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現金回收率／內部報酬率暨會計報酬率／內部報酬率關係之回顧與展望

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摘要

長久以來，經濟學家皆公認內部報酬率爲一理想的績效衡量指標。鑑于內部報酬率不可觀察之特性，會計研究人員亟思從財務報表尋找內部報酬率的外在替代變數。現金回收率與會計報酬率爲此一類研究的二大方向。本文乃就現金回收率／內部報酬率與會計報酬率／內部報酬率間關係的文獻加以地毯式地探討，最後提出作者對此二領域的看法與未來走向之建議。基本上，現金回收率的文獻同意現金回收率與內部報酬率間具一定的函數關係，因此現金回收率可用來做爲估計內部報酬率的基礎。然而一般對會計報酬率與內部報酬率間的關係持悲觀的看法，因此利用會計報酬率估計內部報酬率其衡量誤差特性之研究便成爲這類研究的主流。

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CRR/IRR and ARR/IRR Relationships: A Critical Review

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1.Introduction

The main objective of this study is to critically review the literature relating to the *CRR/IRR* (Cash Recovery Rate/Internal Rate of Return) 2nd the *ARR/IRR* (Accounting Rate of Return/Internal Rate of Return) relationships. This type of research assumes that the *CRR* or the *ARR* can be a good estimator of the *IRR*. The *CRR/IRR* relationship generally assumes that a firm would repeatedly reinvest an amount equal to the cash recovery each year such that the *CRR/IRR* functional relationship can be established. The studies relating to the *ARR/IRR* relationship investigate the conditions under which the *ARR* equals the *IRR*. If the *ARR* is not equal to the *IRR*, the properties of the measurement error arised from *ARR/IRR* relationship are then examined.

The Internal Rate of Return (*IRR*) has long been recognized as a basic profitability measure (e.g., Dorfman 1981, Fisher and McGowan 1983). The *IRR* can be found by solving Equation 1 for r[1]

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[1]Equation 1, in effect, could result in multiple rates of return because Equation 1 is a nth-degree polynomial in term of $(1+r)$. The solution of a n-th degree polynomial has p roots, $p \leq n$ (Marden, 1949). Generally, it assumes that the *IRR* is the unique and the largest real and positive root of the *IRR* equation.

$$C_0 = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \cdots + \frac{C_n}{(1+r)^n} + \frac{R_n}{(1+r)^n}, \tag{1}$$

where C_0 denotes initial cash flow at the beginning of period 1, C_t denotes total cash flows at the end of period $t, t = 1, 2, \cdots, n$, n denotes the project's life, r denotes the IRR, and R_n denotes the terminal economic value of assets at the end of period n.

On the basis of previous studies, Stark (1987) summarizes three definitions of IRR under consideration as follows, if the IRR is used as a performance measure of a firm which is considered as composite projects.

1. The firm's IRR is defined as the rate of return being earned by the projects (investments) of the firm active in some specified period under consideration. Thus, the IRR is the interest rate which equates the present value of the costs of acquiring the active projects with the present value of the cash inflows that arise as a result of the active projects (Solomon 1966, p.234; 1970, p.68).

2. The firm's IRR is defined as the appropriately weighted average of all of the firm's projects up to some specific date. This will, therefore, include both past projects and the projects active at the specific date. Thus, the IRR is the interest rate which equates the present value of the costs of acquiring the past projects with those active at the specific date the present value of the cash inflows that arise as a result of those projects (Wright 1978, p.465).

3. The firm's IRR is defined as the appropriately weighted average of all the firm's projects over its entire lifetime. Thus, the IRR is the interest rate which equates the present value of the costs of acquiring all projects with the present value of all the cash inflows that arise as a result of these projects (Edwards, Kay and Mayer 1987, p.33; Kay 1976).

In the past 30 years, there have been two main research approaches to estimating the IRR from accounting information. One is based on the cash recovery rate (CRR) and the other is based on the accounting rate of return (ARR).

The CRR approach attempts to establish the functional relationship between the CRR and the IRR. The CRR is defined as C_t/I_t, the ratio of total cash flow, C_t, to gross investments, I_t, at period t. The CRR approach was first discussed by Ijiri (1978, 1979, 1980) and, subsequently, Salamon (1982), Gordon and Hamer (1988), and Griner and Stark (1988).

Griner and Stark indicated that there are two feasible defnitions of CRR—Ijiri's CRR (1978, 1980) and Lee and Stark's CRR (1987)[2].

