solve for the optimal investment level. The choice of I, in deriving the perfect Bayes' Nash equilibrium, is

$$\max_I \quad P(H)m(q^*)^{c_H}_{HC} + P(L)m(q^*)^{c_L}_{HC}$$

where the superscripts c_H and c_L denote the optimal q conditioned on high and low costs, respectively. Using (1), I find that the objective function is linear in I which implies a corner solution. The slope of the optimal investment level is

$$\frac{\alpha(c_H - c_L)(2a - c_H - c_L)}{4b(1-\delta)}$$

which is always positive. This implies that the equilibrium strategy in a historical cost regime is to choose $I = 1$ which implies low costs. Given this equilibrium strategy, solving for the firm's expected profit, I find that

$$\pi^*(q^*) = \frac{(a - c_L)^2}{4b}. \tag{2}$$

3.3 Fair Value

Under a fair value regime, period 0 is identical to a historical cost regime. However, under fair value, beginning at period 1, the investment is subject to periodic assessment that the balance sheet may reflect the current value of the investment. I don't assume anything about how conservative the fair value accounting standards are. Assuming an efficient market, the true value of the investment to the firm is the profitability of the firm with the investment less the profitability of the firm without the investment. With the investment ($I \in (0, 1]$), the profit function is

$$\pi^I(q) = (a - bq)q - c_j q.$$

Without the investment ($I = 0$), costs would be high by definition and the profit function becomes

$$\pi^{-I}(q) = (a - bq)q - c_H q.$$

Taking the difference of these two equations, I find that

$$\pi^I(q) - \pi^{-I}(q) = q(c_H - c_j). \tag{3}$$

The intuition behind (3) is clear: if $j = H$, then $I = 0$ and (3) evaluates to 0. If $j = L$, then $I = 1$ and (3) is how much more the firm is producing given that they can now claim low costs. Thus, (3) is the difference in production between investing and not investing. Therefore, any objective function will allow for the manager to choose a q such that the present value of future cash flows attributed to firm profits are maximized and those attributed to gains (losses) on investment are maximized (minimized). The resulting objective function is

$$m(q)_{FV} = \alpha \left[\sum_{t=0}^{\infty} \pi(q)\delta^t - I + \sum_{t=1}^{\infty} \left(\pi^I(q) - \pi^{-I}(q)\right)\delta^t \right]$$

which, after substituting in (3), converges to

$$m(q)_{FV} = \alpha \left[\frac{\pi(q)}{1-\delta} - I + [q(c_H - c_j)] \frac{\delta}{1-\delta} \right].$$

Therefore, the optimal choice of q is

$$\max_q \quad m(q)_{FV}$$

which turns out to be

$$q^* = \frac{a - c_j + (c_H - c_j)\delta}{2b}. \tag{4}$$

Given (4), I can continue backward inducting and solve for the optimal investment level. The choice of I, in deriving perfect Bayes' Nash equilibrium, is

$$\max_I \quad P(H)m(q^*)^{c_H}_{FV} + P(L)m(q^*)^{c_L}_{FV}.$$

Using (4), I find that the objective function is linear in I which implies a corner solution. The slope of the optimal investment level is

$$-\alpha + \frac{\alpha(c_H - c_L)(1+\delta)(2a + c_H(\delta - 1) - c_L(1+\delta))}{4b(1-\delta)}$$

which is positive if

$$0 < b < \frac{(c_H - c_L)(1+\delta)(2a + c_H(\delta - 1) - c_L(1+\delta))}{4(1-\delta)} \tag{5}$$

holds and negative if

$$b < \frac{(c_H - c_L)(1+\delta)(2a + c_H(\delta - 1) - c_L(1+\delta))}{4(1-\delta)} \tag{6}$$

holds. Assuming inequality (5) holds implies that the equilibrium strategy is to choose $I = 1$ which implies low costs. Given this equilibrium strategy, solving for the firm's expected profit, I find that

$$\pi^*(q^*) = \frac{(a - c_L)^2 - \delta^2(c_L - c_H)^2}{4b}. \tag{7}$$

Assuming inequality (6) holds implies that the equilibrium strategy is to choose $I = 0$ which implies high costs. Given this equilibrium strategy, solving for the firm's expected profit, I find that