1. *Ijiri Rate:*

   the ratio of the sum of total funds from operations, interest expense, proceeds of disposal of long-term assets, and net decrease in total current assets (should such a decrease occur) to the average of opening and closing gross assets (total assets before accumulated depreciation) (Ijiri 1978, 1980, Salamon 1982, 1985, 1988).

2. *Lee and Stark Rate:*

   the ratio of entity cash flow (gross of investment expenditures) to the average of opening and closing gross fixed assets. Entity cash flow (gross of investment expenditure) is defined as the sum of total funds from operations, interest expense, proceeds of long-term assets, less the sum of the change in receivables, inventories, and other current assets (excluding cash) plus the change in accounts payable, income taxes payable, and other current liabilities (excluding short-term debt).

By contrast, the purposes of the ARR approach are to investigate the conditions under which the ARR equals the IRR, and to investigate the nature of the measurement error in using the ARR to estimate the IRR, if the ARR is not equal to the IRR. The ARR can be defined as Π_t/A_{t-1}, where Π_t denotes the net income at period t, and A_{t-1} denotes the net book value (gross investments less accumulated depreciation) at period $t-1$. Harcourt (1965) and Solomon (1966) were the first to analyze the relationship between the ARR and the IRR.

2. CRR Approach

In general, the CRR approach attempts to establish the theoretical link between a firm's CRR and the IRR. Such a CRR/IRR relationship

[2]Griner and Stark commented that the Ijiri rate is more akin to working capital recovery rate than a cash recovery rate, while the Lee and Stark rate is a truly cash-based CRR.

is conditioned upon the steady-state conditions. In mathematical terms, steady-state conditions are the limit of the *CRR* sequence. In addition, the *CRR* is the function of the *IRR*. Ijiri (1978, 1979, 1980) was the first to study the functional relationship between the *CRR* and *IRR* under steady-state conditions. In Ijiri's model (1979), the firm repeatedly reinvests all of its cash flows each year.

Subsequently, Salamon (1982), Gordon and Hamer (1988), and Griner and Stark (1988) extended Ijiri's findings (1979). The models of Salamon, and Gordon and Hamer weakened Ijiri's assumption in 1979 by allowing the rate of reinvestment of less than 100%. They also added a factor of inflation. Furthermore, the model of Griner and Stark could accomodate a wide variety of cash flow profiles which is another progress beyond Salamon, and Gordon and Hamer.

2.1 *CRR* Constant

Assume that a firm initially invests one dollar in a typical project that has a life of two years. At the end of the first and subsequent years, the firm reinvests in identical, perfectly divisible projects an amount equal to total cash recoveries. Thus, if the reinvestment mechanism stated above repeats year by year, the *CRR* sequence converges to a limiting value. This value is called the *CRR* constant.

The derivation of the *CRR* sequence and its convergent constant can be illustrated by the following example presented in Table 1 (Ijiri 1979, p. 260). The column totals give the amount of cash recoveries (reinvestment) in a year, beginning with an initial investment of one dollar. The rows corresponding to each column total indicate the cash recoveries on each amount reinvested. A firm which invests $1 at the end of year 0 in a project that returns in cash 60% of the investment one year later and 72% of the investment two years later. At the end of year 1, the firm recovers $0.6 in cash, which the firm immediately reinvests in the same project. At the end of year 2, the firm recovers $0.72 from the investment in year 0 and $0.36 from the investment in year 1 (60% of $0.6), for the total of $1.08 which the firm immediately reinvests in the same project. Therefore, the *CRR*, defined as the ratio of cash recovery during a period to gross investments that was outstanding during the year, is 0.6 in the year 1, and 0.675 in the year 2.

Table 1: Example of CRR Sequence

	0	1	2	3	4	5	6
0	(1)	0.6	0.72				
1		(0.6)	0.36	0.432			
2			(1.08)	0.648	0.7776		
3				(1.080)	0.6480	0.7776	
4					(1.4256)	0.8554	1.0264
5						(1.6330)	0.9798
6							(2.0062)
C_n		0.6	1.08	1.080	1.4256	1.6330	2.0062
I_n	1	1.6	1.68	2.160	2.5056	3.0586	3.6392
CRR		0.6	0.675	0.643	0.6600	0.6517	0.6559

* () represents reinvestments, positive numbers represent recoveries
* project life = 2 periods
C_n denotes cash recoveries at period n
I_n denotes investments at period n

In Table 1, the CRR sequence fluctuates in the early stage, as predicted by Ijiri (1979), it converges to 0.6545.[3] This convergent constant of the CRR sequence is called CRR constant which can be written as R (or CRR_I).

$$R = \frac{r}{1-(1+r)^{-n}} \tag{2}$$

The CRR constant is the function of IRR of the typical project. Thus, the IRR can be estimated from CRR based on Equation 2 which is called conditional IRR described in most studies.