$$\pi^*(q^*) = \frac{(a - c_H)^2}{4b}. \tag{8}$$

3.4 Welfare Implications

If I assume inequality (5) holds, then the equilibrium investment level is $I = 1$ under both regimes. Therefore, conditioned on $j = L$, the optimal output levels under historical cost and fair value will be (1) and (4), respectively. Conditioned on $j = L$, (4) > (1) which implies that output is higher under fair value. However, expected firm profits for historical cost and fair value are (2) and (7), respectively. (2) > (7) which implies that expected profit is greater under historical cost. The measure of social welfare that I'll employ is consumer surplus plus firm profit. Therefore, under historical cost, welfare is

$$\int_0^{q^*} p(q)\, dq + \pi^*(q^*) = \frac{5a^2 - 6ac_L + c_L^2}{8b}.$$

Under fair value, welfare is

$$\int_0^{q^*} p(q)\, dq + \pi^*(q^*) = \frac{(a + c_H\delta - c_L(1+\delta))(5a - 3c_H\delta + c_L(3\delta - 1))}{8b}.$$

Therefore, welfare is greater under fair value if $c_H \leq 5c_L$.

If I assume inequality (8) holds, then the equilibrium investment level is $I = 1$ under historical cost and $I = 0$ under fair value. Therefore, conditioned on $j = L$, the optimal output level under historical cost is (1) and conditioned on $j = H$, the optimal output level under fair value is (4). Under these conditions, (1) > (4). Expected firm profits for historical cost and fair value are (2) and (8) respectively. (2) > (8) implies that expected profit is greater under historical cost. Social welfare under historical cost then becomes

$$\int_0^{q^*} p(q)\,dq + \pi^*(q^*) = \frac{5a^2 - 6ac_L + c_L^2}{8b}$$

while social welfare under fair value is

$$\int_0^{q^*} p(q)\,dq + \pi^*(q^*) = \frac{5a^2 - 6ac_H + c_H^2}{8b}.$$

Therefore, social welfare is greater under historical cost.

Notice that the inequalities that result in different equilibrium strategies have to do with the slope of the demand curve. Under historical cost, the cost of the investment is always covered which is why the manager always prefers lower costs even if it is not efficient to do so. However, under fair value, the cost of the investment is measured against the increase in profit from doing so. For this reason, investing is not always efficient under fair value if it does not result in a greater increase in profitability relative to the elasticity of the market.

As is evident, a historical cost regime is strictly preferred by the monopolist which, given my assumptions, is a result consistent with that of [9] who find that historical cost is preferred by banks and insurance companies because of the inefficiencies fair value induces given the nature of their assets. Concerning social welfare, depending on the size of b, historical cost may or may not be welfare enhancing. The inequalities above state that for a small b, fair value implies greater social welfare while for a larger b, historical cost implies greater social welfare. This would seem to imply that which regime is better for the aggregate economy depends on the elasticity of the market.

4 Oligopoly Model

Extending the monopoly model to an oligopoly model, I'll employ the Cournot model. Assume there are n symmetric firms (an assumption made to more easily derive the optimal strategy of each firm) and each firm simultaneously and independently commits to an output level q_i. Let q_i denote the production choice of firm i and

$$q = \sum_{i=1}^{n} q_i$$

denote the aggregate quantity produced by all n firms. Following convention, let

$$q - q_i = q_{-i} = \sum_{i \neq j} q_i$$

denote the aggregate production quantity of all n firms with the exception of firm i. Assume the same linear inverse demand function used in part 3. Firm i's profit function becomes

$$\pi_i(q_{-i}, q_i) = (a - b(q_i + q_{-i}))q_i + c_j q_i.$$

4.1 Historical Cost

The definitions of the objective functions have the same motivation as in part 3. Therefore, when choosing q_i, the objective function is

$$m(q_i)_{HC} = \frac{\alpha \pi_i(q_{-i}, q_i)}{1-\delta}$$

where the choice of q_i is

$$\max_{q_i} \quad m(q_i)_{HC}.$$

Solving this problem yields firm i's reaction function which is

$$q_i^* = \frac{a - c_j}{2b} - \frac{1}{2} q_{-i}.$$

This reaction function induces the system of n first-order conditions

$$\begin{aligned}
\frac{\alpha}{1-\delta}\left[-bq_1^* + (a - bq^*) - c_j\right] &= 0 \\
\frac{\alpha}{1-\delta}\left[-bq_2^* + (a - bq^*) - c_j\right] &= 0 \\
&\vdots \\
\frac{\alpha}{1-\delta}\left[-bq_n^* + (a - bq^*) - c_j\right] &= 0.
\end{aligned}$$