2.2 Theoretical Development

Ijiri (1978, 1979, 1980) assumed that a firm is a collection of identical projects with the same cash flow profile, useful life, IRR, and 100% reinvestment. He then proves that the CRR is a function of the IRR under steady-state conditions. The 100% reinvestment assumption means that

[3]The calculation of 0.6545 can be derived from Ijiri's CRR (1979) as follows: $R = r/[1-(1+r)^{-n}] = 0.2/[1-1.2^{-2}] = 0.6545$.

the firm reinvests the full amount of cash recovery (i.e., no dividend distribution) with no time lag, and that projects are fully divisible.

Ijiri (1979) proved that CRR_{I_t} (Ijiri's CRR at period t) converges to a constant as $t \to \infty$. Ijiri's CRR (CRR_I) is as follows.

$$CRR_I = \lim_{t\to\infty} CRR_{I_t} = \lim_{t\to\infty} \frac{C_t}{I_t} = \frac{r}{1-(1+r)^{-n}}$$

Salamon (1982) elaborated on Ijiri's study, weakened the 100% reinvestment of recoveries assumption, and added the factors of constant inflation rate and constant growth rate of investment. Salamon derived the following expression for the CRR (CRR_S):

$$CRR_S = \left[\frac{(1-pg)p^n g^n}{1-p^n g^n}\right]\left[\frac{g^n - b^n}{g^n(g-b)}\right]\left[\frac{r^n(r-b)}{r^n - b^n}\right], \tag{3}$$

where p denotes the annual rate of change in all prices, g denotes the annual rate of growth in real gross investement, and b denotes the cash flow pattern parameter, defined as $C^0_{j+1} = b^j C^0_1$, $j = 0, 1, 2, \cdots, n-1$.

Gordon and Hamer (1988) empirically examined patterns of cash flows and concluded that CRR_S should be modified based upon their empirical findings. They found that a concave increasing cash flow profile is the most pervasive pattern. Gordon and Hamer formulated the cash recovery rate that includes a concave increasing cash flow profile as CRR_{GH}:

$$CRR_{GH} = \left[\frac{(1-pg)p^n g^n}{1-p^n g^n}\right]\left[\frac{r-B}{g-B}\right]\left[\frac{\frac{g^n-B^n}{g^{n-1}(g-B)} - \frac{nB^n}{g^n}}{\frac{r^n-B^n}{r^{n-1}(r-B)} - \frac{nB^n}{r^n}}\right]$$

where B denotes the "new" (concave) cash-flow pattern parameter such that $C_i = (iB^{i-1})C_1$.

Griner and Stark (1988) improved the CRR formula as in Equation 4 (CRR_{GS})

$$CRR_{GS} = gn(g)/(1-e^{-gN}), \tag{4}$$

where g is a steady growth rate of investments, $n(r) = 1$ ($n(x)$ is the Laplace transformation of $N(\tau)$ with respect to x, that is, $n(x) = \int_0^N N(\tau)e^{-x\tau}d\tau$, and $\int_0^N N(\tau, a_1, \cdots, a_n)e^{-r\tau}d\tau = 1$). Griner and Stark's method permits a wider range of cash flow profiles than CRR_S and CRR_{GH}.

2.3 Empirical Issues

The CRR is used to estimate the IRR so that the estimate of the IRR can be used to evaluate the profitability of the firm. Most empirical studies have used either Salamon's CRR (1982) or Griner and Stark's CRR (1988). Their studies attempt to examine the fundamental properties of the CRR and to test the robustness of the CRR theory.