Solving the system yields

$$q^* = \frac{a - c_j}{b} \frac{n}{n+1} \tag{9}$$

which is the perfect Bayes' Nash equilibrium quantity. Given the assumption of n symmetric firms, the equilibrium quantity for firm i is

$$q_i^* = \frac{a - c_j}{b(n+1)}. \tag{10}$$

Given (10), I continue backward inducting. The choice of I, in deriving the perfect Bayes' Nash equilibrium, is

$$\max_{I} \quad P(H) m(q_i^*)_{HC}^{c_H} + P(L) m(q_i^*)_{HC}^{c_L}.$$

Given (10), I find that the objective function is linear in I which implies a corner solution. The slope of the optimal investment level is

$$\frac{\alpha(c_H - c_L)(2a - c_H - c_L)}{b(n+1)^2(1-\delta)}$$

which is always positive. This implies that the equilibrium strategy in a historical cost regime is to choose $I = 1$ which implies low costs. Given this equilibrium strategy, solving for the firm's expected profit, I find that

$$\pi_i^*(q_i^*) = \frac{(a - c_L)^2}{b(n+1)^2}. \tag{11}$$

4.2 Fair Value

When choosing q_i, the objective function is

$$m(q_i)_{FV} = \alpha \left[\frac{\pi(q_i, q_{-i})}{1-\delta} - I + [q_i(c_H - c_j) - I] \frac{\delta}{1-\delta} \right]$$

where the choice of q_i is

$$\max_{q_i} \quad m(q_i)_{FV}.$$

Solving this problem yields firm i's reaction function which is

$$q_i^* = \frac{a - c_j + (c_H - c_j)\delta}{2b} - \frac{1}{2} q_{-i}.$$

This reaction function induces the system of n first-order conditions

$$\begin{aligned}
\frac{\alpha}{1-\delta} \left[-bq_1^* + (a - bq^*) - c_j + (c_H - c_j)\delta \right] &= 0 \\
\frac{\alpha}{1-\delta} \left[-bq_2^* + (a - bq^*) - c_j + (c_H - c_j)\delta \right] &= 0 \\
&\vdots \\
\frac{\alpha}{1-\delta} \left[-bq_n^* + (a - bq^*) - c_j + (c_H - c_j)\delta \right] &= 0.
\end{aligned}$$

Solving this system yields

$$q^* = \frac{a - c_j + (c_H - c_j)\delta}{b} \frac{n}{n+1} \tag{12}$$

which is the perfect Bayes' Nash equilibrium quantity. Given the assumption of n symmetric firms, the equilibrium quantity for firm i is

$$q_i^* = \frac{a - c_j + (c_H - c_j)\delta}{b(n+1)}. \tag{13}$$

Given (13), I continue backward inducting. The choice of I, in deriving the perfect Bayes' Nash equilibrium, is

$$\max_{I} \quad P(H) m(q_i^*)_{FV}^{c_H} + P(L) m(q_i^*)_{FV}^{c_L}.$$

Given (13), I find that the objective function is linear in I which implies a corner solution. The slope of the optimal investment level is

$$-\alpha + \frac{\alpha(c_H - c_L)(1+\delta)(2a + c_H(\delta - 1) - c_L(1+\delta))}{b(n+1)^2(1-\delta)}$$

which is positive if

$$0 < b < \frac{(c_H - c_L)(1+\delta)(2a + c_H(\delta - 1) - c_L(1+\delta))}{(n+1)^2(1-\delta)} \tag{14}$$

holds and negative if

$$b > \frac{(c_H - c_L)(1+\delta)(2a + c_H(\delta - 1) - c_L(1+\delta))}{(n+1)^2(1-\delta)} \tag{15}$$

holds. Assuming inequality (14) holds implies that the equilibrium strategy is to choose $I = 1$ which implies low costs. Given this equilibrium strategy, solving for the firm's expected profit, I find that

$$\pi_i^*(q_i^*) = \frac{(a - c_L - (c_H - c_L)\delta n)(a - c_L + (c_H - c_L)\delta)}{b(n+1)^2}. \tag{16}$$