Some of these studies have examined the effect of the cash flows profile on the nature of the CRR. Salamon and Griner and Stark hypothesized that the CRR theory is valid if and only if a certain pattern of cash flows is assumed. However, Salamon's findings (1982) indicated that the pattern of cash flows (a level or declining exponential cash flow profile) is not a significant factor. Gordon and Hamer (1988) concluded that the concave increasing cash flow profile is the most pervasive cash flow pattern. This issue of cash flow profiles cannot however be fully understood unless broader classes of cash flow profiles are examined. In addition, the operational definition of $\{CRR_t\}_{t=1}^{\infty}$ sequence may have averaged out the impacts of cash flow profile on the steady-state properties leading to the CRR formula. Therefore, no matter what cash flow profile is assumed, the CRR formula would remain the same.

One of the basic properties in the IRR/CRR relationship is the steady-state conditions. Both Ismail (1987) and Stark (1987) tested whether the CRR has steady-state time-series properties. Their results were inconclusive. There are two possibilities for these results: First, the design of the reinvestment mechanism (e.g., Ijiri 1979, and Salamon 1982) may not conform to reality. For example, a firm may not reinvest in the same project because of technological improvements. Also, the investment opportunity may not be perfect. Second, the research methodology may not be precise enough to capture theoretical steady-state conditions. For example, the time-series model applied in these studies may not be an appropriate one.

If a "good" estimator of the IRR can be based on the CRR, this estimate IRR should have economic implications. That is, the estimate IRR derived from the CRR formula can be used for evaluating firm's performance properly. Based on economic rationality, Salamon (1985, 1988) hypothesized that the firm size positively associates with firm profitability. Thus, Salamon uses conditional IRR estimates to examine the properties of the measurement error in the ARR in a study of the relationship between firm profitability and firm size. Salamon found no statistically significant association between firm economic profitability and firm size.[4] Salamon's evidence indicates that the conditional *IRR* may also consist of measurement error. Thus, to estimate the *IRR* based on the *CRR* may not be an adequate procedure. That is, the model of Salamon's *CRR* (CRR_S) (1982) may not capture sufficient economic reality.

Griner and Stark (1988) investigated the relative merits of profitability estimates based on the *CRR* using two different concepts of cash flow. The first, based on Ijiri (1978), is a working capital concept, while the second, from Lee and Stark (1987), is considered a cash concept. The results of their work suggest that the Lee and Stark definition produces a better estimate of economic performance. That is, the cash concept can result in a better estimate of the *IRR* than the working capital concept.

2.4 Major Problems

The *CRR* approach has several problems resulting mainly from the underlying assumptions concerning constant growth of investment, the cash flow profile (Salamon 1982) and the fact that 100% reinvestment (Ijiri, 1979) are assumed. Brief (1985) argued that in the case of Salamon's model (1982) the assumption relating to the constant growth rate of cash flows lacks external validity. So far, no empirical or theoretical evidence has been established, even in the studies by Ismail (1987) and by Stark (1987), to fully answer the question of constant growth rate of the investment. Intuitively, Ijiri's framework (1979) might imply the constant growth of cash flow. Under Ijiri's framework, the path of investments and cash recoveries would grow exponentially in terms of $(1 + r)$ where r represents the *IRR*.

The second problem is the applicability of a specific pattern of cash flow in the *CRR* model. Salamon's *CRR* (1982) assumed an exponential cash flow profile. Ijiri's (1979) *CRR* did not make specific assumptions about cash flow profile, and Griner and Stark's (1988) *CRR*, by contrast, allows

[4] Buijink and Jegers (1989) commented on Salamon's (1985) results that if the growth rate is not equal to zero, the useful life estimated by Salamon's procedures is biased. They derived a correct formula for estimating useful life under sum-of-the-years-digits and double-declining-balance method (no bias for straight-line depreciation method). Salamon (1989) then followed these corrected formulae to replicate his empirical procedures. These findings, with Salamon's corrections, did not change significantly from the original results.

for a variety of cash flow profiles. In reality, the cash flows generated by a project may not form a specific pattern, e.g., exponential increasing pattern. In addition, each specific pattern of cash flow profile might associate with different properties of *CRR* constant, e.g., convergent properties of the *CRR* sequence.

A major question about Ijiri's (1979) model concerns the assumption of 100% reinvestment. The cash recoveries can be used for distributing dividend or reinvestment purpose. Because of investment opportunity, stock price considerations, political factors, or other reasons, the firm may reinvest an amount less than 100% of cash recoveries. Therefore, the question can be addressed is whether this functional formula holds "reasonably well" when the reinvestment is less than the cash recoveries.