Assuming (15) holds implies that the equilibrium strategy is to choose $I = 0$ which implies high costs. Given this equilibrium strategy, solving for the firm's expected profit, I find that

$$\pi_i^*(q_i^*) = \frac{(a - c_H)^2}{b(n+1)^2}. \tag{17}$$

4.3 Welfare Implications

If I assume (14) holds, then the equilibrium investment level is $I = 1$ under both regimes. Therefore, conditioned on $j = L$, the optimal output levels under historical cost and fair value will be (9) and (12), respectively. Conditioned on $j = L$, (12) $>$ (9) which implies that output is higher under fair value. However, expected firm profits for historical cost and fair value are (11) and (16), respectively. (11) $>$ (16) which implies that expected profit is greater under historical cost. Social welfare under historical cost is

$$\int_0^{q^*} p(q)\,dq + \pi^*(q^*) = \frac{n(a - c_L)(c_L(n-2) + a(4+n))}{2b(1+n)^2}$$

while social welfare under fair value is

$$\int_0^{q^*} p(q)\,dq + \pi^*(q^*) = \frac{n(a + c_H\delta - c_L(1+\delta))(a(4+n) - 3c_H n\delta + c_L(-2+n+3n\delta))}{2b(1+n)^2}.$$

Therefore, welfare is greater under fair value if $a \leq \frac{7c_L}{5}$.

If I assume (15) holds, then the equilibrium investment level is $I = 1$ under historical cost and $I = 0$ under fair value. Therefore, conditioned on $j = L$, the optimal output level under historical cost is (9) and conditioned on $j = H$, the optimal output level under fair value is (12). Under these conditions, (9) $>$ (12). Expected firm profits for historical cost and fair value are (11) and (17) respectively. (11) $>$ (17) implies that expected profit is greater under historical cost. Social welfare under historical cost is

$$\int_0^{q^*} p(q)\,dq + \pi^*(q^*) = \frac{n(a - c_L)(c_L(n-2) + a(4+n))}{2b(1+n)^2}$$

while social welfare under fair value is

$$\int_0^{q^*} p(q)\,dq + \pi^*(q^*) = \frac{n(a - c_H)(c_H(n-2) + a(4+n))}{2b(1+n)^2}.$$

Therefore, welfare is greater under historical cost.

It would therefore seem that the results from part 3 extend nicely to the case of n firms.

5 Conclusion

Given the standard monopoly and n firm oligopoly models as proposed, the general result is that historical cost is strictly preferred by the firm whether that firm be a monopolist or an oligopolist (a finding consistent with [9]). This seems to fly in the face of conventional wisdom (fair value detractors) which says manager's prefer fair value as it provides them with more wiggle room when reporting costs. However, these results suggest that in an efficient market, if the manager is tasked with choosing a non-depreciable investment, historical cost is always preferred.

As far as the aggregate economy is concerned, different market conditions lead to greater social welfare under different regimes. If the market is elastic enough (if b is small enough), then social welfare is greater under fair value. Whereas, if the market is inelastic enough (if b is large enough), then social welfare is greater under historical cost. This result challenges the assumption that fair value is better for the economy because it provides more relevant information to users of financial statements. These results suggest that there is an output-information trade-off: a fair value regime trades higher output levels for "better information." Furthermore, one would conclude that there are unintended consequences associated with the way in which assets are measured. If accounting standards change the incentives of managers and lead to sub-optimal market outcomes, as these results would suggest they do, such standards cannot seemingly be justified by the existing conceptual framework.

These results are interesting, though not as general as they could be. Future research would consider generalizing functional forms used herein. For example, the probability and inverse demand functions were both linear resulting in only corner solutions. Such functional form assumptions sacrifice generalizability for the sake of tractability. Future research would also consider adjusting the models to account for earnings management, conservatism, disclosure behavior, etc. Whether these results hold experimentally is another important question.

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