Another issue relates to steady-state properties of the *CRR*. Salamon (1982) contended that the convergence properties derived by Ijiri (1979) have no great practical importance. However, a particular pattern of cash flow may take a longer period to reach steady-state conditions than another pattern. Thus, the steady-state properties in the *CRR*/*IRR* relationship need to be evaluated in relation to a variety of cash flow pofiles.

Other significant issues are not generally considered in this line of research. For example, the reinvestment opportunity is normally neither complete nor perfect. That is, there may not be an investment opportunity for a fractional amount. In addition, a firm does not reinvest in the same project over time. Technological improvements or changes in the economic environment obviously may lead the firm to invest in other types of productive equipment.

3. *ARR* Approach

The *ARR* approach attempts to explain the divergence between the *ARR* and the *IRR*, or, equivalently, to estimate the error which arises from using the *ARR* to estimate the *IRR*. Research has gone down two paths: (1) investment/reinvestment approach; and (2) Kay's approach.

The work of Harcourt (1965), Solomon (1966), Stauffer (1971), and Fisher and McGowan (1983) follow the investment/reinvestment approach. They assume that the firm invests in a project or mix of projects for which the costs are depreciated by the standard method, such as straight-line or sum-of-year-digits. The firm is assumed either to reinvest a fixed percentage of its cash flows or to grow at a constant rate. After a steady state is reached, a comparison is made of the accounting rate of return and the economic return. Unless the standard depreciation method happens to be equivalent to economic depreciation, the accounting rates of return will not equal the economic return.

The second line of research is based on work by Kay (1976). Kay shows that if a firm's book values at the beginning and at the end of a multiperiod time horizon were equal to economic values, it would be possible to derive the economic return from the sequence of accounting rate of return. The error arising from the use of ARR to estimate the IRR is discussed by Kay (1978), Wright (1978), Stark (1982), Peasnell (1982a, 1982b), Steele (1986) and Brief and Lawson (1991a). The error term is shown to be a function of $r-g$ (the IRR less the assumed constant growth rate of net book value), q_0 (opening valuation error), q_n (closing valuation error), and n (an assumed time horizon).

Stated mathematically, let IRR, r, be defined as in Equation 1 and a be defined by Equation 5.

$$A_0 = \frac{C_1}{(1+a)} + \frac{C_2}{(1+a)^2} + \cdots + \frac{C_n}{(1+a)^n} + \frac{A_n}{(1+a)^n}, \tag{5}$$

where A_0 is opening book value and A_n is closing book value. If A_0 equals C_0 (opening book value equals opening economic value) and R_n equals A_n (closing economic value equals closing book value), a equals r (economic rate of return equals accounting rate of return).

If A_0 is not equal to C_0 and A_n is not equal to R_n, a is not equal to r (Kay 1976; Peasnell 1982a). In this case, r can be defined as

$$r = a + E$$

where

$$a = \sum_{t=1}^{n} w_t a_t$$

$$w_t = \frac{A^*_{t-1}/(1+a)^{t-1}}{\sum_{j=1}^{n} A^*_{j-1}/(1+a)^{j-1}}$$

and

$$E = f(q_0, q_n, r-g, n)$$

where $q_0 = C_0/A_0$, $q_n = R_n/A_n$, and A_t^* are imputed book values analogous to the concept of "*economic value*" and book values are calculated so that the ratio of net income to book value equals a (Brief and Lawson, 1991b). The above results assume that comprehensive income is employed, i.e., $I_t = C_t + (A_t - A_{t-1})$.

3.1 Theoretical Development

The studies of Harcourt (1965), Solomon (1966), Stauffer (1973), and Fisher and McGowan (1983) set up a model to study the *ARR/IRR* relationship by assuming that the firm is to invest in a project or mix of projects depreciated by a standard method such as straight-line depreciation or sum-of-the-years digits depreciation. The project generates a series of cash flows or grows at a constant rate. Depending on the specific assumptions made about these variables, a steady-state situation is reached. A comparison is then made of the accounting rate of return with the economic rate of return.

Harcourt examined the length of life of machines, the patterns of cash flows, rate of growth, and the method of depreciation under *Golden Age* periods, i.e., when steady-state conditions obtained. Solomon investigated the impact of the length of project life, cash flow profiles, capitalization and depreciation policy, and the growth rate of outlays on the *ARR/IRR* relationship. Stauffer introduced the factors of corporate tax and working capital requirements in the model of the *ARR/IRR* relationship, while Fisher and McGowan surveyed the *ARR/IRR* relationship with a series of examples.

These studies all demonstrated that the *ARR* is a misleading estimate of the *IRR*. That is, *the ARR does not equal the IRR* unless economic (*Hotelling*) depreciation method is adopted (Fisher and McGowan, 1983, p. 494).

3.2 Major Problems

The investment/reinvestment approach to studying the *ARR/IRR* relationship has shown that, in general, the *ARR* is not an accurate estimate of the *IRR*. In all of these studies the depreciation method reflects "accounting policy". When accounting policies happen to coincide with *Hotelling* depreciation, there will be no divergence between the *ARR* and *IRR*.

In addition to the allowable accounting alternatives, e.g., depreciation methods, other accruals may also contribute to the measurement error in the ARR. Griner and Stark (1988) examine this issue and their results demonstrate that the measurement error in the ARR is a function of the product of the relative size of non-depreciation accruals in the balance sheet and the difference between the constant growth rate of investment and the IRR. DeAngelo (1986) explains the magnitude of the accrual as the extent to which the manager can strategically manipulate the earning number. Thus, the measurement error in the ARR may be derived from the strategic selection based on management compensation consideration. An elaboration on this conjecture is an interesting future empirical study.

Stauffer (1973) also introduces factors other than depreciation, such as working capital requirements and corporate tax. He found that these factors would contribute even more measurement errors. A different approach to studying the ARR/IRR relationship, and one found in the works of Kay (1976), Wright (1978), Stark (1989), Peasnell (1982a, 1982b), Steele (1986), and Brief and Lawson (1991) have indicated that the measurement error in the IRR/ARR relationship results from the opening and closing valuation errors, i.e., the difference between opening (and closing) economic values and book values. There exist factors other than accounting methods, the magnitude of accruals, tax, and working capital requirements affecting the measurement error in the ARR. In addition, elaborations on how the opening and closing valuation errors are determined, and the association between the determination of the valuation errors and the measurement error in the ARR are open questions.

4. Concluding Remarks

The CRR/IRR and ARR/IRR relationships provide some insights into the usefulness of accounting information for estimating the economic profitability. The derived CRR formula give one approach for estimating IRR. The CRR-based profitability assumes a systematic cash flow profile, fixed length of asset's life, constant growth rate of investments, and depreciation method adopted. To improve the knowledge of CRR/IRR relationship, the assumptions of CRR approach should be relaxed. In addition, if the CRR/IRR relationship possesses a systematic relationship, it should consist of a systematic error. Thus, particularly, future research in the CRR

approach should consider the impacts of constant growth rate of investment on the CRR/IRR relationship and the properties of measurement error contained in the CRR. Furthermore, to generalized the domain of CRR/IRR relationship is another direction for future research. For example, Kang (1991) attempts to develop a generalized CRR/IRR relationship that allows the reinvestment equals an amount in an interval between depreciation charges and cash recoveries. That is, the investment at period t, a_t can be written as Equation 6.

$$a_t = \Delta_t + \theta(C_t - \Delta_t), \tag{6}$$

where Δ_t and C_t denotes the depreciation charges and cash recoveries at period t, respectively. Kang also proposes to prove that the Ijiri's framework (1979) relating to CRR/IRR relationship implies a constant growth rate of investment.

To study the ARR/IRR relationship is another alternative for understanding how accounting information can be used for estimating IRR. The general results in this area indicate that the ARR is not equal to the IRR unless the economic depreciation method is adopted; thus, the ARR obtained from public financial statements is not generally a 'good' estimate of the IRR. Moreover, the systematic factors of the measurement error contained in the ARR is a function of the opening and closing valuation errors, constant growth rate of investments, and the project's life.

The difference between ARR and CRR is the net accrual, intuitively, ARR/IRR and CRR/IRR relationships to some extent should have their theoretical link. Thus, the theoretical linkage between the CRR/IRR and the ARR/IRR relationships is a worthwhile future research. Second, the CRR approach has proved that the CRR and the IRR have systematic relationship under steady-state conditions. If ARR and CRR have theoretical link, an open question is: does the ARR/IRR relationship characterize similar properties to the CRR/IRR relationship? Third, the underlying implications of net accrual are the central theme of positive accounting theory (Watts and Zimmerman 1978, 1979). In addition, ARR is a major measure of monopolistic profit in the court (Fisher and McGowan 1983). To survey whether manager has incentive in manipulating ARR for affecting the judge of monopolistic profit is an interesting future study.

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